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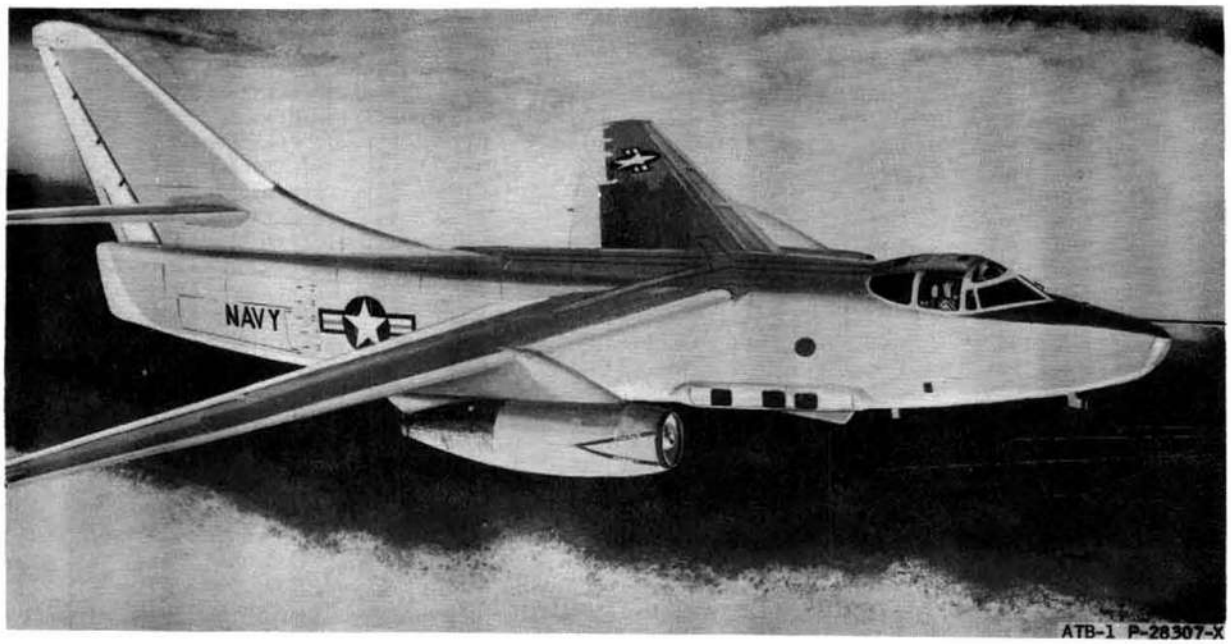
NAVWEPS 01-40ATB-1

NATOPS Flight Manual

NAVY MODEL

RA-3B AIRCRAFT

THIS PUBLICATION IS INCOMPLETE WITHOUT CONFIDENTIAL SUPPLEMENT NAVWEPS 01-40ATD-1A



ATB-1 P-28307-X

ISSUED BY AUTHORITY OF THE CHIEF OF NAVAL OPERATIONS
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BUREAU OF NAVAL WEAPONS

15 October 1964

Changed 1 October 1965

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DEPARTMENT OF THE NAVY
OFFICE OF THE CHIEF OF NAVAL OPERATIONS
WASHINGTON, D.C. -20350

LETTER OF PROMULGATION

1. The Naval Air Training and Operating Procedures Standardization Program (NATOPS) is a positive approach towards improving combat readiness and achieving a substantial reduction in the aircraft accident rate. Standardization, based on professional knowledge and experience provides the basis for development of an efficient and sound operational procedure. The standardization program is not planned to stifle individual initiative but rather, it will aid the Commanding Officer in increasing his unit's combat potential without reducing his command prestige or responsibility.

2. This Manual is published for the purpose of standardizing ground and flight procedures, and does not include tactical doctrine. Compliance with the stipulated manual procedure is mandatory. However, to remain effective this manual must be dynamic. It must stimulate rather than stifle individual thinking. Since aviation is a continuing progressive profession, it is both desirable and necessary that new ideas and new techniques be expeditiously formulated and incorporated. It is a user's publication, prepared by and for users, and kept current by the users in order to achieve maximum readiness and safety in the most efficient and economical manner. Should conflict exist between the training and operating procedures found in this manual and those found in other publications, this manual will govern.

3. Check lists and other pertinent extracts from this publication necessary to normal operations and training should be made and may be carried in Naval aircraft for use therein. It is forbidden to make copies of this entire publication or major portions thereof without specific authority of the Chief of Naval Operations.

4. This NATOPS Flight Manual is effective upon receipt. It supersedes NAVWEPS 01-40ATB-1 Flight Manual dated 15 June 1960 and declassified portions of NAVWEPS 01-40ATB-1A Supplement to Flight Manual dated 15 December 1960, both changed 15 March 1962; and RA-3B portions of NATOPS Manual EA/RA/TA-3B (Rev. 2) of June 1963.

Paul H. Ramsey

PAUL H. RAMSEY
Vice Admiral, USN
Deputy Chief of Naval Operations (Air)

INTERIM CHANGE SUMMARY

CANCELED OR PREVIOUSLY INCORPORATED IN THIS MANUAL

Nos. 1 thru 7

No. 8 (Declassified portions of
No. 9 NAVWEPS 01-40ATB-1A)

INCORPORATED IN THIS REVISION ON PAGES INDICATED

No. 8
No. 9 (Rewritten for NATOPS)

INTERIM CHANGES OUTSTANDING: (to be maintained by custodian of Flight Manual)

No.	Date	Purpose

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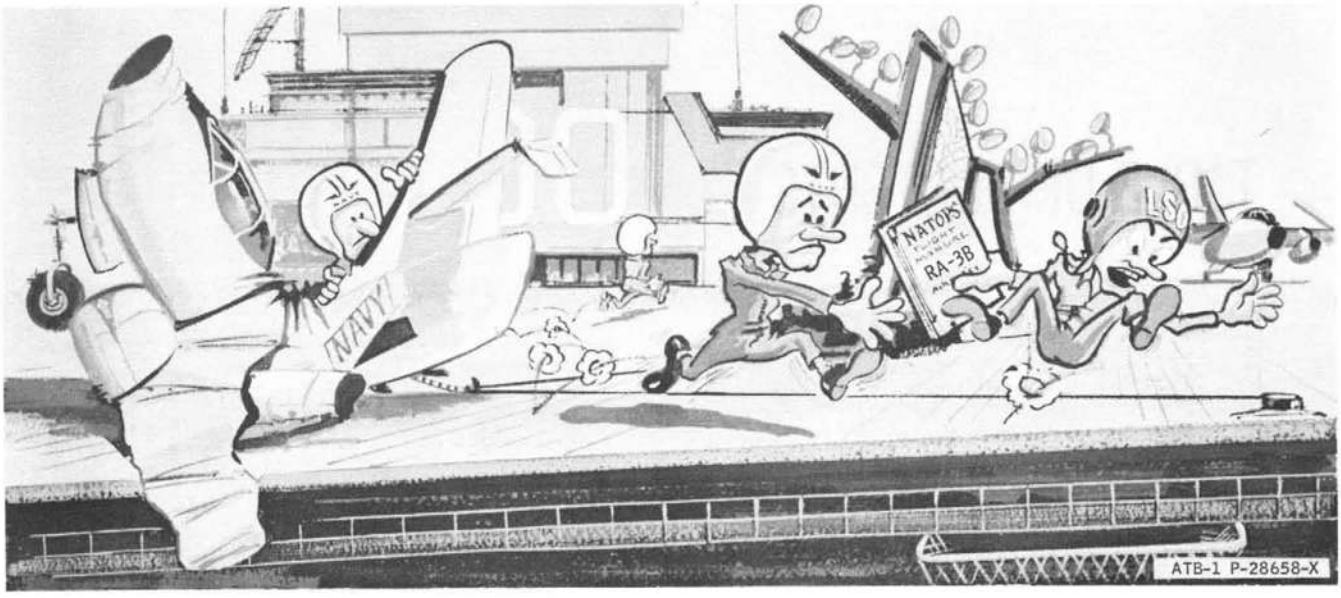
*Also refer to the Supplemental NATOPS Flight Manual (NAVWEPS 01-40ATD-1A)



NOW HEAR THIS!

The letter of Promulgation from the Chief of Naval Operations outlines the reasons for combining the Naval Air Training and Operating Procedures Standardization Manual with the present RA-3B Flight Manual. The combined NATOPS Flight Manual and Confidential Supplement, and the Pocket Checklist present up-to-date, readily-available flight information that will enable the pilot to realize the full potential of the aircraft. Operational procedures in the combined Flight Manual have been developed from Navy training and operation experiences, while the presentation of the systems operational procedures and engineering changes reflect continuing study and development by the engineering groups at Douglas Aircraft Co. Careful study and application of the information contained in these Manuals will pay dividends to the pilot who understands and uses this information.

SCOPE

The combined Manual contains a general discussion of the aircraft systems, flight characteristics, and specific normal and emergency operating procedures. The Manual is designed to perfect the techniques of experienced crewmembers and to teach new procedures to the inexperienced. Thorough knowledge of these procedures will be of great benefit to the pilot in time of need, especially in the case of multiple malfunctions, adverse weather, or terrain problems that require a quick evaluation of the situation and a possible change from the printed procedures. The pilot must know the aircraft well enough to handle it in any emergency and to react correctly when the situation demands it.

ARRANGEMENT

The Flight Manual is divided into eleven sections. The supplement is also divided into eleven sections; but declassified sections appear only in the Flight Manual. Section I, THE AIRCRAFT, is subdivided into four parts: Part 1 describes the aircraft and its use; Part 2 describes the aircraft systems, controls, and normal and emergency systems operation; Part 3 discusses aircraft servicing, danger areas, and starting/power requirements; Part 4 defines the aircraft and engine operating limitations.

Section II, INDOCTRINATION, lists training requirements, operating criteria, personnel flying equipment, and the like.

Section III, NORMAL PROCEDURES is subdivided into four parts; Part 1, Briefing/Debriefing; Part 2, Mission Planning; Part 3, Shore-Based Procedures; and Part 4, Carrier-Based Procedures.

Section IV describes FLIGHT PROCEDURES from familiarization and transition to flight test.

Section V describes EMERGENCY PROCEDURES.

Section VI describes ALL-WEATHER OPERATION under both simulated and actual instrument conditions.

Section VII describes COMMUNICATIONS PROCEDURES.

Section VIII describes WEAPONS SYSTEMS from station loading to flight procedures for weapons delivery.

OPNAVINST 3510.9B
1 January 1964

NATOPS MANUAL/NATOPS FLIGHT MANUAL/FLIGHT MANUAL CHANGE RECOMMENDATION FORM
OPNAV FORM 3500-22 (10-63) Reference OPNAVINST 3510.9 (Current revision)

RECOMMENDED CHANGE TO MANUAL (Check one)
[x] NATOPS MANUAL [ ] NATOPS FLIGHT MANUAL [ ] FLIGHT MANUAL
AIRCRAFT (Specify): RA-3B
REVISION/CHANGE DATE

SECTION	PAGE	PARAGRAPH	PARAGRAPH TITLE
4	4-6	407	FCLP AND CQ

RECOMMENDATION (Be Specific)

Change paragraph 407.2 to read as shown in enclosure (1).

REASON

SAMPLE

Revise to conform to COMNAVAIRLANT/COMNAVAIRPAC CATC procedures.

NAME: LCDR U. B. STANDARD, USN
DATE: 10/5/63
ADDRESS: VAW-12 c/o FPO, N.Y., N.Y.

OP-561

Enclosure (2)

Section IX, FLIGHT CREW COORDINATION.

Section X, STANDARIZATION EVLAUATION procedures.

Section XI, PERFORMANCE DATA.

NATOPS FLIGHT MANUAL CHANGES

WHO MAY SUBMIT CHANGE RECOMMENDATIONS? Anyone in the Naval establishment may submit recommendations for changes to this NATOPS Flight Manual.

TYPES OF CHANGES

Change recommendations initiated in the field shall be designated URGENT or ROUTINE. URGENT changes are those which involve safety of flight and require immediate promulgation. ROUTINE changes are issued to promulgate new information or to modify or correct existing material.

PROCEDURES FOR SUBMITTING CHANGE RECOMMENDATIONS

URGENT change recommendations are submitted by priority message to the NATOPS Advisory Group Member in the chain of command. (Advisory Group Members are: CNO, COMNAVAIRPAC, COMNAVAIRLANT, C.G. AIRFMFPAC, C.G. 2nd Marine Air Wing, CMC, CNATRA, and BUWEPS.) Routine Change recommendations are submitted to the aircraft Model Manager (Commanding Officer, VAH-123, NAS Whidbey Island, Oak Harbor, Washington) with a copy to Navy Tactical Doctrine Development and Production Activity, Naval Station, Washington, D. C. using OPNAV form 3500-22 (10-63).

PROCEDURES FOR PROCESSING CHANGE RECOMMENDATIONS:

Advisory Group Members and Model Managers shall process recommendations for changes to this manual in accordance with OPNAV 3510. 9 series.

From time to time, the reader will see Warnings, Cautions, or Notes inserted in the running text. These are to call attention to some phase of aircraft operation that is especailly important, as follows:

WARNING

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

CAUTION

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

Note

An operating procedure, condition, etc., which need emphasis.

Use of the words "SHALL," "WILL," "SHOULD," and "MAY" in this NATOPS Flight Manual shall have the following meaning:

1. Whenever the word "shall" appears, it shall be construed to mean that the requirements are mandatory.

2. Whenever the word "will," "should," or "may" appear, they shall be construed as nonmandatory provisions.

3. The word "will" is used to express declaration of purpose or an obligation.

4. The word "should" is normally used to express nonmandatory desire or preferred method of accomplishment.

5. The word "may" is normally used to express an acceptable or suggested method of accomplishment.

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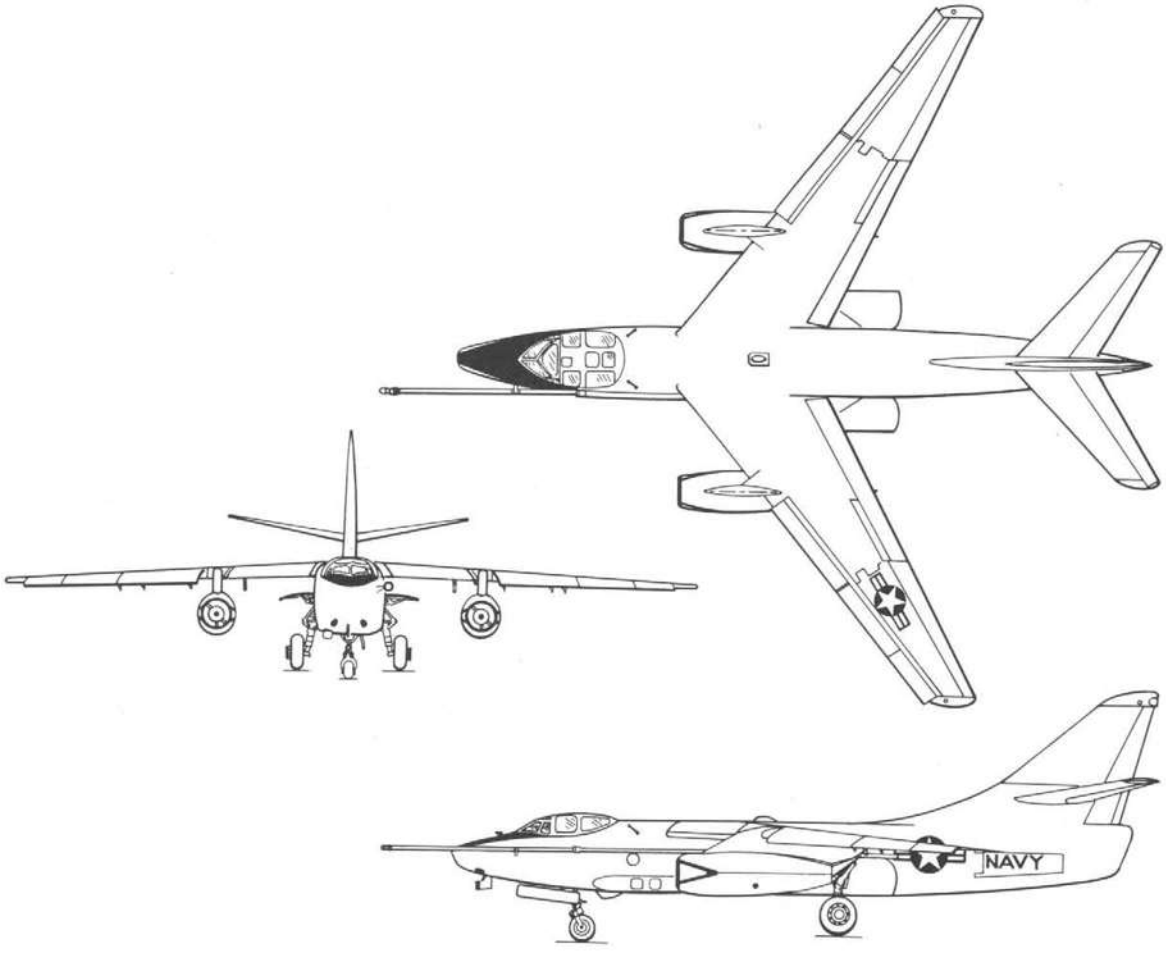

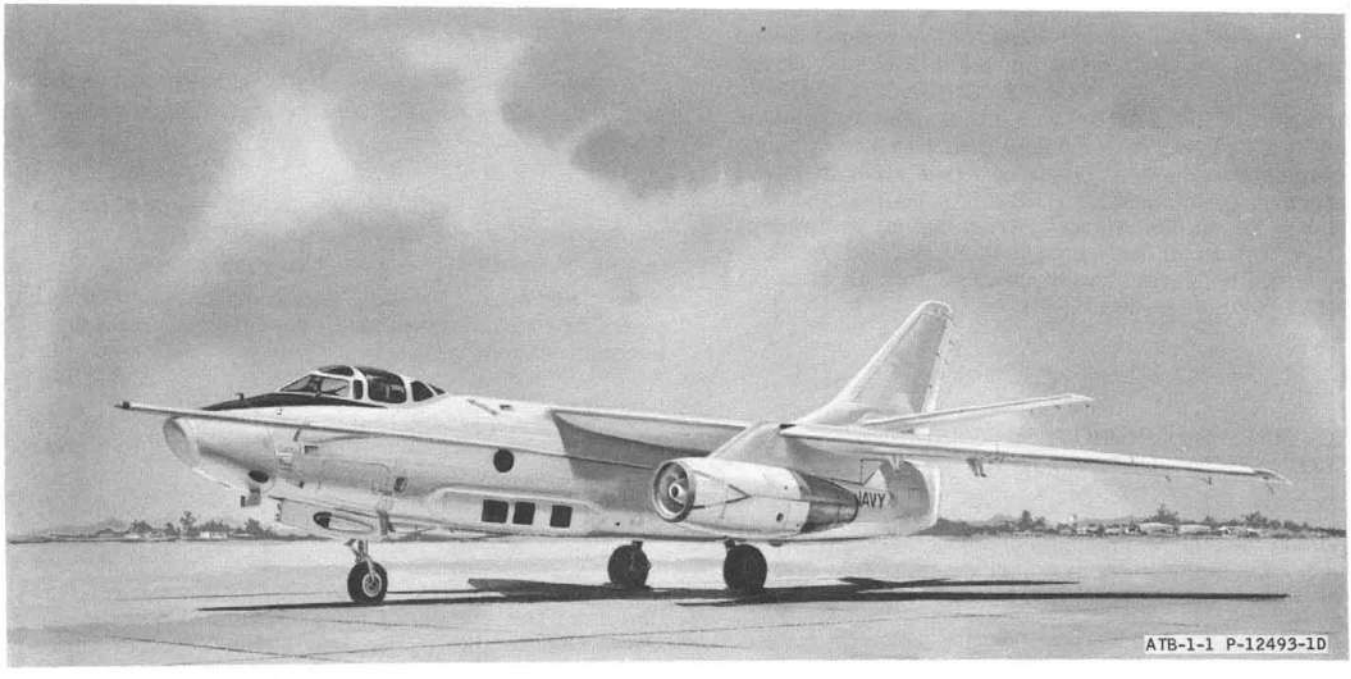

Figure 1-1. Model RA-3B Aircraft

SECTION I

THE AIRCRAFT

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PART 2 Aircraft Systems 1-23

PART 3 Aircraft Servicing 1-109

PART 4 Aircraft Operating Limitations 1-139

PART 1

GENERAL DESCRIPTION

INTRODUCTION

Navy Model RA-3B is a three-place, carrier-based, long range, high performance, day and night photographic-reconnaissance aircraft (see figure 1-1). It is powered by two Pratt and Whitney J57-P-10 series turbojet engines installed in underwing nacelles, and is equipped with retractable tricycle landing gear with a steerable nosewheel. The aircraft (see figure 1-1) is operable from carriers equipped with C-7 and C-11 steam catapults and Mark 7 arresting gear. It is also designed for field JATO installations, using a maximum of twelve 4500-pound thrust bottles.

MAIN DIFFERENCES

BuNo. 142256, 142666 – 142669, and 144825 – 144847 are basic wing; BuNo. 146446 and 146447 are cambered leading edge (CLE) wing. The RA-3B aircraft differs from the A-3B (see figure 1-2) in that it has:

1. A camera compartment.
2. A flash bomb bay in the fuselage between the camera compartment and the forward fuel tank.
3. A greater gross weight.
4. A simpler fuel transfer system.
5. A higher cockpit pressure differential.
6. A drop-out generator, but no storage battery.
7. No bomb bay spoiler.
8. Different ATM location.

PRINCIPAL DIMENSIONS

Length (fin erect) and probe installed . . . . . 78 ft

Length (fin folded) . . . . . 74 ft 6 in.

Wing span (wings spread) . . . . . 72 ft 6 in.

Wing span (wings folded) . . . . . 49 ft 5 in.

Height (fin erect) . . . . . 22 ft 9-3/4 in.

Height (fin folded) . . . . . 15 ft 9-3/8 in.

Maximum height during folding . . . . . 27 ft 3-3/4 in.

Height over wings (wings folded) . . . . 16 ft 7-1/4 in.

See figures 1-3 and 1-40 for minimum turning radius and ground clearances.

GENERAL ARRANGEMENT

For general arrangement of the aircraft, including location of the various compartments, water containers, external power receptacles, escape hatch, and fuel tanks (see figure 1-4.) Only the camera compartment and cockpit are pressurized and accessible in flight.

CREW

The aircraft normally has three crewmembers; pilot, photo-navigator (P/N), and a photo-technician (P/T). There are provisions for a fourth crewmember in the photo compartment.

SEATS

The aircraft is equipped with a pilot's seat, a photo-navigator's seat, and a photo-technician's seat (see figures 1-5, 1-6, 1-11 and 1-14). All seats are designed for use with integrated flight suits. (For details common to all three seats refer to Integrated Flight Gear in Section II.)

PILOT'S SEAT

The pilot's seat may be electrically actuated UP or DOWN by means of a seat adjust switch (25, figure 1-6) on the right side of the seat. The headrest may be locked in position by means of the headrest lock (3, figure 1-6).

A-3 MAIN DIFFERENCES TABLE

	A-3A	A-3B			VERSIONS		
	BOMBER	BOMBER	TANKER	BOMBER	RA-3B PHOTO	FA-3B ECM	TA-3B TRAINER
WING							
BASIC	YES	YES	NO	NO	28 A/C	13 A/C	NO
CAMBERED	NO	NO	YES	YES	2 A/C	12 A/C	YES
ENGINES	J57-P-6B	J57-P-10	J57-P-10	J57-P-10	J57-P-10	J57-P-10	J57-P-10
FUSELAGE							
FUELING PROBE	NO	NO	YES	YES	YES	YES	YES
FUELING DROGUE	NO	NO	CONVER-TIBLE	CONVER-TIBLE	NO	NO	NO
TOTAL USABLE FUEL	4385	5158	5158	5158	4872	4872	4982
CAMERA WINDOWS	NO	NO	NO	NO	YES	NO	NO
CAMERA FAIRING	NO	NO	NO	NO	YES	NO	NO
WINDOWS & DOOR	NO	NO	NO	NO	NO	YES	YES
LOWER RADOME	NO	NO	NO	NO	NO	YES	NO
BOMB BAY	YES	YES	YES	YES	FLASH BOMBS OR CARTRIDGES	NO	NO
SPOILER	YES	YES	YES	YES	NO	NO	NO
HORIZONTAL STABILIZER TRAVEL							
6° ANU 2° AND	YES	116 A/C	NO	NO	NO	NO	NO
10½° ANU 2° AND	NO	7 A/C	YES	YES	YES	YES	YES
FIN TIP RADOME	NO	NO	NO	NO	NO	YES	NO
TAIL TURRET							
AERO-21B	YES	NO	NO	NO	NO	NO	NO
DECM	NO	YES	YES	YES	YES	YES	NO
ASB GEAR	ASB-1A	ASB-1A ASB-7 13 A/C	ASB-1A	ASB-7	ASB-1B	ASB-1B	ASB-1A
FUEL TRANSFER	ELECTRIC PUMP	ELECTRIC PUMP	ELECTRIC PUMP	ELECTRIC PUMP	ELECTRIC PUMP OR AIR	ELECTRIC PUMP OR AIR	ELECTRIC PUMP OR AIR
DROP OUT GENERATOR	NO	NO	NO	NO	YES	YES	YES
BATTERY	YES	YES	YES	YES	NO	NO	NO
INTERIOR							
SEATS	3	3	3	3	3	7	8
4TH CREWMAN PROVISIONS	YES	YES	YES	YES	YES	NOT APPLICABLE	NOT APPLICABLE
PERISCOPE	YES	YES	YES	YES	NO	NO	YES
ESCAPE							
BAIL OUT	CHUTE	CHUTE	CHUTE	CHUTE	CHUTE	CHUTE & SIDE DOOR	CHUTE & SIDE DOOR
DITCHING	SLIDING HATCH	SLIDING HATCH	SLIDING HATCH	SLIDING HATCH	1 HINGED HATCH	2 HINGED HATCHES	2 HINGED HATCHES

ATB-1-1 P-17230-1B

Figure 1-2. Main Differences

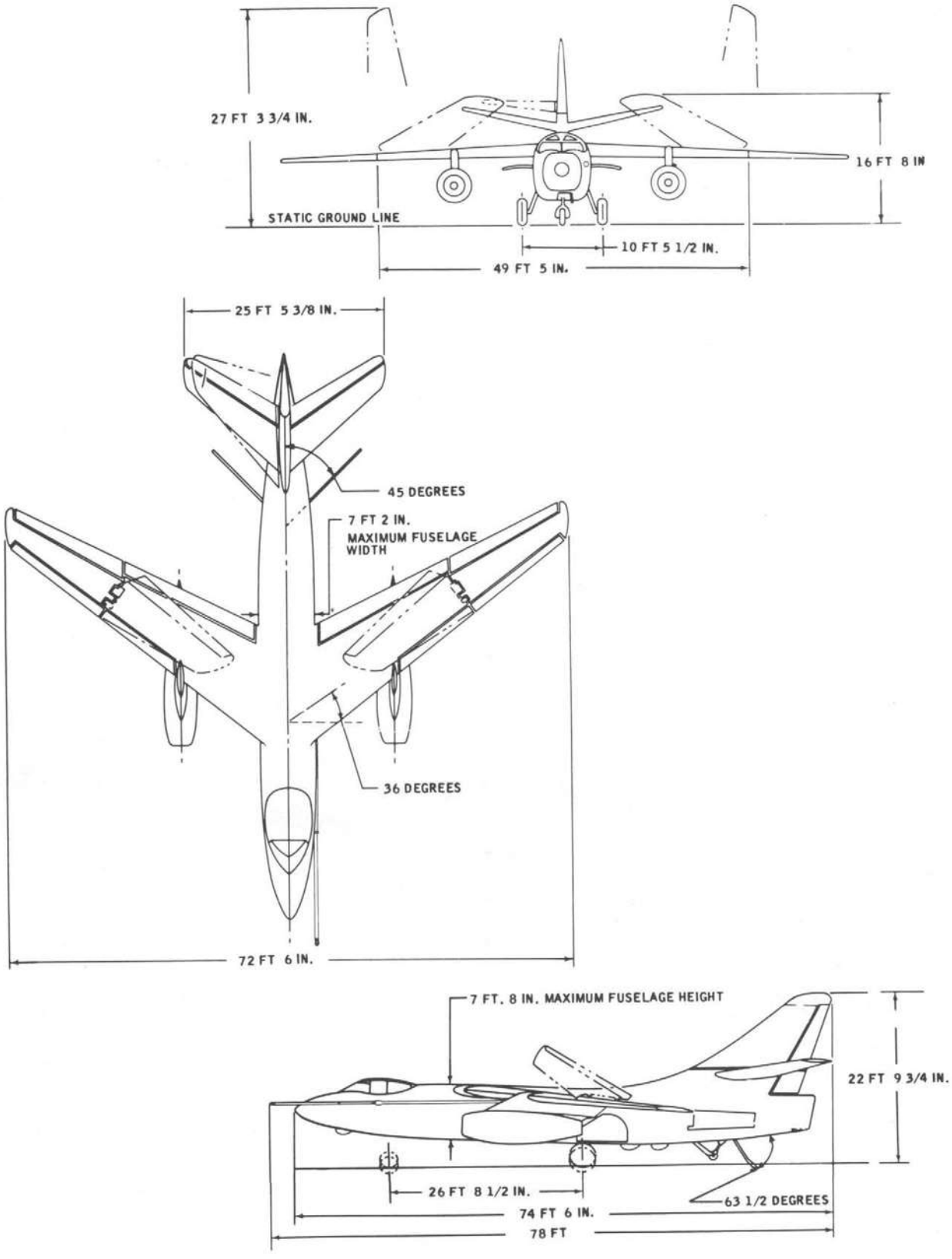


Figure 1-3. Principal Dimensions

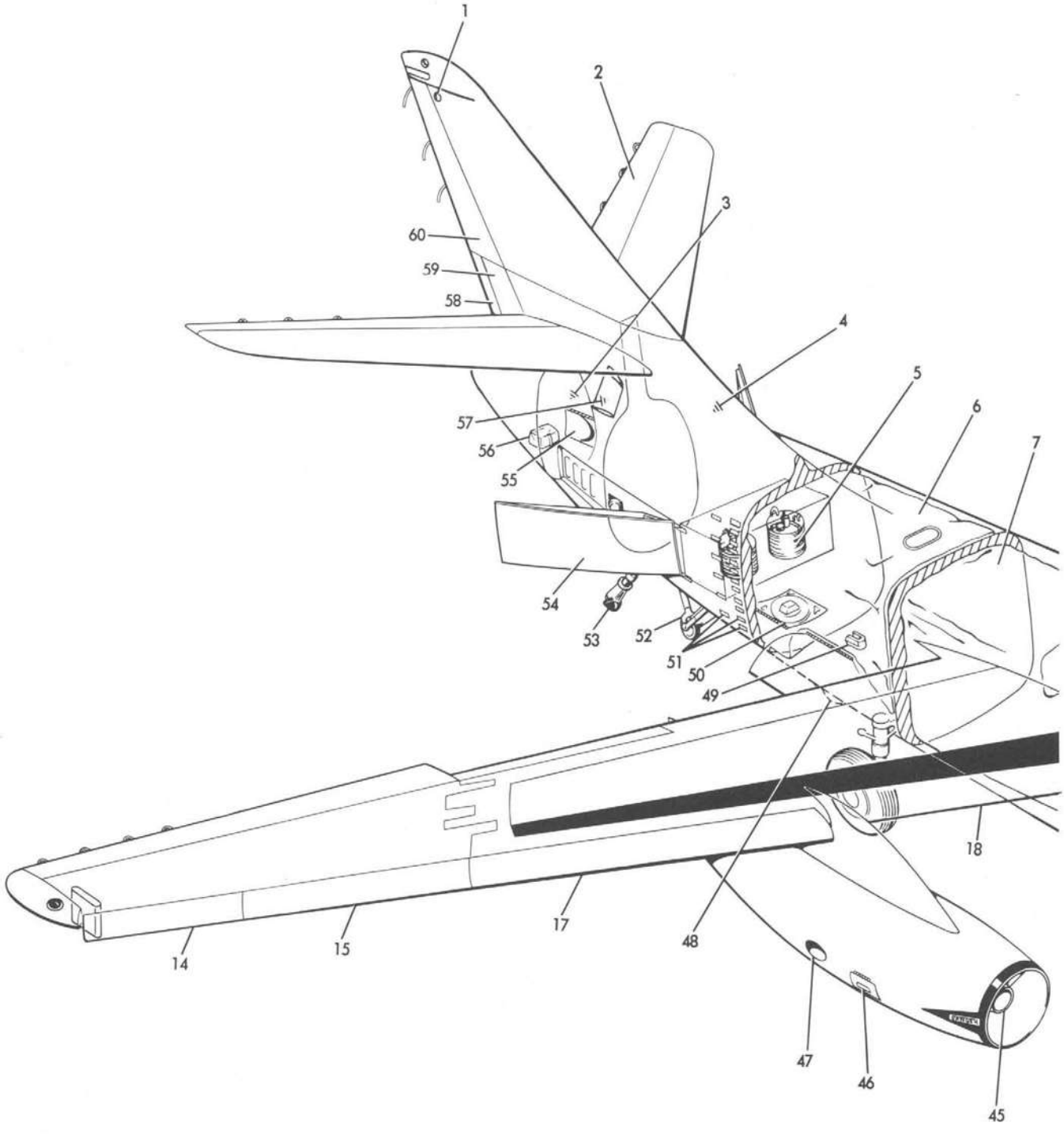


Figure 1-4. General Arrangement (Sheet 1)

1. Fin navigation lights
2. Elevator
3. Tail compartment
4. Aft compartment
5. Liquid oxygen tanks
6. Aft fuselage fuel tank
7. Forward fuselage fuel tank
8. Anticollision rotating beacon
9. Flap
10. Spoiler
11. Aileron
12. Static dischargers
13. Wing navigation lights
14. Outer wing outboard slats
15. Outer wing inboard slats
16. Wing fuel tanks
17. Center wing outboard slats
18. Center wing inboard slats (cambered wing only)
19. J57-P-10 engine
20. Camera compartment
21. Typical camera window
22. Ditching hatch
23. Thermos bottles
24. Photo-technician's position
25. Pilot's position
26. External electrical power receptacle
27. Pitot tube
27A. Air refueling probe light
28. LH ATM compartment
29. Air refueling boom
30. Nose radome
31. Taxi (landing) light
32. Approach lights
33. Jack pads container
34. Static vent
35. RH ATM compartment
36. Photo-navigator's position
37. Emergency generator
38. Pilot compartment entrance door
39. Water canteens
40. Catapult hooks
41. Flash bomb bay access door
42. Flash bomb bay door
43. Flash bomb compartment
44. Fuselage lights
45. Oil cooler air duct
46. External air starter connection
47. Compressor discharge bleed air exit
48. Anticollision rotating beacon
49. Catapult holdback fitting
50. Aft compartment access door
51. Jato mounting hooks
52. Tail bumper
53. Arresting hook
54. Speedbrake
55. DECM compartment access door
56. Drag chute
57. Fuel system vent exit
58. Rudder trim tab
59. Lower rudder
60. Upper rudder

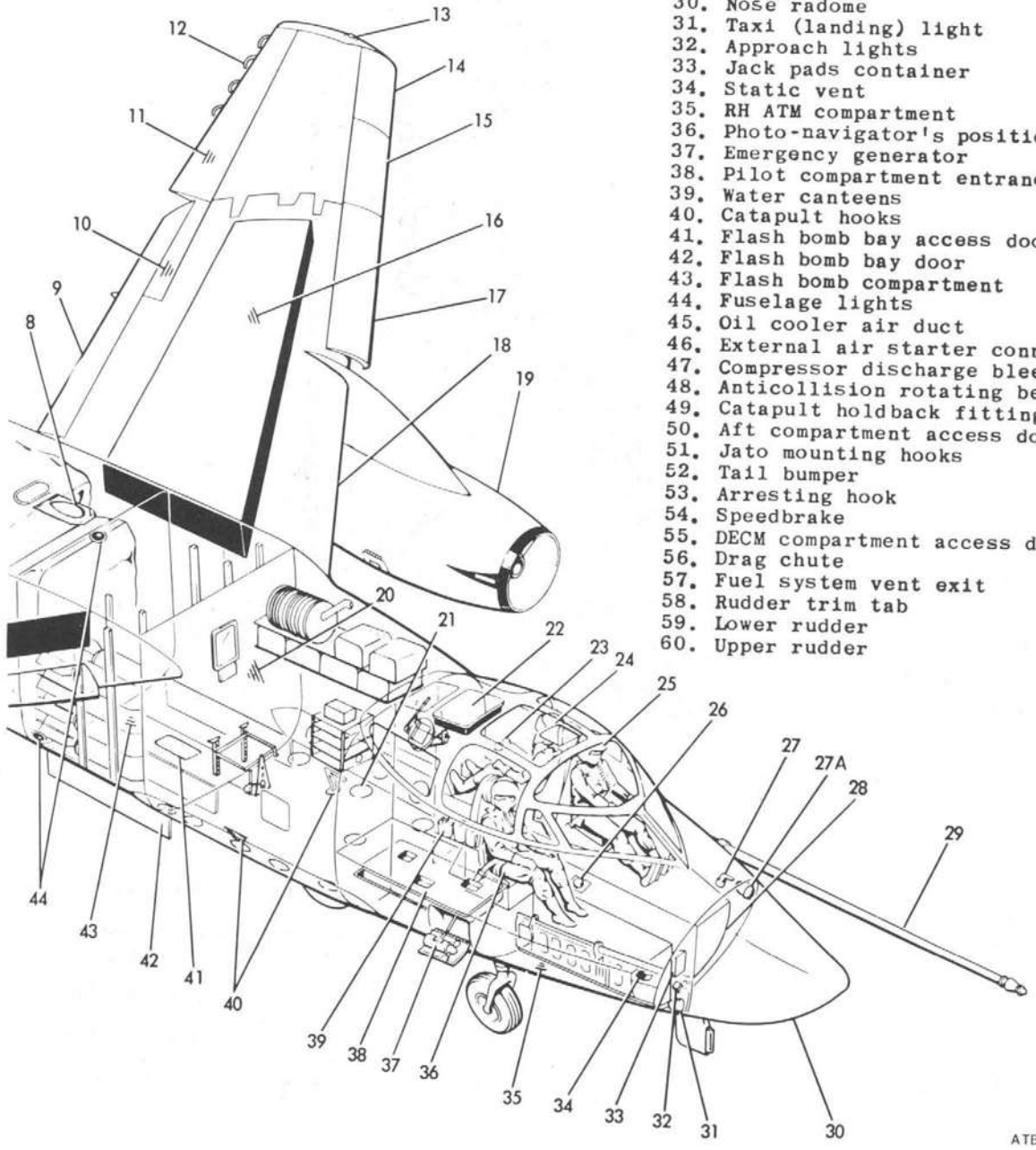
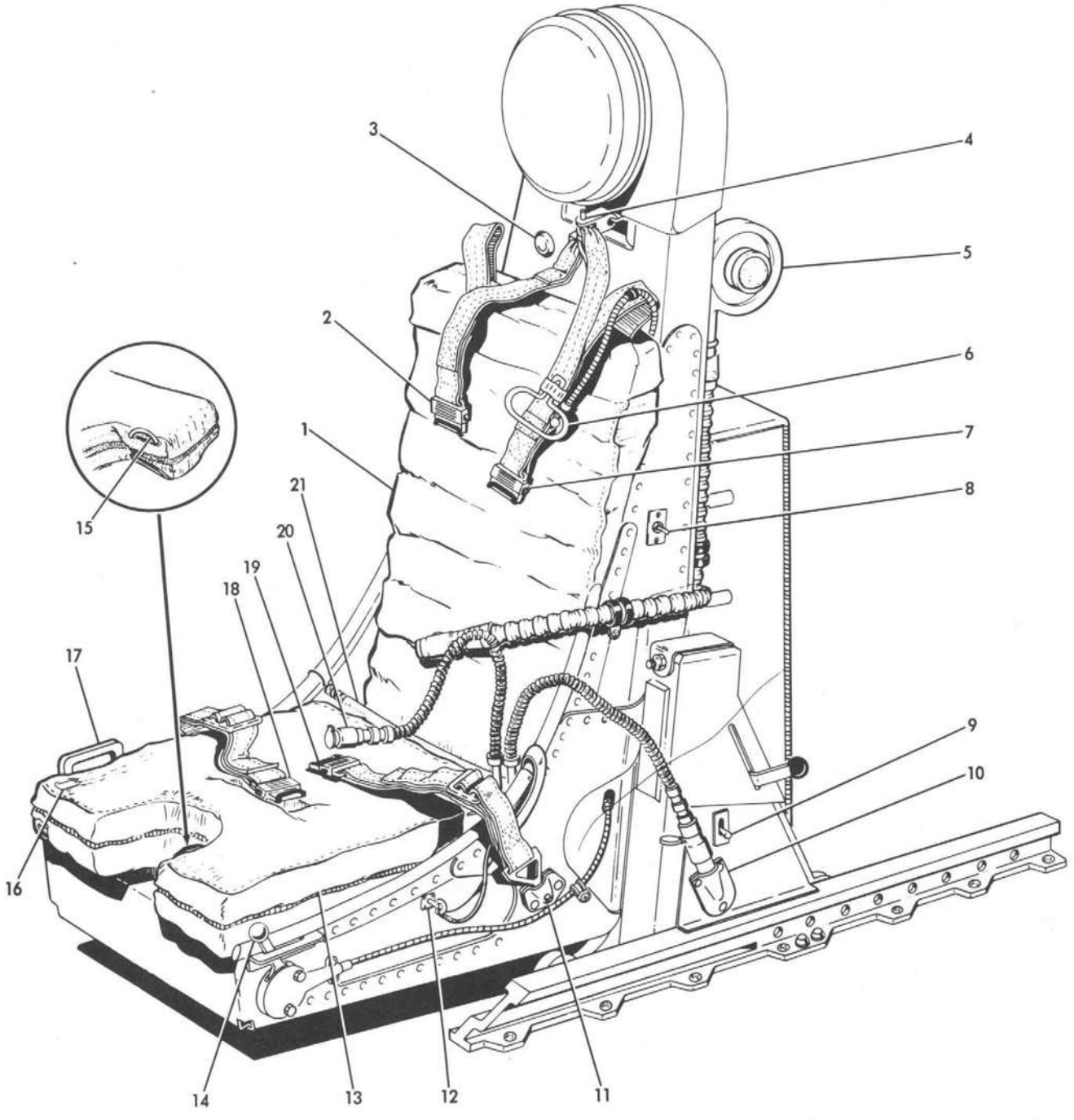


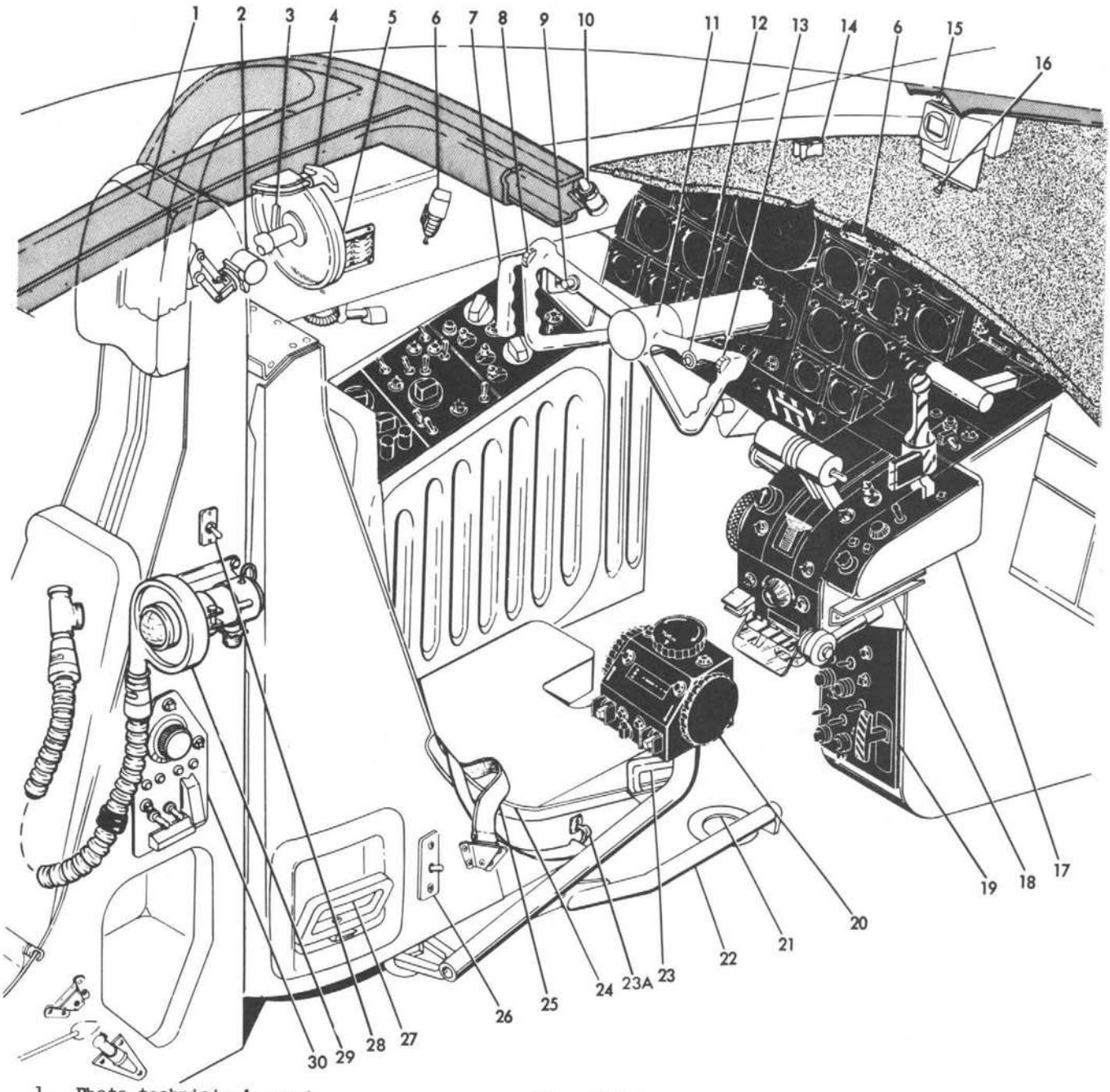
Figure 1-4. General Arrangement (Sheet 2)



1. Parachute
2. Shoulder harness-to-flight suit rocket-jet fitting
3. Push-to-reset harness button
4. Shoulder harness release pin
5. Antiexposure suit blower
6. Parachute ripcord
7. Shoulder harness-to-flight suit rocket-jet fitting
8. Antiexposure suit blower switch
9. Up and down seat adjust switch
10. Seat-to-seat cushion oxygen connection
11. Lap belt release pin
12. Bailout lanyard attachment eyebolt
13. Seat cushion
14. Shoulder harness inertia reel lock
15. Emergency oxygen bottle actuating green ring
16. Emergency oxygen bottle pressure gage
17. Harness release handle
18. Lap belt-to-flight suit rocket-jet fitting
19. Lap belt-to-flight suit rocket-jet fitting
20. Seat cushion-to-pilot oxygen connection
21. Parachute support pouch

ATB-1-1 PS-10863-1D

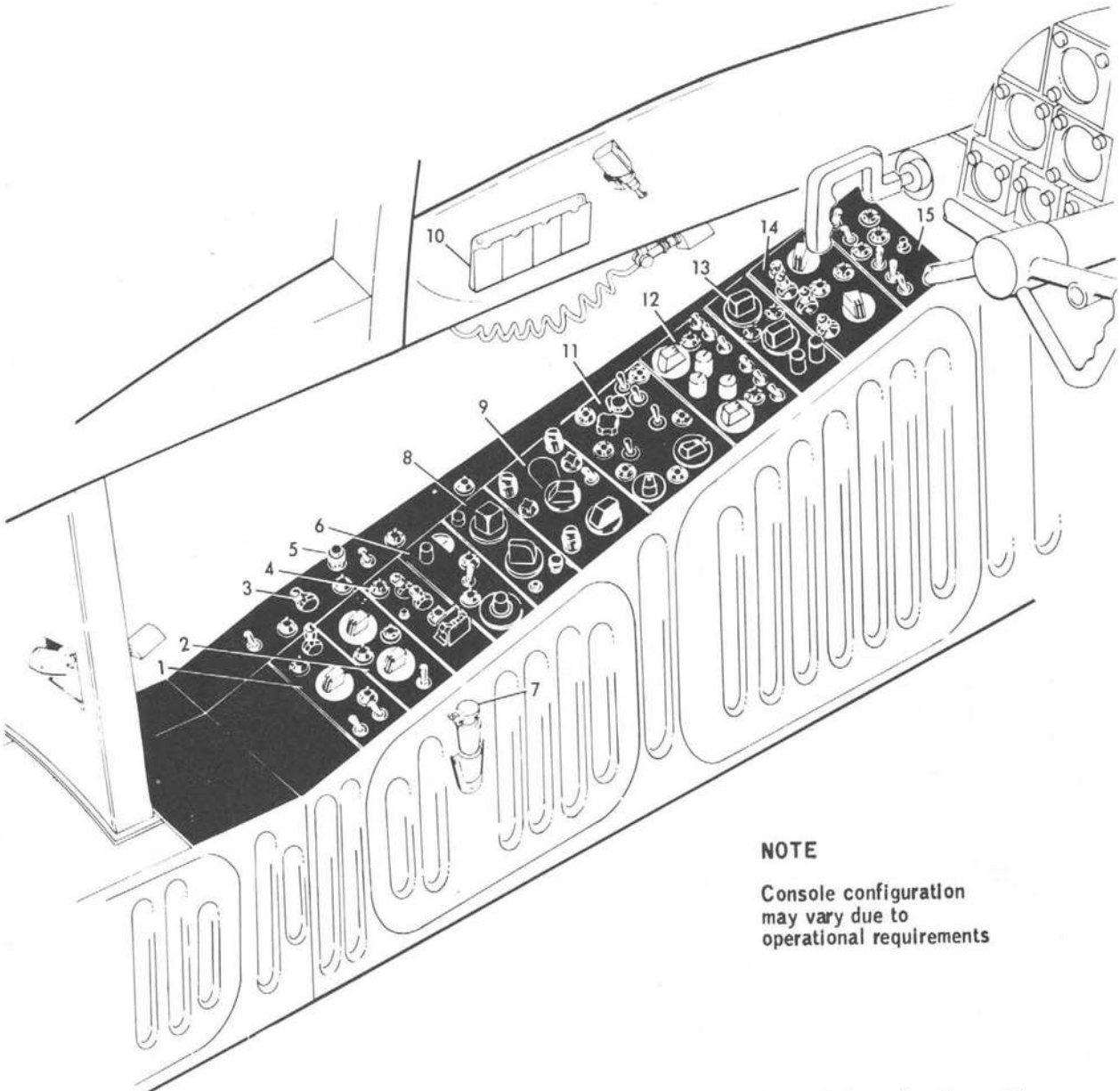
Figure 1-5. Seat Controls and Fittings (Typical)



1. Photo-technician's seat
2. Side oblique sight
3. Headrest lock
4. Bailout warning horn handle
5. Pilot's headrest
6. Instrument panel floodlight
7. Nosewheel
8. Horizontal stabilizer AC control switch
9. Autopilot release switch
10. Autopilot floodlight
11. Control column
12. Extra picture switch
13. Radio - ICS switch
14. Angle-of-attack indexer
15. Standby compass
16. Drag chute switch
17. Skid-turn control
18. Chartboard support
19. AC/DC power panel
20. Autopilot control (extended position)
21. Handpump hydraulic gage
22. Brake system hydraulic handpump handle (operating position)
23. Harness release handle
23A. Bailout Lanyard attachment eyebolt
24. Pilot's seat
25. Seat Belt
26. Seat adjust switch
27. Emergency lower escape handle
28. Antiexposure suit blower switch
29. Antiexposure suit blower
30. Photo-technician's seat bomb release panel

ATB-1-1 P-12586-1G

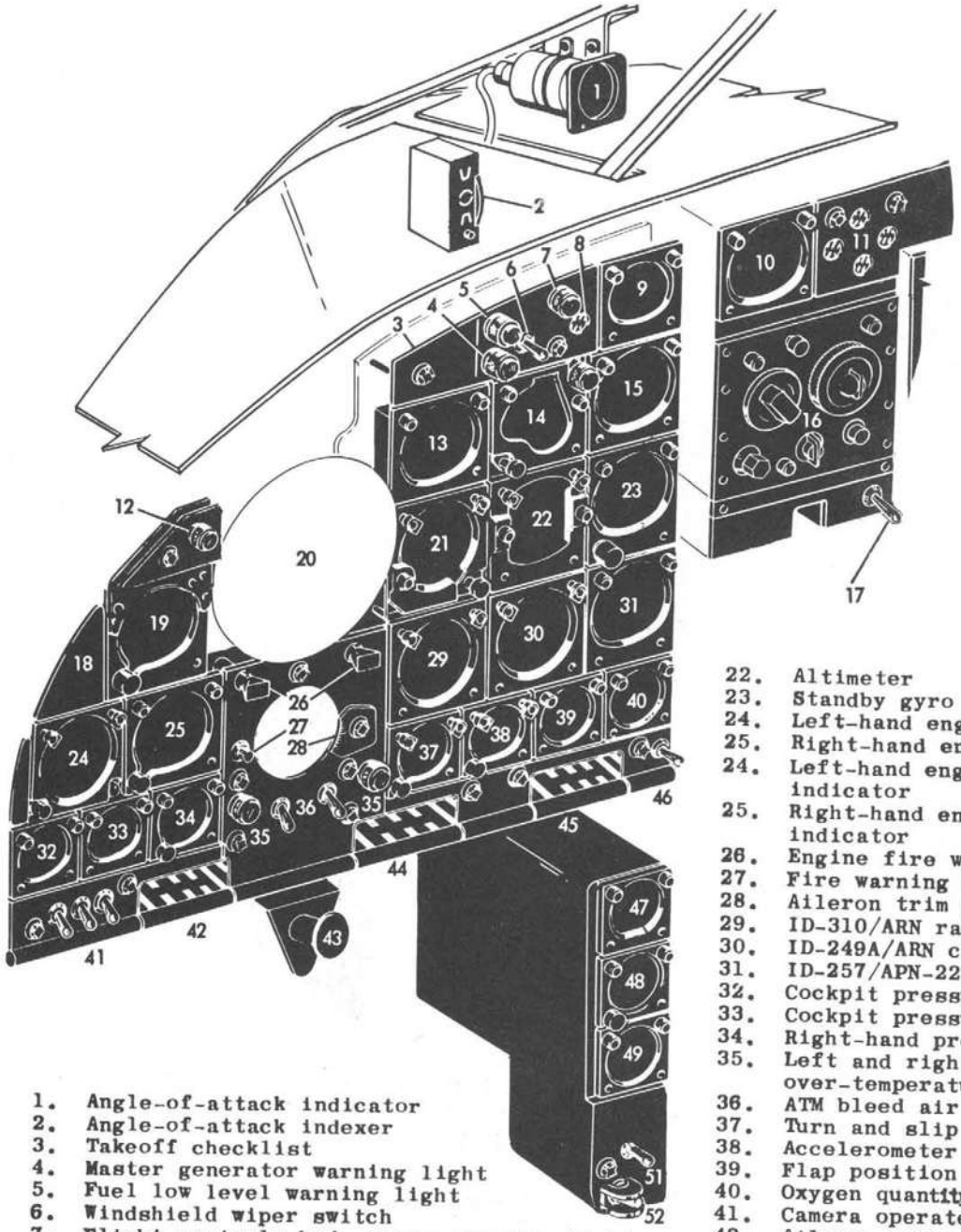
Figure 1-6. Pilot's Station - General Arrangement



1. Air-conditioning and pressurizing control panel
2. Interior lights control panel
3. Oxygen control
4. ATM and AFCS control panel
5. Fin unlocked indicator light
6. MA-1 compass controller
7. Pilot's oxygen outlet
8. ARC-1 radio control panel
9. ARN-6 radio control panel
10. Card holder
11. Viewfinder control panel
12. Interphone control panel
13. ARR-40 radio control panel (when installed)
14. Fuel system control panel
15. Exterior lights control panel

ATB-1-1 P-12494-1F

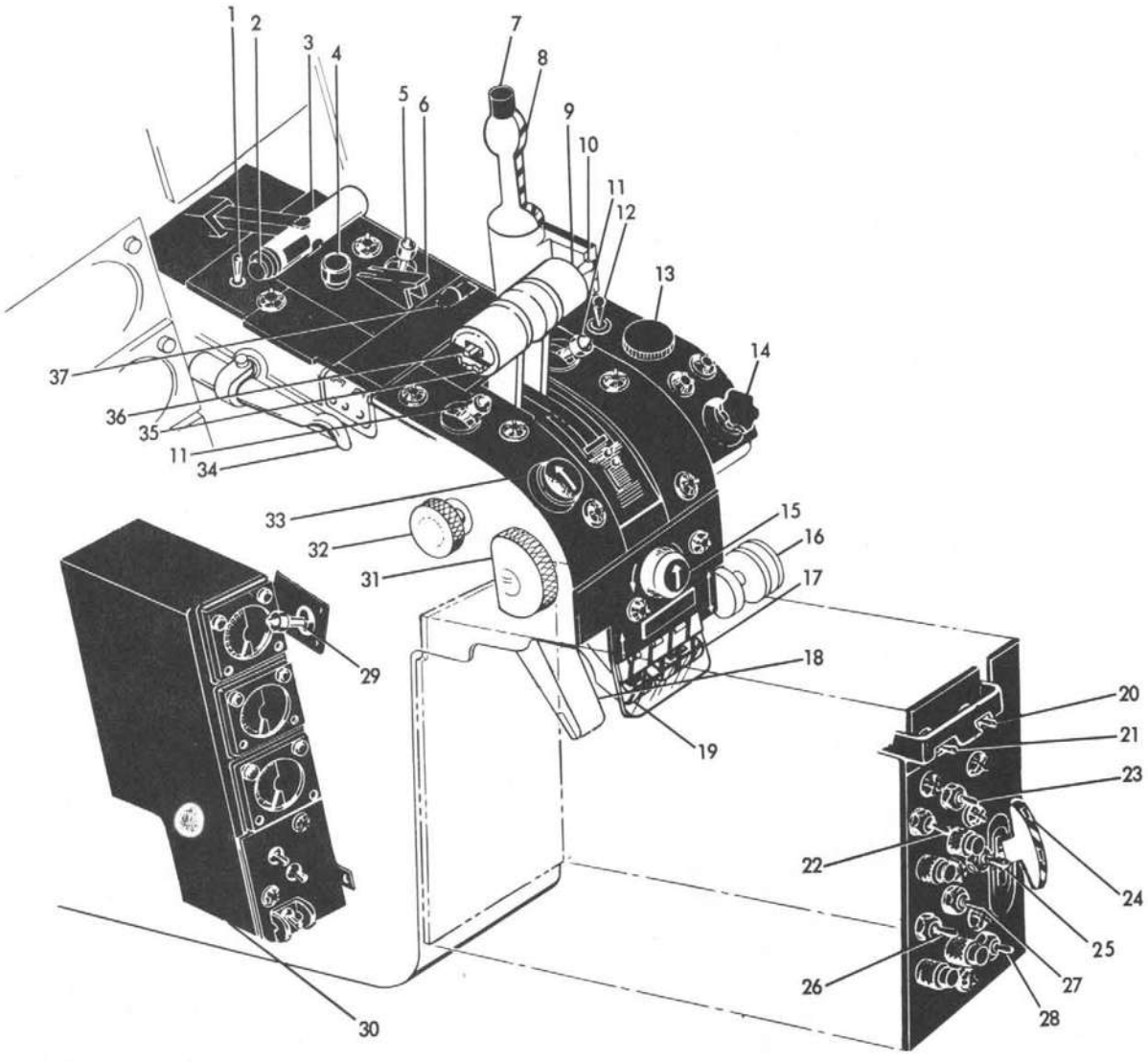
Figure 1-7. Pilot's Station - Left-Hand Console



1. Angle-of-attack indicator
2. Angle-of-attack indexer
3. Takeoff checklist
4. Master generator warning light
5. Fuel low level warning light
6. Windshield wiper switch
7. Flight controls hyd. press. warning light
8. Utility hyd. press. warning indicator
9. Dual fuel flowmeter
10. Trim position indicator
11. Wheel position indicators
12. Tri-met camera indicating light
13. ID-250/ARN indicator
14. Airspeed and mach indicator
15. Rate-of-climb indicator
16. ATC-27A UHF control panel
17. TACAN/OMNI switch
18. Landing checklist
19. Fuel quantity indicator
20. Viewfinder
21. Vertical gyro attitude indicator
22. Altimeter
23. Standby gyro
24. Left-hand engine performance
25. Right-hand engine performance
24. Left-hand engine performance indicator
25. Right-hand engine performance indicator
26. Engine fire warning lights
27. Fire warning lights test switch
28. Aileron trim position indicator
29. ID-310/ARN range indicator
30. ID-249A/ARN course indicator
31. ID-257/APN-22 indicator
32. Cockpit pressure altimeter
33. Cockpit pressure altimeter
34. Right-hand pressure ratio indicator
35. Left and right-hand ATM compartments over-temperature warning lights
36. ATM bleed air shutoff switches
37. Turn and slip indicator
38. Accelerometer
39. Flap position indicator
40. Oxygen quantity indicator
41. Camera operate switches
42. Aileron power boost release handle
43. Rudder pedal adjust knob
44. Rudder and elevator boost release handle
45. Emergency air brake handle
46. Antiskid switch
47. Free air temperature indicator
48. Left-hand ATM compartment temperature indicator
49. Right-hand ATM compartment temperature indicator
50. Deleted
51. ATM compartment over-temperature test switch
52. ATM over-pressure test switch

ATB-1-1 P-12495-1F

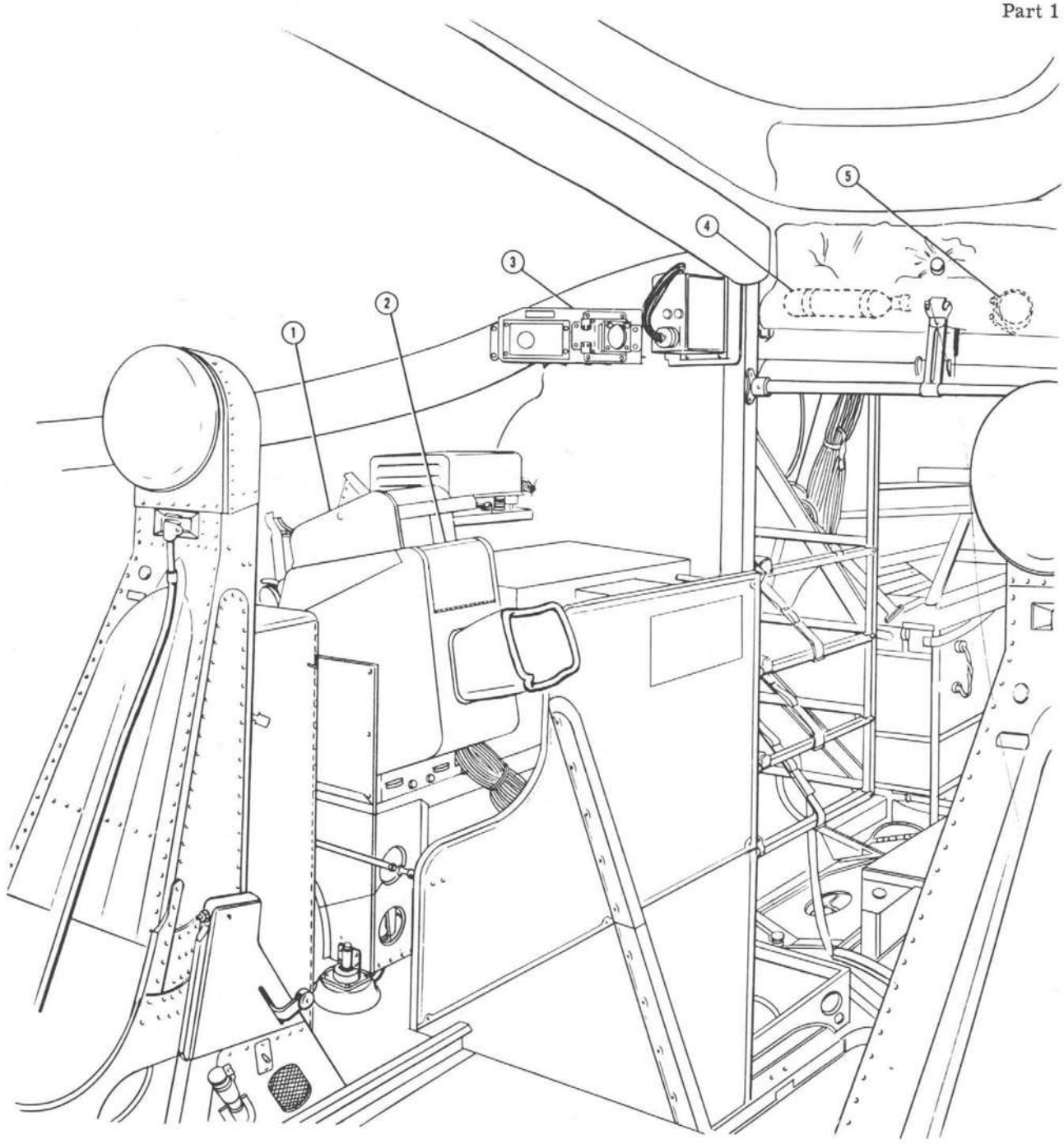
Figure 1-8. Pilot's Station-Instrument Panel



1. Engine starter switch
2. Jato firing switch
3. Catapult handgrip
4. Jato armed warning light
5. Jato jettison switch
6. Jato arming switch
7. Gust lock handle release button
8. Gust and wing pin lock handle
9. Throttles
10. Exterior lights master switch
11. Master engine switches
12. Skid-turn engage switch
13. Skid-turn knob
14. Skid entry outside wing trim knob
15. Aileron trim control switch
16. Landing gear control
17. Emergency landing gear control
18. Flap control
19. Emergency flap control
20. Horizontal stabilizer DC emergency off switch
21. Horizontal stabilizer AC emergency off switch
22. LH DC generator
23. RH DC generator
24. Emergency generator
25. Bus tie switch
26. LH AC generator
27. RH AC generator
28. External power switch
29. Horizontal stabilizer DC trim power supply Buno. 142668-142669, 144825-144836
30. Pilot's auxiliary instrument panel
31. Horizontal stabilizer trim control
32. Throttle friction control
33. Rudder trim control switch
34. Arresting hook control
35. Speed brake switch
36. Throttle radio-ICS switch
37. Wing fold control lever

ATB-1-1 P-12580-1D

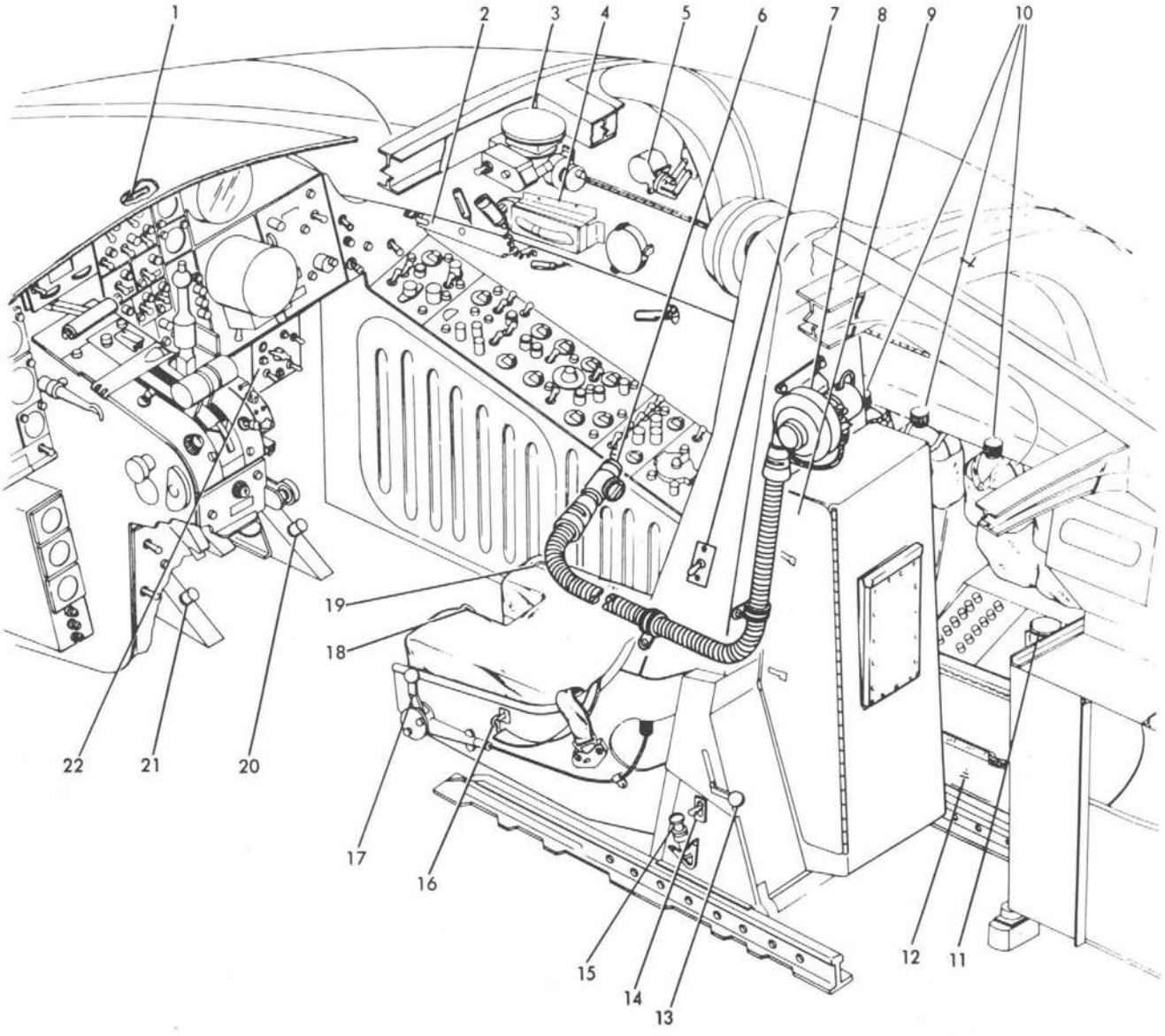
Figure 1-9. Pilot's Station – Center Console



1. Radar recorder.
2. IP-333 azimuth and range indicator.
3. Camera vacuum gage.
4. Bailout warning horn bottle and pressure gage.
5. Bailout warning horn.

ATB-1-1 P-17034-1A

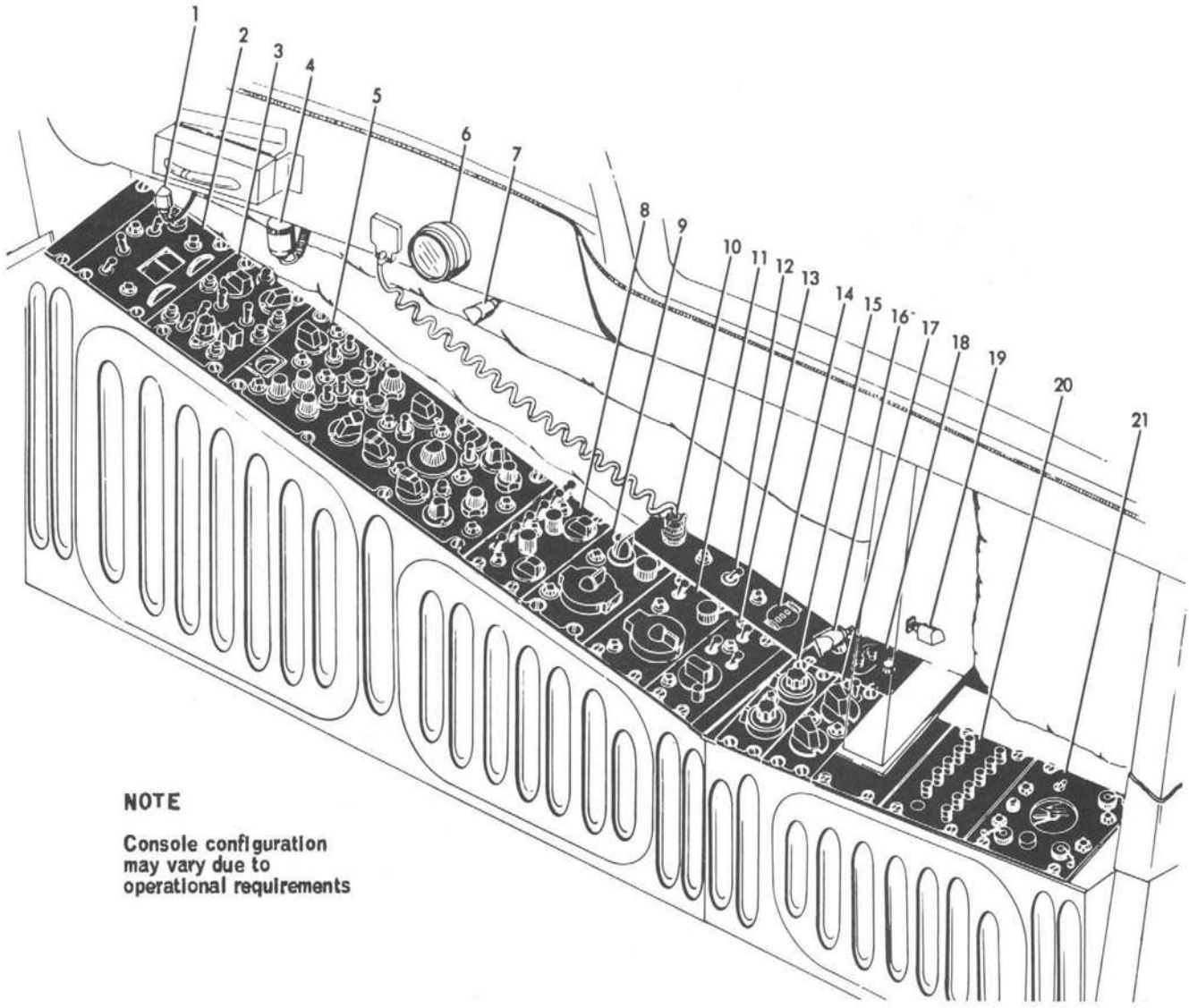
Figure 1-10. Photo-navigator's Station - Right-Hand Side



1. Instrument panel floodlight
2. Chartboard support (stowed)
3. Periscopic sextant mount
4. Inclinometer
5. Side oblique camera sight
6. Antiexposure suit blower air hose
7. Antiexposure suit control panel
8. Antiexposure suit blower
9. Periscopic sextant stowage
10. Water canteens
11. Relief tube
12. Chartboard (stowed)
13. Fwd and aft seat adjust
14. Up and down seat adjust
15. Oxygen container
16. Bailout lanyard attachment eyebolt
17. Harness release
18. Bailout oxygen bottle actuation green ring
19. Bailout oxygen bottle pressure gage
20. MIC-RAD switch
21. MIC-ICS switch
22. AN/ASB-1B gyro control

ATB-1-1 P-12587-1E

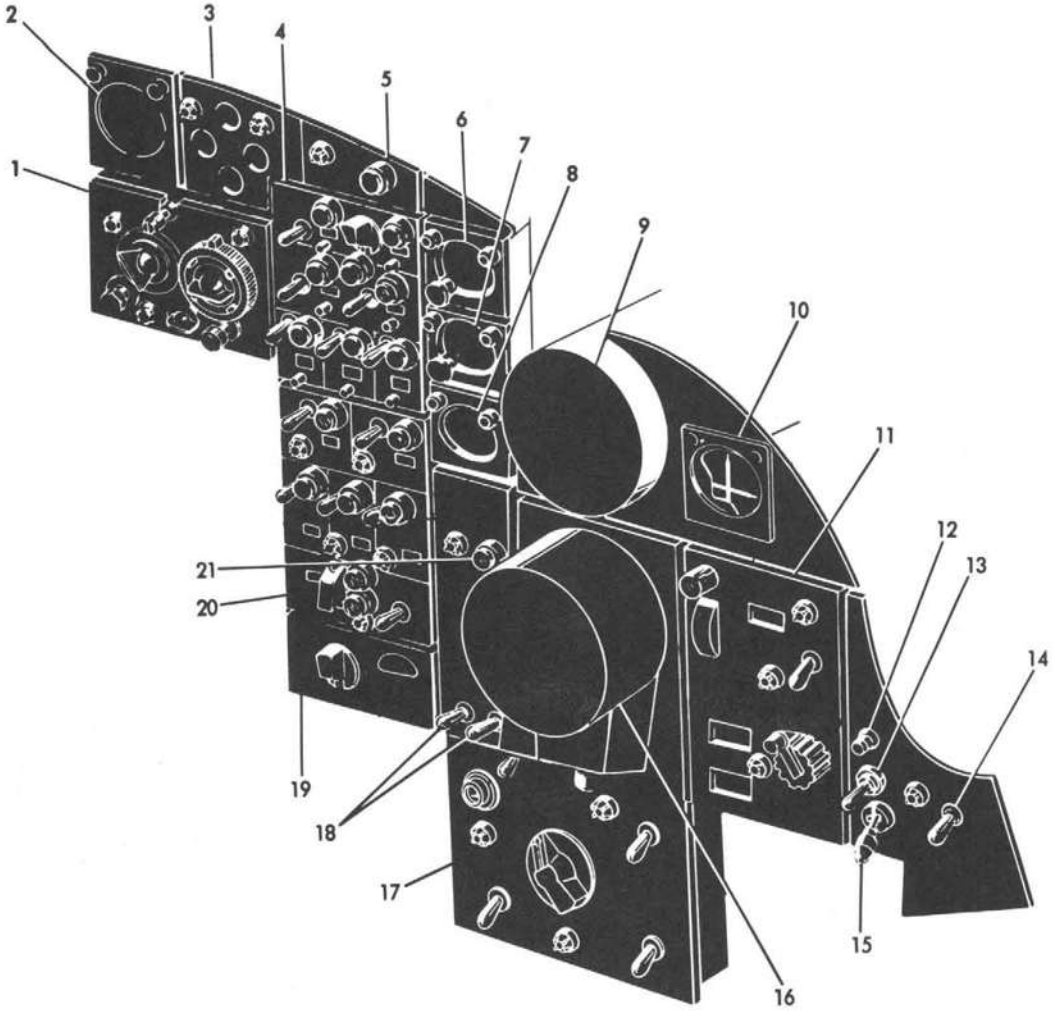
Figure 1-11. Photo-navigator's Station - General Arrangement



1. Instrument panel floodlight
2. Master camera control panel
3. Viewfinder control panel
4. Portable floodlight
5. ASB-1B control panel
6. Navigation watch case
7. Console floodlight
8. ICS control panel
9. ARN-21-TACAN radio control panel
10. Extra picture handle control
11. VHF navigation control panel
12. Oblique sight illumination switch
13. APX-6B-(IFF)
14. Camera counter
15. APA-89 (SIF) control panel
16. Aft console floodlight (fwd)
17. Interior lights control
18. Navigator's circuit breaker and fuse panel
19. Aft console floodlight (aft)
20. ASB-1B circuit breaker panel
21. ASB-1B pressure monitor panel

ATB-1-1 P-12588-1D

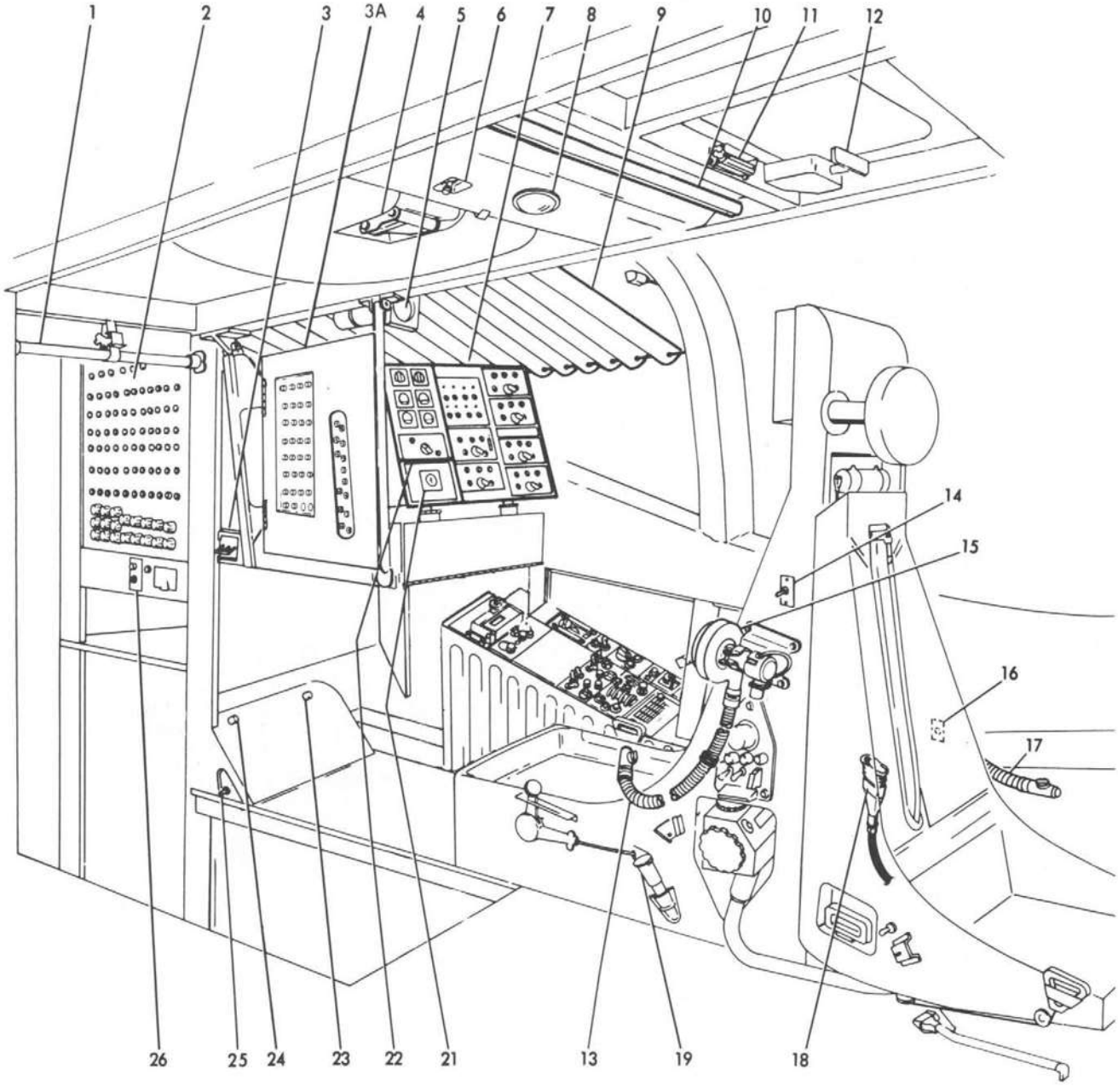
Figure 1-12. Photo-navigator's Station - Right-Hand Console



1. ARC-27 control panel
2. Trim position indicator
3. Wheel position indicators
4. Camera control panels
5. Flash bomb doors open light
6. Eight day clock/elapsed timer
7. LH frequency meter
8. RH frequency meter
9. Viewfinder
10. CN-502 gyro control indicator
11. ASB-1B indicator control
12. Extra picture switch
13. Tape recorder switch
14. Radar picture switch
15. Oxygen control
16. ASB-1B auxiliary indicator
17. CN-502 gyro monitor panel
18. Camera operate switches (OP1-OP2)
19. Exposure control panel
20. Illuminant control panel
21. Radar range light (4)

ATB-1-1 P-12497-1C

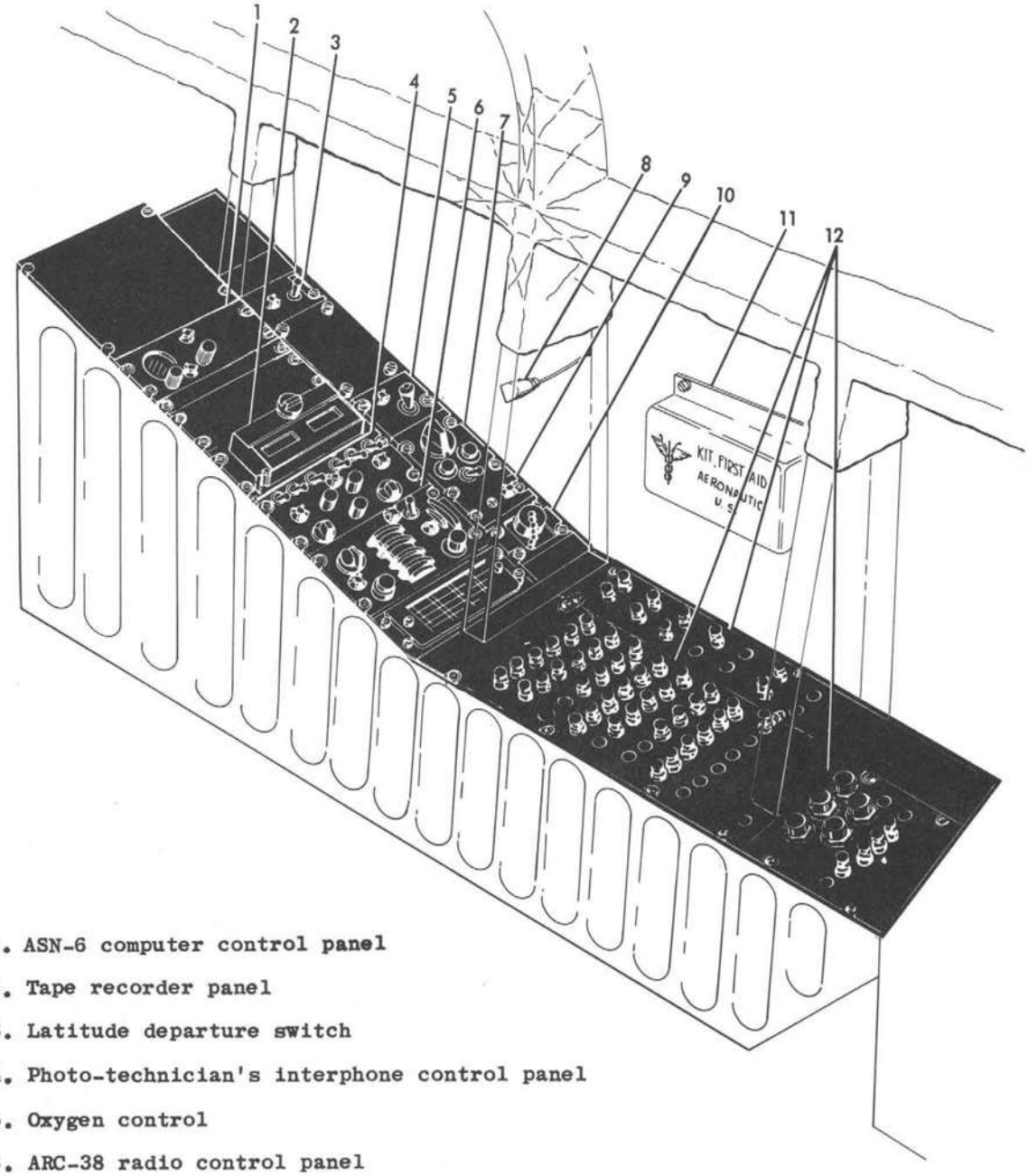
Figure 1-13. Photo-navigator's Station - Instrument Panel



1. Vaulting bar
2. Companionway circuit breaker and fuse panel
3. Forward tank fuel pump circuit breakers
3A. ECM circuit breaker panel
4. Ditching hatch handle
5. ID-389/ASN indicator
6. Cockpit dome light switch
7. DECM control panel
8. Cockpit dome light
9. Photo-technician's sun screen
10. Overhead assist handle
11. Ditching hatch release handle
12. Bailout warning horn handle
13. Antiexposure suit blower air hose
14. Antiexposure suit blower switch
15. Antiexposure suit blower
16. Pilot's antiexposure suit blower switch
17. Pilot's antiexposure suit blower air hose
18. Relief tube
19. Photo-technician's oxygen outlet
20. Deleted
21. Cabin altimeter
22. Aft power panel
23. Photo-technician's MIC-RAD switch
24. Photo-technician's MIC-ICS switch
25. Camera compartment dome lights switch
26. Control boost latch test light and button

ATB-1-1 P-11155-1D

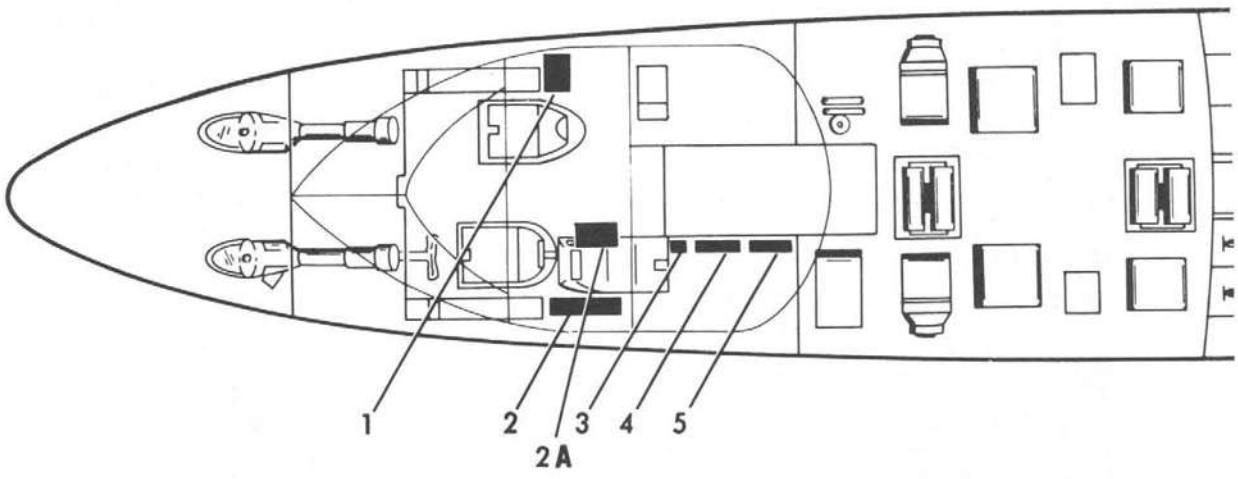
Figure 1-14. Photo-technician's Station - General Arrangement



1. ASN-6 computer control panel
2. Tape recorder panel
3. Latitude departure switch
4. Photo-technician's interphone control panel
5. Oxygen control
6. ARC-38 radio control panel
7. Photo-technician's console lights control panel
8. Panel floodlight
9. Transmitter key jack
10. Cockpit utility receptacle
11. First aid kit
12. Pilot's circuit breaker and fuse panels

ATB-1-1 P-12458-1D

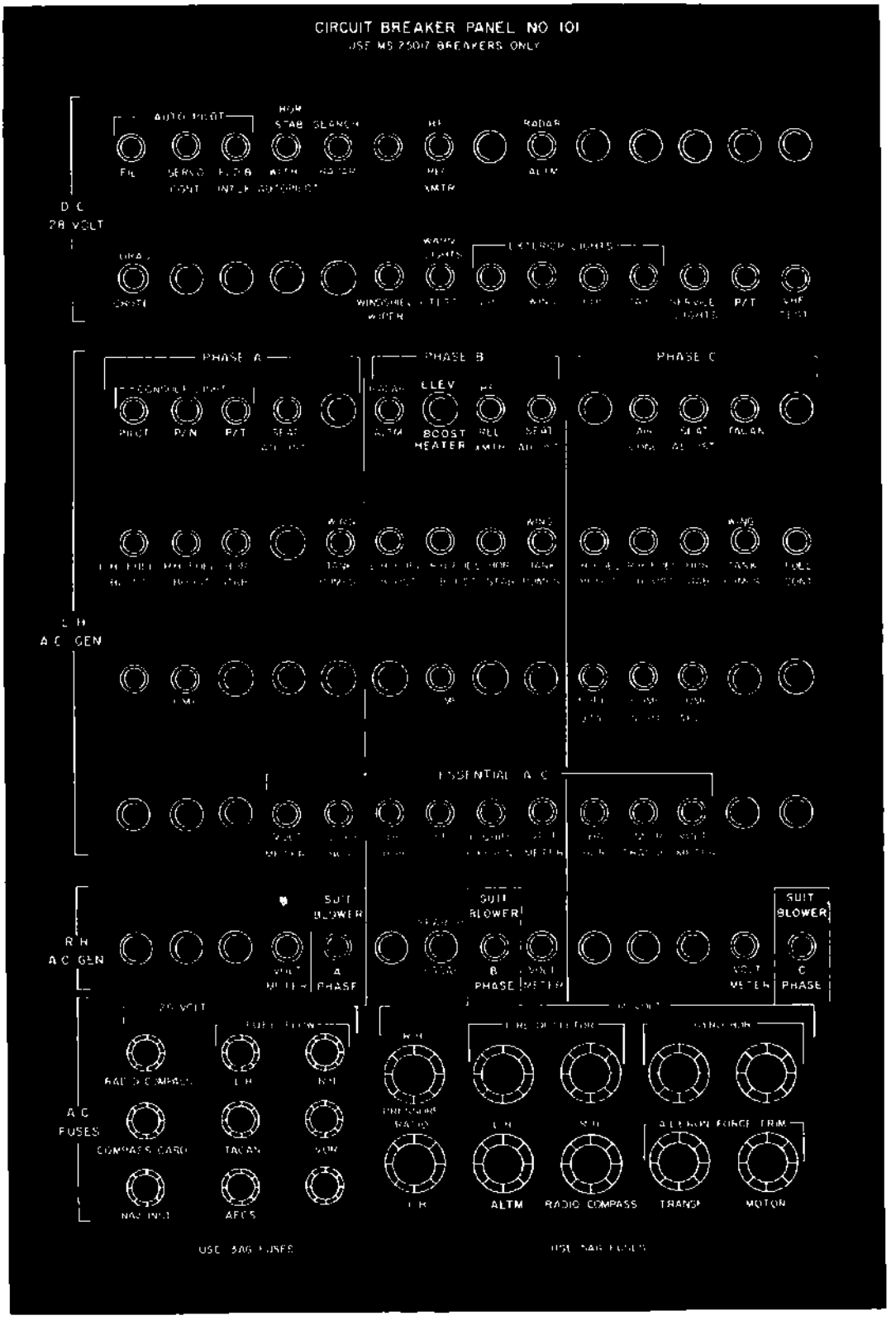
Figure 1-15. Photo-technician's Station – Console



1. Photo-navigator's circuit breaker and fuse panel
2. Pilot's circuit breaker and fuse panel
2A. ECM circuit breaker panel
3. Forward fuel tank pump circuit breaker and fuse panel
4. Companionway circuit breaker and fuse panel
5. Photo circuit breaker and fuse panel

ATB-1-1 P-11479-3B

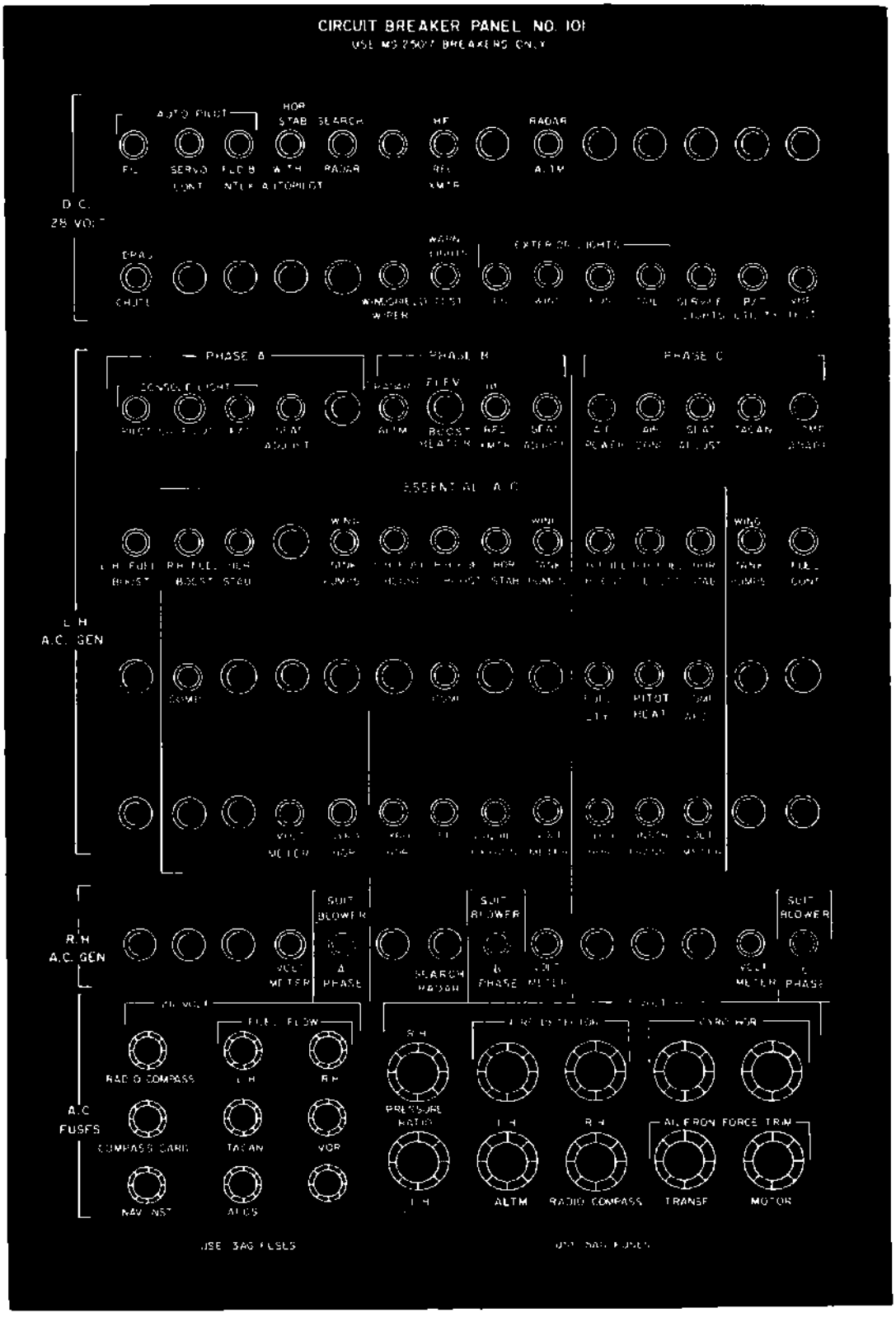
Figure 1-15A. Circuit Breaker and Fuse Panel - Location Diagram (Sheet 1)



ATB-1-1 P-11479-10

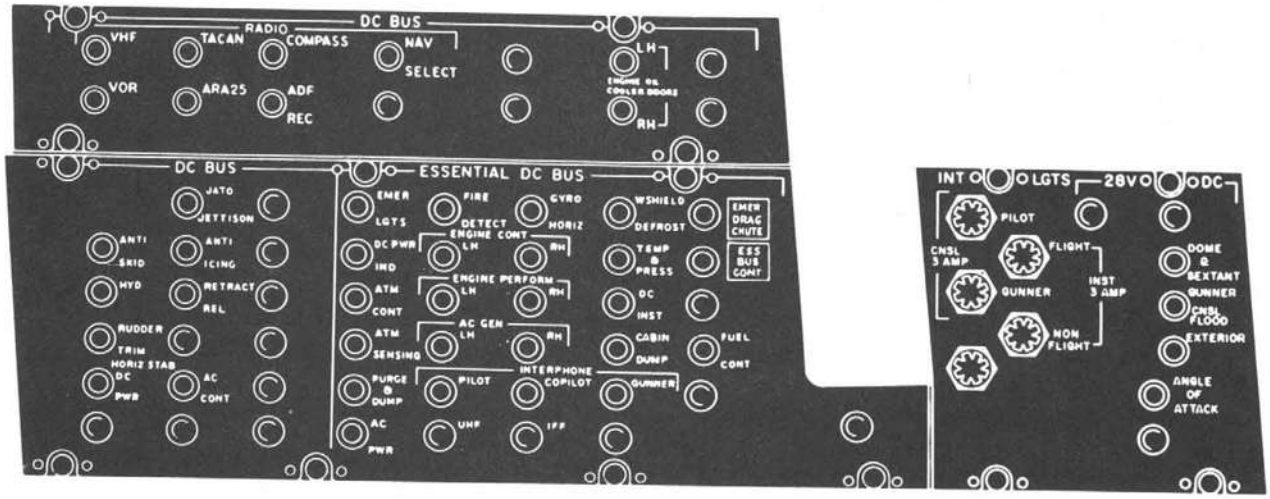
BuNo. 142668, 142669, 144825 - 148836

Figure 1-15A. Circuit Breaker and Fuse Panel - Companionway (Sheet 2)

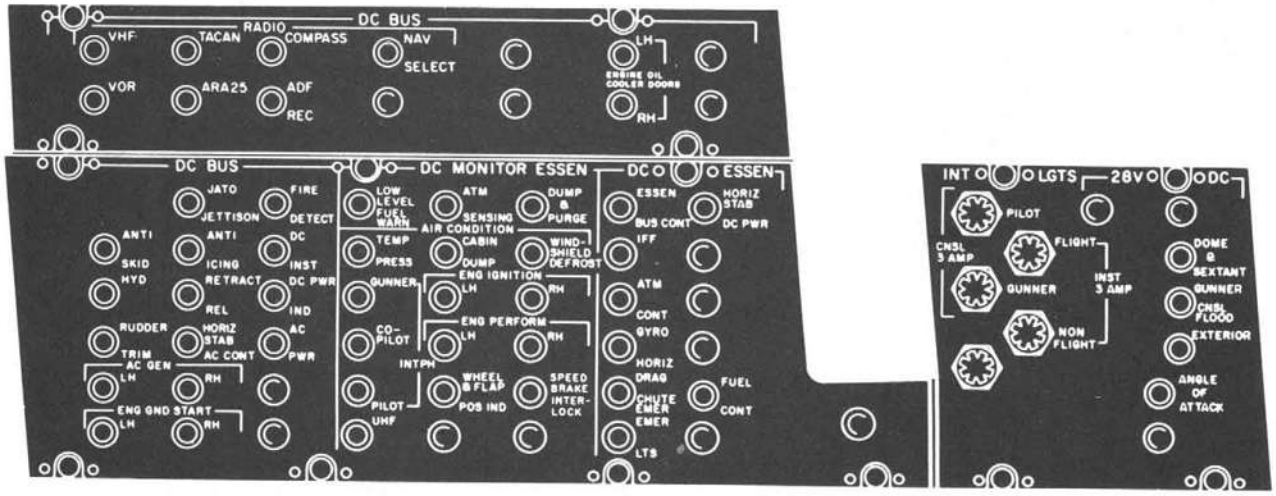


BuNo. 142256, 142666, 142667, 144837 and subsequent

Figure 1-15A. Circuit Breaker and Fuse Panel – Companionway (Sheet 3)



AIRCRAFT BUNO. 142668-142669, 144825-144836



AIRCRAFT BUNO. 142256, 142666-142667, 144837-144847 AND SUBSEQUENT

ATB-1-1 P-14013-1D

Figure 1-15A. Circuit Breaker and Fuse Panel - Pilots (Sheet 4)

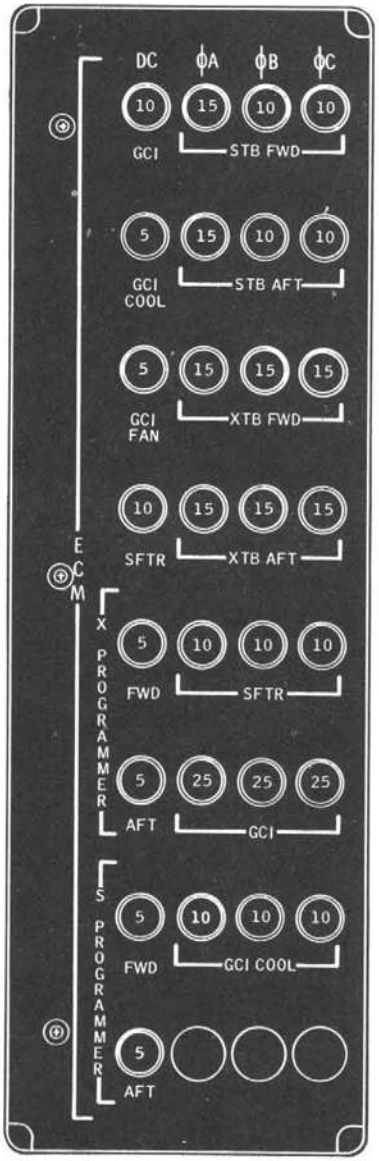


PHOTO-TECHNICIAN CIRCUIT BREAKER PANEL 109-(DECM)

PHOTO-NAVIGATOR CIRCUIT BREAKER AND FUSE PANELS

ATB-1-1 P-14013-2A

Figure 1-15A. Circuit Breaker and Fuse Panel - Photo-navigator (Sheet 5)

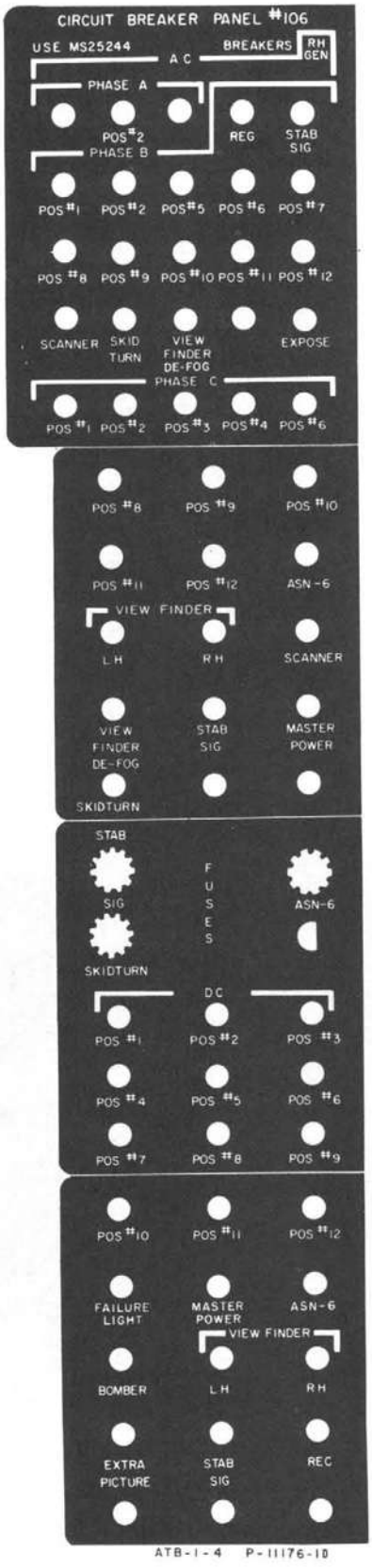


Figure 1-15A. Circuit Breaker and Fus Panel - Companionway Photo (Sheet 6)

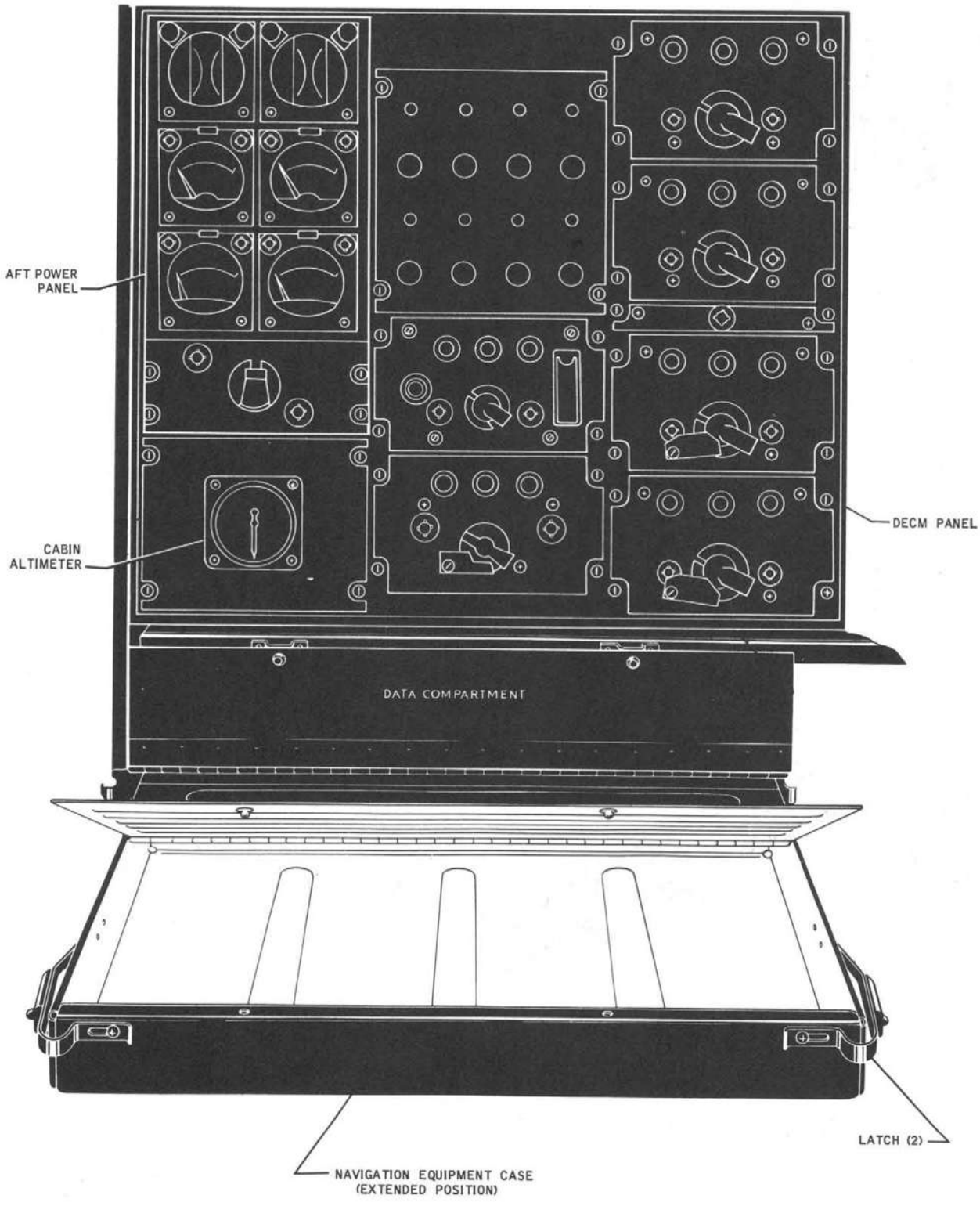


Figure 1-16. Photo-technician's Station – DECM Console

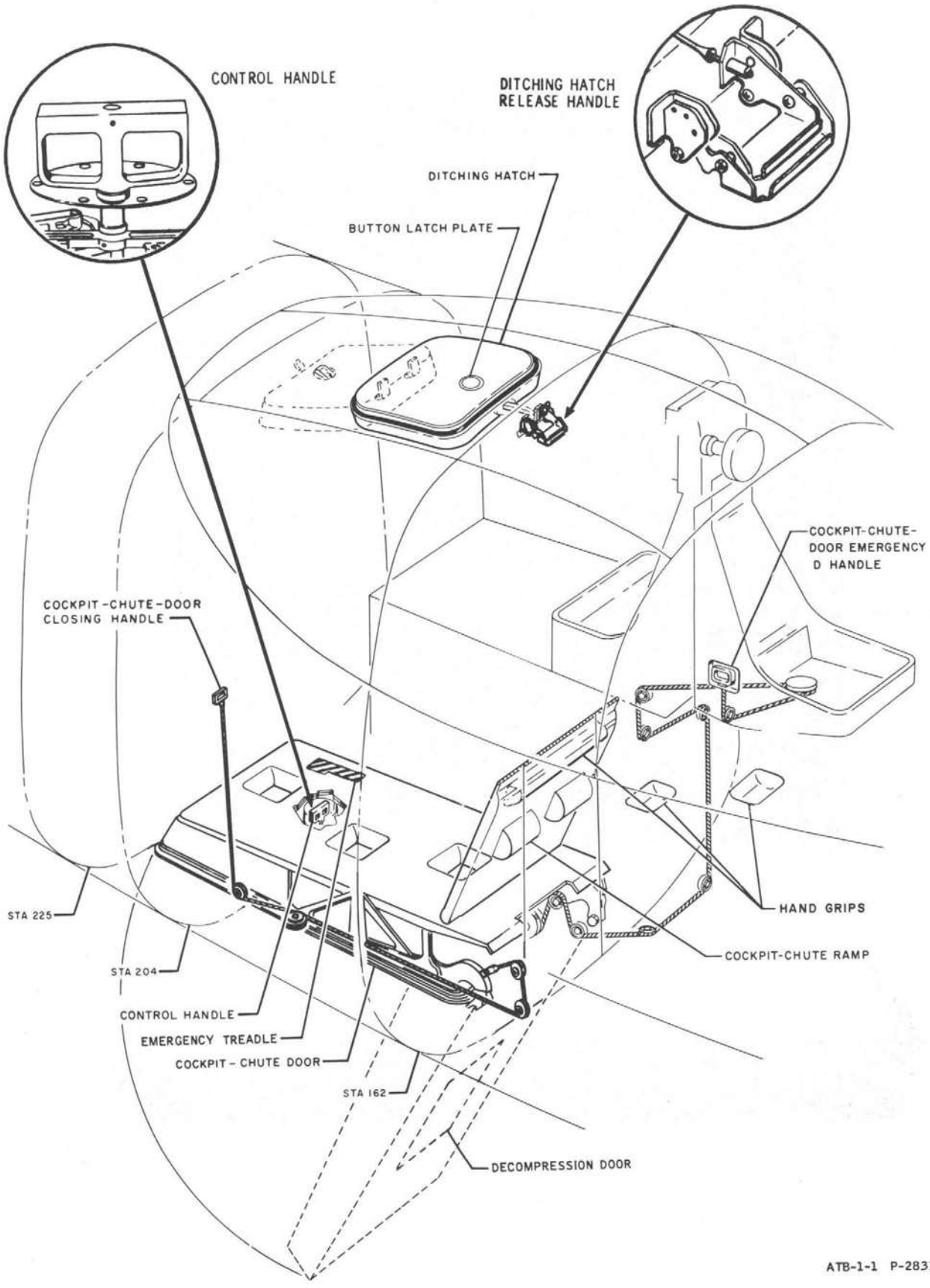


Figure 1-17. Escape Provisions

PHOTO-NAVIGATOR'S SEAT

The photo-navigator's seat may be electrically actuated UP or DOWN by means of a seat adjust switch (14, figure 1-11) on the left side of the seat. The headrest is mounted on a threaded shaft; forward and aft adjustment may be made by turning the headrest. Forward and aft manual adjustment of the seat may be made after the forward and aft seat adjust handle (13, figure 1-11) is moved from the LOCKED to UNLOCKED position. The photo-navigator's oxygen connection is located on the left side of the seat (7, figure 1-5).

PHOTO-TECHNICIAN'S SEAT

The photo-technician's seat (figure 1-14) is not adjustable. An oxygen outlet (19, figure 1-14) is located on the left side of the seat. A bomb release panel is also mounted on the left side of the seat (27, figure 1-6).

ENTRANCE DOOR

EMERGENCY ESCAPE CHUTE AND ENTRANCE DOOR

The emergency escape chute (see figures 1-17 and 5-1) serves as the normal entrance and exit on the ground and provides for emergency exit from the aircraft in flight. Emergency exit is made by sliding down the chute. Refer to BAILOUT in Section V.

GROUND OPERATION

Entrance to the aircraft is made by turning the flush-folding outer latch handle on the pilot compartment entrance door to OPEN, releasing two latches, then pulling down on the door. A ground safety latch is provided to prevent injury, should the cabin be pressurized. The door may be secured and locked from the outside by pushing upward until closed, then turning the outer latch to CLOSE. The door may be closed from inside the aircraft by pulling up on the door closing handle. When closed, the door must be locked by turning the inner door latch to CLOSE. A window adjacent to the inner latch handle permits visual inspection of the locked position safety latch.

UPPER ESCAPE HATCH

The upper escape hatch is located on the upper cockpit enclosure (see figure 1-17). The hatch is manually operated and opens inward when the pull-to-operate handle is pulled downward. The hatch is not operable when the cabin is pressurized. The hatch may be opened from the outside when a 50-pound force is applied to the circular disc on the exterior surface of the hatch. The disc is labeled PUSH and the hatch external surface is marked EXIT RELEASE.

UPPER HATCH RELEASE HANDLE

A hatch release handle is provided to enable the ditching hatch to be released from the latched open position by any crew member without leaving his seat. The release handle is located overhead adjacent to the bailout warning horn handle and is marked SQUEEZE 1/4 PULL TO CLOSE FWD DITCHING HATCH.

MISCELLANEOUS EQUIPMENT

FLAK CURTAINS

Flak curtains are available and may be installed on the sides of the cockpit area.

WATER CANTEENS

Three canteens for carrying drinking water are located at the aft end of the photo-navigator's console (10, figure 1-11).

RELIEF TUBE

A relief tube is located aft of the photo-navigator's seat (11, figure 1-11) and on the photo-technician's seat (18, figure 1-14).

PART 2

SYSTEMS

ENGINE

The Pratt and Whitney J57-P-10 turbojet engine (figure 1-17A) comprises two multistage, axial-flow compressors, eight combustion chambers, and a split, three-stage turbine assembly. The three main engine sections are: the compressor section; the accessory section; and the combustion chamber, turbine, and exhaust section. The compressor section consists of a low pressure, nine-stage unit driven by the second and third stage of the turbine assembly, and a high pressure, seven-stage unit driven by the first stage of the turbine assembly. The eight combustion chambers are interconnected by crossover tubes to allow flame passage and continuous burning in all chambers. The main accessory section is located on the engine at the point of smallest diameter and contains those components necessary for proper operation of the engine: the fuel control unit, fuel pump, oil system pressure and scavenging pumps, fuel filter, pressurizing and dump valve, oil cooler reservoir, compressor air bleed valves, and the air turbine starter. Power to drive the fuel control unit, fuel and oil pumps, and connection to the air turbine starter is provided by an accessory drive shaft geared to the high pressure compressor rotor. The engine is rated at 10,500 pounds for both military and maximum thrust.

ENGINE MALFUNCTION/FAILURE

Indication of impending engine failure will usually be in the form of unstable engine operation and may be manifested by one or a combination of the following symptoms:

1. Vibration.
2. Erratic increase in turbine outlet temperature.
3. Fluctuation of engine rpm at constant throttle setting.
4. No increase in engine rpm when throttle is advanced.
5. Compressor pulsation.
6. Loss of thrust.

If unstable engine operation occurs during acceleration or deceleration, retard the throttle to IDLE until the engine operation becomes stable. When the operation becomes stable, slowly advance the throttle to the desired power setting. If unstable operation occurs during steady state operation, immediately reduce power, reduce altitude, and increase airspeed by changing the attitude of the aircraft. If necessary, due to continued instability, shut down the malfunctioning engine.

WARNING

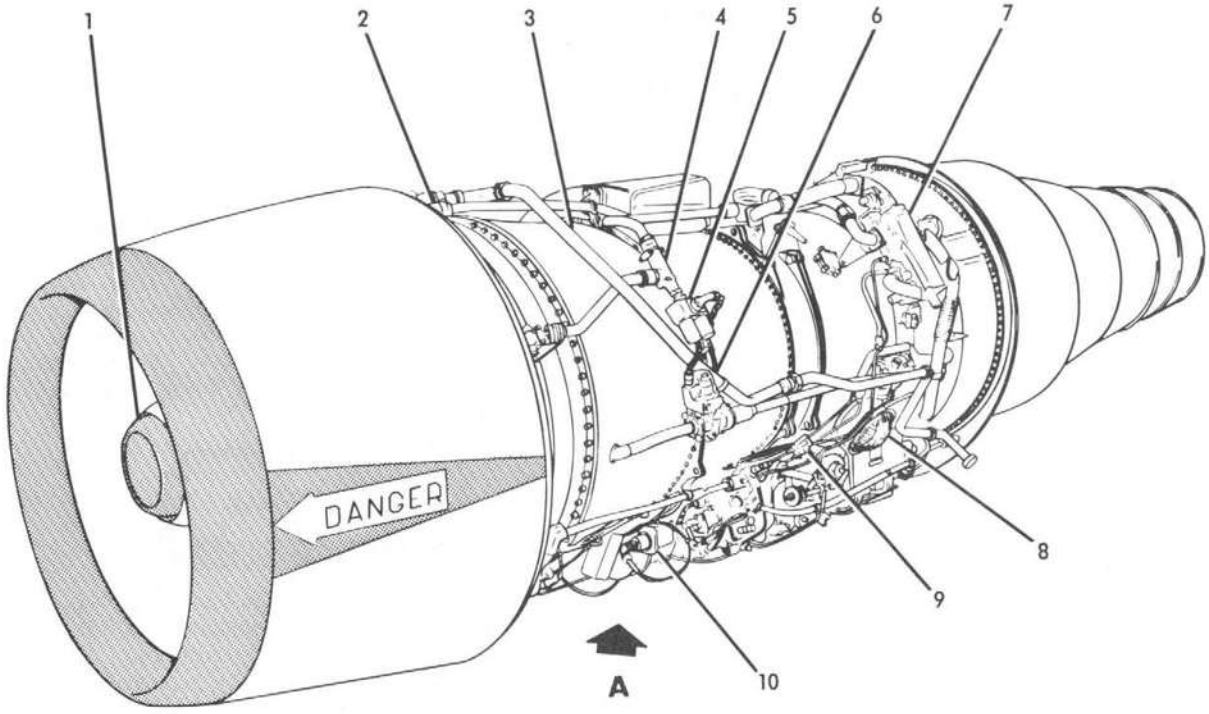
- Continued operation of an unstable engine is dangerous. Maximum temperature limits must be observed under all conditions. If over-temperaturing cannot be controlled, shut down the affected engine.
- Engine malfunction or failure can in rare instances result in toxic fumes being introduced into the cockpit. Oxygen masks should be worn by all crewmembers, during periods of engine failure or malfunction.

One engine normally provides sufficient power for climbing out; however, at high gross weights and high outside temperatures, climb performance immediately after takeoff is marginal. Directional control is adequate for single-engine operation at all airspeeds above 1.2 times the power-off stall speed if the required rudder and elevator trim is combined with banking of the aircraft. Once a safe altitude and airspeed have been reached, determine whether to attempt a restart or to plan a single-engine landing.

ENGINE FIRE DETECTION SYSTEM

The engine fire detection system (see figure 1-8) indicates fire and hazardous temperature conditions in the engine nacelles and pylons by making appropriate fire warning lights come on. Components of the system include:

Name	Type	Location
Heat-sensing elements (2)	Six-section thermistors	Engine nacelles and pylons, LH and RH (inside)



1. Oil cooler fairing
2. Breather pressure valve
3. Oil vent line
4. Oil temperature control adapter
5. Oil temperature regulator
6. Anti-icing air valve
7. Fuel heater
8. Compressor bleed valve
9. Automatic oil-drum valve
10. Oil Pressure switch
11. Cartridge starter location (when installed)

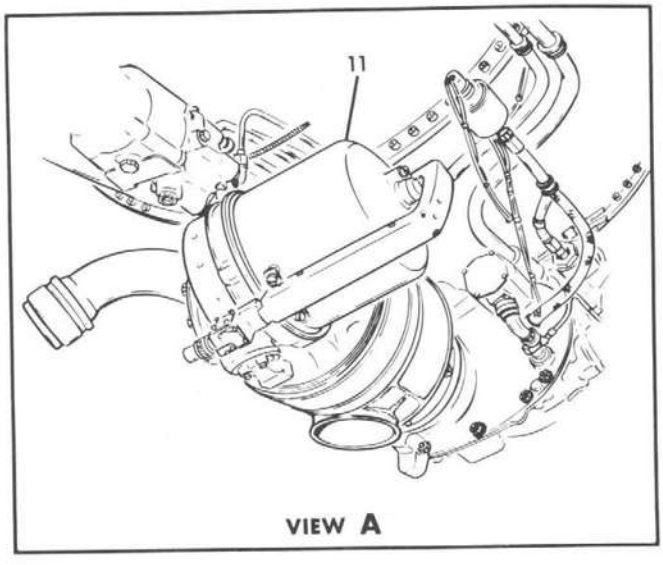


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Figure 1-17A. J57-P-10 Engine

Name	Type	Location
Heat-sensing-element guards (4)	3/8-inch aluminum tubing	Forward doors, LH and RH engine nacelles (inside)
Fire-detection control units (2)	Two-stage amplifier first stage, thyratron second stage	Engine pylons, LH and RH (inside)
Fire-warning lights (2)	Press-to-test	Cockpit, pilot's instrument panel
Fire-detection test switch	Press-to-test	Cockpit, pilot's instrument panel
Fire-detection test relays (2)	Double-pole, double-throw	Engine pylons, LH and RH (inside)

The engine-fire detection system consists of two identical fire detection circuits, one for each engine nacelle, and a test switch (27, figure 1-8) common to both circuits. Each circuit operates independently of the other to make its associated left- or right-hand fire warning light come on when the circuit is affected by excessive heat in the nacelle and pylon which it serves.

Note

Testing the five warning circuit requires ac and dc power.

Each fire detection circuit utilizes a six-section heat-sensing element located in the engine nacelle and in the engine pylon. The electrical resistance of the sensing element varies inversely with the temperature of the nacelle, so that an increase in heat results in a decrease of sensing element resistance. The resistance of the sensing element is continuously monitored by the fire-detection control unit which indicates, by means of a red warning light for each engine (26, figure 1-8), labeled FIRE WARN, any great decrease in resistance caused by an excessive temperature along some section of the sensing element.

Each fire detection circuit receives 115-volt ac power (phase C for left-hand and phase A for right-hand circuit) from the left-hand ac generator essential bus on terminal panel No. 101. A supply voltage for the test switch is provided by the 28-volt dc essential bus on terminal panel No. 100. Circuit protection for the fire detection circuits is provided by the 3-ampere LH FIRE DETECTION and RH FIRE DETECTOR fuses on terminal panel No. 101; circuit protection for the test switch is provided by the 5-ampere FIRE DETECTOR circuit breaker on terminal panel No. 100.

HEAT-SENSING ELEMENTS

The sensing element provided in each fire detection circuit is installed within its related (left- or right-hand) engine nacelle and pylon. The sensing element is constructed in six sections, with mated connectors and four flexible interconnectors, and is protected by two aluminum guards. The sensing element is essentially a thermistor, consisting of two wires embedded in a ceramic core with an inconel (nickel alloy) casing. The ceramic core has a high negative temperature coefficient of resistance: at extremely high temperatures, the electrical resistance of the ceramic material decreases sufficiently to permit current flow. The wires within the ceramic core facilitate heat conductivity throughout the sensing element. At normal temperatures, the resistance within the sensing element is such that the fire-detection control unit is inoperative. Only at excessively high temperatures does the resistance within the sensing element decrease sufficiently to permit the control unit to supply an output voltage which energizes the fire warning lights.

FIRE-DETECTION CONTROL UNIT

The fire-detection control unit in each fire detection circuit is installed within the related engine pylon aft of the front spar, and is accessible through an access door on the inboard side of the pylon. The control unit monitors the heat-sensing element and electrically energizes the fire warning light when the electrical resistance of the heat-sensing element is lowered by a fire or hazardous temperature condition in the nacelle or pylon.

The fire-detection control unit is a two-stage unit with a transformer power supply that contains four secondary windings and receives single-phase, 115-volt, 400-cycle a-c power. The first stage of the unit consists of an amplifier in the form of a triode tube (V101) whose bias is controlled by the current flow in the heat-sensing element. The amplifier-grid voltage is always the same value when the tube is conducting and is dependent on the resistance of the adjustable potentiometer (R102). Under normal operating conditions, the amplifier is effectively biased by the voltage appearing across the R104 resistor so that there is no current flow through the amplifier. As temperature increases within the areas monitored by the heat-sensing element, the resistance of the heat-sensing element is lowered and allows an increased current flow. When current flow from the heat-sensing element is sufficient, the bias is lifted and the amplifier conducts.

The second stage of the control unit includes an electronic relay in the form of a thyratron tube controlled by the output of the triode amplifier, and an output transformer. The thyratron is biased below cutoff by the voltage across windings 9 and 10 of the power transformer. At the firing point (the point at which the output voltage of the amplifier is sufficient to fire the thyratron) the bias is lifted by the output of the amplifier. The thyratron then conducts, and its plate current in the form of half-wave pulses passes through the output transformer to energize the fire warning light.

ENGINE FUEL CONTROL SYSTEM

Each engine has an independent fuel control system. The function of the system is to maintain automatically a selected percentage of trimmed engine speed for a given throttle setting. The system consists of three major assemblies: the throttle, the two-stage engine fuel pump, and a fuel control unit.

HYDROMECHANICAL CONTROL UNIT

Engine speed selection is accomplished mechanically by means of throttle movement, which positions a fuel valve within a fuel metering orifice. A positive minimum flow adjustment is provided in this valve. The percent of trimmed engine speed selected by throttle position is closely regulated for all operating conditions through the action of a flyball governor which governs fuel flow through a servo. During acceleration, the hydromechanical control senses burner static pressure, engine inlet temperature, and engine speed, and combines these variables to limit fuel flow to the maximum allowable for a given engine to prevent compressor surge and over-temperaturing. When the engine is operating at a steady state for a given throttle setting, the hydromechanical unit compensates automatically for variations in altitude, airspeed, compressor inlet temperature, engine speed, and burner pressure, to prevent over-speeding, over-temperaturing, and compressor surge. During deceleration, the unit schedules a minimum fuel flow as a function of burner pressure to prevent flame-out. This minimum flow schedule also provides a low limit of fuel flow for altitude idle and the starting operation.

ENGINE FUEL CONTROL MALFUNCTION

Malfunction of certain components of the engine fuel control can result in either a rapid uncontrollable increase in rpm or a rapid decrease to minimum fuel flow. In both instances, the only recourse is to shut down the engine (throttle OFF, engine master OFF) immediately, particularly in case of an overspeed condition, since complete destruction of the engine may occur.

ENGINE FUEL PUMP

A two-stage engine driven fuel pump, one located in each nacelle, supplies the fuel pressure necessary for proper engine performance. Fuel is delivered at boost pump pressure (12 to 30 psi) to the engine driven pump, where the pressure is increased for delivery to the combustion chambers. Fuel is filtered prior to entering each of the two stages of the pump. No control or pressure indicator for the engine driven pump is provided.

THROTTLES

The throttles (9, figure 1-9) are located on the pilot's center console. Each throttle is mechanically linked to an engine-mounted fuel control unit. The left-hand throttle contains the speedbrake switch (35, figure 1-9) and the radio-ICS switch (36, figure 1-9). Mounted outboard on the right-hand throttle is the three-position exterior lights master switch (10, figure 1-9).

A throttle friction control (32, figure 1-9) controls the freedom of movement of the throttles. The engine ignition system control is incorporated in the throttle assembly. Outboard movement of either throttle while in the OFF position energizes the ignition system for the corresponding engine. Gates in the throttle channel prevent the levers from being inadvertently retarded below the IDLE position. Each throttle is mechanically linked to a fuel flow shutoff valve in the fuel control unit. This linkage provides a positive shut off of fuel flow to the engine when the throttle is moved to the OFF position. This action also permits a fuel manifold drain valve in the engine to open and allows complete draining of all residual fuel in the manifold within ten seconds after shutdown.

MASTER ENGINE SWITCHES

The master engine switches (11, figure 1-9) control the ac powered fuel boost pumps, the fuel shutoff valves, and power for the ignition timers and spark-igniters, and the engine starter air shutoff valves. In the ON position, the fuel shutoff valves in the engine pylon are opened. Through relays initially energized by the momentary-contact switches, these switches furnish power to the spark-igniter and timer system and to the starter air shutoff valve and limit switch system. The master engine switches receive power from the 28-volt dc monitored essential bus through the left- and right-hand engine control circuit breakers on the pilot's console circuit breaker panel. Master engine switches, in aircraft not equipped with the dc monitored essential bus, receive power from the dc essential bus.

ENGINE INSTRUMENTS

FUEL FLOWMETERS

A dual-needle fuel flowmeter (9, figure 1-8) is installed on the pilot's instrument panel. The meter shows individual engine fuel consumption in thousands of pounds per hour. The fuel flowmeter dial is marked 0 to 3 in 100-pound increments and from 3 to 12 in 1,000-pound increments.

PRESSURE RATIO INDICATORS

Two pressure ratio indicators (33 and 34, figure 1-8), one for each engine, are located on the pilot's instrument panel. These instruments indicate the ratio of engine exhaust tailpipe pressure (Pt 7) to the impact pressure at the intake (Pt 0), and provide means of checking that the minimum thrust acceptable for take off is available at the military rated throttle setting. Each instrument is calibrated from 1.2 to 3.4. A setting knob on the lower left side of the instrument operates a counter on the face of the dial and simultaneously moves a pressure ratio index around the perimeter of the dial. Prior to take off, the minimum pressure ratio for the existing ambient conditions

should be determined from the Military Power Pressure Ratio chart (figure 3-5). The setting knob is used to set this minimum pressure ratio reading on the counter. As this is done, the pressure ratio index will move to a position on the calibrated dial that corresponds to the reading of the counter. When military rated power is applied, the needle should advance around the dial until it lines up or exceeds the pressure ratio index. If the needle falls short of the pressure ratio index, the engine is not developing its rated takeoff thrust. (For additional information about pressure ratio indications, refer to ENGINE MANAGEMENT in part 4 of this section.)

ENGINE PERFORMANCE INDICATORS

Left and right engine performance indicators (24, 25, figure 1-8) are located on the pilot's instrument panel. These instruments provide engine speed, exhaust temperature, fuel boost, and oil pressure indications on one instrument. The engine speed and exhaust temperature indications operate independently of the airplane electrical systems. Engine speed is shown as a percentage of 9700 rpm. Exhaust temperature is shown in degrees centigrade. A small oil pressure window (located at the bottom of the gage) will read NORM when the oil pressure at the switch is between 40 and 50 psi, HIGH if the pressure is above 50 psi, and OUT if the pressure is at or below 40 psi. OUT also appears when electrical connection is broken. The fuel boost pressure windows indicate NORM when the fuel boost pressure is 5 ± 1 psi or above. OUT appears if the fuel boost pressure is 5 ± 1 or below, or an electrical connection is broken. In the range between 4 to 6 psi it is possible to get either an OUT or NORM indication, depending on the pressure indication variation in the instrument. The fuel boost and oil pressure portions of the engine performance indicators require external or aircraft electrical power for their operation.

IGNITION SYSTEM

Each engine ignition system incorporates two spark-igniters and an ignition timer. The spark-igniters are located in the lower two combustion chambers of each engine. The ignition timers, which automatically energize the igniters for a 30-second firing cycle, are located in the engine pylons. Each ignition system is controlled by an ignition switch, located in the throttle quadrant.

IGNITION SWITCH

The ignition switch, which energizes the ignition timer, is incorporated in the throttle system. The switch is a momemtary-contact switch and is actuated by outboard movement of the throttle from the OFF position toward the engine to be started. The ignition switch is energized through the master engine switch by power from the dc monitored bus or from the dc essential bus (see figure 1-23) through the ON position of the master engine switch.

ENGINE STARTER

An air turbine starter is located on each engine accessory section. The starter is powered by an external compressed air supply and drives the engine through the accessories drive shaft. Control of the starter is through a shutoff valve in the external air supply duct and a limit switch on the starter. The shutoff valve is controlled by the engine starter switch on the pilot's center console, which initially energizes a holding starter air valve relay. The relay is held closed by power from the dc bus or from the dc essential bus (see figure 1-22) through the engine control relays which are energized when the master engine switches are on. These relays complete a circuit to the starter air shutoff valve solenoid, which holds the shutoff valve open until the engine reaches approximately 36 to 40 percent rpm. At that speed the starter limit switch is opened, deenergizing the starter air valve relay, which opens to break the circuit to the starter air valve solenoid. This action closes the starter air shutoff valve, discontinuing the flow of the starter's external air supply.

ENGINE STARTER SWITCH

The engine starter switch (1, figure 1-9) is located on the center console. This switch has three positions: a momentary LEFT ENG, a momentary RIGHT ENG and an OFF position. The switch utilizes dc power to energize the starter air valve relays. Through the ON contacts of the master engine switches, dc power is furnished to hold the relays closed. Ground is furnished by the starter limit switches. Power from the dc monitored essential bus (essential dc bus in some airplanes) is also transmitted through the master engine switches and the starter air valve relays to the starter air shutoff solenoid.

CARTRIDGE STARTER

The ATSC 100-83 cartridge starter (see figure 1-17A), may be installed on RA-3B aircraft that are deployed to areas not having pneumatic starters available. The addition of the cartridge starter significantly increases the versatility of any squadron A-3 aircraft. See Section III, Part 3 for operating procedures for the cartridge starter.

ENGINE OPERATION

The pilot's management of the engine consists essentially of selecting throttle positions and of controlling air flow through the engine by changing aircraft attitude. If the engine is in trim, its fuel control system will schedule correctly any thrust setting (operating condition) that the pilot selects with the throttle. He does not directly select any engine indication – not even the engine pressure ratio (EPR) indication, which he uses principally to check that the minimum thrust acceptable for takeoff (as shown in figure 3-5) is available when he selects military rated with the throttle. In a general way, EPR tells the pilot how much work the engine can do. Exhaust gas temperature, on the other hand, tells him how much "effort" the engine is making, rather than how much work the engine should be, or is doing. EGT must never be used, therefore, as a basis for setting thrust except when it becomes necessary to reduce a throttle setting to avoid exceeding a temperature limit, or to cope with unstable operation.

The pilot must not only know and observe the engine operating limitations specified in table 1-5, he must also recognize relationships like those between operating temperatures and temperature limits. For example, although it is permissible for an engine to operate at the actual temperature limit corresponding to a selected thrust setting (operating condition), an engine that does so may have something wrong that causes it to run abnormally hot. Also, it is the thrust setting, not the EGT indication, that determines the allowable time limit specified in table 1-5. That is, the time limit is 30 minutes because the thrust setting is military rated – not because the EGT indication happens to be 610° C. In fact, if the EGT indication is 610° C at normal rated, the pilot should be concerned about a possible malfunction instead of time limits. He should retard the throttle to get the EGT within the limits specified for normal rated. If that isn't possible, he must shut down the engine or land as soon as possible. He must report as an engine discrepancy every instance of overtemperature, noting not only the peak temperature reached, but also the length of time that the EGT exceeded limits.

STARTING

During an engine start, the maximum EGT specified in table 1-5 is permited only momentarily. After lightoff, EGT rises steadily until a peak is reached; then drops gradually to stabilize at the normal value for idle. If the start is normal, this peak is well below the starting maximum; if abnormal, this peak may exceed that maximum. The momentary starting time limit will probably never be exceeded unless some abnormal condition like a hung start results. In such a start, rpm hangs at some value below idle, and the engine "cooks" at some high internal temperature at or above the starting temperature limit. The engine starting attempt must be discontinued immediately, and the reason for the hot or hung start should be determined.

The EGT tendency may be more significant that the EGT itself. A ground starting EGT of 500° C and rising rapidly should concern the pilot more than one of 600° C and falling. The 500° C value, fortunately, is sufficiently below the allowable starting EGT to permit him to abort the start before the starting temperature limit is reached.

ACCELERATION

The acceleration temperature limit and corresponding two-minute time limit apply, of course, to engine rpm, not aircraft speed, acceleration. Although the EGT limit specified in table 1-5 applies to both cold and hot engines, its relatively high value was set to take care of cold engines. A cold engine is defined as one that has just been started or has been permitted to cool at idle for at least five minutes before an acceleration. The time limit applies to the period between the time that the throttle is advanced and the time that the EGT first starts falling after reaching its peak. Another criterion of a properly functioning engine is that the EGT should stabilize at or near the normal operating temperature for the higher thrust setting within five minutes after the throttle is advanced for an acceleration.

The performance of an engine is not acceptable if it violates either the EGT or time limit. The acceleration temperature limit applies only when an acceleration is made over the full thrust range of the engine, as from idle to military rated. For an acceleration from idle to normal rated, the EGT limit for normal rated, instead of for acceleration, applies. Throttle movement during acceleration should be smooth, and continuous.

STEADY-STATE OPERATION

Exhaust gas temperatures for normal rated should not be considered limits, but the temperatures which, if attained or exceeded during routine operations, should warn the pilot of a possible engine malfunction. For, an engine which exceeds the maximum EGT for cruise conditions when it is operated below normal rated can be expected also to exceed the temperature limits when it is operated at higher thrust settings. The same assumption can be made about EGT at idle, which is intended only as a guide, and is not a firm operating limit. Nevertheless, the temperatures shown for military rated and normal rated are positive limits that can not be exceeded without compromising the engine's service life. A normally functioning engine should operate somewhat below the EGT limits published for the several operating conditions.

Specified temperature limits serve two purposes: they assure that an engine will always be operated at internal temperatures that will not shorten the service life expectancy of engine components; they enable the pilot

to detect an engine fuel control system or instrumentation malfunction in time to take proper corrective action.

The length of time that an engine may be operated at each of the thrust settings (operating conditions) was established to conserve the life of the engine and to make the time between overhauls predictable. Without these time limits to guide him, the careless or insensitive pilot might literally wear out an engine in a few hours of operation, and would certainly disrupt the logistic structure of any large-scale operation predicated on fixed overhaul periods.

An engine that is always operated conservatively will last many times longer than one which is habitually operated at maximum limits. In the high thrust range, an increase of only 5° C may double the rate of turbine blade creep. Just so much creep can be tolerated by each blade. How fast the blade life is depleted is up to the pilot. And, unfortunately, no operational technique can reverse the effect of blade creep.

The time limit for operation at military rated is specified not so much to permit a cooling period between intervals of operation at high thrust as it is to distribute the rate of blade creep throughout the engine's normal life. Nothing is gained, therefore, by reducing a high thrust setting only momentarily before repeating it – just to be able to report that time limits were not violated.

An engine's service life "budget" has just so many hours of operation at high thrust. Whether these hours are used up quickly or are distributed throughout a normal, calculated period depends on how conscientiously the EGT and time limits are observed by the pilot.

ENGINE OIL SYSTEM

Each engine is lubricated and partially cooled by an independent oil system. The oil tanks are located in the engine nacelles. Each tank, when fully serviced, contains 5-1/2 gallons of oil, which amount is in addition to approximately 3 gallons in each engine oil system. (See figure 1-38 for engine oil grade and specification.) An engine driven oil pressure pump and five engine driven scavenger pumps provide a constant flow of oil through the seven main bearings of each engine. Scavenged oil is filtered and routed through the oil cooler (45, figure 1-4). Maximum oil consumption of each engine is approximately 4 pounds (0. 5 gallon) per hour at normal rated power.

OIL COOLING

Oil cooling is effected by an independent oil cooler and associated piping and control equipment for each engine. Sufficient air flows through the oil coolers to cool the oil under most flight conditions, and for ground operation, is achieved by placing the cooling air inlet and exit in the engine inlet duct so as to create a differential pressure across the oil cooler. This differential pressure exists whenever the engine is in operation. Cooling air flow through the oil cooler is automatically increased in flight, whenever the need exists, by means of an oil temperature sensing element and actuator which open a door to provide increased cooling airflow. The sensing element-actuator combination positions the door so as to maintain the oil temperature below 112 ± 3°C. No oil temperature gage is provided. The oil cooler door remains closed when the landing gear strut is compressed.

OIL SYSTEM MALFUNCTION

As there are no oil temperature indicators, the only indication of oil system malfunction will be shown on the oil pressure window of the engine performance indicator. As there are no manual controls for the oil cooler doors, no corrective action can be taken for oil cooler door malfunction. When an OUT indication occurs on the oil pressure indicator, a visual inspection of the affected engine for an open oil cooler door may help to establish the possibility of impending oil system failure.

JET-ASSISTED TAKEOFF (JATO) SYSTEM

A JATO system provides additional thrust during takeoff. A maximum of six JATO bottles may be mounted (51, figure 1-4) on each side of the fuselage forward of the speedbrakes. Each bottle is capable of producing 4,500 pounds of thrust for a period of five seconds. The bottles are fired electrically and are jettisoned hydraulically by utility hydraulic system pressure supplied through a solenoid-operated selector valve.

WARNING

JATO arming switches must be SAFE, firing switches must be off, and a no-voltage test must be made at all aircraft igniter terminals immediately prior to attaching any igniter leads.

JATO ARMING SWITCH

The JATO arming switch (6, figure 1-9) is located on the center console. The switch has two positions: ARM and SAFE. In the ARM position, the switch energizes the circuit to a limit switch in the catapult handgrip which, when pulled to the aft position, energizes the circuit to the JATO firing switch in the end of the handgrip.

JATO WARNING LIGHT

A JATO armed warning light (4, figure 1-9), located left of the JATO arming switch, glows when the arming switch is actuated. The light also serves as a preflight check of the JATO arming and firing circuit, since the light is in series with the JATO circuit breaker and current limiter.

JATO FIRING SWITCH

The JATO firing switch (2, figure 1-9) is located in the end of the catapult handgrip. To fire the JATO system, move the catapult handle to the horizontal position and press the button, which energizes a relay that completes a circuit between the firing mechanism and the 28-volt dc bus.

JATO JETTISON SWITCH

The JATO jettison switch (5, figure 1-9) is located adjacent to the JATO arming switch on the center console. The switch has two positions: SAFE and JETTISON. In the JETTISON position, the switch energizes a solenoid controlled hydraulic selector valve that supplies pressure to the JATO mounting hooks actuating cylinders. The mounting hooks are actuated to release all the JATO bottles simultaneously.

CATAPULT EQUIPMENT

The aircraft is designed for catapult operations. The catapult hooks (40, figure 1-4) are located on the lower fuselage forward of the photoflash bomb bay. The hooks are extended manually by the deck handling crew, and are retracted hydraulically in conjunction with raising the landing gear. The catapult holdback fitting (49, figure 1-4) is on the bottom of the fuselage aft of the main landing gear well.

CATAPULT HANDGRIP

A catapult handgrip (3, figure 1-9) located on the center console, provides a means of maintaining a forward throttle position during a catapult takeoff. When pulled aft, the handgrip is positioned so that the handgrip and throttles (when moved to the MILITARY position) may be grasped together. The JATO firing switch is installed in the handgrip.

AIRCRAFT FUEL SYSTEM

The engine fuel supply is carried in four fuel tanks. (For fuel quantity data, see figure 1-21.) These tanks may be serviced through a two-point pressure fueling system or by means of three gravity fillers, one located at the top of each wing tank and the forward fuselage tank. Fuel transfer is provided to the engine boost pumps sump through a piping system by means of electric transfer pumps, tank pressurization, or gravity. To prevent icing of the airframe fuel filters, fuel heat exchangers (figure 1-20) are installed in the engine fuel-feed lines. The fuel system also incorporates wing fuel dumping, wing tank purging, and air refueling provisions. See figure 1-38 for fuel grades and specifications of recommended and alternate fuels. See figure 1-20 for a schematic presentation of the fuel system.

FUEL TANKS, PRESSURIZING, AND VENTING SYSTEM

FUSELAGE TANK

Two fuel tanks are provided in the fuselage. The aft fuselage tank (6, figure 1-4), straddles the main gear well; the forward fuselage tank (7, figure 1-4) is situated between the main gear well and the flash bomb bay. Both tanks are self-sealing types, constructed of rubber-impregnated cloth with sealant. The aft fuselage tank contains two fuel boost pumps, which deliver fuel to the engines, a control valve for regulation of fuel transfer from the forward or wing tanks, a low level switch for fuel state warning indication, and two float switches for control of pressure fueling. All fuel aboard the aircraft is transferred to the aft tank before delivery to the engines.

FUSELAGE TANK TRANSFER

The forward fuselage tank contains an electric fuel transfer pump to deliver fuel to the aft fuselage tank, a low level switch which automatically shuts down the transfer pump when forward tank fuel is depleted, a pressure fueling shutoff valve, a dual float pilot valve to control the shutoff valve, an alternate wing to aft fuselage tank transfer line with a shutoff valve, and a solenoid valve to control the shutoff valve.

Both fuselage tanks are vented at all times. The vent system exit, located aft of the left-hand speedbrake, provides a small positive pressure differential between the tank system and ambient pressure to prevent tank collapse. The fuselage fuel tanks cavity (surrounding support structure) is ventilated by ambient air entering the fuselage through intake scoops and leaving the fuselage through exit ducts on the bottom of the fuselage. Both fuselage tanks contain fuel quantity probes, and provisions for water and sediment drainage. A gravity filler is provided in the forward fuselage tank only. For information concerning total and usable fuel capacities of each tank, see figure 1-21 and 1-38.

FUEL VENT MAST ICING. Fuel vent mast or line icing, which is a remote possibility, can cause the following sequence of events:

1. As fuel is consumed, the normal slight pressure (above ambient) maintained on the forward and aft fuel tank by the vent system is reduced to below ambient.

2. Ambient pressure tends to collapse both fuselage tanks, the aft tank being more susceptible to volume reduction by collapsing.

3. Aft tank volume is reduced faster than fuel level, giving erroneous fuel quantity reading and precluding functioning of low fuel level light and automatic transfer of fuel to aft tank. Aft fuel tank quantity could be reduced to a dangerously low level without sufficient warning to the pilot.

Fortunately, the pilot can recognize the sequence of events because of the following indications: fuel consumption, as indicated by fuselage quantity gages, will not correspond to fuel flow observations; in advanced stages, abnormal amounts of nose-up trim will be required at approach airspeeds. (For recommended action, refer to Section V.)

WING TANKS

Two integral fuel tanks (16, figure 1-4) are provided in the wings, one on each side between the fuselage and the wing fold joint. Each wing tank contains an electric fuel transfer pump which delivers fuel to the forward or aft fuselage tank, provisions for tank pressurization to effect alternate fuel transfer or dumping, a pressure fueling shutoff valve, a dual float pilot valve to control the shutoff valve, and a dump valve in the dump line to control wing tank fuel dumping. Both wing tanks are vented under all fuel system operating conditions when the landing gear handle is in the DOWN position, except during dumping. The tanks are vented when the landing gear handle is in the UP position whenever the tanks are not pressurized to effect alternate wing fuel transfer or dumping. Both wing tanks also contain provisions for gravity-filling, CO_2 purging, fuel quantity probes, and water and sediment drainage. (For information concerning total and usable fuel capacities of each tank, see figure 1-21.)

FUEL TRANSFER

FORWARD FUSELAGE TANK TRANSFER

Fuel transfer from the forward fuselage tank is normally accomplished by an electric fuel transfer pump powered by the 115/200-volt left hand ac generator. This pump is operative whenever the left hand ac bus is energized, and the forward fuselage fuel tank contains fuel. A low level switch situated in the bottom

of the tank shuts off electrical power to the transfer pump whenever the forward tank fuel supply is depleted. A transfer fuel control valve is situated in the aft fuselage fuel tank at the 1000-gallon (6500 pounds) level therefore, forward fuselage tank fuel will not begin to transfer until aft fuselage tank fuel has been consumed down to this level. The purpose of this arrangement is to limit the quantity of fuel in the aft fuselage tank to prevent excessive shift of the aircraft center of gravity as the wing tanks and forward fuselage tanks are emptied. A gravity transfer line and control valve, provided between the forward and aft fuselage fuel tanks, may be employed in the event of failure of the electric transfer pump or failure of the aft tank control valve in the closed position. The gravity transfer valve is powered by the 28-volt dc monitored essential bus or the 28-volt dc essential bus (see figure 1-23) and is controlled by the gravity transfer switch in the cockpit.

Note

Because of the location of the transfer fuel control valve in the forward part of the aft tank, the controlled aft tank fuel quantity will vary with attitude. The 1000-gallon level is sensed correctly only at an attitude of 3 degrees nose up.

FORWARD FUSELAGE TANK FUEL TRANSFER FAILURES

Forward fuselage tank fuel transfer failure may occur due to one of the following major causes: fuel transfer pump failure, rupture or puncture of the tank, or failure of the aft tank fuel level control valve in the closed position.

TRANSFER PUMP FAILURE. Failure of the forward fuselage tank fuel transfer pump will be indicated first by the fuel quantity indication of AFT FUS fuel level, and secondly by lighting of the fuel low level warning light. Upon failure of the pump, the fuel quantity in the aft fuselage tank will begin to drop below the 1000 gallon (6500 pounds) level.

AFT TANK FUEL LEVEL CONTROL VALVE FAILURE. If the aft fuselage tank fuel level control valve fails in the open position, it will be indicated by the aft tank fuel quantity increasing above the 1000 gallon (6500 pounds) level. The fuel level in the aft tank may be manually controlled by turning the forward tank transfer pump OFF and ON, as necessary, through the use of the forward tank transfer pump circuit breakers on the companionway panel (figure 1-15A). Provided that fuel remains in the wings and/or forward tanks, an aft fuselage tank fuel level control valve failure in the closed position will be indicated by a drop in fuel quantity in the aft tank. To obtain fuel transfer to the aft tank under this condition, the gravity transfer switch must be placed at OPEN.

GRAVITY TRANSFER MANAGEMENT

Gravity transfer of fuel from the forward fuselage tank to the aft fuselage tank can be successfully accomplished only when the forward tank fuel level is higher than the aft tank fuel level. Figure 1-18 shows the pounds-per-hour transfer rates for varying fuel level relationships of the two tanks. Under this method of transfer, the forward tank will always contain some unavailable fuel when the aft tank fuel is depleted. The amount of unavailable fuel (figure 1-19) is directly influenced by the attitude of the aircraft and the rate of engine fuel consumption. (For emergency fuel transfer procedures, refer to Section V.)

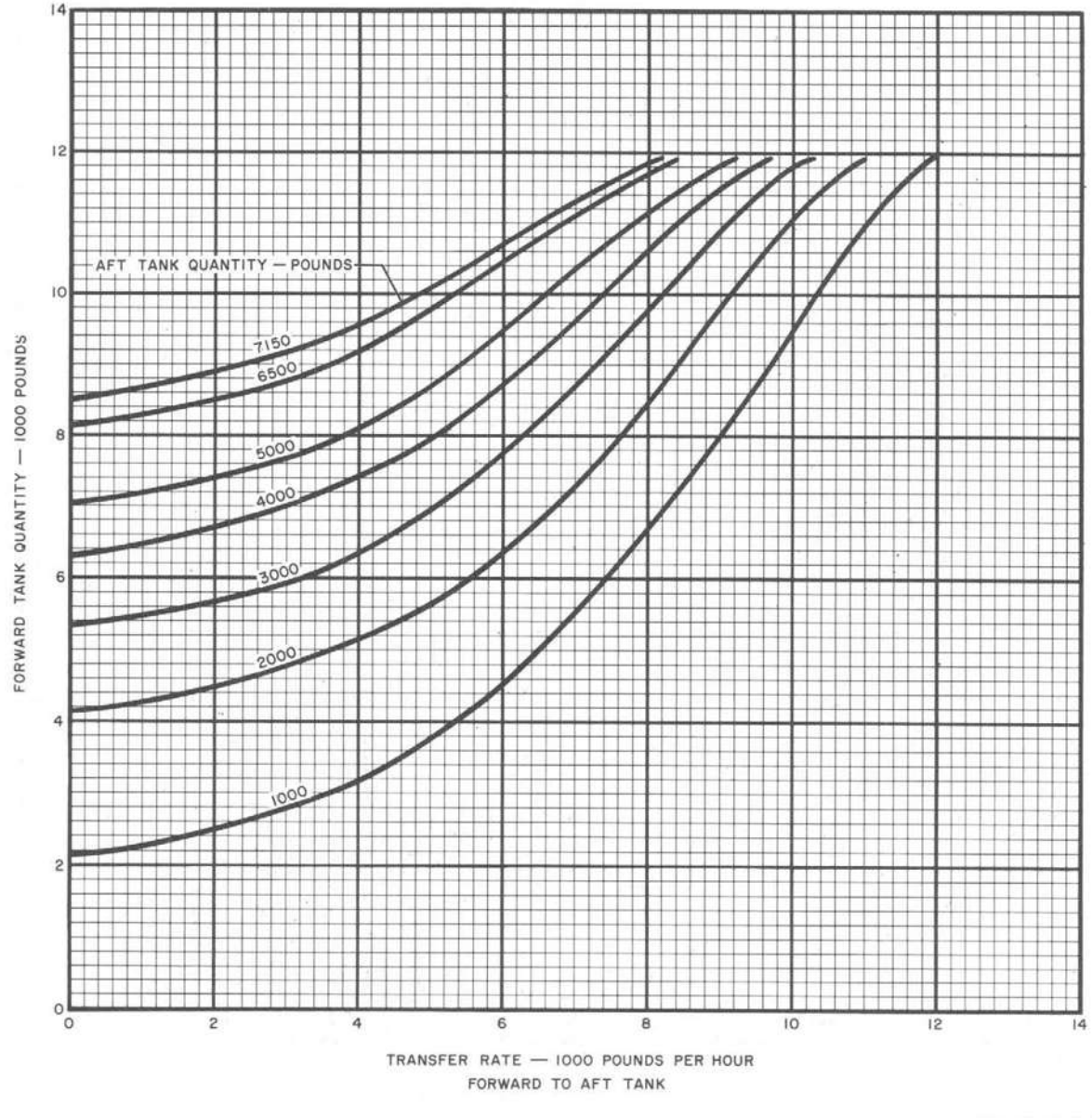
GRAVITY TRANSFER SWITCH. The gravity transfer switch is located on the fuel control panel (14, figure 1-7) on the pilot's left-hand console. This switch has two positions, NORMAL and OPEN. Placing the switch at OPEN opens the gravity transfer valve, allowing fuel to flow between the forward and aft fuselage fuel tanks. A warning light adjacent to the switch comes on when the switch is positioned at OPEN. Placing the switch at NORMAL closes the gravity transfer valve.

WING TANK TRANSFER (NORMAL COURSE)

Fuel transfer from the wing tanks to the forward fuselage tank is normally accomplished by an electric fuel transfer pump in each wing tank, powered by the 115/200-volt left hand ac generator. These pumps are operative whenever the left hand ac bus is energized and the transfer switch on the fuel control panel is placed at WINGS. The duel float pilot valve and pressure fueling shutoff valve in the forward fuselage tank shut off the flow of wing tank transfer fuel whenever the forward fuselage tank is full, and allow the transfer to resume when space is available. This arrangement is necessary to prevent wing transfer fuel from being pumped overboard through the vent system when the wing fuel to forward fuselage tank transfer rate exceeds the forward to aft fuselage tank transfer rate. An alternate method of wing tank fuel transfer is provided in the event of electric transfer pump or ac electrical system failure by means of wing tank pressurization. Wing tank transfer by air pressure is effected, when the transfer switch is placed at ALT WINGS, by closing the wing vent valve and opening the wing tank air valve, which permits compressor bleed air to pressurize the tanks. These valves are powered by either 28-volt dc monitored essential or essential bus power (see figure 1-23).

GRAVITY TRANSFER RATE

MODEL: EA-3B, RA-3B, TA-3B



ATB-1-1 PS-16837-1A

REMARKS:

1. Aircraft attitude — 3 degrees nose up
2. Transfer rates are momentary rates only
3. Normal transfer pump shutoff levels are:
   6500 pounds for EA-3B, RA-3B
   7150 pounds for TA-3B
4. Aft tank quantity intercept with zero transfer rate ordinate indicates equal forward and aft tank levels. Forward tank quantities below this intercept result in reverse transfer.

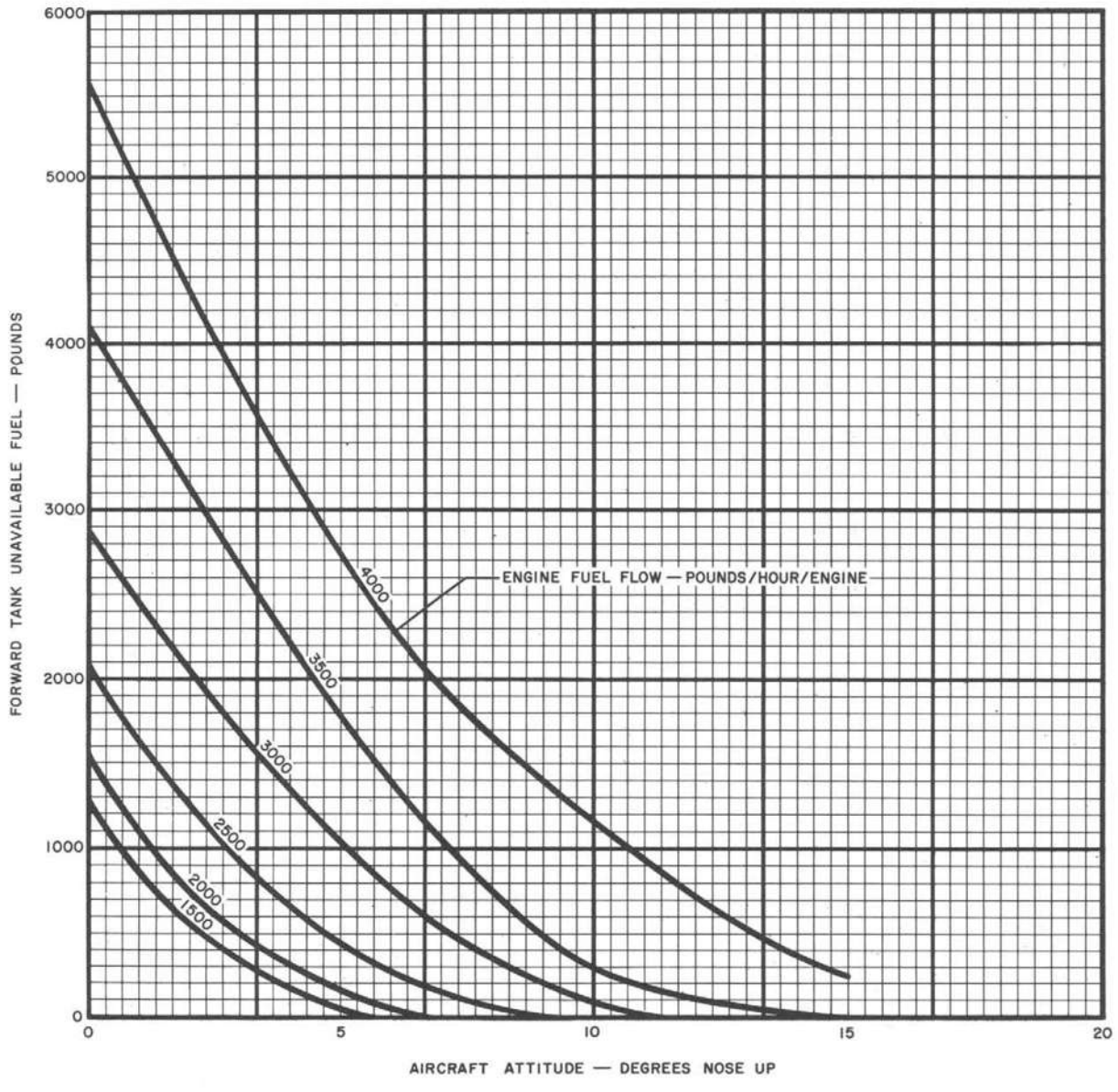
DATA AS OF: 1 October 1959
DATA BASIS: Calculations

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 lb/gal

Figure 1-18. Gravity Transfer Rate

UNAVAILABLE FUEL WITH GRAVITY TRANSFER

MODEL: EA-3B, RA-3B, TA-3B



ATB-1-1 PS-16838-1A

DATA AS OF: 1 October 1959
DATA BASIS: Calculations

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 lb/gal

Figure 1-19. Unavailable Fuel with Gravity Transfer

WING TANK TRANSFER (EMERGENCY COURSE)

An emergency system to permit transfer of wing tanks fuel directly to the aft fuselage tank is provided in the event of forward fuselage tank rupture, forward fuselage tank transfer pump failure, ac electrical failure, or forward fuselage tank pressure fueling shutoff valve failure. This system utilizes a solenoid controlled wing-to-aft-tank shutoff valve, and a bypass fuel line which routes wing tank fuel through a line in the forward fuselage tank directly to the aft fuselage tank. Emergency wing tank fuel transfer may be accomplished either by pumps or by wing tank pressurization. Placing the transfer switch on the fuel control panel at EMER WINGS powers the wing transfer pumps, closes the forward fuselage tank pressure fueling shutoff valve, and opens the wing to aft tank shutoff valve; thus transferring wing tanks fuel directly to the aft fuselage tank. Placing the transfer switch at EMER WINGS ALT pressurizes the wing tanks with engine compressor bleed air, closes the forward fuselage tank pressure fueling shutoff valve, and opens the wing to aft tank shutoff valve; thus transferring wing tanks fuel directly to the aft fuselage tank. During emergency wing tanks fuel transfer either by means of the wing tank pumps or wing tank pressurization, the aft fuselage tank fuel level control valve will shut off the flow of wing tanks fuel when the fuel level in the aft tank reaches the 1000 gallon (6500 pounds) level, and allow the transfer to resume when space is available. The wing to aft tank shutoff valve solenoid is powered by the 28-volt dc monitored essential bus or the essential bus (see figure 1-23) when the transfer switch is at EMER WINGS, and by the 28-volt dc bus when the transfer switch is positioned at EMER WINGS ALT.

Note

- The wing-to-aft-tank shutoff valve solenoid is on the dc essential bus, allowing wing fuel transfer to the aft tank with emergency generator power when the transfer switch is in EMER WINGS ALT position.
- With fuel remaining in the forward fuel cell and with the forward fuel cell boost pump operating, the emergency course of fuel flow cannot be checked nor utilized until the forward fuel cell boost pump circuit breakers are turned OFF.

WING TANK FUEL TRANSFER FAILURES

DURING NORMAL TRANSFER BY PUMP. Failure of one or both of the wing tanks fuel transfer pumps will be indicated primarily through observance of the fuel quantity indicating system. Failure of one wing transfer pump, if unnoticed for a period of time, will manifest itself by an increasing wing heaviness on the side of the failed transfer pump. When initiating wing tanks fuel transfer, note the fuel quantity of the wings, forward, and aft fuselage tanks individually before placing the transfer switch at WINGS. After transfer has begun, check to see that the wings fuel quantity diminishes at a rate equal to or better than the engines fuel consumption rate. If it is determined that wing tank transfer pump failure has occurred, place the transfer switch at ALT WINGS to obtain fuel transfer by means of wing tanks pressurization.

DURING EMERGENCY TRANSFER BY PUMP. When transferring wing fuel directly to the aft fuselage tank, failure of one or both wing tanks fuel transfer pumps will be indicated primarily by the fuel level in the aft fuselage tank falling below the 1000 gallon level while wing fuel is still available, and secondly by wing heaviness on the side of the failed transfer pump. If it is determined that wing transfer pump failure has occurred, place the transfer switch at EMER WINGS ALT to obtain emergency course of fuel flow transfer by means of wing tanks pressurization.

COMPLETE ELECTRICAL FAILURE. If complete aircraft electrical failure occurs and it becomes necessary to operate with the emergency generator extended, both wing tank fuel transfer pumps will be inoperative. In this event, wing tank fuel may be transferred normally by placing the transfer switch at ALT WINGS or by emergency course by placing the transfer switch in EMER WINGS ALT position.

SHUTOFF VALVE FAILURE. If the forward fuselage tank pressure-fueling shutoff valve fails in the closed position, wing tanks fuel transfer to the forward fuselage tank will not be possible. To obtain wing tanks fuel transfer to the aft fuselage tank, place the transfer switch at EMER WINGS or EMER WINGS ALT, as applicable.

TRANSFER SWITCH. The TRANSFER switch is located on the FUEL control panel (14, figure 1-7) on the pilot's left-hand console. The switch has six positions, IFR, OFF, WINGS, ALT WINGS, EMER WINGS, and EMER WINGS ALT.

Placing the switch at:

1. IFR

   a. Opens wing vent valve

   b. Closes wing dump valve

   c. Deenergizes circuit to wing dump and purge switch.

2. OFF

   a. Opens wing vent valve

   b. Closes wing air valve

   c. Deenergizes wing fuel transfer pumps discontinuing all wing tank fuel transfer

   d. Energizes wing pilot float valve, which closes wing pressure fueling shutoff valves. This prevents reverse transfer from forward tank to wing tanks during dives.

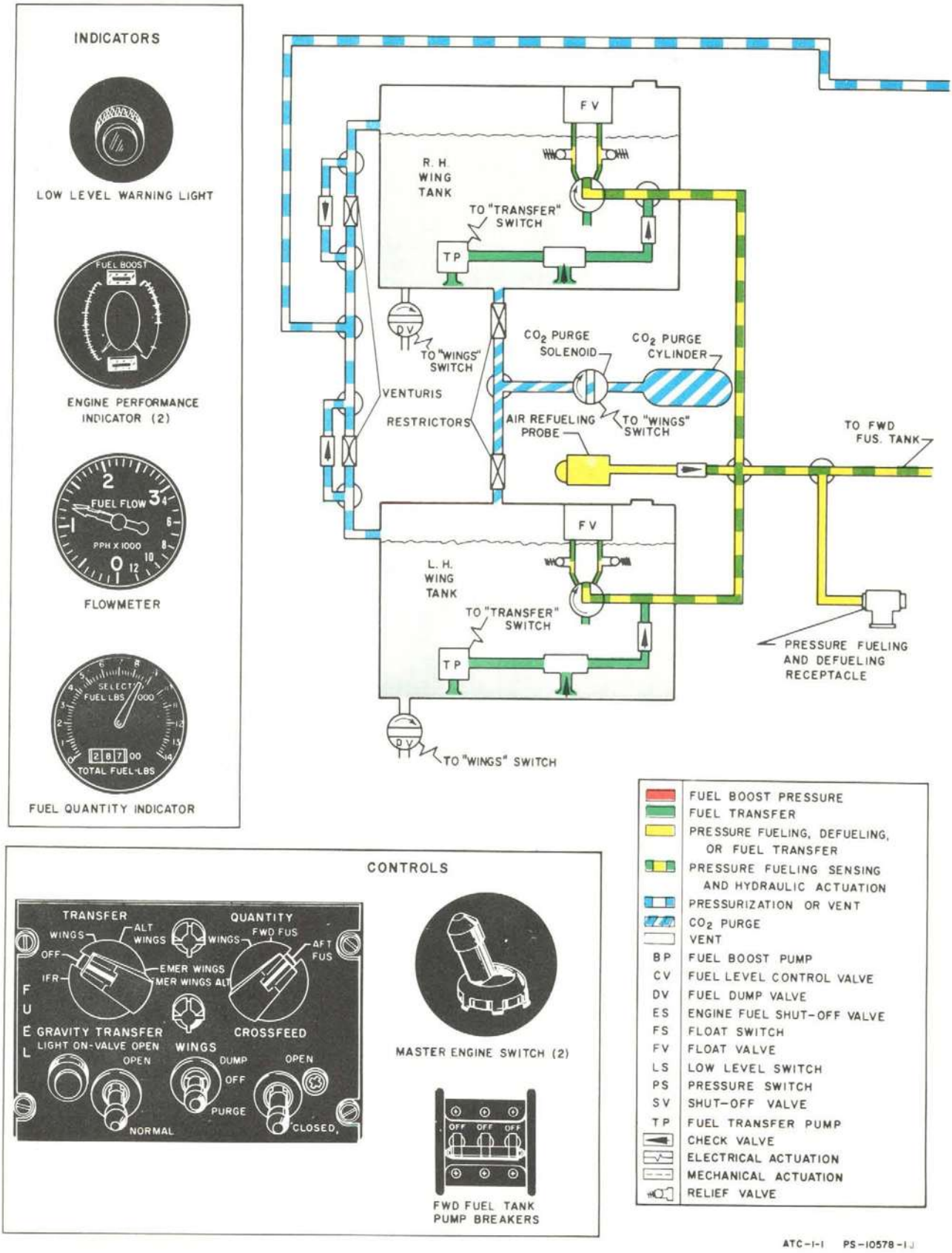


Figure 1-20. Fuel System (Sheet 1)

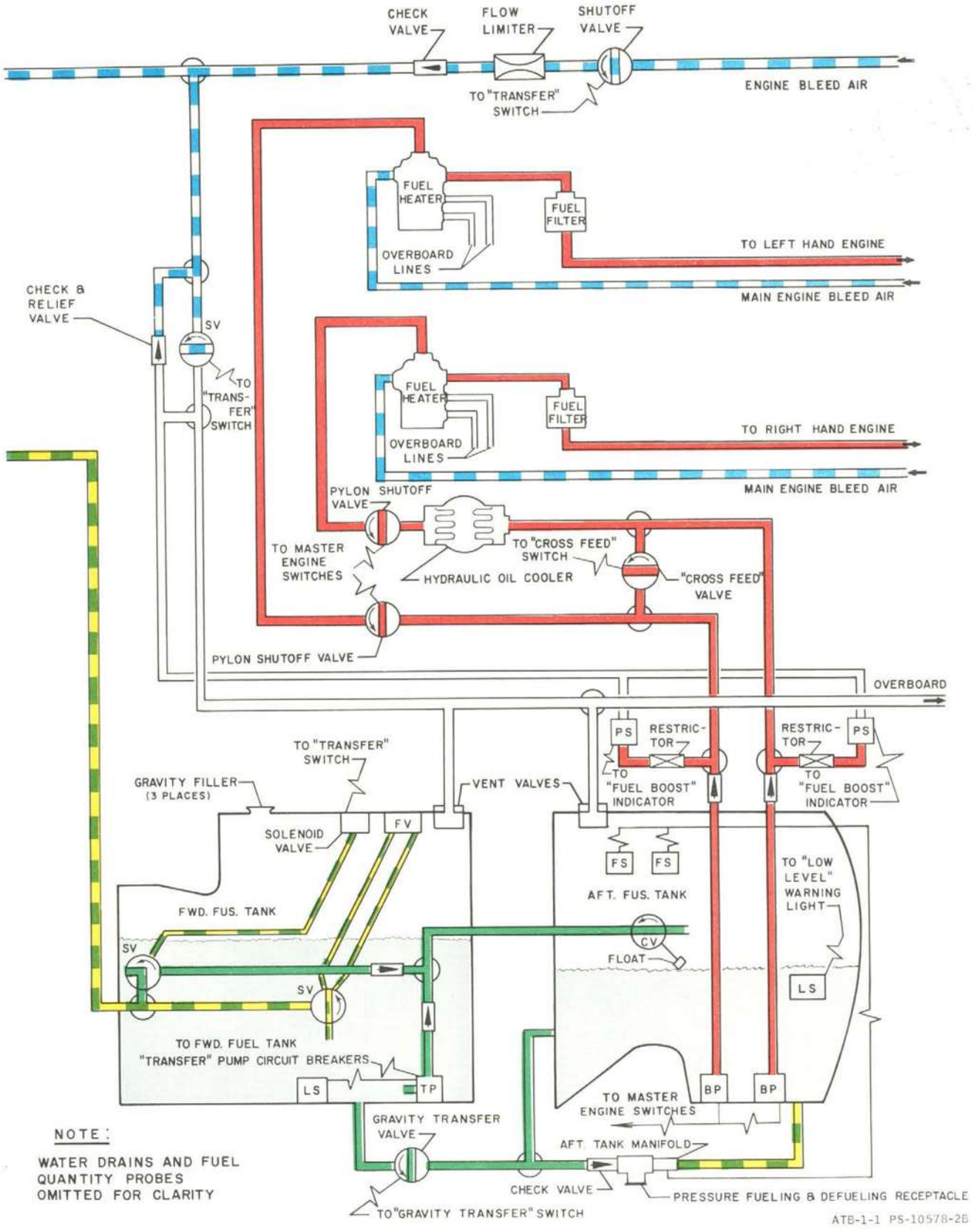
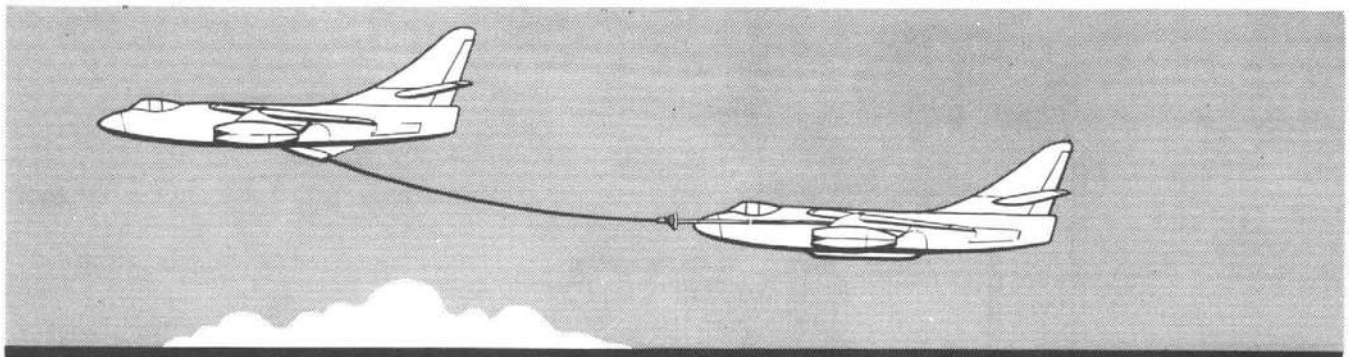


Figure 1-20. Fuel System (Sheet 2)



FUEL QUANTITY DATA

TANKS		USABLE FUEL (POUNDS)	UNUSABLE FUEL (POUNDS)	EXPANSION SPACE (GALLONS)	TOTAL VOLUME (GALLONS)
AFT FUSELAGE	P	11,968*	20.4	168.0 GALS.	1928.0
FWD FUSELAGE	P	12,335	20.4	18.0	1835.0
	G	12,458	20.4	0.0	
LEFT WING	P	4,413	6.8	18.0	668.0
	G	4,536	6.8	0.0	
RIGHT WING	P	4,413	6.8	18.0	668.0
	G	4,536	6.8	0.0	

P=PRESSURE FUELING

G=GRAVITY FUELING

*AFT FUSELAGE TANK LIMITED TO THIS QUANTITY BY FLOAT SWITCH TO MAINTAIN AIRPLANE TAKE-OFF C.G. WITHIN AFT C.G. LIMIT.

USABLE FUEL LOADS	PRESS. (POUNDS)	GRAVITY (POUNDS)
FWD AND AFT FUSELAGE TANKS	24,303	24,426
FWD AND AFT FUSELAGE TANKS AND WING TANKS	33,130	33,497

DATA AS OF: 10 JANUARY 1962

DATA BASIS: CALCULATIONS BASED ON USE OF JP-5 FUEL AND INCORPORATION OF ASC NO. 284

ATB-1-1 PS-12581-1F

Figure 1-21. Fuel Quantity Data

3. WINGS

a. Opens wing vent valve

b. Energizes wing fuel transfer pumps

c. Energizes primary solenoid of dual float valves, closing wing tanks pressure fueling shutoff valves.

4. ALT WINGS

a. Closes wing vent valve

b. Opens wing air valve, pressurizing wing tanks to effect alternate wings fuel transfer

c. Energizes CLOSE circuit of wing dump valves.

5. EMER WINGS

a. Opens wing vent valve

b. Energizes CLOSE circuit of wing dump valves.

c. Energizes wing pilot float valves which close wing pressure fueling shutoff valves

d. Energizes forward fuselage tank dual pilot float valve, which closes forward fuselage tank pressure fueling shutoff valve

e. Energizes wing to aft fuselage tank valve control solenoid which opens valve

f. Energizes wing fuel transfer pumps, effecting emergency wing fuel transfer.

6. EMER WINGS ALT

a. Closes wing vent valve

b. Energizes CLOSE circuit of wing dump valves

c. Energizes forward fuselage tank dual pilot float valve which closes forward fuselage tank pressure fueling shutoff valve

d. Energizes wing to aft fuselage tank valve control solenoid which opens valve

e. Energizes wing air valve, effecting emergency alternate wing fuel transfer by means of wing tank pressurization.

CAUTION

- Place the transfer switch at OFF when wing tanks fuel transfer has been completed. Do not operate the wing fuel transfer pumps over 30 minutes with the wing tanks empty and the pumps not submerged in fuel.
- When transferring wing fuel either by the EMER WINGS or EMER WINGS ALT systems, be sure the gravity transfer switch is at NORMAL to insure complete isolation of the forward fuselage tank.

FUEL BOOST PUMPS

Two electrically driven fuel boost pumps powered by the 115/200-volt left-hand ac generator bus are mounted in the bottom of the aft fuselage fuel tank. The boost pumps supply fuel under pressure at 12 to 30 psi to the engine fuel pump mounted on each engine. The fuel system is interconnected by a fuel crossfeed valve, making possible the operation of both engines from either boost pump. Each boost pump line has a shutoff valve located downstream of the pump, between the fuel crossfeed valve and the engines. The boost pumps are operative and the shutoff valves open, whenever the left-hand ac generator bus is energized and the master engine switches (11, figure 1-9) are ON.

FUEL BOOST PRESSURE INDICATORS

Fuel boost pressure is displayed in the fuel boost window of each engine performance indicator (24 and 25, figure 1-8). The indicator is powered by the 28-volt dc monitored essential or the 28-volt dc essential bus (see figure 1-23), and has two positions, NORM and OUT. The NORM position indicates that fuel boost pressure is 5 ± 1 psi or above, and the OUT position indicates that pressure is 5 ± 1 psi or below. Refer to ENGINE PERFORMANCE INDICATORS in this section.

FUEL CROSSFEED CONTROL

The crossfeed valve is controlled by the crossfeed switch on the fuel control panel (see figure 1-7) on the pilot's left-hand console. The switch has two positions, OPEN and CLOSE. Placing the switch at CLOSE closes the crossfeed valve and causes independent fuel boost pressure to be delivered to each engine from its respective fuel boost pump. Placing the switch at OPEN opens the crossfeed valve, permitting both engines to be served by either fuel boost pump in the event of failure of the other.

Note

Proper crossfeed valve operation can be determined only by disabling one fuel boost pump by pulling its circuit breaker on the companionway panel.

FUEL BOOST FAILURES

FUEL BOOST FAILURE WITH CONTINUED ENGINE OPERATION. If the engine continues to operate normally, loss of fuel boost pressure indication can generally be regarded as boost pump failure, fuel pressure switch failure, electrical failure or fuel boost indicator flag malfunction. Place the crossfeed switch at OPEN. If the fuel boost indicator of the affected boost system engine performance indicator then reads NORM, the pressure loss is due to boost pump failure.

CAUTION

Under these conditions the crossfeed switch should remain at OPEN for the remainder of the flight as long as fuel boost pressure is indicated. If complete loss of fuel boost pressure occurs, indicating failure of both boost pumps, return the crossfeed switch to CLOSED to obtain the best fuel flow. The engine fuel pumps can draw enough fuel through the failed boost pumps to satisfy most engine requirements. However, at very high altitudes, vapor lock may limit the pumping capacity of the engine driven pump below that required to supply enough fuel for maximum power.

If the fuel boost indicator remains at OUT with the crossfeed switch OPEN, and the other fuel boost indicator reads NORM, the trouble is in the indicator. In this event, return the crossfeed switch to CLOSED.

FUEL BOOST FAILURE WITH ACCOMPANIED FLAME-OUT. Engine flame-out with simultaneous

loss of fuel boost pressure indication can be due to a failed boost pump or ruptured fuel boost line. However, boost pump failure should not cause engine flame-out at cruise power since the engine fuel pump will continue to draw fuel from the tank by suction, except at extremely high altitude. If a ruptured fuel line is suspected, a check may be made for this condition before attempting an air start of the flamed out engine.

FUEL DUMPING SYSTEM

The wing tank fuel dumping system jettisons fuel from the wing tanks, and is effected by means of two wing tank dump valves and wing tank pressurization. The system is controlled by the wing fuel dump or purge switch on the fuel control panel (see figure 1-7) on the pilot's left-hand console. The switch has three positions, DUMP, OFF, and PURGE. The DUMP position of the switch opens the wing tanks dump valves, closes the wing tanks vent valve, closes the forward fuselage tank pressure fueling shutoff valve to prevent wing tanks fuel transfer, and opens the wing tanks air valve to effect pressurization and resultant dumping. The OFF position of the switch is self-explanatory. For a description of the function of the PURGE position of the wings fuel dump or purge switch, refer to WING TANK PURGE SYSTEM in this section. (For fuel dumping operating limitations, refer to Part 4 of this section.)

Note

The DUMP and PURGE positions of the wings fuel dump or purge switch override all functions of the transfer switch, regardless of transfer switch position.

WING TANK PURGE SYSTEM

A wing tanks purge system is installed in the airplane to reduce the possibility of explosion due to anti-aircraft fire penetrating the wing tanks. The purge system is controlled by the wings fuel dump or purge switch of the fuel control panel (14, figure 1-7) on the pilot's left-hand console. Placing the switch at PURGE closes the wing dump valves, closes the wing vent valve, and energizes the wing tanks purge solenoid, releasing CO_2 gas from the CO_2 purge cylinder in the left-hand wheel well into the wing tanks. A complete purge can be assured only if accomplished with completely empty wing tanks at an altitude above 30,000 feet. Below this altitude, purging will be relatively less effective according to the decrease in altitude. If the wing tanks have not been fueled, purging can be initiated immediately after takeoff, but the effect at low altitude is negligible.

Note

- The DUMP and PURGE positions of the wings fuel dump or purge switch override all functions of the transfer switch, regardless of transfer switch position.

- A red blowout disc is located in the right-hand wheel well. When ruptured, the disc indicates loss of CO_2 pressure due to blowout from over-temperaturing. This indicator disc is not affected by normal depletion of the CO_2 bottle. It is imperative that operation of the purge system be logged in the Naval Aircraft Flight Record form so that the CO_2 cylinder will be replaced prior to the next flight.

AIR REFUELING SYSTEM

The air refueling system utilizes all of the components of the wing and forward fuselage tanks pressure fueling system, plus a refueling probe (29, figure 1-4) mounted on the left side of the fuselage. Air refueling is controlled by the transfer switch on the fuel control panel (14, figure 1-7) on the pilot's left-hand console. Placing the switch at IFR opens the wings vent valve, closes the wing dump valves, and disables the circuits to the wings switch controlling fuel dumping and purging. Once the air refueling probe has been connected to the tanker's drogue, the wing and forward fuselage tanks dual float pilot valves are in control of the refueling operation insofar as the receiver automatic equipment is concerned. The pilot may monitor the refueling operation through use of the WINGS and FWD FUS positions of the fuel quantity switch or by observing the fuel totalizer window. The air refueling system is designed to accept fuel at rates as high as 400 gpm. The actual fuel transferred will be limited by the flow rate of the tanker. The aft fuel tank is not fueled directly by the air refueling system, and fuel flow from the forward to aft tank will be at the transfer pump rate of 84 gpm.

The transfer fuel control valve in the aft tank will limit the aft tank fuel to a maximum of 6000 pounds. Engine fuel consumption from the aft tank may vary from approximately 15 to 55 gpm (depending on altitude and power setting used for air refueling), therefore, the actual increase in fuel level of the aft tank will be 84 gpm minus engine fuel consumption. If air refueling is started after the aft tank reaches a low fuel level, and the tanker transfer rate is high, the aft tank fuel level will not reach the 6000 pounds level during the time it takes to air refuel the forward fuselage tank and the wing tanks. (For procedures assuring maximum air refueling effectiveness, refer to Section IV.)

CAUTION

- The IFR position of the transfer switch should always be used, when refueling in flight, to prevent overpressurizing the wing tanks, in the event ALT WING, EMER WINGS ALT, or DUMP has been previously selected.

- After air refueling has been completed, the wings fuel dump or purge switch should be checked in the OFF position before moving the transfer switch from IFR to OFF.

FUEL QUANTITY INDICATING SYSTEM

The fuel quantity indicating system comprises eleven dielectric-type fuel quantity probes, master display unit (fuel quantity and totalizer indicator), fuel quantity selector switch, low level switch, warning light, and associated wiring. The wing tanks contain four fuel quantity probes each; the forward fuselage tank, one; the aft fuselage tank, two. These probes are wired into the fuel quantity indicator in such a manner as to indicate through the use of a selector switch total fuel quantity remaining in a counter-type window, and individual tank quantities on a dial.

CONTINUOUS INDICATING FUEL TOTALIZER

The fuel quantity indicator (19, figure 1-8), located on the pilot's instrument panel, indicates, in pounds, the quantity of fuel aboard the airplane. A counter-type window at the bottom of the instrument will show the total fuel aboard to the nearest 100 pounds. In addition to total fuel, the indicator displays individual fuel tank fuel quantity, utilizing a pointer and dial. Readings of the dial indicator must be multiplied by 1000 to obtain the correct values. The indicator dial is graduated in 200-pound increments from 0 through 14,000 pounds. The fuel quantity indicating system is powered by the 115-volt ac left-hand generator.

Note

- A given volume of fuel will vary in weight, depending on its density; and, although the system partially compensates for this variation, the indication of fuel quantity in pounds will vary when the tanks are full if standard conditions do not prevail.

- To obtain the most nearly accurate fuel quantity indication, the aircraft should be in a ground or flight attitude of 3 degrees nose-up.

FUEL QUANTITY SELECTOR SWITCH

The fuel quantity selector switch is located on the fuel control panel (14, figure 1-7) on the pilot's left-hand console. The quantity switch has three positions, WINGS, FWD FUS, and AFT FUS. Placing the switch at WINGS, causes the pointer-dial portion of the indicator to read total wing tanks fuel quantity; placing the switch at FWD FUS or AFT FUS causes the indicator to display the fuel quantity of the forward fuselage and aft fuselage fuel tanks, respectively.

Note

The fuel quantity selector switch is spring-loaded to the AFT FUS position and must be held in the WINGS or FWD FUS positions to determine the fuel quantity in these tanks.

LOW LEVEL WARNING LIGHT

A fuel low level warning light (4, figure 1-8) is mounted on the pilot's instrument panel. Illumination of this warning light is controlled by a low level float switch in the aft fuselage fuel tank. The float switch is situated at the 3000 pounds of fuel remaining level, and closes to complete an electrical circuit (independent of the fuel quantity circuit) from the 28-volt dc essential bus or the 28-volt dc monitored essential bus (see figure 1-23) to the fuel low level warning light when the fuel quantity drops below this level.

AIR TURBINE MOTORS (ATM'S)

Two air turbine motors, driven by engine compressor bleed air (see figure 1-22), provide the necessary power for driving the ac and dc generators, the utility hydraulic pumps and the flight controls hydraulic pumps. The ATMs are located one on each side of the nosewheel well (28 and 35, figure 1-4) under the cockpit floor.

The left-hand ATM drives:

1. Utility system hydraulic pump

2. Surface control system hydraulic pump (supplies hydraulic pressure for rudder, elevator, and one half of aileron tandem power system)

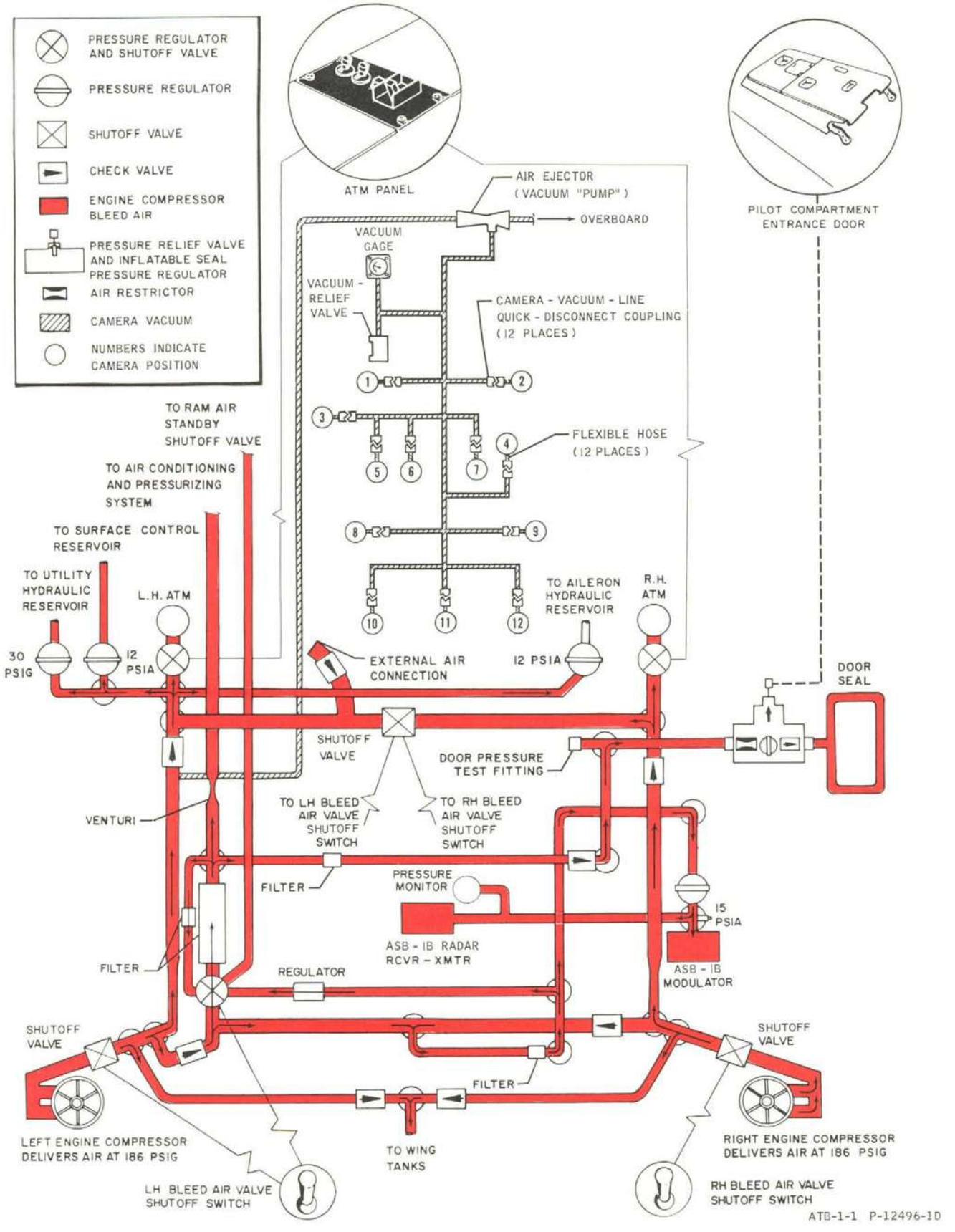


Figure 1-22. Engine Compressor Bleed Air Schematic

3. Dc generator

4. Ac generator.

The right-hand ATM drives:

1. Utility system hydraulic pump

2. Aileron and spoiler system hydraulic pump (supplies hydraulic pressure for one half of aileron tandem power system, and for spoiler operation.)

3. Dc generator

4. Ac generator.

In normal operation, 16th stage compressor air bled from the engine is directed through ducts to the ATMs. At each ATM the air passes through a solenoid operated shutoff and pressure regulating valve and is directed through a variable vane nozzle to a turbine wheel, which in turn, through a gear box, drives the accessory units. Speed of the turbine wheel is controlled by a flyball governor and a servo motor, which uses oil pressure supplied by an integral oil pump to vary the area of the air inlet nozzle vanes and maintain a constant turbine speed. A hydraulically-actuated switch in the governor oil pressure system provides protection against over-speeding due to failure of the governor. The switch, when closed by excessive oil pressure due to overspeed, actuates the shutoff valve in the air intake duct of the overspeeding unit and stops all air flow to the ATM. As the ATM decelerates, the oil pressure will drop, opening the overspeed switch which opens the shutoff valve and allows bleed air to power the ATM again. As protection against excessive bleed air pressure within the units, an overpressure circuit is provided. This circuit utilizes a pressure actuated switch, located within the bleed air duct of each ATM, wired in series with each ATM control switch. The switch, when closed by pressure within the duct in excess of 70 ±5 psi, actuates the air shutoff valve in the bleed air duct to shut down the affected unit. Once an overpressure signal has been introduced into this circuit, a holding relay is energized to keep the circuit shut down. It is possible to deenergize this relay and recycle the affected ATM by turning the applicable ATM switch to OFF and then back to ON. A test switch, for preflight checking of the overpressure sensing circuit, is provided on the pilot's auxiliary instrument panel. Refer to OVER PRESSURE TEST SWITCH in this section. Two one-way flapper valves, one located between each engine and the crossover ducting, serve to prevent a loss of air flow during single engine operation, permitting both ATMs to operate from one engine.

In flight, the ATMs will provide sufficient drive to the accessory units for normal operation of the electrical and hydraulic systems at 85 percent rpm on one engine. Normal operation of the ATMs is indicated by the ac generator frequency meters (7 and 8, figure 1-13) located on the photo-navigator's instrument panel. A frequency of 400 ± 20 cycles per second indicates normal ATM operating rpm. Normally, 75 percent rpm is high enough for ground operation.

Note

- With external electrical power connected to the aircraft and the external power switch at ON, the ac frequency meters cannot be used as an indication that the ATMs are operating.

- Make sure that the engine rpm is at least 85 percent when the ATMs are operated on one engine. This is especially important for the single engine landing where loss of ATMs will deprive the pilot of nosewheel steering.

An air inlet provided in the left side of the fuselage near the nosewheel well permits the use of an external air supply to operate the ATMs to ground check the electrical and hydraulic systems without operating the engines. Ground operation of the ATMs requires the use of an external source of dc power to provide overspeed protection.

ATM SWITCHES

Two switches, one for each ATM, are located on the ATM panel (4, figure 1-7) of the pilot's left-hand console. These ON-OFF switches supply power from the dc essential bus to the air shutoff and pressure-regulating valve solenoids and the overspeed switch, and control the air supply to the air turbine motors.

ATM BLEED AIR SHUTOFF SWITCHES

Motor operated shutoff valves are located on the pylon section of each engine bleed air duct and in the crossover duct between the two ATMs. Their purpose is to prevent escape of high temperature air in the event of a bleed air duct rupture. These valves are energized from the 28-volt dc essential bus through the ATM bleed air switches (36, figure 1-8) located on the pilot's instrument panel. Placing the left-hand ATM bleed air switch at OFF closes the left-hand pylon bleed air shutoff valve, ATM crossover duct valve and the solenoid-operated air conditioning shutoff valve, shutting down the left-hand ATM. The OFF position of the right-hand ATM bleed air switch closes the right-hand pylon bleed air shutoff valve and ATM crossover duct valve, shutting down the right-hand ATM.

ATM OVER PRESSURE TEST SWITCH

A three-position over pressure test switch (52, figure 1-8) located on the pilot's auxiliary instrument panel, provides a check on the proper operation of the ATM over-pressure circuit when the ATMs are operating. When this switch is moved from OFF to either the momentary LH or RH position, a simulated over-pressure signal is introduced into the left or right ATM over-pressure sensing circuit. Proper operation of the circuit will then be indicated by shut down of the ATM being tested with loss of ac frequency from the associated generator, and illumination of the corresponding dc generator warning light. The interlock circuit requires the applicable ATM switch to be cycled to OFF and back to ON to restart the ATM after utilizing the over pressure test circuit.

ATM COMPARTMENT OVER-TEMPERATURE WARNING LIGHTS

Thermo switches in sensitive areas of the left and right ATM compartments control the lighting of the ATM compartment over-temperature warning lights on the pilot's instrument panel (35, figure 1-8). When the temperature near one of these thermo switches exceeds 175 ± 10° C the switch closes to complete a circuit, and lights the corresponding left-hand or right-hand ATM compartment over-temperature warning light. Monitoring of the ATM compartment temperature indicator becomes mandatory upon lighting of either warning light.

OVER-TEMPERATURE TEST SWITCH

The ATM over-temperature warning light system circuitry may be tested by means of the over-temperature test switch on the pilot's auxiliary instrument panel (51, figure 1-8). Placing this momentary contact switch in the LH or RH position introduces a current in the ATM warning light circuit. Circuit integrity will be indicated by lighting of the corresponding warning light. To test the bulb, PUSH TO TEST on the light itself.

ATM COMPARTMENT TEMPERATURE INDICATOR

The ATM compartment temperature indicators are located on the pilot's auxiliary instrument panel (48 and 49, figure 1-8). The instruments show in degrees centigrade the temperature of the left and right ATM compartments. The ATM compartment temperature indicator is used in conjunction with the ATM compartment over-temperature warning lights. When one of the lights is on, monitoring of the temperature indicator becomes mandatory.

WARNING

- A temperature of 315°C is dangerously close to the autoignition point of hydraulic fluid. A possible reason for a high temperature indication could be a ruptured bleed air duct, and closing the ATM bleed air duct valve on the affected side may alleviate the trouble. ATM compartment temperature above 175°C and rising; if uncontrollable, is an emergency situation which may, at the discretion of the pilot, necessitate abandoning the aircraft.
- Experience has shown that ATM temperature in excess of 100°C is a valid indication of bleed air leaks.

ATM MALFUNCTION OR FAILURE

Malfunction or failure of either ATM is indicated when the flight controls hydraulic pressure warning light (7, figure 1-8) and the master generator warning light (4, figure 1-8) come on. (Refer to Left-Hand ATM Failure and Right-Hand ATM Failure for means of determining which ATM has failed.) ATM malfunction or stoppage may be due to any of several causes: over-pressure, overspeed, failure of ducting, or internal failure. In the case of over-pressure, shut down will be accomplished automatically through the actuation of the over pressure cutout circuit. An attempt may be made to restart the unit by first throttling back to a lower power setting, then recycling the applicable ATM control switch. If the unit again shuts down, no further attempt should be made to restart the unit and the ATM compartment temperature should be carefully monitored for the remainder of the flight.

Note

- At the pilot's discretion, in an extreme emergency in which electrical or hydraulic power is momentarily essential for control of the aircraft, the ATM over pressure circuit can be overridden. To accomplish this, pull out on the ATM control circuit breaker located on the pilot's left console circuit breaker panel.
- Failure of either ATM will result in the loss of one-half of the aileron tandem hydraulic power system. Avoid high speed flight (500 knots) when operating on one ATM.

If stoppage is due to duct or internal failure, the pilot has no choice except to secure the unit. Depending upon the location of the failure of the ducting, the ATM compartment overtemperature warning light may come on. In any event, monitor the ATM compartment temperature indicator (48 and 49, figure 1-8) on the pilot's auxiliary instrument panel. In the event of a duct rupture, the affected side should be shut down through the ATM bleed air shutoff switches (36, figure 1-8) located on the pilot's instrument panel. (Refer to ATM BLEED AIR SHUTOFF SWITCHES in this part.)

If the ATM governor fails, the ac frequency will oscillate from approximately 370 to 450 cps, being limited to this range by the overspeed control cutting in and out. In this event, the oscillating ATM should be shut down providing that the remaining ATM is operating satisfactorily. Should the speed governors of both ATMs fail, it is possible to operate on overspeed control only, without damaging frequency sensitive equipment, although the accuracy of some ac electrical components may be compromised.

LEFT-HAND ATM FAILURE

The most immediate indication of left-hand ATM failure will be the appearance of the vertical gyro indicator (21, figure 1-8) warning flag. Other indications will be lighting of the flight control hydraulic pressure warning light, the left-hand dc generator and master generator warning lights, loss of voltage on the left-hand ac generator, loss of surface control boost pressure, and zero reading on left-hand ac generator frequency meter.

RIGHT-HAND ATM FAILURE

The most immediate indication of right-hand ATM failure will be the lighting of the flight control hydraulic pressure warning light, the right-hand dc generator and master generator warning lights, loss of voltage on the right-hand ac generator, and zero reading on right-hand ac generator frequency meter.

DUAL ATM FAILURE

A dual engine failure or rupture of the crossover portion of the ATM air duct will result in stoppage of both ATMs, complete hydraulic pressure loss, loss of hydraulic flight control and control boost, and complete electrical failure until the emergency generator is extended. With dual ATM failure but with engine power available, forced landing or ditching is possible. Carrier landings should not be attempted. With dual ATM stoppage due to dual engine failure, where it has been determined that the engines cannot or should not be started, bailout is recommended.

If an ATM malfunctions, a restart can normally be accomplished by recycling the applicable ATM switch. If the loss is due to a negative g load being applied to the aircraft, closing the nozzle vanes, it will be necessary to reposition the servo piston rod to the open position before a restart can be accomplished. Repositioning of the servo piston rod can be done only on the ground.

ELECTRICAL SYSTEM

For normal operation the aircraft is provided with two electrical systems: a 28-volt direct current system (see figure 1-23) and a 115/200-volt, 400-cycle, three-phase, alternating current system (see figure 1-24). Two ATM driven generators are incorporated in each system. Emergency electrical power is supplied by a retractable, wind driven emergency generator (37, figure 1-4). An external ac and dc power receptacle (26, figure 1-4) is provided for use of external power during engine starting or ground operation of electrical equipment.

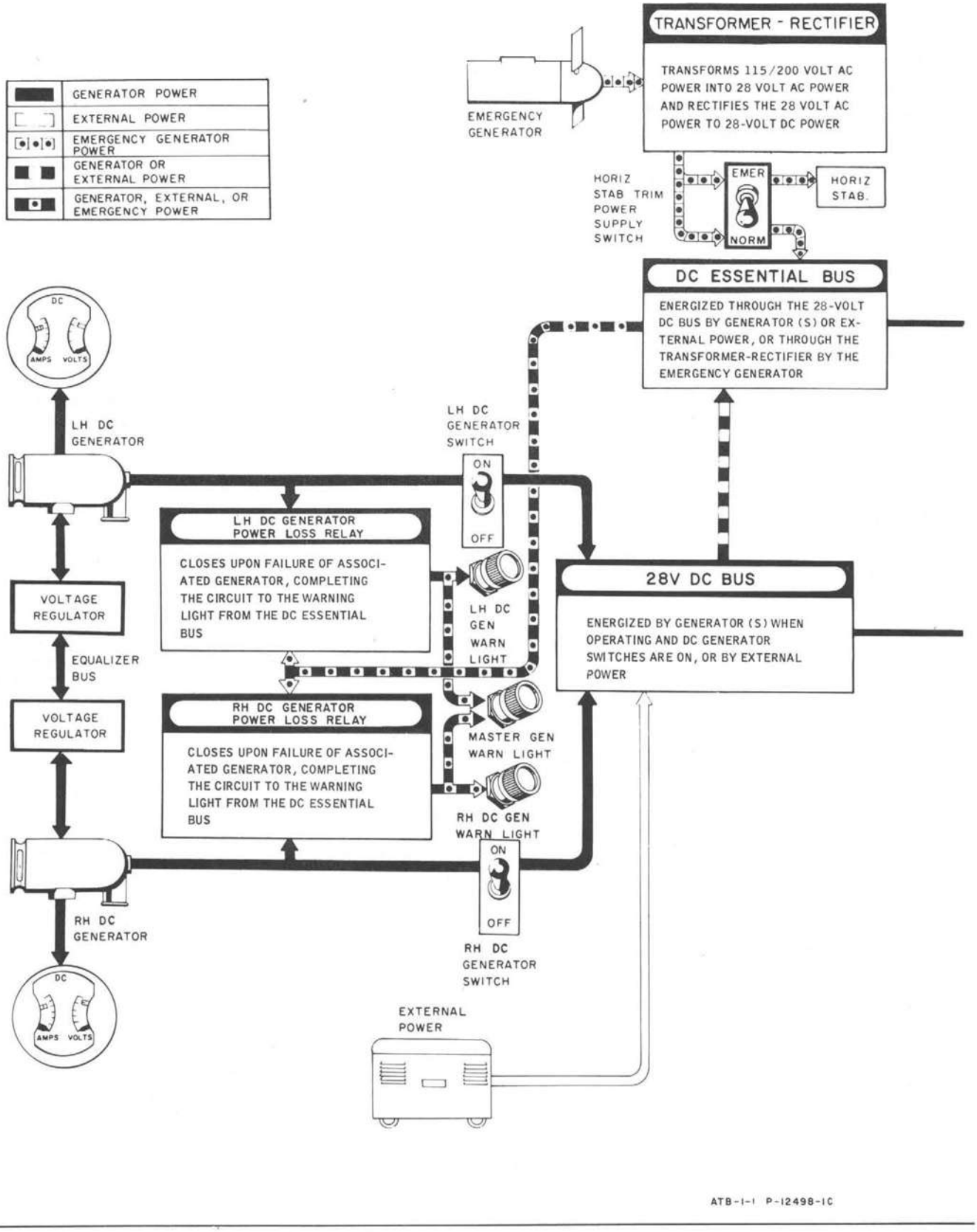
DC POWER SYSTEM

The normal dc power supply consists of two 28-volt, 300-ampere, generators. The generators are mounted on and driven by the ATMs. Three main bus systems are used for dc power distribution. These are the 28-volt dc, essential dc, and monitored essential busses. Some aircraft (see figure 1-23) have a dual main bus system, in which case the monitored essential bus is eliminated. The generators are controlled by two dc generator switches on the ac-dc power panel (see figure 1-25). Each generator circuit is protected by a voltage regulator, an over-voltage relay, and a reverse current cutout. Power from the generator passes through these devices to the 28-volt dc bus. Circuit breakers for the dc powered units are located on the pilot's circuit breaker panel and the companionway circuit breaker and fuse panel (see figures 1-15 and 1-15A).

EMERGENCY DC POWER

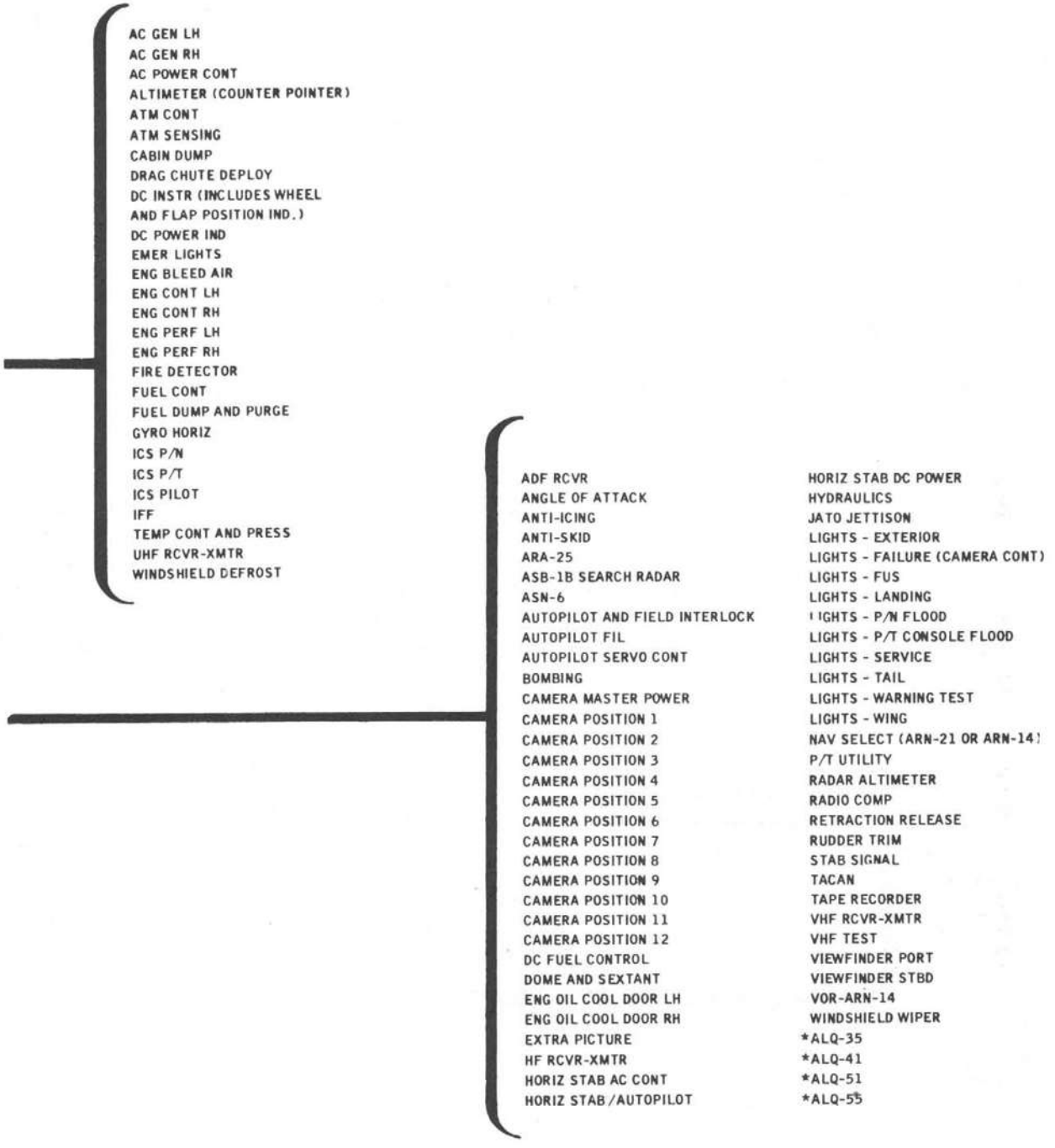
Emergency dc power is supplied by a wind driven, 115/200-volt ac, three-phase, 350 to 460 cps, 1,700-va emergency generator. The emergency generator (37, figure 1-4) is located aft of the right-hand ATM compartment and is extended and retracted by use of the emergency generator handle on the AC-DC POWER PANEL of the center console (see figures 1-9 and 1-25). When the emergency generator is extended in flight, part of its output is rectified by a transformer-rectifier into 28-volt dc power. This 28-volt dc output energizes the essential dc power relay, monitored essential dc power relay(1), disconnects the essential bus and monitored essential bus(1) from the 28-volt dc bus, and connects the emergency generator dc output to either the essential bus and monitored essential bus(1) or the emergency dc stabilizer trim circuit. Only those systems connected to the essential bus, monitored essential bus or the emergency dc stabilizer trim circuit will receive dc power from the emergency generator when the emergency generator is extended. (See figure 1-23.)

(1) Aircraft BuNo. 142256, 142666, 142667, 144837 and subsequent.



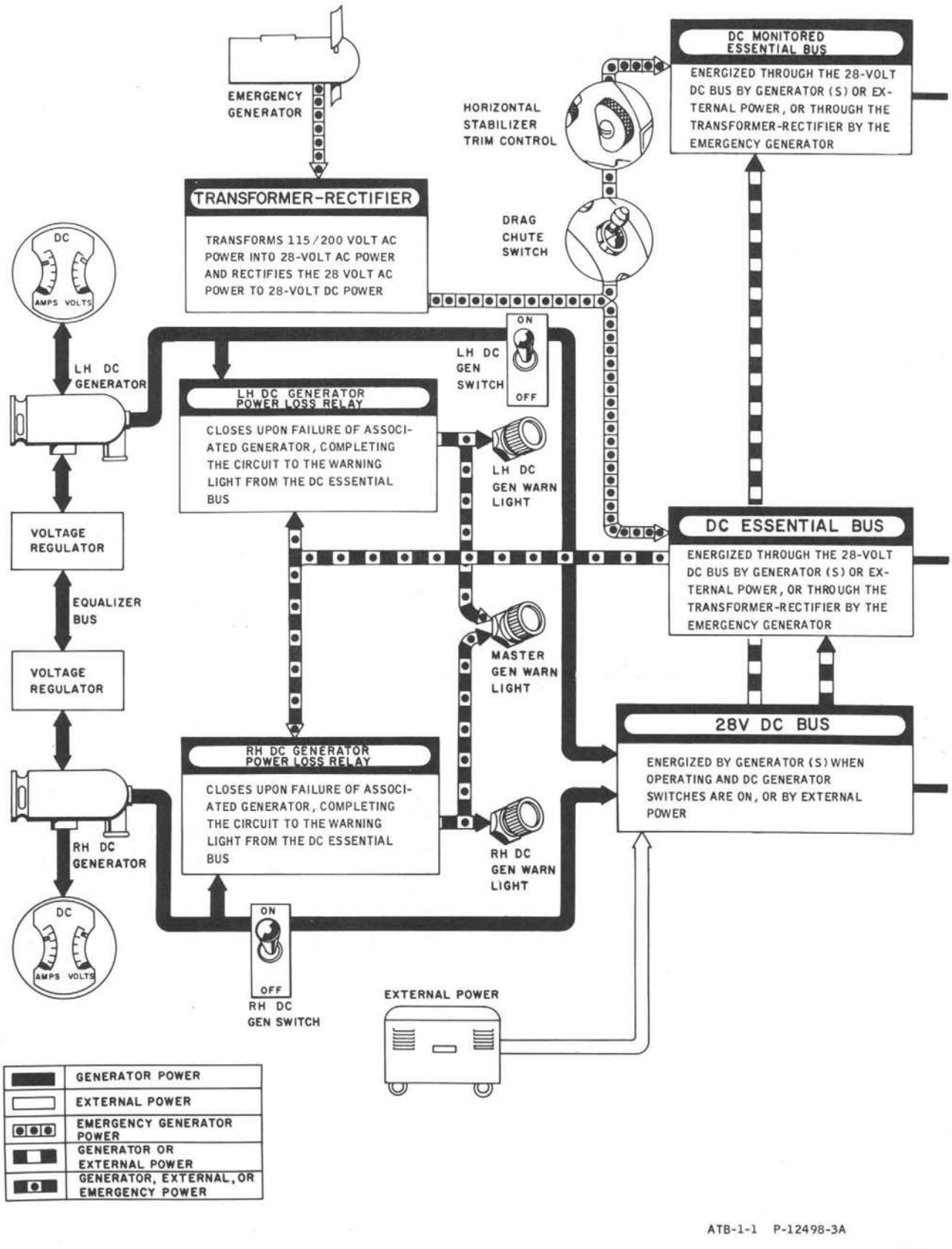
BuNo. 142668, 142669, 144825-144836

Figure 1-23. DC Electrical System (Sheet 1)



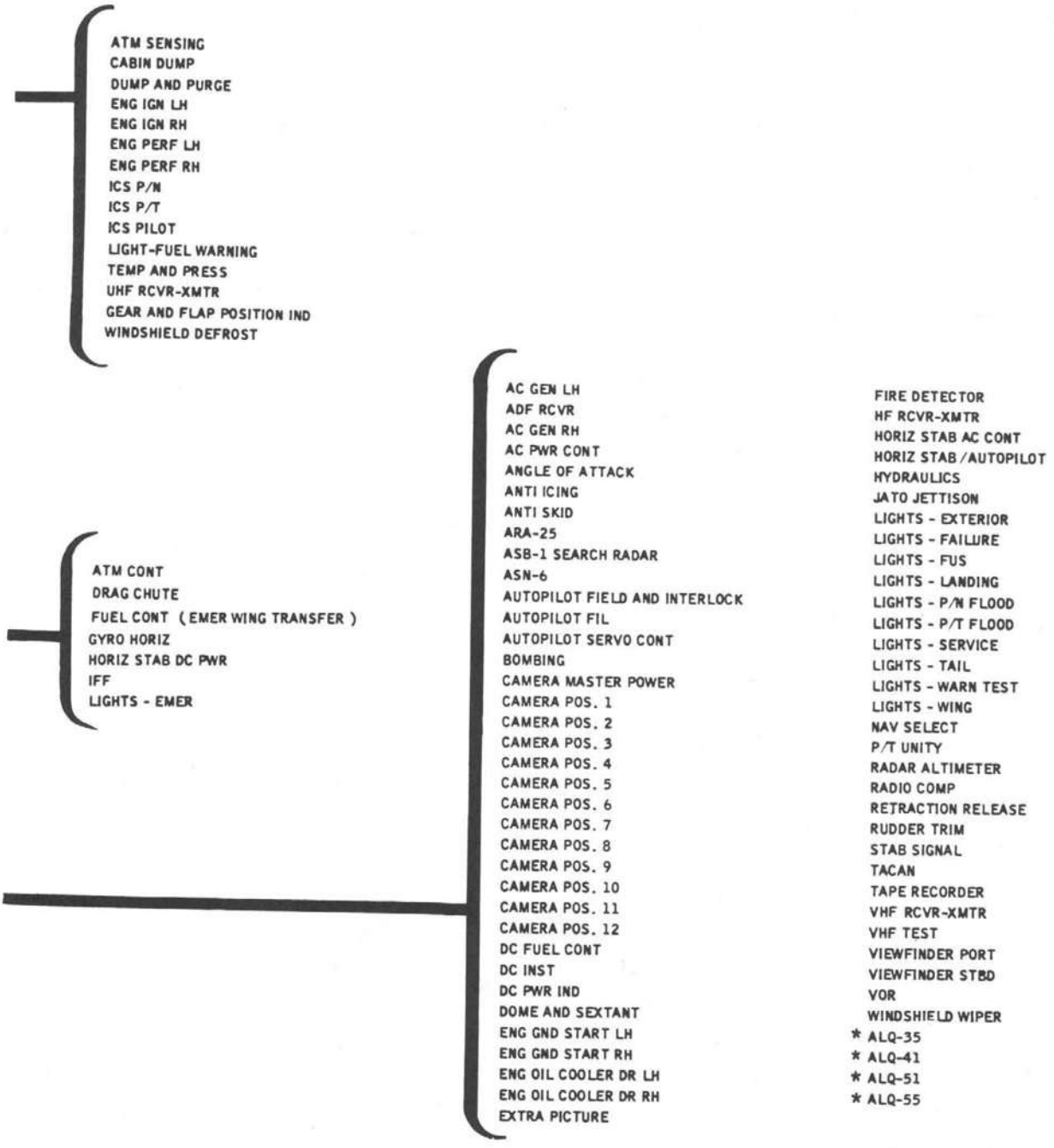
BuNo. 142668, 142669, 144825-144836

Figure 1-23. DC Electrical System (Sheet 2)



BuNo. 142256, 142666, 142667, 144837 and subsequent

Figure 1-23. DC Electrical System (Sheet 3)



BuNo. 142256, 142666, 142667, 144837 and subsequent

Figure 1-23. DC Electrical System (Sheet 4)

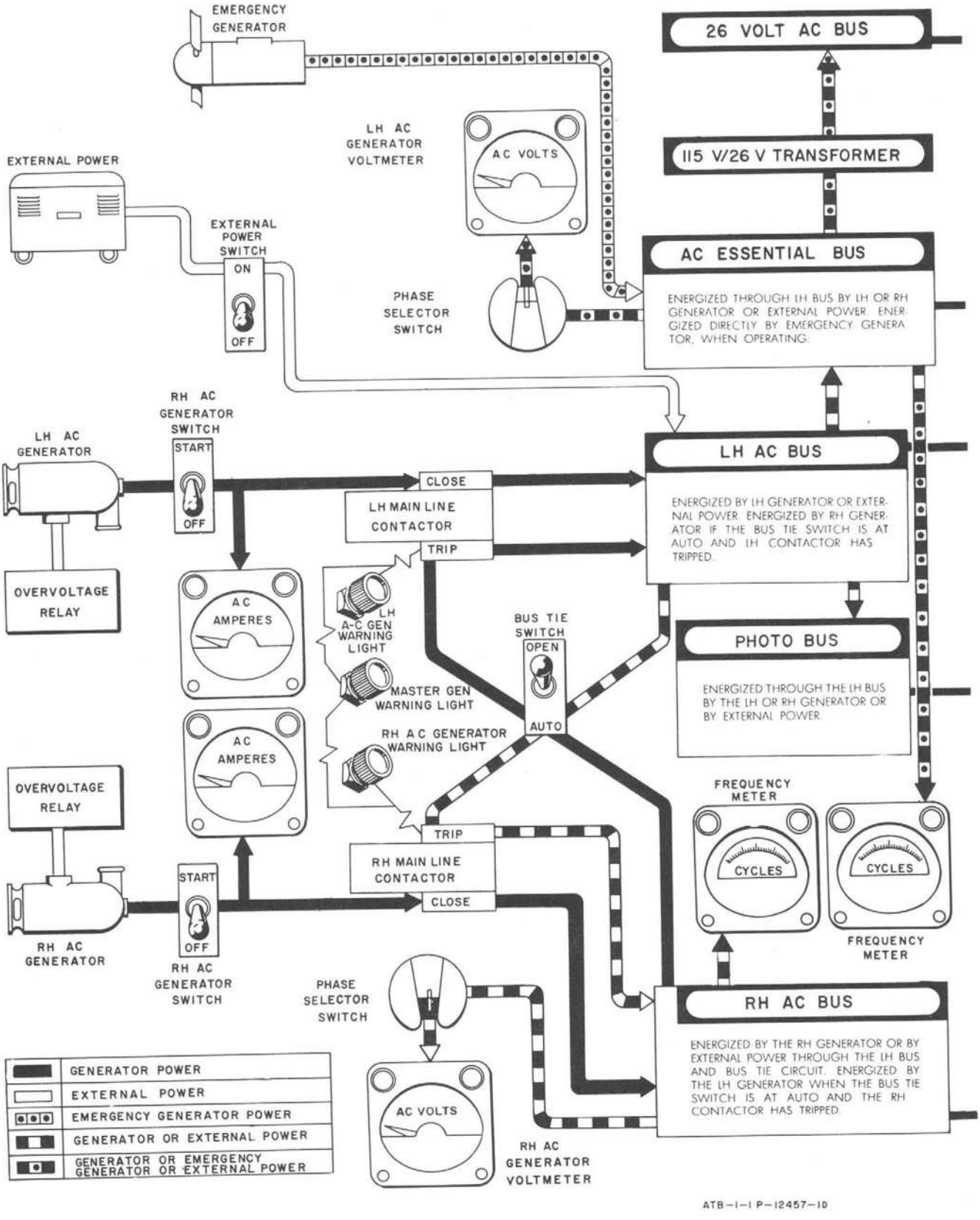


Figure 1-24. AC Electrical System (Sheet 1)

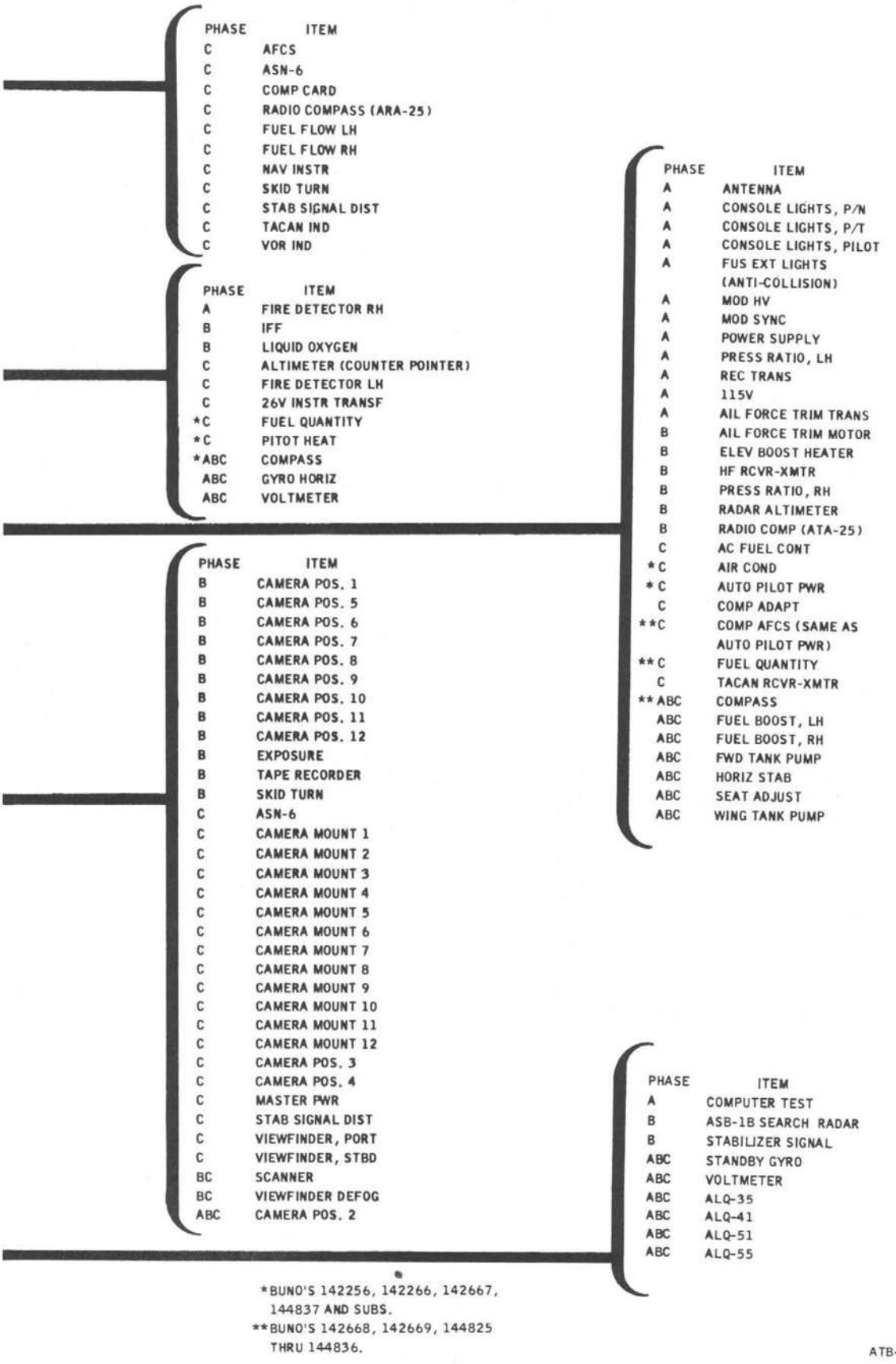


Figure 1-24. AC Electrical System (Sheet 2)

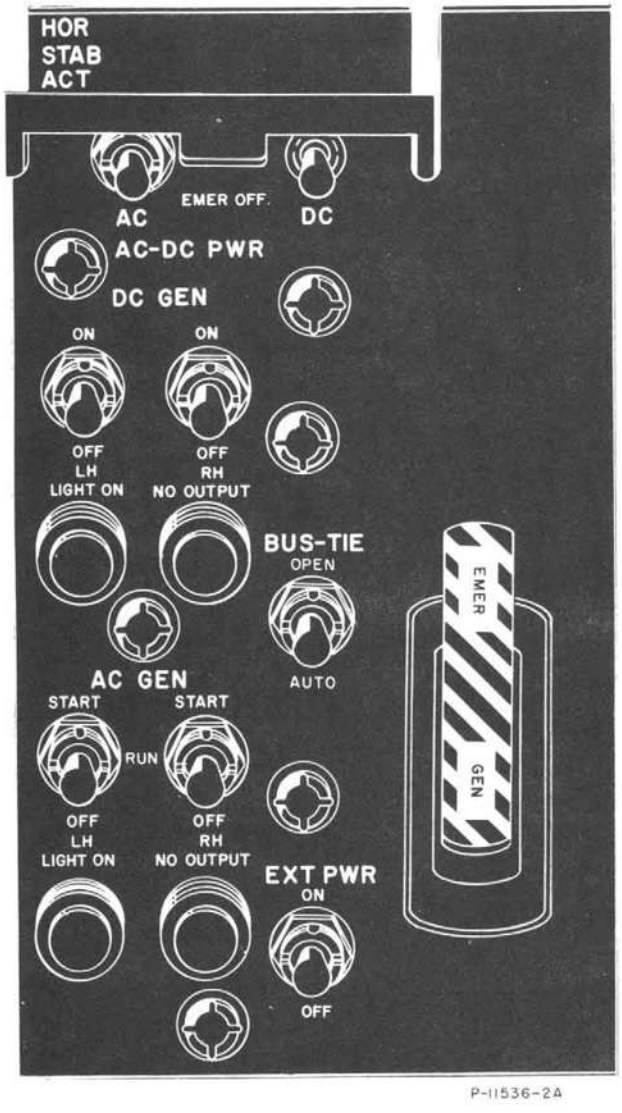


Figure 1-25. AC/DC Power Panel

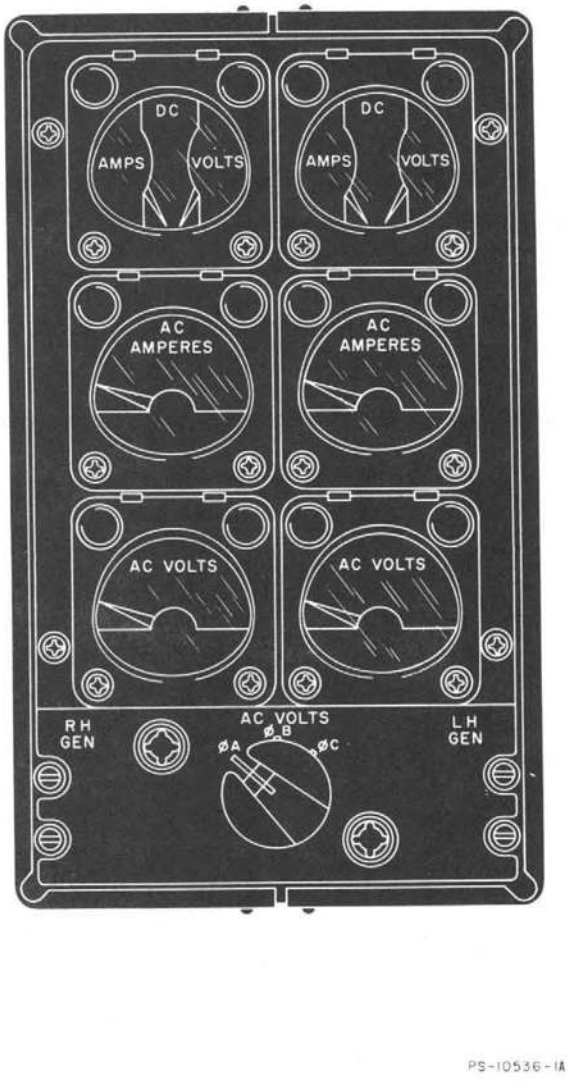
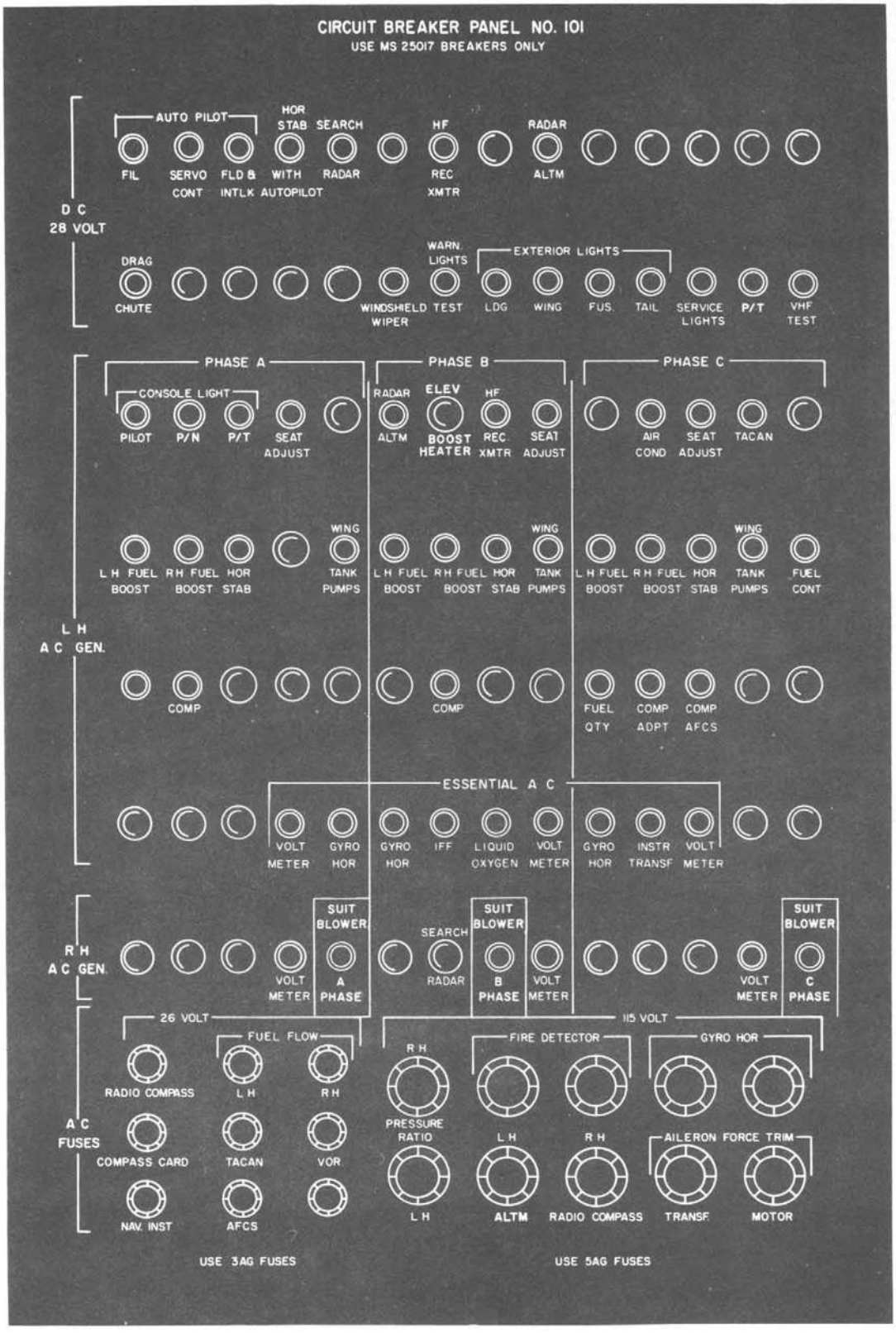


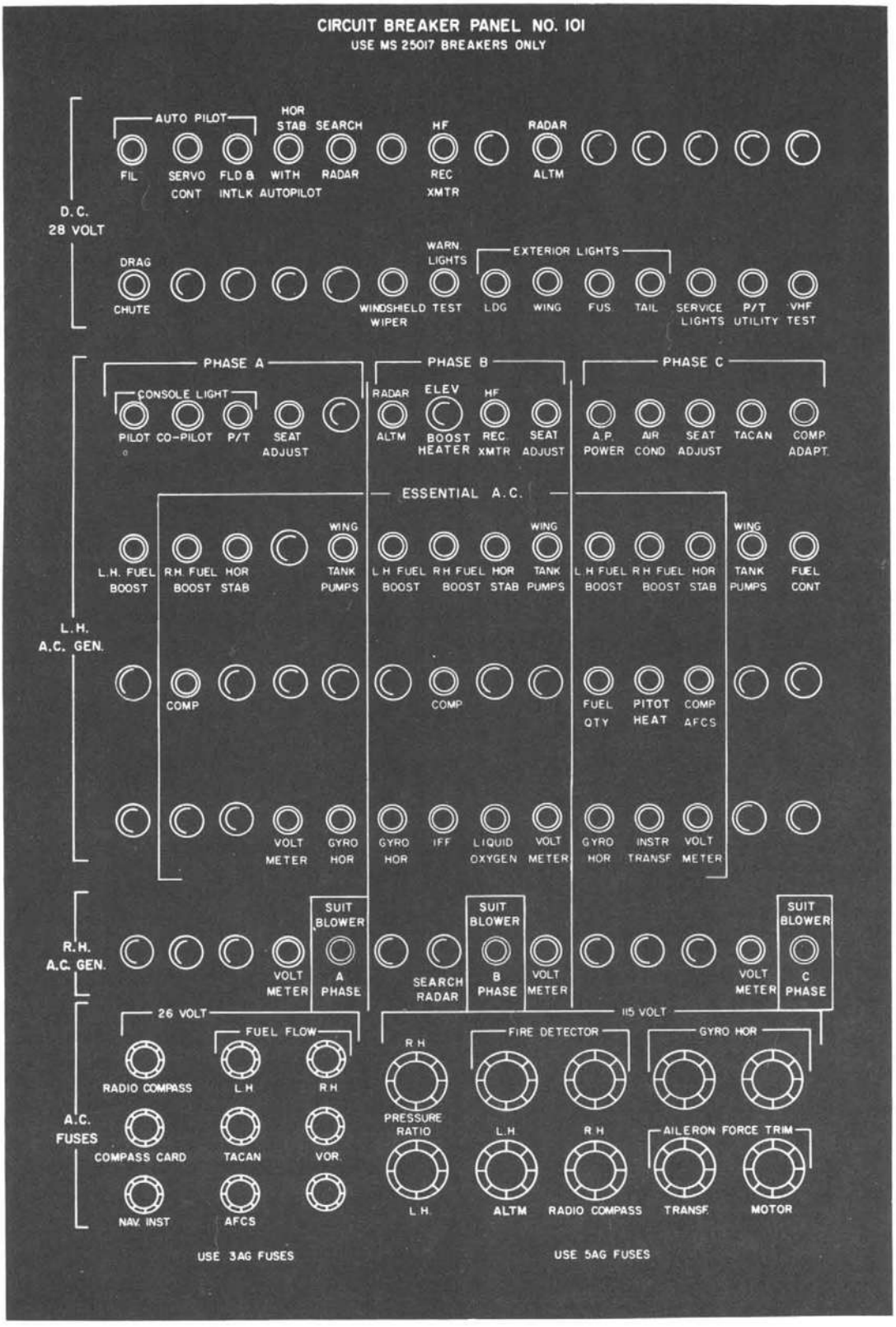
Figure 1-26. Aft Power Panel



ATB-1-1 P-11479-1D

BuNo. 142668, 142669, 144825 – 144836

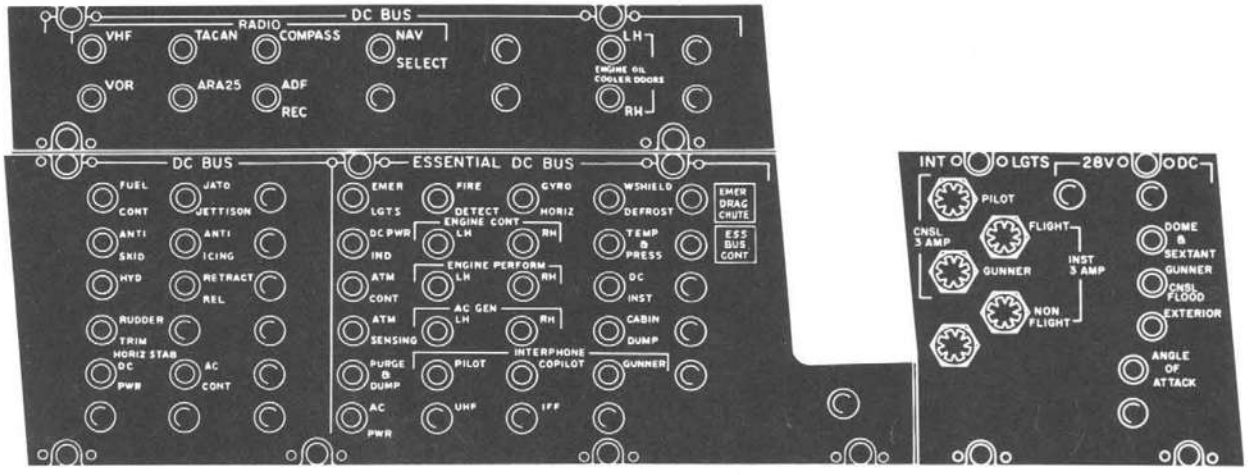
Figure 1-27. Circuit Breaker and Fuse Panel – Companionway (Sheet 2)



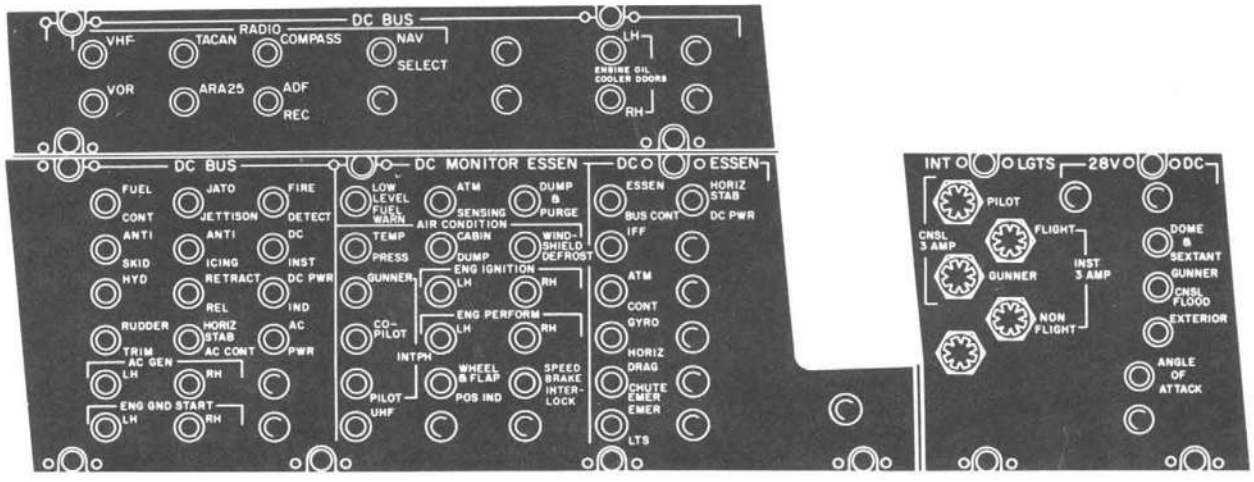
ATB-1-1 P-11479-2A

BuNo. 142256, 142666, 142667, 144837 and subsequent

Figure 1-27. Circuit Breaker and Fuse Panel – Companionway (Sheet 3)



AIRPLANES BUNO. 142668-142669, 144825-144836.



AIRPLANES BUNO. 142256, 142666-142667, 144837-144847, 146446-146447.

ATB-1-1 P-14013-1C

Figure 1-27. Circuit Breaker and Fuse Panel – Pilots (Sheet 4)

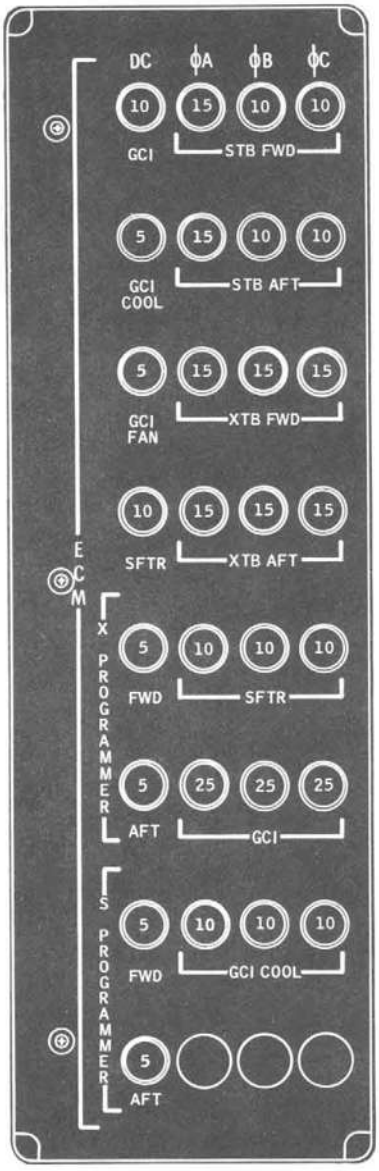


PHOTO-TECHNICIAN CIRCUIT BREAKER PANEL 109-(DECM)

PHOTO-NAVIGATOR CIRCUIT BREAKER AND FUSE PANELS

ATB-1-1 P-14013-2A

Figure 1-27. Circuit Breaker and Fuse Panel – Photo-navigator (Sheet 5)

Note

The emergency generator will deliver sufficient power to operate all essential bus equipment at airspeeds in excess of 145 KIAS flaps up, and 133 KIAS flaps down. Below these airspeeds, essential bus equipment other than the vertical gyro indicator should be turned off. The emergency generator will not deliver sufficient power to operate the ARC-27 radio and the vertical gyro indicator below 128 KIAS.

DC POWER DISTRIBUTION

28-VOLT DC BUS. The 28-volt dc bus is energized by either or both operating generators when the associated dc generator switch or switches are ON. The 28-volt dc bus is energized by external power when external power is plugged into the external power receptacle. The 28-volt dc bus serves as the dc power distribution point to the aircraft systems. (See figure 1-23.)

DC ESSENTIAL BUS. The dc essential bus is energized through the 28-volt bus by the generator(s) or external power during normal operation. When the emergency generator is extended in flight, part of its output is rectified and energizes the essential dc power relay and directs all dc output of the emergency generator to either the dc essential bus or the emergency dc stabilizer trim circuit. The dc essential bus supplies dc power to those aircraft systems essential to flight. (See figure 1-23.)

Note

When electrical power is furnished from the emergency generator only, and the horizontal stabilizer dc trim power supply switch(2) (29, figure 1-9) is positioned at EMER to obtain horizontal stabilizer trim power, all essential bus loads are disconnected. This switch must be repositioned back to NORM upon completion of horizontal stabilizer trimming to reenergize the essential bus.

DC MONITORED ESSENTIAL BUS. Under normal operation this bus is powered through the 28-volt dc bus and furnishes current to some of the aircraft systems essential to flight. When the emergency generator is extended during flight, its dc output energizes the monitor dc power relay which connects the emergency generator to the dc monitored essential bus(1) and disconnects the 28-volt dc bus from this system. Actuation of the horizontal stabilizer dc trim or drag chute deploy circuits will automatically deenergize the dc monitored essential bus.

(1) Aircraft BuNo. 142256, 142666, 142667, 144837 and subsequent.
(2) Aircraft BuNo. 142668, 142669, 144825-144836.

DC POWER CONTROL

EXTERNAL POWER. When an external power source is plugged into the external power receptacle (26, figure 1-4) it will energize the dc external power relay and through this relay automatically energize all dc busses. The external power switch (28, figure 1-9) does not control dc external power to the dc busses.

DC GENERATOR SWITCHES. The left and right dc generator switches (22 and 23, figure 1-9) are located on the ac-dc power panel (see figure 1-25) of the center console. These generator switches control the flow of current from the dc generators to the 28-volt dc bus. When either switch is ON and its associated generator is operating, the output of that generator will energize all busses. In normal operation both switches will be ON and both generators will energize the busses.

MASTER GENERATOR WARNING LIGHT. The master generator warning light is located on the pilot's instrument panel (5, figure 1-8). The light will come on upon failure of any dc generator, or overvoltage of any ac generator.

DC GENERATOR WARNING LIGHTS. A warning light for each generator is located on the ac-dc power panel (see figure 1-25). Lighting of the left or right dc generator warning light in conjunction with the master generator warning light, indicates loss of output by the left or right dc generator, and may indicate failure of the associated ATM. Refer to Air Turbine Motors in this section. The dc generator warning light circuit is protected by the dc power indicator circuit breaker on the pilot's console (see figure 1-15A).

VOLTAMMETERS. A voltammeter for each dc generator is located on the aft power panel (see figure 1-26). The voltmeter side of the instrument is calibrated from 15 to 33 volts. The voltmeters of both instruments indicate 28-volt dc bus voltage, and both voltmeters will, if operating normally, indicate the same voltage regardless of the source of power to the bus. The ammeter side indicates ampere load on each generator from 0 to 450 amperes.

GENERATOR MANUAL RESET. The dc generator overvoltage relays are equipped with a manual reset control. The overvoltage reset pushbuttons are located behind the circuit breaker and fuse panel in the companionway.

Note

The dc generators are normally very lightly loaded, and may drop out because of lack of parallelism.

CAUTION

Do not reset the overvoltage relay of either generator until the cause of the overvoltage has been corrected.

DC ELECTRICAL SYSTEM FAILURES

DC POWER FAILURE. Failure of a dc generator will be indicated by the associated generator warning light on the ac/dc power panel (see figure 1-25), and the master generator warning light (5, figure 1-8) on pilot's instrument panel. Turn the indicated dc generator switch OFF. The remaining operative dc generator will supply sufficient power for the operation of most of the equipment, but the load must be limited to 300 amperes.

DC GENERATOR POWER FAILURE DUE TO OVERVOLTAGE. A dc generator will automatically shut down, under an overvoltage condition. If the cause of the overvoltage has been corrected, the generator may be reset by pushing in on its overvoltage reset button. These buttons are located behind the upper part of the companionway circuit breaker and fuse panel.

Should both dc generators fail in flight, the emergency generator must be extended, and both dc generator switches turned OFF. The horizontal stabilizer dc trim power supply switch (see figure 1-23) must be at EMER only when dc trimming is required, and returned to NORMAL when trimming has been accomplished. Trim power will still be available from the emergency generator following failure of both dc generators.

AC POWER SYSTEM

WARNING

The ac electrical system contains voltages dangerous to life. Do not attempt repairs or adjustments to any component of the ac system or to any of the ac powered units. Do not rely on interlocks for protection. The ac system and equipment may be serviced only by qualified personnel on the ground.

The normal ac electrical power supply consists of two 115/200-volt, three-phase, 400 cycle, 20 kva generators. Each generator is essentially three 115-volt generators combined into one unit. They are Y-connected and common grounded. The voltage between

any line (or phase) and ground is 115 volts, and between any two lines, 200 volts. Each generator is driven directly by an ATM whose constant governed speed drives the generator at the rpm required to furnish ac power at 400 ± 20 cycles per second (cps). Dc power is supplied to the generator controls from the 28-volt dc essential bus (or, in some aircraft from the 28-volt dc bus) through the ac power control circuit breaker on the pilot's left-hand console. Each generator's output is regulated by a voltage regulator, and protected from overvoltage by an overvoltage relay which automatically disconnects the generator from its three-phase distribution bus if an overvoltage condition exists.

Each ac generator is rated for continuous duty at 20 kva. The generators must not be loaded in excess of 150 percent of rated capacity for more than 2 minutes, or in excess of 200 percent for more than 5 seconds.

CAUTION

The overvoltage relay protects the ac generator circuit from an overvoltage condition only. Any other malfunction of a generator or its circuit will require manual shutdown by positioning the applicable ac generator switch at OFF. The ac frequency meters (7 and 8, figure 1-13) on the photo-navigator's instrument panel must be checked frequently for an indication of such malfunction.

No protection is provided against an under-voltage or an over- or under-frequency condition. The ac frequency meters (7 and 8, figure 1-13) are located on the photo-navigator's instrument panel. A voltmeter and ammeter for each generator are located on the aft power panel (figure 1-26). Circuit breakers for the ac powered equipment and located on the companionway circuit breaker and fuse panel (figure 1-15A).

EMERGENCY AC POWER

Emergency ac power is supplied by a wind driven, 115/200-volt ac, three-phase, 350 to 460 cps, 1,700-va emergency generator. The emergency generator (37, figure 1-4) is located aft of the right-hand ATM compartment and is extended and retracted by the emergency generator handle (24, figure 1-9) on the lower center console. When extended in flight, the emergency generator supplies ac power either to the essential ac bus, and dc power to the essential dc bus and the monitored essential dc bus, or emergency dc power to the emergency stabilizer trim circuit. (See figure 1-23 and 1-24.) The emergency generator is extended by compressed air from the same 3000 psi air bottle used for emergency extension of the flaps. Utility system hydraulic pressure is used to retract the emergency generator. Extension and retraction are controlled by pulling (extend) or pushing (retract) the emergency generator handle (24, figure 1-9) on the lower center console.

CAUTION

- During generator retraction, the brake pedals should be depressed to prevent air entrapment in the brake lines.
- The emergency generator will deliver sufficient power to operate all essential bus equipment at airspeeds in excess of 145 knots flaps up, and 133 knots flaps down. Below these airspeeds, essential bus equipment other than the vertical gyro indicator should be turned off. The emergency generator will not deliver sufficient power to operate the ARC-27 radio and the vertical gyro indicator below 128 KIAS.

AC POWER DISTRIBUTION

LEFT-HAND AC GENERATOR BUS. The left-hand ac generator power distribution bus consists of three separate 115-volt busses designated the A-, B-, and C-phases. The left-hand ac bus is energized by the left-hand generator when the left-hand main line contactor has been energized to its close position. The left-hand ac bus may be energized by the right-hand ac generator through the bus tie relay when the main line contactor has been energized to trip and the bus tie switch is at AUTO. The left-hand ac bus is energized by external power when the external power switch is ON, the ac generator switches are OFF, and the external power source is plugged in the external power receptacle.

RIGHT-HAND AC GENERATOR BUS. The right-hand ac generator power distribution bus consists of three separate 115-volt busses designated the A-, B-, and C-phases. The right-hand ac generator bus is energized by the right-hand generator when the right-hand main line contactor has been energized to close. The right-hand ac bus is energized by the left-hand generator through the bus tie relay when the bus tie switch is at AUTO and the main line contactor has tripped from overvoltage or the OFF position of the right-hand generator switch. The right-hand ac bus is energized by external power through the left-hand ac generator bus and bus tie relay when the external power switch is ON, the bus tie switch is at AUTO, and the ac generator switches are OFF.

AC ESSENTIAL BUS. The essential ac bus consists of three separate 115-volt busses designated phases A, B, and C. When the emergency generator is retracted, the

essential ac bus is energized through the left-hand ac generator bus by the left-hand generator, the right-hand generator or by external power. When the emergency generator is extended in flight, its output energizes the essential ac power relay, breaking the connection between the left-hand ac bus and the essential bus, and connecting the essential bus to the emergency generator. When the ac power relay is energized all emergency generator ac output goes to the essential ac bus. The essential ac bus distributes ac power to the instruments and systems necessary for flight (see figure 1-24). Power for the 26-volt ac bus is taken from the C phase of the essential ac bus.

CAUTION

When the emergency generator is extended, and the horizontal stabilizer dc trim power supply switch (29, figure 1-9) is positioned at EMER to obtain emergency stabilizer dc trim power, all other essential bus loads are disconnected.

26-VOLT AC BUS. The 26-volt ac bus distributes power to equipment requiring 26-volts ac for operation. It is energized by the C-phase of the ac essential bus through a step-down instrument transformer. The 26-volt ac circuit is protected by the instrument transformer circuit breaker located on the companionway circuit breaker and fuse panel (figure 1-15A).

AC PHOTO BUS. The ac photo bus consists of three separate 115-volt busses designated the A-, B-, and C-phases and distributes ac power to components of the photo system. When the photo bus relay is energized, the photo bus receives power from the left-hand ac bus. If left-hand ac power is not available and the bus tie relay is energized, the right-hand generator will supply power to the photo bus. External power is also made available to the photo bus by the ON position of the external power switch.

Note

The photo bus relay is energized by the 28-volt dc bus or (see figure 1-15A) by the dc monitored essential bus through the close position of both main line contactors or the ON position of the external power switch. If either main line contactor has been energized to trip either on the ground or in flight, dc power will not be available to energize the photo bus relay unless the external power switch is ON.

AC POWER CONTROL

The ac power supply and distribution system is controlled by dc power from the dc bus or (see figure 1-23) by the dc monitored essential bus. This bus must be energized before the ac power control switches become effective. Distribution of ac generator power to the ac busses is controlled by five major power control relays: two main line contactors (one for each generator), and three bus tie relays. The operation of these relays is determined by the position of the ac generator switches, bus tie switch, and the external power switch.

MAIN LINE CONTACTORS. The main line contactors act to connect or disconnect the ac generators and the ac generator-busses. The contactors are of the push-pull type, with a coil at either end. When either coil is energized momentarily, the contactor moves toward that coil and is latched in position until the opposite coil is energized. The actuation of the close coil of each contactor completes the circuit between the ac generator and its bus. The close coil is energized by dc power supplied to the coil when the applicable ac generator switch is cycled to START, but only if the bus tie switch is in the OPEN position and the external power switch is OFF. The trip (open) coil of each contactor is energized by dc power through action of the overvoltage relay or the OFF position of an ac generator switch. The overvoltage relay automatically trips the contactor to disconnect the generator from its bus when overvoltage occurs. If either contactor is tripped by overvoltage or the OFF position of its respective generator switch while the bus tie switch is in AUTO the bus tie relay will be energized to tie the left- and right-hand ac busses together. When the left- and right-hand busses are tied together the operating generator powers both busses.

CAUTION

- A malfunction or failure (other than overvoltage) will not cause the contactor of that generator to trip. The most immediate warning of such malfunction or failure of the left-hand ac generator will be the appearance of the vertical gyro indicator warning flag. Other warnings will be the loss of fuel flow indication, volt and ammeter indications and the readings of the left-hand ac frequency meter.
- Malfunction or failure of the right-hand ac generator will be shown by the right-hand ac voltmeter, and ammeter, and by the right-hand ac generator frequency meter. (Refer to Ac Power Failure in Section V.)

Dc power for energizing the ac generator warning lights and the external ac power relay is also supplied through the trip position of the main line contactors. Both generator switches must be OFF (to trip the contactors) before the external ac power relay can be energized. (Refer to External Power Switch in this section.)

MASTER GENERATOR WARNING LIGHT. A master generator warning light (labeled GEN) is located on

the pilot's instrument panel (4, figure 1-8). This light will come on upon failure of either dc generator or OVERVOLTAGE condition of either ac generator.

AC GENERATOR WARNING LIGHTS. The ac generator warning lights on the ac-dc power panel (figure 1-25) are energized by dc power through the trip position of the main line contactors. Only two conditions will trip a contactor: overvoltage or the OFF position of an ac generator switch. Therefore, lighting of either the left- or right-hand ac generator warning light will only show that an overvoltage has occurred or that the generator switch is OFF. If the left or right ac warning light should come on during normal flight, the left or right ac generator switch may be turned OFF and then recycled through the ac starting procedure described under Ac Power Failure in Section V. If the light comes on again the generator switch should be turned OFF for the remainder of the flight. Power to the bus of the inoperative generator will be supplied from the operating generator if the bus tie switch is in AUTO.

BUS TIE SWITCH. The two-position bus tie switch on the ac/dc power panel (figure 1-25) controls the bus tie relay which provides a means of energizing both the left-hand ac generator and the right-hand ac generator busses from one generator. With the switch in the OPEN position, both ac generator circuits function normally as two independent circuits. When the switch is placed in the AUTO position, part of a circuit is completed between the dc primary bus and the bus tie relay. This circuit is completed if either of the main line contactors is tripped, energizing the bus tie relay which in turn closes to complete a direct circuit between the left- and right-hand ac busses.

Note

A main line contactor will trip only when its trip coil is energized by the overvoltage relay or by the OFF position of the generator switch. If a generator is lost for any reason other than an overvoltage, the generator switch must be turned OFF before the bus tie relay will be energized and tie the left- and right-hand ac generator busses together.

External power is supplied directly through the external power receptacle to the left-hand ac generator bus only. In order to energize the right-hand ac generator bus for ground operation of ac powered equipment, the bus tie switch must be in the AUTO position and the 28-volt dc bus energized.

Note

The bus tie switch must be in the OPEN position before the ac generator can be started.

The bus tie switch is powered from the dc bus or (see figure 1-23) the dc monitored essential bus, through the ac power control circuit breaker on the left-hand console circuit breaker panel.

AC GENERATOR SWITCHES. Two, three-position ac generator switches, located on the ac-dc power panel (figure 1-25), control the output and distribution of ac power. Each switch has a momentary contact position marked START, and a position marked OFF. When released from its momentary contact START position each switch will fall into the operating position, labeled RUN. The OFF position of each switch energizes the trip coil of the main line contactor and the exciter relay, which in turn cuts off dc power to the generator controls and opens the generator field to deenergize the generator and the circuit. The momentary contact START position of each switch supplies dc power to the exciter relay, which closes part of the circuit between the primary bus and the generator controls. This circuit, including the generator field, is not completed and the main line contactor close coil is not energized until the ac generator switch is released to fall into its operating position. The generator switches are dc powered through the ac generator left-hand and the ac generator right-hand circuit breakers on the pilot's left console.

EXTERNAL POWER SWITCH. A two position external power switch is located on the ac-dc power PANEL (figure 1-25). The ON position of this switch supplies power from the dc main bus to close a relay which connects the left-hand ac bus to the ac external power source. The relay can be energized only if both ac generator switches are OFF and the external power supply is plugged into the receptacle. To energize the right-hand ac bus from the external power supply the bus tie switch must be placed in the AUTO position after the external power switch is turned ON.

FREQUENCY METERS. Two ac frequency meters, one for each ac generator, (7 and 8, figure 1-13) located on the photo-navigator's instrument panel, indicate A-phase frequency. The normal operating frequency of either generator is 400 ±20 cps. The frequency of the emergency generator is indicated on the left-hand ac frequency meter.

CAUTION

No protection against an under frequency condition is provided. Much of the electronic equipment operated by ac power is frequency sensitive; therefore a generator producing less than 380 cps should be turned OFF and the necessary equipment operated from the remaining generator through the bus tie circuit.

An under-frequency condition on either generator indicates that the corresponding ATM is operating at lower than normal rpm. (Refer to ATM Malfunction or Failure in this section.)

VOLTMETERS. Ac generator voltage is indicated by two voltmeters on the aft power panel (figure 1-26). The right-hand ac generator voltmeter will show the voltage of a selected phase of the right-hand ac bus. The left-hand ac generator voltmeter will show the voltage of a selected phase of the left-hand ac bus and/or the ac essential bus. Phase selection is made by positioning the ac volts phase selector knob at A, B, or C. The phase selector knob is located on the lower face of the aft power panel. Each voltmeter is calibrated from 0 to 150 volts. Normal indication is 115 volts on each phase.

AMMETERS. An ammeter for each ac generator is located on the aft power panel (figure 1-26). The ammeter reflects the ampere load on the A-phase only. Normal ammeter indication may range from approximately 10 to 30 amperes on the left-hand ac generator ammeter, and from 12 to 35 amperes on the right-hand ac generator ammeter. Maximum continuous rated amperage is 43.

AC ELECTRICAL SYSTEM FAILURES

AC POWER FAILURE (OVERVOLTAGE). Under normal conditions (bus tie switch in AUTO), the lighting of either ac generator warning light in conjunction with the generator master warning light indicates the loss of that generator due to an overvoltage condition. Under this condition, the bus tie system will automatically tie the left- and right-hand ac busses together and the operative generator will energize both busses. A generator that has shut down due to an overvoltage condition may be recycled once.

AC POWER FAILURE (OTHER THAN OVERVOLTAGE). If the left-hand ac generator fails for reasons other than overvoltage, the left-hand ac generator warning light will not glow and the automatic bus-tie system will not operate. The most immediate indication of this type of failure will be the appearance of the vertical gyro indicator warning flag. If it does, place the left-hand ac generator switch at OFF. This will trip the contactor and place the bus-tie system in operation, since the bus-tie switch is in AUTO. Continue operation on one generator, using ac powered equipment only as needed.

If the right-hand ac generator fails for reasons other than overvoltage, the right-hand ac generator warning light will not glow and the automatic bus-tie system will not operate. The most immediate indication of this type of failure will be the loss of equipment normally powered by the right-hand ac generator and readings of the aft power panel. If the DECM system is urgently needed, place the right-hand ac generator switch at OFF. This will trip the contactor and place the bus-tie system in operation, since the bus-tie switch is in AUTO. If the DECM system is not urgently needed, place the right ac generator switch at OFF and place the bus-tie switch at OPEN. Refer to the caution listed above. Should both ac generators fail in flight, extend the emergency generator and turn all ac generator switches OFF. DC stabilizer trim will still be available following failure of both ac generators.

CAUTION

The emergency generator will deliver sufficient power to operate all essential bus equipment at airspeeds in excess of 145 knots flaps up, and 133 knots flaps down. Below these airspeeds, essential bus equipment other than the vertical gyro indicator should be turned off. The emergency generator will not deliver sufficient power to operate the ARC-27 radio and the vertical gyro indicator below 128 KIAS.

EMERGENCY GENERATOR DC POWER DISTRIBUTION (1)

The following is a list of dc circuit breakers and systems receiving power from the emergency generator dc essential bus.

AC GEN LH AC GEN RH	Control of left- and right-hand ac generators.
AC PWR	Control of BUS TIE. Overvoltage protection left- and right-hand ac generators. Ac generator warning lights and generator master warning light.
ATM CONT	Control of left- and right-hand ATM's. ATM overpressure protection, overpressure test, and overspeed protection.
ATM SENSING	ATM temperature warning circuits and lights, temperature warning circuits and light test, ATM compartment temperature indicator LH and RH.
CABIN DUMP	Control of cabin pressurization through DUMP position of cabin pressure control switch.
DC INST	MLG position indicators. Elevator trim position indicator. Rudder trim position indicator. Flap position indicator.
	Free air temperature indicator. Utility hydraulic pressure indicator. Surface control and aileron hydraulic combination indicator light. Aft tank fuel low level warning light.

(1) Aircraft BuNo. 142668, 142669, 144825-144836.

DC PWR IND	DC generator warning lights and generator master warning light.
EMER LGTS	Cockpit flood lights.
ENGINE CONT LH ENGINE CONT RH	Controls engine ignition cycle through engine master switches.
ENGINE PER-FORM LH ENGINE PER-FORM RH	Fuel boost indicators and oil pressure indicators.
FIRE DETECT	Power for press-to-test circuits of ac powered fire detection system.
EMER DRAG CHUTE	Power to deploy and jettison drag chute.
ESS BUS CONT	Switches power source for the ac essential bus from the left-hand ac bus to the emergency generator.
PURGE & DUMP	Controls purge and dump. Wing fuel transfer to aft tank by EMER WINGS ALT position fuel transfer switch. Wing fuel transfer to forward tank by ALT WING position fuel transfer switch. Control for gravity transfer valve and light.
GYRO HORIZ	Power for gyro horizon (VGI). AC power also required.
INTERPHONE (ICS)	Power for transistorized interphone system.
PILOT	
PHOTO-NAVIGATOR	
PHOTO-TECHNICIAN	
IFF	Power for APX-6 IFF transponder. Ac power also required.
TEMP & PRESS	Controls air conditioning air supply and depressurization of cabin through ON and OFF position of cockpit temperature selector knob. Temperature control only through MANUAL HOT and MANUAL COLD positions of cockpit temperature selector knob. Control to select COMBAT or NORMAL through cabin pressure control switch.
UHF	Power for UHF transmitter and receiver.
WSHIELD DEFROST	Control of windshield defrost valve.
ENG BLEED AIR	Controls left-hand and right-hand bleed air shutoff valves and crossover valve. Left hand switch will also close air conditioning air valve.
TURN & SLIP	Power to miniature electrical turn and bank indicator.
LIQUID OXYGEN	Power to LOX quantity system.
FIRE DETECT LH RH	Engine fire detector. Circuit is energized.

EMERGENCY GENERATOR DC POWER DISTRIBUTION (2)

The following is a list of dc circuit breakers and systems receiving power from the emergency generator dc essential bus and dc monitor essential bus.

DC ESSENTIAL BUS

ATM CONT	Control of left- and right-hand ATM's. ATM overpressure protection, over pressure test, and overspeed protection.
DRAG CHUTE EMER	Power to deploy, but not to jettison drag chute.
EMER LTS	Cockpit flood lights.
ESSEN BUS CONT	Switches power source for the ac essential bus from the left-hand ac bus to the emergency generator.
FUEL CONT	Wing fuel transfer to aft tank by EMER WINGS ALT position fuel transfer switch.
GYRO HORIZ	Power for gyro horizon (VGI). AC power also required.
HORIZ STAB DC PWR	Power to slowtrim dc motor of the horizontal stabilizer actuator. DC monitor essential bus disconnected during horizontal stabilizer trimming.
IFF	Power to APX-6 IFF transponder. AC power also required.
ENG BLEED AIR	Controls left- and right-hand bleed air shutoff valves and crossover valve. Left-hand switch will also close air conditioning air supply valve.

(2) Aircraft BuNo. 142666, 142667, 144837 and subsequent.

DC MONITOR ESSENTIAL BUS

ATM SENSING	ATM temperature warning circuits and lights, temperature warning circuit and light test. ATM compartment temperature indicator LH and RH.
AIR CONDITION	
CABIN DUMP	Control of cabin pressurization through DUMP position of cabin pressure control switch.
ENG IGNITION LH RH	Controls engine ignition cycle through engine master switches.
ENG PERFORM LH RH	Fuel boost indicators and oil pressure indicators.
DUMP & PURGE	Controls dump and purge. Wing fuel transfer to aft tank by EMER WING ALT position fuel transfer switch. Wing fuel transfer to forward tank by ALT WING position fuel transfer switch. Control for gravity transfer valve and light.
INTERPHONE (ICS)	Power for transistorized interphone system.
PILOT	
PHOTO-NAVIGATOR	
PHOTO TECHNICIAN	
LOW LEVEL FUEL WARN	Power to aft tank fuel low level warning light.
AIR CONDITION TEMP PRESS	Controls air conditioning air supply valve and depressurization of cabin through ON and OFF position of cockpit temperature selector knob. Temperature control only through MANUAL HOT and MANUAL COLD positions of cockpit temperature selector knob. Control to select COMBAT or NORMAL through pressure control switch.
UHF	Power for UHF transmitter and receiver.
WHEEL & FLAP POS IND	MLG position indicators and gear handle warning light. Flap position indicator.
AIR CONDITION WINDSHIELD DEFROST	Control of windshield defrost valve.
TURN & SLIP	Power to miniature turn and slip indicator
COMPASS	Provides power for MA-1 compass.
PITOT HEAT	Uses ac power for pitot heat.
FUEL QUANT	Provides fuel quantity.
FIRE DETECT LH RH	Engine fire detector circuit is energized.
ALTM	Counter pointer altimeter is energized.
LIQUID OX	Liquid oxygen quantity circuit is energized.
IFF	Power for APX-6 IFF transponder. AC power also required.

HYDRAULIC SYSTEMS

Note

The term "hydraulic power system" as used in this manual refers to flight control surfaces (ailerons and spoilers) moved solely by hydraulic pressure on response to pilot movement of the flight controls. The term "boost," in reference to flight controls, refers to control surfaces (rudder and elevator) moved by pilot operation of the flight controls with the aid of hydraulic pressure

The aircraft is equipped with three independent hydraulic systems. A hydraulic handpump is provided for auxiliary operation of the brakes. The systems are: the main or utility hydraulic system, the surface control hydraulic systems, and the aileron hydraulic power system. The hydraulic reservoirs, reservoir pressure gages and filler valves, for both the utility and surface control systems are located in the left ATM compartments. The aileron power system reservoir, reservoir air pressure gage, system hydraulic pressure gage and the filler valve are located in the right ATM compartment. Hydraulic pressure gages for each utility system hydraulic pump and the surface control system are located in the nosewheel well. Operation of the landing gear, wing flaps, wing and fin fold, arresting hook retraction, and emergency generator retraction is accomplished through manually operated slide valves. Operation of the speed brakes, flash bomb bay doors, and JATO jettison is accomplished by solenoid operated slide control valves. Brake pedals mechanically lined to master cylinders relay pedal force as hydraulic pressure to the power brakes valves. Nosewheel steering is provided through manual control of hydraulic powered cylinders. (Refer to figure 1-28 for a schematic presentation of the hydraulic system.)

UTILITY HYDRAULIC SYSTEM

Pressure for the utility hydraulic system is supplied by two hydraulic pumps. Each pump is driven by a separate air turbine motor. After passing through separate check valves, the pressure lines from the two pumps join to form a single utility pressure supply line. Both pumps are supplied with hydraulic fluid from a single utility hydraulic reservoir. The utility hydraulic system operates at a normal pressure of 3000 psi. Either pump can supply sufficient pressure for normal operation. A partial or complete failure of either pump will have no effect on the system other than to require more time to operate the hydraulically powered units. The utility hydraulic system supplies hydraulic pressure for the normal operation of the landing gear, arresting gear, wing flaps, speed brakes, wheel brakes, flash bomb bay doors, JATO jettison, wing and fin folding, nosewheel steering, and the emergency generator actuator.

UTILITY HYDRAULIC PRESSURE WARNING INDICATOR

The utility hydraulic pressure warning indicator (8, figure 1-8) is located on the pilot's instrument panel. This indicator will read NORM when the utility system hydraulic pressure is above 1200 psi. The indicator will read OUT if the utility system pressure drops below 1000 psi or if electrical power failure occurs. When the pressure is between 1000 and 1200 psi the indicator may read either NORM or OUT.

LANDING GEAR SYSTEM

The aircraft is equipped with hydraulically actuated tricycle landing gear, fairing doors, and tail bumper. The system is normally operated by utility hydraulic system pressure. The landing gear hydraulic selector valve is manually actuated by a landing gear handle on the center console. Operation of the fairing doors, door latches, and the tail bumper is accomplished by separate actuating cylinders whose operation is timed by the landing gear sequence valves. The landing gear doors remain in the open position when the landing gear is extended. The landing gear has a maximum retraction time of 12 seconds and an extension time of 15 seconds.

LANDING GEAR CONTROL. Operation of the landing gear is controlled by a landing gear control (16, figure 1-9) on the pilot's center console. The end of the control is wheel-shaped to aid identification. The landing gear control must be left in the position selected for the gear as indicated by the two marked positions UP or DOWN. A safety latch on the control prevents inadvertent lowering of the gear and must be compressed before moving the control from the UP position to DOWN. A solenoid-operated safety lock prevents inadvertent retraction of the gear when the weight of the aircraft is on the gear. The safety lock can be manually released by pressing the solenoid release button in the landing gear control recess. (See figure 1-29.)

WHEEL POSITION INDICATORS. Wheel position indicators (11, figure 1-8) are located above and forward of the center console. These indicators reflect the position of the three landing wheels and the tail bumper. Positions are indicated as follows: by the word UP when the component is fully retracted and locked; by showing red for any position between locked up or locked down; and by presentation of a wheel when the component is full DOWN and locked.

The indicators are actuated by electrical power controlled through limit switches operated by the landing gear and the bumper when these are in the latched UP or latched DOWN position. The indicator circuit receives electrical power from the 28-volt dc essential bus through the dc instruments circuit breaker or (see figure 1-15A) from the 28-volt dc monitored essential bus through the wheel and flap position indicator circuit breaker. In the event of dc power failure, the indicator will show red.

LANDING GEAR WARNING LIGHT. A landing gear warning light is located in the end of the landing gear control. The light comes on when the handle is moved to the UP or DOWN position and remains on until the landing gear is latched up or down. A solenoid control valve and timing device has been introduced into the landing gear system which causes the tail bumper to retract fifteen seconds after touchdown. The landing gear warning light will come on when the tail bumper retracts and will remain on until the retraction release relays are deenergized. The light will not stay on while the major weight of the aircraft is on the main landing gear.

Note

Since the tail bumper will be in the retracted position, the pilot should anticipate illumination of the landing gear warning light after takeoff – between the time he breaks ground and the time the landing gear is fully retracted and latched.

EMERGENCY LANDING GEAR CONTROL. The emergency landing gear system is a dual bottle "one-shot" compressed air system. Two air bottles containing 3000 psi pressure are released simultaneously when the emergency landing gear control (17, figure 1-9) on the center console is unlatched and lowered. Actuation of the emergency landing gear control will automatically lower the landing gear control. The main gear air bottle and the gear doors air bottle are located in the right-hand ATM compartment. The air bottle pressure gages are located in the nosewheel well. When the emergency landing gear control is lowered, air pressure from the main system air bottle releases the main gear door latches, the nose gear latches, and powers the main gear actuating cylinder to extend the gear. The gear doors air bottle opens the main gear doors only. A spring-loaded bungee locks the main gear down. The nose gear falls by gravity into the down and

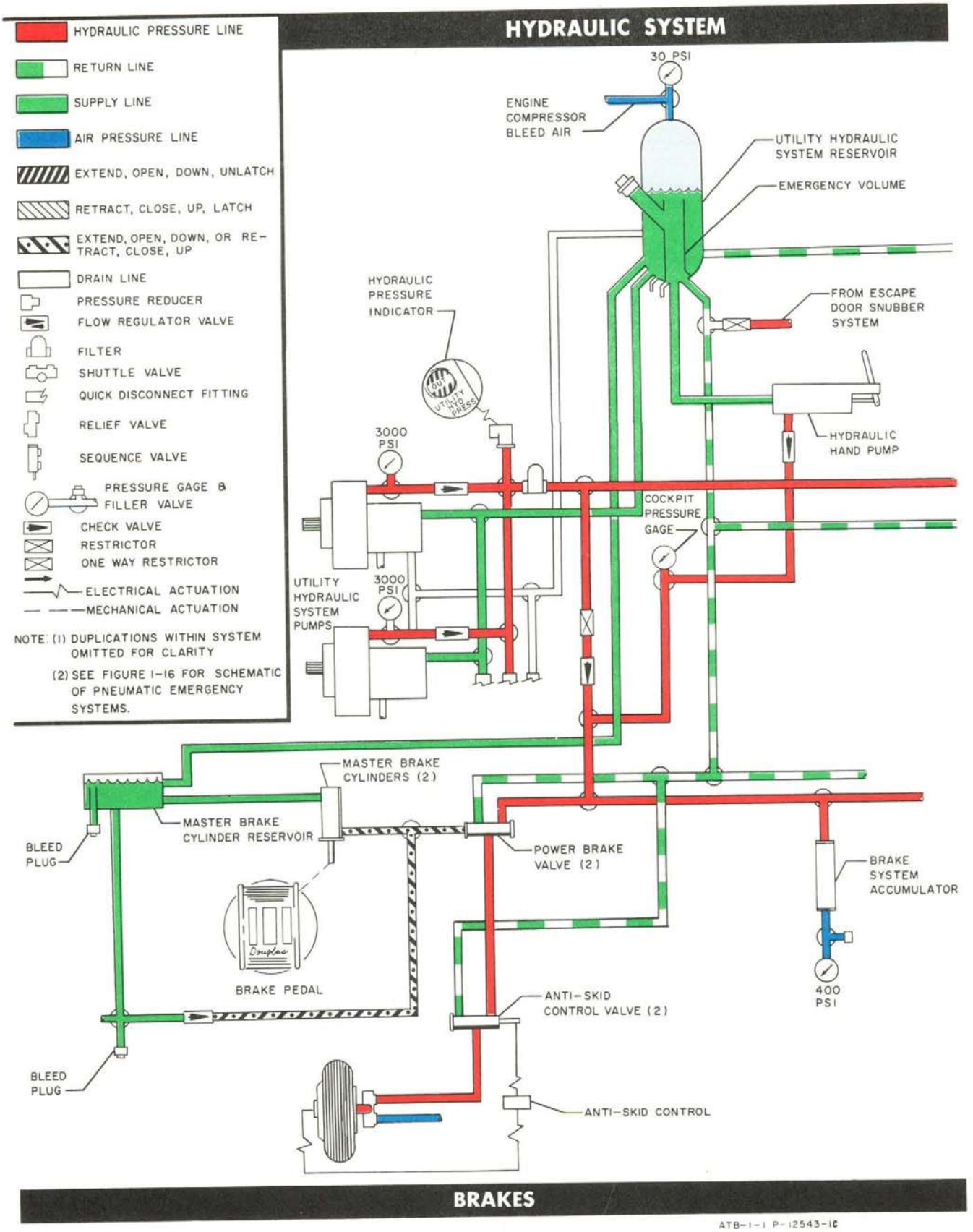


Figure 1-28. Hydraulic System (Sheet 1)

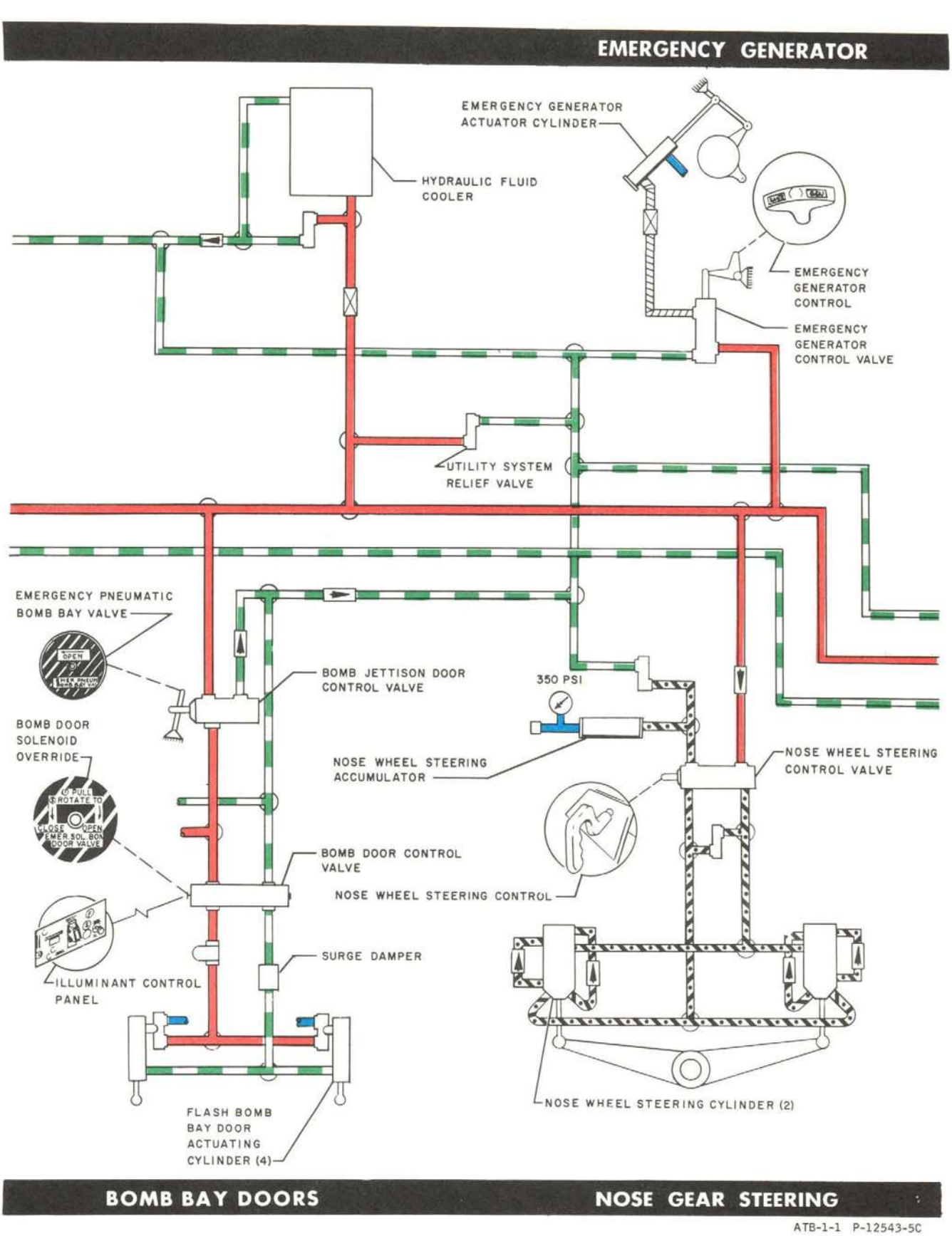


Figure 1-28. Hydraulic System (Sheet 2)

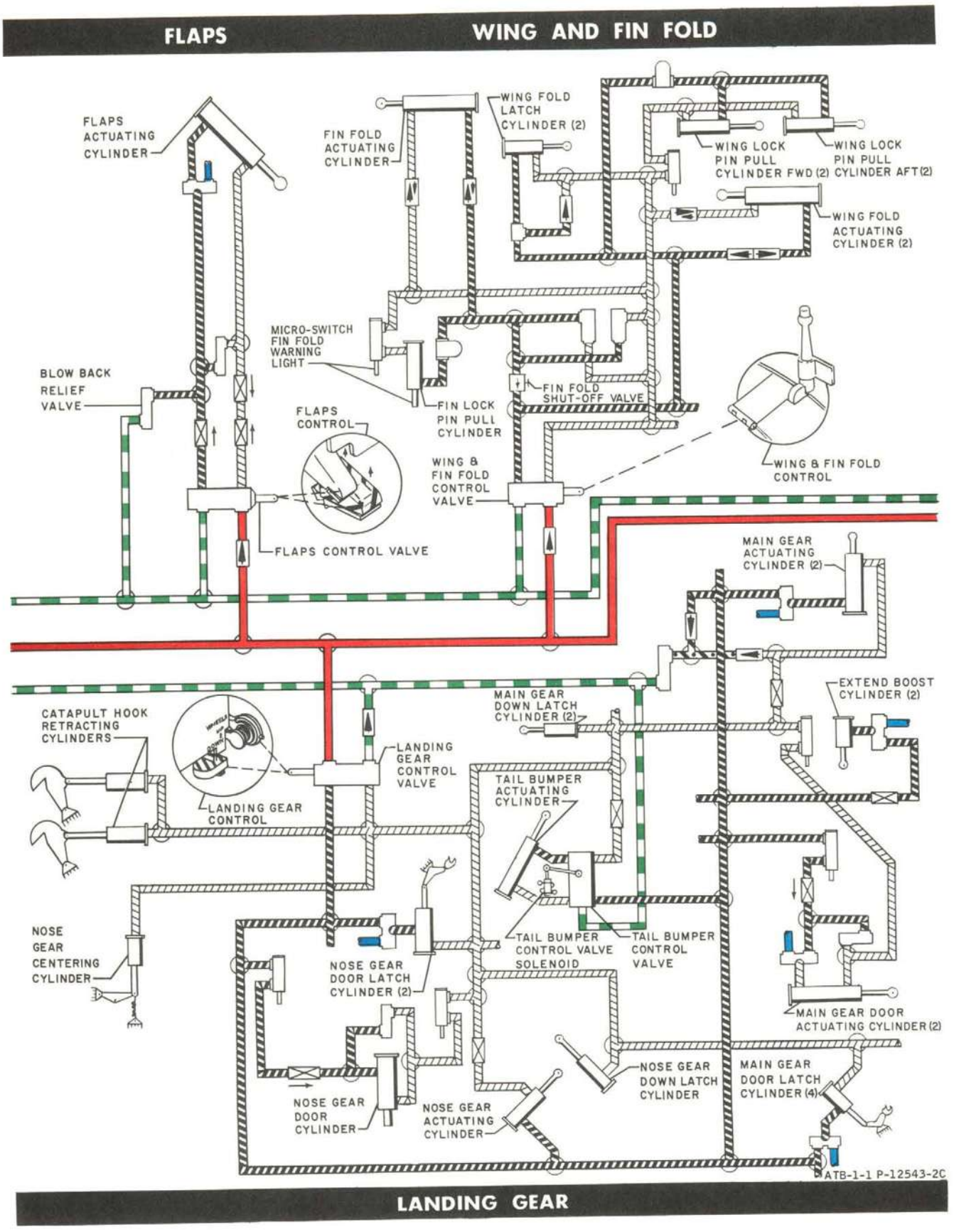


Figure 1-28. Hydraulic System (Sheet 3)

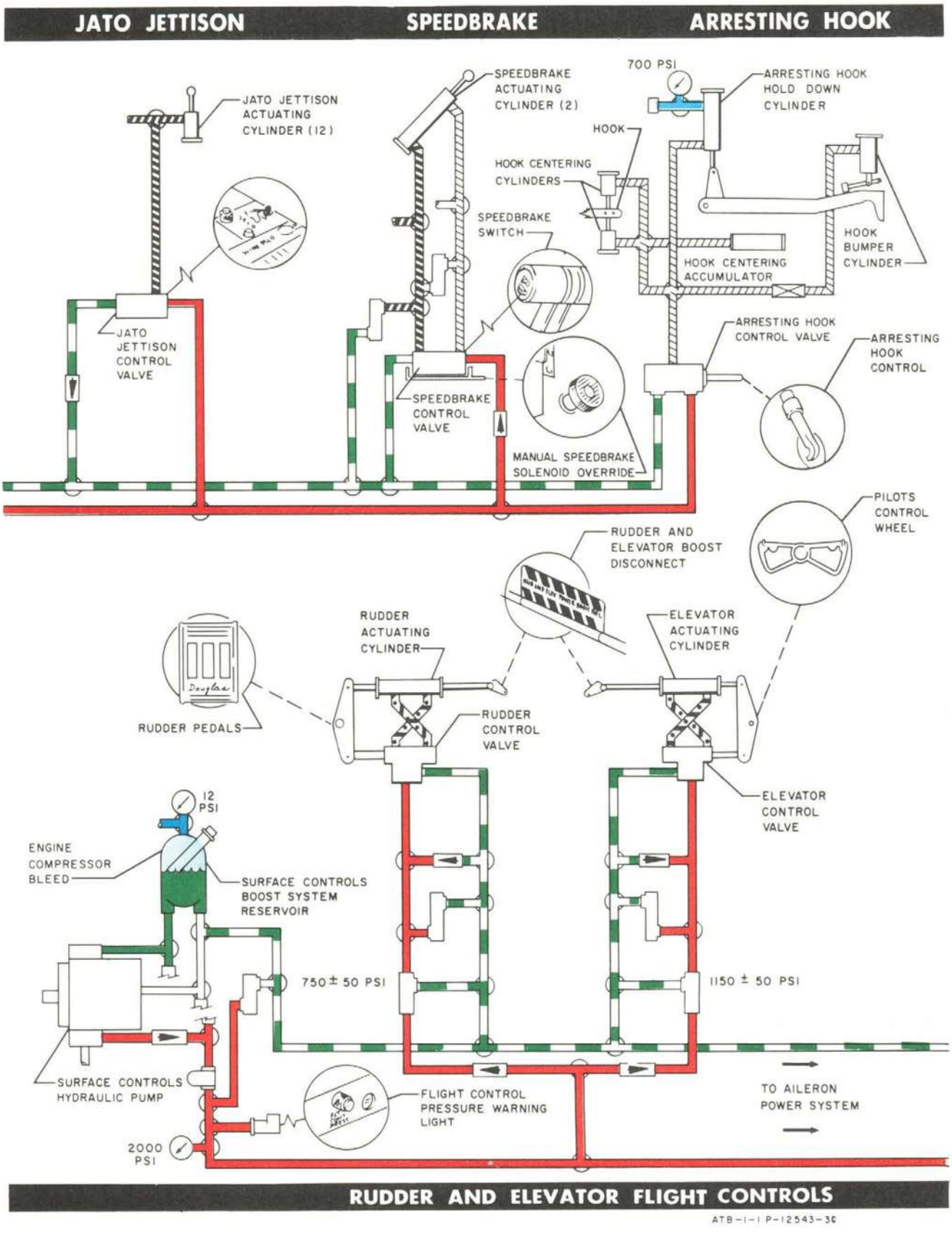


Figure 1-28. Hydraulic System (Sheet 4)

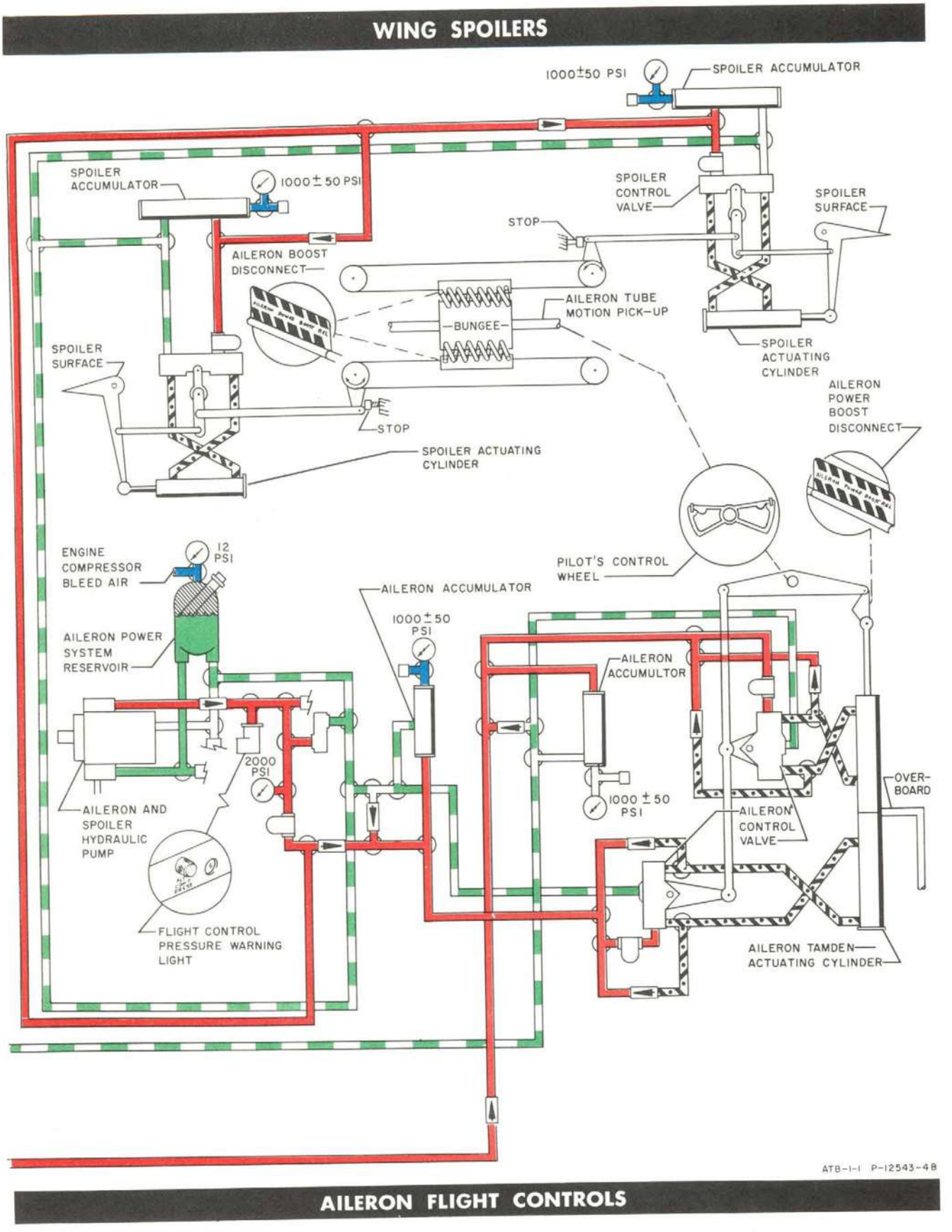


Figure 1-28. Hydraulic System (Sheet 5)

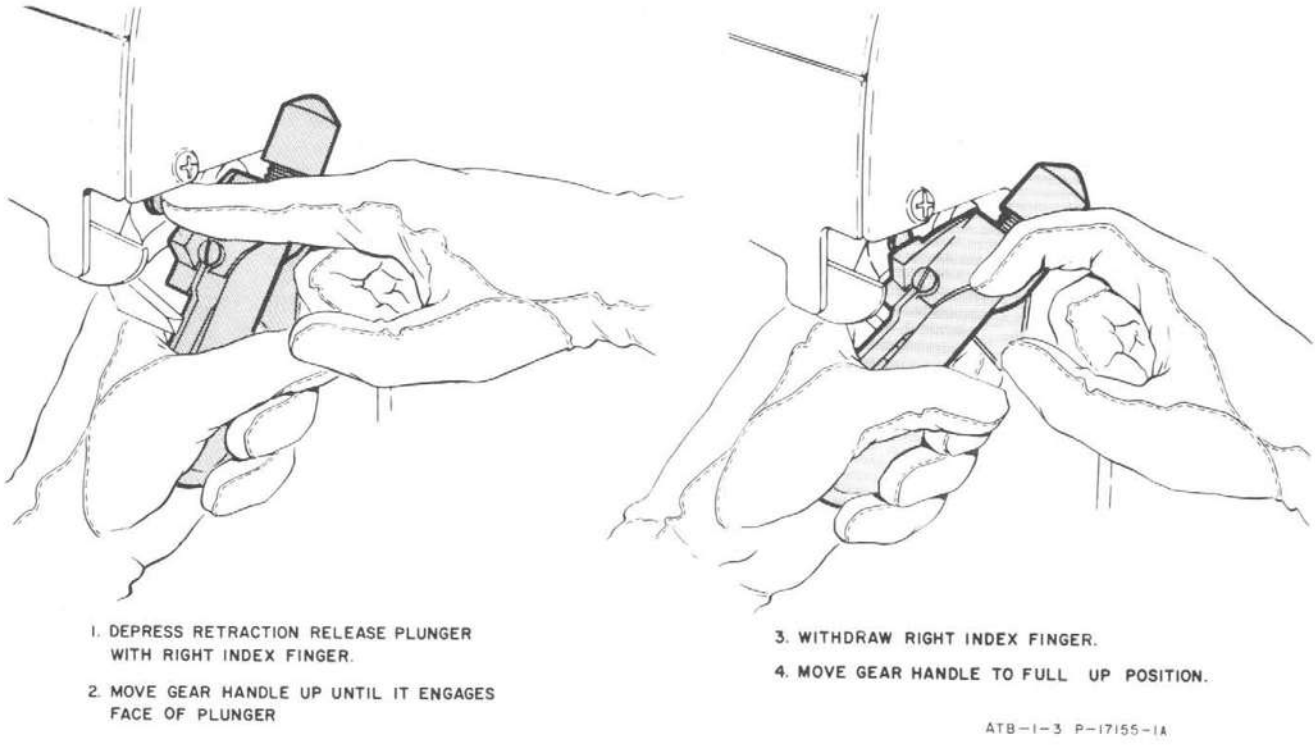


Figure 1-29. Retraction Release Solenoid Operation

locked position. The tail bumper is not extended by the emergency air bottle system, and no power is available for nosewheel steering. The gear cannot be retracted except by utility hydraulic system pressure.

WARNING

- Following emergency extension of the landing gear, do not attempt to retract the gear by raising the normal landing gear control. This action prior to bleeding air from the system can result in a rupture of the hydraulic reservoir.
- Do not return system to normal control until hydraulic pressure is restored in the brakes. In order to prevent air from entering the brake lines through the shuttle valves, depress the brake pedals and generate hydraulic pressure in the system with the handpump. Hold brake pedals depressed until all air is exhausted from the system; then return emergency brake handle to the normal position.

WING FLAPS

The airplane is equipped with single slotted-type wing flaps (9, figure 1-4) which extend from the fuselage to the inboard edge of the ailerons. The flaps are normally operated by utility system hydraulic pressure by means of the flaps control on the center console. The flaps control mechanically positions a slide valve to supply hydraulic pressure to raise or lower the flaps. A blowback relief valve in the flaps control system allows the flaps to blow back when the air load against them exceeds the hydraulic extending force. With the flaps fully extended (36^{O}), blowback begins between 215 and 250 knots indicated airspeed. In normal operation the flaps require 7 to 10 seconds to extend fully and 20 to 25 seconds to retract from the full down position.

WING FLAPS CONTROL. The wing flaps are normally raised and lowered by the flaps control (18, figure 1-9) on the center console. The control has three marked positions: UP, STOP, and DOWN. The STOP position is used to stop flap travel to obtain partial flap settings.

WING FLAPS POSITION INDICATOR. The flaps position indicator (40, figure 1-8) is located on the pilot's instrument panel and is marked in increments of one quarter of full flap travel.

EMERGENCY WING FLAPS CONTROL. An emergency pneumatic system is provided for extension of the flaps in the event of utility hydraulic system failure. The compressed air bottle for the system is located in the right-hand ATM compartment. The air bottle pressure

gage is located in the nosewheel well and should normally read 3000 psi. When the emergency flaps control (19, figure 1-9) on the center console is lowered it opens the control valve of the system air bottle, permitting compressed air to extend the flaps full down. Actuation of the emergency flaps control will automatically lower the flaps control. The flaps cannot be retracted after extension by this system until the air system is completely bled of all pressure by moving the emergency flaps control to the UP position. Then hydraulic pressure, if available, can be used to retract the flaps. If pressure is not available the flaps will blow back to a trail position.

CAUTION

Following extension of the flaps by emergency system air, do not actuate the normal hydraulic flaps control until the emergency flaps control has been returned to the UP position and a 20-second interval allowed for air to exhaust. Failure to observe this precaution can cause a rupture of the hydraulic reservoir.

SPEEDBRAKES

The speedbrakes (54, figure 1-4) are located on the aft fuselage and are actuated by utility hydraulic system pressure. The selector valve for speedbrakes is electrically controlled through a solenoid which is powered by the 28-volt dc bus through the hydraulics circuit breaker of the pilot's circuit breaker and fuse panel (figure 1-15A). The speedbrakes may be extended to the full open position only, except when the airspeed is above the speedbrake blowback speed (590 KIAS). Above this speed, the speedbrakes will extend to a point where the extending hydraulic pressure and the air load against the brakes counterbalance. There is no airspeed restriction on opening or closing the speedbrakes. No emergency system other than the solenoid override is provided for extension of the speedbrakes. No extension is possible without utility hydraulic system pressure.

SPEEDBRAKE SWITCH. The speedbrake switch (35, figure 1-9) is located on the left-hand throttle. The switch has two positions: OPEN and CLOSE. Moving the switch to OPEN starts the opening cycle which is automatically completed unless the cycle is reversed by placing the switch in the CLOSE position. The switch will remain in the position selected. This feature allows the position of the speedbrakes to be checked merely by reference to the speedbrakes switch position.

WARNING

After energizing the 28-volt dc bus and before obtaining hydraulic pressure, place the speedbrake switch in the position corresponding to the positions of the speedbrakes. Otherwise, the brakes may open or close, endangering personnel in the area of the brakes.

EMERGENCY SPEEDBRAKE CONTROL. The speedbrake solenoid valve is mounted in the bomb bay and, in the event of electrical failure, may be operated manually. The emergency solenoid speedbrake valve (see figure 8-29) located on the aft camera compartment bulkhead is used for manual operation of the solenoid. Placards on the control knob describe the emergency manual operation as follows: PULL, ROTATE TO CLOSE or OPEN.

WHEELBRAKES

Hydraulically operated wheelbrakes are provided for the main landing gear only. They are conventionally controlled by toe pressure on the upper portion of the rudder pedals. The pedals are mechanically linked to master cylinders, which relay the pedal force as hydraulic pressure to the power brake valves. The master brake cylinders are supplied with fluid from a separate brake reservoir within the utility hydraulic reservoir. The wheelbrake system is powered by the utility hydraulic system when either ATM is running. For operation of the brakes following loss of utility system pressure, a hydraulic handpump and an emergency pneumatic system are provided.

The wheelbrake system is very sensitive without the antiskid system in operation. With the antiskid system operating, the pilot can apply maximum toe pressure on the rudder pedals without fear of skidding the tires. Without the antiskid system, toe pressure should be applied judiciously to prevent skidding and blowouts. It is advisable that pilots become familiar with the effectiveness of the normal braking system by deactivating the antiskid system and conducting several taxi runs. In this manner the pilot can become cognizant of the proper technique required to stop the aircraft without damaging the tires or wheels, should the antiskid system ever fail during landing. The landing gear should be left extended to provide additional cooling if repeated take offs and landings are necessary. The operating temperature of the brake components may become excessive if caution is not used in braking the aircraft while taxiing. Allow a cooling period of at least two hours between aborted take offs, taxi tests, or normal landing without drag chute.

CAUTION

The antiskid brake switch should remain OFF during all carrier operations.

HYDRAULIC HANDPUMP. A hydraulic handpump (see figure 1-6) is located on the cockpit floor adjacent to the pilot's seat. This pump supplies hydraulic pressure for brake operation when neither ATM is running. Through a check valve, the handpump system hydraulic line joins the utility brake system and utilizes the utility brake system accumulator, valves, and brake cylinders. When the handpump is used to build up a pressure of 1500 psi on the brake system pressure gage, three applications of the brakes may be made. The handle (21, figure 1-6) for operation of the hydraulic handpump is either mounted in the pump socket under the pilot's seat or is stowed under the photo-technician seat.

CAUTION

Do not attempt ground or deck handling of the aircraft unless the brake system is pressurized to 1500 psi minimum.

BRAKE SYSTEM HANDPUMP HYDRAULIC GAGE. The brake system handpump hydraulic gage (20, figure 1-6) is located on the cockpit floor slightly forward of the handpump handle. Handpump hydraulic pressure is shown on the gage when neither ATM is running and the handpump is used. (Refer to Utility Hydraulic System Failure in this part.)

EMERGENCY BRAKE CONTROL. The emergency brake control system utilizes a 3000 psi compressed air bottle to provide emergency wheelbrake pressure. This pressure is available for use when the emergency air brakes handle (45, figure 1-8) on the lower right side of the pilot's instrument panel is pulled. Brakes may then be applied in the normal manner by use of the brake pedals. Individual braking of the right and left wheels is provided by means of pneumatic brake control valves controlled by the right and left rudder pedals. At an initial pressure of 3000 psi, three or more applications of the brakes are possible. The pressure available will diminish with each application.

Note

- Apply pedal force gradually until the desired braking effect is obtained. Avoid frequent pumping to prevent rapid depletion of the air supply.
- Antiskid detection is not available with the emergency brake control system.
- Air must be bled from the brakes after using the emergency air system before reverting to hydraulic system braking.

The emergency brakes air bottle pressure gage is located in the nosewheel well. The compressed air bottle is located in the right-hand ATM compartment.

ANTISKID SYSTEM. The wheelbrake system is supplemented with a Hytrol antiskid system. This equipment is effective in preventing blowouts through its skid-detection and metered pressure control, and also provides greater braking efficiency. It is recommended that normal pedal applications be used to preclude excessive skid in the event of an antiskid system malfunction. The Hytrol equipment applies control in the braking operation by relieving pressure when either of the main landing gear wheels begins to approach a skid condition. A flywheel mechanism, attached to each wheel, senses the rate of change of wheel rotational speed, and actuates a double pole switch to furnish either a skid or a recovery signal, depending on which way the switch is moved. The antiskid switch (46, figure 1-8) on the pilot's instrument panel must be ON to energize the antiskid system. In case of antiskid system malfunction, the pilot should immediately release brake pressure then place the switch in the OFF position, which deactivates the system by disconnecting the electrical supply.

CAUTION

Braking should not be applied until both main wheels are firmly on the runway. Full braking can be used down to 50 knots. Below 50 knots wheel skid detector units are less sensitive; less than full braking should be used, or blowouts can occur.

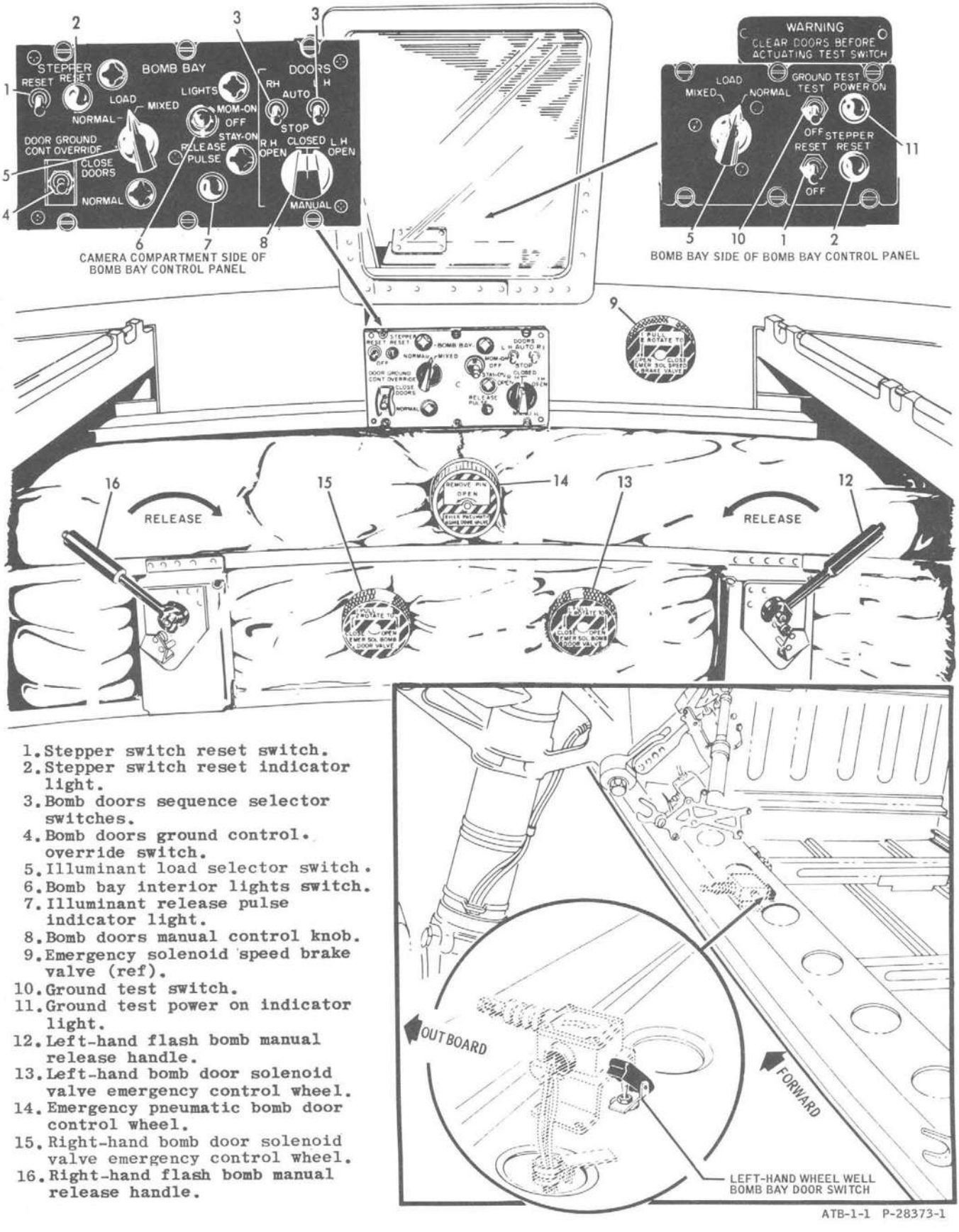
BOMB BAY DOORS

Operation of bomb bay doors, which are actuated by utility hydraulic system pressure, is described under ILLUMINANT SYSTEM in Section VIII.

EMERGENCY BOMB BAY DOORS CONTROL. Emergency bomb bay doors control is described under BOMB BAY EMERGENCY CONTROLS in Section VIII. (For locations of controls, see figure 1-30.)

JATO JETTISON SWITCH

The JATO jettison switch (5, figure 1-9) is located adjacent to the JATO arming switch (6, figure 1-9) on the center console. The switch has two positions: SAFE and JETTISON. In the JETTISON position, the switch energizes a solenoid controlled hydraulic selector valve that supplies pressure to the JATO mounting hooks actuating cylinders. The mounting hooks are actuated to release all the JATO bottles simultaneously.



1. Stepper switch reset switch.
2. Stepper switch reset indicator light.
3. Bomb doors sequence selector switches.
4. Bomb doors ground control override switch.
5. Illuminant load selector switch.
6. Bomb bay interior lights switch.
7. Illuminant release pulse indicator light.
8. Bomb doors manual control knob.
9. Emergency solenoid speed brake valve (ref).
10. Ground test switch.
11. Ground test power on indicator light.
12. Left-hand flash bomb manual release handle.
13. Left-hand bomb door solenoid valve emergency control wheel.
14. Emergency pneumatic bomb door control wheel.
15. Right-hand bomb door solenoid valve emergency control wheel.
16. Right-hand flash bomb manual release handle.

Figure 1-30. Bomb Bay Controls

CAUTION

JATO bottles should be jettisoned as soon as possible after takeoff, in a level flight attitude, with the flaps full down, and at airspeeds below 200 KIAS. JATO bottles can be carried safely at speeds up to 300 KIAS, but not jettisoned above 200 KIAS.

WING AND FIN FOLD

The wings and fin are folded and spread by hydraulic pressure from the utility hydraulic system. Hydraulically actuated wing locking pins are safetied by a mechanically operated mechanism which also controls extension and retraction of the wing and fin fold warning flags.

CAUTION

The maximum relative wind for operation of wing and fin fold is 50 knots.

GUST AND WING PIN LOCK HANDLE. The gust and wing pin lock handle (8, figure 1-9) on the center console controls the gust locks and the wing and fin locking pin safety latches. The handle has detents in the vertical and horizontal positions and is released from either detent position by a release button (7, figure 1-9) on the end of the handle. The gust and wing pin lock handle is mechanically interconnected with the wing fold control lever (37, figure 1-9), and operation of either control is dependent upon the position of the other control. The horizontal position of the gust and wing pin lock handle mechanically engages the gust locks and releases the wing and fin locking pin safety latches. The wings and fin may then be folded. Release of the wing and fin locking pin safety latches is accompanied by mechanical extension of the wing fold warning flags, located at the lower forward inboard section of each wing at the hinge point, and the fin fold warning flag, located on the forward right-hand side of the fin below the hinge point. The vertical position of the gust and wing pin lock handle releases the gust locks and engages the wing and fin locking pin safety latches. Movement of the wing and fin locking pin safety latches to the full lock position causes mechanical retraction of the wing and fin fold warning flags. The gust and wing pin lock handle can not be placed in the vertical position until the wings and fin have been spread. While in the horizontal position, the handle forms a barrier to prevent the throttles from being moved into the takeoff power range. For engine runup with the wings folded, the spring-loaded barrier tab may be lifted to make full throttle travel possible.

WING AND FIN FOLD CONTROL LEVER. The wing fold control lever (37, figure 1-9), on the center console controls the hydraulic folding and spreading of the wings and vertical fin. Placing the wing fold lever in the vertical position causes the unlatched locking pins to be pulled and the wings and fin to be folded; when the lever is positioned horizontally, the wings and fin are extended and the locking pins are engaged. Through a mechanical interlock with the gust and wing pin lock handle, the wing fold lever is prevented from being moved to either the vertical or horizontal position out of the proper sequence. (Refer to Gust and Wing Pin Lock Control in this section.) In addition, limit switches (at the ailerons, rudder and elevators gust locks) prevent the wing and fin fold control lever solenoid from being energized until the control surfaces are centered and locked. The system uses utility hydraulic system pressure controlled by a manually operated slide valve. A fin fold shutoff valve, accessible to ground personnel through the aft compartment access door, permits folding and spreading the wings while the fin is secured erect.

FIN-UNLOCKED INDICATOR LIGHT

The fin-unlocked indicator light (5, figure 1-7) is located on the pilot's left-hand console. Two microswitches, located one each on the fin lockpin pull and fin-fold latch cylinders, activate the light when the fin is not erect, latched and the fin lockpin secured.

AUTOMATIC JURY STRUT. The aircraft is equipped with a locking device in the wings that eliminates the need for a jury strut. The operation of this locking device is controlled by the wing and fin fold control lever (37, figure 1-9) on the center console. This locking device consists of a latch roller in the outboard wing and a latch hook and overcenter linkage located in the inboard wing.

NOSEWHEEL STEERING

The steerable nosewheel provides directional control through 79 degrees to either side of center during ground operation. Operation of the nosewheel steering system is controlled by a handle (7, figure 1-6) on the pilot's left console. This handle, through mechanical linkage, positions a control valve to direct utility hydraulic system pressure to two double acting hydraulic cylinders. Due to the caster angle of the nosewheel strut, the steering control handle must be held in the position that will give the desired rate of turn. The nosewheel is automatically centered and the steering control is locked by utility hydraulic gear up pressure when the landing gear control is placed at UP. When the arresting hook is extended, a centering detent in the nosewheel steering linkage is engaged to prevent nosewheel swivel during arrested landings. The nosewheel steering system is provided with an accumulator which supplies hydraulic fluid pressure to the control cylinders for nosewheel shimmy dampening. The nosewheel is free to caster when the steering system is not operated.

CAUTION

- Do not restrain nor even touch the nosewheel steering handle at the time of touchdown during landings. The steering handle must be free to swivel as the nosewheel casters to prevent possible damage from extreme loads which would be imposed on the nose gear scissor linkage if the handle were restrained.
- Pressure is not available for operation of nosewheel steering when the airplane is operated without utility hydraulic pressure. An attempt to use the system under this condition may produce an undesirable shimmy of the nosewheel due to a lack of damping action of the nose gear steering cylinders.

ARRESTING HOOK

An arresting hook (53, figure 1-4) of conventional design and operation is provided for carrier operations. The hook is unlatched mechanically and free-falls to the down position. An arresting hook holddown unit, consisting of an air chamber containing 675 to 700 psi air pressure, an air pressure gage, and an air filler valve, is utilized to increase the force and rate of extension and for snubbing the hook. The hook is retracted by 3000 psi utility hydraulic system pressure through the holddown cylinder and is latched mechanically.

ARRESTING HOOK CONTROL. The arresting hook control (34, figure 1-9) is located on the left-hand side of the center console. The control is hook-shaped for identification. Movement of the control to the HOOK DOWN position mechanically releases the hook up-latch and actuates the hydraulic selector valve to relieve hydraulic pressure in the actuating piston, allowing the hook to extend by free-fall even when the air chamber is not charged. Air pressure through the holddown unit holds the hook down to prevent hook bounce on landing. A spring-extended and hydraulically retracted hook bumper acts to absorb hook impact during arrestment. Extension of the hook locks the nosewheel in the centered position. A fail-safe mechanism allows the hook to extend if the up-latch control cable is severed. A warning light at the end of the arresting hook control comes on when the hook control is moved to the HOOK DOWN position, and goes off when the hook is unlatched. There is no indication of hook position during the retracting cycle after the hook control has been placed at HOOK UP.

UTILITY HYDRAULIC SYSTEM FAILURE

Failure of the utility hydraulic system will be indicated by OUT in the utility hydraulic pressure "flip-flop" indicator and will result in loss of the following systems:

1. Landing gear extension and retraction
2. Speedbrake operation
3. Nosewheel steering
4. Wing/fin fold
5. JATO jettison
6. Tail hook retraction
7. Normal and handpump braking system (with and without antiskid).

(For emergency procedures, refer to Section V.)

Note

The brake pressure gage shows the maximum pressure imposed on the brake system and will remain at the highest pressure attained. Until brake pedals are tapped to reduce this pressure, the gage should not be relied upon as a utility hydraulic pressure gage.

PNEUMATIC EMERGENCY SYSTEM

Compressed air bottles are provided for the emergency operation of the following systems: landing gear doors, landing gear extension, wing flap extension, emergency generator extension, flash bomb bay door opening, and brake operation. (For emergency operating procedure refer to the individual systems in Section I and Section V. For a schematic presentation of the pneumatic emergency system, refer to figure 1-31.)

CAUTION

Following pneumatic emergency operation of a system, air must be exhausted from lines before normal hydraulic controls are actuated. Failure to follow this sequence can cause rupture of the system hydraulic reservoir.

FLIGHT CONTROLS

The aircraft is equipped with conventional flight controls operated from a single station in the cockpit. Two hydraulic systems are provided to reduce the control force required in high speed flight. Trim is provided by a trim tab on the rudder, a controllable horizontal stabilizer, and an aileron force trim mechanism. Wing slats are provided to delay the loss of lift and aileron control at high angles-of-attack. To

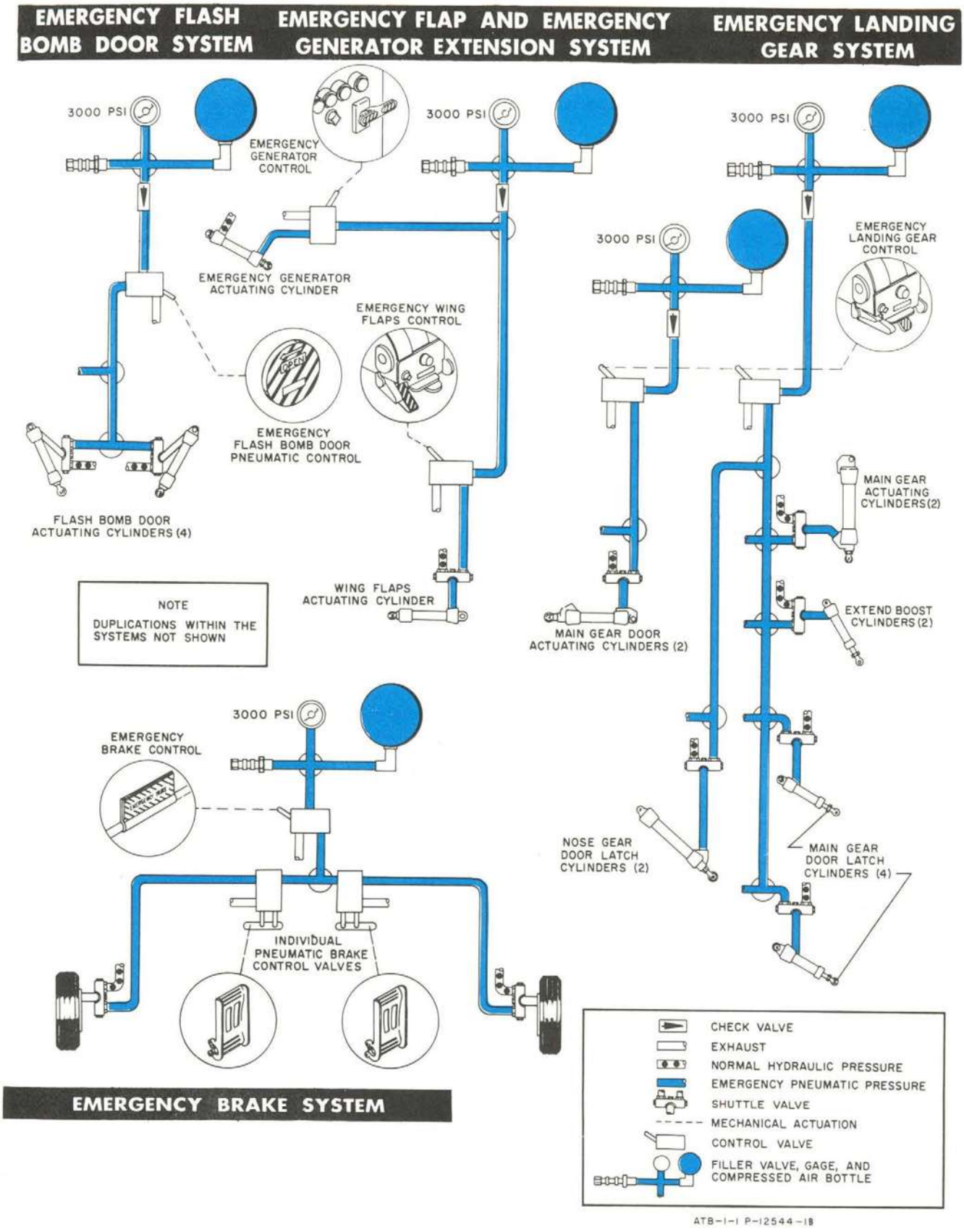


Figure 1-31. Pneumatic Emergency System

eliminate aerodynamic buzz of the ailerons, elevator, and rudder at high speeds, an independent self-contained snubber system is provided for each of these controls. Wing spoilers, powered by the aileron hydraulic power system, aid in lateral control. Provisions are made to disconnect the hydraulic systems from the flight controls.

Note

Neither the aileron hydraulic power system nor the rudder-elevator power boost system can be reconnected in flight.

SURFACE CONTROL HYDRAULIC SYSTEM

The elevator and rudder controls and one-half of the aileron tandem power system are provided with hydraulic pressure by the left-hand ATM driven, constant speed surface control system hydraulic pump. The 2000-psi pressure from the pump is used to provide a boost ratio of 7:1 to the rudder and a boost ratio of 10:1 to the elevators. Hydraulic fluid for the surface control system is supplied from a reservoir located in the left ATM compartment. A flight control hydraulic pressure warning light (7, figure 1-8) will come on if the surface control system pressure drops below 1000 psi. The surface control hydraulic system can be mechanically disconnected from the rudder and elevator by pulling the rudder and elevator boost release handle (44, figure 1-8), located on the lower center of the pilot's instrument panel. (Refer to Flight Controls in Section IV.)

RUDDER CONTROL

The rudder is controlled by conventional rudder pedals. Rudder pedal force is transmitted through a hydraulic boost system, which provides a 7:1 boost ratio to the rudder. Hydraulic pressure from the surface control system passes through a pressure reducer to provide 750 psi to the rudder boost system. The rudder hydraulic boost can be disconnected by pulling the rudder and elevator power boost release handle (44, figure 1-8) on the lower center of the pilot's instrument panel.

Note

Rudder-elevator boost cannot be reconnected in flight.

RUDDER TRIM CONTROL. The rudder is provided with an electrically actuated trim tab, electrically controlled by a rudder trim control switch (33, figure 1-9) on the center console. The switch, labeled NOSE, has two marked positions, LEFT and RIGHT, and is turned and held in the direction of the desired trim, to trim rudder pedal forces to zero for all normal flight conditions. When the switch is released the trim tab will remain fixed in position.

ELEVATOR CONTROL

The elevators are of conventional design and are controlled through the pilot's control column. The surface control hydraulic system, through a pressure reducer set at 1150 psi, provides a boost pressure ratio of 10:1 to the elevators. To prevent excessively fast pullups, which would impose dangerous loads on the wings, a bobweight has been added to the elevator mechanical linkage. This synthetic load increases at the rate of 5 pounds per g during pullups. The boost system can be disconnected from the elevator controls by pulling the rudder and elevator boost release handle (44, figure 1-8) on the lower center of the pilot's instrument panel. Disconnecting the boost system does not release the hydraulic flutter damper. Electrically heated blankets have been added for the elevator boost mechanism located in the fin structure. These blankets are installed for the purpose of preventing icing of the mechanism at high altitudes and low temperatures, and keeping the viscosity of the hydraulic fluid more nearly constant. The blankets are heated by phase-B current from the left-hand generator ac bus through the elevator boost circuit breaker on the companionway circuit breaker and fuse panel (see figure 1-15A). Elevator control characteristics are described in Section IV ■

STABILIZER TRIM CONTROL

Elevator forces are trimmed out by a controllable horizontal stabilizer, which provides longitudinal trim through a range of 3 degrees nose down and 10-1/2 degrees nose up. Movement of the stabilizer is controlled by the horizontal stabilizer ac control switch (8, figure 1-6) on the pilot's control column or by a horizontal stabilizer trim control (31, figure 1-9) on the center console. Both controls have momentary positions, NOSE UP and NOSE DOWN. The trim control switch has five positions: off (center); dc nose up and dc nose down (first detents offcenter); ac nose up and ac nose down (second detents offcenter). The switch on the control column provides fast-rate ac adjustment only. In order to assure power for the longitudinal trim, the slow rate system is powered from the dc bus and the high rate system is powered from the ac bus. The control column switch controls the ac high-speed trim motor through a dc powered relay; the trim control fast-rate position is mechanically linked to the trim motor control. Therefore, should the control column switch fail, trim control will still be available through the console switch high rate position. The console switch will override the control column switch. With ac trim failure, dc trim will be available through the console trim switch in any position.

Note

When emergency generator is extended, only dc trim will be available, even when console switch is in second (ac) detent.

CAUTION

To avoid overheating the horizontal stabilizer trim motor during ground operation, observe the following precautions:

1. Fast rate. Maximum period of steady operation is 20 seconds. Allow 4 minutes for cooling. If the maximum period is repeated for another 15 seconds, allow 15 minutes for cooling.

2. Slow rate. Maximum period of steady operation is 40 seconds. Allow 4 minutes for cooling before resuming operation.

If the aircraft is to be secured for an extended period, the horizontal stabilizer should be actuated to the full noseup position to retract the jackscrew and lessen the possibility of corrosion. This procedure is not recommended for routine post flight shutdown. (For stabilizer trim characteristics, refer to Trim Devices, in Section IV.)

AILERON HYDRAULIC SYSTEM

Hydraulic power for operating the ailerons is supplied by two independent hydraulic pressure systems. One half of the aileron tandem actuating cylinder is powered by the surface control hydraulic system. The other half of the tandem cylinder is powered with pressure from the aileron system hydraulic pump. The aileron system hydraulic pump is driven by the right-hand ATM and provides 2000 psi to the system. Fluid for the aileron system hydraulic pump is supplied from a reservoir in the right-hand ATM compartment. Aileron system pressure is also used to operate the wing spoilers. Both the aileron tandem actuating cylinder and the spoilers can be mechanically disconnected from the aileron control by pulling the aileron power boost release handle (42, figure 1-8), located on the lower left side of the pilot's instrument panel. (Refer to Flight Controls in Section IV.)

AILERON CONTROL - HYDRAULIC POWERED

The ailerons are controlled by the pilot's control column in the cockpit (see figure 1-6). For all normal operation, hydraulic pressure, supplemented by accumulator pressure, is used to move the ailerons. Pressure for aileron hydraulic power operation is supplied by two independent hydraulic systems to a tandem actuating cylinder. The tandem cylinder houses two pistons acting on a single rod. One piston is powered by 2000-psi pressure from the aileron control hydraulic system. The second piston is powered by 2000-psi pressure from the surface control hydraulic system. The aileron power system does not permit feedback of air loads to the control column. This feedback is simulated by a load-feel bungee incorporated in the aileron linkage. Loss of hydraulic pressure to either side of the tandem actuating cylinder, with resultant loss of half of the effective aileron deflecting force, will reduce the maximum available roll rate, especially at high airspeeds (500 knots) and in the landing configuration. At airspeeds in excess of 500 knots, loss of aileron control hydraulic pressure, which also powers the wing spoilers, may, due to wing twist, give a roll response opposite to that normally obtained; that is, left wheel may give right roll. Pilots should avoid high airspeeds with spoilers inoperative. Following loss of hydraulic pressure to both sides of the cylinder, the accumulator will provide pressure for two or three full-travel deflections of ailerons.

AILERON CONTROL - MECHANICAL

For emergency operation following dual hydraulic system or mechanical failure, the tandem actuating cylinder can be disconnected from the aileron controls (refer to Flight Controls in Section IV) by pulling the aileron power boost release handle (42, figure 1-8) on the lower left side of the pilot's instrument panel. When the handle is pulled:

1. Ailerons are linked solidly to control column through a mechanical advantage changer, which doubles effective control column torque.

2. Linkage permits feedback of aileron air loads to control column.

3. Spoiler system is inoperative.

4. Aileron trim control is not available. Lateral trim must be held in with control column. (Refer to Boost-Off-Flight in Section IV.)

AILERON TRIM CONTROL

Because the aileron control system is irreversible, aileron trim is accomplished without the use of conventional trim tabs. Actuation of the aileron trim control switch (15, figure 1-9) on the center console causes the neutral position of the pilot's control column to be relocated, thus repositioning the simulated airload at the control column and positioning the ailerons to trim the aircraft about the roll axis. The aileron trim position indicator (28, figure 1-8) is calibrated to show aileron displacement in terms of control column displacement. (For aileron trim characteristics, refer to Trim Devices in Section IV.)

WING SPOILERS

The ailerons are operated by an irreversible dual hydraulic power system; the spoilers are operated by one-half of this dual system. Control feel is artificially

furnished by a load-feel bungee. In the event of a failure of one of the completely independent power systems, one-half of the full-power output of the aileron tandem actuating cylinder will be lost. The spoilers may remain operative or become inoperative, depending on which half of the dual aileron system fails. When inoperative, the spoilers remain faired. With the spoilers operative, the loss of one-half of the power output of the ailerons will have little effect on lateral control; with the spoilers inoperative, lateral control effectiveness decreases but is considered adequate up to speeds approaching 500 knots. Manual operation of the ailerons, at a mechanical advantage of 2:1 over the no-boost ratio, is provided when the aileron power boost release handle is pulled. If, as a result of a double failure, it becomes necessary to revert to manual operation, lateral control characteristics at low speed should be investigated at a safe altitude prior to landing. The approach and landing with the manual control system should be made at speeds higher than normal. Pulling the aileron power boost release handle disconnects the load-feel bungee, the tandem cylinder, the spoilers, and the aileron force trim mechanism, making it necessary for the pilot to hold in the aileron trim desired.

WING SPOILER CONTROL

The wing spoilers (10, figure 1-4) are powered by the right-hand ATM hydraulic system supplemented by accumulator pressure, and controlled by the pilot's control wheel. Movement of the aileron push-pull tube by the aileron tandem actuating cylinder in the center wing is transmitted through two bungees and a cable system to the spoiler control valves. The spoilers operate from the faired position in an upward direction only.

Movement of the pilot's control wheel approximately 20 degrees to the left of neutral causes the left spoiler to open in proportion to the displacement of the control wheel while the right spoiler remains in the faired position. Displacement of the pilot's control wheel to the right of neutral reverses this movement. Since the wing spoiler system is a hydraulic power system, no air loads on the spoilers are transmitted back to the pilot's control wheel. If the aileron tandem actuating cylinder is disconnected by pulling the AILERON BOOST REL handle, the spoilers are mechanically disconnected at the aileron tube motion pickup. In the event of hydraulic failure, the spoilers automatically move to and remain in the faired position.

FLIGHT CONTROL SYSTEM FAILURES

Flight control system failure causative factors may be classified in two major categories: failure within the flight control system itself; or failure of a flight control system as a result of failure within another system. The first category includes hydraulic selector valve failure and mechanical failure of cranks, rods, bearings, cables, etc. The second category includes hydraulic pump failure, ATM failure due to internal damage, ATM failure or shut down due to compressor bleed air over-pressure or over-temperature, and ATM stoppage due to loss of compressor bleed air following duct rupture or dual engine failure or flameout. As a general rule, whenever a failure affecting either flight control hydraulic system occurs, terminate any accelerated maneuver, reduce airspeed, and make an assessment of the nature of the failure before employing one of the emergency procedures described in Section V.

EMERGENCY STABILIZER TRIM CONTROL. Certain aircraft (see figure 1-23) are provided with a two-position horizontal stabilizer dc trim power supply switch (29, figure 1-9). Through this, dc horizontal stabilizer trim may be utilized when operating with the emergency generator extended. With the emergency generator retracted and this switch positioned at NORMAL, power is supplied to the dc horizontal stabilizer trim motor from the 28-volt dc bus whenever the console trim knob is placed in the slow-rate positions. When the emergency generator is extended and dc horizontal stabilizer trim is desired, the horizontal stabilizer dc trim power supply switch must be positioned at EMER. This position of the switch disconnects the dc essential bus from the emergency generator and connects the dc horizontal stabilizer trim motor, through the slow-rate trim positions of the console trim knob, directly to the dc output of the emergency generator. Upon completion of trimming, the switch must be repositioned to NORMAL to reenergize the dc essential bus. (See figure 1-23, and refer to table 1-1.)

HORIZONTAL STABILIZER ACTUATOR GANG-BAR. A horizontal stabilizer trim emergency shutoff gang-bar (figure 1-25) controls the horizontal stabilizer actuator ac and dc power cutoff switches. Actuation of this gang-bar provides emergency disconnection of electrical power to the horizontal stabilizer trim motors. (For operating instructions, refer to Section V.)

FLIGHT CONTROL BOOST LATCH TEST CIRCUIT

The aileron, rudder, and elevator boost disconnect latches can be checked with the control boost latch light and test button (26, figure 1-14), located below the companionway circuit breaker panel 101. The test circuit includes a light, test button, and three microswitches in series, and is powered by the 28-volt dc bus. If all boost linkages are correctly latched, the light comes on when the test button is pressed. The light does not come on if a boost disconnect occurs in flight.

Note

The control boost latch test circuit does not include the spoiler system.

FLIGHT CONTROL HYDRAULIC PRESSURE WARNING LIGHT

The flight control hydraulic pressure warning light (7, figure 1-8) is located on the pilot's instrument panel. The light will come on if either the surface control system or the aileron control system hydraulic pressure drops below 1000 psi.

TABLE 1-1. HORIZONTAL STABILIZER TRIM CONTROL

ELECTRICAL POWER CONDITION	AVAILABLE TRIM CONTROL MODE		
	PRIMARY	ALTERNATE	ALTERNATE
Ac and dc power (normal operation)	Control column horizontal stabilizer trim switch	Fast-rate position, horizontal stabilizer trim control on center console	Slow - rate position, horizontal stabilizer trim control on center console
Ship's dc power failed	Fast-rate position, horizontal stabilizer trim control on center console		
Ship's ac power failed (emergency generator retracted or extended)	Slow-rate position, horizontal stabilizer trim control on center console		
Emergency generator only	Slow-rate position, horizontal stabilizer trim control on center console after placing the horizontal stabilizer dc trim power supply switch(1) to EMER		
Ship's dc power failed and emergency generator extended		Slow-rate position, horizontal stabilizer trim control on center console	See control available for "Emergency generator only" (this table)

(1)Bu No. 142668, 142669, 144825 – 144836.

TRIM POSITION INDICATORS

The rudder and stabilizer trim position indicator located above the center console (10, figure 1-8) indicates the direction and degree of displacement of the rudder trim tab and the horizontal stabilizer. An aileron trim position indicator (28, figure 1-8) is located at the base of control column on the pilot's instrument panel.

WING SLATS

The wing slats (14, 15 and 17, figure 1-4) form a part of the leading edge of each wing. The slats are in three sections and extend from each engine pylon outboard to the wing tips. Cambered wing aircraft have, in addition to the three sections, a fourth section (18, figure 1-4) that extends from the engine pylon inboard to the fuselage. No manual control over the slats is provided; their position is entirely dependent upon the flight attitude and airspeed of the aircraft. At high angles-of-attack, the slats extend automatically and direct airflow over the wing and ailerons, reducing loss of lift and aiding control. The slats retract to the normal faired position when the angle-of-attack is reduced and airspeed is increased. The outer wing inboard slat on each wing is mechanically extended when the wings are folded. (For the effect of slat malfunctions on flight characteristics, refer to Wing slats in Section IV.)

DRAG CHUTE

A drag chute is installed to provide rapid deceleration during the initial part of the landing roll or for emergency use on aborted takeoffs. To deploy the drag chute, the pilot operates the two-position DRAG CHUTE switch located directly beneath the standby compass at the top center of the windshield. The switch is normally set on the JETTISON-STOWED position and must be pulled out of detent and moved upward to DEPLOY for drag chute operation. This electrically triggers open the spring-loaded dual doors on the lower aft fuselage receptacle, releasing the pilot chute which carries the deployment bag aft containing the canopy. As the deployment bag clears the aircraft, the pilot chute pulls the canopy into the slipstream. After landing, the drag chute may be jettisoned by returning the DRAG CHUTE switch to the JETTISON-STOWED position. (For operating technique refer to Section III, LANDINGS, MINIMUM RUN WITH DRAG CHUTE.)

Note

If, when the emergency generator is operating, the switch is placed at DEPLOY, all ac essential and dc monitored essential busses are disconnected from the emergency power source until the switch is returned to JETTISON-STOWED.

INSTRUMENTS

The aircraft is equipped with the necessary instruments and indicators for the operation of the power plant, navigation, basic flight, or the monitoring of aircraft systems, emergency and auxiliary equipment. Pitot pressure is supplied by an electrically heated pitot tube (27, figure 1-4) located on top of the fuselage forward of the windshield. Static pressure is supplied by four static pressure vents (34, figure 1-4), two on each side of the fuselage aft of the radome. Vent lines connect to the following: airspeed indicator, altimeter, rate of climb indicator, autopilot amplifier and camera positions 5-6-7-11.

The instruments are of conventional design and operation. All are located on the instrument panel or above the center console. The instruments and sources of power are as follows:

DC Powered Instruments

Hydraulic pressure flip-flop indicator

Wheel position indicator

Flap position indicator

Trim position indicator

Free air temperature gage

ATM compartment temperature gages

Angle-of-attack indicator

Turn-and-slip indicator

AC Powered Instruments

Position deviation indicator (PDI)

Vertical Gyro indicator (VGI)

Standby gyro horizon

MA-1 compass

Dual fuel flowmeter

Fuel quantity gage

Fuel boost pressure indicator

Oil pressure indicator

Liquid oxygen quantity gage

Pressure ratio indicators

Self Generating Instruments

Tachometer

Turbine outlet temperature indicators

Pitot Static Instruments

Airspeed indicator

Altimeter

Rate-of-climb indicator

Direct Pressure Instruments

Cabin pressure altitude indicator

Pneumatic pressure gages

Brake pressure gage

AIRSPEED INDICATOR

A combination airspeed and Mach indicator (14, figure 1-8) is mounted on the pilot's instrument panel. The airspeed portion of the dial is fixed in position, and is calibrated from 80 to 650 knots. The Mach meter scale is a rotating disc, marked from 0.50 to 2.20, turning beneath the airspeed dial. Only a portion of the disc can be seen through a cutout in the airspeed dial. Both airspeed and corresponding Mach number are indicated simultaneously by a single needle pointer. The Mach number disc has a movable index which is used to set the limiting Mach number of the aircraft by depressing and turning a Mach limit knob on the lower left corner of the instrument case. On the edge of the airspeed dial is an airspeed index, adjustable through a range of 80 to 145 knots by means of the Mach limit knob. The airspeed index is used as a reference point to indicate the minimum safe airspeed for a particular gross weight during approach and landing or slow speed flight. (See figure 4-1 for stalling speeds at various gross weights, aircraft configurations, and angles-of-bank.)

ALTIMETER

A conventional three-pointer pressure altimeter (22, figure 1-8) provides an indication of the altitude of the aircraft. A barometric pressure scale and pointer, controlled by a knob on the lower left corner of the instrument, is used to adjust the altitude indicator for pressure variations or field elevation. The unit is compensated for temperature variations throughout the range normally encountered.

RATE-OF-CLIMB INDICATOR

A conventional rate-of-climb indicator (15, figure 1-8) is installed on the pilot's instrument panel.

Note

A simultaneous drop in altimeter, airspeed, and rate-of-climb readings may indicate a cabin pressure leak into the instrument static pressure line. The altimeter and rate-of-climb drop increases with altitude; airspeed drop decreases with altitude. If the vertical gyro indicates steady aircraft attitude before and during the erratic operation, reducing cabin pressure to ambient will restore approximately normal readings.

TURN AND SLIP INDICATOR

A conventional needle-and-ball type turn and slip indicator (39, figure 1-8) is provided for basic instrument flight. The instrument is dc powered.

ACCELEROMETER

The accelerometer (38, figure 1-8) provides a record of the g-forces applied to the aircraft structure both during and after maneuvers. The instrument uses three pointers for recording g; a free pointer, which indicates the g-force being applied at any given moment; a pointer indicating the greatest positive-g applied to the aircraft during a given period; and a pointer indicating the greatest negative-g during a given period. The last two pointers hold the greatest indication until reset to the base position by use of the knob on the lower left of the instrument.

STANDBY COMPASS

A standard magnetic compass (15, figure 1-6) is mounted on the canopy between the pilot and photo-navigator. The compass lighting may be controlled by the pilot's interior lights console lighting control knob.

CLOCK

An elapsed time clock (6, figure 1-13) is mounted on the photo-navigator's instrument panel. Directly above the elapsed time clock is an 8-day clock.

ANGLE-OF-ATTACK SYSTEM

The angle-of-attack system consists of a sensing probe, a transmitter unit, an angle-of-attack indicator, a tri-colored external approach light, and an indexer. The probe extends outboard, on right-hand side of the cockpit, and senses the attitude of the aircraft relative to the airstream. The probe is electrically heated when the anti-icing switch of the air conditioning panel (figure 1-32) is moved from OFF. Angle-of-attack information from the probe is transmitted to the angle-of-attack indicator (1, figure 1-8), located on the pilot's instrument panel. The indicator is in operation during the entire flight to present angle-of-attack information for approach or optimum cruise. The angle-of-attack indexer and external approach lights are inoperative until the landing gear and hook are extended in flight. The entire system is inoperative if dc electrical power is not available. The system may be used for FCLP landings with the hook retracted if the hook bypass switch in the nosewheel well (or cockpit) is used.

Note

Readings on the angle-of-attack indicator represent attitude of the aircraft relative to the airstream, not the flight path or the terrain.

ARRESTING HOOK BYPASS SWITCH

The arresting hook bypass switch is installed in the nosewheel well directly above the approach light. To use the approach light during night, field, or carrier landing practice, the bypass switch must be moved to the ON position. The approach light will then operate with the wheels down and locked and the arresting hook up. Turning the electrical power switch to OFF or placing the arresting hook control in the hook down position, will release the bypass switch relay and restore normal operation of the approach light.

ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator (1, figure 1-8), located on the pilot's glareshield, incorporates a graduated dial, a pointer, and an OFF warning flag. The pointer indicates the angle-of-attack in units marked from 0 to 30 on the face of the dial. The position of the pointer determines which of the three lights on the external

approach light comes on and also determines the lighting of the cockpit indexer light. The OFF warning flag is visible when dc power is lost or when the aircraft is resting on the landing gear.

ANGLE-OF-ATTACK INDEXER

The angle-of-attack indexer of the angle-of-attack system is mounted on the top side of the pilot's glareshield (2, figure 1-8). The unit has three light emitting apertures and a mechanical dimming control. The top aperture is a V, the center aperture is a ring, and the lower aperture is an inverted V. At low angles-of-attack, only the lower light will be on and the external approach light will be red. As the angle-of-attack increases and approaches the optimum, both the lower light and the center light will be on, and the external approach light will change to amber. When the optimum angle-of-attack is reached, only the center light will be on and the external approach light will remain amber. As the angle-of-attack is increased above the optimum, both the center and the upper light will be on, and as the limits of the optimum angle-of-approach are passed, the center light will go off and the external approach light will change to green. At any time the center light is on, the external approach light will be amber and the aircraft is within the optimum angle-of-attack limits.

STANDBY GYRO HORIZON INDICATOR

The standby gyro horizon indicator (23, figure 1-8) is an ac electrically driven flight instrument with a manual control mechanism for fast erection. The instrument is non-tumbling and provides indications of roll attitude through 360 degrees. The horizon bar pitch attitude indicators are mechanically limited to ±27 degrees; an auxiliary indicator of pitch is provided up to ±80 degrees by a subdial mounted in the center of the mask. Quick erection of the gyro is accomplished by means of a momentary mechanical erection device that is controlled by a knob on the front bezel. The knob should be pulled out steadily and firmly and held extended until the horizon bar and bank index cease to oscillate, at which time they should indicate zero roll, and pitch within 3 degrees. The time required for mechanical erection should not exceed 10 to 15 seconds after power is applied to obtain rapid settling of the gyro to the vertical.

WARNING

The erection device erects the gyro to the true aircraft attitude and not to the true vertical. The aircraft must be in straight and level flight during the entire erecting procedure.

A power warning flag is incorporated within the instrument, and is visible whenever the power supply is not sufficient for proper operation of the gyro. The flag is not visible when the unit is operating properly.

WARNING

Do not rely on indications of the instrument whenever the warning flag is visible. Also appearance of the warning flag during flight may indicate an ac power failure. The voltage and frequency of the right-hand ac generator should be checked immediately.

VERTICAL GYRO INDICATOR (VGI)

The vertical gyro indicator (21, figure 1-8) provides the pilot with a constant visual indication of aircraft pitch and roll. Aircraft attitude indication signals are transmitted to the indicator from a remotely located vertical gyro. The indicator will show the aircraft attitude accurately and continuously through 360 degrees of roll and 85 degrees of climb or dive. Pitch and roll attitudes are shown on the indicator by the motion of a universally mounted sphere in relation to a miniature reference aircraft mounted on the instrument case. The horizon is represented on the sphere as a white line dividing the top and bottom halves. The upper half of the sphere, labeled CLIMB, is painted light gray to

symbolize the sky. The lower half, labeled DIVE, is painted black to symbolize the earth. The climb and dive sections of the sphere are graduated every five degrees. A pitch trim knob, located on the lower right face of the indicator, is used to center the sphere horizon line with respect to the miniature aircraft. A power failure warning flag displaying the word OFF will be visible at the lower left of the indicator if essential ac or dc power is lost.

CAUTION

The power failure flag is actually what its name implies: a warning device indicating loss of ac and/or dc power to the VGI system. It does not indicate other failures that might occur within the VGI system. Do not use the indicator for attitude reference if the OFF flag is visible.

The VGI system is powered by both the ac essential bus and the dc essential bus. The system is always in operation when the ac and dc gyro horizon circuit breakers are depressed and both the ac and dc essential busses are energized. When power is applied to the system, pitch axis erection starts immediately; roll axis erection starts approximately 15 seconds later. After 2-1/2 minutes the indicator should show the ground attitude of the aircraft and the OFF warning flag should be raised out of view. If not, pull and reset the dc gyro horizon circuit breaker (figure 1-15A).

Note

To insure proper gyro erection, both the ac and dc gyro horizon circuit breakers may be pulled before applying electrical power to the aircraft. After applying power, reset the ac circuit breakers first, then the dc circuit breaker. Fast erection can be accomplished during ground checks or when the aircraft is in a level flight attitude by pulling momentarily then resetting the dc circuit breaker, with both ac and dc power on.

VERTICAL GYRO INDICATOR (VGI) OPERATION AFTER ELECTRICAL POWER LOSS

If either essential ac or dc power is lost, the power OFF warning flag will appear on the face of the indicator. If essential dc power is lost momentarily, the warning flag will appear. When dc power is regained, the system will automatically recycle. Recycle time is 2 ± 1/2 minutes.

If ac power is lost for a period in excess of 5 minutes, pull and reset the dc gyro horizon circuit breaker on the pilot's circuit breaker and fuse panel to obtain the fast slaving rate feature of the VGI system. When essential ac power is regained, the VGI system will automatically recycle. Recycle time is 2 ± 1/2 minutes.

CAUTION

- The indicator must not be used for attitude reference during the recycle period or when the OFF flag shows on the instrument face.
- During the recycle period the aircraft should be flown straight and level. (For operating procedure and checks refer to Preflight Checklists in Section III.)

A separate attitude indicator is incorporated in the pilot's viewfinder (20, figure 1-8). Attitude indications can be superimposed on the field of view of the pilot's viewfinder. Attitude indications thus shown will be limited to 30 degrees of pitch and 30 degrees of roll. (Refer to Viewfinder System in Section VIII.)

RADAR ALTIMETER ID257/APN-22

The ID257/APN-22 radar altimeter (31, figure 1-8) is designed to provide reliable indications of altitude from 0 to 10,000 feet over land and from 0 to 20,000 feet over water. The accuracy of indication is plus or minus 2 feet from 0 to 40 feet and plus or minus 5 percent of the indicated altitude from 40 to 20,000 feet. A function switch, labeled ON-LIMIT, located on the altimeter, is used to turn the equipment on and off and to select the limit altitude by adjustment of a bug pointer on the outside of the calibrated scale. An altitude limit indicator system is included to provide a visual indication of flight at, or below, a preset altitude. When at or below a preset altitude as selected by the function switch, a red warning light on the indicator comes on.

DROPOUT ALTITUDE

The dropout altitude (altitude at which the signal becomes too weak to operate the radar altimeter) is above 10,000 feet over land, and 20,000 feet over water. The dropout altitude decreases in banks, climbs, and dives of 50 degrees or more. When dropout occurs, an electrical circuit disables the indicator and moves the indicator needle behind a mask to prevent the pilot from depending on an unreliable reading.

OPERATION OF THE RADAR ALTIMETER ID257/APN-22

1. Turn function switch in clockwise direction.
2. Allow approximately three minutes for equipment to begin operating.

3. Set bug pointer to desired altitude limitation with functions switch.

4. To shut off equipment, turn function switch in counterclockwise direction to fullest extent.

MA-1 COMPASS SYSTEM

The MA-1 is a gyro-stabilized compass system designed to present visual indication of aircraft heading, and to provide the automatic flight control system with heading information. Visual presentations of the system are made on the compass card of the ID-250/ARN indicator (13, figure 1-8). The compass card of the ID-250/ARN indicator may be operated as a magnetically slaved instrument, or as one controlled by a free gyro corrected for the effects of the earth's rotation (refer to Bearing Indicator ID-250/ARN in this section). When the system is operating in the slaved mode, the heading information is supplied by means of a magnetic flux valve. The MA-1 system may be operated in the slaved mode up to about 60 degrees latitude. Due to the declination of the magnetic lines of force at the earth's magnetic poles, the slaving system becomes unreliable above 60 degrees latitude. Similarly, at any latitude where large quantities of iron or steel, such as a carrier, are in close proximity, the flux valve will not supply accurate heading information. For these reasons, the system may be operated under control of a free gyro. When the system is operated under control of a free directional gyro, the drift due to the rotation of the earth must be counteracted. This is accomplished by directing a proportionate voltage to the winding of a gyro torquer to cause the spin axis to rotate at a rate that will counteract the earth's motion effect. The proportionate voltage to the torquer is determined by the setting of the latitude control knob of the compass control panel. When the system is operating in the free mode, the index of the latitude control knob must be set to correspond with the existing latitude of the aircraft. The MA-1 system is powered by both the ac and dc buses and will be in operation when the normal aircraft electrical system is energized. The system will not be in operation when the emergency generator is in operation.

COMPASS CONTROL PANEL

The control panel for the MA-1 compass system is located on the pilot's left console (6, figure 1-7), and is labeled GYRO COMP. The panel contains the following controls: a compass mode switch marked SLAVED-FREE, a set heading knob marked SET HDG, a synchronization indicator marked SYNC IND, and a latitude control knob marked LAT CONT.

COMPASS MODE SWITCH. The compass mode switch position determines the mode of operation. When the switch is in SLAVED position, magnetic flux valve referenced heading information will be shown on the compass card of the ID-250 bearing indicator. When the switch is in the FREE position, the compass card of the ID-250 bearing indicator will operate under control of a free gyro.

SET HEADING KNOB. The set heading knob is used to precess the directional gyro electrically to obtain a specific known reference heading on the compass card of the ID-250 bearing indicator when using free gyro mode. It is also used to precess the gyro to align with the magnetic flux valve (as indicated by the synchronization indicator) when using the compass-controlled mode.

SYNCHRONIZATION INDICATOR. The synchronization indicator incorporates a black pointer visible through a window on the compass control panel. The indicator is used to synchronize the magnetic flux valve and the directional gyro (ID-250 compass card) when operating in the SLAVED mode. To synchronize the system the knob must be rotated until the black pointer is aligned with the black reference line on the face of the synchronization indicator. The pointer must approach the reference line from the right when the knob is turned counterclockwise or from the left when the knob is turned clockwise before the system is considered to be in proper synchronization for slaved operation.

Note

When the system is set for free gyro operation, the synchronization indicator is inoperative.

After synchronization, the pointer may wander back and forth but will not remain off to one side for any appreciable length of time. This condition is normal and indicates that the magnetic flux valve is oscillating due to aircraft acceleration, etc.

LATITUDE-COMPENSATION CONTROL. The latitude control is used only during FREE mode operation. It is then used to compensate for the apparent drift of the compass card from an established heading, caused by the earth's rotation. This apparent drift varies with the latitude in which the aircraft is flying. To compensate for the drift at various latitudes, the latitude control has indexed calibrations around the control knob that must be set to correspond with the aircraft position in latitude. These calibrations run from 0° to 90° NORTH for operation in northern latitudes, and from 0° to 90° SOUTH for southern latitude operation.

Note

When the system is set for SLAVED operation, the latitude control knob is inoperative.

MA-1 COMPASS OPERATION

For SLAVED compass operation proceed as follows:

1. Compass mode switch . . . . . SLAVED

2. Use set heading knob to initially orient compass system. Synchronization indicator reference line needle should be aligned.

3. Compass system will now maintain magnetic heading reference on ID-250 bearing indicator compass card.

For FREE gyro operation proceed as follows:

1. Compass mode switch . . . . . FREE

2. Set latitude control knob to degree of NORTH or SOUTH latitude in which flight is operating.

3. Use set heading knob to orient compass card to fixed point in space of known direction. This point now becomes aircraft heading reference.

4. During flight latitude control knob must be reset to compensate for each 5 degree change in latitude as it is reached.

MA-1 STOPPING PROCEDURE

The system is inoperative when the aircraft's electrical system is deenergized or when the emergency generator is operating. The control panel settings are not important for shutdown.

BAIRD-ATOMIC SEXTANT

The primary purpose of the Baird-Atomic sextant is to give reliable readings of celestial observations in high speed aircraft. It can also be used to make true heading checks, to find relative bearings, and to identify unknown stars. The sextant can be used to observe external parts of the aircraft that cannot ordinarily be checked during flight.

OPERATIONAL FEATURES

The most important feature of the sextant is the manner in which celestial observations can be made without any movement by the observer. This is made possible by rotating the optical components in the sextant head while the control panel and scope remain stationary. It is possible to make observations through 360 degrees in azimuth and from -4 to +90 degrees in elevation without the observer changing position. Due to the location of the mount on the A/C, observations of low elevation are not possible in some azimuth positions. Automatic bubble control is another improvement in the Baird-Atomic sextant. The bubble size is maintained within close tolerance by a thermostatically operated heating element. Another important feature is the simplicity of operation. All major controls are located on one panel and the necessary information to solve a celestial problem is read directly from the face of the scope.

DESCRIPTION

The Baird-Atomic sextant consists of the following five major components: A sextant head containing a double dove prism and a corrector lens enclosed in a glass dome. The dome protrudes three inches above the airframe and is permanently mounted in place. The prism and lens are sealed in dry nitrogen which prevents condensation and frosting of the lenses. Any residual moisture is absorbed by a molecular sieve desiccant. The viewer consisting of lenses and mirrors bring the field of view into the observer's line of sight. A three-inch lens displays the lubber line, bubble, cursor arrow, bearing dial, elevation stop light and celestial body. The optical system has a one-to-one magnification and a 15-degree field of view to facilitate locating celestial bodies. The control panel has controls for azimuth and elevation, a filter selector, and rheostats for the bubble, bearing dial and counter. The azimuth and elevation controls are used dually during an observation and are located in readily accessible positions on the panel. The elevation control has mechanical stop limits at approximately -4 and +90 degrees. Four filters are provided: clear, red, and two green. To the left of the control panel is a clip for the observer's watch. The averager is mounted under the sextant head. It has two levels: START, REWIND-RESET. The averager provides a continuous moving average of the observed elevation for any period of time ranging from 26 seconds to two minutes. A time dial, calibrated in seconds, indicates the half-time of the observation so that the mean time of the average altitude may be determined immediately. A white light automatically appears in the upper right quadrant of the scope presentation at the conclusion of a two minute observation. A detachable rubber viewing hood is provided to facilitate eye alignment and to shield the scope presentation during daylight use.

PREFLIGHT CHECK

These preflight checks must be performed before each flight.

DOME. Make sure outside of the dome is clean. Do not clean unless necessary because excessive cleaning will mar or scratch optical glass. If cleaning is necessary, use lens paper and liquid optical cleaner (MIL-P-16898 [SHIPS]). Check desiccant indicator and desiccant plug in optical system to be sure color is dark blue.

FILTERS. Connect sextant to 28-volt dc power supply in aircraft. Turn FILTER knob on control panel through cycle to ensure that four filters rotate through field of view. Depending on light conditions, colors of filters may not be distinguished, but change in density and rotation of filters should be apparent.

LIGHTING. Turn LIGHTING knob through seven values to check variable intensity. Values 1 and 2 are of such low intensity that they may not be checked in daylight. Turn BUBBLE knob to ascertain that bubble lighting can be varied from dim to bright.

ELEVATION. By turning ELEVATION knob and observing counter, make sure elevation upper step is set at approximately 90 degrees after complete rotation to stop, and at approximately -4 degrees after complete, reverse rotation.

AZIMUTH-HEADING LEVER. Place AZIMUTH-HEADING lever on AZIMUTH. Crank AZIMUTH knob on control panel and observe that cursor arrow rotates 360 degrees. With lever on HEADING, crank AZIMUTH knob and observe that cursor and bearing dials move 360 degrees together.

SEXTANT ALIGNMENT CHECK

The sextant lubber line alignment (see figure 1-31A) can be checked as follows:

1. AZIMUTH-HEADING lever to AZIMUTH.

2. Rotate AZIMUTH knob to position cursor pointer at 180 degrees on the bearing dial.

3. AZIMUTH-HEADING lever to HEADING.

4. Rotate AZIMUTH knob until the tail vent (located on lower leading edge of vertical stabilizer) is positioned directly under the inner end of cursor. The reading under the lubber line should be 2.5 degrees.

5. After bubble stabilizes (approximately 20 minutes after power is applied) check diameter as follows:

(a) Sight object at least 50 yards away.

(b) Turn ELEVATION knob until top, outer ring of bubble is on object. Note elevation reading.

(c) Turn ELEVATION knob until bottom, inner ring of bubble rests on same point of object. Note elevation reading.

(d) Difference in two elevation readings is diameter of bubble. Bubble diameter should be 1° 30' ±20 percent.

6. Wind averager. Indices should line up and timer should run to zero in few seconds. If averager does not stop at zero, depress START lever and after cycle is run, wind again and check that averager stops at zero. When averager stops, depress START lever.

CAUTION

Do not depress the START lever until the averager has stopped running.

7. Time 2-minute cycle with stopwatch. Running time should be 2 minutes ±4 seconds. Rewind averager. Check to see whether averager will stop after 26 seconds by depressing START lever.

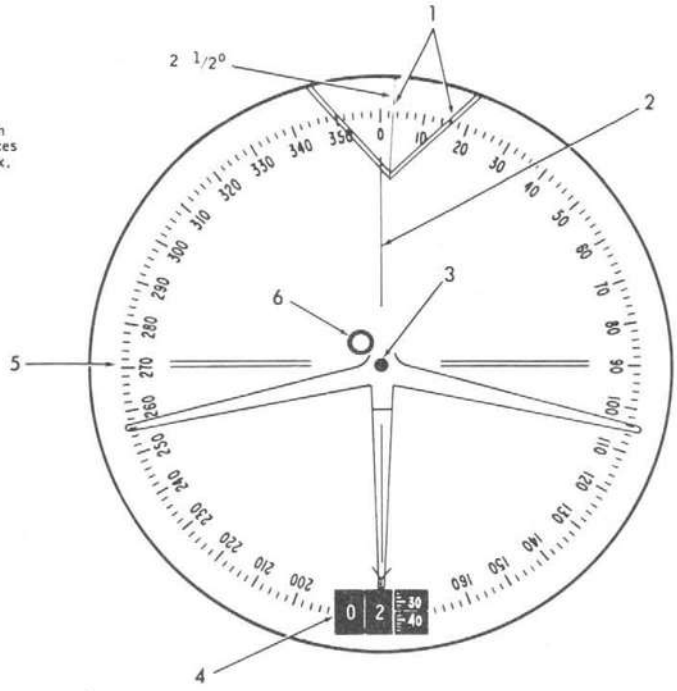
Note

The averager should not be stopped between 0 and 26 seconds. It should be remembered that the half-time dial will actually read 13 seconds when 26 seconds have expired.

8. Check integrating action of averager by sighting on object for one minute with bottom, inner ring of bubble. Note elevation reading. Then for second minute, sight on same object with top, inner ring of bubble. Note elevation reading. Turn ELEVATION knob until averager induces are aligned; elevation counter should now read midway between two edge readings.

NOTE:

Elevation readings will vary between aircraft, therefore elevation references are not available for alignment check.



1 = Lubber's Line
2 = Cursor
3 = Stabilizer Cooling Vent
4 = Elevation Counter
5 = Bearing Dial
6 = Bubble

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Figure 1-31A. AQU-1/A Baird Atomic Sextant Azimuth Alignment Check

OPERATION

Before sextant is used, attach viewing hood to scope, if it is necessary. Daytime observations usually require hood. Use following steps:

1. Select proper filter. . . clear filter at night, colored filter during day.

2. Adjust lighting and bubble knobs . . . . . as required.

3. Set azimuth of celestial body . . . . . by placing AZIMUTH-HEADING lever at AZIMUTH. Turn cursor arrow to precomputed azimuth of celestial body.

4. AZIMUTH HEADING lever . . . . . to HEADING and heading of aircraft is placed under lubber line.

5. Celestial body should be . . . . . centered in bubble for best results.

Note

The error will be small if the bubble is anywhere on the vertical line of the bubble chamber field.

6. Wind averager and depress START lever . . . . begin observation, time of shot can run from 26 seconds to two minutes. White light will appear in upper right quadrant of scope after two minutes.

7. Determine elevation of observation . . . . . by aligning indices of half-time dial.

Note

It is necessary to read the time of the shot on the half-time dial within ±4 seconds for a one mile accuracy.

NAVIGATIONAL FUNCTION

The true heading of the aircraft can be determined by use of the sextant. This is accomplished by setting the precomputed elevation in the counter window and placing the azimuth under the cursor. Position the AZIMUTH-HEADING lever on the HEADING and crank the azimuth knob until the body lies along the cursor

arrow. The heading of the aircraft can now be read directly under the lubber line.

PERISCOPIC SEXTANT

A periscopic sextant is provided for celestial navigation. When not in use, the sextant is stored behind the navigator's seat. When in use, the sextant is attached to a mount (3, figure 1-11) which is installed in the upper sextant station. The mount is normally sealed by a flat shutter which is flush with the aircraft skin. When the sextant is to be used, the sealing shutter is drawn aside and the sextant extended so that the tip of the tube is exposed 1 inch above the aircraft. The mount is equipped with gimbals which allow the navigator to compensate for variations in aircraft attitude up to 15 degrees, and with a ring whereby the sextant may be rotated through 360 degrees azimuth. An independently rotatable compass rose is engraved in increments of 0.5 degrees on the azimuth ring and is provided with two indices, one fixed, indicating the airplane heading, the other rotatable with the sextant to indicate the direction of the observed body. Thus, the mounting of the sextant permits the determination of both the relative or true bearing and the altitude of a celestial body. The index prism in the top of the periscopic tube is rotatable about a horizontal axis to permit observation at any angle from +5 to +92 degrees in elevation.

SEXTANT INSTALLATION

1. Insert sextant into mount with arrows of tube and mount aligned, and lock in retracted position by turning lower ring of mount in counterclockwise direction with respect to sextant and locking with retractable plunger on azimuth ring 180 degrees from retraction knob.

2. Place sextant in operating position by moving lever of mount to open position of shutter. Push sextant up until retraction knob snaps into place.

WARNING

In pressurized aircraft, do NOT open the shutter mount until AFTER the sextant has been inserted into its retracted position.

PREFLIGHT CHECK

After sextant is installed, perform the following to check alignment of the mount:

1. Turn hand crank and set 181.7 degrees in azimuth counter.

2. Depress averager winding lever to clear field of view of periscope.

3. Swing sextant around until vertical and horizontal line of sextant's reticle is coincident with centerline of the leading edge of vertical fin at joint between fiberglas fin top and metal vertical stabilizer. Altitude knob may be rotated until bubble and centerline of leading edge center in reticle field.

4. If compass mount is properly aligned, vertical line of reticle will also be coincident with zero degree (N) ±0.5 degree on the azimuth scale.

EMERGENCY ESCAPE SYSTEM

BAILOUT WARNING HORN

A bailout warning horn is located overhead between the cockpit and the camera compartment. The horn is actuated by pulling and holding the bailout warning handle (14, figure 1-14), located above the pilot's seat. Power for the horn is supplied by a 2000 psi nitrogen gas bottle. A pressure gage for the nitrogen bottle is located adjacent to the warning horn.

UPPER DITCHING ESCAPE HATCH

The upper ditching escape hatch is located on the upper cockpit enclosure (figure 1-17). The hatch is manually operated and opens inward when the pull-to-operate handle (figure 1-14) is pulled downward. The hatch is not operable when the cabin is pressurized. The hatch may be opened from the outside when a 50-pound force is applied to the circular disc on the exterior surface of the hatch. This disc is labeled PUSH and the hatch external surface is marked EXIT RELEASE. (Escape provisions are shown in figure 1-17.)

UPPER DITCHING HATCH RELEASE HANDLE.

A ditching hatch release handle (11, figure 1-14) is provided to enable the ditching hatch to be released from the latched open position by any crew member without leaving his seat. The release handle is located overhead adjacent to the bailout warning horn handle and is marked SQUEEZE 1/4 PULL TO CLOSE FWD DITCHING HATCH.

EMERGENCY ESCAPE CHUTE

EMERGENCY OPENING

The emergency escape chute may be extended in flight by pulling the escape chute door emergency lower escape handle (26, figure 1-6) on the right-hand side of the pilot's seat. When this handle is pulled the following operating sequence takes place:

1. Small pressure relief door on the lower surface of escape chute is unlatched allowing air to escape for controlled depressurization of cockpit and camera compartment.

Note

The pressure relief door will open automatically if the cabin differential pressure reaches 12.5 psi.

2. Fuze in time delay actuating cylinder is fired.

3. After delay of approximately 2 seconds, sufficient to allow depressurization, time delay actuating cylinder charge will fire and actuate cable that will; first, release escape chute door latches; second, fire two cartridge operated actuating cylinders that extend escape chute. When fully opened by actuating cylinders escape chute will latch in open position.

ALTERNATE EMERGENCY OPENING

An alternate means of opening the emergency escape chute door is provided through means of a foot operated treadle on the port inboard surface of the door itself. This treadle is marked ALTERNATE ESCAPE. Operating instructions are engraved on the treadle as follows: IF LEVER IS UP, FORCE DOWN. OTHERWISE – PULL UP – WAIT 2 SEC. – THEN FORCE DOWN. Raising the treadle opens the decompression door. Depressing the treadle bypasses the time delay cylinder, firing the door actuating cylinders directly.

WARNING

- If treadle is up, extreme care should be exercised not to step on the treadle inadvertently when travelling between the photo compartment and the cockpit. The hazard is obvious.

- When emergency escape door actuation is attempted by use of escape handle on pilot's seat, and door fails to fire, the door alternate treadle will be UP, forcing the treadle down will do nothing, as treadle has to be pulled up hard to release door latches and set door up to fire. After approximately 2 seconds delay to assure depressurization of cabin, force treadle down, firing door actuating cylinders directly.

AIR CONDITIONING AND PRESSURIZING SYSTEM

An interconnected air conditioning and pressurizing system heats, cools, ventilates and pressurizes the camera compartment and cockpit. Hot compressed air from the engine compressor section passes through a pressure regulator, a decontamination filter, a

venturi, and a refrigeration unit. This air is mixed with a regulated amount of hot air that has bypassed the refrigeration unit. The mixture provides the conditioned air for maintaining desired cockpit and camera compartment temperature. Conditioned air is also ducted to the windshield and to the scanner and camera windows to prevent fogging and frosting. The hot compressed air from the engine may be shut off prior to entering the air conditioning system. When the hot air is shut off, ram air flows through the ducts and temperature control will not be available.

The cockpit and camera compartment are pressurized by automatic regulation of the release of conditioned air. Pressurization will not be available when the system is operating with ram air. With either conditioned or ram air, part of the air is passed through the electronic equipment compartment in the companionway area, for cooling the radio and radar equipment. (For a schematic presentation of the air conditioning system see figure 1-32.)

AIR CONDITIONING CONTROL PANEL

The air conditioning and pressurizing control panel is located on the pilot's left-hand console (1, figure 1-7). This panel contains a cabin pressure switch for selection of pressurization schedule, a cockpit temperature selector knob for temperature control of pressurized conditioned air or the selection of ram air, a defrost switch for control of windshield defrosting, and an anti-icing switch for operation of the engine anti-icing system and the pitot tube heat. (Refer to Anti-Icing System in this section.)

COCKPIT TEMPERATURE SELECTOR

Positioning of the cockpit temperature selector knob controls the air conditioning system. The switch has a rotary knob and positions marked MAN COLD and MAN HOT for manual control of cockpit temperature. The area between MAN HOT and MAN COLD is marked with a directional arrow and the word WARMER. This area, through an electronic temperature controller, provides automatic regulation of the desired cockpit temperature. (Refer to Electronic Temperature Controller.) The MAN COLD position of the switch will provide refrigerated air to the cockpit. The MAN HOT position of the switch will allow the maximum available hot air to mix with the refrigerated air prior to entering the cockpit. Placing the switch at either of these positions moves the cabin air temperature valve in a corresponding direction that will supply hot or cold air. The MAN COLD position of the cockpit temperature selector knob is spring loaded and must be held in position as long as needed to motor the cockpit temperature control valve in the cold direction. When released from the MAN COLD position, the switch will spring to a position slightly above MAN COLD and the temperature control valve will remain at the position at which it stopped. The MAN HOT position of the switch is not spring loaded and will remain in the MAN HOT position when released. If less than full MAN HOT air is desired the cockpit temperature selector knob should be positioned at MAN HOT momentarily than rotated to a position slightly counterclockwise from MAN HOT into a small dead band which exists between MAN HOT and WARMER. Repeat this procedure until the desired temperature level is reached.

A marked OFF position of the cockpit temperature selector knob closes the engine air shutoff valve. With this valve closed, pressurization ceases and the source of hot and cold air for the air conditioning system is shut off. Simultaneously with the closing of the engine air shutoff valve an ambient air shutoff valve opens allowing ram air to flow through the air conditioning system ducts. The cockpit temperature selector knob must be pushed down in order to enter the OFF position.

ELECTRONIC TEMPERATURE CONTROLLER

An electronic temperature controller automatically maintains a selected cockpit temperature by regulating the position of the cabin air temperature control valve. Any position of the cockpit temperature selector knob other than OFF, MAN HOT or MAN COLD will establish the desired cabin temperature as reference voltage in the electronic temperature controller. The controller then maintains the desired temperature by opening or closing the cabin air temperature control valve in response to signals from three temperature sensing elements. These elements are: the cabin air temperature pickup, the cabin air temperature high limit pickup and the cabin air temperature anticipator. The cabin air temperature pickup is the basic sensing unit and provides signals for temperature control. The high limit pickup acts to prevent air above 190 ± 5°F from entering the cabin in order to prevent damage to the windshield and other heat sensitive materials. The anticipator controls the rate of temperature change. If a small change in temperature is called for, the anticipator will prevent an excessive amount of hot or cold air entering the cabin. The anticipator also senses changes in the temperature of the conditioned air, due to variables of ambient conditions or engine power settings, before such air reaches the cockpit. The anticipator then acts to change the temperature before a signal is received from the cabin temperature control.

Note

During ground operation of the airplane air conditioning system, both ac and dc power must be provided for the operation of the cabin air temperature pickups and the electronic control units.

COCKPIT AND CAMERA COMPARTMENT PRESSURE CONTROL

The desired pressure schedule is controlled by the cockpit pressure switch, through the cabin pressure

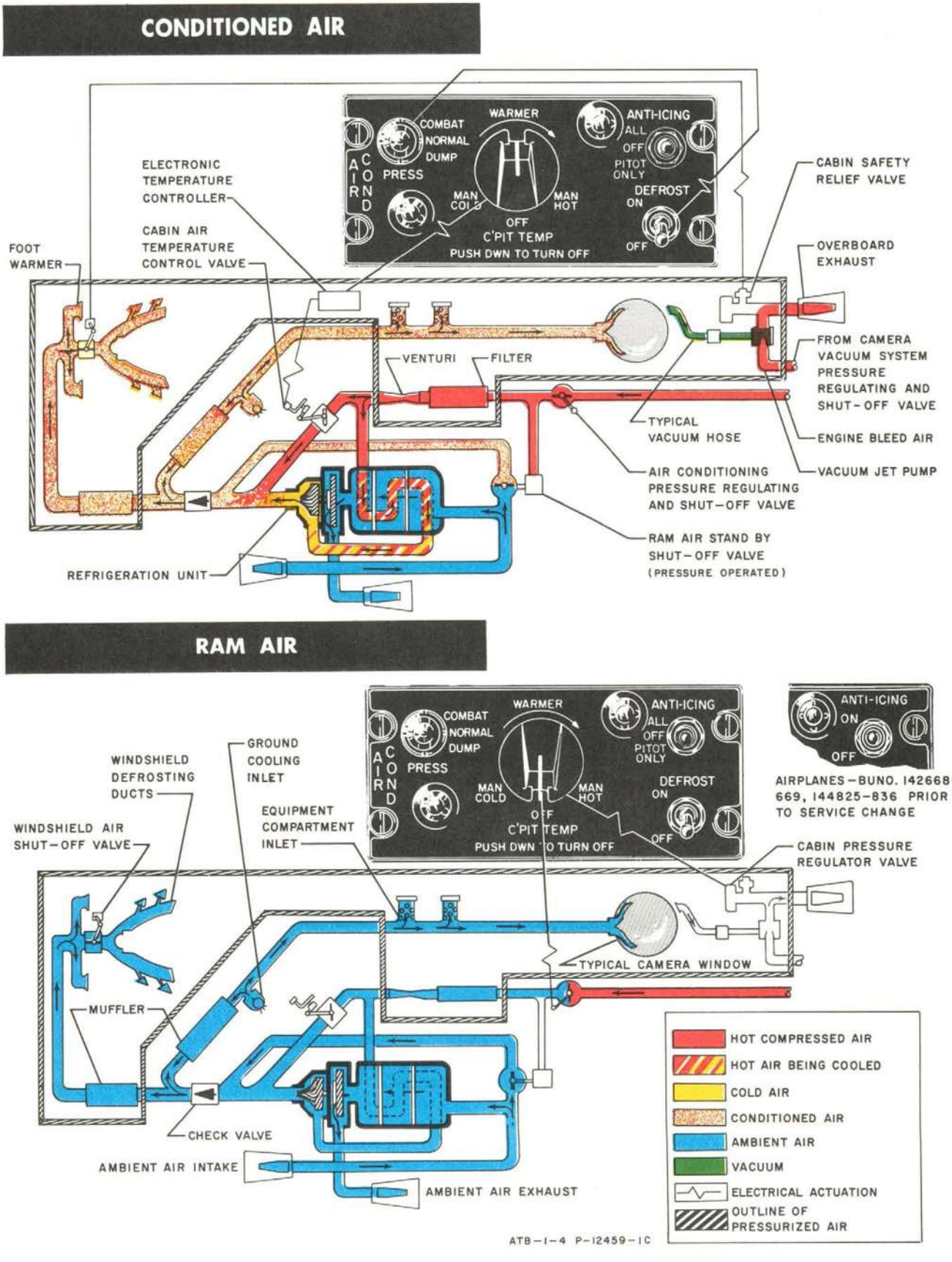


Figure 1-32. Air Conditioning and Pressurizing System

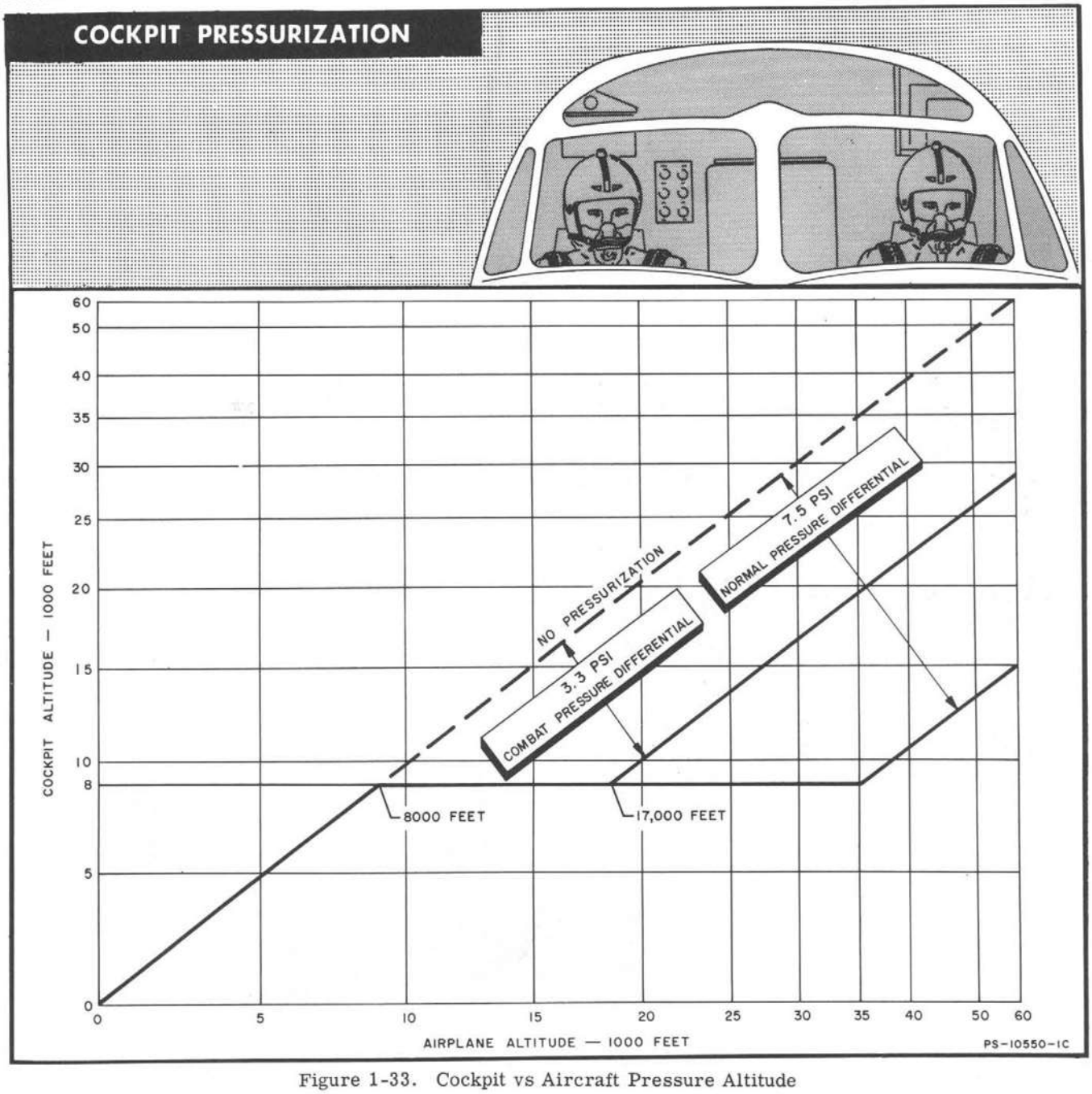


Figure 1-33. Cockpit vs Aircraft Pressure Altitude

regulator valve. The cockpit pressure switch is located on the air conditioning control panel and has three marked positions: DUMP, NORMAL, and COMBAT. When the switch is set at NORMAL, a cockpit pressure altitude of 8000 feet will automatically be maintained at flight altitudes of from 8000 feet to 35,000 feet. At flight altitudes above 35,000 feet, a cockpit pressure differential of 7.5 psi will automatically be maintained. When the switch is set at COMBAT, a cockpit pressure altitude of 8000 feet will automatically be maintained at flight altitudes of from 8000 to 17,000 feet. Above 17,000 feet, a cockpit pressure differential of 3.3 psi will be automatically maintained. (See figure 1-33.)

The indicated cabin altitude may drop below the indicated airplane altitude during flights under 8000 feet, and under some flight conditions the cabin altimeter may read below sea level. This condition is due to a slight positive cabin pressure caused by pressure drops through the cabin air flow exit ducting. The positive cabin pressure below 8000 feet is considered a normal condition. There are two ways to minimize this condition:

1. Reduce power.

2. Rotate the cockpit temperature selector knob to a colder setting.

Placing the cockpit pressure switch at DUMP will open a cabin safety relief valve and depressurize the cabin and cockpit. With the switch at DUMP, hot and cold conditioned air will be available for crew comfort.

Placing the cockpit temperature selector knob at OFF

will open the cabin pressure regulator valve and depressurize the cockpit and camera compartment. With the cockpit temperature selector knob at OFF, conditioned air will not be available for crew comfort. With the switch at OFF ram air will circulate through the cockpit and camera compartment.

WARNING

If possible, reduce flight altitude to an altitude that will avoid uncomfortable decompressioning effects, and make sure all crewmembers are wearing oxygen masks before placing the cabin pressure switch at DUMP, or the cockpit temperature selector knob at OFF.

The cabin safety relief valve will automatically open to relieve a positive cabin pressure differential in excess of 7.9 ± 0.1 psi or a negative differential pressure in excess of -0.1 ± 0.1 psi.

WINDSHIELD DEFROST SWITCH

The defrost switch located on the air conditioning panel controls the flow of air to the windshield defrost ducts. When the switch is ON conditioned air flows to the outlets under the pilot's and photo-navigator's seats, through the windshield shutoff valve and through the defrost ducts. When the switch is OFF the windshield shut off valve will partially close to divert most of the conditioned air to the underseat outlets.

COCKPIT FOG AND SNOW

The windshield defrost system normally requires no control. Small amounts of fog, however, or even finely divided snow, will occasionally appear at the windshield defroster and air conditioning outlets. While this is a normal condition resulting from the rapid cooling of air by the refrigeration unit, an excessively large volume of fog which obstructs vision can occur under extreme conditions of high humidity and warm outside air temperature at very low altitude. This fog may be eliminated by turning the cabin air temperature control up to increase the temperature of cabin air. In some cases the ducting may have cooled to a point where fog will persist for a short time after the cockpit temperature has been increased. After the fog has dispersed, a temperature setting should be selected that will provide the most comfortable temperature above the fogging point. In takeoffs or landings during which fogging conditions exist, it is suggested that the cockpit temperature selector knob be turned to the OFF position until the climb is established or the landing is completed.

Windshield fogging may occur during idle descent or power pullout even when no fog is coming out of the defroster ducts – if the windshield is cold enough to cool the warm humid defrosting air to its dew point. However, this fogging will persist only until the windshield is heated by the defrosting air.

SMOKE OR FUMES

Should smoke or fumes appear in the cabin, they may sometimes be eliminated by operating the engines at a lower power setting. If the source of smoke and fumes appear to be from the bleed air ducts in the camera compartment, close the bleed air shutoff switch (in those aircraft so equipped) on the affected side.

Note

Closing the bleed air shutoff switch will shut down its corresponding ATM. Also, the air conditioning will be shut down whenever the left-hand bleed air shutoff switch is closed.

If this is not effective, the cabin area may be ventilated with ram air by placing the cockpit temperature selector knob at OFF. If any crewmember who has removed his oxygen mask suspects contaminated cockpit air, he should replace the oxygen mask at once. (For smoke and fumes elimination procedures, refer to Section V.)

NORMAL OPERATION

AFTER TAKEOFF

After takeoff, perform the following:

1. Place cockpit temperature selector knob in WARMER zone, approximately half way between MAN COLD and MAN HOT.

Note

If there is high humidity and consequent likelihood of cockpit fogging, position the cockpit temperature selector knob at MAN HOT after takeoff.

2. Place cabin pressure switch at NORMAL or COMBAT as desired.

DURING FLIGHT

Rotate the cockpit temperature selector knob to a setting which provides maximum comfort.

Fogging can be minimized by:

1. Heating windshield before starting descent.

2. Using speedbrakes and increased engine power during descents to increase defroster airflow.

AFTER FLIGHT

Place the cockput temperature selector knob in the OFF position.

EMERGENCY OPERATION

AIR CONDITIONING CONTROL

If the air conditioning unit fails, the cabin air temperature will become excessively high and operation of the MAN COLD position of the cockpit temperature selector knob will be ineffective. In this event, place the cockpit temperature selector knob in the OFF position.

WARNING

Placing the cockpit temperature selector knob in the OFF position depressurizes the cabin. Before depressurizing, the pilot should check that all crewmembers are wearing oxygen masks, and should descent to an altitude that will assure crew safety and comfort and avoid harmful decompression effects.

CABIN AIR DECONTAMINATION FILTER

The aircraft is equipped with a decontamination filter designed to eliminate the contaminants which cause eye irritation and nausea. The unit is a combination of a filter and a Hopcalite catalyst agent. The filter portion consists of a screen that will remove large solid impurities from the bleed air. The Hopcalite catalyst does not actually remove the impurities from the bleed air, but it will break them down and convert them into compounds which are nonirritating to humans.

ANTIEXPOSURE SUIT VENTILATION

Antiexposure suit ventilation is controlled at each crewmember's position, when using the Mark V antiexposure suit. Control is provided by the EXPOSURE SUIT VENT and OFF toggle switch (7, figure 1-11), a ventilation blower, and a quick-disconnect flexible hose for antiexposure suit connection. The suit hose disconnect coupling contains a butterfly valve to control the flow of ventilating air to the antiexposure suit or, to close off the opening when the suit is not used.

ENGINE ANTI-ICING SYSTEM

In order to prevent dangerous icing of the engine inlet surfaces, an anti-icing system is incorporated in the engine. High temperature compressor discharge air is piped forward to the compressor case and inlet guide vanes through external tubes on each side of the engine. An anti-icing air regulator and air valve are incorporated in each tube system. The regulator automatically controls the volume of air flowing through the tubes, permitting maximum flow at 70° F bleed air temperature and minimum flow at 560° F bleed air temperature.

ANTI-ICING SWITCH

The anti-icing switch on the air conditioning and pressurizing control panel (1, figure 1-7) controls operation of the anti-icing system. Positions of the switch are ALL, OFF and PITOT ONLY. Placing the switch at ALL actuates the anti-icing valves to permit temperature-regulated air to flow through the engine inlet guide vanes and at the same time controls the current for heating the pitot tube and the angle-of-attack sensing probe.

PITOT TUBE AND ANGLE-OF-ATTACK SENSING PROBE HEAT CONTROL

Heat for the pitot tube and angle-of-attack sensing probe is supplied by electrical power through an electrical resistor coil in the pitot tube and angle-of-attack sensing probe. The heating coils are energized by the ALL and PITOT ONLY positions of the anti-icing switch on the pilot's left-hand console.

EQUIPMENT GROUND COOLING

The aircraft has two locations for the attachment of ground cooling blowers. The attachment for cooling the cabin area is located on the right-hand side of the fuselage near the nosewheel well. An access door covers the opening when the blower is not attached. The attachment for cooling the aft equipment compartment is located within the compartment itself.

WINDSHIELD WIPER

The windshield wiper is controlled by a four-way switch (6, figure 1-8) at the top of the pilot's instrument panel. The switch has OFF, SLOW, FAST, and PARK positions. Rotate the windshield wiper switch to the momentary-contact PARK position to remove the blade from view after the wiper motor has been shut down.

CAUTION

Do not operate the windshield wiper at airspeeds greater than 200 KIAS.

RADIO AND ELECTRONIC EQUIPMENT

The aircraft has provisions for the following radio equipment (see figure 1-34): AN/ARA-25 radio compass, AN/ARR-40 ADF receiver, AN/ARN-21B TACAN system, AN/ARN-14E VOR omni system,

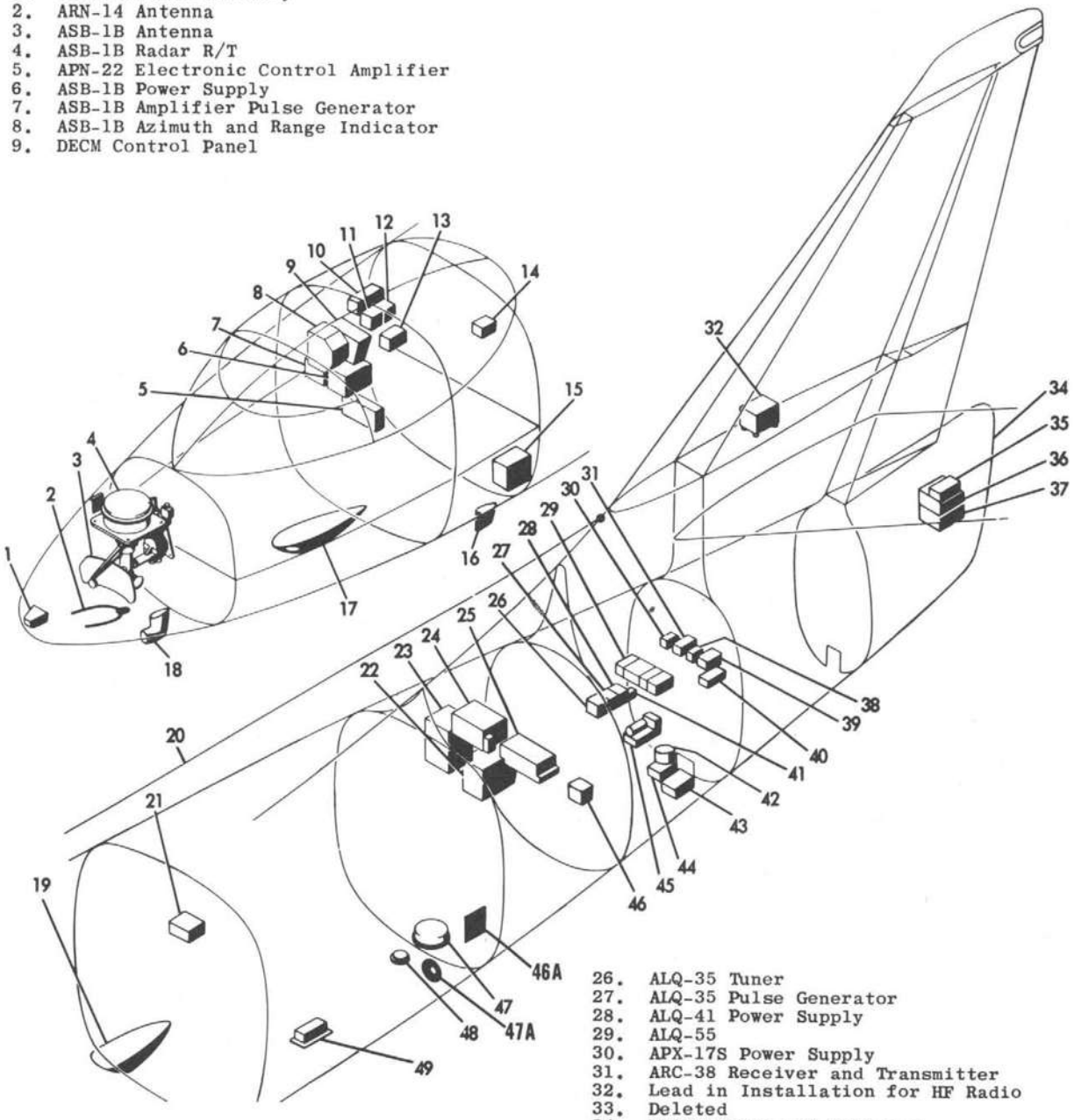


Figure 1-34. Radio and Electronic Equipment Locations

AN/ARN-6 radio compass, AN/ARC-1 receiver-transmitter, AN/ARC-27A UHF receiver-transmitter and the AN/ARC-38 HF receiver-transmitter. The radios can be operated as long as ac and dc electrical power is available from the ship's electrical busses. When the emergency generator is operating, all radio equipment is inoperative except the AN/ARC-27A, which receives power from the 28-volt dc monitored essential bus, or, in some aircraft from the 28-volt dc essential bus.

PILOT'S RADIO-ICS SWITCHES

The pilot's radio-ICS switches are located on the left throttle (36, figure 1-9), and on the control column (13, figure 1-6). Both switches have positions OFF, RAD, and ICS, and are spring loaded to the OFF position.

P/N AND P/T FOOT-OPERATED RADIO-ICS SWITCHES

Two sets of foot-operated radio-ICS switches are located on the navigator's footrest (17, 18, figure 1-11). The lower set is used when the seat is in the aft position. Two similar switches are located on the photo-technician's footrest (23, 24, figure 1-17). At each station the switch operated by the left foot is marked MIC ICS and, when depressed, permits transmission on the intercom. The switch operated by the right foot is marked MIC RADIO and, when depressed, permits transmission on UHF, VHF, or HF as selected on the individual ICS control panel.

INTERPHONE SYSTEM (ICS)

A transistorized interphone system provides communication between crewmembers. Volume control and a mixed selection of interphone and radio facilities are provided at each crew members ICS control panel. The interphone system is always on when the electrical system is energized. The system is designed to reduce automatically a crew member's radio reception volume as his individual ICS volume control setting is increased.

PILOT'S ICS PANEL

The pilot's ICS control panel is located on the left console (12, figure 1-7). Six receiver toggle switches, individually marked UHF, VHF, HF, ADF, VOR, and TACAN, provide selection of radio reception. The radio volume is determined by the receiver volume control setting. A transmitter selector switch with four positions marked OFF, UHF, VHF and HF permits the pilot to transmit on any one of these frequencies. To transmit, the pilot selects the desired frequency range on the transmitter selector switch, turns the corresponding receiver switch to the REC ON position, places the throttle or column radio-ICS switch at RAD, and speaks into his microphone. The pilot's ICS interphone control consists of an ICS volume control, an ICS selector switch with positions marked NAV, ALL, EMER, and an amplifier switch with positions marked NORM and ALT. When the ICS selector switch is at NAV, the pilot's ICS transmission is heard by the photo-navigator only, and when the switch is at ALL his transmission may be heard by all crew members. In the EMER position the pilot's ICS transmission will be heard by all crew members at full volume regardless of their ICS volume control settings. For normal operation the amplifier switch should be at NORM. Should the ICS malfunction the pilot may change the amplifier switch to ALT. In the ALT position, the pilot utilizes the photo-technician's amplifiers and voltage regulator through his own switches and volume control. However, to minimize volume reduction during radio reception, the photo-technician must move the same receiver toggle switches to ON that the pilot does.

PHOTO-NAVIGATOR'S ICS PANEL

The photo-navigator's ICS panel (8, figure 1-12) located on the right console contains six receiver toggle switches for selection of UHF, VHF, HF, ADF, VOR, or TACAN radio reception. Reception volume is determined by the receiver volume control setting. Selection of radio transmitting frequency range is made by means of a transmitter selector switch with positions OFF, UHF, VHF, and HF. To transmit, the navigator selects the desired frequency on the transmitter selector switch, places the corresponding receiver switch at the REC ON position, depresses his foot switch, and speaks into his microphone.

The photo-navigator's ICS interphone controls consist of an ICS volume control and an ICS selector switch marked PILOT, GUNNER and ALL. The photo-navigator may communicate with the pilot or photo-technician individually by selecting PILOT or GUNNER on the ICS selector switch, or to both simultaneously in the ALL position. To transmit on interphone the navigator selects the desired position on the ICS selector switch, depresses his foot switch, and speaks into his microphone.

PHOTO-TECHNICIAN'S ICS PANEL

The ICS control panel is located on the photo-technician's console (4, figure 1-15). The panel contains six receiver toggle switches for selection of UHF, VHF, HF, ADF, VOR, or TACAN radio reception. Reception volume is determined by the receiver volume control setting. Desired transmitting frequency range is selected by means of a transmitter selector switch with marked positions of OFF, UHF, VHF, and HF. To transmit, the gunner selects the desired frequency on the transmitter selector switch, places the corresponding receiver switch to the REC ON position, depresses his foot switch, and speaks into his microphone.

TABLE 1-2. ELECTRONIC EQUIPMENT			
TYPE	DESIG-NATION	FUNCTION	DISTANCE RANGE
RADIO EQUIPMENT			
UHF Radio Receiver and Transmitter	ARC-27A	Two Way Voice Communication or Signal Input to the ARA-25 Direction Finder.	Horizon
VHF Radio Receiver and Transmitter	ARC-1	Two Way Voice Communication.	Horizon
HF Radio Receiver and Transmitter	ARC-38/38A	Two Way Communication of Voice, CW, or CWS.	Up to 2000 Nautical Miles
Omni-Range Distance Measuring	ARN-21B	Transmits and Receives Distance Measuring Signals. Receives Radial Bearing Signals (AIR/AIR TACAN).	Horizon. 195 Nautical Miles for Distance Measing
Omni-Range Receiver	ARN-14E	Directional Homing on VOR, VAR, and Localizer.	Horizon
UHF Radio Receiver	ARR-40	Normally Provides Signal Input for the ARA-25 (ADF). May Be Used As Alternate For ARC-27 Voice Reception.	Horizon
UHF Homing Adapter	ARA-25	Provides Homing on UHF Transmissions through the ARC-27 or ARR-40 Radios.	Horizon
Radio Compass	ARN-6	Provides Aircraft to Station Bearing Information (Alternate to ARR-40).	200 Nautical Miles
RADAR EQUIPMENT			
Radar Altimeter	APN-22	Indicates Actual Altitude Above Terrain.	Over Land: 0-10,000 Feet. Over Water: 0-20,000 Feet.
IFF Transponder	APX-6B	Identification.	Horizon
SIF Coder	APA-89	Identification.	Horizon
Radar	ASB-1B	Navigational Aid, Reconnaissance, and Radar Return Photography.	–
DECM (Refer to Supplement to NATOPS Flight Manuals NAVWEPS 01-40ATD-1A.)			
OTHER EQUIPMENT			
Transistorized Interphone (3)	(ICS)	Intercommunication of Crew Members.	None
Dead Reckoning Computer	ASN-6	Displays Latitude and Longitude of Airplane.	None
Tape Recorder	–	Records Voice Communications of Crew Members.	None

The photo-technician interphone controls consist of an ICS volume control and an ICS selector switch marked NAV, ALL and MAINT. The photo-technician may transmit to the photo-navigator individually when the ICS selector switch is at NAV, or to the pilot and photo-navigator simultaneously when the switch is positioned at ALL. When the photo-technician ICS switch is positioned at MAINT he may transmit to and receive from the pilot, the photo-navigator, or any of six maintenance stations on the aircraft. Any of the six maintenance stations may transmit and receive from their station when the photo-technician ICS select switch is at MAINT. To transmit on the interphone the photo-technician selects the desired position on the ICS selector switch, depresses his foot operated switch, and speaks into his microphone.

ICS MAINTENANCE STATIONS

To aid ground maintenance, interphone facilities are provided at the following locations: turret compartment, radar compartment, forward ammunition compartment, bomb bay, nose gear well, left engine nacelle, and the right engine nacelle.

ICS SYSTEM EXTENSION CORDS

A 24 inch, combined oxygen hose and interphone extension cord is provided for the photo-navigator's use when at the sextant station. When needed, the extension cord is inserted between the photo-navigator's oxygen-interphone seat connector and his personal gear disconnects. When the extension cord is used the foot operated RAD-ICS switch is not needed and transmission is automatic when the navigator speaks into the microphone. This permits the use of both hands for operation of the sextant. When the extension cord is used, radio transmissions cannot be made and the interphone transmission will be directed according to the navigator's ICS panel setting. A similar extension cord 168 inches long is provided for use of the photo-technician when working in the camera compartment. The method of attachment and operation is the same as that used by the photo-navigator.

TAPE RECORDER

A tape recorder is installed to record the intercommunication system transmissions of crew members. The recorder may be turned ON or OFF by means of a switch (13, figure 1-13) located on the photo-navigator's instrument panel. When the switch is ON, the ICS transmissions of all crew members will be recorded on tape. The tape recorder unit is located on the photo-technician console (2, figure 1-15). The panel of the unit contains a power switch (wired in the ON position) and a locking knob. Spare tapes are stowed behind an access door in the companionway. To insert a new tape proceed as follows:

1. Push down and turn panel locking knob.

2. Pull back on hinged panel. This will pull tape cartridge part way out of unit.

3. Remove used tape cartridge and insert new cartridge.

4. Close panel cover and secure by turning locking knob.

UHF COMMUNICATION AND DIRECTION FINDING SYSTEM

The UHF system provides direction finding and communication in the range of 225 to 399.9 megacycles. The system consists of the AN/ARC-27A receiver-transmitter, the AN/ARR-40 receiver, and the AN/ARA-25 direction finder. Either the ARR-40 or the ARC-27A radios may be used for direction finding by proper positioning of the selector switch on the C-1457/ARR-40 control panel (13, figure 1-7). UHF direction finder information will be shown by the number one needle of the ID-250/ARN course indicator.

Note

The aircraft has provisions for either the ARA-25 or the ARN-6, depending on type of antenna installed.

AN/ARR-40 UHF RECEIVER

The ARR-40 radio receiver is powered from the 28-volt dc bus and operates in the UHF range of 265 to 284.9 megacycles. While normally used to provide a signal input to the ARA-25 direction finder, the ARR-40 may also be used for voice reception should the ARC-27A fail. The receiver tuning system provides 20 preset channels. Each channel may be set to any one of ten frequencies, giving a total selection of 200 frequencies. Controls for the set are located on the UHF control panel C-1457/ARR-40.

C-1457/ARR-40 UHF CONTROL PANEL

When installed, all operating controls for the ARR-40 receiver are located on the C-1457/ARR-40 control panel of the pilot's console (13, figure 1-7). On the panel are four knobs; a function knob, a channel selector knob, a sensitivity control knob and a volume control knob. The function knob is marked AUX REC at the top of the panel and MAIN T/R at the bottom of the panel. The perimeter of the function knob is marked

OFF, ADF, CMD, and GRD, for positions that may be aligned with the index of the AUX REC; and T/R, ADF, ADF for positions that may be aligned with the MAIN T/R index. As the knob is rotated, the function of the ARC-27A and the ARR-40 radios will change. The function of each will be determined by the marked position aligned with each index as follows:

Position	AUX REC (ARR-40)	MAIN T/R (ARC-27A)	Audio Input to intercom.
1	OFF	Normal T/R	MAIN T/R (ARC-27A)
2	ADF	Normal T/R	MAIN T/R (ARC-27A)
3	CMD	ADF	AUX REC (ARR-40)
4	GRD	ADF	AUX REC (ARR-40)

Position 1. ARC-27A voice T/R in operation.

Note

The audio input to the intercom is connected to either the MAIN T/R or the AUX REC but never to both at the same time. Thus, the 100 cycle tone associated with the ADF is eliminated from the intercom.

Position 2. ADF operation is provided by the ARR-40 and the ARA-25 equipment while the ARC-27A is operating on command frequency.

Note

There are two types of signals utilized in direction finding; the 100 cycle tone and the identification signal. In position 2 for ADF operation an audio signal is not present. Although elimination of the 100 cycle tone is desirable, the loss of the dot dash identification signal is not. Therefore, to establish station identification and ensure proper operation under homing ADF conditions, operation of the function knob at position three is required.

Position 3. This places the ARR-40 receiver on the command antenna and audio into the headphones. The ARC-27A is now operating on ADF. Thus, the 100 cycle tone has been eliminated but the identification signal may be heard through the ARR-40. For homing with the ARR-40 the function knob is then returned to the No. 2 position after the station has been identified.

Position 4. This position places the ARR-40 guard receiver in operation, while the ARC-27A is operating on ADF. The operator may now monitor the guard channel frequency and still operate on ADF.

The auxiliary channel selector knob is used to select any one of twenty preset channels in the range of 265 to 284.9 megacycles. The volume control knob regulates the audio output to the intercom. The sensitivity control knob is used to eliminate the background noise when no signal is being received.

AN/ARC-27A UHF RADIO RECEIVER-TRANSMITTER

The ARC-27A radio provides radio telephone communication in the UHF range of 225.0 to 399.9 megacycles, and may also be used to provide signal input to the AN/ARA-25 direction finder. A manual selection of 1750 frequency channels is possible in this operating range. The pilot is also provided with the selection of any one of 20 preset channels, or operation on a guard channel. Transmission and reception are on the same frequency and antenna. The AN/ARC-27A receives power from the essential dc bus.

UHF RADIO CONTROL PANEL C-1015/ARC-27A

The C-1015/ARC-27A control panel (1, figure 1-13) is located on the photo-navigator's instrument panel. On the panel are the following controls: a channel set button, channel selector knob, three concentric frequency selector dials, volume control knob, sensitivity control knob, and the function knob. The channel selector knob has positions numbered from 1 to 20 for selection of preset channels, a position marked G for the guard channel, and a position marked M which permits manual selection of 1750 available frequencies by adjustment of the three concentric frequency selector dials.

OPERATION OF THE C-1015/ARC-27A CONTROL

For all operation, place the function knob at a position other than OFF.

PRESETTING CHANNELS. If it is desired to preset a frequency on the channel selector knob proceed as follows:

1. Turn channel selector knob to desired number.

2. Adjust three concentric frequency dials to desired frequency. Outer dial sets first two digits of frequency, center dial sets third digit and inner dial sets digit to right of decimal point.

3. UNLOCK and press channel set button until stop is felt. Selected frequency is now stored as preset channel.

4. Procedure may be repeated until 20 channels have been selected.

MANUAL FREQUENCY SELECTION. To manually select one of 1750 available frequencies proceed as follows:

1. Turn channel selector knob to M.

2. Adjust three concentric frequency selector dials to desired frequency.

FUNCTION SWITCH OPERATION. The function knob has positions marked OFF, T/R, T/R + G, and ADF; and operates as follows:

Setting	Function
OFF	Set inoperative.
T/R	Transmitter and main receiver in operation. Guard receiver in standby. ADF in standby.
T/R + G	Transmitter and main receiver in operation. Guard receiver in operation. ADF in standby.
ADF	Transmitter will operate on the same frequency as the homing receiver. ADF in operation thru the main receiver.

Note

When the function knob of the ARC-27A control panel is positioned at ADF, the ARR-40 receiver will be inoperative.

To transmit and receive:

1. 28-volt dc essential bus . . . . . ENERGIZED

2. ICS panel, UHF receiver switch . . . . . REC ON

3. To transmit, ICS panel transmitter selector knob . . . . . UHF

4. Turn channel selector knob to channel number that will give desired frequency.

5. Turn function knob to . . . . . T/R

CAUTION

Allow a one-minute warmup period before transmitting on the AN/ARC-27A radio.

Note

If monitoring of the guard channel is desired, the function knob must be at T/R + G. If transmission on the guard channel is desired, the channel selector knob must be on G.

AN/ARA-25 AUTOMATIC DIRECTION FINDER

The AN/ARA-25 homing adapter operates in conjunction with signal reception of either the ARC-27A or the ARR-40 communication equipment. Continuous indication of the relative direction of the signal source is provided by the number one pointer of the ID-250/ARN bearing indicator (13, figure 1-8). Signals are received in the 225.0 to 399.9 megacycle band. Control of the AN/ARA-25 is determined by the setting of the function knob of the C-1457/ARR-40 UHF control panel (13, figure 1-7).

VHF COMMUNICATION RADIO

AN/ARC-1 RECEIVER-TRANSMITTER

The AN/ARC-1 receiver-transmitter provides two-way communication on nine prearranged main channel communication frequencies and a guard channel frequency. Incoming signals can be received on the AN/ARC-1 radio at any time except when transmitting. The change from receiving to transmitting is accomplished by operating the microphone switch.

C-865/ARC-1 RADIO CONTROL PANEL

The C-865/ARC-1 control panel (8, figure 1-7) provides a function and channel selector switch, for selecting one of nine preset channels or guard channel. The function switch provides choice of operation on the selected main channel or the guard channel, or operation on the selected main channel and monitoring on the guard channel. The function switch positions are labeled MAIN T/R, MAIN T/R & G REC and GUARD.

OPERATION OF THE AN/ARC-1 RECEIVER-TRANSMITTER

1. 28-volt dc bus . . . . . ENERGIZED

2. ICS panel VHF toggle switch . . . . . REC ON

3. To transmit, ICS panel transmitter switch . . . . . VHF

4. Function switch . . . . . AS DESIRED

5. Channel selector switch . . . . . DESIRED CHANNEL

6. Allow at least 20 seconds for warmup.

It is possible that while operating on the main channel and monitoring the guard channel, interference will prevent reception on either channel. If this should happen the interference may be suppressed by turning the function switch to the MAIN T/R position.

AN/ARN-6 RADIO COMPASS

Provisions are made for the alternate installation of the AN/ARN-6 Radio Compass in place of the AN/ARA-25 Direction Finder. The ARN-6 operates in the frequency range of 100 to 1750 kilocycles. The direction finding information of the ARN-6 will be indicated by the number one needle of the ID/250 ARN bearing indicator (13, figure 1-13). The system provides the following:

1. ADF information and simultaneous aural reception.

2. Aural reception using nondirectional antenna.

3. Aural reception using loop antenna.

4. Aural null direction finding using loop antenna.

AN/ARN-6 RADIO COMPASS CONTROL PANEL

When installed, the AN/ARN-6 radio compass is controlled from the radio compass panel, which is an alternate installation for the UHF ARR-40 control panel (9, figure 1-7) on the pilot's left hand console. The radio compass panel contains the following controls: a band selector for four frequency bands; a function switch marked OFF (power control), COMP (for ADF operation), ANT (for nondirectional reception) and LOOP (for aural reception or aural null direction finding); a frequency selector knob with positions DEC, INC (used to tune the desired frequency in a selected band); a control marked LOOP L-R (for rotation of the loop antenna); a two position reception mode selector switch marked CW, VOICE; and a volume control.

OPERATION OF AN/ARN-6 RADIO

1. 28-volt dc bus . . . . . ENERGIZED

2. ICS panel, ADF switch . . . . . REC ON

3. Function switch . . . . . ANT

4. Band selector switch . . . . . TUNE AS DESIRED

5. Volume control . . . . . AS REQUIRED

6. Frequency switch . . . . . INC OR DEC AS REQUIRED

7. Reception mode selector switch . . . . . AS DESIRED

8. Function switch . . . . . COMP OR LOOP AS DESIRED

NAVIGATION SWITCH FOR OMNI RADIO SELECTION

Selection of either the AN/ARN-21B (TACAN) or the AN/ARN-14E (VOR) radios for omninavigation is determined by the position of the omni switch (17, figure 1-8) on the pilot's instrument panel. The switch has two positions marked VOR and TACAN. When the ARN-21B (TACAN) system is selected for use, omnibearing and distance information is supplied. When the ARN-14E (VOR) system is selected for use, course information is displayed on the ID-249A/ARN, and bearing information of the ID-250/ARN indicators from the selected VOR stations through the ARN-14E, while range information continues to be displayed on the ID-310 indicator (29, figure 1-8) through the ARN-21.

CAUTION

- Be certain that the navigation switch is at the position (VOR or TACAN) corresponding to the system desired, or the azimuth information received will be inaccurate.
- It is possible to be receiving mileage on a TACAN station and bearing information on an omnistation.

TACAN

The AN/ARN-21B airborne TACAN equipment operates in conjunction with special surface or shipboard stations to provide continuous directional and distance information. Coverage of the surface station is limited to line of sight. Airborne equipment may receive bearing information in excess of 200 nautical miles, while distance measurement is limited to 195 nautical miles. Course information and TO-FROM indications are shown on the pilot's ID-250/ARN (13, figure 1-8) and the ID-249A/ARN (30, figure 1-8) indicators respectively. Aircraft distance from the station is shown on the ID-310 indicator (29, figure 1-8) of the pilot's instrument panel. The airborne receiver-transmitter has 126 preset frequency channels for transmitting the interrogation pulses, receiving the respondor pulses for range indications, and for receiving radial signals from the ground station for bearing and azimuth indications.

C-866/ARN-21B NAVIGATION CONTROL PANEL. The C-866/ARN-21B control panel (9, figure 1-12), identified as NAV, is located on the photo-navigator's console. Operating controls are: the function switch with OFF-REC-T/R positions, two channel selector knobs, and a volume control.

AN/ARN-21B NAVIGATION RADIO OPERATION. A warmup period of 90 seconds is required after the function switch is turned from the OFF position. There is no delay when switching from REC to T/R. Observe the following procedure for operating the equipment:

1. 28-volt dc bus . . . . . ENERGIZED
2. Navigation switch. . . . . TACAN
3. ICS panel, TACAN switch . . REC ON
4. AN/ARN-21 function switch . REC OR T/R, AS REQUIRED
5. Channel selector knob . . . . . SET CHANNEL

Identify beacon by tone signal in headset and read bearing to station on the number 2 pointer of the ID-250 course indicator. Directional information will also be supplied by the ID-249A course indicator. For distance information the function switch must be turned to T/R. Aircraft distance in slant range from the ground station will be shown on the ID-310 range indicator in nautical miles.

TACAN AIR-TO-AIR RANGING

Air-to-air ranging requires cooperating aircraft to be within line of sight distance. The A/A mode enables the TACAN installation to provide range indications between aircraft or between the lead aircraft and up to five others. TACAN displays normal range and azimuth information in the T/R mode and range information only, and is obtained in the A/A mode with the azimuth indicator (No. 2 needle) rotating continuously. If A/A operation is desired between two aircraft, the channel selected by one aircraft must be separated exactly 63 channels from the other aircraft, e.g., number one aircraft set to channel 64, number two aircraft set to channel 1. Both aircraft must then select A/A on the TACAN function switch. Range between aircraft will then be displayed on the DME indicator in each aircraft. The maximum lock-on range is 198 miles. However, due to the relative motion of the aircraft, the initial lock-on range will usually be less.

If A/A operation is desired between one lead aircraft and five others, the channel selected by the lead aircraft may be 63. The other five aircraft must be separated by exactly 63 channels. The A/A mode must then be selected on the TACAN selector switch.

VOR

The AN/ARN-14E radio receiver provides reception of all VHF Omnirange, tone localizer, and voice transmissions in the 108.0 to 136.0 megacycle spectrum. Navigational information is registered on two indicators located on the pilot's instrument panel, the ID-249A/ARN course indicator and the ID-250/ARN bearing indicator. Voice transmissions are received on communications channels or superimposed on navigation signals in the localizer and omnirange bands.

C-760A/A CONTROL PANEL. The control panel for the AN/ARN-14E receiver contains a power switch with marked positions of ON TONE, OFF, and PHASE; frequency selector knobs, and a volume knob. The ON TONE position of the power switch is used for VHF omnirange and tone localized reception. The PHASE position is used for phase localizer only and a locking bar prevents the switch from being unintentionally thrown to the PHASE position. Frequency selection is accomplished by setting the desired frequency into the vertical window with the concentric knobs provided. Vertically downward the numbers represent hundreds, tens, units, and tenths of megacycles. The C-760A/A control panel provides simultaneous selection of VHF omni-range and tone localizer frequency channels.

AN/ARN-14E RADIO OPERATION. For operation, proceed as follows:

1. 28-volt dc bus . . . . . .ENERGIZED
2. Navigation switch . . . . . VOR
3. ICS panel, VOR switch . . . . . .REC ON
4. Power switch . . . . . .ON TONE
5. Channel selector knob . DESIRED FREQUENCY

AN/ARC 38 AND AN/ARC 38A HF RADIO RECEIVER-TRANSMITTER

Radio set AN/ARC-38 or radio set AN/ARC-38A provide radio communication between aircraft and a ground station or another aircraft. Voice and CW operation from 2.0 to 25.0 megacycles are provided by the equipment. Frequencies from 2.0 to 14.2495 megacycles may be selected in 500 cps steps. From 14.250 to 25.0 megacycles, channels may be selected in steps of 1000 cps. A selection of 20 frequencies may be preset on a drum within the ARC-38 or ARC-38A control panel. Transmission and reception are on the same frequency and atenna.

AN/ARC-38 AND AN/ARC-38A CONTROL PANEL. The HF radio control panel (12, figure 1-14) located on the plane captain's console, contains the operating controls for the ARC-38 or the ARC-38A radio. A 4-position rotary function switch labeled OFF, PH, CW, CWS (C-1399/ARC-38) or OFF, AME, CW, SSB/FKS (C-3428/ARC-38A) is used to select type of emission, receiver selectivity, and to control application of power to the equipment. A 3-position frequency mode knob marked MAN, LOCAL; REMOTE, permits use of the manual frequency selection feature when positioned at MAN, or use of the preset channels when positioned at LOCAL. The REMOTE position is not used in this aircraft. Four thumb wheel manual frequency selectors are used in conjunction with the MAN position. A 20-position thumb wheel channel selector is used to select one of the preset channels in conjunction with the LOCAL position of the frequency mode knob. A 2-position CW RECPT- CW XMSN switch permits monitoring the received signal without operating the dynamotor when positioned at CW RECPT. A beat frequency oscillator (BFO) control knob is used for remote control of the beat frequency oscillator. A volume control knob controls the audio gain in the PH or AME position and controls the rf gain in CW positions. The sensitivity control knob, regulates rf gain in the PH or AME position. Accessible by lifting a hinged door on the panel are the following; a drum for presetting 20 channels, a tool for presetting the drum, and a code book with the instructions and code needed to set up the desired frequencies on the drum or the manual frequency selectors.

OPERATION OF AN/ARC-38 OR AN/ARC-38A RADIO

For operation with the preset channels proceed as follows:

1. Aircraft electrical system . . . . . .ENERGIZED
2. ICS panel, HF switch . . . . . REC ON
3. To transmit, ICS panel transmitter switch . . . . . HF
4. Frequency mode knob . . . . . LOCAL

5. Turn the channel selector thumb wheel to the channel of the desired frequency. (The frequency of the 20 preset channels may be logged on the chart on the hinged door of the control panel.)

6. Energize the equipment and select the type of emission on the function knob.

7. Regulate the rf gain to a comfortable level with the volume or sensitivity knob.

8. For CW or CWS operation, regulate signal pitch with the beat frequency oscillator control knob.

9. To transmit, press the microphone button and speak into the mike. A sidetone should be heard in the headset. Release the mike button to hear incoming signals. If operating in CW, press the key. A 400-cps sidetone is monitored in this case. Release the key to receive incoming signals. For CW transmission the cw xmsn-cw recpt function knob syould be at CW XMSN. When a CW signal is being received the cw mxsn - cw recpt toggle switch should be placed in CW RECPT which disables the dynamotor to permit monitoring the received signal without operating the dynamotor.

For operation with manual selection of frequency:

1. Turn frequency mode knob to MAN.

2. Use code book to set up the desired frequency on the four manual frequency selection thumb wheels. Proceed with steps 5, 6, 7 and 8 of the procedure for operation with preset channels.

Note

Automatic tuning circuits in the AN/ARC-38 or AN/ARC-38A radio receiver transmitter require time to perform their tuning and loading functions. Fifteen seconds is required to tune the receiver-transmitter and a slightly longer time to load the antenna. Certain relays in the receiver-transmitter open the keying circuits during tuning so that no transmission may be made. A 400-cycle note will be audible in the headset during the antenna coupler loading cycle. Do not attempt transmission until the tuning cycle is complete, and the 400-cycle tone is no longer heard in the headset.

To secure the equipment, position the function knob at OFF.

COURSE INDICATOR ID-249A/ARN

The ID-249A course indicator (30, figure 1-8) is located on the pilot's instrument panel. The indicator operates in conjunction with either the ARN-21 (TACAN) or the ARN-14E (VOR) radio. The indicator contains a course window showing the desired course to or from any omnistation. A desired course is set into this window by turning the set knob. A second window will indicate whether the course shown is to or from the station by display of the word TO or FROM. The position of the airplane (left or right) in relation to the selected course will be shown by the displacement of a vertical bar from center (on course) position. A relative heading indicator consisting of a pointer with a white circle on the outer end is mounted on the face of the instrument. The end of the pointer moves around the inside edge of the circular instrument face to indicate the angle between the aircraft heading and the course set into the course window. Travel of the pointer is calibrated to 45 degrees each side of center, top and bottom. This calibration facilitates approaching the desired track at definite angles and establishing wind correction angles. The horizontal glide slope bar and the marker beacon light of this instrument are inoperative on this aircraft.

BEARING INDICATOR ID-250/ARN

The ID-250/ARN bearing indicator is located on the pilot's instrument panel (13, figure 1-8). This multipurpose instrument can provide the pilot with simultaneous omni and UHF radio bearings plus aircraft magnetic heading or free gyro indication. The face of the instrument is a rotating compass card and may be operated under control of a slaved magnetic compass or a free gyro (refer to MA-1 COMPASS SYSTEM in this section). Mounted in front of the compass card are two rotating needle pointers. The needle marked "1" will show aircraft-to-station radio bearing information of signals received by either the AN/ARN-6 radio compass or the ARA-25 homing adapter (refer to UHF COMMUNICATION AND DIRECTION FINDING SYSTEM in this section). The needle marked "2" will show aircraft-to-station radio bearing information when used in conjunction with either the ARN-14E or the ARN-21 radio receiver (refer to Navigation Switch for Omni Radio Selection in this section). Radio bearings of either needle will be shown as magnetic bearings to the station, if the compass card has been correctly slaved to the MA-1 gyro compass. When the ARA-25 homing adapter or the AN/ARN-6 radio compass is not in use, the two needles interlock to simplify reading the instrument.

AN/APX-6B TRANSPONDER (IFF)

The radar identification set AN/APX-6B is an airborne transponder and is one of several units which may be operated together to provide a system of electronic identification and recognition. Its purpose is to identify the aircraft in which it is installed as friendly when correctly challenged by friendly radar, and to permit surface tracking control of aircraft. Functionally the receiver portion of the AN/APX-6B equipment receives the challenges initiated by an interrogator responder, and applies a single pulse corresponding to each interrogation to the AN/APA-89 coder. In response to interrogations in modes 1, 2, or 3, the AN/APA-89 provides coded pulse train replies (the coding of which can be selected for each of the three modes) back to the AN/APX-6B. This pulse train is transmitted by the transmitter portion of the AN/APX-6B to the interrogator responder where proper replies, decoded or as raw video are displayed along with the associated radar targets on the radar indicator. When a radar echo is accompanied by a proper IFF reply, that target is considered friendly.

C-1159/APX-6B CONTROL PANEL (IFF)

The IFF control panel (13, figure 1-12) is located on the photo-navigator's console. The panel contains a rotary master selector knob with positions marked: OFF, STBY, LOW, NORM, and EMERGENCY.

APX-6B OPERATION

The system is energized when the master knob on the IFF control panel is set to any position other than OFF. A pushbutton below and to the left of the function selector switch must be pressed before the EMERGENCY position can be entered. This prevents inadvertent entering of the EMERGENCY position. Two lights on the panel provide lighting of the master selector control and the three toggle functional switches. The master knob functions as follows:

Position	Function
OFF	Set is inoperative.
STBY	Set is ready for operation but transponder-receiver is not sensitized and no replies can be transmitted.
NORM	Transponder-receiver is given full sensitivity and transponder operates with maximum performance. Transmitted power from transponder is same for both LOW and NORM positions of switch.
EMERGENCY	Emergency replies are transmitted upon receipt of any IFF interrogation regardless of mode of interrogation or settings of MODE toggle switches on control panel.

Note

To enter the EMERGENCY position, first depress the dial stop button.

AN/APA-89 CODER (SIF)

The AN/APA-89 coder is used in conjunction with the AN/APX-6B transponder to supply multiple coded replies to the transmitter portion of the AN/APX-6B. By such means selective and individual identification of aircraft is possible, thus facilitating ground control and providing flexibility to the identification process. The AN/APA-89 coder accepts the decoded output of the AN/APX-6B transponder and generates coded information pulse trains, enabling the transponder to reply on SIF. The AN/APA-89 has two supplementary purposes: to provide two-train coded replies automatically for I/P purposes; to provide four-train coded emergency replies. Emergency and I/P replies occur only for mode 1 interrogations.

SIF CONTROL PANEL

The C-1272/APA-89 SIF control panel (15, figure 1-12) is located on the photo-navigator's console. The panel contains two coaxial type switches identified as MODE 1, and MODE 3. Each switch has an inner and an outer rotary dial. The MODE 1 inner dial is numbered from one to three and the outer dial is numbered from one to seven. The MODE 3 selector switch has both inner and outer dials numbered from one to seven. Positioning of these switches provides the pilot with a selection of various codes in MODE 1 or MODE 3. Four rotary switches for the selection of codes in MODE 2 are located behind a door on the face of the AN/APA-89 coder and are normally preset on the ground.

AN/ASN-6 LATITUDE AND LONGITUDE COMPUTER

The AN/ASN-6 computer system consists of four units connected by cabling. The units are: the computer control panel C-1316/ASN-6; the latitude and longitude indicator ID-389/ASN-6; the latitude and longitude computer CP-188/ASN-6; the electronic control amplifier AM-916/ASN-6. When in operation, the system continuously computes and displays the present latitude and longitude of the aircraft.

COMPUTER CONTROL (GROUND POSITION INDICATOR PANEL) C-1316/ASN-6

The computer control panel is located on the console (1, figure 1-15). This panel is used to introduce wind direction, wind force, and variation information into the system. The wind direction indicator of the panel consists of an (outer) coarse scale graduated in 10-degree intervals and an (inner) fine scale graduated in 0.5-degree intervals. The known wind direction of the area and altitude are set into the wind force indicator window by means of a knob located beneath the indicator. Wind force is displayed on a drum type counter with a range of 0 to 200 knots. The counter fine scale is graduated to 0.2 knot. Setting is made by turning the knob located beneath the counter. The magnetic variation of the area is set on the variation indicator of the panel. This indicator is graduated to 0.5 degree, east or west of true north. Variation setting is made by turning a knob located beneath the variation indicator. All setting knobs are provided with friction grips that prevent them from turning because of vibration. To turn the knobs, use a slight downward pressure.

GROUND POSITION INDICATOR ID-389/ASN-6

The ground position indicator is located at the photo-technician's station (5, figure 1-14). The indicator contains a latitude window, a longitude window, and two slew switches for setting longitude and latitude information into the windows. Longitude and latitude are displayed by drum type counters located behind the windows. After the longitude and latitude of the departure point have been set on the counters, the slew switches should be locked to prevent accidental movement. A lock for each slew switch is located on the rear of the indicator case.

LATITUDE DEPARTURE SWITCH

A two-position switch, located on the photo-technicians console (3, figure 1-15), is used to place the ASN-6 system in operation. The two positions of the switch are STANDBY and RUN and operate as follows:

1. Set latitude departure switch to STANDBY.

2. Use slew switches on ground position indicator to set in latitude and longitude of predetermined point. Lock slew switches when position has been set.

Note

The predetermined point should be a ground reference point which is to be passed over after the aircraft is in normal flight. Do not use the point of departure as the predetermined point; inaccuracies will be introduced by the steep angle of climb.

3. Set in wind direction and wind force (winds aloft) and magnetic variation of area by use of computer control panel setting knobs. The knobs require slight downward pressure to unlock. To magnetic variation, add or subtract compass error (deviation) as appropriate.

4. With aircraft in normal attitude and at cruise altitude, fly over predetermined point and place latitude departure switch in RUN position.

At this point the equipment is in full operation and registering ground position in longitude and latitude.

The accuracy of the indications will be determined by the accuracy of the winds aloft and variation settings. As new winds aloft and variation information is received it should be set into the system. If possible, it is recommended that the indicated position be checked over some known ground position after a minimum distance of 100 miles from the departure point.

SEARCH RADAR SET AN/ASB-1B

In this aircraft, the AN/ASB-1B equipment is used primarily for radar photographic purposes (described in Section VIII).

LIGHTING EQUIPMENT

INTERIOR LIGHTS

The interior lighting system includes all instrument lights, console lights, dome lights, camera compartment lights, floodlights, service lights and the necessary controls. The instrument and console lights operate on ac electrical power while the floodlights operate on dc electrical power. This provides standby lighting in case of failure of either system.

PILOT'S INTERIOR LIGHTS CONTROL

The pilot's instrument panel, console, standby compass, bailout warning horn panel and floodlight lighting are all controlled from the interior lights panel (2, figure 1-7) located on the pilot's left-hand console. A console lighting knob provides variable intensity lighting of the pilot's left-hand console, the auxiliary instrument panel, the standby compass and the bailout warning horn panel, when rotated from OFF toward BRIGHT. A rotary instrument lights knob provides variable intensity lighting of the pilot's instrument panel when rotated from OFF toward BRIGHT. A floodlight knob, with positions BRIGHT-DIM-MEDIUM, controls the floodlights for the pilot's console, the center console, and the instrument panel lights under the glareshield. The instrument panel floodlights will come on only when the floodlight knob is positioned at BRIGHT.

Note

When the pilot's instrument light knob is rotated from OFF toward BRIGHT, a warning light dimming relay automatically dims all cockpit warning lights for night flying. When flying during the hours of daylight, ascertain that the instrument light knob is turned OFF, so that the dimming light relay will be deenergized.

PHOTO-NAVIGATOR'S INTERIOR LIGHTS CONTROL

The photo-navigator's instrument panel, console, and floodlights, and the night lighting of the viewfinders are all controlled from the instrument lights panel on the photo-navigator's console (1, see figure 1-12). An interior lights knob provides variable intensity lighting of the photo-navigator's instrument panel when rotated from OFF toward BRIGHT. A consoles lighting knob provides variable intensity lighting of the photo-navigator's console when rotated from OFF toward BRIGHT. A floodlight knob, with positions BRIGHT-DIM-MEDIUM, controls the floodlights for the photo-navigator's chartboard, console and instrument panel.

Note

Operation of the photo-navigator's instrument lights control knob from the OFF position also activates a dummy relay that controls viewfinder reticles and the pilot's viewfinder VGI lighting. ▮

PHOTO-TECHNICIAN'S INTERIOR LIGHTS CONTROL

The photo-technician console lights, electric power panel lights, bomb release control, and floodlights are all controlled from the panel labeled panel lights (7, figure 1-15) on the photo-technician console. A console lights knob marked OFF-BRT provides variable intensity lighting of the photo-technician console, the electric power panel, and the photo-technician seat bomb release control. A floodlights knob, with positions BRT-DIM-MED controls the floodlights for the photo-technician console, the electric power panel, the ground position indicator and the photo compartment.

DOME LIGHTS

The cockpit dome light (8, figure 1-14) is located forward of the ditching hatch and contains both a red and a white lamp. The dome light switch has three positions: RED, OFF, and WHITE. The WHITE detent is guarded to prevent inadvertent entry. Two similar dome lights located in the camera compartment are controlled by a switch located in the companionway.

PORTABLE FLOODLIGHTS

Outlets for portable floodlights (3, figure 1-12) are provided in the tail compartment, and at various points in the camera compartment. ▮

SERVICE LIGHTS

Service lights are provided in the tail, and flash bomb compartments. Switches for the lights are located in each compartment. The service lights in the flash bomb compartment may be operated only when the gear is extended.

EXTERIOR LIGHTS

The exterior lighting system includes navigation lights on wing tips and tail, fuselage lights or rotating beacon lights on the upper and lower fuselage surfaces, and a combination landing or taxilight on the nosewheel door. Colored filters for the lower fuselage light are stowed in a container reached through an access door forward of the tail bumper gear. The exterior lights system receives power from the 28-volt dc bus through five circuit breakers.

EXTERIOR LIGHTS CONTROL

All exterior lights are controlled by a master exterior lights switch (see figure 1-35) located on the right-hand throttle. This three-position toggle switch functions as a catapult signal when pressed to the aft momentary position and also provides exterior lights on-off control. Selective operation of the lights is provided by the exterior lights panel (15, figure 1-7) on the pilot's left-hand console. Five switches are provided. The steady-flash switch is a two-way switch with FLSH and STDY positions. The fuselage lights knob has BRT, MAN, and DIM positions. A manual key button is provided for manual flashing of the fuselage lights when the fuselage lights knob is in the MAN position. No automatic coding is provided. An indicator light on the panel monitors the flashing of the fuselage lights. The exterior lights panel contains five toggle switches: an anticollison light switch, a fuel probe switch, a wing lights switch, a taillights switch, and a taxilight switch. The ANTI-COLL lights switch has positions of ANTI-COLL and OFF. The FUEL PROBE light switch has positions OFF and ON. Both the wing lights switch and the taillights switch has positions of DIM, OFF, and BRT. The TAXI light switch has positions OFF and ON.

CAUTION

Turn off the anticollison light switch prior to engine shutdown.

AIR REFUELING PROBE LIGHT

An air refueling probe light (figure 1-4) is located between the left-hand canted frame station 62 and bulkhead 76. The light is recessed within the nose of the aircraft adjacent to the probe and is capable of lighting both the probe and drogue for a distance of approximately 50 feet. The light can be turned OFF and ON, without affecting the aircraft's refueling capabilities.

TAXI AND LANDING LIGHT

The taxi and landing light is mounted on the forward edge of the nosewheel door immediately below the approach light. To operate the taxilight, the taxi switch on the exterior lights control panel is placed in the ON position. The taxilight is powered by the 28-volt dc bus through the landing light circuit breaker on the companionway circuit breaker panel.

Note

Readings on the angle-of-attack indicator represent attitude of the aircraft relative to the airstream – not the flight path or the terrain.

ANGLE-OF-ATTACK APPROACH LIGHT

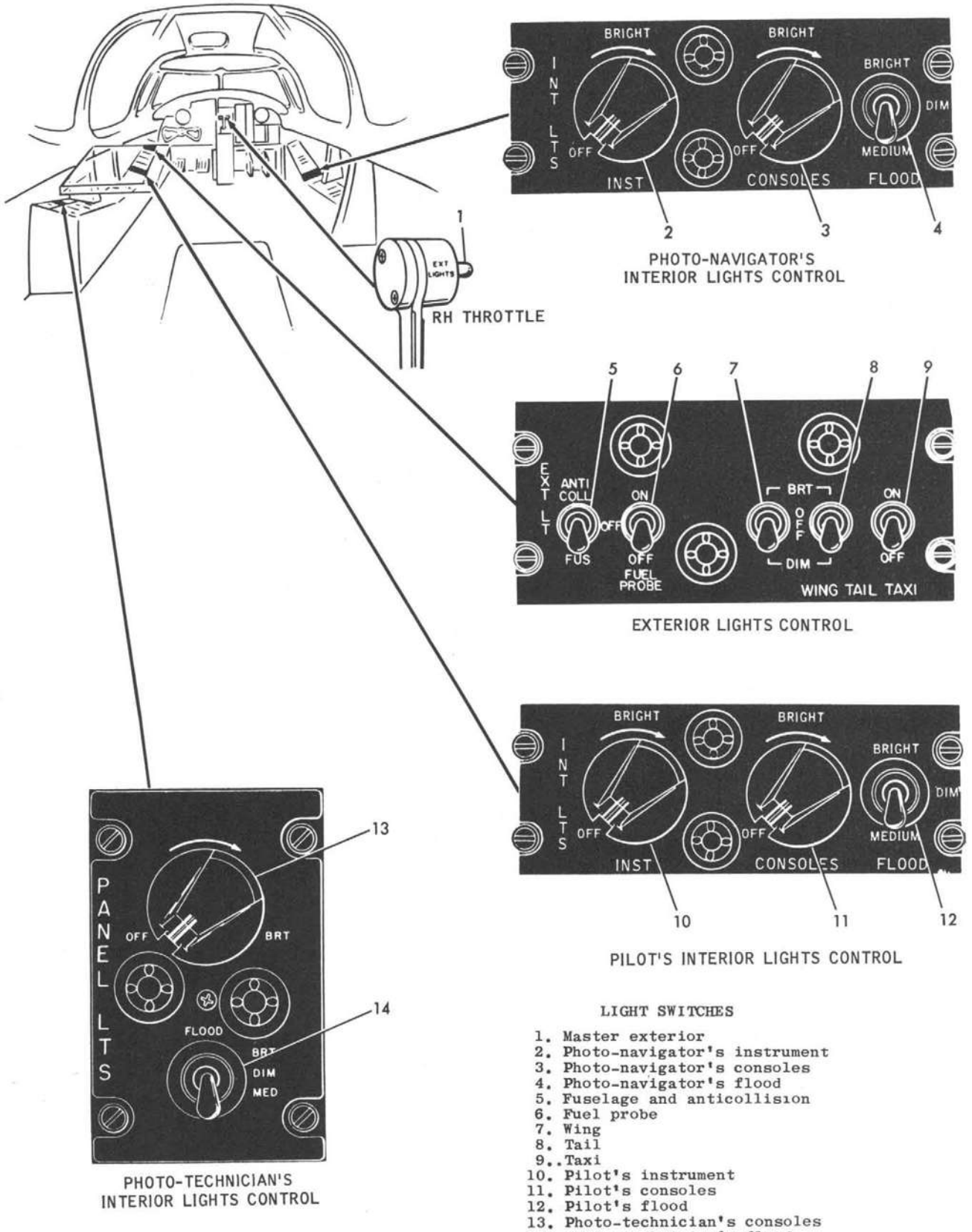
The external angle-of-attack approach light assembly (32, figure 1-4) is mounted on the nose gear door and consists of a red, green, and amber light. These lights come on one at a time. When the pointer is lined up with the center mark on the angle-of-attack indicator (3 o'clock position), the amber, or optimum approach angle-of-attack, light comes on. The approach light gives the following visual information to the LSO:

1. Amber light – glows when aircraft is within optimum angle-of-attack limits.

2. Red light – glows when angle-of-attack is too low.

3. Green light – glows when angle-of-attack is too high.

The lights are bright for daytime use, but become dim automatically when the exterior lights master switch is turned on for night flying. The lights operate only when the landing gear and hook are down and no weight is on the struts.



LIGHT SWITCHES

1. Master exterior
2. Photo-navigator's instrument
3. Photo-navigator's consoles
4. Photo-navigator's flood
5. Fuselage and anticollision
6. Fuel probe
7. Wing
8. Tail
9. Taxi
10. Pilot's instrument
11. Pilot's consoles
12. Pilot's flood
13. Photo-technician's consoles
14. Photo-technician's flood

ATB-1-1 P-28314-1A

Figure 1-35. Lighting Controls

OXYGEN SYSTEMS

LIQUID OXYGEN SYSTEM

A positive pressure, demand type, liquid oxygen system provides 100 percent oxygen at all times when the system is in use. The liquid oxygen system comprises two interconnected, ten-liter liquid oxygen tanks, check valves, relief valves, filler valves, shutoff valves, regulators, associated piping, and a quantity gage. The two insulated tanks (5, figure 1-4) are mounted in a converter compartment in the aft fuselage. Access to the converter compartment is through a door in the lower fuselage. Individual filler valves for each tank are located in the converter compartment. Evaporation of the liquid oxygen is constant when the system is not in use and this evaporation loss is used to pressurize the system. By venting any excess pressure overboard through relief valves, pressure is kept below 112 psig. When the system is being used, liquid oxygen flows through noninsulated lines in the converter compartment and between the converter and the cockpit. As it flows, the liquid oxygen warms and changes to gaseous oxygen.

CAUTION

The following instructions must be followed to prevent malfunction or contamination of the liquid oxygen system:

1. Liquid oxygen converter should be left in buildup condition with supply valve in OFF position, except while filling system;

2. Liquid oxygen system must not be permitted to go dry and be exposed to surrounding atmosphere. If converter system is exposed, water vapors or other gases may condense in liquid oxygen bottle causing malfunction of system valves or odors in oxygen supply;

3. If liquid oxygen quantity has become nearly depleted and aircraft remains for over two hours without refilling, maintenance crew should purge system with dry oxygen prior to further use.

LIQUID OXYGEN QUANTITY INDICATOR

A liquid oxygen quantity indicator is mounted on the pilot's instrument panel (37, figure 1-8). The outer edge of the dial face is marked in two liter units, from 0 to 20 with numerals at each even liter mark. To show the gage is inoperative, a small window on the upper face of the dial will read OFF when electric power is not available. A small red light on the lower face of the indicator will come on when the total liquid oxygen in the tanks is less than 2 liters. Quantity probes in each tank are wired together in conjunction with a power unit so that the indicator will show the total liquid oxygen in both tanks. If the aircraft is flown with only one converter, the electrical connecting wires to the missing converter must be connected to the simulator in the converter compartment in order to balance the gaging system. The gaging system will correctly indicate the quantity of liquid oxygen in the remaining converter.

CONTROLS AND EQUIPMENT

Each crew member is provided with a toggle-type ON, OFF, oxygen valve control switch. The pilot's oxygen control (3, figure 1-7), is located outboard on the left console, the photo-navigator's control (15, figure 1-13) is located on the right instrument panel, and the photo-technician's oxygen control (5, figure 1-15), is located outboard on the photo-technician's console. When any of these oxygen controls are positioned at ON, oxygen at approximately 85 psig is delivered to the corresponding crew members' oxygen receptacle. Each crew member's oxygen receptacle is located at the left rear corner of his seat except the pilot's which is on the side of the left console. When a crew member's oxygen hose is plugged into the receptacle and his oxygen switch is ON, oxygen will flow to the mask mounted regulator. From the regulator, oxygen is metered to the face mask at a slight positive pressure at all altitudes.

CAUTION

- The Type A-13A face mask used with this oxygen system should be fitted properly to the face for best results. Relatively small leaks around a mask are cumulative in effect and result in considerable oxygen loss over long periods of operation.
- Check oxygen hose connections for security before moving the oxygen switch to ON, as escaping oxygen creates a fire hazard in the proximity of oil or grease.

A 24-inch oxygen-radio extension hose is provided for the photo-navigator's use when at the periscopic sextant station, and a 168-inch oxygen-radio extension hose is provided for use of the photo-technician when working in the camera compartment. When used, the extension hose is inserted between the oxygen receptacle and the photo-navigator's, or photo-technician's oxygen hose coupling. When not in use, the photo-navigator's extension hose is stored in a compartment in the photo-navigator's seat carriage. The photo-technician's extension hose is stored beneath the photo-technician's seat.

EMERGENCY OXYGEN BOTTLE

Emergency gaseous oxygen is contained in a cylindrical, U-shaped emergency oxygen bottle installed in each seat cushion. An oxygen pressure gage located on the upper right-hand corner of each cushion (figure 1-48) shoudl read 1800 psi when the bottle is fully charged. Duration of the oxygen is approximately 10 minutes, dependent upon the altitude, since it is delivered by the mask regulator only upon demand. Oxygen is supplied from the bottle when a green ring secured to the left front side of the seat cushion is pulled. A pressure reducer valve in the system releases oxygen at 70 psi through the crewmembers oxygen receptacle, to the hose, regulator, and mask. A check valve in the segment of the supply tube which plugs into each oxygen receptacle prevents loss of oxygen when the emergency oxygen bottle is actuated.

NORMAL OPERATION

Before each flight the liquid oxygen quantity gage and each emergency oxygen bottle pressure gage should be checked to assure there is adequate oxygen for the mission. Before each flight the oxygen system and mask should be checked as follows:

1. Check condition of fittings, hose, regulator, and mask.

2. Inspect exhalation valve for foreign matter (sand, grit, lint, etc.).

3. Inspect inhalation valves to see that valve body is properly seated in mask.

4. Inspect inhalation valves for foreign matter and proper mounting of plastic covers; arrow scribed on cover must point down.

5. Insert end of oxygen hose into mouth and suck lightly. Inhalation valves should collapse firmly against valve bodies.

6. Place mask on face without connecting oxygen hose to aircraft oxygen system and exhale. Exhalation should be possible without difficulty or resistance if exhalation valve is unseating properly.

7. Under same conditions, inhale. Inhalation should be difficult if exhalation valve is seating properly. Some air will enter mask through inhalation valves via oxygen regulator and restrictor in supply tube.

8. With mask in place, connect mask oxygen supply tube to oxygen receptacle on seat cushion and turn oxygen switch ON. Inhalation should be very easy to accomplish if regulator is operative and delivering oxygen at slight positive pressure. Exhalation should also be possible without difficulty. If exhalation is difficult there is inhalation valve leakage.

9. During above, check for odors or contamination in oxygen supply.

10. Check security of hose and radio couplings.

DURING FLIGHT

The following should be checked frequently during flight:

1. Oxygen supply.

2. Oxygen mask for secure fit.

3. Security of oxygen disconnect couplings.

WARNING

- Loss of radio communication may indicate separation of the oxygen hose couplings. Check these connections for security before making any other check of the communication equipment.

- If there is any indication of oxygen contamination during flight, descend immediately to below oxygen altitude. If necessary use the emergency oxygen supply.

Duration of the oxygen supply (see figure 1-36) can be increased by either of the following methods:

1. Reduce number of crewmen breathing oxygen. With cabin pressurization at 7.5 psi (normal) and aircraft altitude below 38,000 ft., cabin altitude will be below 10,000 ft. No oxygen will be required except for pilot.

2. Reduce cabin pressurization from 7.5 psi (normal) to 3.3 psi (combat) to increase duration of oxygen supply. Volume of available oxygen increases as altitude increases. Thus, because volume of oxygen required by pilot's lungs is approximately same at any altitude, less of 100 percent oxygen delivered at reduced cockpit pressure is required to satisfy demand.

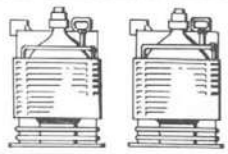
AFTER FLIGHT

After each flight, check:

1. Oxygen switches (3) . . . . . OFF

2. Disconnect mask-to-seat cushion oxygen connection and see that dust cover snaps into place.

LIQUID OXYGEN DURATION



CABIN PRESSURE ALTITUDE FEET	MAN HOURS REMAINING GAGE READING (LITERS)									
	20	18	16	14	12	10	8	6	4	2
40,000	121.2	109.1	97.0	84.8	72.6	60.6	48.5	36.4	24.2	12.0
35,000	74.0	66.6	59.2	51.8	44.4	37.0	29.6	22.2	14.8	7.4
30,000	54.4	49.0	43.6	28.0	32.6	27.2	21.8	16.4	10.8	5.4
25,000	40.8	36.8	32.8	28.6	24.4	20.4	16.4	12.4	8.2	4.0
20,000	32.0	28.8	25.6	22.4	19.2	16.0	12.8	9.6	6.4	3.2
15,000	25.6	23.0	20.4	18.0	15.4	12.8	10.2	7.6	5.2	2.6
10,000	20.0	18.0	16.0	14.0	12.0	10.0	8.0	6.0	4.0	2.0
8000	18.8	16.8	15.0	13.0	11.2	9.4	7.4	5.6	3.7	1.8
SEA LEVEL	14.0	12.6	11.2	9.8	8.4	7.0	5.6	4.2	2.8	1.4

P-40626-1

REMARKS:
(1) Based on 800 liters of gaseous oxygen per liter of liquid oxygen.
(2) Data assume the use of a properly fitted mask.

DATA AS OF: 15 October 1957

DATA BASIS: Specification MIL-I-19326(Aer) taken from NAVAER 03-50-517

Figure 1-36. Oxygen Duration

3. Report any oxygen system discrepancies.

4. If oxygen quantity is low have system refilled to prevent contamination.

EMERGENCY OXYGEN OPERATION

In the event of liquid oxygen system failure or depletion of supply, activate the emergency system by pulling the green ring at the left front of each seat cushion. Descend to a lower altitude.

AUTOPILOT

The aircraft is equipped with a Sperry S-5 autopilot system, which provides three-axis control of the aircraft when operating in the autopilot mode of operation, and rudder control alone when operating as a yaw damper assist to the manual control of the aircraft. In the autopilot mode, it is possible to switch from the normal attitude control to the altitude-hold and/or the skid-turn mode. The skid-turn control provides cross-control signals to the rudder and ailerons to make flat turns during photographic missions. The autopilot mode incorporates automatic trim control circuitry which senses the steady-state trim held by the elevator and drives the horizontal stabilizer to assume the trim requirement.

Note

There may be some instability during the altitude-hold mode of operation above 400 KIAS.

The autopilot is completely electrical in operation and derives 115/200 volt, 400-cycle, ac power from the ac primary bus through the compass adapter, compass AFCS, and two compass circuit breakers. DC electrical power is provided by the 28-volt dc primary bus

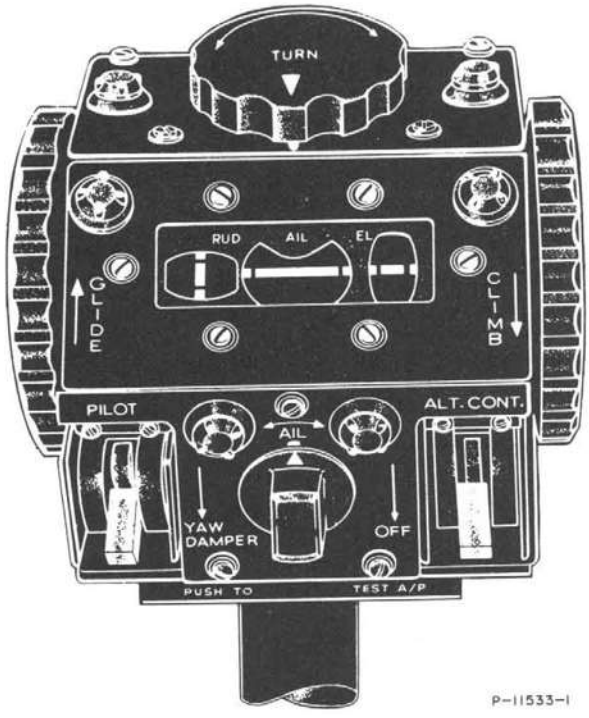


Figure 1-37. Autopilot Pedestal Controller

through the following circuit breakers: autopilot filament, autopilot servo control, autopilot field and interlock, and horizontal stabilizer – with autopilot. All autopilot circuit breakers are located on the companionway circuit breaker and fuse panel (see figure 1-27). Two skid-turn circuit breakers located on the photo circuit breaker panel 106 (see figure 1-27) supply phase C and phase B, 115-volt, 400-cycle, ac power to the skid turn units. 26-volt ac power is supplied to the amplifier-integrator through a fuse.

In the yaw-damper mode, the yaw-rate damping signal is generated by integrating the outputs of the forward and aft accelerometers. Since the yaw damper and autopilot utilize different command transducers and different components of the autopilot amplifier, their modes of operation and their malfunctions are essentially isolated.

The autopilot receives its primary command signals from the directional gyro controlling the MA-1 compass system for control about the yaw axis, and from a vertical gyro for control about the lateral and longitudinal axes. Both gyros are located in the flash bomb bay. Secondary command signals governing turns, climbs, glides, trim, and constant pressure altitude control may be introduced into the system by the pilot through use of the autopilot pedestal controller (see figure 1-37) and the skid-turn control knob (13, figure 1-9).

When the autopilot is engaged, an automatic trimming feature makes it unnecessary to trim the aircraft longitudinally after autopilot controlled maneuvering or upon shutdown of the autopilot. After engagement of the autopilot, changes in trim about the roll axis must be corrected by the pilot through an aileron control provided on the autopilot pedestal controller. A signal system aligns itself continuously with the attitude of the aircraft so that the autopilot may be engaged with the aircraft in any normal flight attitude except a turn. However, it is recommended that the aircraft be trimmed for hands-off flight by the pilot through his normal trim controls prior to engaging the autopilot. This will prevent unduly severe control movement and trim change requirements when the autopilot is engaged. An autopilot out-of-trim condition about any axis is indicated to the pilot visually by autopilot trim indicators provided on the pedestal controller. When engaged, the autopilot will maintain the attitude and heading which existed at the time of engagement. Electrical and mechanical interlocks are provided so that the autopilot cannot be turned on or the servos engaged unless the proper procedure is followed.

Manual execution of skid turns used during a photographic mission requires precise control to maintain a wings-level attitude within ± 3 degrees. Moreover it requires that the proper rudder and aileron control for the sequence of incremental control surface deflections and aircraft responses which lead to a skid turn – must be scheduled without the help of the reflexes the pilot has developed for coordinated turns. The skid-turn mode facilitates the execution of small, wings-level heading corrections by inducing programmed rudder and aileron deflections through the autopilot system. The roll integrator provides the signal – between skid entry and skid exit – to maintain wings level even though the programmed rudder and aileron signals may not be perfectly matched. This roll-angle correction signal, which prevents a steady-state wing-down condition, is essential: an outside wing-down condition of only 3/4 degree is sufficient to cancel the turning moment available from the torque-limited rudder system.

In the speed range of 200 to 400 KIAS, and above 10,000 feet, skid-turn operation capability is as follows:

Roll Angle: Less than ± 2 degrees

Roll Rate: Less than one degree per second

Turn Rate: Six degrees per minute maximum

Although the skid-turn system was designed for small course corrections through the autopilot during cartographic photographic missions, skid-turn rates up to 40 degrees per minute are made feasible by reducing the thrust of the "inside" engine.

An autopilot release switch (9, figure 1-6) is provided on the pilot's control column for autopilot emergency disengagement.

AUTOPILOT CONTROLS

AUTOPILOT PEDESTAL CONTROLLER

The autopilot pedestal controller (figure 1-37) incorporates controls for turning the autopilot on and off, maneuvering, trim indication, maintenance of constant pressure altitude, and ground testing the autopilot system. These controls are: the autopilot-yaw damper switch; the altitude control switch; the climb-glide knobs; the turn knob; the aileron trim knob; and the ground test bar.

CAUTION

Do not use the pedestal controller as a step, as this action will damage the unit.

AUTOPILOT-YAW DAMPER SWITCH. The autopilot-yaw damper switch has two positions, PILOT and YAW DAMPER. In the YAW DAMPER position of the switch, automatic yaw damping, through control of the rudder alone, is provided to damp or decrease the amplitude of lateral-directional oscillations during normal flight. This damping is effected by making rudder servo movement a function of the rate of change of airplane heading which is sensed by two accelerometers, one located in the aft fuselage and one located in the flight compartment. If an uncoordinated maneuver is to be performed, the yaw damping system servo can be deenergized by applying pressure in excess of 25 pounds to the rudder pedals. Engagement of the yaw damper system is effected by placing the AFCS switch (4, figure 1-7) at SERVOS ENGAGE. (Refer to Automatic Flight Control System (AFCS) Switch, in this section). Placing the autopilot-yaw damper switch at PILOT energizes the rudder, elevator, and aileron circuits of the autopilot system. With the switch at PILOT it is only necessary to place the AFCS switch at SERVOS ENGAGE to obtain complete automatic flight control.

ALTITUDE CONTROL SWITCH. The altitude control switch has two positions, ALT CONT and OFF. The autopilot-yaw damper switch must be in the PILOT position to engage the altitude control switch. Placing the switch at ALT CONT when the autopilot-yaw damper switch is at PILOT and the AFCS switch is at SERVOS ENGAGE will cause the autopilot system to maintain the aircraft at a constant pressure altitude, even during turns. Under certain conditions, the altitude-hold transducer may permit a constant-rate loss or gain of altitude during autopilot operation in the altitude-hold mode. For example, the transducer will saturate if the aircraft pitch attitude at engagement is 4.8 degrees greater or less than the level-flight pitch attitude. Recommended practice is to attain a level-flight attitude at the selected cruising altitude before engaging the altitude-hold mode, and to avoid large airspeed variations after engagement. Loss of altitude during turns is likely only near the top of the flight envelope.

CAUTION

If the altitude control is turned on during a climb, the aircraft tends to overshoot the desired altitude momentarily. This overshooting may damage the bellows in the altitude sensing mechanism.

CLIMB-GLIDE CONTROL. The pitch control wheels, labeled CLIMB and GLIDE, mounted one on each side of the autopilot pedestal controller, provide control of pitch attitude. These wheels are operative only when the autopilot-yaw damper switch is at PILOT, the AFCS switch is at SERVOS ENGAGE, and the altitude control switch is at OFF. Interlocks deactivate the pitch control wheels when the altitude control switch is in the ALT CONT position. The rate of climb or descent is proportional to the degree of rotation of the wheels.

TURN CONTROL. The turn control knob on top of the autopilot pedestal controller provides coordinated turning control if the autopilot-yaw damper switch is at PILOT and the AFCS switch is at SERVOS ENGAGE. Rotating the turn knob out of detent in the desired direction of turn applies both rudder and aileron, resulting in coordinated turns at any airspeed. The rate of turn depends upon the degree of rotation of the turn knob from the center position.

AILERON CONTROL. The aileron control knob on the front face of the autopilot pedestal controller has a centering or neutral mark. Rotating the knob clockwise or counterclockwise from this mark adjusts the lateral reference point for the autopilot which results in a right or left wing down movement to effect lateral trim.

TRIM POSITION INDICATORS. The rudder, aileron, and elevator trim indicators on the front of the autopilot pedestal controller give a visual indication of autopilot servo voltage for each axis. These trim indicators should center and remain motionless within 20 seconds after the autopilot-yaw damper switch is placed at PILOT. If one or more of the indicators are not centered, tap the bezel glass. If the indicator still remains offcenter, do not place the AFCS switch at SERVOS ENGAGE; else severe engagement of the servos, with consequent undue control movement and accelerated maneuvers, may result.

GROUND TEST BAR. The ground test bar is mounted underneath the front edge of the autopilot pedestal controller. This press-to-test bar is used to simulate inflight autopilot operation by completing a circuit that

bypasses the main landing gear interlocks, which disable the autopilot when the aircraft is on the ground. For the applicable preflight procedure steps, the photonavigator holds the ground test bar depressed while the pilot performs the autopilot checks. When the bar is not depressed, the autopilot-yaw damper switch is locked in YAW DAMPER, the altitude control switch is locked in OFF, and the AFCS switch is locked in OFF.

SKID-TURN CONTROLLER

The skid-turn controller incorporates the engage switch (12, figure 1-9), the skid-turn knob (13, figure 1-9), and the skid entry outside wing trim knob (14, figure 1-9).

SKID-TURN ENGAGE SWITCH. The skid-turn engage switch (12, figure 1-9) makes the necessary connections between the skid-turn system and the autopilot circuits.

SKID-TURN KNOB. The skid-turn knob (13, figure 1-9) programs secondary command signals into the aileron and rudder channels of the autopilot command loops. The heading reference is synchronized during the skid turn to allow the autopilot to maintain the new heading. Rotation of the skid-turn knob also removes the erection voltage from the autopilot vertical gyro and the leveling voltage from the MA-1 compass, and engages the bail locks of the ASB-1 gyro. This switching prevents erection of the gyros to a false vertical when lateral acceleration is applied during the skid turn. To prevent excessive gyro drift, however, the skid-turn knob should not be left out of detent longer than necessary.

SKID-ENTRY OUTSIDE WING TRIM KNOB. The skid-entry trim knob (14, figure 1-9) controls a voltage in the aileron channel which cancels the rolling moment induced during skid-turn entry and exit. The trim is adjusted once for each flight condition to correct for an outside wing-up or wing-down condition. (Refer to Skid-Turn Pretarget Calibration in this section.)

Note

Jumper plugs must be installed in place of the skid-turn units when these units are removed.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS) SWITCH

The AFCS switch (4, figure 1-7), located on the pilot's left-hand console, has two positions, SERVOS ENGAGE and OFF. The function of the AFCS switch is to engage the rudder servo when the autopilot-yaw damper switch is at YAW DAMPER, or to engage the rudder, elevator, and aileron servos when the autopilot-yaw damper switch is at PILOT. The AFCS switch should be placed at SERVOS ENGAGE for automatic pilot operation only after the autopilot-yaw damper switch has been placed at PILOT. An interlock circuit will cause the AFCS switch to drop into the OFF position if it is placed at SERVOS ENGAGE before the autopilot-yaw damper switch is moved to PILOT. Placing the AFCS switch at OFF during any phase of autopilot controlled flight will cause the servos to disengage and all switches to drop to OFF.

EMERGENCY PROCEDURES

HARDOVER FAILURES

Hardover failures are indicated by abrupt movement of flight controls and by g-forces. Hardovers are limited in magnitude by force saturation of the autopilot servos, which can be overpowered by the pilot. Maximum manual overpowering forces are 90 pounds in the rudder channel, 60 pounds in the aileron channel, and 45 pounds in the elevator channel. A mechanical limiter protects the rudder channel by limiting rudder torque to a safe value in case of a hardover. An aileron limit switch automatically disengages the autopilot whenever the single aileron deflection exceeds 10 degrees. A torque limiter in the elevator channel prevents autopilot induced hardovers from exceeding the airplane structural limit within 2 seconds.

AUTOMATIC PITCH-TRIM FAILURES

An automatic pitch-trim failure can cause the horizontal stabilizer to become inoperative or to run away. An inoperative horizontal stabilizer reduces the capability of the longitudinal channel to maintain altitude through varying flight conditions, such as airspeed or c g changes. A loss of altitude may result. The horizontal stabilizer runs away at 0.05 degree per second. The autopilot will compensate for this runaway to the limit of its output torque (45 pounds at the control column); then the aircraft will respond slowly to the horizontal stabilizer movement. The pilot should immediately correct the aircraft attitude and disengage the autopilot. Disengagement will stop this type of stabilizer runaway. The pilot can then retrim the aircraft with the pitch-trim button.

AUTOPILOT USE FOLLOWING BOOST DISCONNECT

The autopilot may be used with the control boost disconnected to prevent pilot fatigue; however, the rate of response will be slow. In calm air cruising, no problem will be encountered, as control inputs will be of small magnitude. Turbulence should be avoided, as the autopilot will not be capable of the greater control deflections required. Response of the aircraft to control inputs will be rather sloppy. Since the autopilot is designed for saturation loads, it will not be damaged when used with boost disconnected.

PART 3

SERVICING

INTRODUCTION

This section contains detailed procedures for towing, pushing and parking, minimum turn radius and vertical clearance, servicing (points, capacities, and specifications see figure 1-38), hoisting provisions, external GTC starter operation, and danger areas (ground hazards) (see figure 1-53). Also included are detailed procedures for fueling (pressure and gravity) and defueling the aircraft.

GROUND HANDLING PROCEDURES

To tow the aircraft, first disconnect the nosewheel torque link. After this has been done the aircraft can be towed either forward or backward by a tow bar attached to the nosewheel axle. Maintain a minimum of 1500 psi on the brake system pressure gage by operation of the deck handling hydraulic handpump.

TOWING AND PUSHING

(See figure 1-39.)

WARNING

Do not tow or push aircraft with one engine removed; overbalance will cause damage to wing and nacelle and possibly injure personnel.

1. Install landing gear locking pins.
2. Disconnect nose gear torque link (scissors).
3. Verify that arresting hook is retracted and latched.
4. Attach tow bar with extension to nosewheel axle.
5. Verify that nose gear shock strut is extended sufficiently to provide clearance between nose gear door and tractor on turns.
6. Verify that brake accumulator pneumatic pressure is 400 psi.
7. Provide minimum of 1500 psi hydraulic pressure for brakes by manually operating GROUND HANDLING PUMP HANDLE (on cockpit floor, RH side of pilot's seat).

CAUTION

For emergency braking, pull emergency brake handle (in pilot's lower instrument panel).

8. Station man in cockpit to operate brakes and man at either wing tip to watch for clearance (see figure 1-40).

PARKING

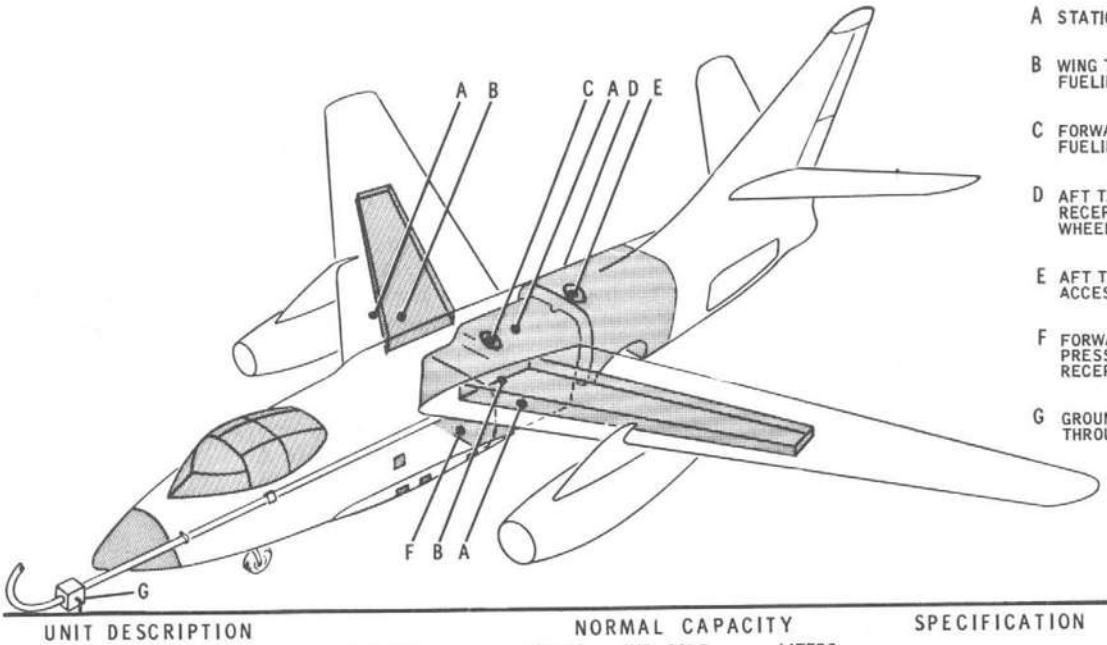
1. If possible, head aircraft into wind.
2. Engage gust locks.
3. Install main and nose landing gear ground locking pins, and lower escape door safety pins.
4. Chock wheels fore and aft.
5. Fold wing and fin, if desired.

CAUTION

Close escape chute and upper escape hatch at night, during rainstorms, and when washing aircraft.

MOORING

The aircraft is equipped with fittings to accept tiedown cables or chains for all mooring conditions. (For locations of tiedown fittings, see figure 1-41.)



A STATIC GROUND POINT

B WING TANK GRAVITY FUELING POINT

C FORWARD TANK GRAVITY FUELING POINT

D AFT TANK PRESSURE FUELING RECEPTACLE (RIGHT HAND WHEEL WELL)

E AFT TANK DIPSTICK ACCESS POINT

F FORWARD AND WING TANKS PRESSURE FUELING RECEPTACLE

G GROUND OR AIR RE-FUELING THROUGH PROBE

UNIT DESCRIPTION	NORMAL CAPACITY U.S. GALS	POUNDS	IMP. GALS	LITERS	SPECIFICATION	NATO SYMBOL
Aft tank pressure fueling receptacle	1760	11,968	1466	6661	MIL-J-5624E (JP-5)	F-44
Wing and fwd fuselage tank pressure fueling receptacle	3112	21,262	2591	11,779	MIL-J-5624E (JP-5)	F-44
Fwd fuselage tank gravity filler	1832	12,458	1525	6934	MIL-J-5624E (JP-5)	F-44
Left-hand wing tank gravity filler	667	4536	555	2525	MIL-J-5624E (JP-5)	F-44
Right-hand wing tank gravity filler	667	4536	555	2525	MIL-J-5624E (JP-5)	F-44
Engine oil tank (2)	5.5		4.5	20.8	MIL-L-23699 (OIL)	O-156
ATM (2)	2.6 Qts.		2.1 Qts.	2.4	MIL-O-6081 (OIL) Grade 1010 (-18°C and above) or grade 1005 (-18°C and below)	O-133 (Grade 1010) O-132 (Grade 1005)
Utility hydraulic system reservoir	4.4		3.7	17	MIL-H-5606 (Hyd. fluid)	H-515
Aileron control system hydraulic reservoir	0.33		0.27	1.25	MIL-H-5606 (Hyd. fluid)	H-515
Surface control system hydraulic reservoir	0.33		0.27	1.25	MIL-H-5606 (Hyd. fluid)	H-515
Spoiler system accumulator and pressure gage	1150 psi				Compressed air	
Arresting hook accumulator and pressure gage	650-700 psi				Compressed air	
M. G. brake accumulator hytrol and pressure gage	400 psi				Compressed air	
Nosewheel steering accumulator and pressure gage	350 psi				Compressed air	
Landing gear doors air bottle	3000 psi				Compressed air	
Emergency wing flaps and emergency generator air bottle and gage	3000 psi				Compressed air	
Emergency landing gear air bottle and gage	3000 psi				Compressed air	
Emergency wheel brakes air bottle and gage	3000 psi				Compressed air	
Flash bomb bay doors air bottle and gage	3000 psi				Dry nitrogen gas	
Bailout warning horn bottle and pressure gage	2000 psi				Liquid oxygen	
Liquid oxygen converter and filler valve (2)	10 liters each				Dry breathing oxygen	
Emergency oxygen bottle and pressure gage	1800 psi				Replace unit if blowout disk is ruptured or if the system has been used	
CO_2 bottle wing tank purge	1800 psi 15.0 pounds CO_2				Drinking water	
Canteens (3)	1 quart each		0.83 Qts.	0.95	Hot or cold beverage	
Thermos bottles (2)	1 quart each		0.83 Qts.	0.95		

FUEL RECOMMENDED:		NATO SYMBOL	
Afloat	JP-5	MIL-J-5624E	F-44
Ashore	JP-5	MIL-J-5624E	F-44
	JP-4	MIL-J-5624E	F-40
Emergency Fuel	AVGAS 100/130	MIL-G-5572B	F-18
	AVGAS 115/145	MIL-G-5572B	F-22

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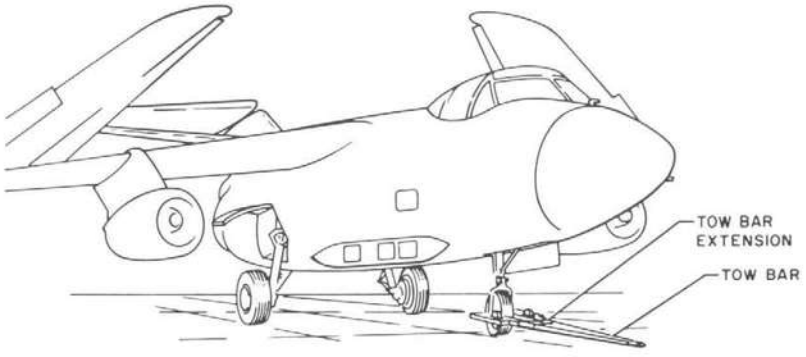
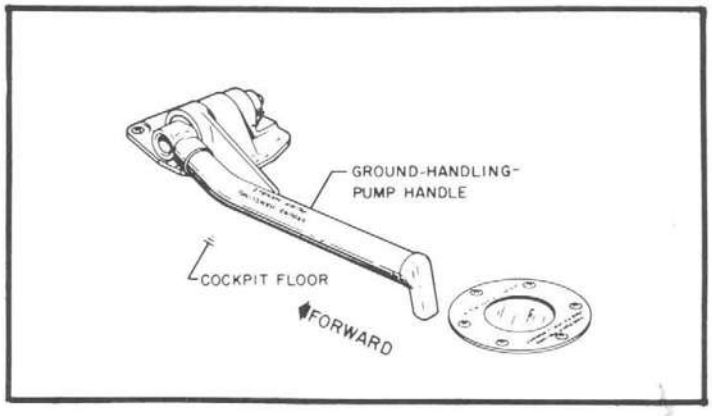
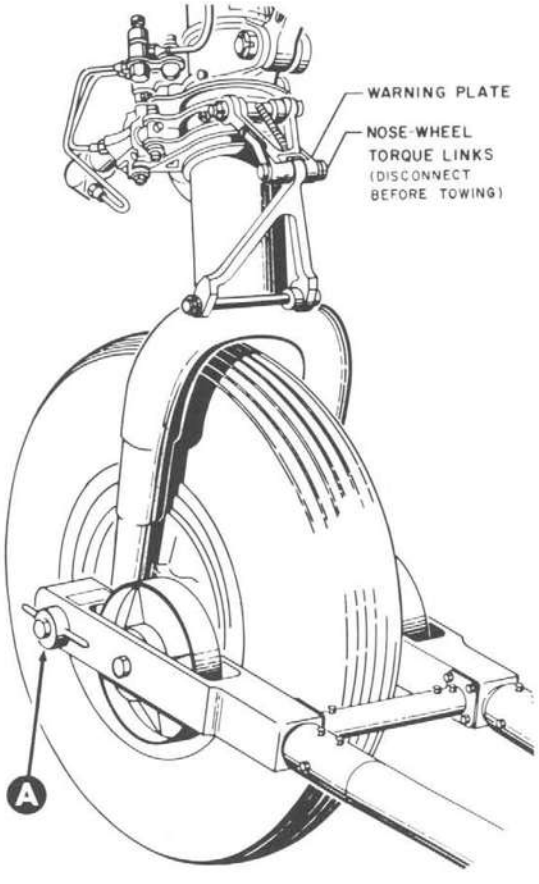
Figure 1-38. General Servicing







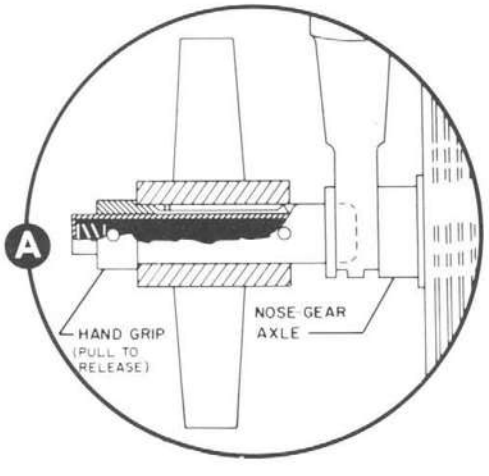


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Figure 1-39. Towing and Pushing

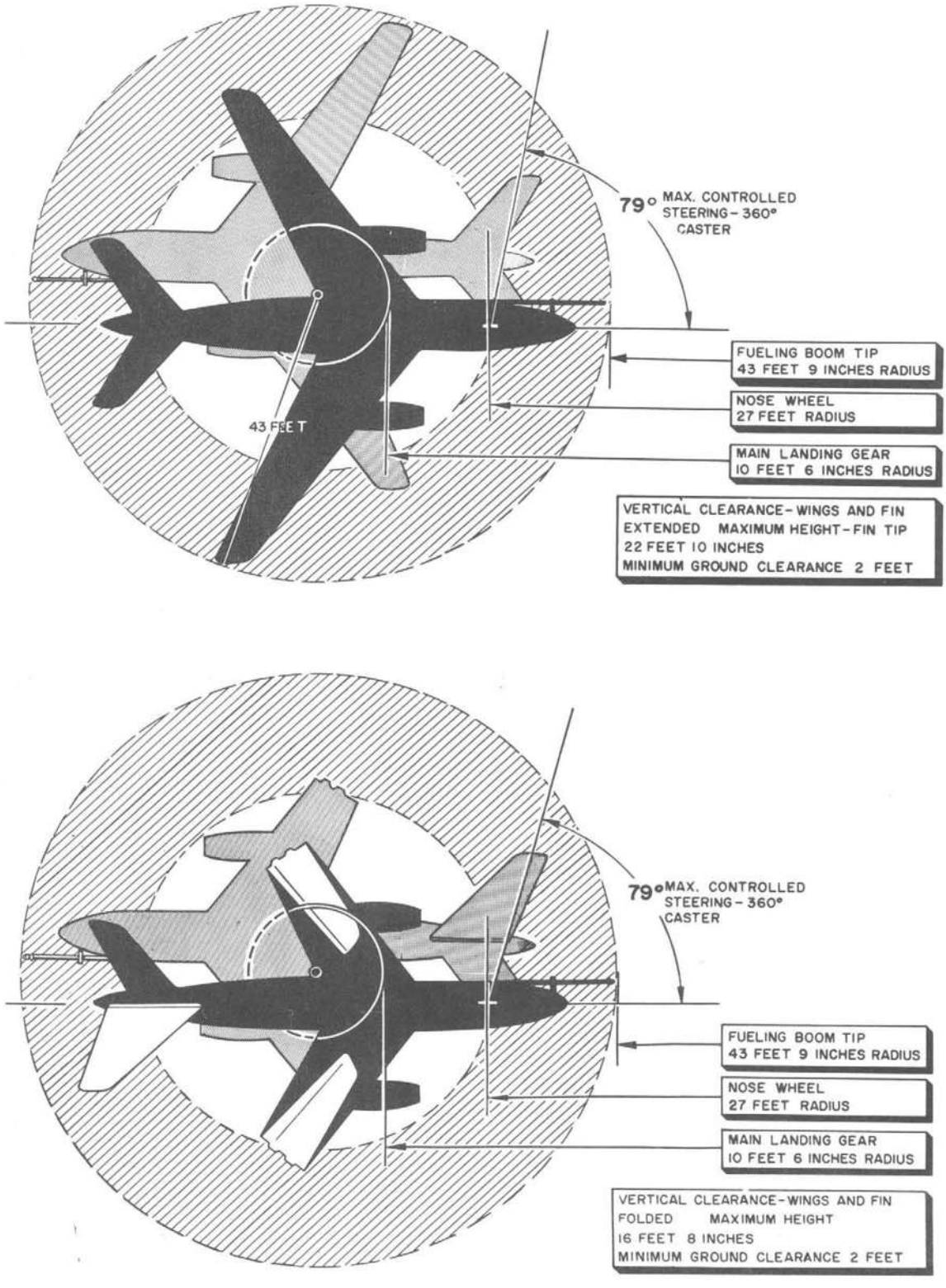

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Figure 1-40. Minimum Turn Radius and Vertical Clearance

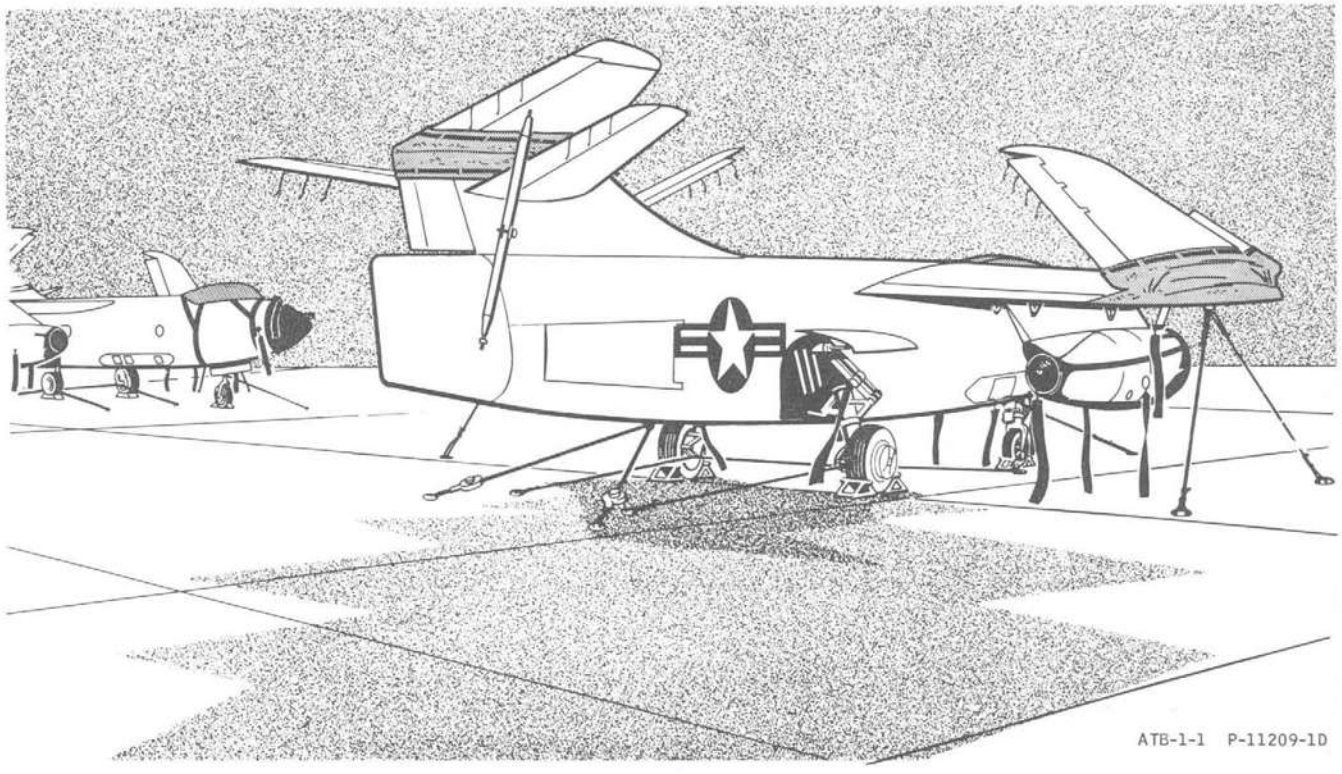


Figure 1-41. Mooring

FUELING

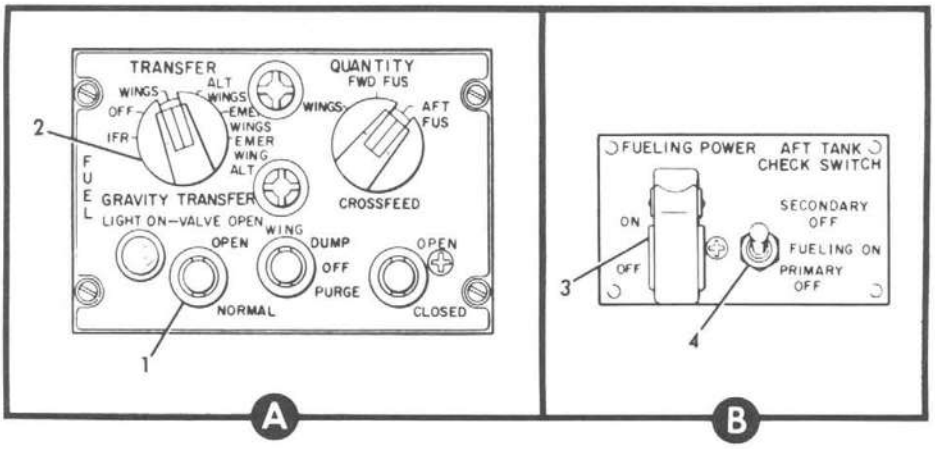
(See figure 1-42.)

Note

Partial wing fuel loads are not recommended: wing tanks will not fuel evenly during pressure fueling.

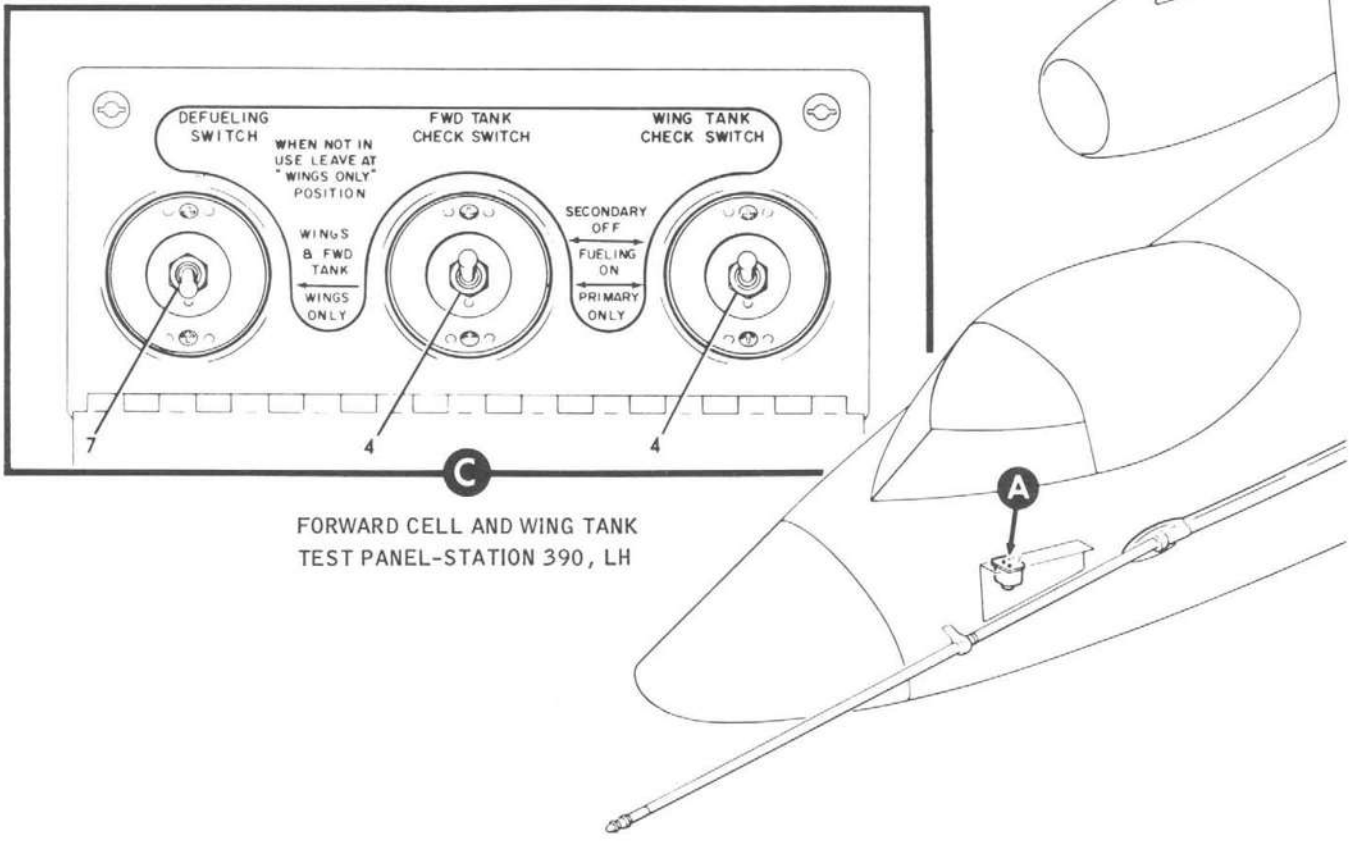
PRESSURE FUELING AND DEFUELING

The pressure fueling system is designed to permit fueling at a rate of 150 to 300 gallons per minute (see table 1-3) through each of two pressure fueling receptacles. One receptacle, servicing the aft fuselage tank, is located in the right-hand wheelwell. The other, servicing the forward fuselage and wing tanks, is located on the bottom of the fuselage forward of the left-hand wheelwell. The system may be defueled through the same receptacles at a rate of 60 to 100 gallons per minute each. It is necessary to connect external dc electrical power to fuel all tanks and to defuel the fuselage tanks. A pressure fueling switch panel is located adjacent to each pressure fueling receptacle to control the fueling and defueling operation. When fueling the wing and forward fuselage tanks through the wing and forward tank pressure fueling receptacle, fuel pressure opens the fueling shutoff valve in each tank, allowing fuel to enter the tank and also to flow through the pressure sensing lines to the dual float pilot valves. When a tank becomes full, the floats of the pilot valve close the pressure sensing lines, causing pressure to increase behind the diaphragms of the shutoff valve and close it. This stops the flow of fuel into the tank. The two check switches provided on the pressure fueling switch panel for the forward fuselage and wing tanks may be used to check the functional status of the dual float pilot valves. The check can be made only if 28-volt dc electrical power is supplied to the aircraft and after the pressure fueling operation has begun. If it is desired to pressure fuel the forward tank only, it is necessary to manually hold the wing tanks check switch at either PRIMARY OFF or SECONDARY OFF to prevent fuel from flowing into the wing tanks. When fueling the aft fuselage fuel tank, through the aft fuselage tank pressure fueling receptacle, it is necessary to apply 28-volt dc electrical power to the aircraft and to place the pressure fueling power switch at ON before the fueling operation is begun. This action opens the aft fuselage tank solenoid operated fuel manifold valve, allowing fuel to enter the tank. The dual float pilot switch in the aft fuselage tank breaks the circuit to the manifold valve when the fuel load reaches 1000 gallons, thus closing the manifold valve to discontinue fueling. The check switch on the aft fuselage tank pressure fueling switch panel may be used to check the functional status of the dual float pilot switch after the fueling operation has begun.



FUEL PANEL-PILOT'S CONSOLE

REAR CELL TEST PANEL-RH MAIN GEAR WELL



FORWARD CELL AND WING TANK TEST PANEL-STATION 390, LH

1. Gravity transfer switch
2. Fuel transfer switch
3. Fueling power aft tank switch
4. Shutoff valve check switch
5. Aft pressure fueling cap
6. Forward pressure fueling cap
7. Defueling switch
8. Vent outlet
9. Gravity filling caps

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Figure 1-42. Fueling (Sheet 1)

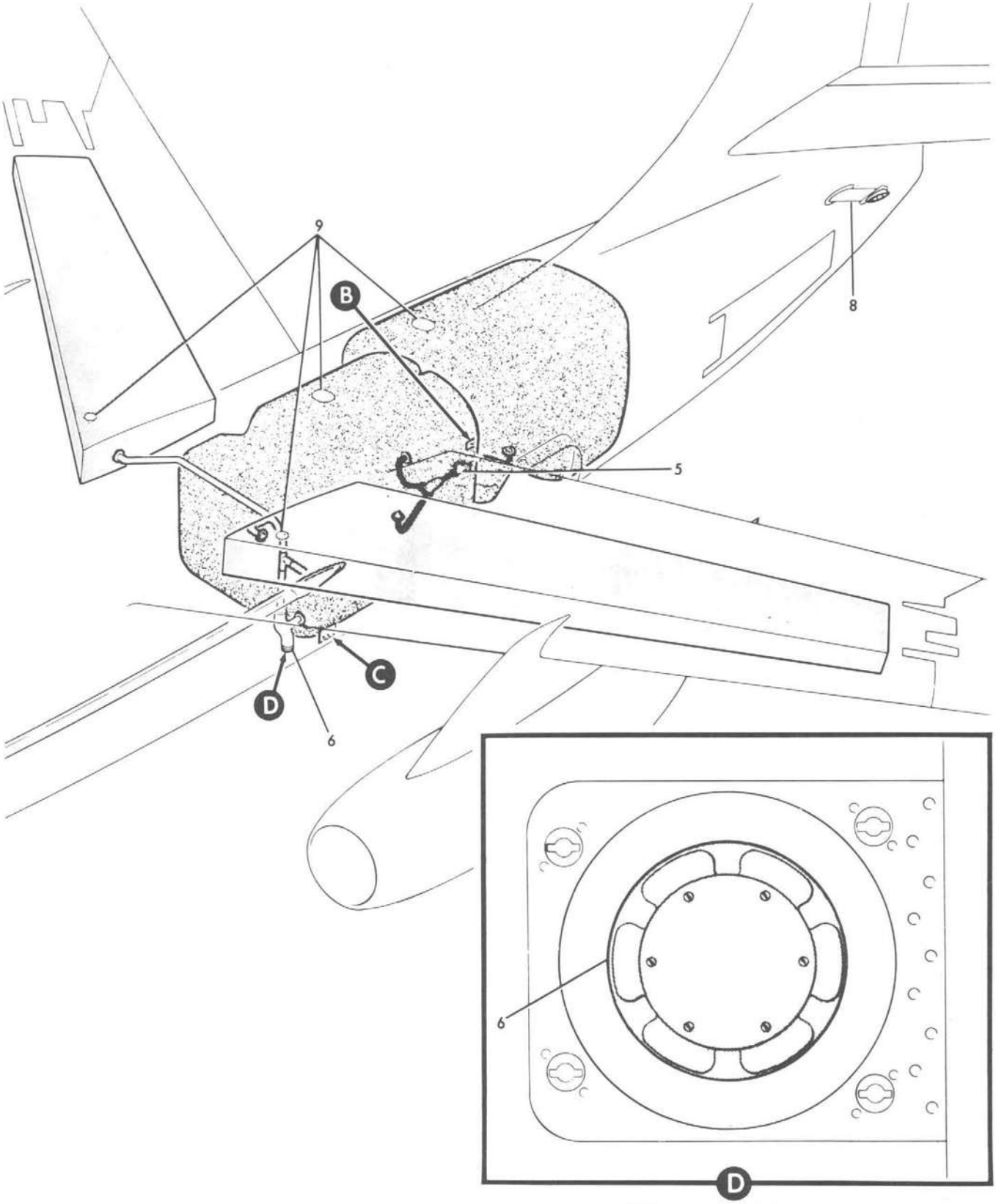


Figure 1-42. Fueling (Sheet 2)

TABLE 1-3. FUEL TANK CAPACITY

TANK OR CELL	TOTAL TANK VOLUME (US GALLONS)	RESIDUAL FUEL (US GALLONS)	EXPANSION SPACE (US GALLONS)	SERVICE CAPACITY		
				US GALLONS	IMPERIAL GALLONS	LITERS
Wing	1336	2	36	1298	1082	4920
Forward fuselage cell	1835	3	18	1814	1513	6870
Aft fuselage cell, airplanes reworked per BuWeps A3D/ASC 284 (Increment II)	1928	3	165	1766	1469	6661
Total, airplanes reworked per BuWeps A3D/ASC 284 (Increment II)	5099	8	219	4872	4068	18,440

Note

An additional 54 gallons may be obtained by using gravity fueling to completely fill the forward fuel cell and wing tanks.

PRESSURE FUELING SWITCH PANELS

(See figure 1-42.)

The pressure fueling switch panel controlling the aft fuselage fuel tank is located in the right-hand wheelwell. This panel has two switches: the pressure fueling power switch and the aft tank check switch. The pressure fueling power switch has two positions, ON and OFF. Placing the switch at ON energizes the circuit to the aft fuselage tank manifold valve solenoids through the aft fuselage tank dual float pilot switches. The aft tank check switch has three positions, PRIMARY OFF, FUELING ON, and SECONDARY OFF. Placing the switch at either PRIMARY OFF or SECONDARY OFF energizes the primary or secondary solenoid operated pilot float switch, deenergizing the respective aft fuselage tank manifold valve solenoid, simulating the normal shutoff valve action at the maximum fuel capacity level.

The pressure fueling switch panel controlling the forward fuselage and wing tanks is located behind an access door on the left side of the fuselage forward of the left wheelwell. This panel has three switches; the forward tank check switch, the wing tanks check switch, and the defueling switch. The defueling switch has two positions, WINGS & FWD TANKS and WINGS ONLY. The system is inoperative when the switch is placed in the WINGS & FWD TANKS position. With the switch positioned at WINGS ONLY, it is possible to defuel the wing tanks only. The forward tank check switch and wing tank check switch each have three positions, PRIMARY OFF, FUELING ON, and SECONDARY OFF. Placing either switch at PRIMARY OFF or SECONDARY OFF energizes the primary or secondary solenoid of its respective dual float pilot valve, closing the pressure fueling pressure sensing lines which closes the pressure fueling shutoff valve to simulate the normal shutoff valve action at the maximum fuel capacity level. (Refer to table 1-4 for pressure fueling switch positions.)

Note

Fuel recommended per BuWeps Inst. 10341 (current revision) should be used. Emergency fuel is to be used only under emergency conditions and for a minimum of flight time. The pilot's permission must be obtained before servicing an airplane with emergency fuel and the aircraft must be conspicuously placarded, indicating which fuel has been used.

CAUTION

When different approved fuels are mixed in fuel cells, maximum engine operating limits, particularly rpm and tail pipe temperature, must not be exceeded. In some cases, fuel controls should be reset to obtain maximum engine efficiency.

	Fuel	NATO Symbol	Remarks
Recommended	JP-5	F-44	Ashore
	JP-4	F-40	Afloat
Emergency	AVGAS	None	Lowest available grade

TABLE 1-4. PRESSURE FUELING/DEFUELING SWITCH POSITIONS

OPERATION AND TANK	FUELING RECEPTACLE		EXTERNAL POWER		GRAVITY TRANSFER SWITCH	WING FUEL DUMP SWITCH	FUEL TRANSFER SWITCH	FUELING POWER AFT TANK SWITCH	DEFUEL SWITCH	TEST SWITCH - FUEL SHUTOFF		
	FORWARD	AFT	AC	DC						WING TANKS	FORWARD TANK	AFT TANK
Fueling Forward Tank	X			X	NORMAL	OFF	OFF	OFF	WINGS ONLY	PRIMARY OFF	FUELING ON	FUELING ON
Fueling Wing Tank	X			X	NORMAL	OFF	OFF	OFF	WINGS ONLY	FUELING ON	PRIMARY OFF	FUELING ON
Fueling Wing and Forward Tanks	X			X	NORMAL	OFF	OFF	OFF	WINGS ONLY	FUELING ON	FUELING ON	FUELING ON
Fueling Aft Tank		X		X	NORMAL	OFF	OFF	ON	WINGS ONLY	FUELING ON	FUELING ON	FUELING ON
Defueling Aft Tank		X			NORMAL	OFF	OFF	OFF	WINGS ONLY	FUELING ON	FUELING ON	FUELING ON
Defueling Forward Tank		X	X		NORMAL	OFF	OFF	OFF	WINGS ONLY	FUELING ON	FUELING ON	FUELING ON
Defueling Forward and Aft Tanks		X	X		NORMAL	OFF	OFF	OFF	WINGS ONLY	FUELING ON	FUELING ON	FUELING ON
Defueling Wing Tanks	X		X		NORMAL	OFF	WINGS	OFF	WING AND FORWARD TANK	FUELING ON	FUELING ON	FUELING ON
Defueling All Tanks		X	X		NORMAL	OFF	WINGS	OFF	WINGS ONLY	FUELING ON	FUELING ON	FUELING ON

PRESSURE FUELING SAFETY PRECAUTIONS

1. Make certain supply hose nozzle is grounded before making contact with airplane.

2. When filling tanks or cells, clean up any spillage, especially fuel spilled on tires or other rubber material. If any amount of fuel is spilled during refueling operation, tow aircraft to safe distance before starting engines, or allow sufficient time for evaporation of spillage.

3. Accomplish all fueling operations out of doors and prohibit smoking within 75 feet of fueling area.

4. Use only fuel trucks equipped with static ground chain. If chain has become fouled and does not touch ground, ground truck to suitable ground connection.

5. Observe all safety precautions when handling jet fuel, vapor spaces in jet fuel tanks contain an easily ignited, highly explosive mixture.

6. Do not fuel aircraft while the radio or radar transmitting equipment is in operation.

7. Weather permitting, remove all fuel caps when pressure fueling.

Equipment Required

7000-gallon supply of fuel.

Pressure fueling source.

External ac/dc power supply.

Preliminary Conditions

Close all fueling circuit breakers.

WARNING

To maintain aircraft center of gravity do not fuel aft tank or defuel forward tank first.

PRESSURE FUELING FORWARD AND WING TANKS

1. Remove pressure fueling receptacle cap and connect pressure fueling nozzle.

2. If forward or wing tank is to remain empty, position applicable check switch to PRIMARY OFF.

WARNING

During first minute of fueling, check for proper operation of fuel shutoff valves and vent system. Failure to check fuel shutoff valves and vent system can result in rupture of fuel tank and serious structural damage.

3. Begin pressure fueling.

4. Continue fueling until tank is full and fueling stops.

5. Disconnect pressure fueling nozzle and install pressure fueling receptacle cap.

PRESSURE FUELING AFT TANK

1. In right-hand main landing gear wheelwell, position FUELING POWER AFT TANK switch to ON.

2. Remove pressure fueling receptacle cap and connect pressure fueling nozzle.

WARNING

During first minute of fueling, check for proper operation of fuel shutoff valves and vent system. Failure to check fuel shutoff valves and vent system can result in rupture of fuel tank and serious structural damage.

3. Begin pressure fueling.

4. Continue fueling until tank is full and fueling stops.

5. Position FUELING POWER AFT TANK switch to OFF.

6. Disconnect pressure fueling nozzle and install pressure fueling receptacle cap.

PRESSURE DEFUELING SINGLE POINT

Note

All tanks can be defueled simultaneously from the fueling receptacle in right-hand wheelwell.

1. Remove pressure fueling cap and connect pressure defueling nozzle.

2. Apply defueling pressure.

3. In pilot's console, position fuel TRANSFER switch to WINGS.

4. Watch wing tank fuel quantity indicator. When wing tanks empty, position fuel TRANSFER switch to OFF.

5. Shut off defueling pressures when fuselage tanks empty.

6. Disconnect defueling nozzle and install pressure fueling receptacle cap.

PRESSURE DEFUELING FORWARD AND AFT TANK

1. Remove pressure fueling cap and connect pressure defueling nozzle.

2. Apply defueling pressure.

Note

If forward tank only is to be defueled proceed to step 4 when tank empties.

3. Shut off defueling pressure when tanks empty.

4. Disconnect defueling nozzle and install pressure fueling receptacle cap.

PRESSURE DEFUELING WING TANKS

1. Remove pressure fueling cap and connect pressure defueling nozzle.

2. On pilot's console, position fuel TRANSFER switch to WINGS.

3. Position DEFUEL SWITCH to WING AND FORWARD TANK.

4. Apply defueling pressure.

5. When tanks empty shut off defuel pressure. Position fuel TRANSFER switch to OFF and DEFUEL SWITCH to WINGS ONLY.

6. Disconnect defueling nozzle and install pressure fueling receptacle cap.

HOT (CARQUAL/FMLP) REFUELING PROCEDURE

Aircraft refueling while engines are running (hot refueling) is used during carquals, shipboard refresher and in some instances during FMLP training operations. The use of this procedure is dangerous and extreme precautionary measures are mandatory with regard to fuel spillage, adequate ventilation to dissipate fuel vapors emanating from fuel vent masts, and movement of personnel in the vicinity of the aircraft.

Fuel shall be pumped into the forward tank. The pilot will ensure that aircraft center-of-gravity limitations are observed by monitoring transfer of fuel into the aft tank. A normal "Hot refueling" load shall not exceed 10,000 pounds.

When the aircraft is in control of the plane captain, chocked (AFLOAT tied down), the pilot will indicate that he is ready to take on fuel by using thumb to open mouth signal (night use red flashlight) pilot shall monitor fuel on board by tank and/or totalizer fuel quantity readings and signal fueling completed by horizontal movement of left hand at eye level (night use red flashlight).

FUEL FLOAT VALVE, SHUTOFF VALVE AND VENT SYSTEM

Note

Test each tank individually to ensure proper operation of fuel shutoff valves and vent system.

Position	Desired Results
1. Position applicable check switch to PRIMARY OFF.	Fuel flow to tank and exhaust air flow from vent outlet will stop within 30 seconds.
2. Verify fuel flow stoppage by observing jerk in fueling hose. Check flowmeter or fuel counter to determine leakage rate for 30 seconds.	Leakage rate to be less than 1.5 gpm for forward or aft fuel tank, or 3 gpm for wing tanks.
3. Position check switch to FUELING ON.	Fuel flow to tank and exhaust air flow from vent outlet will resume.

Note

Verify exhaust air flow from vent outlet by visual observation of fuel vapor.

4. Position check switch to SECONDARY OFF.	Fuel flow to tanks and exhaust air flow from vent outlet will stop within 30 seconds.

Note

Verify fuel flow stoppage as in step 2.

5. Position check switch to FUELING ON.	Fuel flow to tanks and exhaust air flow from vent outlet will resume.

WARNING

If fuel flow (leakage greater than indicated in test) does not stop when check switch is in either PRIMARY or SECONDARY OFF position, stop fueling immediately and replace defective component. If fuel flow stops in one OFF position but not in the other, fueling may be continued with caution. Remove applicable gravity filler cap, station man at filler to watch for overflow, should remaining component malfunction. Place placard in cockpit to warn pilot against performing inflight fueling operation. Correct malfunctions prior to next pressure fueling.

GRAVITY FUELING

(See figure 1-43.)

GRAVITY FUELING SAFETY PRECAUTIONS

1. Ground each tank or cell prior to removing filler cap to prevent static discharge. Keep grounding jacks free of dirt and corrosion.

2. Verify that no external electrical power is connected to airplane.

3. Do not allow fuel flow rate from supply hose into wing tank or fuselage cells to exceed 200 gallons per minute at 18 psi; exceeding this limit can result in damage to structural area around fuselage fuel cells, fuel system valves, or vent system.

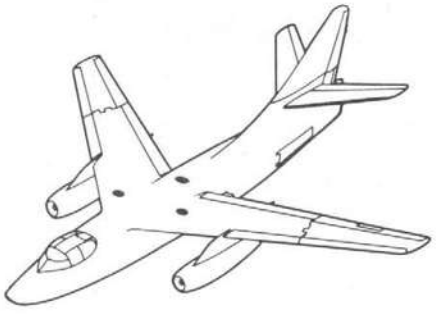
4. Do not pull fueling hose over wing slats.

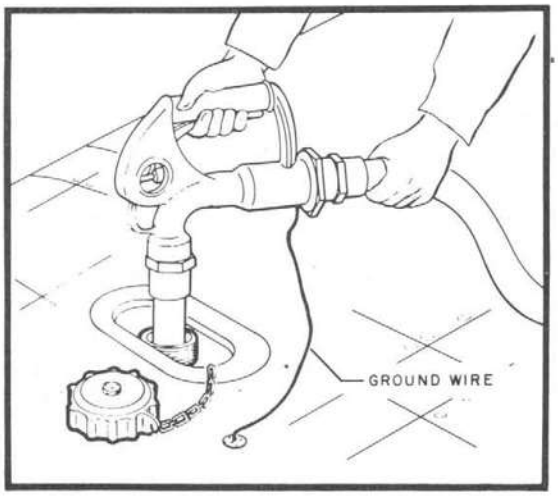
5. Observe all safety precautions when handling jet fuel. Vapor spaces in jet fuel tanks contain an easily ignited, highly explosive mixture.

6. When filling tanks or cell, clean up any spillage, especially fuel spilled on tires or other rubber material. If any amount of fuel is spilled during fueling operation, tow aircraft to safe distance before starting engines, or allow sufficient time for evaporation of the spillage.

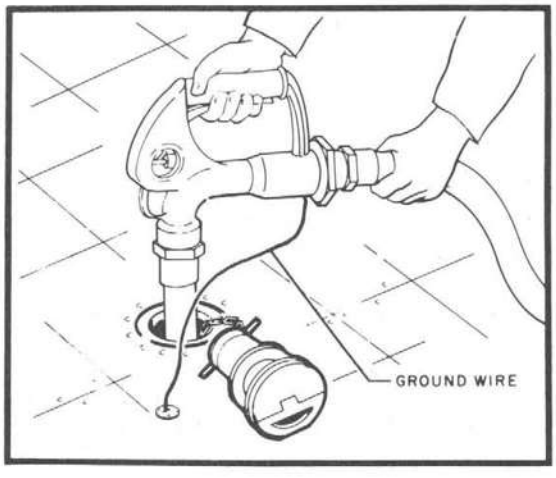
7. Accomplish all fueling operations out-of-doors and prohibit smoking within 75 feet of fueling area.

8. Use only fuel truck equipped with static ground chain. If chain has become fouled and has not recently touched ground, ground truck to suitable ground connection.





FORWARD FUSELAGE FUEL CELL GRAVITY FILLER UNIT



WING TANK GRAVITY FILLER UNIT

ATB-1-1 P-28319-1

Figure 1-43. Gravity Fueling

GRAVITY FUELING PROCEDURES

The fuselage forward fuel cell and the wing fuel tanks can be gravity-fueled individually or simultaneously in accordance with the same fueling procedures except that the applicable gravity-type filler unit or units must be used. If the tanks and cells are fueled individually, it is recommended that they be filled in the following order to maintain the airplane's center of gravity safely forward of the main landing gear: forward fuel cell, wing tanks. (Rear fuel cell is not to be gravity-fueled.)

WARNING

Make certain supply hose nozzle is grounded before making contact with airplane.

1. Remove applicable filler-unit cap and insert supply hose nozzle into filler unit.

CAUTION

Exercise caution when servicing fuel tanks or cell to avoid damage to filler necks. Nozzle must be held by servicing crew and must not be allowed to remain in filler neck without support.

2. Fill fuel cell or tank to capacity.

3. Remove supply hose nozzle and ground from airplane and install unit cap.

FUEL GAGE SYSTEM

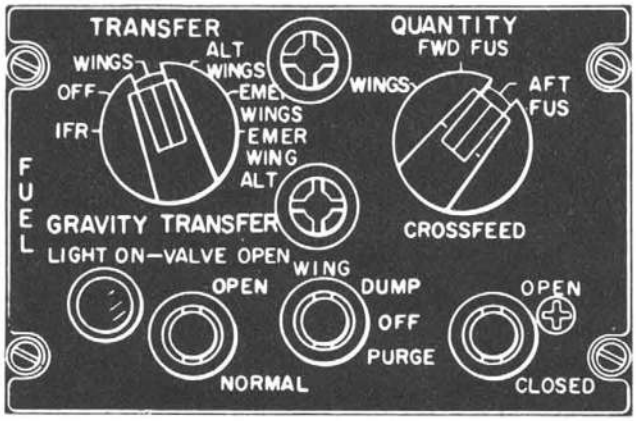
1. Apply external ac and dc electrical power to airplane.

2. Observe fuel-quantity indicator in pilot's instrument panel.

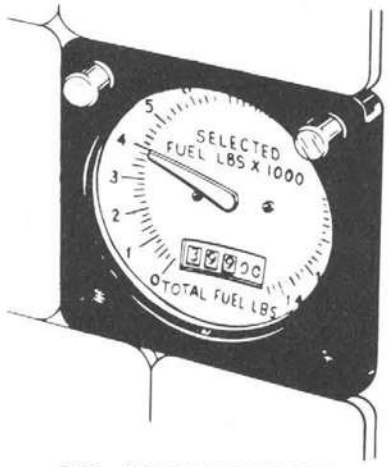
Note

To measure tank individually, position selector switch for applicable tank; pointer on indicator will show fuel quantity of tank in pounds (6.7 pounds = 1 gallon).

3. Disconnect external ac and dc power.



PILOT'S FUEL CONTROL PANEL
(L.H. CONSOLE)



FUEL QUANTITY INDICATOR
(PILOT'S INSTRUMENT PANEL)

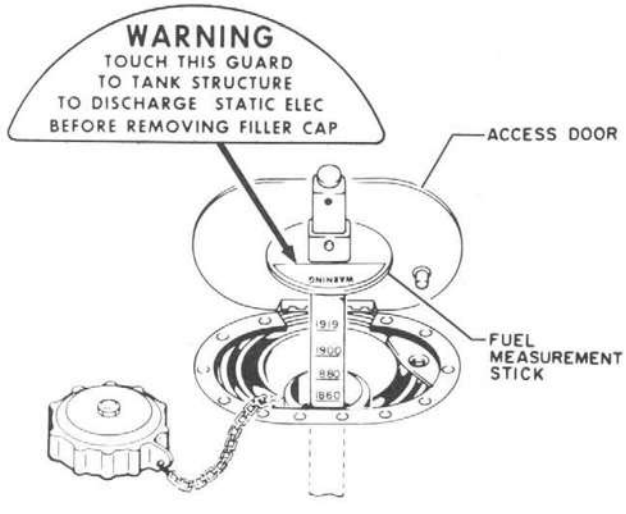
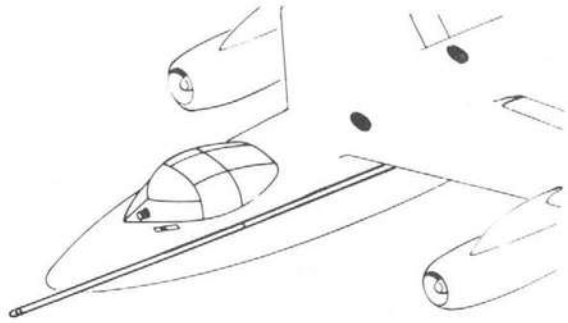


Figure 1-44. Fuel Quantity Measurement



FUEL MEASUREMENT STICK

Note

Measurement stick is to be used to measure forward and aft tanks only.

1. Open applicable filler access doors.

2. Remove applicable filler cap.

WARNING

Before removing cap, ground measuring stick guard (figure 1-44) to fuel-tank filler cap to discharge static electricity.

3. Sink entire measuring stick into fuel tank until guard rests on filler neck. Depress button and hold approximately five seconds to allow fuel level to stabilize.

Note

During fueling operation, depress valve for a longer period of time to allow air bubbles to rise. Verify prior reading with second dipping if evidence of air pocket exists.

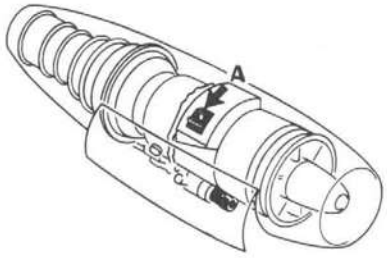
4. Remove stick and read. Insert stick end into tank. Depress button to drain fuel back into tank. Tap stick gently against filler neck to release trapped fuel in tube.

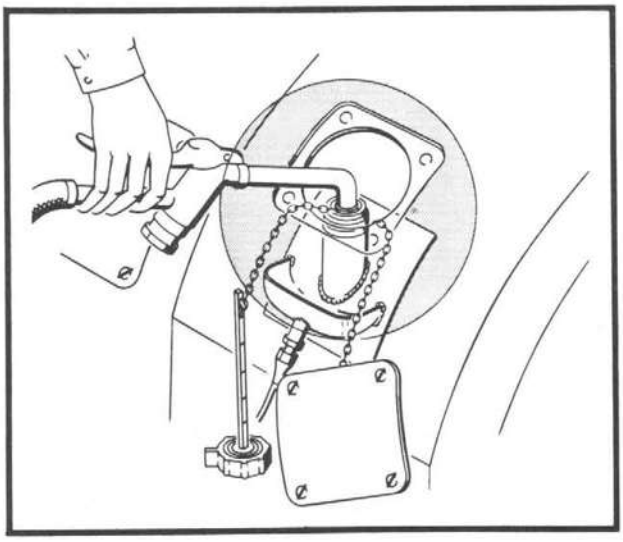
5. Replace tank filler cap.

6. Secure filler access doors.

OIL SYSTEM SERVICING

(See figure 1-45.)





A. ENGINE OIL TANK

ATB-1-1 P-28322-1A

Figure 1-45. Oil System Servicing

ENGINE OIL TANK

CAUTION

Service engine oil system within 30 minutes after engine shut down. Do not add oil after a false start or dry cranking run.

1. Remove oil tank filler access plate from outboard side of upper engine nacelle.

2. Remove cap and dipstick from oil tank. Inspect dip stick.

Note

If oil level is below required level, add oil to meet requirements (figure 1-38).

3. Wipe oil cap off and install on oil tank.

4. Install access plate.

HYDRAULIC SYSTEMS RESERVOIRS SERVICING

(See figure 1-46.)

CAUTION

If any emergency air bottles have been actuated, accomplish special procedures in Section IV before filling reservoirs.

1. Relieve reservoir air pressure by removing cap cautiously.

2. Add hydraulic fluid MIL-H-5606 through filler neck on reservoir.

3. Continue filling slowly until proper level, as shown on instruction plate, is indicated on sight gage.

CAUTION

Do not overfill reservoir or supply fluid at fast rate. Over-filling will cause excessive stress in reservoir and lines.

4. Pressurize reservoir 9 to 12 psi.

5. Slowly supply fluid to reservoir until proper level, as shown on instruction plate, is obtained on sight gage.

6. Remove lines from coupling and valve and replace dust caps.

LIQUID OXYGEN SYSTEM SERVICING

(See figure 1-47.)

LIQUID OXYGEN SAFETY PRECAUTIONS

WARNING

Liquid oxygen is nontoxic. However, because of its extremely low temperature it may cause severe burns upon contact with skin.

1. Permit handling only by personnel familiar with properties of liquid oxygen.

2. Do not locate oxygen supply tanks or cylinders in vicinity of fuel, oil, or other combustible materials; oxygen increases combustibility of such materials.

3. Do not smoke or allow flames, sparks, or fire in the vicinity of oxygen.

4. Do not use flammable substances such as paint thinner, acetylene, hydrogen, or oil in any form near oxygen equipment.

5. Keep oxygen system free from water to prevent corrosion, damage to valves, and freezing at high altitudes.

6. Do not allow liquid oxygen to flow onto or become trapped in anything that has fuel, oil, or other combustible materials on or in it.

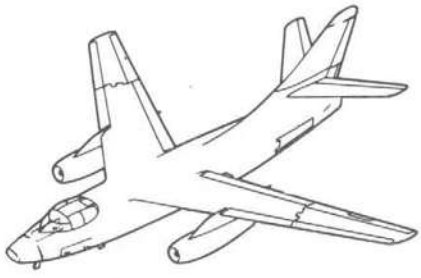
7. Do not handle tubes and fittings through which liquid oxygen is flowing.

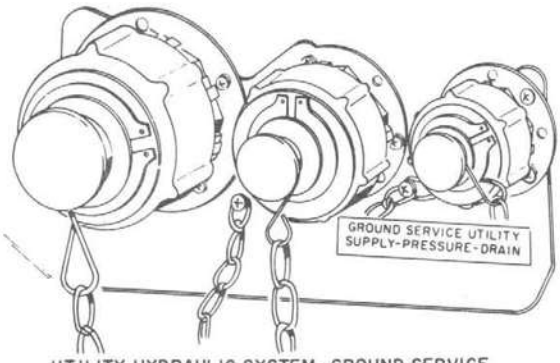
8. Wear protective clothing, such as face shield, gloves and apron. It is recommended that heavyweight, loose-fitting leather or rubber gloves be worn, large enough to be quickly removed if liquid oxygen spills into them.

9. Do not allow liquid oxygen to flow onto any part of body. If liquid oxygen comes into contact with skin, wash immediately with cool, clean water and report to nearest first aid station without delay.

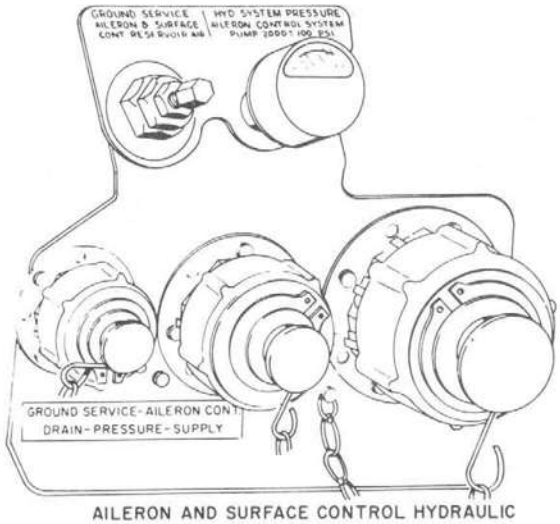
10. Do not allow liquid oxygen to contact clothing.

11. Verify that hoses and fittings are clean and dry before allowing liquid oxygen to flow through them. Fittings with moisture on them freeze into position and cannot be separated or removed without damage.

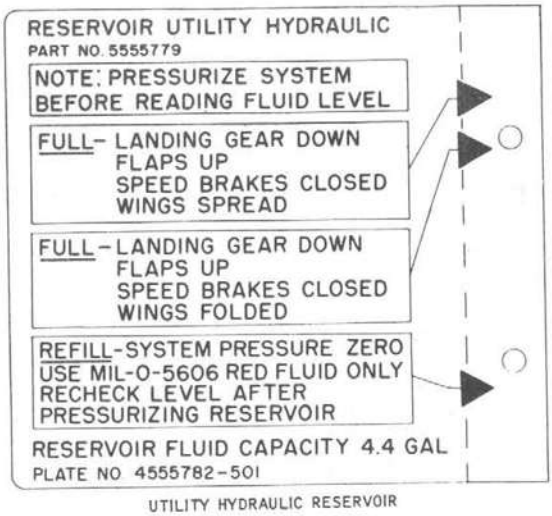




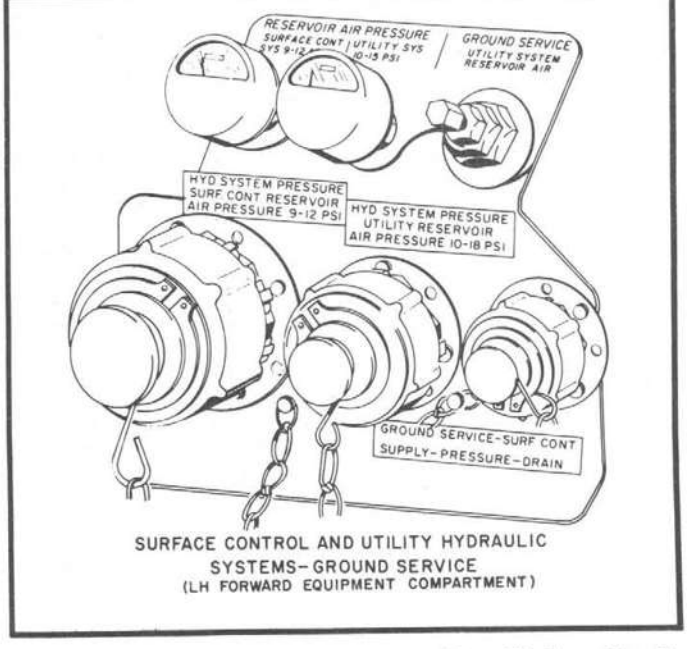
UTILITY HYDRAULIC SYSTEM-GROUND SERVICE
(LH FORWARD EQUIPMENT COMPARTMENT)



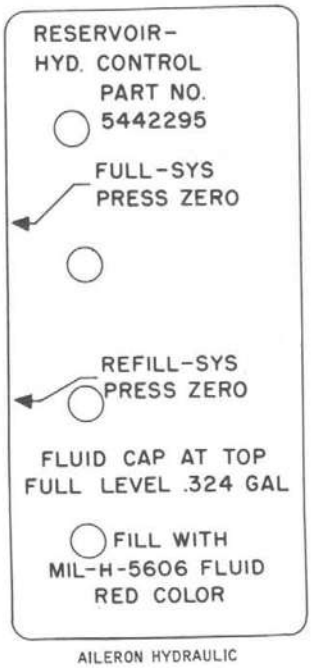
AILERON AND SURFACE CONTROL HYDRAULIC
SYSTEMS-GROUND SERVICE
(RH FORWARD EQUIPMENT COMPARTMENT)



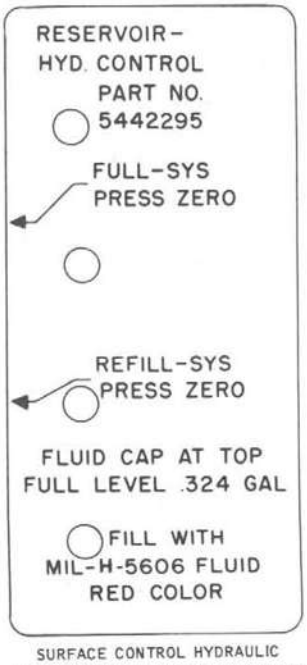
UTILITY HYDRAULIC RESERVOIR
FLUID LEVEL INDICATOR



SURFACE CONTROL AND UTILITY HYDRAULIC
SYSTEMS-GROUND SERVICE
(LH FORWARD EQUIPMENT COMPARTMENT)



AILERON HYDRAULIC
POWER RESERVOIR



SURFACE CONTROL HYDRAULIC
RESERVOIR FLUID LEVEL INDICATOR
ATB-1-1 P-28323-1

Figure 1-46. Hydraulic Systems Reservoirs Servicing

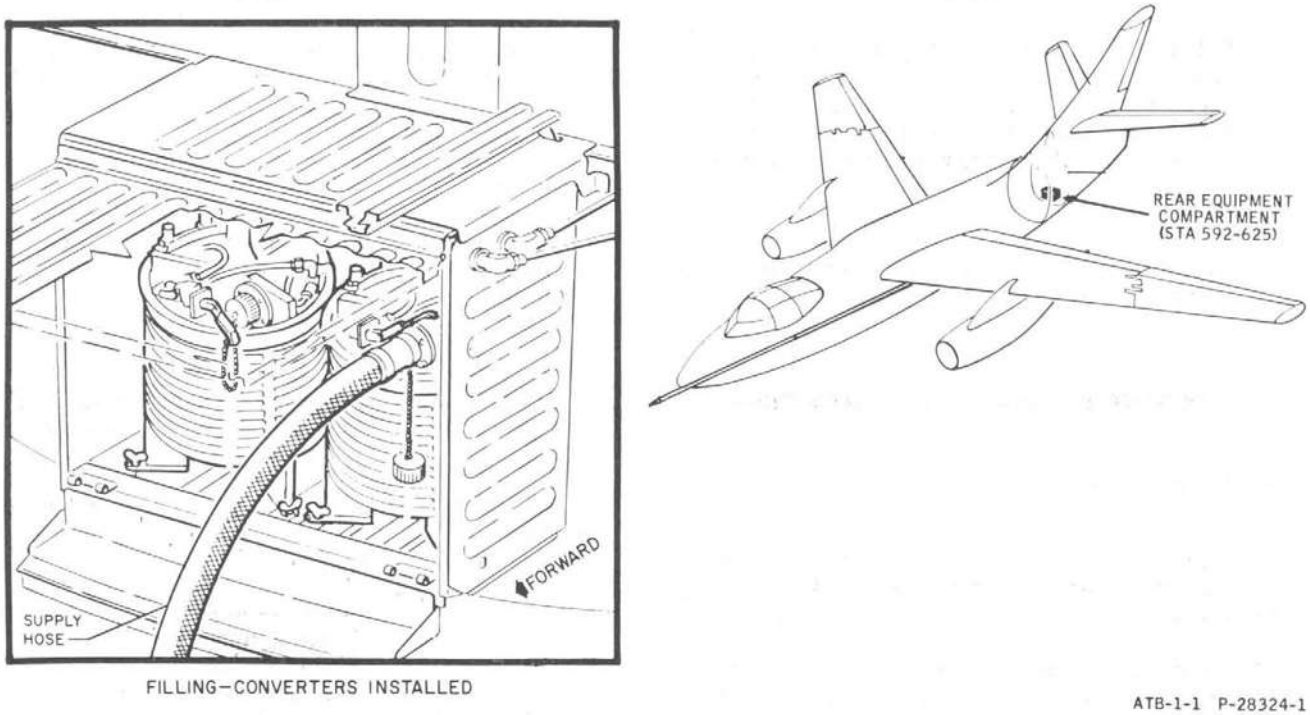


Figure 1-47. Liquid Oxygen System Servicing

12. Keep oxygen system in buildup condition at all times except during filling, testing, or when converter is removed from aircraft.

13. Make certain that liquid oxygen containers are properly vented at all times. Otherwise, pressure buildup resulting from evaporation of liquid oxygen will rupture closed container.

PURGING

Note

Oxygen system should be purged every 90 days or at any time contamination is suspected or oxygen supply has been exhausted.

1. Purge system with hot oxygen if supply has been exhausted for less than two hours and all shutoff valves have been in OFF position since exhaustion.

2. Purge system with hot nitrogen if supply has been exhausted for more than two hours, if shutoff valves have remained open to atmosphere, or if line couplings have been disconnected but not plugged or capped immediately.

FILLING CONVERTERS

Note

These procedures are applicable to each converter independently and may be accomplished either before or after installation of the converter in the aircraft. If only one converter is to be used, the wiring harness of the unused converter should be connected to the simulator on the bulkhead aft of the converter and the disconnected lines should be capped.

1. In airplane cockpit, verify that all oxygen shutoff valve selectors are in OFF position.

2. In rear equipment compartment, place converter vent and buildup valve selector in VENT position.

3. Remove cap from converter filler valve.

4. Purge supply line with liquid oxygen, then connect oxygen supply line to filler valve.

5. Transfer liquid oxygen into converter at maximum pressure of 35 psi until liquid is seen escaping from overboard vent in fuselage below converter.

6. Disconnect supply line and cap filler valve.

Note

If filler valve leaks, heat from cap and ambient air will free mechanism and stop leakage. When leakage stops, verify proper operating pressure. System purging can be delayed until next scheduled ground maintenance.

7. Place vent and buildup valve selector in BUILD-UP position.

OXYGEN BAILOUT BOTTLE SERVICING

(See figure 1-48.)

1. Attach green actuating ring yoke assembly to pressure reducing regulator valve and secure yoke with lockwire.

2. Remove charging valve cap. Connect external high pressure (2100 psi) gaseous oxygen source to bailout bottle charging valve.

3. Charge bottle with gaseous oxygen to 2100 psi.

4. Disconnect external high pressure gaseous oxygen source from bailout bottle charging valve. Install charging valve cap.

RAIN REPELLENT

A rain repellent kit, stock number RM6850-661-1821-LA20, is available through normal channels for coating the external surfaces of the windshield and canopy. The function of the repellent is to increase visibility through windshields and canopies during rainstorms. The kit consists of a can of solvent cleaner, a tube of bonding paste, and a stick of repellent.

RAIN REPELLANT APPLICATION

1. Wash surface in accordance with existing instructions if excessively soiled.

2. Clean surface with kit supplied cleaner. Use clean soft cloth, then dry surface.

3. Polish cleaned surface with clean soft cloth.

4. Apply kit supplied bonding paste very sparingly with clean soft cloth, working it completely over surface.

Note

Do not apply the bonding paste to a wet surface. A satisfactory bond will not be obtained.

5. Polish surface with clean soft cloth until all black color disappears.

6. Apply kit supplied rain repellent by rubbing side of stick lightly over surface.

Note

Do not apply rain repellent stick endwise. An excessive amount of film will be deposited.

7. Polish surface with clean soft cloth until film is clear.

CAUTION

Do not apply rain repellent to the interior of the windshield or canopy.

ANTIFOGGING COMPOUND

An antifogging compound, stock number RM6850-200-2397-6500 is available through normal supply channels for coating the interior surfaces of the windshield and canopy. The function of the compound is to absorb the moisture and prevent fogging of the surfaces.

ANTIFOGGING COMPOUND APPLICATION

1. Wash surface in accordance with existing instructions if excessively soiled.

2. Apply antifogging compound to interior of windshield by means of application unit.

3. Wipe interior surface with clean lintless cloth until surface is clear.

CAUTION

- Do not permit compound to contact instrument panel finish.
- Do not permit compound to remain on windshield and canopy sealant.

Note

One application of compound is effective for a minimum of ten fogging and drying cycles or approximately seven hours of continuous fogging conditions.

DEICING-DEFROSTING FLUID

(For use down to 10°F.)

MATERIAL

Deposits of frost on the exterior surfaces of aircraft on the ground may be removed by the application of MIL-D-7946, deicing-defrosting fluid, Stock No. RM6850-298-9704-G500. When the deposits have been removed, the fluid remaining on the treated surfaces should provide protection for approximately 12 hours, provided the temperature does not fall below 10°F. This material is not particularly efficient at temperatures below 10°F; however, since it is economical and may be sprayed at low pressures, the use of the fluid is suitable for removing frost, ice, etc., at temperatures above 10°F.

DEICING-DEFROSTING FLUID APPLICATION

The defrosting fluid may be applied by swabbing, brushing, or spraying. If wind conditions permit, a back pack pump, five-gallon, water type, or similar spray pump, is convenient application equipment. However, other types of spray equipment may be used. At low temperatures and under unfavorable wind conditions, swabs or brushes should be used, but care must be exercised to prevent their freezing to aircraft surfaces. The defrosting fluid is supplied, mixed ready for use, but it may be diluted, if required for spraying, up to the proportion of one part water to two parts fluid. It should be noted, however, that dilution decreases the ice or frost-melting efficiency of the fluid.

ANTI-ICING, DEICING, AND DEFROSTING FLUID

(For use below 10°F.)

MATERIAL

For preventing the formation of and for removing deposits of frost, ice, etc., on the exterior surfaces of aircraft on the ground at temperatures below 10°F, use should be made of lithium chloride base anti-icing, deicing, and defrosting fluid, Stock No. RM6850-577-4752-G500. The material is very efficient at temperatures down to -15°F, and is effective down to -65°F, but its rate of ice-melting decreases as the temperature decreases. For anti-icing, it should be applied prior to expected ice or snow conditions. As noted, this fluid should be used for temperatures below 10°F, but it may be used between 32°F and 10°F, when MIL-D-7946, deicing-defrosting fluid, is not available.

ANTI-ICING, DEICING, AND DEFROSTING FLUID, APPLICATION

The fluid is supplied ready-mixed for use and may be applied by swabbing or brushing. If wind conditions permit, the fluid may also be applied by high-pressure spray equipment. If required, for low-pressure spraying, it may be diluted up to the proportion of one part of water to two parts of fluid. It should be noted, however, that dilution decreases the ice or frost-melting efficiency of the fluid. For information, an applied film thickness of 0.003 inch will cover approximately 500 square feet of surface per gallon of fluid. This thickness will suffice for most purposes. During service evaluation, four pints of fluid removed one-half inch of ice from one wing of a fighter-type aircraft in thirty minutes at 17°F, and twelve pints removed one-quarter inch of ice from one wing of a patrol-type aircraft in twenty minutes at -5°F.

CAUTION

Although the above defrosting and anti-icing and deicing fluids are nonflammable, nontoxic, noncorrosive, and will not injure fabric, they contain a solid ingredient. Therefore, care shall be exercised to avoid coating engine surfaces; to avoid penetration into air ducts leading to carburetors, oil coolers, etc. and to avoid coating the surfaces of transparent materials where visibility through the materials might be impaired.

If the above fluids are not available, anti-icing fluid (isopropyl alcohol), Stock No. R-51F-516/-519, or specially denatured alcohol, Stock No. R51-A-1946/-1947, may be used, instead. However, these alcohols are volatile, and protection to aircraft surfaces will not be afforded for an extended period after application; whereas, the lithium chloride base fluids are considerably less volatile, and protection to aircraft surfaces will be afforded for an extended period after application; that is, up to twenty-four hours, depending on the rate of dilution caused by melting ice, snow, etc. (Refer to previous paragraphs for method application of the alcohols.)

WARNING

- Care shall be taken to keep these alcohols away from fire, sparks, etc., since they are flammable, and are known to have caused fires when trapped in engine nacelles. Care shall also be taken to ensure that they do not contact acrylic plastic (plexiglas or Lucite) turret domes, canopies, etc., since they will cause cracking or crazing of the transparent plastic material. These alcohols are toxic and shall not be taken internally, and care shall be taken to avoid breathing the vapors to excess.
- All of these fluids have an irritating effect on the eyes, throat, nasal passages, etc., and care shall be taken to prevent contact with mucous membranes, especially if sprayed. Personnel applying these fluids shall wear an approved type of respirator and eye protector.

AIR BOTTLE SERVICING

(See figure 1-49.)

WING-FLAP AND EMERGENCY-GENERATOR AIR BOTTLE

Charge bottle to 100 to 200 psi. Resetting an emergency air system may cause accumulated back pressure to shift brake shuttle valves and admit air to landing gear brake system. Proceed as follows to prevent this condition:

1. Pressurize brake accumulator to 400 psi by using ground-handling brake pump inboard of pilot's seat.

2. Depress – do not pump – brake pedals and hold down with steady pressure.

3. With pedals still depressed, return emergency-air handle to off (valve-closed) position.

4. Continue application of pressure to pedals until all air has been exhausted from emergency system.

5. Depress drain valve at bottom of bottle to release any trapped hydraulic fluid.

6. Release drain valve and charge air bottle to 3000 ± 200 psi.

LANDING-GEAR EMERGENCY AIR BOTTLE (TWO)

1. Charge air bottles to 100 to 200 psi.

2. Depress drain valve at bottom of bottles to release any trapped hydraulic fluid.

3. Release drain valve and charge air bottles to 3000 ± 100 psi.

BRAKE EMERGENCY AIR BOTTLE

1. Charge air bottle to 100 to 200 psi.

2. Depress drain valve at bottom of bottle to release any trapped hydraulic fluid.

3. Release drain valve and charge air bottle to 3000 ± 50 psi.

BOMB BAY DOOR AIR BOTTLE

1. Charge bottle to 100 to 200 psi.

2. Depress drain valve at bottom of bottle to release any trapped hydraulic fluid.

3. Release drain valve and charge air bottle to 3000 psi.

AIR TURBINE MOTORS SERVICING

(See figure 1-50.)

DRAINING

1. At every intermediate inspection, drain oil from ATM by opening drain valve in nose gear well directly below each unit.

Note

A small quantity of oil will remain trapped in oil sump of LH and RH ATM because of canted installation. There is no way of removing trapped oil from LH ATM sump while installed in aircraft. Steps 2, 3 and 4 apply to RH ATM only.

2. Remove RH oil-tank filler-neck extension.

3. Insert a small-diameter flexible-probe suction gun into filler-neck opening and guide into lowermost corner of tank.

4. Remove remaining trapped oil from tank with suction gun; then replace filler-neck extension.

5. Close drain valves.

FILLING

WARNING

Do not overfill oil sump because cavitation at reduction gearing will cause failure of ATM.

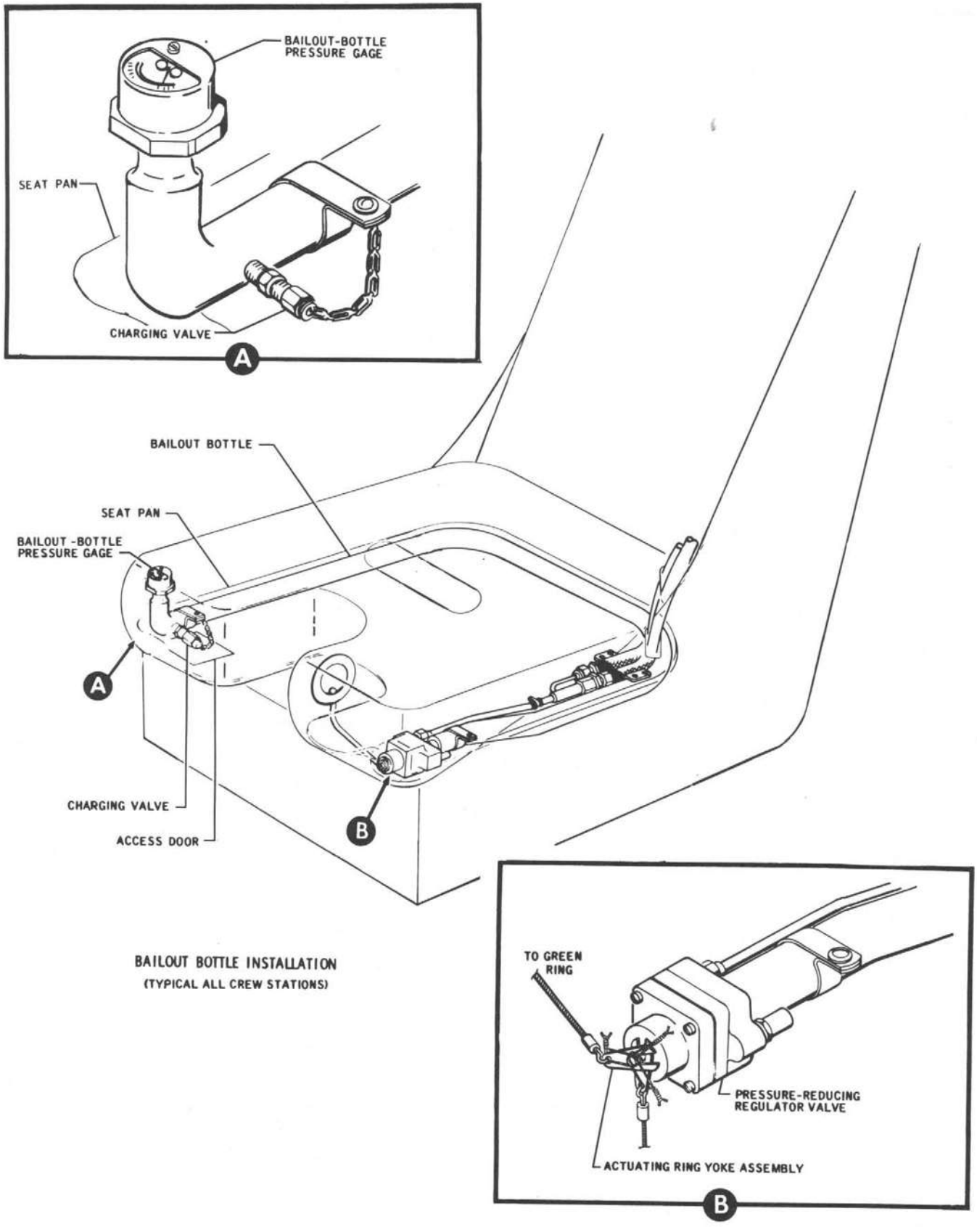
1. Remove filler cap and fill oil sump to full mark on dipstick with correct oil for prevailing temperature:

Temperature	Grade
-18° to 54°C (0° to 127°F)	1010
-18° to -54°C (0° to -65°F)	1005

CAUTION

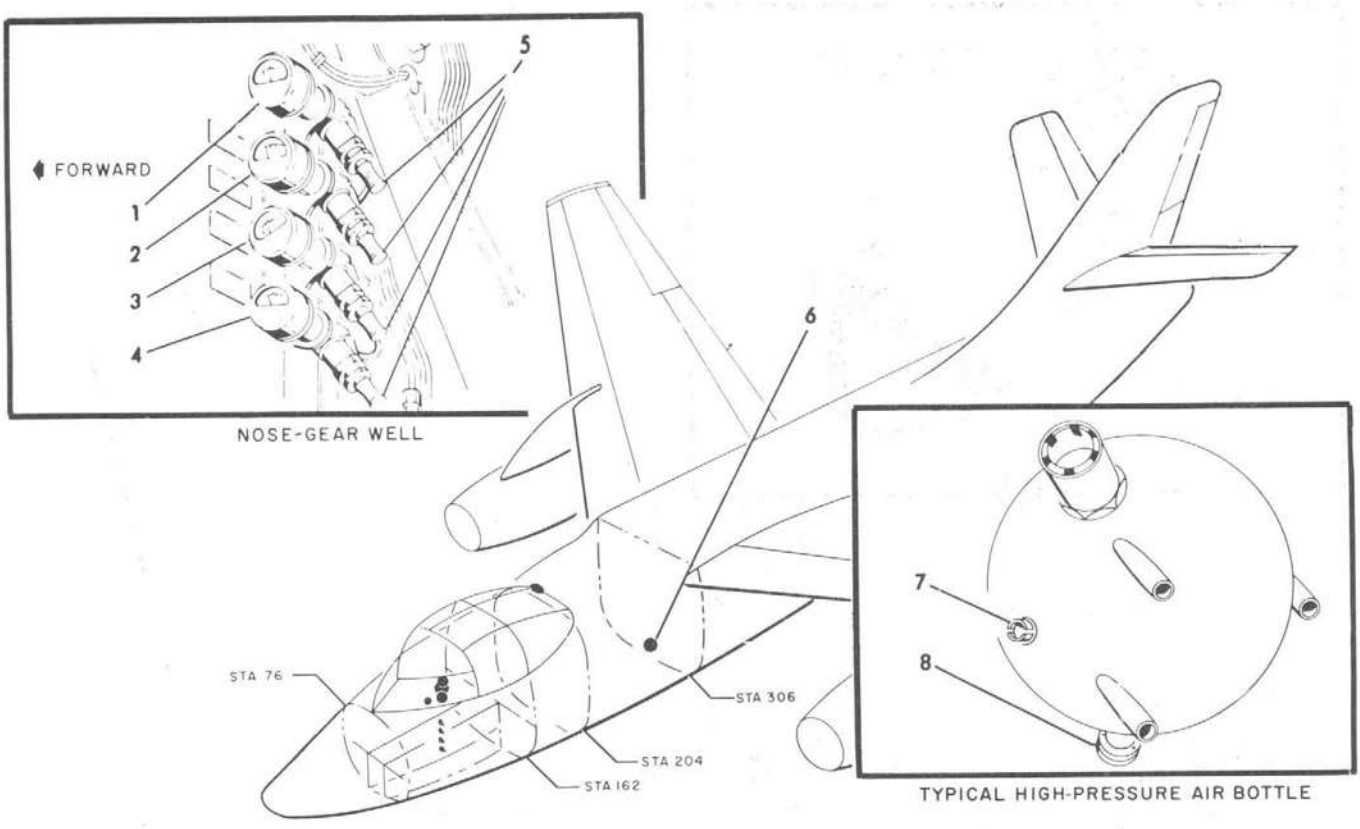
Do not mix 1010-grade oil with 1005-grade oil.

2. Allow unit to reset for approximately 30 minutes to allow oil drainage to sump. Inspect dipstick for proper oil level.



BAILOUT BOTTLE INSTALLATION
(TYPICAL ALL CREW STATIONS)

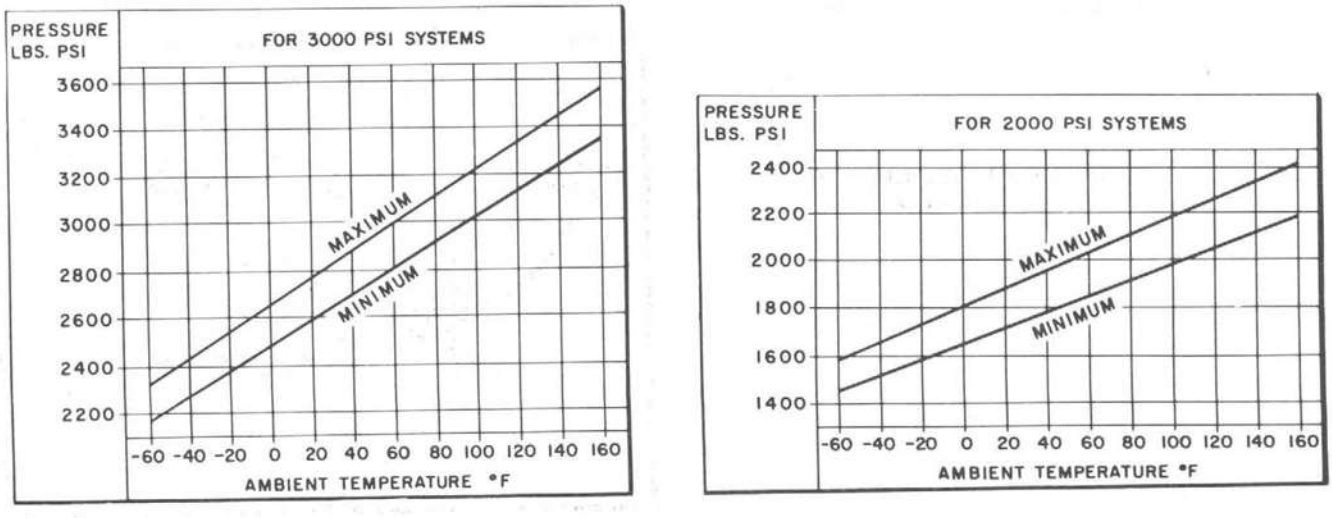
Figure 1-48. Oxygen Bailout Bottle Servicing



NOSE-GEAR WELL

TYPICAL HIGH-PRESSURE AIR BOTTLE

1. Landing gear doors emergency air pressure gage (3000 ±100 PSI)
2. Brake emergency air pressure gage (3000 ±100 PSI)
3. Landing gear emergency air pressure gage (3000 ±100 PSI)
4. Wing flap and emergency generator (3000 ±200 PSI)
5. Air filler valves
6. Bomb bay doors emergency air pressure gage (3000 PSI)
7. Filter
8. Bleed valve



TEMPERATURE CORRECTION CHARTS

ATB-1-1- P-28329-1A

Figure 1-49. Air Bottles Servicing

Note

If oil is being added only to replace oil lost in operation of unit, allow unit to reset approximately 30 minutes after operation to allow oil drainage to sump. Inspect dipstick. If oil shows on dipstick, do not add oil. If no oil shows on dipstick, fill sump to full mark on dipstick.

3. Replace filler cap.

WHEELBRAKES SERVICING

(See figure 1-51.)

BRAKE RESERVOIR — FILLING

Note

The brake reservoir is filled by fluid from the utility hydraulic system reservoir.

BRAKE SYSTEM — BLEEDING

1. Verify that utility hydraulic reservoir is pressurized and filled to proper level on sight gage.

2. Open brake-reservoir bleed and drain ports by removing caps.

3. Bleed until fluid runs clear and is free of air.

4. Inspect utility hydraulic reservoir and add fluid if necessary. (Reservoir air pressurization is not required but is desirable.)

5. Pull EMERGENCY BRAKE handle (on pilot's instrument panel) to actuate air-bottle control valve and fluid-bypass valves.

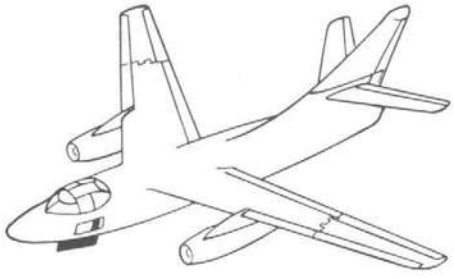
6. Depress both brake pedals; then release.

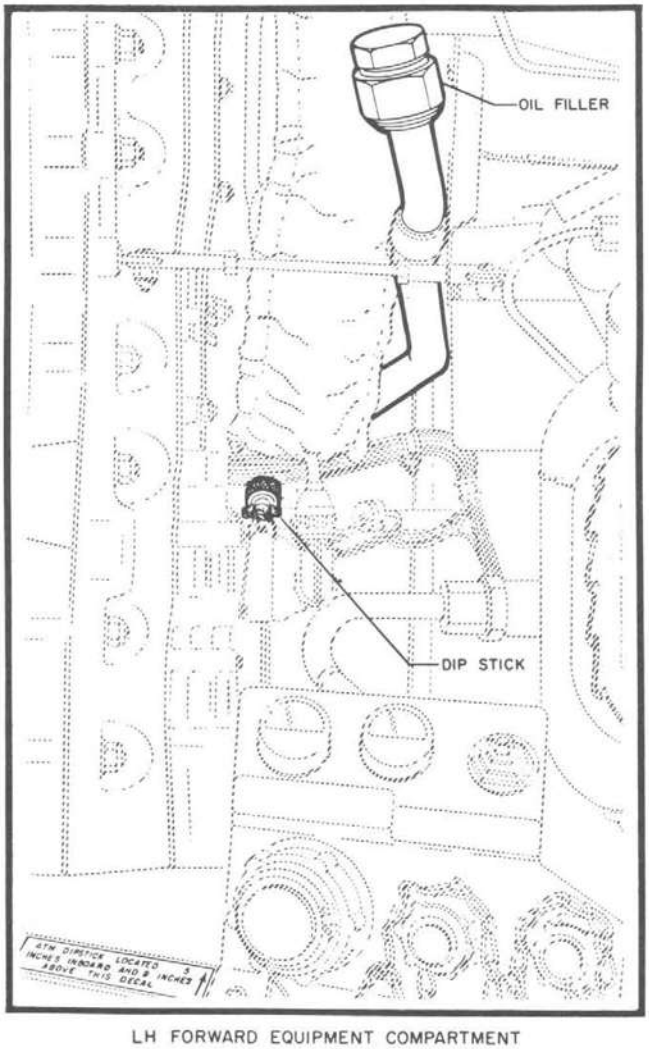
7. Repeat step 6 five or six times to exhaust air bottle.

8. Repeat step 6, 10 times, to circulate fluid through bypass valves and lines.

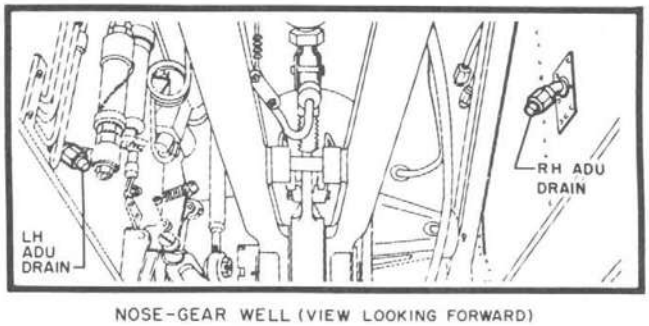
9. Reseat EMERGENCY BRAKE handle in retainer in instrument panel.

10. Reset air-bottle control valve and bypass valves by inserting screwdriver blade (wrapped with tape) between crank and push rod and then lifting screwdriver handle to force crank downward until linkage snaps overcenter.





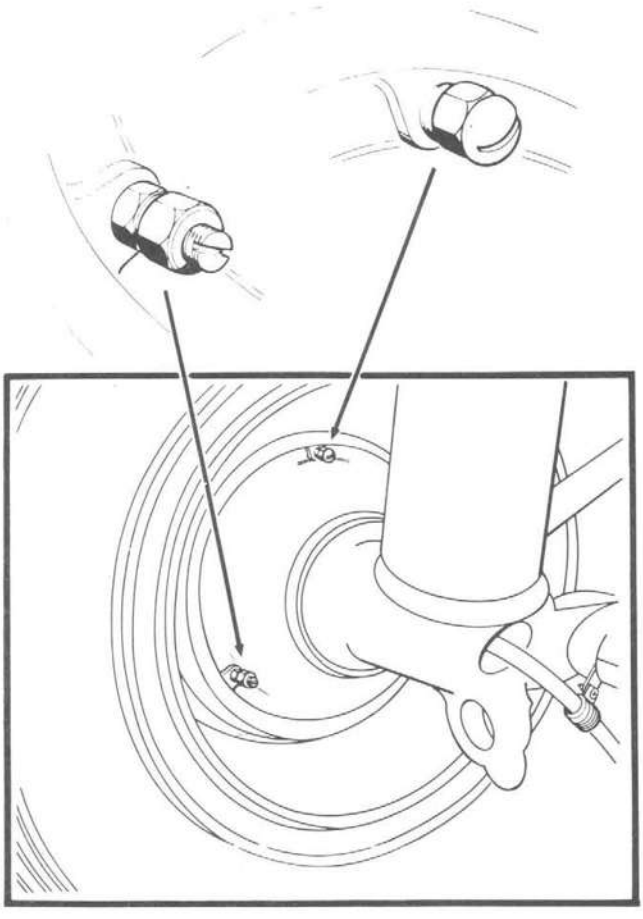
LH FORWARD EQUIPMENT COMPARTMENT



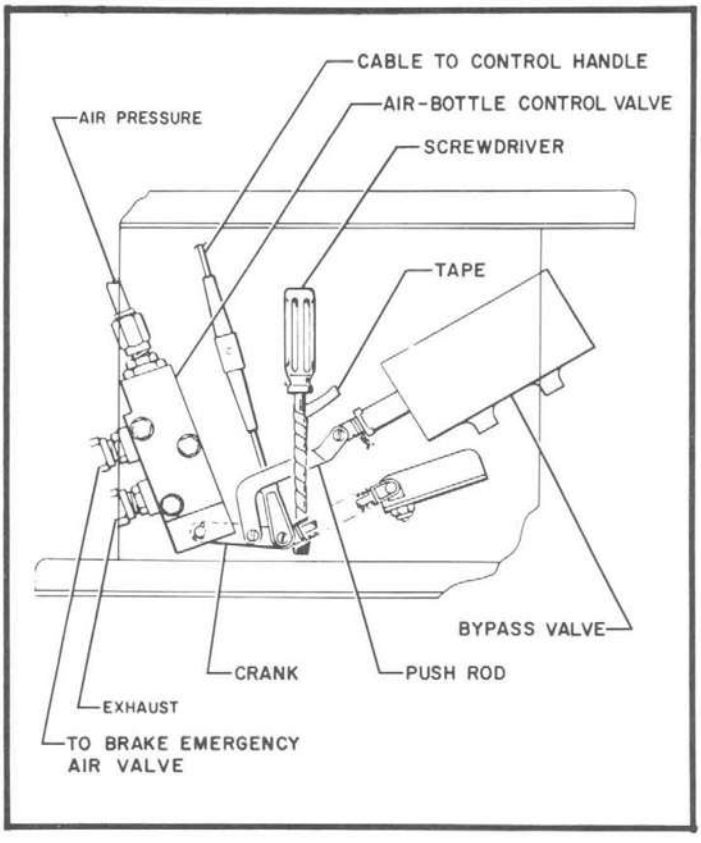
NOSE-GEAR WELL (VIEW LOOKING FORWARD)

ATB-1-1 P-28330-1

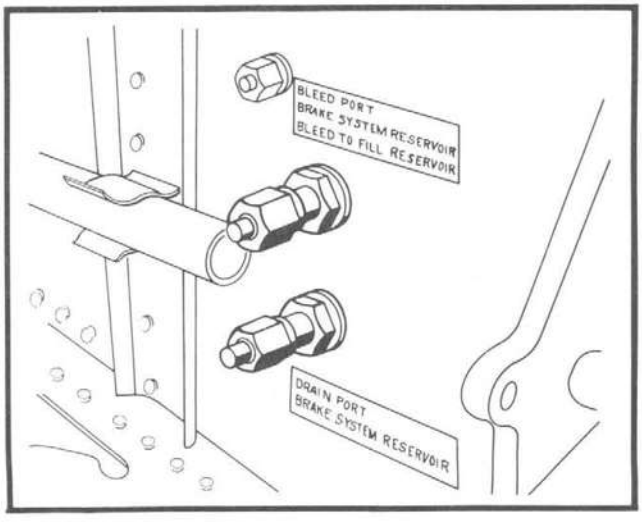
Figure 1-50. Air Turbine Motors Servicing



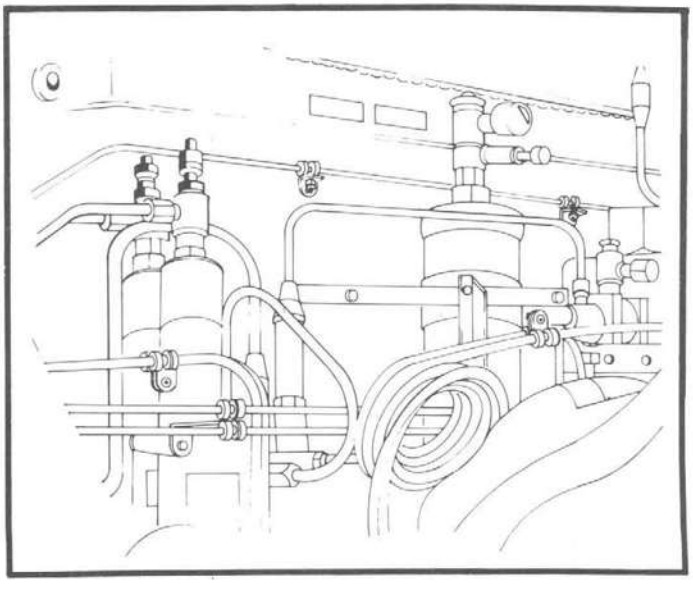
MAIN LANDING GEAR BRAKE
BLEED SCREWS



EMERGENCY AIR-BOTTLE CONTROL VALVE



BRAKE RESERVOIR BLEED AND DRAIN PORTS
NOSE GEAR WELL



BRAKE POWER CONTROL VALVE BLEED SCREWS
L H MAIN-GEAR WELL

ATB-1-1 P-28331-1

Figure 1-51. Wheel Brake System Servicing

11. Recharge brake emergency air bottle.

12. Inspect utility hydraulic reservoir and add fluid if necessary. Pressure reservoir with air.

13. Remove bleed screws from tops of brake power control valves; connect standard bleed hoses to valve bleed ports and submerge open ends of hoses in hydraulic fluid in clean container.

14. Operate brake pedals until fluid from bleed hoses is clear of air.

15. Disconnect hoses from valve bleed plugs and reinstall bleed screws.

16. Pressurize utility hydraulic system.

17. Remove both bleed screws from (port or starboard gear) brake housing; connect standard bleed hoses to bleed ports and place open ends of hose in a clean container.

18. Depress related brake pedal to release fluid into container.

19. Hold ends of bleed hoses submerged in fluid and continue to operate brake pedal until fluid flow is clear of air.

20. Disconnect bleed hoses. Reinstall bleed screw in brake housing and secure with lockwire.

21. Repeat steps 17 thru 20 for other brake.

HOISTING PROVISIONS

WARNING

Hoisting sling (figure 1-52) must not be used when aircraft gross weight exceeds 45,900 pounds.

1. Remove access covers from hoist fittings in fuselage.

2. Engage forward legs of sling with forward fittings, insert pins through lugs and secure by turning handles of lockpins.

3. Engage adapter on rear leg of sling with rear hoist fitting and secure with lockpin.

4. Connect ring of sling with hoisting gear of sufficient capacity to lift and support aircraft.

EXTERNAL AIR STARTER

The external air starter unit comprises a gas turbine compressor, fuel system, and storage battery electrical power system. The unit provides compressed air to operate the pneumatic engine starters or other pneumatic aircraft components as required. Controls for starting and operating are provided on a control panel inside the unit's container.

SUITABLE STARTER UNITS

Starter units which are suitable for use with RA-3B aircraft, other than the GTC-85 (USN), are listed below.

MA-1A

MA-1, MA-2 manufactured by Consolidated

MA-3MP

MD-1A Hough Tractor with the GTC-85 unit

MD-2A with the GTC-85 unit

ME-1A with the GTC-85 unit

GTCE-85-1 with the GTC-85 unit

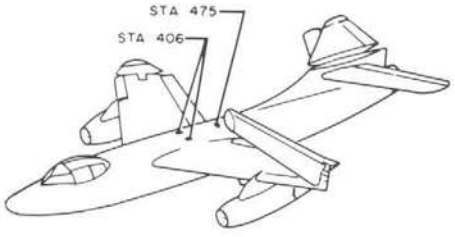
Note

Any air source that meets but does not exceed the following can be used:

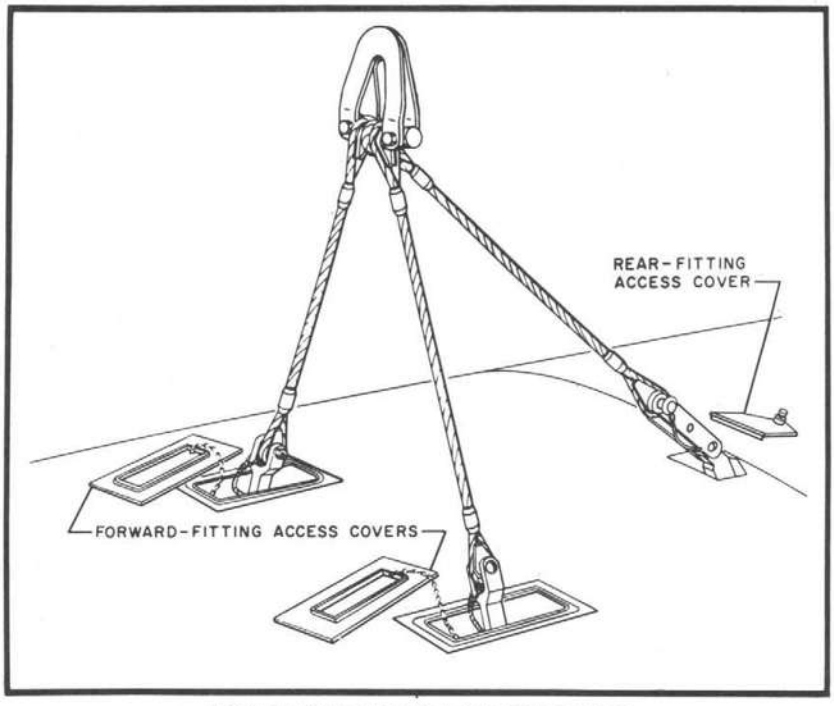
1. 60 lbs/minute air flow.

2. 650°F air inlet temperature.

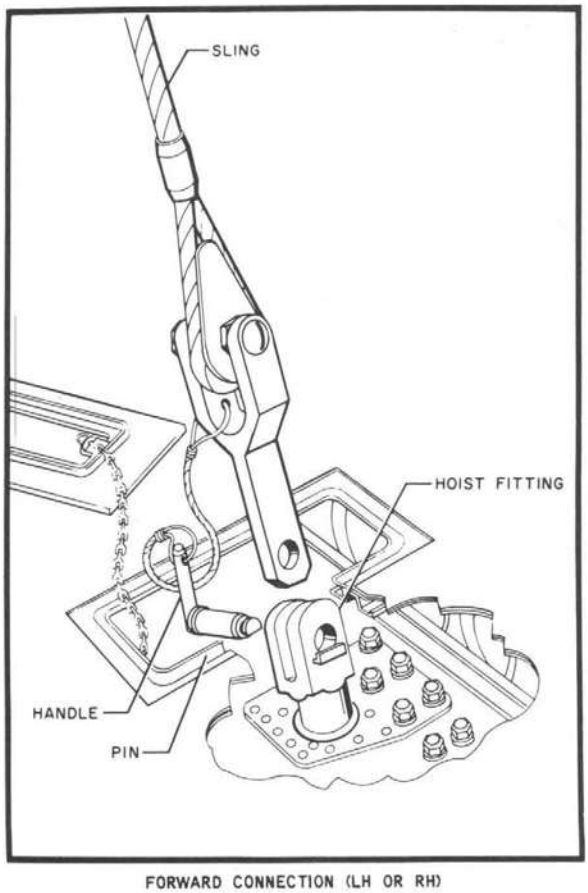
3. 50 PSIA inlet pressure.



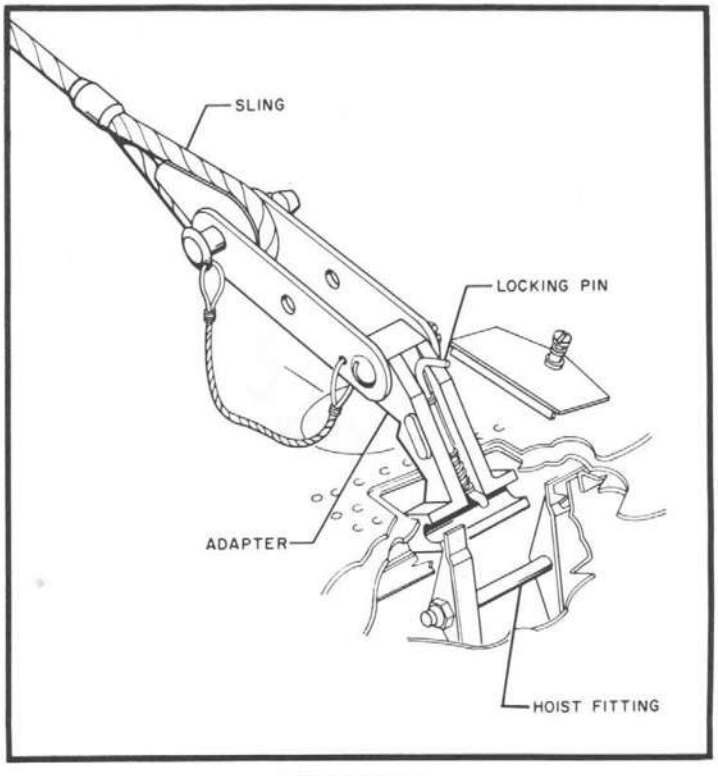
FUSELAGE HOIST POINTS



AIRCRAFT SLING AND FUSELAGE HOIST FITTINGS
(USE AIRCRAFT HOIST IN SLING P/N K-5548845-501 S/N R-1730-685-0809-SDGA)



FORWARD CONNECTION (LH OR RH)



REAR CONNECTION

ATB-1-1 P-28332-1

Figure 1-52. Hoisting Provisions

The GTC 85-15 with 3 inch coupling GTC-85-24, and GTC-85-28 with 3 inch coupling can be used; however, the -24 develops sufficient torque at minimum temperatures (-65°F) to damage the engine starter installation.

The following units are not usable:

Boeing 502, MC-1, MC-11, and MA-1MP.

EXTERNAL ELECTRICAL POWER

External ac/dc power can be applied to the aircraft through the external power receptacle located at station 146 left hand side. Dc power is supplied directly through the dc external power plug to the 28-volt dc bus, the dc essential bus, or to the dc monitored essential bus. Ac power is supplied through the ac external power plug and the ON position of the external power switch on the ac/dc power panel to the left hand ac bus. To power the right hand ac bus, the bus tie switch must be placed in the AUTO position.

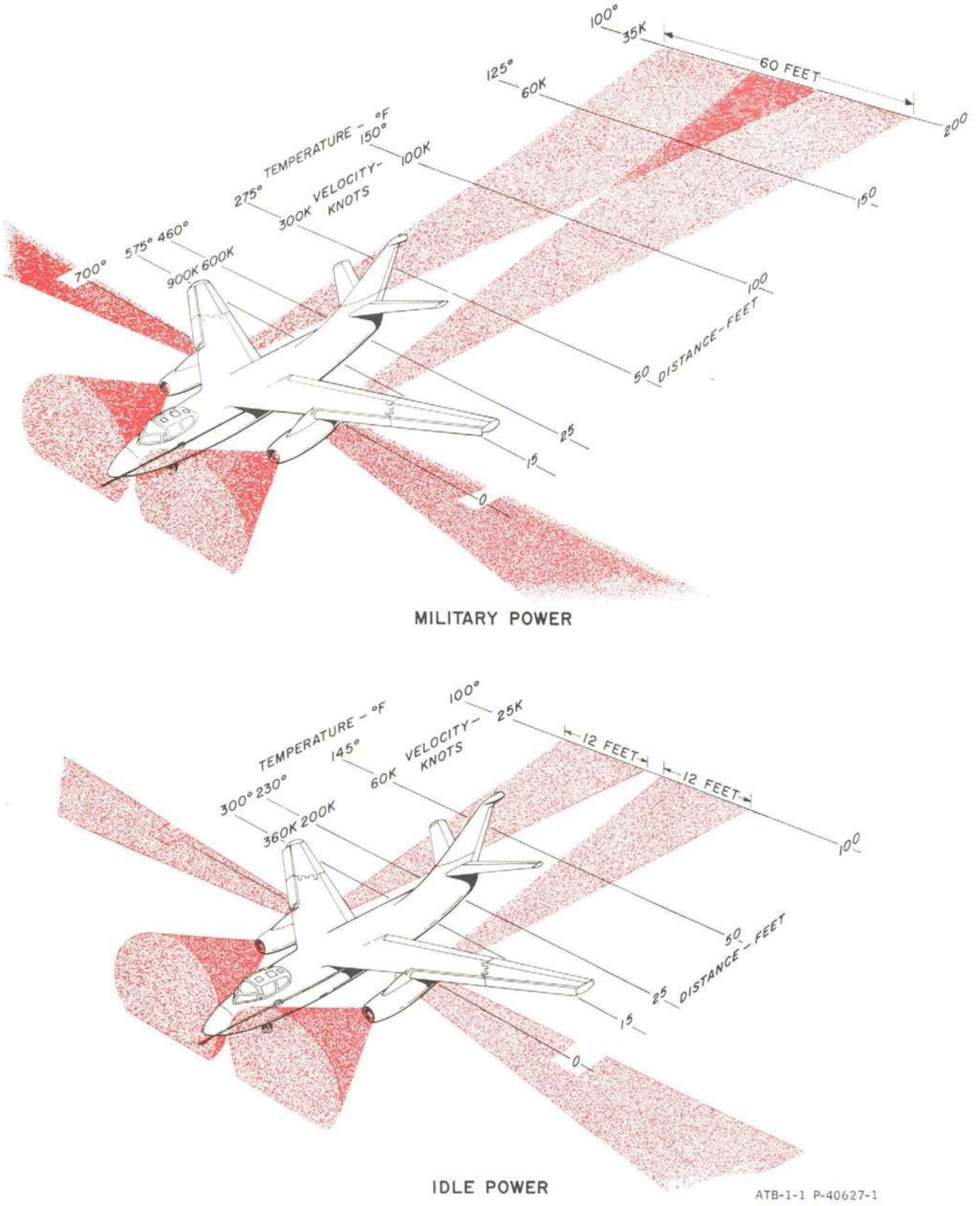


Figure 1-53. Danger Areas (Sheet 1)

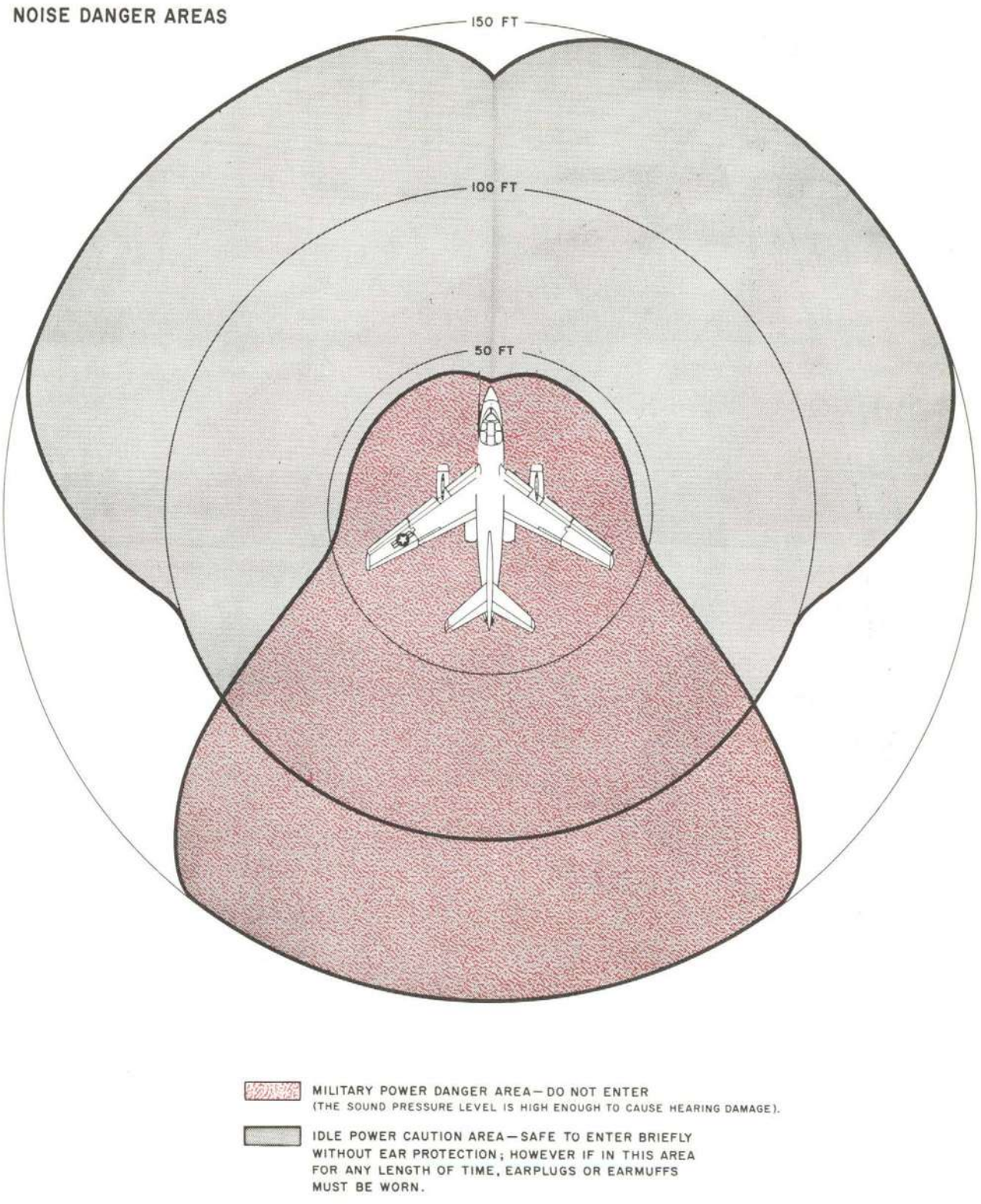


Figure 1-53. Danger Areas (Sheet 2)

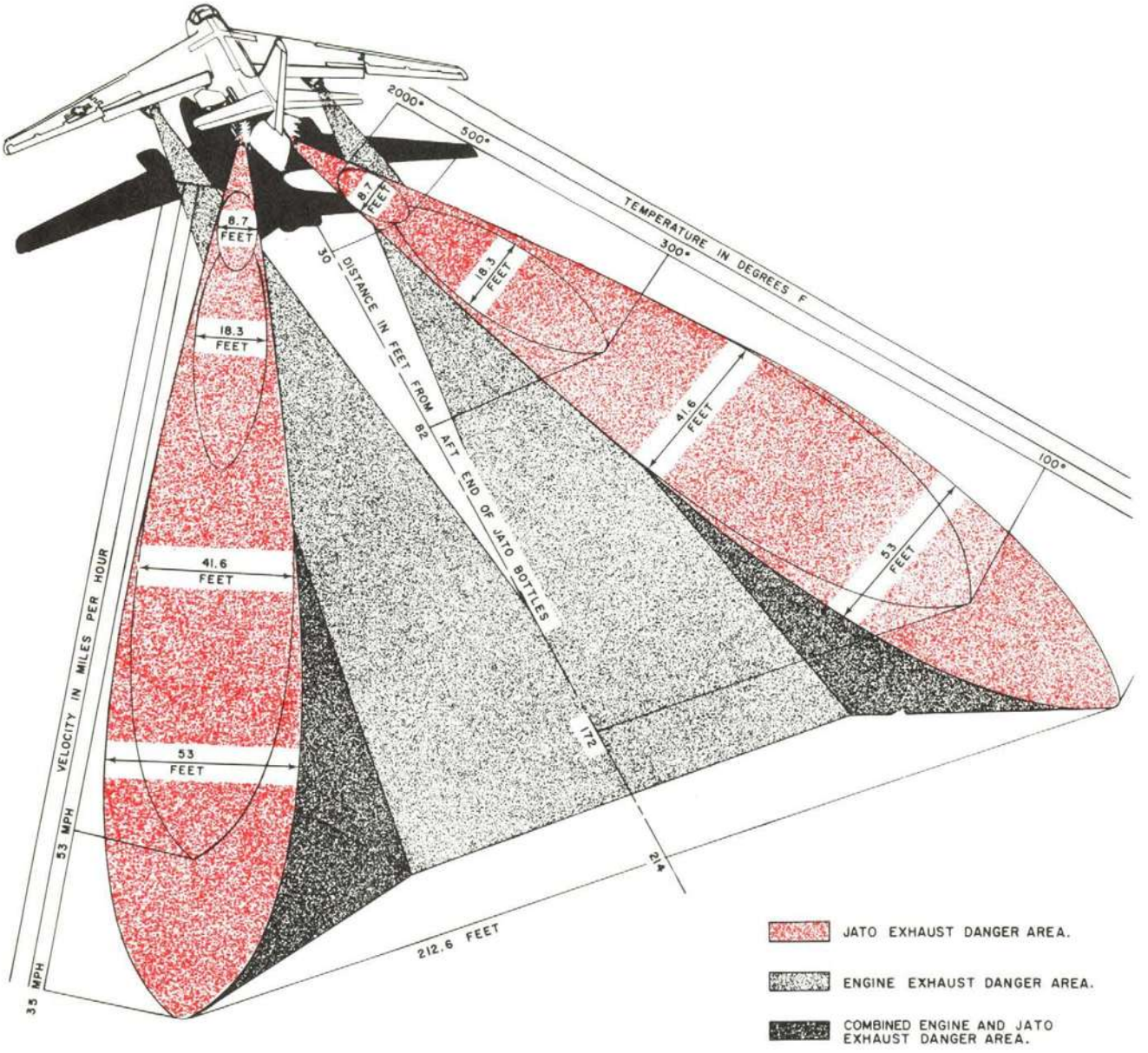


Figure 1-53. Danger Areas (Sheet 3)

PART 4

OPERATING LIMITATIONS

INTRODUCTION

The following section deals with operating limitations that shall be observed during normal operation of the aircraft. It is mandatory that the prescribed limitations be observed at all times, not only for the safety of the pilot and crew, but also to obtain the most satisfactory operation of the aircraft.

Cognizance shall be taken of the engine performance indicators illustrated on figure 1-54 since limitations represented there are not necessarily repeated in the text.

ENGINE LIMITATIONS

The engines and their supporting structure will mechanically withstand any flight maneuver or landing force within the design load factor limitations of the aircraft structure.

ENGINE OPERATING LIMITATIONS

The engine operating limitations are based on a combination of engine speeds and exhaust gas temperatures. The maximum allowable engine rpm under any condition is red-lined at 105.2 percent (10,200 rpm). Should this limiting rpm be exceeded, reduce power and land as soon as possible. Adhere strictly to maximum allowable exhaust gas temperatures to prolong the life of the engine. Table 1-5 shows maximum engine speeds and exhaust gas temperatures under various operating conditions.

AIRSPEED LIMITATIONS

The maximum permissible indicated airspeeds are as follows:

a. In smooth or moderately turbulent air:

1. With arresting hook, landing gear, and wing flaps retracted, with speedbrakes retracted or extended, airspeeds shall be kept below those at which airframe vibration is encountered.

13,000 feet and below . . . . . 480 knots
13,000 to 33,000 feet . . . . . 0.85 IMN
33,000 feet and above . . . . . 0.88 IMN

2. With landing gear extended . . . . . 225 knots

3. With wing flaps fully or partially extended . . . . . 255 knots

4. Drag chute deployment (ground only) . . . . . 150 knots

5. Fuel dumping, in straight and level flight without yaw or in gentle coordinated level turns,
With gear and flaps retracted . . . . . 250 knots
With gear and flaps extended . . . . . 150 knots

6. JATO bottles should be jettisoned at air speeds below 200 knots, in a level flight attitude, with flaps down. JATO bottles can be carried safely at airspeeds up to 300 KIAS, but not jettisoned above 200 KIAS.

7. Camera window door operation.

Opening . . . . . 300 knots

Closing . . . . . 300 knots

TABLE 1-5. ENGINE OPERATING LIMITATIONS

OPERATING CONDITION	MAXIMUM RPM	MAXIMUM EXHAUST GAS TEMPERATURE (°C)		TIME LIMIT IN MINUTES	FUEL BOOST PRESSURE INDICATION	OIL PRESSURE INDICATION
		30,000 FT. & BELOW	ABOVE 30,000 FT.			
Military Rated	105.2%	610	640	30	Norm	Norm
Normal Rated (Max. Continuous)	105.2%	560	580	. .	Norm	Norm
Idle	60-62%	340 (Ground)	. . .	. .	Norm	Norm
Starting	. . . . .	610	610	2	Norm	Norm
Acceleration	105.2%	650	650	2	Norm	Norm

CAUTION

Camera window doors may not be operable above 330 knots.

b. In severe turbulence the maximum permissible airspeeds are:

The aircraft should not be operated in conditions of severe turbulence because gusts can be encountered that impose excessive loads. However, if flight in severe turbulence cannot be avoided, indicated airspeeds in the range from 190 to 300 knots are recommended. For flight in thunderstorms, recommended airspeed for penetration is 220 to 250 KIAS.

MANEUVERS

The following maneuvers are not permitted:

1. Normal and accelerated stalls
2. Loops
3. Bank angles in excess of 120 degrees
4. Under asymmetric power conditions, intentional slips or skids into the dead engine at airspeeds in excess of 350 KIAS.

Note

Flying in moderate or severe turbulence with the autopilot or yaw damper engaged is prohibited. Large magnitude inputs to the autopilot may result in a maneuver which could exceed the structural limits of the aircraft.

5. Abrupt uncoordinated maneuvers, especially abrupt rudder kicks.

ACCELERATION LIMITATIONS

The positive acceleration limits of the RA-3B aircraft vary with the gross weight and the velocity as shown in figure 1-54A, sheets 1 and 2. Figure 1-54A, sheet 1, indicates that the maximum acceleration load factor is 3.4 g's for a gross weight of 56,000 pounds. A time limit of 20 seconds at 1 negative g must be observed in order to preclude the loss of the air turbine motor power. The design parameters at sea level of 41 feet per second gust loading are also shown on figure 1-54A, sheet 1. It is readily apparent by using figure 1-54A, sheet 1, that at speeds of 480 knots, with a gust load of 41 feet per second, only a small maneuvering load factor of 0.75 g is required to reach the design limits of 3.4 g's. Figure 1-54A, sheet 2, shows the relationship between gross weight and acceleration loads. The maximum positive design acceleration load factor is 4.77 g's at a landing weight of 44,000 pounds without wing fuel.

WEIGHT LIMITATIONS

The maximum recommended gross weights are as follows:

a. Field takeoff . . . . . 78,000 pounds
b. Field landing . . . . . 56,000 pounds
c. Catapulting . . . . . 73,000 pounds
d. Shipboard and shore-based arrested landings; touch and go; FCLP . . . . . 50,000 pounds

CARRIER OPERATIONS LIMITATIONS

Arrested landings with fuel in the wing tanks are not permitted. Barricade engagements are permitted to a maximum gross weight of 50,000 pounds. The applicable Recovery Bulletin contains the permissible arresting gear engaging speeds. Catapult shots with partial wing fuel are not permitted.

CENTER OF GRAVITY LIMITATIONS

For center of gravity limitations and aircraft loading data, refer to AN-1B-40 Handbook of Weight and Balance Data.

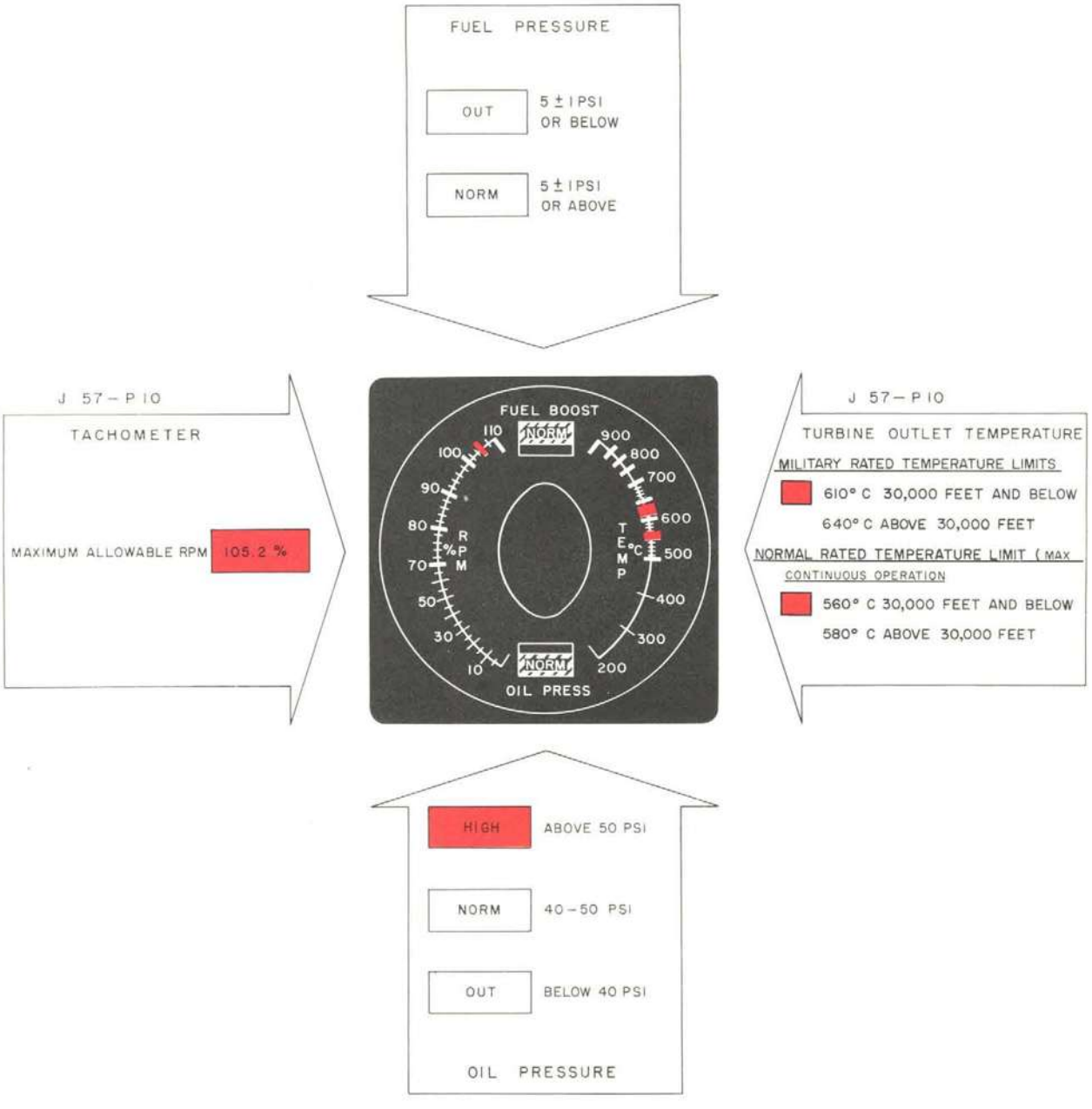
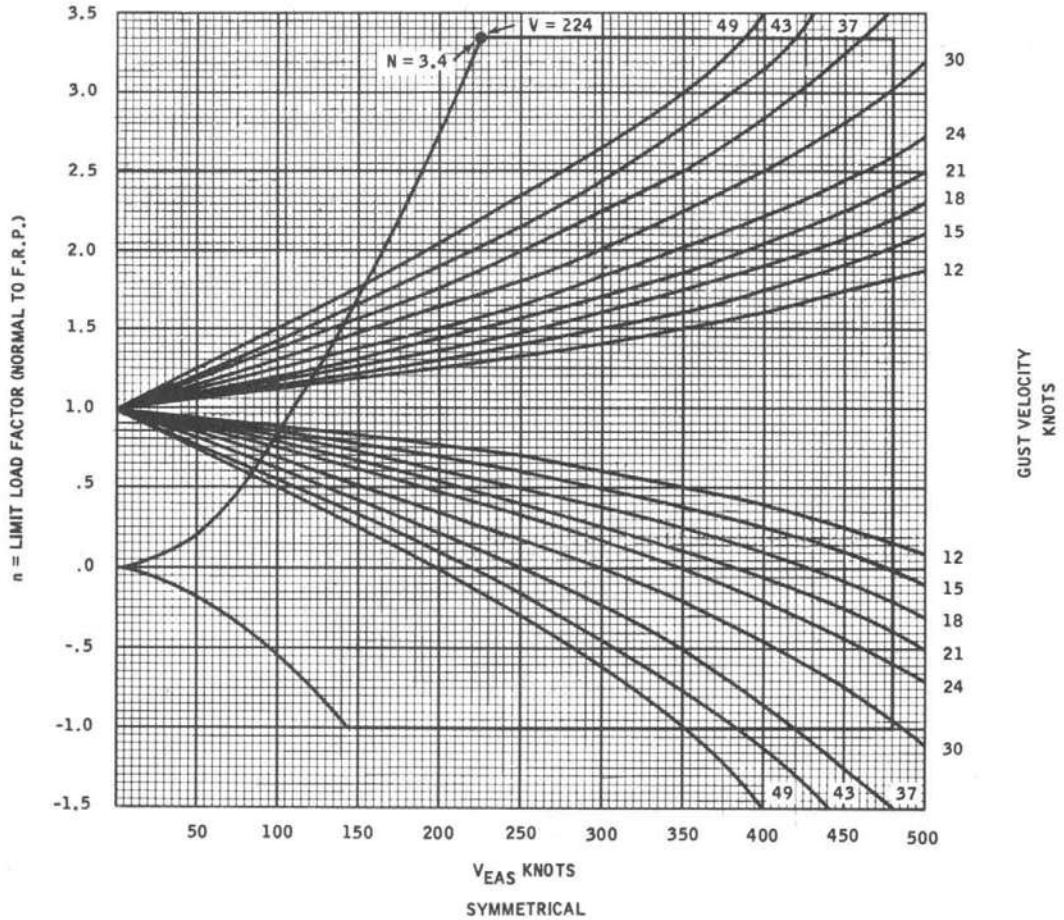
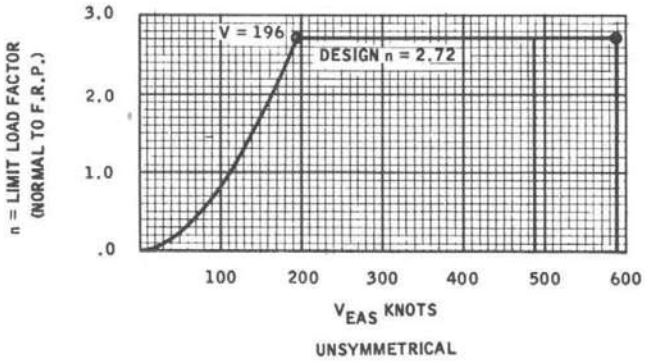


Figure 1-54. Engine Performance Indicators

SEA LEVEL
FLIGHT LOAD FACTOR VS GROSSWEIGHT

MODEL: A-3B **ENGINES:** J-57-P10





ATB-1 P-40501-1

REMARKS:

Basic and High Drag Configuration
Gross Weight = 55,948 LBS.

DATA AS OF: 6-12-56
DATA BASIS: ESTIMATED

EXPLANATION:

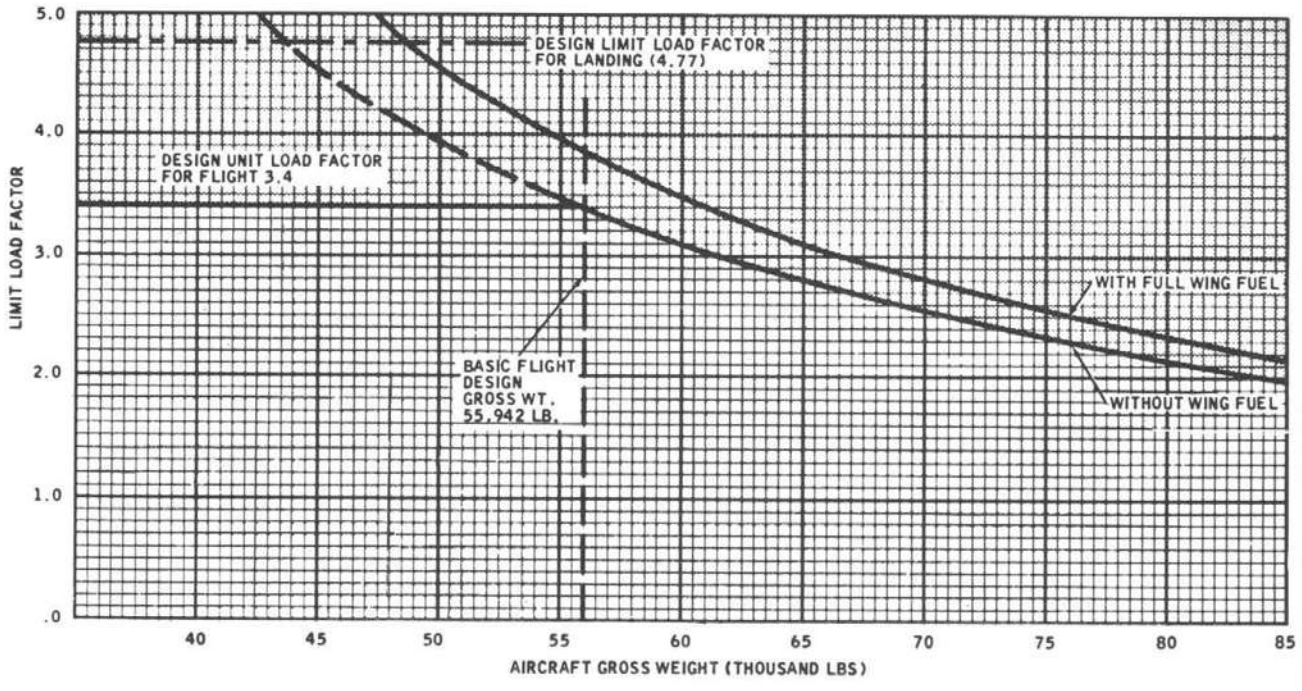
1. Reset Accelerometer after Takeoff.
2. Use "1G" Baseline
3. Read Vertical Gust loads on Accelerometer
4. Do not attempt Maneuvers where the Accumulative "G" Loads (Gust plus Maneuver) will exceed V-n Limitations.

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 Lbs/Gal

Figure 1-54A. Flight Load Factor vs Gross Weight (V-n) (Sheet 1)

FLIGHT LOAD FACTOR VS GROSS WEIGHT

MODEL : A-3B **ENGINES :** J-57 P-10



ATB -I-I P-40501-2

REMARKS:

FUEL TANK VOLUME AND WEIGHTS (JP-5)

WING	1298 GALS.	8826 LBS.
FWD. FUSE.	1178 GALS.	8010 LBS.
AFT. FUSE.	1909 GALS.	12981 LBS.
AUX. FUSE.	773 GALS.	5256 LBS.

EXAMPLE:

DATA AS OF: 8 AUG. 1956
DATA BASIS: ESTIMATED

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LBS/GAL

Figure 1-54A. Flight Load Factor vs Gross Weight (V-n) (Sheet 2)

5. Fuel dumping, in straight and level flight without yaw or in gentle coordinated level turns,
With gear and flaps retracted . . . . . 250 knots
With gear and flaps extended . . . . . 150 knots

6. JATO bottles should be jettisoned at airspeeds below 200 knots, in a level flight attitude, with flaps down. JATO bottles can be carried safely at airspeeds up to 300 KIAS, but not jettisoned above 200 KIAS.

7. Camera window door operation.

Opening . . . . . 300 knots

Closing . . . . . 300 knots

CAUTION

Camera window doors may not be operable above 330 knots.

b. In severe turbulence:

The aircraft should not be operated in conditions of severe turbulence because gusts can be encountered that impose excessive loads. However, if flight in severe turbulence cannot be avoided, indicated airspeeds in the range from 190 to 300 knots are recommended. For flight in thunderstorms, recommended airspeed for penetration is 220 to 250 KIAS.

MANEUVERS

The following maneuvers are not permitted:

a. Normal and accelerated stalls.

b. Loops.

c. Bank angles in excess of 120 degrees.

d. Under asymmetric power conditions, intentional slips or skids into the dead engine at airspeeds in excess of 350 KIAS.

e. All maneuvers or flight with the autopilot or yaw damper engaged, except for aircraft with ASC 268 incorporated.

f. Spins.

g. Abrupt uncoordinated maneuvers, especially abrupt rudder kicks.

ACCELERATION LIMITATIONS

Except that accelerations at which buffeting is encountered shall not be exceeded, the permissible acceleration range for flight in smooth air, at gross weights of 56,000 pounds or less, is 0 to 3.4 g. Accelerations between 0 and 0.5 g are limited to 2 seconds duration. When flying in conditions of moderate turbulence, it is essential that accelerations because of deliberate maneuvers be limited to 2.0 g at gross weights of 56,000 pounds or less in order to minimize the possibility of overstressing the aircraft as a result of combined effects of gust and maneuvering loads. As gross weights are increased above 56,000 pounds, the permissible accelerations decrease. To determine the maximum permissible accelerations at gross weights in excess of 56,000 pounds, multiply the accelerations given above for smooth air or for moderate turbulence by the ratio of 56,000 pounds to the new gross weight. The load factor for buffet onset is presented on figure 4-2.

WEIGHT LIMITATIONS

The maximum recommended gross weights are as follows:

a. Field takeoff . . . . . 78,000 pounds

b. Field landing . . . . . 56,000 pounds

c. Catapulting . . . . . 73,000 pounds

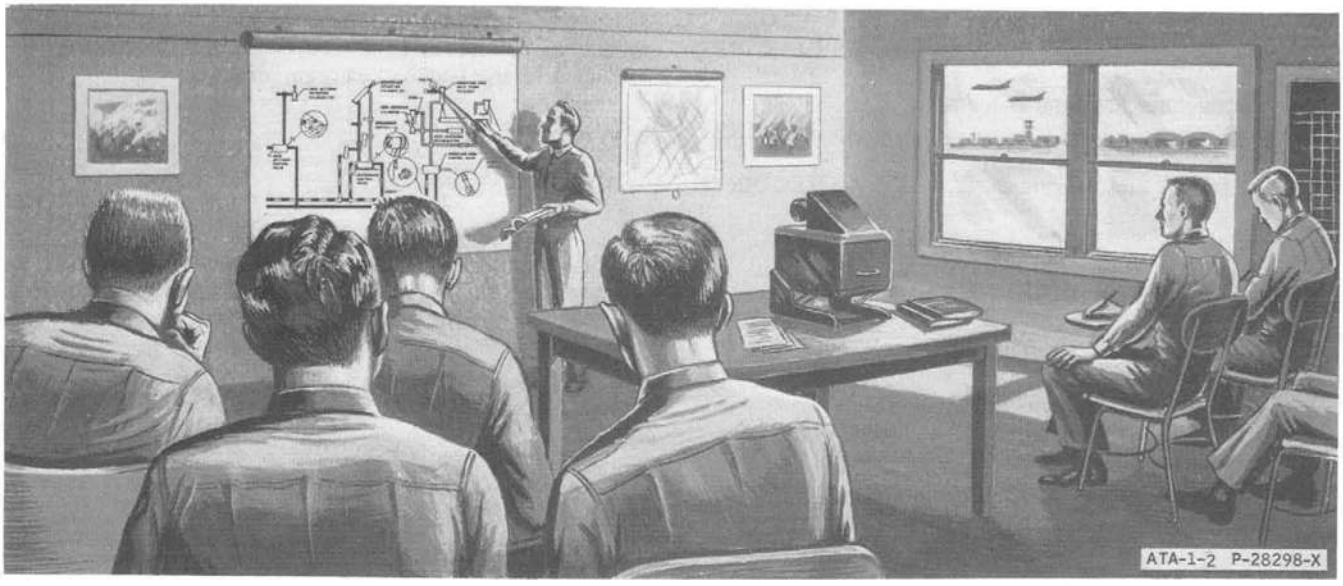
d. Shipboard and shore-based arrested landings; touch and go; FCLP . . . . . 50,000 pounds.

CARRIER OPERATIONS LIMITATIONS

Arrested landings with fuel in the wing tanks are not permitted. Barricade engagements are permitted to a maximum gross weight of 50,000 pounds. The applicable Recovery Bulletin contains the permissible arresting gear engaging speeds.

CENTER OF GRAVITY LIMITATIONS

For center of gravity limitations and aircraft loading data, refer to AN-1B-40 Handbook of Weight and Balance Data.



SECTION II

INDOCTRINATION

INTRODUCTION

This section establishes minimum requirements for training, initial qualification, and currency. Subsequent sections provide the operational information considered necessary to ensure safe and efficient operation of the RA-3B, when used in conjunction with the Naval Warfare Publication series. Unit commanders are authorized to waive, in writing to the individual affected, flight hour minimums and/or OFT/WST training requirements where recent experience in similar models warrants. However, adequate preparation and guidance of the pilot for initial and subsequent flights, so that he attains and maintains a reasonable degree of proficiency in a safe manner, is of prime importance. Too often, under pressure of operational commitments, this groundwork is abbreviated or deleted; and can result only in a deterioration of individual and unit effectiveness. For this reason, commanding officers must continuously promote adherence to these basic criteria. Procedures for submitting changes to and requesting waivers from the provisions of this section are contained in OPNAV Instruction 3510.9 (current revision). Training requirements, checkout procedures, evaluation procedures, and weather minima for Ferry Squadrons are governed by the provisions contained in OPNAVINST 3710, 6 Series.

GROUND TRAINING

Ground training should be continuous throughout the career of the RA-3B pilot and crew. The overall syllabus will vary according to local conditions, facilities, directives from higher authority, and the unit commander's estimation of squadron readiness. However, there are certain specific requirements which must be met to ensure that the crew is properly indoctrinated and briefed prior to flight.

SURVIVAL TRAINING

The requirement for and frequency of survival training shall be as directed by the type commander. It will normally require the following minimum training of all A-3 flight personnel:

1. Low pressure chanber . . EVERY TWO YEARS
2. Night vision . . . . . WHEN REPORTING FROM NON-OPERATIONAL DUTY

3. Swimming tests ..... AS REQUIRED

4. Underwater breathing ..... AS REQUIRED

5. Helicopter rescue ..... AS REQUIRED

6. Parachute harness release and drag ..... AS REQUIRED

7. Ditching and bailout ..... AS REQUIRED

MOBILE SURVIVAL TRAINING

If trainer is available, all crewmembers will be scheduled to attend every two years.

FLIGHT CREW REQUIREMENTS

The crew normally consists of pilot, photo-navigator (P/N), and photo-technician (P/T). An additional crewmember (observer, plane captain trainee) may occupy the P/N or P/T crewmember positions, as deemed necessary. For hazardous operations, the minimum crew, consisting of the pilot and one additional qualified crewman (P/N, P/T, or plane captain), may be used during initial FMLP and Carrier Qualifications, etc. A pilot must complete the following ground syllabus conducted by the RCVW Training squadron prior to commencing A-3 flight transition:

Naval Air Maintenance Training	(8 days)
Pre-familiarization ground training	(3-1/2 days)
A-3 Operational Flight Trainer (OFT)	(10 hours)

The minimum flight training requirements will normally be completed in the RCVW training squadron. However, at the discretion of their commanding officer, non-operational pilots (those who are not ordered to operational A-3 squadrons) may complete the A-3 flight training requirements at their parent activity under the supervision of a currently qualified A-3 pilot. The RCVW squadron will maintain a detailed flight syllabus to be available on request for the conduct of such training. The minimum pilot time requirements while undergoing RCVW training are as follows:

10 hours pilot time prior to SOLO

20 hours pilot time prior to NIGHT SOLO

20 hours pilot time prior to ACTUAL INSTRUMENT FLIGHT

30 hours pilot time prior to CROSSCOUNTRY

30 hours pilot time prior to FCLP

50 hours pilot time prior to CARRIER QUAL

Commanding Officers may waive these minimums where previous or recent experience is indicated. The duties of the flight crewmembers are:

PILOT

1. Complete responsibility for the safe and proper operation of the aircraft in the performance of its assigned mission, and for the performance of his crew in their specified flight duties.

2. Supervision of continued training of crew.

3. Inspection of crew flight gear prior to each flight.

PHOTO-NAVIGATOR

1. Obtain a mission and weather briefing.

2. Complete flight plan, jet log, and navigation planning.

3. Ensure that a navigation bag with contents prescribed in Section III, Part 2, is aboard the aircraft.

4. Complete the pretarget photo checklist as soon as possible after level off.

5. Navigate aircraft to and from target.

6. Maintain aircraft on the photographic flight line except during those runs where the P/N must continually monitor the traveling grid, at which time the flight line navigation will be accomplished by the pilot.

7. Determine proper exposure settings.

8. Operate the photographic system.

9. Complete photo-data cards for all photography except radar and low-level.

10. Supervise the photo-technician in the performance of his assigned duties.

PHOTO-TECHNICIAN

1. Be familiar with all phases of navigation and mission planning. Assist the P/N in navigating the aircraft.

2. Complete walk-around inspection of aircraft at least 45-minutes prior to scheduled taxi time.

3. Report aircraft status to pilot.

4. On flights requiring celestial observations, ensure that Baird Atomic sextant is operative and a standby periscopic sextant is aboard.

5. Complete celestial precomputations and make observations as required.

6. Monitor camera operation and stabilization.

7. Maintain photo-data card for radar and low-level photography.

8. Open and close camera windows as directed.

9. Get permission from pilot prior to operating HF radio or DECM.

10. During flight and ground operations, maintain vigilant lookout. Man upper hatch during taxi.

11. Maintain log of inflight discrepancies and make visual postflight check of aircraft.

12. Initiate inflight checklist.

13. Have thorough knowledge of aircraft systems, emergency procedures, and all radio equipment.

14. Know completely the aircraft servicing requirements.

15. Know duties of plane captain and perform such duties when required.

16. When P/N is not aboard, ensure that navigation bag with appropriate contents is aboard aircraft.

PLANE CAPTAIN (NOT REGULAR MEMBER OF FLIGHT CREW)

1. Properly complete aircraft preflight inspection 2 hours prior to first flight of day.

2. Keep aircraft clean and serviced for mission assigned.

3. Have personal knowledge of all aircraft discrepancies and status of each.

4. Check stowage, availability, and condition of all survival equipment required in aircraft.

5. Ensure that frequency cards and cockpit checklists are up to date, neat, and legible.

6. Assist crew during preflight inspection of aircraft.

7. Assume inflight duties of P/T, excluding navigation, when flying in lieu of a P/T.

8. Have working knowledge of aircraft systems, emergency systems, and radio equipment. Know all procedures related to servicing aircraft.

9. Ensure adequate indoctrination and supervision of plane captain trainees assigned.

FOURTH SEAT

The use of the fourth seat for other than official purposes is not authorized. The following criteria should be followed when authorizing a flight requiring the occupancy of the fourth seat:

1. The presence of the fourth crewman in the aircraft must be essential to the successful completion of the flight or be in support of the squadron's mission or assigned tasks.

2. The fourth crewman must be equipped in accordance with the minimum Personal Equipment Requirements of this manual.

3. The fourth crewman must complete Survival Training requirements of this manual.

Note

While it is not intended to discourage flight by legitimate, qualified observers, flight by sightseeing, non-productive passengers is prohibited.

PERSONAL EQUIPMENT REQUIREMENTS

Appropriate flying equipment will be worn by all personnel flying in the aircraft. All survival equipment shall be secured in such a manner that it will be easily accessible and retained during an emergency. Personal equipment requirements are summarized in table 2-1.

TABLE 2-1. PERSONAL EQUIPMENT REQUIREMENTS

Flight suit
Identification tags
Flight gloves
Flight safety boots, with wool or thermal socks
Anti-buffet helmet
Integrated torso harness with MK3C life preserver
Approved survival knife and sheath
SEEK-1 survival kit
Parachute and seat pan pararaft
A-13A oxygen mask, with mask-mounted regulator
38 caliber pistol with tracer ammunition (on flights over water or sparsely populated areas)
Note An approved signaling device is authorized as a substitute for the pistol when operational and/or security conditions warrant.
Flashlight with red lens
Winter trousers or thermal underwear
Shroud cutter
Whistle
Compass

TABLE 2-1. PERSONAL EQUIPMENT REQUIREMENTS (Continued)

Note

Exposure suit is required on all over-water flights when water temperature is 59° F or below, OAT is 32°F or below, or the combined air/water temperature is 120°F or below. Exceptions to these requirements are as follows:

Not required when the water temperature is 50°F and aircraft is within gliding distance of land. When high ambient cockpit temperature would create a hazardous debilitating effect on the crew, type commanders are authorized to grant a waiver in accordance with current OPNAVINST 3710.9.

INTEGRATED FLIGHT GEAR

(See figure 2-1.)

All seats in the aircraft accommodate a back type parachute and a PK-2 pararaft kit. Each seat has fittings for attachment to an integrated flight suit. Each crewmember is held in his seat by these attachments.

The integrated flight suit incorporates part of the seat belt, shoulder straps, and parachute harness. The shoulder straps are sewn to the parachute risers and attach to the inertia reel connection below the headrest. The loose ends of the parachute risers have quick-action fittings which engage other fittings that extend from the front shoulders of the flight suit. Short seat belts, which are sewn to the pararaft retainer strap on each side, are attached to the seat structure. The loose ends of the seat belts have quick-action (rocket-jet) fittings which engage mating fittings protruding from the hip region of the flight suit. The seat belts are adjustable in length. When all of the quick-action fittings are connected and the seat belt is adjusted, the crewmember is held securely in the seat. When the quick-action fittings are disconnected, the crewmember can move about the aircraft without his parachute and pararaft. A harness release handle is located on the forward right hand side of the seat. When this handle is pulled to the limit of its travel, the pins that secure the seat belt to the seat and the pin that secures the shoulder harness straps to the inertia reel are retracted. This action allows the crewmember to leave the seat with his cushion contained emergency oxygen bottle, parachute, and pararaft attached to the integral flight suit. When he returns to the seat, his survival gear is secured in the following manner:

1. Place combination pararaft and seat cushion in seat bucket and parachute in parachute support pouch.
2. Replace harness release handle in holder.
3. Position shoulder harness and seat belt strap fittings in seat attach fittings.
4. Push harness reset button to allow spring-loaded pins to engage fittings and secure harness to seat.
5. Pull on each fitting to make sure it is secure.

SEAT CUSION, PARARAFT, AND BAILOUT OXYGEN BOTTLE

The seat cushion of each crewmember is secured to the pararaft by straps. Built into the seat cushions is a U-shaped emergency oxygen bottle with a pressure gage and a green ring oxygen release handle. The green ring should be pulled prior to bailout, or at any time emergency oxygen is needed. Refer to Emergency Oxygen Bottle in Section IV.

EMERGENCY LOCATOR BEACON

The emergency locator beacon installed in the PK-2 pararaft container assists search and rescue facilities in locating crewmembers following bailout. The beacon, actuated by parachute deployment, transmits an emergency "beep" signal on the UHF guard channel frequency. For continued transmission after touchdown, an attached telescopic antenna is substituted for the flexible antenna.

SHOULDER HARNESS AND INERTIA REEL

Each seat is equipped with a shoulder harness handle on the left side of the seat. The harness is locked in position when the handle is moved to LOCKED. When the handle is in the UNLOCKED position, the harness will automatically lock if the deceleration force along the thrust line exceeds 2.5 g.

BARO-RELEASE LANYARDS

Each position in the aircraft is equipped with a baro-release lanyard (figure 2-1) and a method of attaching the lanyard.

PARACHUTE BARO-RELEASE LANYARD ACTUATION

WARNING

If the baro-release lanyard is actuated within the cabin at cabin altitudes less than 10,000 feet MSL, the parachute will be actuated within 3 seconds.

The baro-release mechanism is armed by pulling the baro-release lanyard. When armed below an altitude of 10,000 feet MSL, the baro-release mechanism will deploy the parachute within 3 seconds. When armed above 10,000 feet, the parachute will deploy when passing through 10,000 feet.

The baro-release lanyards shall be attached at all times except for carrier takeoffs and landings, ditching, or crew movement in flight with parachute on. The pilot's and photo/navigator's baro-release lanyards are 9 feet in length, while the photo/technician's is 7 feet 4-inches in length. The lanyards are red and are permanently secured at one end to the inboard side of each seat by a bolt through an eyelet and snapped at the other end to the baro-release fitting. As the crewmember moves toward the escape exit, the lanyard feeds from the stored position under the parachute upper and lower bungee opening bands.

1. Emergency oxygen bottle actuating ring
2. Seat cushion
3. PK-2 pararaft
4. Parachute
5. Lap belt adjustment buckle (2)
6. Pararaft actuating handle
7. Lap belt-to-flight suit rocket-jet fitting
8. Flotation gear actuating lanyard
9. Flotation gear
10. Suit harness adjustment buckle
11. Shoulder harness-to-flight suit rocket-jet fittings
12. Parachute ripcord
13. Shoulder harness-to-pilot oxygen connection
14. Flotation gear actuating lanyard
15. Seat cushion-to-pilot oxygen connection
16. Lap belt-to-flight suit rocket-jet fittings

Figure 2-1. Integrated Flight Gear

SECTION III

NORMAL PROCEDURES

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PART 4.	Carrier-Based Procedures	3-37

PART 1

BRIEFING/DEBRIEFING

INTRODUCTION

Planning should begin with a crew briefing that outlines the objectives of the mission. Briefing responsibilities shall be assigned by the Operations officer. The pilot shall ensure that the mission requirements and the procedures to obtain them are thoroughly understood.

BRIEFING

The briefing shall be conducted using a briefing guide that will outline all information necessary to the successful completion of the mission. If air refueling is to be accomplished, a briefing shall be included at this time. The briefing guide shall include the following items:

GENERAL

1. Aircraft assignment and deck spot.
2. Engine start, taxi, and takeoff time.
3. Rendezvous instructions and visual signals.

MISSION

1. Primary
2. Secondary
3. Operating area
4. Controlling agency
5. On-station or target time.

CAMERA/ILLUMINANT EQUIPMENT

1. Camera configuration
2. Magazine stowage
3. Flash cartridge/bomb safety
4. Handling of unexpended illuminants
5. Night illuminant operating procedures
6. Minimum release altitude(s).

COMMUNICATIONS

1. Frequencies
2. Radio procedure and discipline
3. Navigational aids
4. IFF/SIF and ADIZ procedures.

WEATHER

1. Present weather
2. Enroute weather
3. Target weather
4. Forecast terminal weather.

FLIGHT PLANNING

1. Climbout
2. Mission profile including fuel requirements
3. Marshal
4. Penetration
5. GCA or CCA
6. Recovery.

TAKEOFF/ABORT COMPUTATIONS

1. Takeoff airspeed
2. Takeoff roll
3. Distance from liftoff point to the arresting gear (if applicable)

4. Line speed checks
5. Refusal speed, if applicable
6. Minimum single-engine control speed
7. Single engine performance (see Section XI)
8. Surrounding terrain and obstructions altitudes
9. Illuminant jettisoning considerations.

Note

For takeoff on runways not equipped with arresting gear, a refusal speed must be computed.

EMERGENCIES

1. Aborts
2. Divert fields
3. Bingo and low-state fuel
4. Waveoff pattern
5. Ready deck
6. Radio failure
7. Loss of visual contact with flight
8. Aircraft emergencies.

AIR INTELLIGENCE AND SPECIAL INSTRUCTIONS

1. Friendly or enemy force disposition
2. Current situation
3. Targets
4. Safety precautions.

AIR REFUELING PROCEDURES (BRIEFING BY TANKER PILOT)

1. Rendezvous
2. Receiver aircraft movements
3. Amount of fuel to be transferred
4. Signals
5. Emergency procedures.

DEBRIEFING

Immediately after securing the aircraft, the crew shall complete the yellow sheet and be debriefed. The debriefing will normally be conducted by an Air Intelligence Officer, and shall include mission accomplishment, crew performance, and pertinent recommendations for improving crew coordination.

Note

The debriefing of a photographic training mission is not considered complete until the processed film has been reviewed by the crew.

PART 2

MISSION PLANNING

INTRODUCTION

The success and ease with which a mission can be accomplished is dependent on the planning which precedes it. Thorough and detailed mission planning is mandatory. The total planning of a mission is a crew function and will serve as a guide for the flight.

Each crew member shall be aware of the mission requirements, the methods to be utilized in accomplishment of the mission, and the manner in which he is to assist other crew members.

THE PHOTOGRAPHIC MISSION

The photographic mission is to provide aerial photographic intelligence, mosaic and cartographic mapping. Aerial photographic missions are classified as day and night reconnaissance, cartographic, and radar-scope photography. Training missions are planned in accordance with Chapter 4 of FXP-2 to train the crew in obtaining high quality photography under varying conditions.

MISSION CHECKLIST

The following items can be used as a guide in the preparation of the mission checklist. Only items applicable to the mission need be considered.

NAVIGATION

1. Ship PIM
2. TAS checks
3. Deviation checks
4. Ground speed checks
5. Drift readings
6. Pressure readings
7. Celestial fix times
8. Radio nav aid frequencies
9. Enroute elevations
10. Wind checks
11. Visual check points
12. Emergency field location
13. Variation
14. CONSOLAN/CONSOL facilities available
15. Weather forecast.

PHOTOGRAPHIC

1. Mission Requirements
   a. Area
   b. Scale
   c. Altitude
   d. Flight line specifications
   e. Depression angles.
2. Charts
   a. Flight lines
   b. Headings.
3. Camera Configurations
   a. Cameras
      (1) Focal length
      (2) Shutter speed
      (3) Diaphragm settings
      (4) Recycle time
      (5) Format
      (6) Filters.
   b. Aircraft camera positions
   c. Magazines
   d. Amount and type of film required.

4. Stabilization
5. Image Motion Compensation
6. Illuminants
7. Preflight Check
8. Pretarget Check
   a. Camera power time
   b. Altitude sets
   c. Bomb bay door time
   d. Programming
   e. Time over target.
9. Target Procedures Plan
10. Post Target Check.

FUEL MANAGEMENT

1. HOWGOZIT
2. Wing Tank Transfer
3. Climb and Cruise Data
4. Fuel Reserves.

DETECTION

1. EW Detection
2. GCI Detection
3. Aircraft Interception Point.

TACTICAL

1. EMCON
   a. Radar
   b. Nav Aids-OFF/ON.
2. Escort Signals
3. DECM Operation
4. Abort Procedures.

REPORTS

1. ADIZ
2. Strike
3. Position.

NAVIGATION PLANNING

The crew shall use every means at their disposal in navigating the aircraft to the desired position for the final run-in on the target.

Methods of navigation available for use in the RA-3B are DR, pressure drift, consolan, radar, celestial, radio nav-aids, viewfinder and visual. Crew responsibilities for navigation planning are prescribed in Section II, Part 2.

NAVIGATION BAG CONTENTS

A navigation bag shall be aboard on each flight and shall contain the following items:

1. RA-3B NATOPS Flight Manual
2. Flashlight and Red Lens
3. Flight Packet
4. En Route Supplement
5. En Route High Altitude Charts
6. En Route Low Altitude Charts
7. Terminal (high altitude) Charts
8. WAC/ONC Charts (or equivalent)
9. Navigation Computer
10. Rest Computer
11. Photo Computer
12. Dividers and Plotter.

The following additional items shall be carried on all over-water flights:

13. Air Almanac
14. HO 249 (Vol. 1, 2, or 3)
15. Sight Reduction Forms
16. Chronometer.

PHOTOGRAPHIC PLANNING

After the mission briefing and a study of the route and target have been completed, the mission planning checklist shall be prepared. This checklist shall set forth in proper sequence the items to be accomplished prior to reaching the target. With proper planning, the mission can be conducted primarily with reference to the checklists.

FUEL PLANNING

HOWGOZIT

A HOWGOZIT (for sample form, see figure 3-1) is a record of predicted and actual fuel consumption versus distance made good, from which the pilot can determine whether the flight can be safely continued or must be aborted or diverted for landing. A HOWGOZIT shall be prepared for all flights other than local. For flights conducted with periodic fixes determined from electronic navigation aids, the HOWGOZIT may simply consist of a fuel check and a comparison of predicted and actual fuel remaining at each fix. The HOWGOZIT shall be prepared using the latest winds for the flight route. Specific cruise altitudes or cruise climb may be used. The HOWGOZIT for long range over-water flights will show the equal time point.

FUEL RESERVES

Flights will be planned, and wherever possible, conducted in such a manner that the aircraft will be on the deck with a minimum of 3000 pounds of fuel remaining. Three thousand pounds constitutes low-state for the RA-3B; and when it is reached, the pilot shall request immediate priority for approach and/or landing, declaring an emergency, if necessary, to obtain such priority.

When the destination is forecast to be IFR on arrival, reserve fuel will be sufficient to proceed to the destination airport at pre-planned altitude then to the alternate field at penetration altitude with sufficient fuel to hold for 20 minutes and land with 3000 pounds remaining. It is to be noted that this fuel reserve is greater than that required by OPNAV Instruction 3710.7 (current revision).

SPECIAL FUEL CONSIDERATION

To allow for the various altitudes and loiter times that may be required because of target weather, the target loiter fuel charts (see figure 3-2 and refer to Section XI) should be carried on all missions. These charts allow for 6000 pounds of fuel at 20,000 feet over destination, and may be adjusted to allow less if terminal weather is known to be good or if operational requirements dictate.

FUEL COMPUTATIONS

The REST Computer, the RICH Computer, the Confidential Supplement to NWIP41-3, and the performance data charts in Section XI are available for fuel computations.

TACTICAL PLANNING

For mission tactics planning and DECM operation, see NWP 41A and Supplement to NATOPS Flight Manuals NAVWEPS 01-40ATD-1A.

WEIGHT AND BALANCE

After determining that cameras, photoflash bombs, and fuel required for the mission have been loaded aboard the aircraft, check gross weight and center of gravity for takeoff and anticipated loading for landing. Refer to Section I, Part 4, for weight limitations to be observed, and to Handbook of Weight and Balance Data AN 01-1B-40 for loading data.

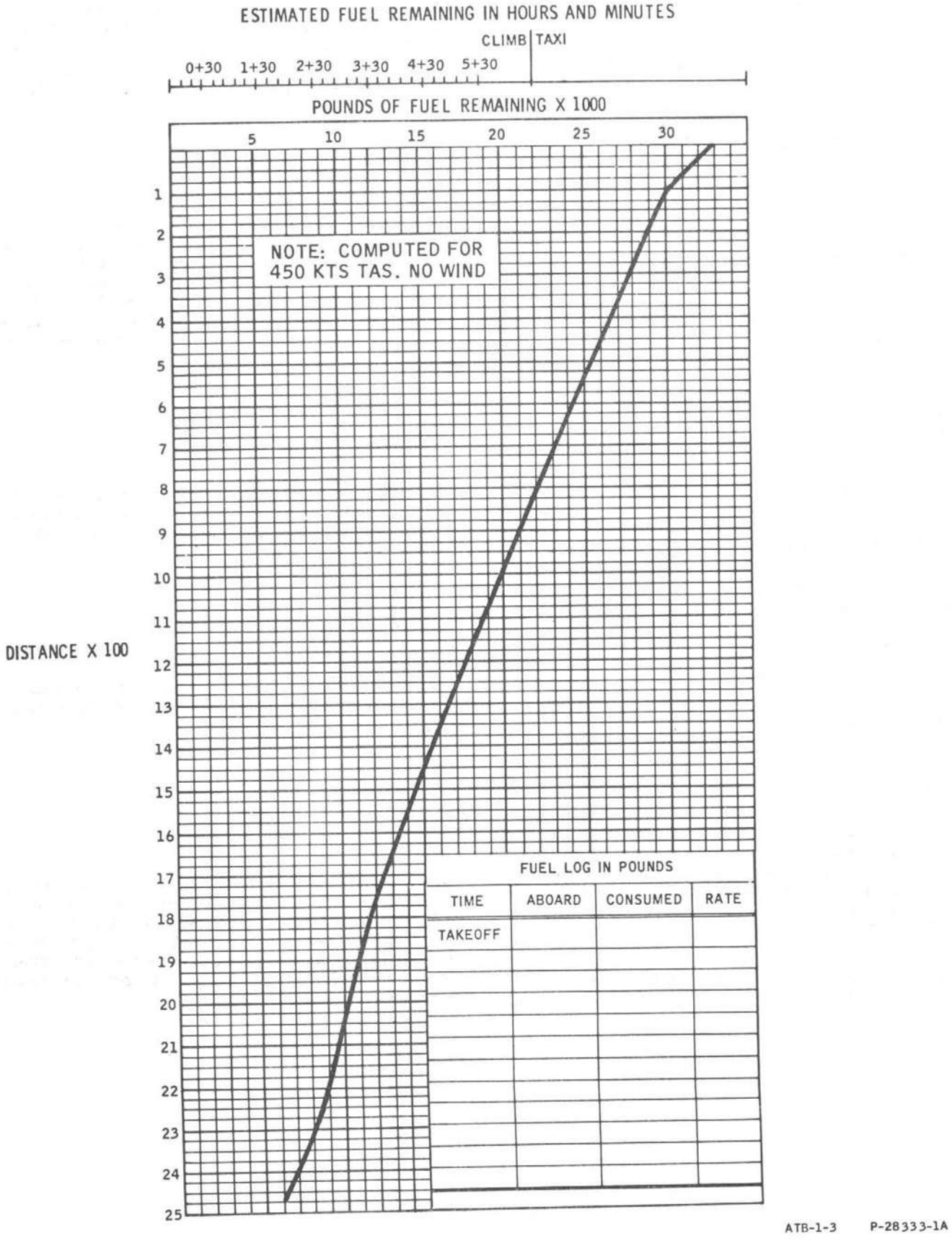
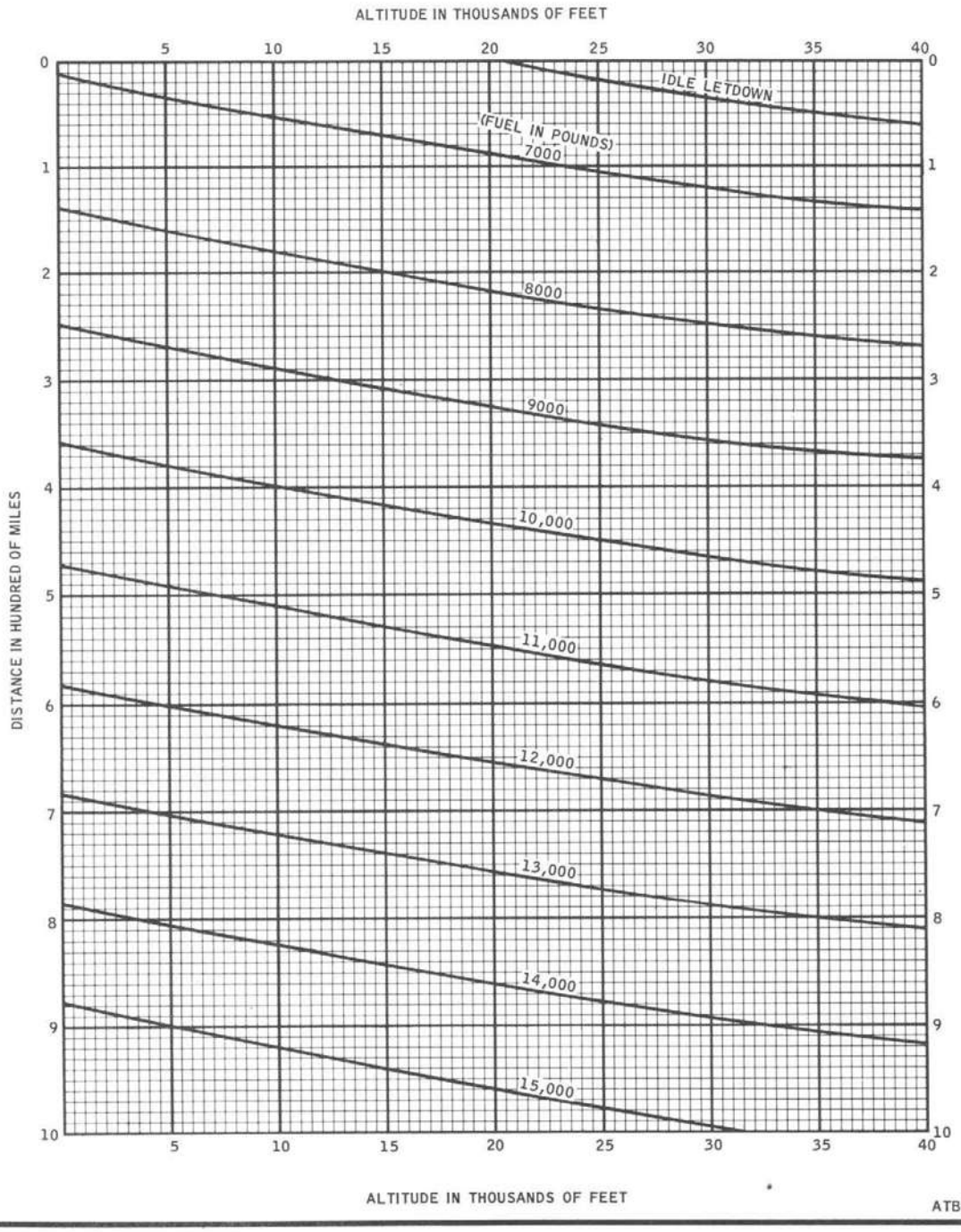


Figure 3-1. Typical Long Range Howgozit

TARGET LOITER FUEL



REMARKS:

(1) Predicted on climb to and return at optimum altitude.

Figure 3-2. Target Loiter Fuel

PART 3

SHORE-BASED PROCEDURES

FAMILIARIZATION AND TRANSITION

The professional approach to flying requires that the entire operation, ground and air, be conducted as safely as the mission permits. Aircraft accidents caused by personnel error cannot be tolerated. Flight safety means:

1. Thorough training and standardization
2. Complete planning and flight preparations
3. Knowledge of aircraft
4. Constant alertness
5. Common sense.

Flying the RA-3B presents problems typical of any sweptwing, high-performance aircraft. Approach speed and sink rate must be carefully controlled. (Stall warning in the CLE aircraft is much less intense than in the basic wing.) At altitude, the aircraft has a slight "Dutch Roll", which becomes unimportant as the pilot gains experience in the aircraft. Transition will normally be accomplished in the Fleet Replacement Training Squadrons. (For a description of flight characteristics, refer to Section IV.)

LINE OPERATIONS

MANNING THE AIRCRAFT

The aircraft should be manned at least 30 minutes prior to launch to ensure sufficient time for a thorough preflight inspection. Before the aircraft is manned, the yellow sheet shall be examined for previous discrepancies, and completed insofar as practicable with information relative to the current flight.

PREFLIGHT CHECKLISTS

A preflight inspection shall be made in accordance with the following checklists (for a suggested inspection sequence, see figure 3-3):

FORWARD FUSELAGE/RADOME (AREA A)

1. Camera windows . . . . . CLEAN SECURED
2. Camera doors . . . . . PROPER OPERATION/ CLOSED
3. Escape chute and door . . . . . CHECK
4. Access plates . . . . . SECURED
5. Refueling probe cover . . . . . REMOVED
6. ATM exhaust duct . . . . . CLEAR
7. Utility and surface control hyd reservoir . . . . . CHECK
8. Generator cooling air scoop . . . CLEAR
9. Fuselage hydraulic leaks . . . . . CHECK
10. Air conditioning exhaust duct . . CLEAR
11. Static vent (port) . . . . . CLEAR
12. Radome condition and security . CHECK
13. Radome cooling intake scoop . . CLEAR
14. Air cond/heat exchanger intake . . . . . CLEAR
15. Viewfinder windows . . . . . CLEAN
16. Pitot tube cover . . . . . REMOVED
17. Static vent . . . . . CLEAR
18. Angle-of-attack probe cover . . REMOVED
19. Utility/aileron con hyd reservoirs . . . . . CHECK
20. Generators cooling air scoop . . . . . CLEAR
21. ATM exhaust duct . . . . . CLEAR
22. Emergency generator door . . . CLOSED SECURED
23. Access plates/doors . . . . . SECURED
24. Camera windows . . . . . CLEAN, SECURE
25. Camera window doors . . . . . PROPER OPERATION/ CLOSED
26. Catapult hooks . . . . . UP

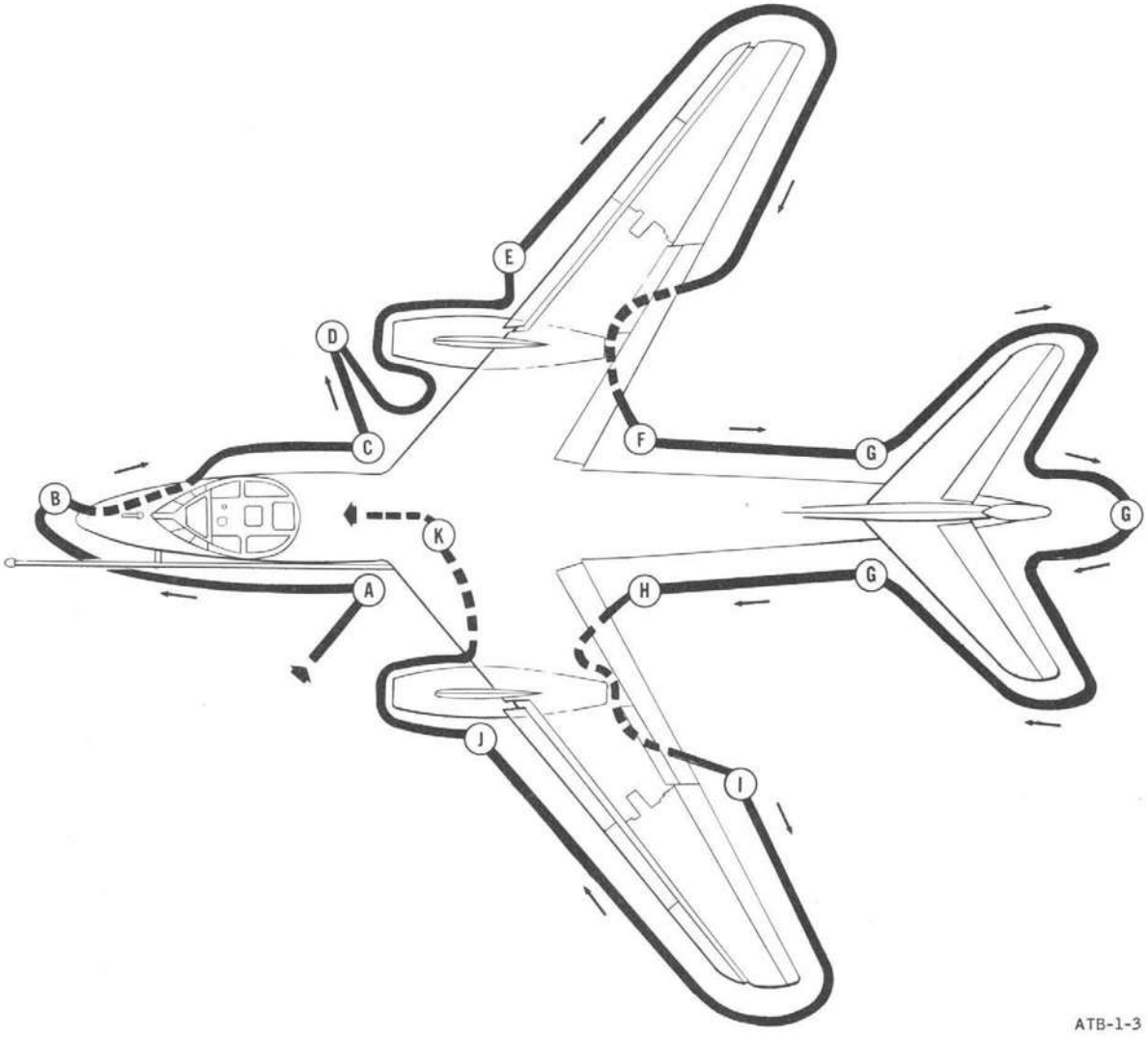


Figure 3-3. Exterior Inspection Sequence

NOSEWHEEL AREA (AREA B)

1. Nosewheel/tire condition, inflation, slippage	CHECK
2. Strut inflation/condition	CHECK
3. Nosewheel steering	CHECK
4. Scissors	CONNECTED
5. Nosewheel steering accumulator	350 PSI
6. Ground lockpin	INSTALLED
7. Taxi/approach light	CHECK
8. Radome lock handles	SECURED
9. Nosewheel door	SECURE
10. Emergency flap air	3000 PSI
11. Emergency gear air	3000 PSI
12. Emergency brakes air	3000 PSI
13. Main gear doors emerg air	3000 PSI
14. Air conditioning unit	SECURE
15. Wheelwell for HYD/ATM fluid	CHECK

STARBOARD SIDE (AREA C)

1. Exhaust ducts	CHECK
2. Access plates	CHECK

3. Bomb bay door ..... CHECK

4. Inboard wing/access plates/ fuel leaks ..... CHECK

STARBOARD ENGINE (AREA D)

1. Left bleed air valve/screen ... CHECK

2. Pylon, access plates ..... CHECK

3. Nacelle fasteners ..... CHECK

4. Oil cooler screen/inlet duct ... CHECK

5. Oil cooler door ..... CHECK

6. Right bleed air valve/screen .. CHECK

7. Pylon, access plates ..... CHECK

8. Tailpipe condition ..... CHECK

STARBOARD WING (AREA E)

1. Access plates ..... CHECK

2. Slats condition/movement .... CHECK

3. Wing fold, hyd leaks and condition ..... CHECK

4. Wing tip lights ..... CHECK

5. Aileron/static wicks/bonding .. CHECK

6. Fuel dump/drain outlets ..... CHECK

7. Flaps/hinges ..... CHECK

STARBOARD WHEEL (AREA F)

1. Wheel/tire condition, brake plates ..... CHECK

2. Hytrol skid detector ..... CHECK

3. Hydraulic/hytrol lines ..... CHECK

4. Strut condition/inflation ..... CHECK

5. Ground locking pin ..... INSTALLE

6. Hydraulic actuating components ..... CHECK

7. Bumper pad. ..... CHECK

8. Wheelwell (free of fuel/oil/ foreign objects) ..... CHECK

9. Pressure fueling receptacle/ switches ..... CHECK

10. Fuel boost pump ground wire .. CONNECTED

11. Wheelwell door/components ... CHECK

12. CO2 purge system blowout disc ..... RED

13. Gravity fuel line valve. ..... CLOSED

AFT FUSELAGE AND EMPENNAGE (AREA G)

1. Access plates ..... CHECK

2. Fuel vent/drain points. ..... CHECK

3. Lox overboard vent. ..... CHECK

4. Radio compt access door ..... SECURED

5. Jato hooks (stbd) ..... CHECK

6. Speedbrakes condition (stbd)... CHECK

7. Tail bumper ..... CHECK

8. Tailhook shank/point ..... CHECK

9. Horizontal stabilizer/trim mark (stbd) ..... CHECK

10. Elevator/curtain/static wicks/ bonding ..... CHECK

11. Vertical stabilizer condition .. CHECK

12. DECM radome/drag chute installed ..... CHECK

13. Rudder/curtain/static wicks/ bonding ..... CHECK

14. Elevator/curtain/static wicks/ bonding (port) ..... CHECK

15. Horizontal stabilizer/trim mark (port) ..... CHECK

16. Fuel vent mast/drain ..... CLEAR

17. Tail access door ..... SECURED

18. Hook holddown pressure (if hook up) ..... 750 PSI

19. Speedbrakes condition (port) .. CHECK

20. Jato hooks (port) ..... CHECK

PORT WHEEL (AREA H)

1. Wheelwell door/components	CHECK
2. Boost pump ground wire	CONNECTED
3. Hytrol/radar altimeter boxes	CHECK
4. Wheelwell (free of fuel/oil/ foreign objects)	CHECK
5. Bumper pad	CHECK
6. Hydraulic actuator components	CHECK
7. Ground locking pin	INSTALLED
8. Strut condition	CHECK
9. Hydraulic/hytrol lines	CHECK
10. Hytrol skid detector	CHECK
11. Wheel/tire/brake plates	CHECK
12. CO2 purge system bottle	SECURE
13. Brake accumulator air	400 PSI
14. Bomb bay door switch	CHECK

PORT WING (AREA I)

1. Flap/hinges	CHECK
2. Fuel dump/drain outlets	CHECK
3. Aileron/static wicks/bonding	CHECK
4. Wingtip/lights	CHECK
5. Wing fold/hyd leaks/condition	CHECK
6. Slats condition/movement	CHECK
7. Access plates	CHECK

PORT ENGINE (AREA J)

1. Left bleed air valve/screen	CHECK
2. Pylon/access plates/doors	CHECK
3. Nacelle fasteners	CHECK
4. Oil cooler screw/inlet duct	CHECK
5. Oil cooler door	RETRACTED
6. Right bleed air valve/screen	CHECK
7. Tailpipe/condition	CHECK

PHOTO FLASH CARTRIDGE/BOMB BAY (AREA K)

1. Bomb bay doors safety pins	INSTALLED
2. Photoflash cartridge/bomb checklists	COMPLETE
3. 16th stage bleed air ducting	CHECK
4. Control cables/hyd/fuel/ vent lines	CHECK
5. Spoiler/aileron boost disconnect check	CHECK
6. Bomb doors air	3000 PSI
7. Bottom camera windows	CLEAN SECURED
8. Bottom camera window doors	PROPER OPERATION/ CLOSED

ENTERING COCKPIT (AREA L)

1. Bailout warning horn	2000 PSI
2. Cabin circuit breakers	IN
3. FWD fuel tank C/B	ON
4. Gyro horizon circuit breaker	OUT
5. Bailout bottles	FULL

OPERATING CHECKLISTS

PRESTART

1. Cabin circuit breakers	IN
2. FWD fuel tank pump C/B's	ON
3. Gyro horizon circuit breaker	OUT
4. Bailout bottles (all)	FULL
5. Baro release lanyards	AS DESIRED
6. Oxygen control valves	OFF
7. Lights, interior	SET
8. Press/temp/anti-icing defrost	AS DESIRED
9. ATM's/AFCS	OFF/OFF
10. Compass	FREE
11. Radio/nav-aids	OFF
12. ICS panels	SET
13. Viewfinder panel	OFF

14. Fuel panel

a. Transfer	OFF
b. Gravity	NORMAL
c. Dump	OFF
d. Crossfeed	CLOSED
15. Exterior lights	SET
16. Camera OP switches	OFF
17. Bleed air switches	OFF
18. Antiskid	OFF
19. Tailhook	POSITIONED
20. Horizontal stab. trim control switch	NORMAL
21. Drag chute switch	LOCKED/ JETTISON STOWED
22. Gear indicators	3 DOWN; SKAG UP
23. UHF	OFF
24. JATO ARM/jettison	SAFE/SAFE
25. Wing/fin fold	POSITIONED
26. Masters/throttles engine	OFF/OFF
27. Light master	AS DESIRED
28. Speedbrakes	AS DESIRED
29. Gear handle/solenoid	DOWN/OUT/ FREE
30. Emergency gear/flap controls	UP
31. Flaps	POSITIONED
32. Elevator ac/dc gang bar and switches	UP/ON
33. Dc generators	ON
34. Ac generators	OFF
35. Bus tie	OPEN
36. External power switch	ON
37. Emergency generator	IN
38. Emergency brake pressure	1500 LBS
39. Master camera control switch	OFF
40. Photo programming switches	OFF
41. ASB	OFF
42. IFF	SET/OFF
43. DECM	OFF

STARTING

1. Aft area	CLEAR
2. Fuel caps/sextant cover/ spoilers	CHECK
3. Masters/fuel boost engine	ON/NORM
4. Crank engine (local or remote)	ON SIGNAL
5. Ignite	12-16%
6. Disconnect	30-35%
7. Oil pressure	NORM
8. LH ATM/RH ATM switches	ON
9. Bleed air check (75%)	
a. LH bleed air on	LH ATM RUNS
b. RH bleed air on	RH ATM RUNS
10. External power	DISCONNECT
11. External power switch	OFF
12. LH ac	ON/STABLE
13. Crank second engine	ON SIGNAL
14. Ignite	12-16%
15. Disconnect	30-35%
16. RH ac	ON/STABLE
17. Bus tie	AUTO
18. Utility hydraulic pressure	NORM
19. Brake pressure	3000 PSI
20. Flight control pressure light	OFF
21. Generator master warning light	OFF
22. ATM compt. temp test	CHECK

STARTING AIRCRAFT

Aircraft shall be started in sufficient time to allow for completion of the pretaxi checklist, and to taxi and takeoff at the scheduled time. To minimize fuel consumption, instrument clearances for long-range flights should be copied prior to engine start.

EQUIPMENT REQUIRED FOR STARTING

The RA-3B aircraft requires a gas turbine compressor (GTC) and external dc power for starting. Use of ac power is not necessary for starting but in most cases is desirable.

CAUTION

Use of ac external power may damage frequency sensitive instruments if cycles cannot be maintained within 380 and 420 CPS.

STARTING PROCEDURES

Starting procedures contained in the prestart and start checklist shall be used. A general discussion of starting procedures follows.

1. Wheel chocks should be in place and a fire extinguisher readily available prior to starting engines. Brake pressure obtained by use of the hydraulic handpump should be available prior to start. The emergency airbrakes may be used as a backup in case either engine accelerates past normal idle during start.

2. Normally the start will be a manual (ground crew controlled) start. The plane captain will indicate ready to start by giving thumbs-up with one hand and, at the same time, indicating which engine to start by holding up one or two fingers of the other hand. On signal from the pilot, the plane captain will signal the ground crew to initiate cranking of the engine. At 12 to 16 percent rpm, the pilot actuates the igniters by moving the throttle outboard (ignition will continue automatically for a 30-second period). Immediately after actuating the igniters, the throttle is brought to the idle position. Fuel is then admitted to the engine in the proper amount for ignition, and upon ignition the tailpipe temperature will start increasing. The pilot must ensure that the starting compressor is shut off prior to 38 percent rpm to prevent shearing of the starter pawls. The starter shutoff signal is a horizontal motion of the fist away from the open palm of the other hand. After ignition the engine should continue to accelerate to an idle rpm of about 58 to 65 percent. Tailpipe temperature will normally rise to a peak of about 450°C, then settle back to about 340°C. TPT must be monitored closely, however, since a temperature in excess of 610°C constitutes a hot start, requiring engine shutdown and inspection.

ATM BLEED AIR SYSTEM CHECK

This check is to be performed after the first engine is started.

A. Port engine operating (75 percent)

(1) Both ATM switches - ON.

ATMs should not run. Indicates that port engine pylon shutoff valve is closed.

(2) LH ATM bleed air switch - ON.

LH ATM should run indicating port engine pylon shutoff valve has opened. RH ATM should not run indicating ATM bleed air crossover valve is closed.

(3) RH ATM bleed air switch - ON.

RH ATM should run indicating opening of ATM crossover valve.

Note

This procedure does not ensure opening of the opposite engine pylon shutoff valve. Therefore, it is recommended that the starting of the first engine be alternated on successive days to ensure proper operation of both valves over a period of time.

If the right-hand engine is started first, proceed as follows:

1. Turn both ATM switches ON. (ATMs should not run.)

2. Turn right-hand bleed air switch ON. (Right-hand ATM should run; left-hand ATM should not run – indicating that ATM crossover valve is closed.)

3. Turn left-hand ATM bleed air switch ON. (Left-hand ATM should run – indicating opening of crossover valve.)

Following completion of the ATM Bleed Air Check procedure, the second engine is started exactly as the first. When either ATM is started the hydraulic pressure flip-flop indicator on the instrument panel should read NORM.

Brake pressure will be indicated on the brake pressure gage located at the pilot's right foot.

Note

Rpm of 75 percent should be sufficient to sustain frequencies between 380 and 420 except in extremely hot weather. If more than 80 percent is required, the aircraft should be downed and the system inspected.

REMOTE (PILOT CONTROLLED) START

If desired, the pilot rather than the ground crew may control the start. The electrical plug (pigtail) is connected from the starting unit to the receptacle on the engine. The starting procedure is then the same, except that the pilot initiates engine cranking by momentarily actuating the starter switch to the desired engine. Although, with this type start, the compressor should disconnect automatically at 36 to 40 percent rpm, it is good practice to signal for shutoff at 30 to 35 percent rpm. The engine is then at an rpm which will sustain acceleration to idle.

CARTRIDGE START

SAFETY PRECAUTIONS

The following safety precautions shall be observed when operating or servicing the ATSC 100-83 cartridge starter:

1. MXU-4/A starter cartridges shall not be removed from their containers in the immediate area of high-powered radio or radar transmitters.

2. Asbestos gloves or welders gloves shall be worn whenever handling live or spent cartridges.

3. Cartridges shall not be loaded while power is on the aircraft.

4. It is possible for a cartridge to hangfire (take an abnormally long time to ignite or burn). This condition will usually be evidenced by smoke in less than normal amounts and may last for a number of minutes. In this case, wait at least 10 minutes after the last signs of combustion before removing the cartridge chamber.

5. In case a cartridge misfires (shows no evidence of combustion), wait at least 10 minutes before opening the cartridge chamber.

6. After a normal cartridge start, allow the chamber to cool for at least five minutes before removing it.

7. Personnel shall remain clear of the starter exhaust during starts and when removing cartridges that have misfired or hangfired.

8. Do not attempt to use a cartridge that has been dropped or damaged as the burning rate may be altered.

9. Do not use solvent for cleaning the cartridge chamber or breech. If deposits cannot be removed with a dry cloth, steel wool or a dry brush shall be used.

10. For pneumatic starts, do not use a compressed air source that is not regulated to less than 62 psia. The GTC-85 and MA-1A compressors are acceptable.

11. Do not attempt a pneumatic start with a cartridge in the chamber.

OPERATING PROCEDURES

The following procedures will be followed for a normal cartridge start:

1. Open engine nacelle doors and remove the cartridge chamber from the starter. Inspect starter exhaust port and secondary air inlet screen to insure that they are clean and free from debris.

2. Place cartridge can on ground near the cartridge chamber.

3. Ensure that there are no high-power radar sets or radio transmitters operating in the immediate area.

4. Open cartridge can with the key provided.

5. Invert the can and with cartridge resting on the ground, remove the can and wrapping.

6. Wear asbestos or heavy leather (welder's) gloves whenever handling a live or spent cartridge.

7. Remove safety clip from top of cartridge, and bend the ground tabs slightly upward.

8. With cartridge setting on ground, slide the cartridge chamber onto the cartridge. Pick up cartridge and chamber, grasp the perforated end of cartridge and rotate it at least 180 degrees while holding a firm pressure against the cartridge, this will ensure good electrical contact to the igniter.

9. Ensure that the mating surfaces of starter breech and chamber are free of carbon deposits. Install and lock the chamber on the starter.

10. Secure engine nacelle doors.

11. Attach 24-volt dc power to external receptacle. AC power; 115/200-volt, 3 phase, 400 cycle; may be applied at this time, but it is not required for a cartridge start.

12. Position cockpit switches and levers as for a normal start.

13. Engage all power plant and fuel system circuit breakers. Place engine master switch (for the desired engine) ON.

14. To ignite the starter cartridge, press LH/RH engine starter control switch to appropriate position.

15. When engine rotation is indicated by movement of the tachometer needle, release the starter control switch. Move throttle to start ignition cycle, then forward to IDLE position.

16. Light-off will occur within 15 seconds after throttle is placed in IDLE position.

17. After the flight, remove the spent cartridge by opening the engine nacelle doors and detaching the chamber from the starter. The interior of the chamber and breech should be wiped with a dry cloth to remove cartridge deposits.

PNEUMATIC STARTS WITH ATSC 100-83 STARTER INSTALLED

The following procedures are applicable for pneumatic starts using the ATSC 100-83 starter:

1. Pneumatic starts must not be attempted with a cartridge in the chamber.

2. The operating air pressure of the pneumatic starter unit must be 62 psia or less.

3. Only ground controlled starts can be made.

4. Attach compressed air source to the pneumatic air inlet on the starter.

5. Proceed as for a ground controlled start with the ATS 70 starter.

DUTY CYCLES AND START INTERVALS

The interval between any two successive cartridge starts are as follows:

1. The interval between any two successive cartridge starts must be at least 5 minutes.

2. No more than two cartridge starts may be attempted in any 1-hour period.

3. If cartridge starts and pneumatic starts are interspersed, no more than three starts may be attempted in a 15-minute period. The 5-minute limitation of successive cartridge starts applies.

4. Do not attempt more than three pneumatic starts in a 15 minute period.

5. Do not motor the starter from a compressed air source for more than 5 minutes during a 15-minute period. The starter may be motored continuously for 5 minutes.

UNSATISFACTORY STARTS

WET STARTS. A wet start occurs when the fuel in the burner baskets fails to ignite. This is usually caused by the pilot failing to strike the igniter microswitch with the throttle when moving it from the off to idle position. One way to tell if the igniters are operating is to have the hard hat on and earphones connected during the start. As the throttle is moved out against the igniter microswitch, the igniters, if operating, will give a cycling, buzzing sound. If the throttle has been moved to idle and ignition is not accomplished, secure the engine master switch, return the throttle to off, and continue to crank the engine for 20 to 30 seconds. The engine should be dried out thoroughly by cranking, draining, and swabbing out the tailpipe prior to attempting another start.

CAUTION

If the engine master switch is not secured PRIOR to moving the throttle to OFF, the igniters could possibly be set in operation by striking the microswitch with the throttle causing an explosion of the raw fuel that has collected in the engine.

FALSE START. False starts result from failure of the engine to accelerate to idle rpm during the start. This malfunction is usually the result of insufficient boost from the starting unit and occurs between 12 to 30 percent rpm. The engine fails to reach auto acceleration rpm and burns idle fuel at an rpm much lower than idle. The pilot must monitor the tachometer and tailpipe temperature very closely during the early stages of the start. The first indication of a false start will be a stall or near stall with the tachometer in the 12 to 22 percent range. The next indication will be a rapidly rising TPT. The power lever should be brought around the horn to OFF, and the engine turned over until the TPT drops to within the normal range. Do not attempt to restart until the cause of the malfunction is remedied.

HOT STARTS AND INTERNAL ENGINE FIRES

In case of a hot start or an internal engine fire during the start, place power lever to OFF position, and, if a ground crew controlled start, turn engine master switch OFF, and signal to continue turning the engine with the starter. This procedure should normally extinguish an internal engine fire. If the fire persists, abandon the airplane and use all available means to extinguish the fire.

WARNING

- After two abnormal starts or after rotating the engine with the starter for a period of 2 minutes, the front engine oil sump must be drained to prevent flooding the compressor with oil and contaminating the air conditioning system. After two abnormal starts or after two consecutive normal shut downs, the fuel dump can will be almost full and must be drained before attempting another start.

- Allow a fuel draining period of at least 30 seconds and then clear the engine of possible trapped fuel and vapors. Refer to CLEARING THE ENGINE in this section.

- If the throttle should at any time be inadvertently retarded to OFF, an immediate flameout will occur. In this case the throttle must remain OFF until a new start is to be made. Failure to do this will introduce unburned fuel into the engine, creating a serious fire hazard.

CLEARING THE ENGINE

When an abnormal start has occurred, or when it is suspected that unburned fuel has accumulated in the engine, the engine may be cleared as follows:

1. Engine master switch ..... OFF
2. Throttle ..... OFF
3. Allow starter to crank engine for 10 to 20 seconds.

CAUTION

To prevent possible damaging of the engine starter, do not re-engage the external starter until the engine has stopped rotating.

ENGINE GROUND OPERATION

After a satisfactory start, allow the engine to run at IDLE until instrument readings are stabilized, then make the following check:

1. Throttle ..... IDLE
2. Tachometer ..... 58-63 PERCENT
3. Tailpipe temperature below ... 340°C
4. Oil pressure ..... NORM
5. Fuel pressure ..... NORM

On long range flights, or when delay in obtaining IFR clearance is anticipated, clearance should be obtained prior to engine starting. Ground operation should be held to a minimum, as idle rpm fuel consumption is approximately 1000 pounds per hour per engine.

HORIZONTAL STABILIZER TRIM CHECK

CAUTION

To avoid exceeding the 20-second continuous ground operating limit of the stabilizer trim motor in the fast-trim mode, the steps outlined in this check must be performed in rapid succession.

Horizontal stabilizer trim: (Pilot views trim position indicator while gunner-radioman views horizontal stabilizer through ditching hatch.)

a. Rotate console trim knob counterclockwise to observe slow nosedown trim on indicator as stabilizer leading edge moves slowly upward.

b. While holding knob as in step a, operate control wheel trim switch to NOSE UP. Observe fast noseup trim on indicator as stabilizer leading edge moves rapidly downward.

c. While holding control wheel trim switch as in step b, rotate console trim knob further counterclockwise to second detent. Observe fast nosedown trim on indicator as stabilizer leading edge moves rapidly upward. Release the control wheel trim switch.

d. Release control trim knob. Note that the knob springs back to neutral position without binding.

e. Rotate console trim knob clockwise to first detent. Observe slow noseup trim on indicator as stabilizer leading edge moves slowly downward.

f. While holding trim knob per step e, operate control wheel trim switch to NOSE DOWN. Observe fast nosedown trim on indicator as stabilizer leading edge moves rapidly upward.

g. While holding trim switch per step f, rotate the trim knob further clockwise to second detent. Note fast noseup trim on indicator as stabilizer leading edge moves rapidly downward. Release the control wheel trim switch.

h. While holding trim knob setting per step g, set horizontal stabilizer emergency-off gang-bar(1) on center console to EMERGENCY OFF. Note that stabilizer trim motion stops.

i. (1)Rotate trim knob back to first detent in noseup direction. Observe that no trim motion takes place.

j. (1)Release trim knob. Note that it returns automatically to neutral position without binding.

k. (1)Set horizontal stabilizer emergency-off switches to ON position.

TRIM, FLAPS, AND FUEL TRIM

For normal takeoffs, between 0 and 3 degrees of noseup elevator trim shall be used depending upon aircraft C. G. For abnormal C. G.'s of 15 percent MAC or less, use 5 degrees of noseup trim. The aileron and rudder trim shall be neutral. Flaps shall be full down for all takeoffs.

(1)BuNo. 144837 and subsequent; 142256, 14266 – 142669, 144825 – 144836 after service change.

AUTOPILOT PREFLIGHT PROCEDURE

Note

- If the manual dc trim has just been operated, allow adequate cooling time before energizing the repeat-back mode of the autopilot.
- Ground operating duty cycle for autopilot trim is 20 seconds on, 4 minutes off.

Perform the following autopilot and skid-turn preflight procedure, using either external power or ship's power:

CAUTION

Do not perform the following steps with the wings and fin folded.

1. Check that all control surfaces move freely from hardover to hardover positions and that surface deflections and control movements correspond in sense.

CAUTION

Do not engage the horizontal stabilizer-with-autopilot circuit breaker until the horizontal stabilizer test is to be performed.

2. All autopilot circuit breakers, except horizontal stabilizer-with-autopilot . . . . . ENGAGED

3. Autopilot turn knob . . . . . IN DETENT

4. Aileron trim knob. . . . . CENTERED

5. Compass mode switch . . . . . SLAVED

6. Skid-turn knob . . . . . IN DETENT

7. Ground test bar . . . . . HOLD DEPRESSED

8. Autopilot-yaw damper switch . . . . . YAW DAMPER

CAUTION

Do not engage the servo unless the rudder trim meter is centered and approximately stationary.

9. AFCS switch . . . . . SERVOS ENGAGED

Note

- Servo engagement should not cause excessive rudder movement.
- The AFCS switch will be locked off for two minutes after the electrical system is energized.

10. Autopilot – yaw damper switch . . . . . PILOT

CAUTION

Do not engage the servos unless the trim meters are centered and approximately stationary.

11. AFCS switch . . . . . SERVOS ENGAGED

Note

Servo engagement should not cause excessive control surface movement.

12. Overpower right rudder pedal and observe autopilot rudder trim indicator. Needle should move to left. Overpower left rudder pedal and observe autopilot rudder trim indicator. Needle should move to right. Overpower force should be 65 to 90 pounds (for ±10-degree deflections).

13. Overpower aileron function of control column clockwise and observe autopilot aileron trim indicator. Needle should rotate counterclockwise. Overpower aileron function of control column counterclockwise and observe autopilot aileron trim indicator. Needle should rotate clockwise. Overpower force should be 27 to 57 pounds with hydraulic power; 37 to 67 pounds without hydraulic power.

Note

Aileron control surface deflections should not exceed ±10 degrees, or the autopilot will disengage.

14. Overpower elevator function of control column forward (nose down) and observe autopilot elevator trim indicator. needle should deflect upward. Overpower elevator function of control wheel aft (noseup) and observe autopllot elevator trim indicator. Needle should deflect downward. Overpower force should be 20 to 50 pounds.

15. Check that autopilot-yaw damper switch drops to YAW DAMPER when ailerons are deflected ±11 degrees (single aileron deflection).

16. Autopilot-yaw-damper switch ..... PILOT

17. AFCS switch ..... SERVOS ENGAGED

18. Rotate climb-glide control knobs forward then aft. Control column should move fore and aft to indicate normal autopilot nosedown and noseup control.

19. Rotate aileron trim knob clockwise and counterclockwise and check for related movement of control column.

20. Rotate turn control knob toward left and right to check coordination of controls. For left turn, control column should move counterclockwise and left rudder pedal should move slightly forward. When turn control knob is centered control column will return to neutral but rudder pedal should remain displaced. It is necessary to move turn control in opposite direction to return rudder pedals to neutral.

21. Altitude control switch ..... ALT CONT
There should be little or no elevator movement.

22. Pitch trim knob ..... OPERATE
There should be no yoke movement.

23. Skid-turn engage switch ..... ON

Note

Skid-turn engagement should not cause excessive control surface movement. However, it may cause the aileron control surfaces to move slowly to approximately 10 degrees (single aileron deflection) from their position at the instant of engagement. This characteristic of ground operation does not indicate a skid-turn malfunction, and does not occur in flight. To return the aileron system to neutral disengage the autopilot and fair the surfaces manually.

24. Compass mode switch ..... FREE

25. Set heading knob, rotate ..... RIGHT OR LEFT

All autopilot switches should drop to the OFF position.

26. AFCS switch ..... SERVOS ENGAGE

27. Set heading knob, rotate ..... RIGHT OR LEFT

The AFCS switch should remain at SERVOS ENGAGE.

28. Gyropilot release button ..... DEPRESS

The AFCS switch should drop to OFF.

29. Horizontal stabilizer-with-autopilot circuit breaker ..... ENGAGED

30. Autopilot-yaw damper switch ..... PILOT

31. AFCS switch ..... SERVOS ENGAGED

32. To check automatic longitudinal trim feature of autopilot, overpower elevator function of control column aft. The longitudinal trim position, indicator above center console should move toward nosedown trim. (Stabilizer leading edge should move up.) Overpower control column forward and observe for noseup trim indication. (Stabilizer leading edge should move down.)

CAUTION

For checking the automatic longitudinal trim feature, the duty cycle of the trim motor is not more than 20 seconds on and not less than 4 minutes off.

33. Ground-test bar ..... RELEASE

The autopilot-yaw damper switch should drop to YAW DAMPER and the AFCS switch should drop to OFF.

NORMAL OPERATION (INFLIGHT PROCEDURE) TO ENGAGE YAW DAMPER

1. Autopilot-yaw damper switch ..... YAW DAMPER

2. Turn control knob ..... CENTERED

3. Rudder trim indicator ..... CENTERED

4. AFCS switch ..... SERVOS ENGAGE

CAUTION

Do not engage the rudder servo while the aircraft is in a turn.

TO DISENGAGE YAW DAMPER

1. AFCS switch ..... OFF, or

2. Gyropilot release button ..... DEPRESS

TO ENGAGE AUTOPILOT.

1. Autopilot-yaw damper switch	PILOT
2. Turn control knob	CENTERED
3. Aileron control knob	CENTERED
4. Trim aircraft	
5. Rudder, aileron and elevator trim indicators	CENTERED
6. AFCS switch	SERVOS ENGAGE

AUTOPILOT OPERATION

1. Use pitch control wheels on sides of pedestal controller to make climbs and descents.

2. Use turn knob on top of pedestal controller to perform coordinated turns.

3. Use aileron knob on front of pedestal controller to trim aircraft in roll.

4. Place altitude control switch at ALT CONT to maintain constant pressure altitude.

Note

With the altitude control switch at ALT CONT, the climb-glide knobs are inoperative.

TO DISENGAGE AUTOPILOT.

1. Autopilot-yaw damper switch	YAW DAMPER, or
2. AFCS switch	OFF, or
3. Gyropilot release button	DEPRESS

TO ENGAGE SKID-TURN

1. Engage autopilot.

2. Trim aircraft to wings-level attitude with aileron trim knob.

3. Skid-turn engage switch ..... ON

Refer to Viewfinder and Skid-Turn Operation in this section for suggested operational use of skid-turn mode in conjunction with autopilot and viewfinder system.

TO DISENGAGE SKID TURN

1. Skid-turn knob	IN DETENT
2. Skid-turn engage switch	OFF, or
3. Gyropilot release button	PRESS, or
4. AFCS switch	OFF, or
5. Autopilot-yaw damper switch	YAW DAMPER

CAUTION

An improper skid-turn switching sequence may introduce minor transients into the autopilot control system. Do not disengage the skid-turn unless both the autopilot and skid-turn knobs are in the detent position.

Note

If the yaw damper or autopilot is engaged when the airplane is brought in for a landing, automatic disengagement will occur at touchdown.

ENERGIZING THE RADAR

When it is necessary to energize the radar during ground operations, the aircraft shall be placed in a position that will permit the radar antenna to be directed into a suitable absorbing screen or an open area. An open area is interpreted as:

1. An area clear of large obstructions, such as buildings, parking lots, or residential areas, for a distance of a half mile.

2. An area clear of ordnance material for a distance of 300 feet.

3. An area clear of personnel.

PRETAXI CHECKLIST

1. Gyro horizon	ON/SET
2. ASB gyros	ON
3. Radios/nav aids	ON

4. On signal, 70 percent rpm

   a. Nosewheel well check..... PRESSURE UP

   b. Speedbrakes cycled ..... CHECKED/ CLOSED

   c. Flaps ..... DOWN

   d. Bomb bay doors ..... CLOSED

   e. Tailhook ..... UP

   f. Emerg. gen. ..... CHECK

5. Fuel quantity..... RECORD

Note

Partial wing fuel loads for takeoff are not permitted unless wing fuel loading is known to be equal.

6. Gravity transfer ..... CHECKED NORMAL

7. Oxygen quantity ..... CHECK

8. Warning lights..... CHECK

9. Control boost test light ..... GREEN

Note

The control boost latch test circuit does not include the spoiler system.

10. Radar and pressure altimeters..... SET

11. Trim tabs..... OVERRIDES CHECKED/ SET

12. ASB..... SET

13. IFF ..... STANDBY

14. Voltages ..... NORMAL

15. Autopilot (when required)..... CHECK

Note

Wings must be spread and controls free for autopilot check.

16. Pins ..... 5 ABOARD

17. Emergency escape door..... CLOSED

18. Overhead hatch ..... LOCKED OPEN/ MANNED

TAXI

TAXI PROCEDURE

The aircraft can be taxied utilizing minimum power and nosewheel steering. To start taxiing, it may be necessary to increase RPM to about 70 or 80 percent. Check the brakes (ANTISKID-OFF) by actuating them when leaving the line. Once the aircraft is moving, reduce power to idle. Idle rpm normally produces sufficient power for taxi speeds even with heavy loads. Excessive power required to taxi may indicate dragging brakes. If brakes are dragging, return to the line.

LOOKOUTS AND BRAKE FAILURE PRECAUTIONS

When taxiing in congested areas, a director in front of the aircraft and a wingtip walker at each wingtip will be provided to ensure safe clearance from obstructions. The crew shall be alert for obstructions. The crewman shall man the upper hatch until clear of congested areas. If the brakes do not function normally with the ANTISKID ON, it shall be turned OFF. If the malfunction continues, the emergency hydraulic handpump shall be operated. If the brakes are malfunctioning, return to the line. If the handpump hydraulic system does not respond properly, use the emergency brake air bottle.

BRAKING PROCEDURES

With the aircraft at light weight, intermittent braking will be necessary to stay at an acceptable taxi speed.

CAUTION

Continual riding of the brakes will cause overheating which could result in loss of brake effectiveness and possible fire or explosion in the wheelwell when the wheels are retracted after takeoff. If brake overheating is suspected, proceed to designated hot brake area.

NOSEWHEEL STEERING PROCEDURES

To steer the airplane, a smooth steady application is used on the nosewheel steering control handle. Abrupt

movements of the control handle will whip the nose of the airplane about uncomfortably. Asymmetrical braking, although helpful in tight spots or on a carrier deck, is usually unnecessary and tends to overheat the brakes. The nosewheel steering control handle rotates through an arc of 160 degrees to obtain the limits of steering. If possible, the nosewheel should be returned to the center position before stopping.

Abrupt, high speed operation of the nosewheel steering system and braking against the direction of nosewheel steering should be avoided.

TAXIING AT NIGHT

Night taxiing demands extreme care. The third crewman is in a better position to see from the upper hatch than the pilot. He should constantly check ahead and from side to side on each wingtip. The taxilight will be used judiciously for all night taxiing. There is provision for an aldis lamp in the aircraft and it can be used by crewman when available.

PREFLIGHT-AIRCRAFT CONTROLS CHECK

1. Spread and lock wings and fin. See that gust and wing pin lock handle is in vertical position and that wing fold lever is flush with center console. Red warning indicators on lower wing surface inboard of each fold joint, and below fin fold joint must be faired to indicate that unfolded wings and fin are locked. (A crewmember may view fin lock warning indicator area by standing in cockpit and looking aft from open escape hatch.)

2. Check control surfaces for freedom of movement.

3. Check spoiler operation. (The photo-navigator may check spoiler operation by viewing them through open ditching hatch.)

Note

Abrupt fore and aft movement of the control wheel will cause a small deflection on the left-hand ac frequency meter, which can be used in conjunction with the control boost latch test light to indicate proper elevator boost connection.

TAKEOFF CHECKLIST

1.	Antiskid	ON FIELD OFF SHIP
2.	Wings/fin/gustlocks	SPREAD/ OFF
3.	Controls	CHECKED FREE
4.	Compass	SET/ SLAVED
5.	Clock/altimeter/	SET
6.	Take off performance data	SET
	a. Pressure ratio	
	b. Liftoff speed	
	c. Ground roll	
	d. Line speeds	
	e. Refusal speeds	
7.	Radios/nav aids/IFF	CHECK/SET
8.	Speedbrakes	CLOSED
9.	Flaps	FULL DOWN
10.	Trim tabs	SET
11.	Anti-icing	AS DESIRED
12.	Shoulder harness	LOCKED
13.	Crew ready for takeoff	REPORT
14.	In takeoff position full power	CHECK
	a. Compass alignment	CHECK
	b. ATM temperatures	CHECK
	c. Ac frequencies	CHECK
15.	Hydraulic pressure gauge	CHECK

AIR CONDITIONING, PRESSURIZING, AND DEFROSTING PROCEDURES

Pressurizing is not normally used during takeoff, but may be necessary in areas of high humidity. If it is anticipated that air conditioning will be used during takeoff, the system should be turned on sufficiently early to ensure proper operation. The temperature control setting selected should be hot enough to prevent fog or snow even at full power. The defrost ON/OFF switch should be OFF for takeoff. For normal operation, the pilot should turn the air conditioning on when comfortably airborne, established in the climbout, and/or clear of other traffic.

PILOT CHECKLIST

(See figure 3-4.)

The pilot will insure that all items on his take-off checklist have been accomplished prior to takeoff.

FULL POWER CHECK

After assuming the takeoff position and assuring that the nosewheel is straight, the brakes are applied and the power levers advanced to full power. Check compass alignment, ATM compartment temperature, and ac frequencies. When engines have stabilized at full power, engine instruments will be checked as follows: Percent rpm on both engines within two percent of trim rpm; TPT within 25 degrees of the temperature recorded when the engine was last trimmed. Maximum TPT 610 degrees, fuel pressure NORMAL. Oil pressure NORMAL, fuel flow 7,000 to 10,000 lbs. Compare the above information against the readings of the pressure ratio gauges.

TAKEOFF PROCEDURES

Section takeoffs are prohibited. When individual takeoffs are made with two or more aircraft at close interval, the second aircraft shall not commence takeoff roll until the first is airborne. Jet exhaust and turbulence, particularly on hot, calm, days can materially increase the takeoff roll of succeeding aircraft. To minimize this effect during close-interval takeoffs, the lead aircraft should take the downwind side of the runway, with succeeding aircraft lining up on the upwind side of preceding aircraft.

If instrument readings are satisfactory at full power turnup, the pilot will release brakes and start the takeoff roll. The left hand shall be on the nosewheel steering and the right hand shall be on the control column in the neutral position. At about 80 knots, rudder control becomes effective. At this point, the left hand is shifted to the control column and the right hand to the power levers. (Extreme turbulence or gusty conditions may require both hands on the control column.) During heavy-load takeoffs on rough runways, the nosewheel may have a tendency to bounce, and require slight forward pressure on the control column.

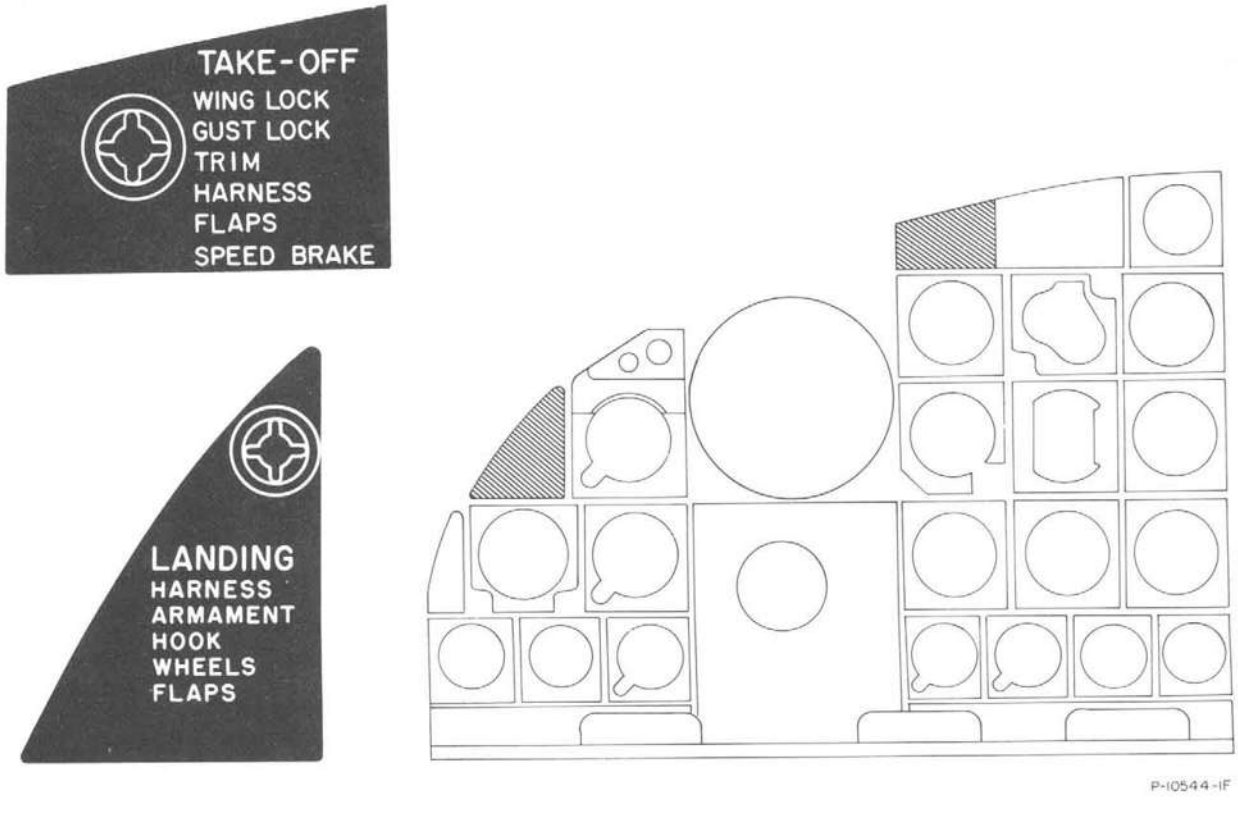
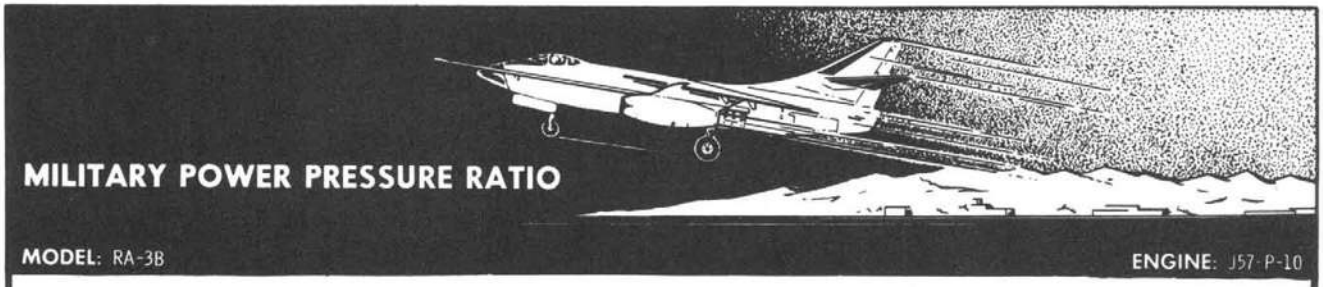


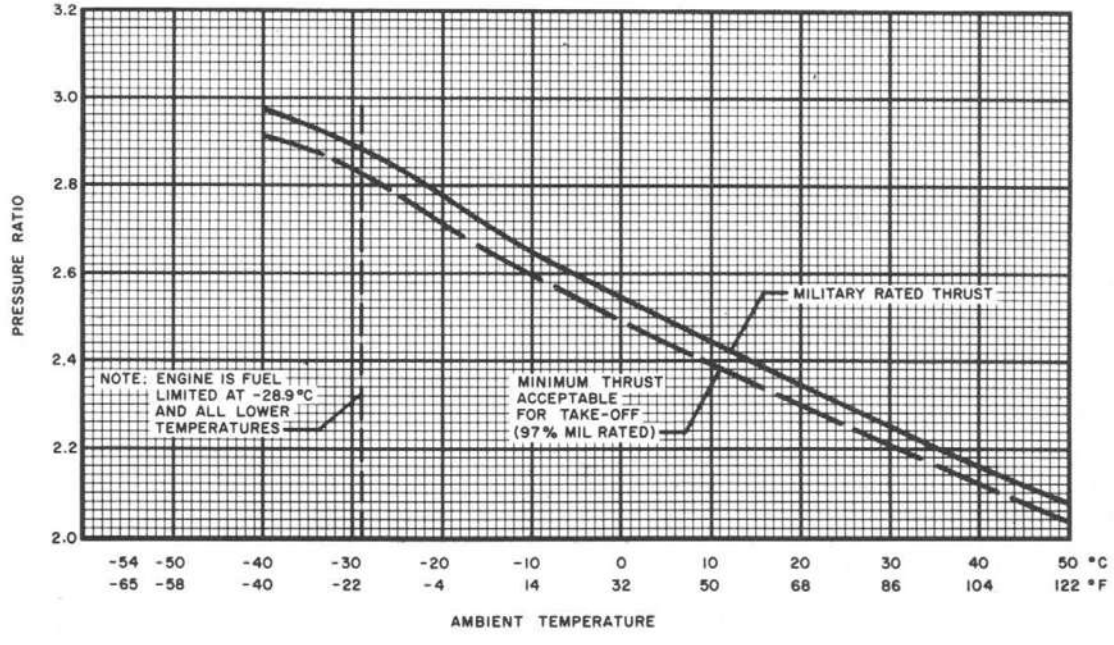
Figure 3-4. Pilot Checklist



MILITARY POWER PRESSURE RATIO

MODEL: RA-3B

ENGINE: J57-P-10



ATB-1-3 PS-10589-1H

REMARKS:

EXAMPLE:

DATA AS OF: 4 February 1960

DATA BASIS: Calculations; P & W

Figure 3-5. Military Power Pressure Ratio

Line speed checks will be called by the right seat crew member at the 2,000 or 3,000-foot markers. When takeoff speed is reached, the nose shall be smoothly rotated. Caution shall be exercised to prevent the aircraft from being overrotated prior to becoming airborne. After lift-off, when a positive rate of climb has been established, tap brakes lightly prior to raising the landing gear. Assume a climbing attitude to maintain 180 KIAS (in no case exceed 225 KIAS until the landing gear is fully retracted). The right seat crew member should assist the pilot by monitoring the landing gear indicator and calling the gear up and locked when it occurs after takeoff. As the aircraft accelerates through 180 KIAS, and with at least 500 feet altitude above the terrain, raise the flaps. Avoid raising flaps in a turn. If entering landing pattern and the gear and flaps are to remain down, initial climb will be made with full power. When comfortably airborne, complete the post takeoff checklist.

JATO TAKEOFF

The use of JATO is restricted to airfield takeoffs. Pressure calculations indicate that the most effective use of JATO will be during the last five seconds of the takeoff run. Flight characteristics during JATO operations, including lift-off and burnout, are satisfactory. Refer to Section XI for JATO firing speeds. For detailed information concerning JATO takeoff procedures, refer to the paragraph entitled Takeoff Distance Minimum Ground Roll – 12 Units JATO, Appendix I and II.

JATO JETTISONING. JATO bottles should be jettisoned as soon as possible in a level flight attitude, with the landing flaps down, and at airspeeds below 200 KIAS. A slight nosedown pitch will occur upon jettisoning a battery of 8, 10, or 12 bottles.

WARNING

- JATO bottles can be carried safely at speeds up to 300 KIAS, but not jettisoned above 200 KIAS.
- Simultaneous installation of MK 7 Mod 1 and MK 7 Mod 2 JATO bottles can cause a dangerous asymmetrical thrust condition on firing.

POST TAKEOFF CHECKLIST

1.	Gear	4 UP
2.	Overhead hatch	CLOSED
3.	Flaps	UP
4.	External inspection	CLEAN
5.	Pressurization	ON
6.	Cabin altitude	8,000 ± 500 FEET PASSING 15,000 FEET

INFLIGHT CHECKLIST (every 30 minutes)

1.	Fuel quantity/transfer	CHECK
2.	Oxygen quantity	CHECK
3.	Cabin altitude	CHECK
4.	Engine instruments	CHECK
5.	ATM compartment temps.	CHECK
6.	Compasses	CHECK
7.	Ac freqs/ac/dc voltages	CHECK

DESCENT CHECKLIST

1.	Photo system/ASB	AS DESIRED
2.	Fuel quantity/approach speed	CHECKED
3.	Landing roll	COMPUTED
4.	Radar/pressure alt.	SET
5.	Air cond/defrost	HOT/ON
6.	Anti-icing	AS REQUIRED
7.	Autopilot	OFF
8.	Loose gear	STOWED
9.	Exterior lights	AS DESIRED
10.	5,000/1,000-ft intervals	P/N REPORT

LANDING CHECKLIST

1.	Shoulder harnesses	LOCKED
2.	Antiskid	ON (FIELD)/ OFF SHIP)
3.	Pressurization	AS DESIRED
4.	Fuel quantity/dump.	CHECK/OFF
5.	Hook	UP (FIELD)/ DOWN SHIP)
6.	Flaps	DOWN
7.	Slats	WORKING
8.	Gear	4 DOWN
9.	Nosewheel steering.	STRAIGHT

10. Hydraulic pressure ..... NORM

11. Overhead hatch ..... OPEN

Note

For touch-and-go, FMLP, and CARQUAL repeat items 6 through 11 on downwind leg for each landing.

GENERAL INFLIGHT CONSIDERATIONS

The following items apply to all flights:

1. Checklists shall be used.

2. At least one crew member shall maintain an alert watch for other aircraft.

3. 100 percent oxygen shall be used at all times from takeoff to landing by all crew members.

Note

Oxygen may be removed for short periods for crew comfort, but must be immediately available: masks must be connected and hanging from protective helmet. Masks must not be disconnected until aircraft altitude is above 10,000 feet and cabin pressurization is holding cabin altitude below 10,000 feet.

4. Inflight checks shall be performed every 30 minutes.

5. On other than local flights, heading check shall be performed at least once each leg.

6. Photo-technician shall notify pilot prior to entering photo compartment, and make sure that walk-around hose is securely connected to mask.

WARNING

Do not step on outside access door when moving between flight and photo compartments.

7. Fuel remaining shall be recorded at leveloff and at least every 30 minutes thereafter.

Note

The pilot must be prepared to divert the flight if necessary, and initiate appropriate action while fuel still remains to reach an adequate alternate airfield. Altitude must be maintained until a suitable field is available.

8. Barometric release lanyards and bailout bottles shall be checked for hookup and proper air bottle charge.

Note

For shore-based operation, lanyards should be hooked up at all times; for carrier-based, should be connected after takeoff and disconnected prior to landing.

CLIMB SCHEDULE

After becoming airborne (and aircraft is clean), trim for acceleration to 300 KIAS unless tactical or operational considerations require otherwise. Hold 300 KIAS (or assigned/required airspeed) until reaching cruising MACH. Maintain cruising MACH until reaching assigned altitude. When established in the climb, the post-takeoff checklist will be completed. To achieve maximum rate of climb, unnecessary turns, particularly at high altitude, should be avoided. Full power should be used within engine operating limitations.

CG/ICING

If constant longitudinal retrimming is necessary during climb, investigate the possibility of faulty fuel transfer. At leveloff, be especially conscious of excessive nosedown elevator trim requirement. If more than one degree of nosedown trim is required, either a poor CG condition or icing of the elevators is indicated. If the fuel distribution is normal, icing is likely.

CRUISE PROCEDURES

Performance is affected primarily by gross weight and secondarily by engine performance and aircraft cleanliness. When a constant airspeed and altitude are to be maintained, it will be necessary to decrease fuel flow as gross weight decreases. While pressure ratio gauges do not accurately indicate the actual thrust output in flight, they are a valuable aid in obtaining symmetrical thrust.

CRUISE CLIMB

Cruise climb trades reduction in gross weight for a gain in altitude and a resultant decrease in fuel flow for the same MACH number. No hard and fast rules can be established as cruise climb is dependent on aircraft cleanliness, engine performance, temperature and winds aloft. The general procedures for cruise climb are as follows:

1. At optimum altitude, set power levers to establish the appropriate IAS, TAS, or MACH number.

2. Maintain MACH number.

EN ROUTE DESCENT

If necessary to conserve fuel, an en route descent at idle rpm with aircraft clean can be used. This technique will result in a significant fuel saving but should be attempted only in event terminal weather is known to be satisfactory.

ANGLE-OF-ATTACK

The angle-of-attack indicator is a valuable aid in all conditions of flight. While a primary landing approach instrument, it should be used only as a secondary cruise control instrument. (See figure 4-2A.)

LANDINGS

The landing pattern (see figure 3-6) will be entered for a break at 250 knots IAS at the prescribed altitude. The landing checklist should have been completed up to "flaps" by this time. At the "break", the speedbrakes are opened and fuel flow reduced to about 1500 lbs per engine. The angle-of-bank should be about 30 degrees and will not exceed 45 degrees. At 200 KIAS the flaps are lowered. The aircraft will tend to pitch up and climb during the last part of the flap extension. This tendency can be controlled with forward pressure on the control column to hold the required altitude. When the flaps are down, the landing gear is extended. At the proper altitude and an airspeed of 140 knots, the speedbrakes will be retracted and the fuel flow increased to about 3000 lbs per engine. It is necessary that fuel flow be utilized as a measure of power adjustment during the approach. Smaller and more precise power changes can be made utilizing fuel flow as opposed to rpm. When the aircraft is downwind in the landing configuration, a fuel-remaining check will be made. The aircraft should arrive at the 180-degree position on approach speed at the prescribed field pattern altitude. The turn from the 180-degree position should be planned to have about 1-1/4 mile final. Speedbrakes should be extended and power adjusted to arrive at the 90-degree position, 700 to 800 feet altitude, at the proper approach speed. The approach will be made at 15 units angle-of-attack, which will correspond to an airspeed of approximately 120 kts + 1 kt per 1000 pounds of fuel aboard for most aircraft. When turning into final and sighting the meatball, fuel flow will be adjusted to give about a 500 to 700 ft/per minute rate of descent. The landing checklist will be completed prior to reaching this point. The fuel flow will be about 2700 to 3100 lbs per hour per engine depending on landing weight. The aircraft is flown onto the runway in the approach altitude (15 units angle-of-attack) and at the approach speed. Touchdown target should be approximately 500 feet from the approach end of the runway.

Note

If touchdown is not effected within the first 1000 feet from the touchdown end of the runway, a waveoff shall be taken.

Immediately after touchdown, the power levers shall be pulled to the IDLE position. If the rate of descent is slightly high at touchdown, the aircraft will normally take a short skip as the main landing gear oleos are compressed and extended. This is a very critical point in successfully landing the aircraft. If the control column is allowed to move forward at the start of the skip, a porpoise will be aggravated by further pumping of the control column. The only reasonable correction for such a porpoise is a full-power waveoff. The porpoise can be prevented by holding the control column "as is" at touchdown and throughout the skip. If the aircraft bounces moderately, a slight back pressure on the control wheel must be maintained, and the aircraft relanded main gear first. After the throttles are brought to idle and the aircraft begins its rollout, it is necessary to continue flying the aircraft, keeping the wings level with the ailerons. If the landing speed, rate of descent, and attitude were satisfactory, the aircraft will rock forward on the nosewheel and run smoothly down the runway. When it is assured that the landing has been safely accomplished, the drag chute will be deployed. After the chute has been deployed, the aircraft will continue to be "flown" down the runway using ailerons, as necessary to keep the wings level and using

TYPICAL LANDING AND WAVEOFF PATTERN

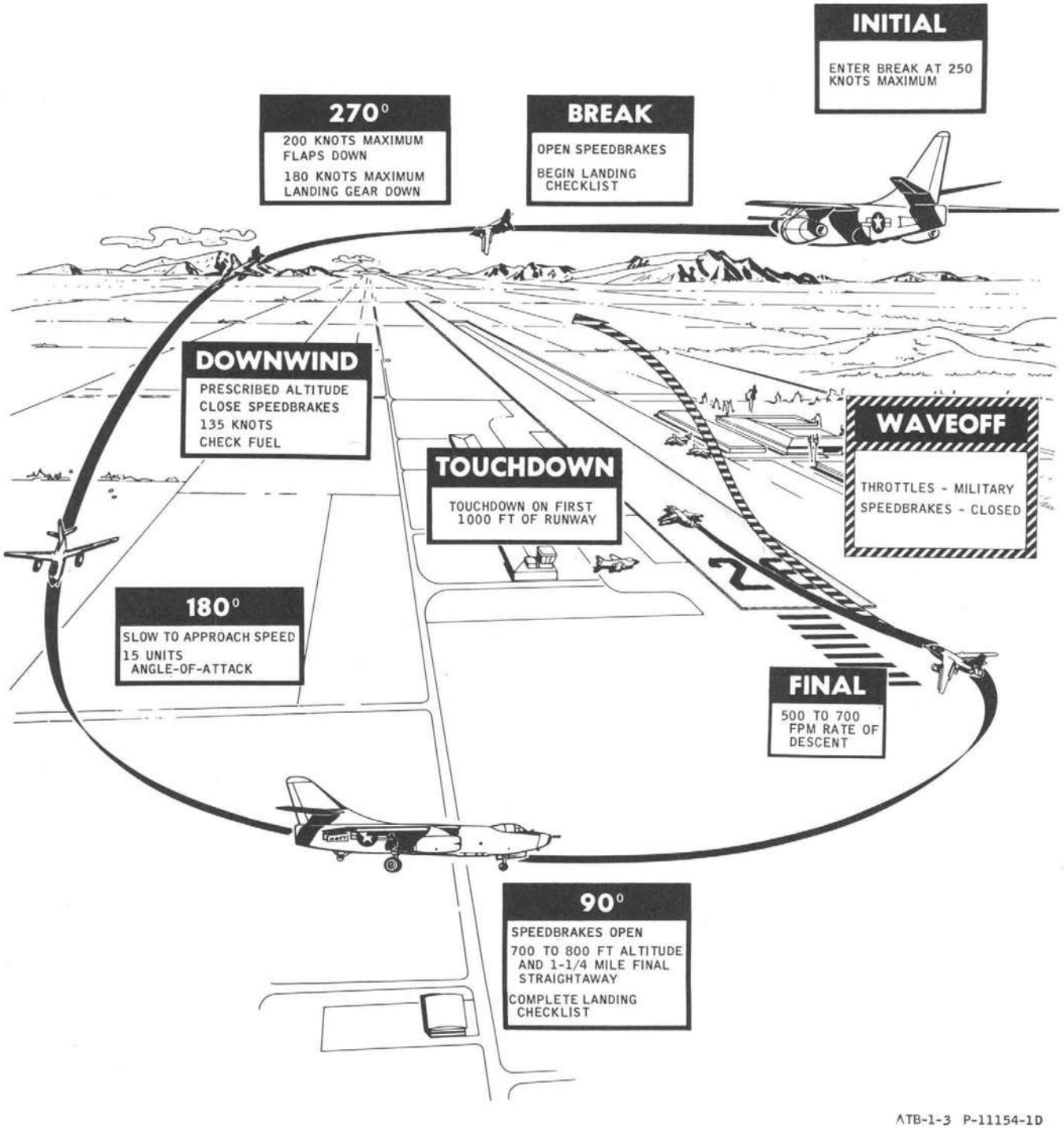


Figure 3-6. Landing and Waveoff Pattern (Typical)

the rudder to maintain directional control. The brakes shall be used during the runout, as necessary. See Antiskid Brake System, Section I, Part 2, when the rudder and ailerons become ineffective (below 80 knots). Nosewheel steering should be utilized to help maintain a straight runout. For landing on a wet and/or slippery runway, use the normal landing technique. No-chute landings for training purposes may be made at the Commanding Officer's discretion.

CROSSWIND LANDINGS

Crosswind landings are critical, due to the narrow landing gear and the closeness of the wingtips to the ground. The best crosswind technique is as follows: The same approach as described previously for a normal landing will be made. While in the final, a wing down or crab can be used to compensate for the drift. After landing, the pilot must continue to fly the airplane, keeping the wings level with the ailerons and maintaining directional control with rudder and nose steering until speed is such that the aircraft no longer has a tendency to tip or bank downwind. The aircraft longitudinal axis must be in line with the runway on touchdown. Because of the short stopping times encountered, and the long flap retraction time, raising the flaps in crosswinds up to 15 knots, 90 degrees to the runway, with drag chute deployed is of little practical value and should not be attempted. If the drag chute fails to deploy on a crosswind landing, flaps should be raised on touchdown.

CAUTION

- The flap and gear handle are in close proximity.
- Do not exceed 10 degrees of bank angle, else the low wing tip may drag on the runway on initial landing impact.

Immediately after touchdown, deploy the drag chute. Deploying the drag chute will minimize the time the aircraft is exposed to the crosswind, and will add a corrective component for the aircraft tendency to arc downwind. Lead with the aileron control to keep the upwind wing level or slightly low. Some lateral control is available through the use of ailerons above 60 KIAS.

Crosswind landings are controllable in wind up to 15 knots, 90 degrees to the runway, with full flaps. In the event of loss of right-hand ATM and/or wing spoilers not operating, the acceptable crosswind component is lowered to 7 knots, 90 degrees to the runway with full flaps. If existing crosswind exceeds these limits, request another runway or proceed to an alternate airfield where acceptable wind conditions are available.

HIGH CROSSWIND LANDINGS

WARNING

This presentation of alternative action shall not be construed as preventing the pilot from ordering a bailout.

When 90° crosswinds exceed 15 knots, and no other suitable landing field or runway is available, the pilot must make decision as to the best course of action. In all cases, a short field arrestment would be the most advantageous solution, with other types of field arrestments only slightly less desirable. If, however, no such arrestment facilities are available, consideration must be given to the problems associated with high crosswind landings.

To aid the pilot in making a decision, the following aircraft characteristics in high crosswinds are presented:

1. The aircraft has a marked tendency to arc downwind during rollout, in an amount directly proportional to the crosswind until slowed to below 60 knots at which time it begins to weathercock.

2. Pitch-up of the upwind wing will occur immediately after touchdown, and will require prompt corrective aileron control to prevent severe wing rock.

3. The speed range where control will be most difficult extends from touchdown to approximately 60 knots. While in this speed range, the pilot must continue to "fly" the aircraft even though on the runway.

CAUTION

Use of nosewheel steering above 50 knots should be avoided, as loads can be imposed on the nose gear scissor linkage that are of sufficient magnitude to cause structural damage

The following techniques can be employed to optimize these characteristics:

1. Take full advantage of the tendency to arc downwind by landing wing-down on the downwind side of the

runway with the aircraft pointed into the wind as much as possible. This will:

(a) Cause the aircraft to rollout toward the upwind side of the runway prior to beginning its arc downwind. This technique serves to lengthen the effective distance of the runway, and

(b) Lessen the crosswind component to the degree that the aircraft can be pointed successfully into the wind.

2. Raise the flaps on, or immediately prior to, touchdown, taking care to ensure that aircraft will not drop in on the runway. This will decrease lift thereby increasing the effective weight of the aircraft on the landing gear, tire footprint area, friction, and braking effectiveness.

3. Deploy the drag chute as soon as the decision is made to remain on the runway rather than attempt another approach. The chute will have a stabilizing effect by pointing the aircraft more nearly down the runway.

4. Use the brakes in as judicious a manner as the situation will permit taking note of the probability of blown tires if full braking is initiated before the aircraft has firmly settled on the landing gear.

TOUCH-AND-GO LANDING

Touch-and-go practice shall be accomplished using the same techniques as described above. The landing checklist will be completed, and called out as complete, prior to each landing. The landing gear and flaps normally will not be retracted after a touch-and-go. It will be necessary to reduce power shortly after the takeoff if a comfortable climb attitude is desired. After each landing, the power levers will be pulled to idle position allowing the aircraft to settle down on a short runout prior to the takeoff. Caution must be observed to prevent asymmetrical acceleration when advancing the power levers for takeoff. Approximately 600 lbs of fuel is required for each circuit. Touch-and-go landings will not be practiced with less than 3000 lbs of fuel remaining.

SINGLE ENGINE APPROACH/LANDING

Single engine landings can be accomplished with ease in the RA-3B. If time permits, the fuel load should be burned down to a gross weight of 50,000 pounds. A GCA approach is recommended if available. LSO assistance in short final is also desirable. If short field arresting gear is available, consider making an arrestment as this would eliminate braking and control problems if ATMs drop off line when power is reduced.

Note

Under poor field conditions (wet runway, short runway, crosswind, etc.), consider making a short field arrestment. However, it should be noted that if a short field arrestment is unsuccessful, nosewheel steering will not be available until the tailhook handle is raised. If an arrested landing is not attempted, braking and control problems may occur if ATM's drop off the line when power is reduced.

Upon entry downwind, the flaps should be lowered to 1/2 flaps at 200 KIAS. The landing gear should be lowered at the 180-degree position and the aircraft slowed to 15 units angle-of-attack, which will be approximately 137 to 140 KIAS, and should be flown until touchdown. Speedbrakes normally should be in during the approach, however they may be used, as necessary, to slow the aircraft. Approximately 2800 to 3400 pounds per hour fuel flow will be required by the operating engine during approach. Full rudder trim against the good engine should be used in order to control the aircraft during a waveoff. Waveoffs can be accomplished at any time up to and including touchdown.

Caution must be exercised to prevent the aircraft from going below the normal glide slope, as considerable power and trim changes are required to recover from a low, slow final. After touchdown and when power is reduced to IDLE, the loss of both ATMs may result. Engine rpm requirements will vary according to temperature, maintain sufficient power on the good engine to support both ATM's. The aircraft will be landed normally main gear first. At touchdown, direction control will be maintained with rudder as the power is slowly reduced to idle. Deploy the drag chute as soon as the aircraft is firmly on deck. During the approach, if doubt arises as to the success of the landing, an early waveoff will be initiated by applying full power and full rudder into the good engine. Yaw must be controlled during the waveoff. The landing gear will be raised as soon as altitude and directional control can be maintained. Directional control can be aided by a shallow turn into the good engine as full power is applied. After the airspeed has increased to 150 knots, a shallow climb back to landing pattern altitude will be established. Simulated single engine approaches will be practiced periodically with one engine in the IDLE position. (Refer to Carrier-based Procedures, Section III, Part 4.) If a single engine approach to a short runway is necessary, lower full flaps prior to intercepting glideslope. Do not slow below 135 KIAS until landing is assured.

MINIMUM RUN WITHOUT DRAG CHUTE

For minimum run landings, utilize approach speed shown in the landing chart (see figure 3-6). As soon as the aircraft is on the ground, retard the throttles to IDLE, place nosewheel on the runway, and smoothly apply maximum braking effort. Maximum braking effect occurs between 90 and 50 knots. The antiskid system utilizes a flywheel mechanism in the control column to relieve pressure when approaching a skid condition. As the effectiveness of the flywheel diminishes as speed decreases, it is recommended that only normal braking pressure be used at speeds under 50 knots. (Refer to Antiskid Brake System in Section I, Part 2.)

MINIMUM RUN WITH DRAG CHUTE

Deployment of the drag chute can be safely accomplished immediately after touchdown. Observe the

recommended approach procedure and landing technique for minimum run and place the drag chute switch at DEPLOY as soon as both main wheels are firmly on the runway. Deployment of the chute will require 3 seconds maximum, and airspeed should be approximately 120 KIAS as drag chute deceleration takes effect.

FIELD ARRESTMENTS

There are several types of field arrestment equipment. At most USN fields the field arrestment gear includes the anchor chain and/or water squeeze types. Other types include some form of jet barrier, usually the Davis barrier, and Morest gear. Although some arrestment capability exists with the Davis and Morest equipment, these two types are not reliable for RA-3B use and probably will not stop the aircraft. It is imperative that all pilots be aware of the type, location and load limitations of the gear in use. Usually the abort, overrun, and short field arresting gear are rigged at all times. In general, the arresting gear is to be engaged on the centerline at as slow a speed as possible.

SHORT-FIELD ARRESTMENT

At any time before landing that it is known a directional problem exists or a minimum rollout is desired (i. e., single-engine, utility hydraulic failure), the short field equipment should be utilized. In addition, an LSO, equipped with a radio should be stationed near the touchdown point to aid the pilot in landing. The hook should be lowered while airborne and a positive hook check made. The pilot lands just short of the arresting gear with his shoulder harness locked and his feet off the brakes. Be prepared for a waveoff if the gear is missed.

NORMAL OR LONG-FIELD ARRESTMENT

This situation occurs when a stopping problem exists. Lower the hook in sufficient time for it to effectively extend (normally at 1000 or 2000 feet in front of arresting gear). If the arrestment is to be made at night, the pilot should request to have the position of the arresting gear illuminated. The procedure for a normal arrestment is:

1. Make a normal landing
2. Deploy the drag chute
3. Extend arresting hook
4. Use optimum braking
5. Control the aircraft to enter the arresting gear as close to the center as possible.

FIELD BARRIER

If the field barrier is to be engaged, the aircraft should be in the three-point attitude and the engines secured prior to entering the barrier.

FIELD MIRROR LANDING PRACTICE (FMLP)

FMLP shall be required for all pilots prior to engaging in basic carrier qualifications or refresher carrier landings. The exact number of FMLP periods required shall depend on the experience and ability of the individual pilot and shall be determined by the Squadron Commanding Officer and Landing Signal Officer. A pilot shall not engage in day FMLP until he has become proficient in emergency procedures, slow flight characteristics, and instrument flying. A minimum of 50 hours pilot time shall be accumulated prior to commencing carrier qualifications. The final decision in regard to a pilot's readiness rests with the Squadron Commanding Officer.

LANDING WEIGHT

Current landing weight restrictions are published in Section I, Part 4, and shall not be exceeded. Approach may be made in an overweight condition, but shall be terminated in a waveoff.

DAY FMLP

Prior to taxiing onto the runway for takeoff, a radio check will be made with the LSO and the tower. Aircraft will not engage in FMLP unless two-way communications with both the tower and the LSO have been established. After takeoff and an initial landing gear check to the tower on paddle frequency, the LSO will assume control of aircraft in the FMLP pattern until the aircraft are ready for a final landing, at which time the LSO will pass control back to the tower. Landing gear and flaps will be left in the down position throughout the pattern. Upon touchdown, full power will be applied, speedbrakes will be closed, and the aircraft will climb out straight ahead accelerating to 150 knots. The upwind turn may be started at 300 feet altitude continuing the climb to 600 feet actual altitude, terrain permitting. The aircraft should be rolled smoothly into a 25-degree bank and held there for the upwind turn to establish proper distance abeam. When

the upwind turn has been completed, the aircraft should be slowed to 135 knots and a fuel quantity check made. The final landing will be made with at least 3000 lbs of fuel remaining.

SPEED, PATTERN, AND TECHNIQUE

Approach speeds will depend upon and vary with fuel weight. An Angle-of-Attack setting of 15.0 units will be used which will result in an approach speed of approximately 120 KIAS plus one knot per thousand pounds of fuel on board.

The 180-degree position will vary with the wind velocity, but can generally be considered to have been reached when the mirror is 45 degrees aft of the abeam position; with practice, this position can be determined and checked by TACAN bearing and distance.

Upon reaching the 180-degree position, a turn should be initiated, smoothly increasing the angle-of-bank up to about 20 degrees, parallel to the runway, at 600 feet actual altitude, and at the proper approach speed. At this point, terrain permitting, a crosscheck will be made between the radar and pressure altimeters. It may be necessary to add a small amount of power in order to stay out of the buffet range during the turn. The angle-of-bank may be varied as necessary to fly a rounded pattern. Altitude should be constant and power adjusted as required to rollout on the landing line at 600 feet at the proper approach speed. As soon as the meatball is sighted (this should be a few seconds prior to rolling wings level), rate of descent is set up by extending speedbrakes and reducing the power slightly. The approach altitude (15 units angle-of-attack) should be set up no later than 180-degree position. The speedbrakes will be extended upon sighting the meatball. This will be reported to the LSO: Side Number, Meatball, Fuel State, and type A/C. Three things are necessary to fly a "ROGER" approach: The meatball must be kept in the center, the proper approach attitude/speed maintained, and the aircraft lined up with the center of the landing area. Power changes, when necessary, should always be minor and monitored by fuel flow. Altitude and power will be varied in order to correct for a meatball not in the center. The only proper correction for a low meatball is an addition of power to slow the rate of descent and bring the meatball back to center. A readjustment of power to hold the proper rate of descent will then be required. A slightly high meatball can be centered by taking a "high dip". With a very high meatball, power must be reduced to decrease altitude. In order to keep from accelerating, maintain proper approach attitude. When quite close to the ramp, there should be no attempt to correct for a high meatball; "hold what you have" and land long. This is extremely important, inasmuch as aboard ship a late correction for a high meatball can easily result in a hard landing of even striking the ramp if the deck is pitching. It is very important that proper line-up be established early in the approach. Line-up must be monitored constantly on every approach. The aircraft should be trimmed during the approach as necessary to lighten control pressure (4 to 5-degree-noseup trim usually being sufficient). Good landings usually feel quite hard as the aircraft is actually flown into the deck in its approach attitude. Any tendency to flare the aircraft should be avoided just as much as diving for the deck. Flaring just before touchdown will usually extend the touchdown point by as much as 100 feet which, aboard ship, will normally result in a bolter. As soon as the aircraft touches the deck, the throttles should be advanced to full power and the speedbrakes closed in the same motion. The waveoff is a mandatory signal and will always be answered by immediately adding full power and closing the speedbrakes. The aircraft must be kept lined up with the angled deck during late waveoffs, as a possibility of an inflight engagement exists. Normally no change in attitude should be made, as a slight rotation causes the tail to drop considerably before any gain in altitude is experienced and may possibly result in an inflight engagement. The application of power should stop the rate of descent immediately. Shortly after the aircraft has begun to accelerate, the nose may be raised slightly to establish a climb.

NIGHT FCLP

The pattern and approach speeds are identical to those for day FCLP. All lights will be turned on bright and steady, and the approach lights should be turned on prior to leaving the line by the ground crew. Once again, the essential ingredients of a "ROGER" pass are: be properly set up at the 180, fly the meatball, monitor angle-of-attack, and line up. The pilot should fly the angle-of-attack indicator, crosschecking with the airspeed indicator.

BUFFET ONSET CHECK (BASIC WING ONLY)

A buffet onset (nibble) check should be made on the downwind leg when doubt exists as to the accuracy of the angle-of-attack or airspeed systems. See Section IV.

STOPPING THE ENGINES

CAUTION

Allow the engine to idle for 5 minutes if it has been operated at 85 percent rpm or higher for 1 minute during the previous 5 minutes.

1. Advance throttle to 75 percent rpm for approximately 2 seconds, then:

2. Throttles . . . . . OFF

3. Master engine switches (within 2 seconds after moving throttles to OFF) ..... OFF

4. Check that engines decelerate freely and without any metallic rubbing sounds.

POST LANDING CHECKLIST (AFTER LEAVING RUNWAY)

1. Speedbrakes (70%)	CLOSED
2. Gust locks	LOCKED
3. Flaps (70%)	AS DESIRED
4. Antiskid	OFF
5. Anti-icing	OFF
6. Unnecessary radios/radar alt/IFF	OFF
7. Trim tabs	SET
8. Wings (70%) on signal	AS REQUIRED

SHUTDOWN (WHEN IN THE CHOCKS)

1. Lights	OFF
2. ASB	OFF
3. Radios	OFF
4. Ac generators/bus tie	OFF/OPEN
5. Throttles/master switches ...	OFF
6. ATMs	OFF
7. Dc generators	OFF
8. Oxygen control valves	OFF

NIGHT FLYING

Prior to commencing night flying, a pilot must have completed a minimum of 20 hours first-pilot time in type.

TAXI AND TAKEOFF

Prior to leaving the line the pilot will ensure that exterior lights are functioning normally. All exterior lights shall be turned on bright. He shall ensure that cockpit lights, both ac instrument lights, and dc floodlights are operating satisfactorily and that a flashlight with red lens is readily available. The aircraft shall be taxied slowly, using idle power once rolling. It is very easy to taxi at excessive speeds at night without realizing it. The P/T shall man the top hatch, and the taxi light shall be utilized, as necessary.

Night takeoffs shall be accomplished individually, lining up in the center of the runway. Takeoff is accomplished exactly as during daylight, using preplanned accelerations, checks, and liftoff speed.

NIGHT LANDING

The landing is accomplished exactly as in daylight. Maintain a normal rate of descent with power until the aircraft touches down. The use of the taxilight is optional when shore-based, but prohibited aboard ship. Practice landings should be made with and without it. The tendency to use the light to pick out the runway for a flared landing should be avoided. Power should remain on until touchdown.

CROSS-COUNTRY FLIGHTS

Pilots who have demonstrated adequate flight proficiency may perform crosscountry flights as required to complete syllabus training, maintain pilot proficiency in airways flying, or maintain crew member proficiency. Pilots must have a minimum of 30 hours in type, must have completed night and instrument familiarization in type, and must possess a valid instrument card. Flights will be conducted in accordance with instrument flight rules.

The pilot in command of the aircraft will ensure that proper measures are taken to safeguard the aircraft and any classified equipment whenever the aircraft is landed at other than its home base.

Information in sufficient detail to permit proper servicing of the aircraft shall be carried on all flights.

PART 4

CARRIER-BASED PROCEDURES

INTRODUCTION

All evolutions on the flight and hangar deck are the responsibility of the Aircraft Handling Officer. He exercises his authority through the Flight Deck and Hangar Deck Officers. Close liaison must, therefore, be maintained between squadron maintenance personnel and flight deck control to ensure prompt, accurate, dissemination of information concerning squadron aircraft. When the order "Pilots-Man Your Planes" is passed from Air Operations, flight crews will man aircraft in an expeditious manner.

A qualified squadron representative should man "prifly" during launch and recovery operations involving his squadron's aircraft. He should be equipped with a current NATOPS Flight Manual, including latest "Bingo Charts" for available divert fields.

AIRCRAFT INSPECTION

It is the responsibility of the pilot, in conjunction with the crew members and plane captain, to conduct a thorough preflight inspection of the aircraft. These procedures are outlined in Part 3 of this section.

ENGINE STARTING

The procedure for starting the engines is outlined in Part 3.

DOWNED AIRCRAFT

The pilot should determine as quickly as possible whether the aircraft is up or down. The prompt discovery of discrepancies serves two purposes – the maintenance crew may be able to correct the discrepancies prior to launch time or, if it is available, a standby plane may be launched. Primary fly and flight deck control should be notified immediately of changes in aircraft status.

FLIGHT DECK OPERATIONS

TAXIING

CAUTION

A wet, rolling, and/or pitching deck requires extreme caution while taxiing or towing. The aircraft shall not be taxied or towed while the ship is in a hard turn. The antiskid shall remain OFF.

A flight deck director will signal "hold brakes" when the tiedowns and chocks are removed. The pilot must be particularly alert for this signal so that brakes can be held firmly. The emergency air brake handle should be pulled whenever the brakes do not properly respond. The director will bring the aircraft out of the spot and pass control from director to director up to the catapult. The pilot will complete the takeoff checklist, secure all loose gear, and position head rest. Taxiing onto the catapult is a precision maneuver, and every signal must be answered smoothly and promptly. Use small corrections with nosewheel steering. A power setting of 80 percent will normally provide adequate thrust to roll the nosewheel over the shuttle. Once over the shuttle, the director will signal for an immediate stop to allow the holdback bar to be installed. A very slow come ahead will then be directed to apply tension to the holdback cable. Caution should be exercised to tension the holdback cable as gently as possible. When the taxi director gives the signal to the catapult crew for tension to be applied to the launching bridle, the throttles will be advanced to a minimum of 80 percent.

LAUNCHING

When the takeoff checklist is completed and upon signal from the catapult officer the throttles are advanced to military rated thrust (see figures 3-7 and 3-8). The friction locks should be tightened. The control wheel is held in the neutral position by the left hand with the left elbow braced against the pilots body. Upon completion of the full power check, an exaggerated salute is given to the catapult officer (day) or lights turned on dim and steady (night), and the crew is advised on ICS of the impending shot. The right hand is placed on

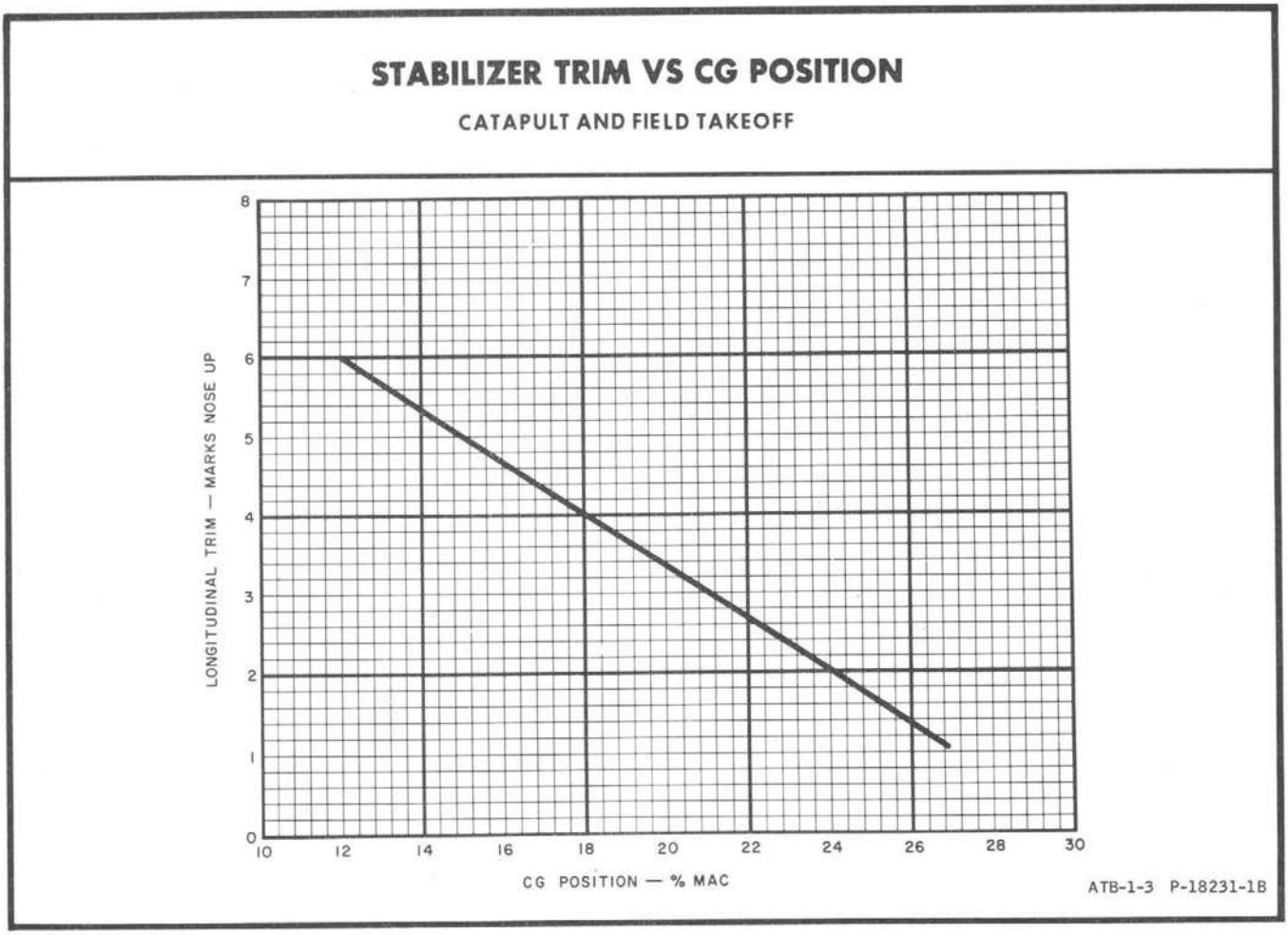


Figure 3-7. Horizontal Stabilizer vs CG Position

the throttles and the catapult grip. After launch, tap brakes lightly and raise the landing gear. An air burble may be encountered off the end of numbers three and four catapults and may cause a wing to drop slightly. When cg is at or near the recommended forward limit (12 percent MAC), a slight amount of back pressure on the controls may be required as the aircraft leaves the deck. Avoid turns until adequate speed is attained. Mild to moderate prestall buffet will be encountered at end speeds within 5 knots of the recommended minimum at a gross weight of 70,000 pounds, and within 10 knots of the recommended minimum at 73,000 pounds.

Note

Refer to A-3 aircraft launching bulletins for additional information.

RENDEZVOUS

Rendezvous and departure will be in accordance with Section IV.

BREAKUP AND LANDING

The sector for climbout, rendezvous, letdown, and orbiting (figure 3-9) in the vicinity of each carrier varies according to the number of carriers in the formation, as well as the position of a specific carrier in formation. This information is contained in ATP-1 (A), VOL. I.

Upon sighting the carrier on an independent flight or after rendezvous in a group flight, the flight leader shall call the ship on the assigned frequency to give a "see you" report which must include the leader's call and the number of aircraft in the flight. In VFR weather and at the proper time, CATTC will clear the flight leader to contact "_____" on land/launch frequency. Landing order will be given at this time. Under IFR conditions, CATTC will maintain control and give marshal instructions, expected approach clearance times, and expected initial and final bearings for the CCA. Each carrier has an established recovery order by aircraft type. As the aircraft return to the ship and are shifted to tower (land/launch) frequency, a Charlie time should be specified by the ship. Charlie time is the time at which the addressed flight leader is to cross the ramp in landing configuration. It is expressed as the number of minutes

from the time of the transmission that the ship expects to be ready to recover the addressed flight leader. This message is usually addressed only to the leader of the first flight to be recovered, and leaders of subsequent flights must then compute their own Charlie time. A good thumb rule is to allow 1 minute for recovery of each aircraft scheduled to be taken aboard. As experience increases, this will be reduced to approximately 35 seconds. Landing interval for night operation should be about 1 minute. The landing pattern is entered by flying along the starboard beam at 800 feet and 250 knots IAS. The leader should extend speedbrakes, reduce fuel flow to about 1500 pounds per hour per engine, and lower flaps, gear, and hook, while slowing to 135 knots. Subsequent aircraft in the flight continue breaking at 15-second intervals. Upon slowing to 135 knots on the downwind leg, close speedbrakes, adjust power to hold altitude and airspeed (about 3000 pounds fuel flow per engine), and complete the landing checklist. After obtaining the fuel state at 135 knots, continue slowing to approach speed. Make all approaches at an angle-of-attack setting of 15 units. Arrive at the 180-degree position at 600 feet, 15 units angle-of-attack. Start the approach turn abeam of the ship.

CARRIER LANDING

The maximum carrier landing weight for the RA-3B is 50,000 pounds; however, limitations of shipboard arresting gear may further reduce this figure. The average fuel required for a circuit of the landing pattern (see figure 3-9 and 3-10) after a touch-and-go is 600 pounds. The average fuel used from an arrested landing, catapult shot, and flying the pattern back to an arrested landing is 800 pounds. Approach the 90-degree position at 600 feet altitude and on approach speed. As the final is approached at approximately 600 feet altitude, pick up the meatball, extend speedbrakes (if not already extended), and adjust power to commence the proper rate of descent. LSO voice signals during the mirror approach are advisory except for the waveoff which is mandatory. Until crossing the ramp, the pilot may take his own waveoff but must be careful of a late waveoff. On a late waveoff, he should maintain a proper landing attitude to ensure clearing the ramp and also to prevent an inflight engagement.

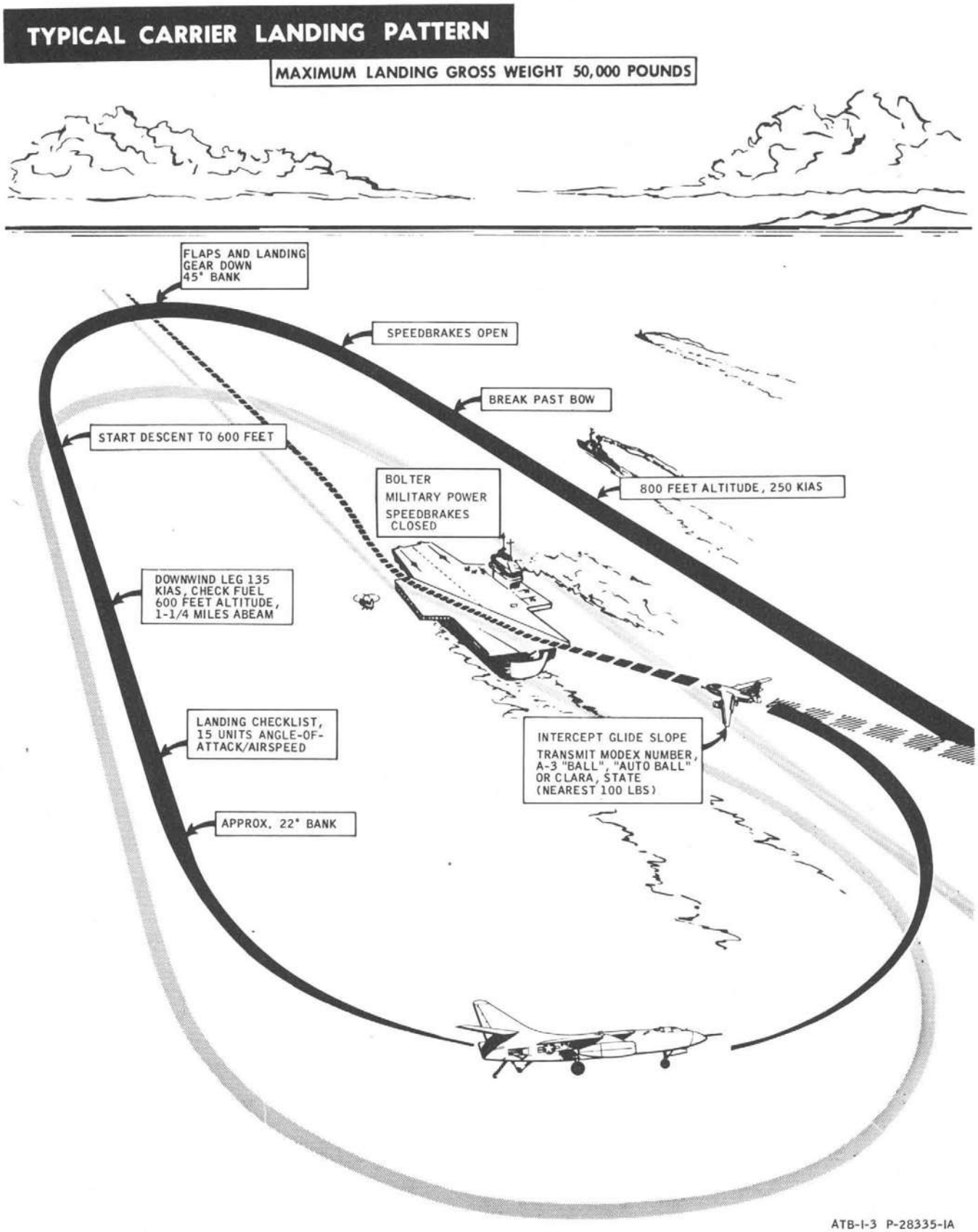


Figure 3-9. Carrier Landing Pattern--Typical

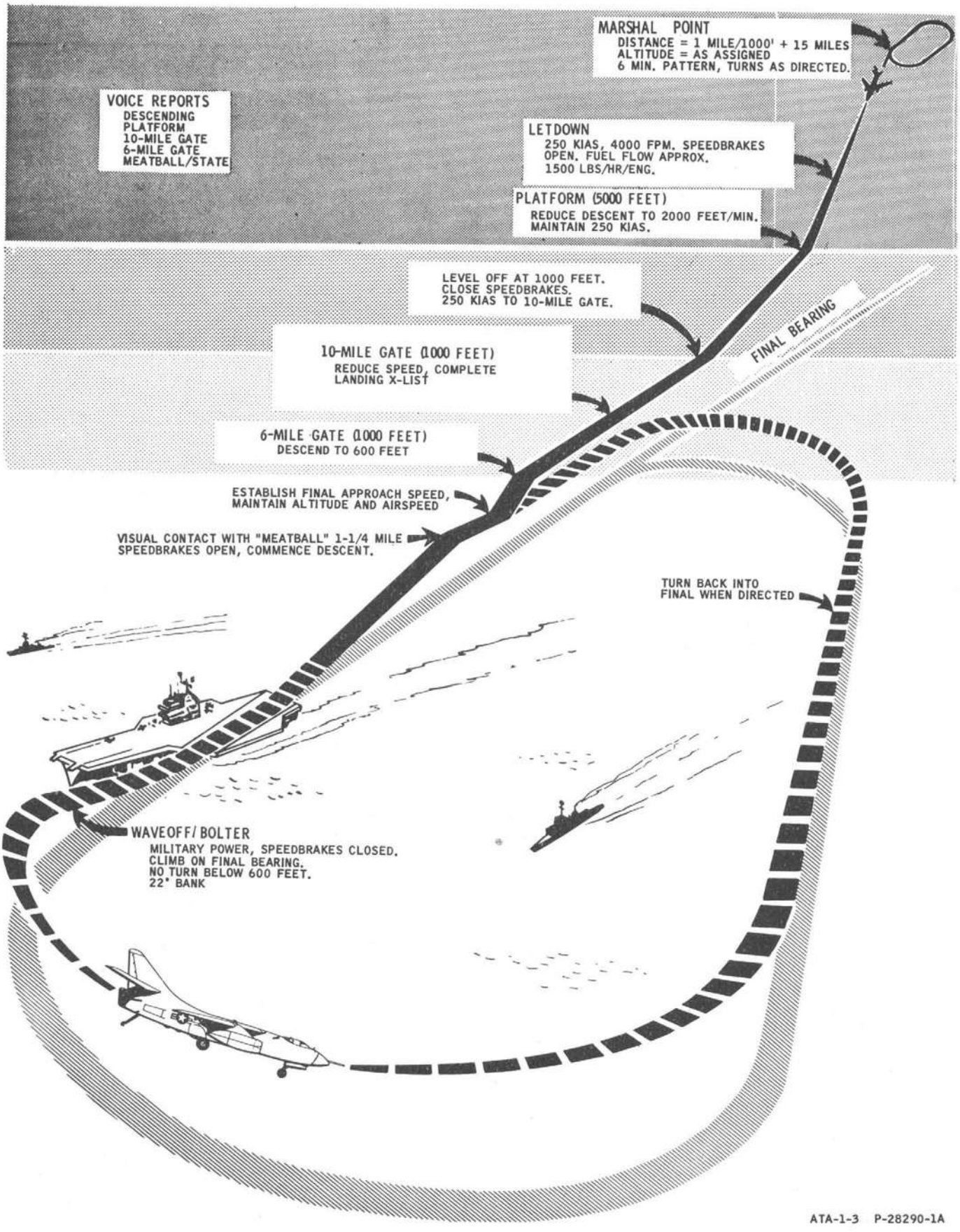


Figure 3-10. Carrier Controlled Approach--Typical

Flying a good approach requires precise control and attention to procedures learned in FCLP. The following rules should become second nature to the pilot:

1. Fly the meatball – not the deck; the meatball is stabilized, and the deck is not.

2. Establish following scan pattern– meatball, lineup, airspeed (angle-of-attack); meatball, lineup, airspeed (angle-of-attack); etc. Check fuel-flow settings every third or fourth scan. Fuel-flow settings for average pass will be 2800 to 3000 lbs.

3. If meatball is low, add power and adjust rate of descent to let ball come back into position.

4. If meatball is lost in close to ramp, take waveoff.

5. Do not dive for deck.

6. Make small corrections when in close to ramp.

7. Do not flare or push over just prior to touchdown. Hold approach attitude. Fly meatball all the way to deck.

8. If it is known or suspected that hook has struck ramp and divert field is within range, aircraft shall be diverted immediately.

NIGHT CARRIER OPERATIONS

The successful night carrier operation begins in the ready room, where night adaption should begin at least 30 minutes prior to manning aircraft. Each member of the flight crew shall carry a flashlight with a red lens. Of necessity, operations on the flight deck at night are slower than during the day. It is imperative that pilots be thoroughly familiar with every signal that is used on the deck at night. If in doubt as to the meaning of a signal, the pilot should hold brakes and wait for clarification.

The exterior lights control panel should be set up prior to taxiing onto the catapult, with the wing and taillight switch on DIM (BRIGHT, if the carrier is equipped with floodlighting), the fuselage switch on MANUAL, the flashing-steady switch on STEADY, and all others OFF. Until ready for the catapult shot, all exterior lights must remain off. The pilot signals that he is ready for the catapult launch by turning on the exterior lights, using the master external lights switch on the right-hand throttle. Once airborne, lights may be adjusted as desired. If the aircraft goes down on the catapult, the pilot should notify primary fly immediately by radio. Do not reduce power until the catapult officer steps in front of the aircraft and gives the retarded throttle signal. (For illustration of the carrier controlled approach, see figure 3-10.)

CCA standard night recovery procedure employs a TACAN penetration with a CCA pickup. The pattern procedures and terms for CCA will be in accordance with CNAP INST 3710.14 or CNAL INSTRUCTIONS P3710.16 (CURRENT REV). For supplementary information, refer to NWP 41(A).

Upon entering the landing pattern, turn all exterior lights on bright and steady. Turn the anticollision light OFF. After the aircraft has been arrested, turn off all exterior lights.

SINGLE ENGINE CARRIER LANDING

Single engine carrier landings can be made by an experienced A-3 pilot. (For an illustration of carrier controlled approach, see figure 3-10.) The pattern should be flown a little wider at the 180-degree position and with a longer final to compensate for the higher approach speeds. Gross weight should not be over 50,000 pounds not less than 44,000 pounds. The lower limit is established in order to maintain single engine control speed. The aircraft should be flown down wind at 150 KIAS with one-half flaps extended. At the 180-degree position the gear should be extended. Full rudder trim should be used into the good engine prior to final approach. This may require the use of some rudder against the over-trimmed condition. The final approach should be flown at 15 units angle-of-attack (137 to 140 KIAS), speedbrakes in. About 2800 to 3400 pounds per hour fuel flow will be required on the operating engine. A waveoff or touch-and-go can be made successfully if full rudder is used into the good engine (full rudder trim is already in effect) simultaneously with power application. This technique will effect heading control during the waveoff or touch-and-go maneuver. Gear should be retracted upon commencing climb and the aircraft accelerated to 150 KIAS. Aircraft gross weights and engaging speeds must fall within current land/launch bulletin limits. It is recommended that this procedure be practiced by experienced pilots prior to deployment aboard ship. It should only be practiced after a thorough briefing and then under the supervision of a qualified LSO.

BINGO FUEL

Bingo fuel is that fuel required to reach a diversionary field within 3000 pounds overhead at the destination approach fix or 3000 pounds at the point of commencing a VFR idle descent. When a diversionary field is not available, 3000 pounds is considered "low state" and the pilot must be given priority landing. When fuel remaining reaches 2000 pounds, the decision whether to rig the barricade or bailout the crew must be made.

ARRESTMENT AND TAXIING

Smart and precise aircraft handling on deck is the mark of an experienced carrier pilot. Every carrier landing must be treated as if it were touch-and-go, even though a wire has been engaged. As soon as the wheels touch the deck, FULL power must be added with deliberate but positive action, closing speedbrakes at the same time. If a wire is engaged and it should break during arrestment, the pilot must be in the best possible position to become airborne. If a bolter occurs, adequate speed is maintained to regain flight before reaching the end of the deck. Once forward motion has been stopped, deck handling begins. Throttles are reduced to IDLE, brakes are off, one hand is on nosewheel steering handle, and the aircraft is allowed to roll backward so that the hook will disengage the wire. When the hook is clear, the director will give the brake signal, followed by the hookup signal. As the hook is raised, the controls are locked and the wings are folded. At night, the exterior lights must be turned off as soon as arrestment is complete. The power added on receipt of the hook signal will be sufficient to provide hydraulic pressure for folding the wings. Through a succession of plane directors, the pilot will be directed to a parking spot and the aircraft checked. The plane captain must ensure that the catapult hooks are retracted. The signal will then be given that the landing gear pins are in and, after the engine "cut" signal, the engines are secured. To prevent taxi accidents, adhere to the precautions listed below:

1. Use checklist conscientiously.
2. Never taxi without signal from director.
3. Check brakes frequently while taxiing.

CARRIER REFRESH/QUAL TAKEOFF CHECKLIST

(To be used between trap and cat shot.)

1.	Controls	CHECKED/ FREE
2.	Compass	SET
3.	Speedbrakes	CLOSED
4.	Flaps	DOWN
5.	Trim tabs	SET
6.	Gross weight GW	CHECK

BARRICADE ENGAGEMENT

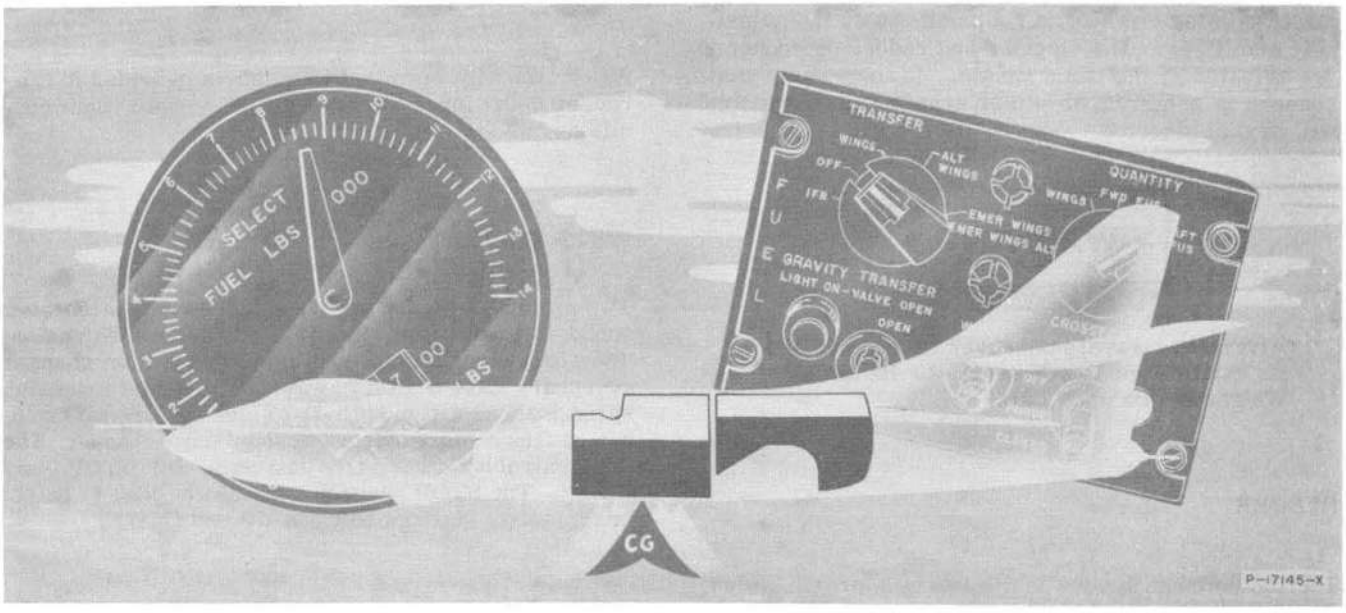
Successful barricade engagements (both day and night) have been made. The barricade engagement shall be attempted only if a divert field is not available. Experience level of the pilot, sea conditions, and location of barricade are all factors to be considered. The normal pass is made with the mirror set at the barricade mirror setting. During the last portion of the approach, the barricade stanchions will obscure the meatball. Use of both port and starboard meatballs (if available) will help; the meatball operated by the LSO may also be used. Lower the hook if possible. If it engages a wire, it will help ensure a successful barricade arrestment by:

1. Keeping aircraft firmly on deck as barricade is entered.
2. Lowering airspeed at barricade entry.
3. Minimizing damage incurred by airframe.

LSO guidance is mandatory to ensure an "on-glide slope" approach and to direct an early waveoff if necessary. The final approach should be flown to ensure that the wheels are on the deck prior to engaging the barricade.

SHUTDOWN

The checkoff list shall be followed for engine shutdown. Bomb bay doors will be opened by the plane captain. On signal from the plane captain that aircraft has tiedowns attached and that it is clear to shut down engines, engines are secured. After shutdown, the pilot shall remain with the aircraft until tiedown is completed or until the plane captain has assumed responsibility for manning the brakes.



SECTION IV

FLIGHT PROCEDURES

INTRODUCTION

Control about all three axes is very good throughout the normal airspeed range. Stall warning (in basic wing aircraft) is early and positive. The control forces required during flight with hydraulic power are not excessive, and trim is effective at all normal airspeeds.

CONTROL SURFACE CHARACTERISTICS

FLIGHT CONTROLS

AILERONS-SPOILERS

The ailerons are operated by an irreversible dual hydraulic power system; the spoilers are operated by one-half of this dual system. Control feel is artificially furnished by a load-feel bungee. In the event of a failure of one of the completely independent power systems, one-half of the full-power output of the aileron tandem actuating cylinder will be lost. The spoilers may remain operative or become inoperative, depending on which half of the dual aileron system fails. When inoperative, the spoilers remain faired. With the spoilers operative, the loss of one-half of the power output of the ailerons will have little effect on lateral control; with the spoilers inoperative, lateral control effectiveness decreases but is considered adequate up to speeds approaching 500 knots. Manual operation of the ailerons, at a mechanical advantage of 2:1 over the no-boost ratio, is provided when the aileron power boost release handle is pulled. If, as a result of a double failure, it becomes necessary to revert to manual operation, lateral control characteristics at low speed should be investigated at a safe altitude prior to landing. The approach and landing with the manual control system should be made at speeds higher than normal. Pulling the aileron power boost release handle disconnects the load-feel bungee, the tandem cylinder, the spoilers, and the aileron force trim mechanism, making it necessary for the pilot to hold in the aileron trim desired.

ELEVATOR

The elevator boost system multiplies by approximately 10 the force transmitted by the control column. The bobweight in the mechanical linkage of the elevator is provided to prevent excessively fast pull-ups, which would impose dangerous loads on the wing structure.

In the event of boost failure, provision is made for direct manual control of the elevators. Because of the increased control forces that will be encountered during manual control, it is important that the out-of-trim

forces be kept small. Adequate control can be maintained with the elevator in conjunction with the adjustable stabilizer. The elevator and rudder disconnects are actuated by the same handle. In the event a disconnect is required on either system, both systems will be disconnected.

WARNING

Aircraft cg travel shall never exceed the limits established in AN 01-1B-40 Handbook of Weight and Balance Data.

RUDDER

The rudder boost system multiplies by approximately 7 the force transmitted by the rudder pedals. Provision is made for direct control of the rudder in case of a failure of the rudder boost system. The elevator and rudder disconnects are actuated by the same handle. In the event a disconnect is required on either system, both systems will be disconnected.

TRIM DEVICES

AILERON TRIM

Because of the irreversible control system, conventional trim tabs are not required. Since the hydraulic surface actuators prevent the transmission of air loads to the pilot's control column, actuating the aileron trim switch merely relocates the wheel center position so that wheel forces supplied by the load feel bungee are zeroed. Since the aileron trim range is within the spoiler actuation deadband, operation of the trim knob will not actuate the spoilers. However, spoiler operation will no longer be symmetrical about the new neutral aileron position. Spoiler action will begin with less aileron displacement in the direction in which the ailerons have been trimmed.

STABILIZER TRIM

Elevator forces are trimmed out by the adjustable horizontal stabilizer. Two actuation speeds are available: a high-speed, powered by an ac source and actuated by the control wheel switch or by a switch on the pilot's center console; and a slow-speed, powered by a dc source and actuated by the console switch. The high-speed trim control is used for normal trimming; the slow-speed acts as standby.

RUDDER TRIM

An electrically operated trim tab is provided to tri. rudder pedal forces to zero for all normal flight conditions.

WING FLAPS

Two speeds are used for wing flap operation: a slow speed for retraction and a fast speed for extension. The slow retraction speed minimizes the trim changes necessary after takeoff or waveoff. The fast extension speed insures a rapid full-flap extension upon demand, but causes a more abrupt noseup trim change. The flap control lever has three positions: UP, STOP, and DOWN. The STOP position permits the pilot to select intermediate settings between UP and DOWN.

SPEEDBRAKES

Opening the speedbrakes will result in a slight but controllable pitchup at all airspeeds.

WING SLATS

Aerodynamically operated wing slats are installed on the leading edge of the wings to improve the stalling characteristics during both accelerated and unaccelerated flight. The slats are fully automatic in operation. A reduction in airspeed causes the slats to extend; an increase in airspeed causes them to retract. Up to a Mach number of approximately 0.45, an increase in g will cause the slats to extend and a decrease in g will retract them. Above a Mach number of 0.45 the slats will not open.

WARNING

Slats can stick in either the open or closed position as a result of mechanical malfunction or icing.

The result of outer wing outboard and/or outer wing inboard slats failing to open will be a SEVERE PITCH-UP, with little or no buffet warning, at approximately approach speed. The outer wing slats should begin to open at 20 to 25 KIAS above normal approach speed and should be approximately half open at approach speed. If a VISUAL CHECK indicates a probable malfunction of any outer wing slats, approach speed should be increased 35 KIAS (basic), or 26 KIAS (CLE) above normal. (For recommended procedures, refer to NO-SLAT LANDING in Section V.)

Center wing slats should begin to open at or slightly above normal approach speed but will not fully open until just above stall speed. The pitchup due to retracted center wing slats is mild and easily controlled. A slight increase in approach speed may be required if buffet or mild pitchup is encountered.

Note

The nomenclature for slat location is outer wing outboard, outer wing inboard, center wing outboard, and (on cambered wing only) center wing inboard.

FLIGHT CHARACTERISTICS

The stability characteristics of the aircraft in level flight are positive. Any increase in airspeed from a trimmed attitude will require nosedown trim, while a decrease in airspeed will require noseup trim in order to maintain the original trimmed attitude.

Flying the RA-3B presents problems typical of any sweptwing, high-performance aircraft. Approach speed and sink rate must be carefully controlled. (Stall warning in the CLE aircraft is much less intense than in the basic wing.) At altitude, the aircraft has a slight Dutch Roll, which becomes unimportant as the pilot gains experience in the aircraft.

LOW SPEED FLIGHT

In general, the handling characteristics of the aircraft during low speed flight are good, although aileron effectiveness decreases quite rapidly with a decrease in airspeed in the power approach configuration.

WARNING

Full noseup trim is not sufficient for hands-off flight at normal landing speeds and cg positions forward of 10 percent MAC. (Refer to Section V and the Handbook of Weight and Balance Data, AN 01-1B-40, for cg limitations.) With boost on and under the most unfavorable forward cg location, a pull force of up to 15 pounds is required for trim at an approach speed of approximately 117 knots. With boost off, a pull force of up to 75 pounds is required. To reduce the pull force to zero, the approach speed must be increased to approximately 133 knots.

In the landing configuration a lateral-directional oscillation or dutch roll appears. When the flight control boost systems are operative, this dutch roll can be adequately controlled through combined use of the ailerons and rudder. Control of the oscillations is extremely difficult with the boost systems inoperative since damping of the dutch roll is virtually zero. Under boost-out conditions, if the wing flaps are retracted, damping is considerably better than when the flaps are extended; therefore, it is recommended that landings with the boost systems inoperative be conducted with the wing flaps retracted if runway length permits (refer to Section V for instructions regarding flight control boost systems failure).

HIGH SPEED FLIGHT

In order to ensure maximum safety during high speed flight, full knowledge of certain characteristics of the aircraft is essential, particularly when operating at low altitude. With spoilers, lateral control is adequate up to maximum permissible speeds. In the following description, the inclusion of flight characteristics at airspeeds above maximum permissible does not imply authorization to exceed the airspeed limitations of the aircraft.

At approximately 425 knots and continuing at higher speeds, a slight buffet is transmitted through the rudder pedal, and a slight directional trim change occurs. This trim change is small and is easily corrected for by the rudder trim tab. The estimated load factor for buffet onset at various altitudes, Mach numbers, and a gross weight of 55,942 pounds is presented in Load Factor for Buffet Onset Charts figure 4-2. When the aircraft is rolled into a turn above 400 KIAS, the incremental load factor resulting from full lateral throw of the control wheel is approximately 1 g. From 450 KIAS to the maximum permissible airspeed, the maximum pitchup resulting from full throw of the control wheel remains at approximately 1 g. Because the pitchup is a result of spoiler deflection, partial throw of the wheel will cause less pitchup.

At high Mach numbers, a reduction in elevator effectiveness and an increase in control wheel force per g are encountered. At medium and high altitude, the control wheel force per g increases from a nominal value of 29 pounds to 61 pounds at Mach number of 0.90. At low altitudes, it increases from 29 pounds to 82 pounds at a Mach number of 0.90. At Mach numbers appreciably above 0.90, elevator effectiveness virtually disappears, and aft wheel deflection does not impose any significant load factor. Under these conditions, the speedbrakes should be extended and recovery effected with the elevator. In an emergency, the horizontal stabilizer can be used, but it should be used with caution, since a pitchup will occur near 0.90 Mach number if there is too much noseup trim. Regardless of the means by which Mach number is reduced, it is important to remember that elevator effectiveness will be regained near 0.90 Mach number, and a noseup pitch will occur if aft wheel deflection is

STALLING SPEEDS
BASIC WING

CONFIGURATION	ANGLE OF BANK DEGREES	APPROXIMATE IAS (KNOTS)											
		GROSS WEIGHT-POUNDS											
		42,000	56,000	70,000	78,000	42,000	56,000	70,000	78,000	42,000	56,000	70,000	78,000
		MAXIMUM THRUST				APPROACH THRUST				POWER OFF			
FLAPS UP, GEAR UP	0	104	123	139	147	110	127	142	150	112	130	145	153
	30	112	132	149	158	118	136	152	161	120	139	156	165
	45	124	146	165	175	130	150	169	179	134	154	172	182
FLAPS HALF DOWN, GEAR DOWN	0	98	116	130	137	103	119	133	140	105	121	135	143
	30	106	124	140	147	111	128	143	150	113	130	145	154
	45	117	138	155	163	122	141	158	167	125	144	161	170
FLAPS FULL DOWN, GEAR DOWN	0	94	111	125	132	98	114	127	134	100	116	129	137
	30	102	119	135	142	106	122	138	144	108	126	139	147
	45	113	132	149	157	117	135	151	160	119	138	154	163

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STALLING SPEEDS
CAMBERED WING

CONFIGURATION	ANGLE OF BANK DEGREES	APPROXIMATE IAS (KNOTS)											
		GROSS WEIGHT – POUNDS											
		42,000	56,000	70,000	84,000	42,000	56,000	70,000	84,000	42,000	56,000	70,000	84,000
		MAXIMUM THRUST				APPROACH THRUST				POWER OFF			
FLAPS UP, GEAR UP	0	92	109	125	138	100	116	129	141	102	118	132	145
	30	99	118	134	148	107	124	139	152	110	127	142	156
	45	110	130	148	164	119	137	154	168	122	141	157	172
FLAPS HALF DOWN, GEAR DOWN	0	89	105	119	131	95	109	122	134	97	112	125	137
	30	96	113	128	141	102	117	131	144	104	120	134	147
	45	106	125	142	156	113	130	145	159	115	133	149	163
FLAPS FULL DOWN, GEAR DOWN	0	88	103	117	129	92	107	119	131	94	109	122	133
	30	94	111	125	138	99	115	128	141	101	117	131	143
	45	104	123	139	153	110	127	142	155	112	129	145	159

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Figure 4-1. Stall Speeds

being held. Dives up to the maximum permissible Mach numbers and airspeed can be accomplished with safety, provided reasonable precautions are taken. The longitudinal trim should be adjusted during the dive to a position that requires a moderate push force on the control wheel to hold the aircraft in the dive: this will decrease the control wheel force required to execute the pullout. Except as noted above, the elevator trim control should not be used as a pullout device unless an emergency exists, such as loss of elevator boost, because of the lack of control feel and the possibility of overstressing the aircraft. At high indicated airspeeds, the aircraft is extremely sensitive to trim changes, and trim adjustments must be made very carefully to avoid excessive load factors.

WARNING

Failure of either the surface control hydraulic system or the aileron control hydraulic system makes it imperative that airspeed be reduced below 510 KIAS, which is the speed at which aileron reversal normally occurs.

BUFFET ONSET (NIBBLE) CHECK

The buffet phenomenon in basic wing aircraft can be used to establish best approach speed whenever angle-of-attack and/or airspeed are erratic or out. When required, this check will be made following the fuel check on the downwind leg as follows:

1. Reduce power to 2500 lbs per hour per engine
2. Speedbrakes out
3. Erase noseup smoothly to maintain altitude as aircraft decelerates.
4. When "nibble" is felt (note IAS), add power, retract speedbrakes, and accelerate to buffet plus five knots for approach.

Note

This procedure is not recommended for CLE aircraft.

STALLS

(See figures 4-1 and 4-2.)

CAUTION

Avoid flight at speeds below prestall buffet onset.

POWER-OFF STALLS (BASIC WING)

The power-off stalling characteristics of the aircraft are good. Early warning occurs in the form of light tail and general airframe buffeting. With the gear and flaps extended, buffeting starts at 15 to 20 knots above the stall. With the gear and flaps up, buffeting occurs at 25 to 30 knots above the stall. An increase in buffet intensity to heavy should be accepted as the stall. If airspeed reduction is continued below buffet onset, a pitching oscillation will begin at four to twelve knots (depending on flap deflection) below the onset of heavy buffet. Slightly below the speed at which pitching oscillations begin, a slow roll-off, mild pitchup or very mild pitchdown will occur. A normal recovery is easily accomplished by moving the wheel forward. During

recovery, both elevator and rudder control are good, and, although aileron control is low, wing position can be controlled with rudder. If speed reduction is carried into the pitch oscillation region, wheel deflections causing spoiler operation should be avoided, as they increase the possibility of spin entry on rollout. Application of power will serve only to reduce the stalling speed, as shown on figure 4-1.

POWER-OFF STALLS (CAMBERED WING)

The power-off stalling characteristics of the cambered wing are not as well defined as those of the basic wing. The stalls are usually evidenced by one or more of the following symptoms: a tendency to pitch and roll; random wing drop; and occasionally a definite pitchdown. In the cruise or glide configuration, stall warning (buffet onset) occurs approximately 20 knots above the stall and increases in intensity to the stall, where buffeting is heavy. In the takeoff, power approach, and landing configurations, buffet onset occurs approximately to 10 knots above the stall; however, because of its low intensity it cannot be classed as stall warning. Airframe buffet classed as moderate, which can be unmistakably recognized as stall warning, occurs approximately 4 knots above the stall.

ACCELERATED STALLS

During maneuvers at low speeds, buffet intensity will build to a high level as the stall is approached. At Mach numbers above 0.45, where the slats do not open, pitchup may occur during maneuvers where large angles-of-attack may be developed. This pitchup is preceded by aircraft buffet and stick force lightening, which should serve as a warning that pitchup is being approached.

CAUTION

In accelerated turns, a tendency for the airplane to dig into the turn is to be regarded as a warning of the approach to a stall; and an immediate recovery must be made. Additional warning is present in the form of airframe buffeting.

ANGLE-OF-ATTACK RELATIONSHIP

The angle-of-attack relationship for the operational envelope of the aircraft is illustrated on figure 4-3.

SPINS

Intentional spins are prohibited. Inadvertent spins should not be difficult to avoid, because stalling characteristics are good. If a spin is entered inadvertently, the normal recovery technique, consisting of full rudder reversal against the spin followed by down elevator, should be initiated immediately. Ailerons should be maintained at neutral during spin recovery, since incorrect usage of ailerons may delay recovery. Retract flaps and landing gear immediately if they are extended at spin entry. Retard both throttles to IDLE upon spin entry.

SINGLE-ENGINE FLIGHT CHARACTERISTICS

The single-engine flight characteristics of the aircraft are good. Altitude can be maintained up to approximately 20,000 feet, under standard day conditions, clean configuration, at the normal gross takeoff weight. However, the problem of holding altitude or climbing will be markedly increased with a high outside air temperature or with the gear and flaps down, or with slow airspeeds. The flight control boost and power systems provide adequate control during single-engine flight at all airspeeds above 1.2 times the power-off stall speed. Even though it requires high rudder pedal forces, maintain a minimum bank angle in straight flight to avoid sideslip, which imposes substantial fin-bending loads.

If an engine has been shut down in flight for any reason for a period of one hour and the windmilling rpm exceeds 25 percent, perform the following steps to cool the engine fuel pump:

1. Master engine switch, inoperative engine..... ON
2. Throttle, inoperative engine, three minutes at..... IDLE

Note

Do not move the throttle out-board when moving from OFF to IDLE, as such action will start the ignition cycle.

3. Throttle, inoperative engine..... OFF
4. Master engine switch, inoperative engine, leave at..... ON

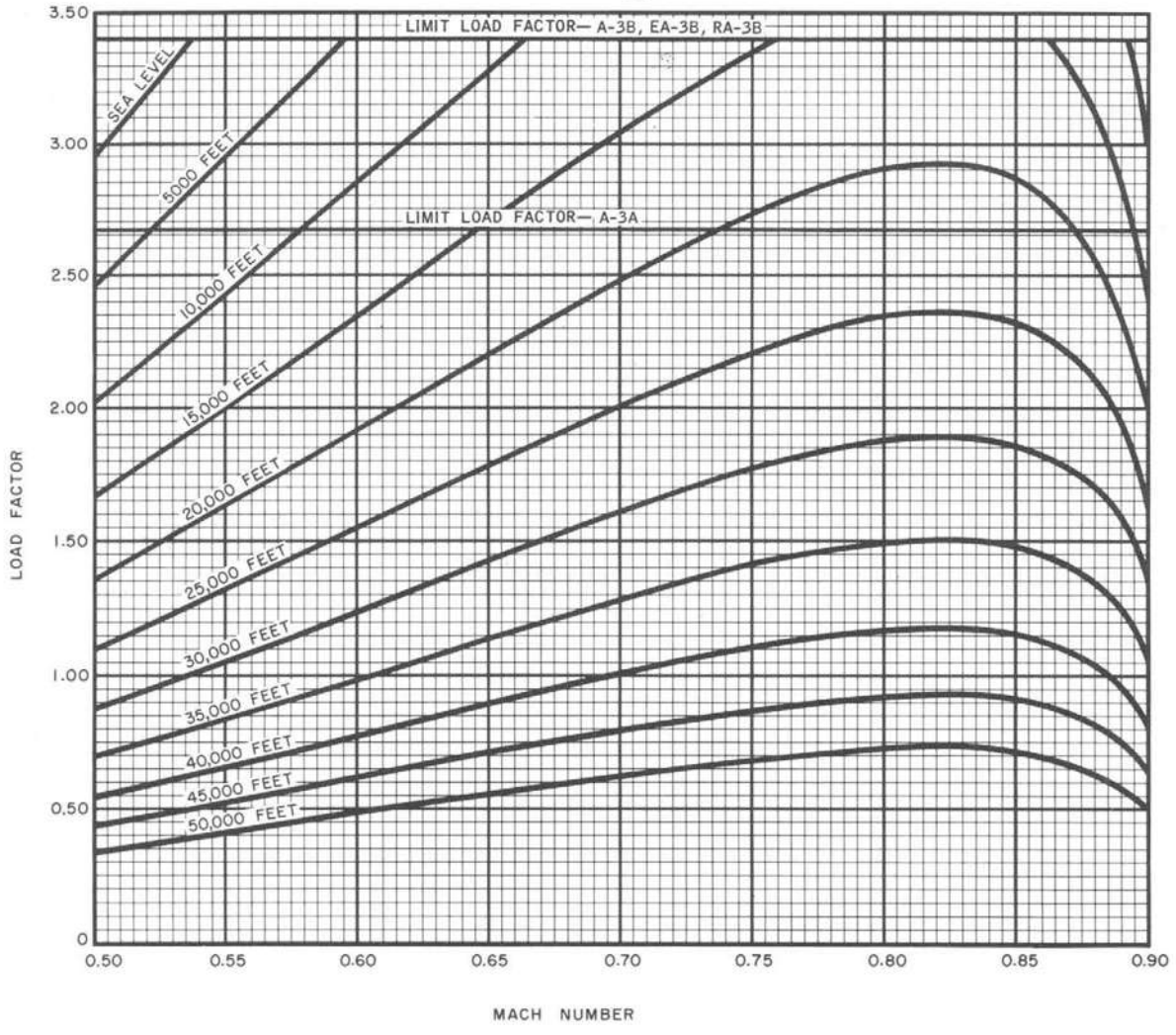
WARNING

Failing to cool the engine fuel pump at one hour intervals can cause excessive temperature in the pumps, leading to subsequent failure.

LOAD FACTOR FOR BUFFET ONSET

MAXIMUM THRUST

MODEL: A-3A/B, EA-3B, RA-3B —**BASIC WING** **ENGINE:** J57-P-6,-10



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REMARKS:

(1) Based on design gross weight of 55,942 pounds. For other gross weights, multiply load factor by ratio of 55,942 pounds to actual gross weight.

DATA AS OF: 1 July 1961
DATA BASIS: Flight Test

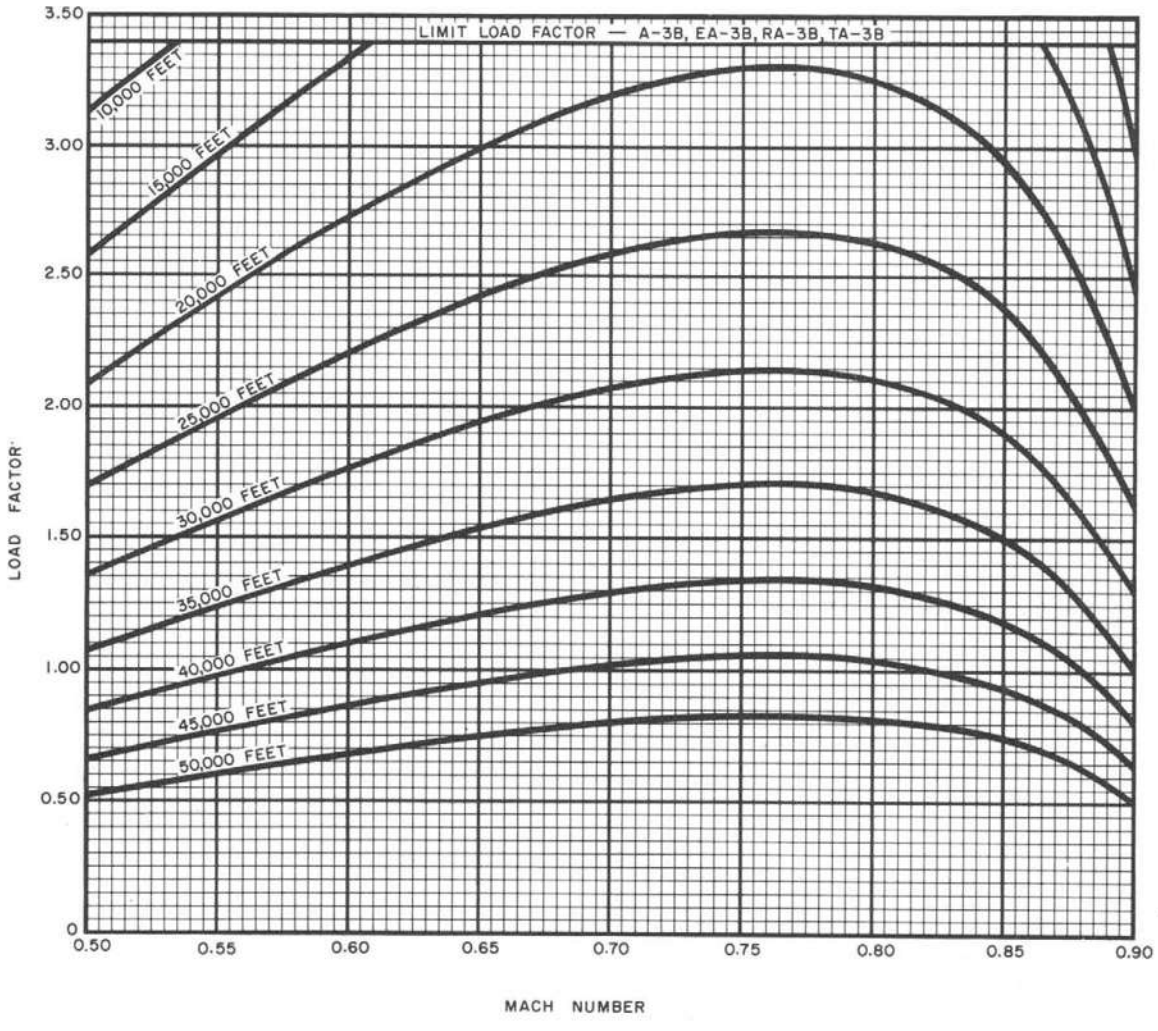
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure 4-2. Load Factor for Buffet Onset (Sheet 1)

LOAD FACTOR FOR BUFFET ONSET

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINE:** J57-P-10



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REMARKS:

(1) Based on design gross weight of 55,942 pounds. For other gross weights, multiply load factor by ratio of 55,942 pounds to actual gross weight.

DATA AS OF: 1 July 1961
DATA BASIS: Flight Test

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure 4-2. Load Factor for Buffet Onset (Sheet 2)

CRUISE AFTER CLIMB

SINGLE-ENGINE CRUISE. Whenever it is required for increased endurance or for practice, single-engine operation should be conducted with the left-hand engine secured. With the right-hand engine secured, fuel does not flow through the hydraulic oil cooler. Following each flight with the right-hand engine secured due to mechanical trouble, the hydraulic pumps must be inspected for damage. (For single-engine cruise performance data, refer to Section XI.)

CRUISING FLIGHT

The handling characteristics are good about all three axes during normal cruise. The ailerons are very effective at high altitude and at moderate airspeeds.

AIR STARTING

CAUTION

No attempt should be made to restart an engine unless it can be determined that it would be reasonably safe to do so and, only if it is suspected that the loss of combustion was due to flameout. If the loss of combustion was accompanied by symptoms that indicated engine malfunction or failure, an attempted relight may result in engine fire.

Consistently successful air starts are dependent upon windmilling rpm. Listed below are the indicated air speeds at various altitudes that will produce windmilling rpm within the best air starting rpm range.

PRESSURE ALTITUDE	IAS RANGE, KNOTS
40,000	150-170
35,000	150-180
30,000	150-205
25,000	150-230
20,000	150-255
15,000	160-285
10,000	170-310
5,000	180-335
Sea Level	200-360

Note

Successful relights may sometimes be obtained at any altitude or airspeed by taking advantage of the high airflow through the engine immediately following a flameout. The minimum rpm for successful air starts will vary with altitude and airspeed.

IMMEDIATE AIR START

In the event of a flameout the following procedure should be accomplished as quickly as possible:

1. Throttle inoperative engine . . . . . OFF

2. Throttle inoperative engine, move outboard to start the ignition cycle.

3. Throttle, inoperative engine . . . . . IDLE

The procedure for normal air start is as follows:

1. Throttle, inoperative engine . . . . . OFF

2. Master engine switch . . . . . ON

3. Fuel pressure . . . . . NORMAL

4. Tachometer . . . . . 12 to 30%

5. Throttle . . . . . IGNITE, THEN IDLE

Note

An air start may be attempted with no oil pressure indications. If indications do not return to normal after air start, secure the engine. If fuel boost pressure reads LOW/OUT, position CROSSFEED switch to affected engine OPEN. If boost pressure does not return, place CROSSFEED switch to normal/CLOSED and continue air start attempt.

6. If an excessive fuel flow is noted, control the fuel flow by placing the throttle between OFF and IDLE.

7. When lightoff occurs, follow the normal procedures outlined in Section III under STARTING PROCEDURES. During an air start, the idling rpm will be 60 to 70 percent.

CAUTION

If lightoff does not occur within 30 seconds after the throttle has been moved to IDLE, or if an unsatisfactory start is indicated in any other way, retard the throttle to OFF and allow the engine to windmill for 30 seconds minimum before attempting another start.

ENGINE FAILURE UNDER SPECIFIC CONDITIONS DURING TAKEOFF. Failure of an engine during takeoff before flying speed is attained normally will necessitate aborting the flight.

Note

At light gross weights the single-engine takeoff can be completed under normal atmospheric conditions. Refer to takeoff and climb charts in Section XI for critical field lengths and single-engine climb performance.

The one engine will normally provide sufficient power for climbing out; however, at heavy gross weights and high outside air temperatures, climb performance right after takeoff is marginal. Aircraft directional control is adequate for single-engine operation at all airspeeds above 1.2 times the power-off stall speed if the required rudder and directional trim are combined with banking of the aircraft. Use a minimum angle of bank to avoid sideslip. Rudder pedal forces may be high, but bending loads at the vertical stabilizer will be small.

In flight planning the pilot should keep in mind the following conditions: aircraft gross weight, air temperature, pressure altitude, wind conditions, runway length, and necessary airspeed. In the following situation aircraft climb performance would be marginal. Assume an aircraft of 70,000 pounds gross weight, standard day temperature at sea level, on a 4000-foot runway with a 10-knot headwind. Under these conditions the recommended takeoff speed is 140 knots. If an engine fails, immediate landing gear retraction and acceleration to at least 150 knots is necessary to enable the aircraft to continue flying. If the landing gear isn't retracted soon enough, the aircraft will not be able to maintain altitude. If the conditions were similar at a lower gross weight, the chances of climbing to a safe altitude would be better. It is unlikely that the airspeed would be sufficient immediately after takeoff to enable the aircraft to zoom to a high enough altitude to permit safe bailout. If an engine fire or fire or fire warning exists, leave the throttle on the inoperative engine OFF, turn the master engine switch on the inoperative engine to OFF, and prepare for an immediate single-engine landing. If there is no fire or other immediate emergency and a restart cannot be made, jettison or consume fuel down to a safe landing weight and make a landing as described in Section III under SINGLE-ENGINE AIRFIELD LANDING. If safe flight cannot be continued, keep the wings level and land straight ahead.

MANEUVERING FLIGHT

The stick force per g increases at the higher Mach numbers, as outlined in the HIGH SPEED FLIGHT. During any flight maneuver, a tendency of the airplane to dig into a turn must be regarded as a warning of approach to a stall; and an immediate recovery must be made. In the event airspeed indications are lost, see figure 4-2A for approximate indicated angle-of-attack to be flown.

PITCHUP CHARACTERISTICS

High-angle-of-attack pitchup can occur when the aircraft is maneuvered in heavy buffet. This pitchup is defined as an increase in load factor without an increase in elevator column pull force. It is most likely to occur at high altitudes; however, in this case aircraft stall would be reached prior to limit load factors. At intermediate altitudes (20,000 to 30,000 ft.), limit load factor can be attained if corrective action is not taken immediately. At low altitudes the aircraft load factor limit prevents the aircraft from attaining the angle-of-attack for pitchup, and the maneuvering characteristics are normal.

Should pitchup be encountered, immediate corrective action should consist of forward elevator and, if necessary, aircraft nosedown stabilizer. If engine stalls are encountered in the pitchup region, they will be relieved as the angle-of-attack is reduced.

CAUTION

Due to the possibility of pitchup, maneuvering flight which carries the aircraft beyond moderate to heavy buffet in the Mach Number range 0.50 to 0.90 should be avoided.

BOOST-OFF FLIGHT

AILERON

The aileron tandem actuating cylinder is provided with pressure from both the aileron control hydraulic system and the surface control hydraulic system. Failure of either of these systems causes a partial loss of power, but adequate lateral control is available at reduced airspeeds. Failure of both systems, however, necessitates a complete mechanical release of the tandem actuating cylinder from the aileron control linkage. Aileron control forces are extremely high with both of the dual hydraulic systems inoperative; but are reduced considerably when the tandem actuating cylinder is disconnected. Pulling the aileron power boost release handle on the pilot's instrument panel mechanically disconnects the tandem actuating cylinder, thus providing direct manual control of the ailerons through a mechanical advantage shifter. This shifter doubles the boost-off mechanical advantage ratio of the controls. The actuating cable system of the two spoilers is disconnected when the aileron power boost release handle is pulled, and the spoilers cannot operate until the actuating cable system lock is reconnected on the ground. Aileron trim is not available during manual control of the ailerons, and aileron load is transmitted directly through the aileron control linkage. Lateral control by use of the ailerons alone

APPROXIMATE INDICATED ANGLE-OF-ATTACK
AIRSPEED RELATIONSHIP
FOR USE ONLY IN THE EVENT AIRSPEED INDICATIONS ARE LOST

MODEL: RA-3B BASIC WING

	PRESSURE ALTITUDE ~1000 FT.	CLIMB KIAS	ANGLE OF ATTACK FOR GROSS WEIGHT ~1000 LB			
			80	70	60	50
MAX. RATE OF CLIMB	S.L.	375	9.1	8.6	7.9	7.2
	10	345	9.6	9.0	8.4	7.7
	20	315	9.8	9.2	8.6	8.0
	30	285	10.4	9.9	9.1	8.1
	40	245	-	-	11.1	10.2

	PRESSURE ALTITUDE ~1000 FT.	ANGLE OF ATTACK: KIAS FOR GROSS WEIGHT ~1000 LB							
		80		70		60		50	
MAX. RANGE	S.L.	10.0	330	9.7	315	9.3	305	8.9	290
	10	10.7	310	10.8	290	10.1	285	9.8	270
	20	9.9	320	10.2	300	10.7	270	10.7	250
	30	10.3	295	9.9	290	9.5	280	10.0	255
	40	-	-	12.1	245	10.9	245	10.2	225

	PRESSURE ALTITUDE ~1000 FT.	ANGLE OF ATTACK: KIAS FOR GROSS WEIGHT ~1000 LB							
		80		70		60		50	
MAX. ENDURANCE	S.L.	13.2	275	13.3	255	13.3	235	13.4	215
	10	12.9	275	13.1	255	13.2	240	13.3	215
	20	12.6	275	12.7	260	12.8	240	13.0	220
	30	11.5	280	11.7	265	12.1	245	12.6	220
	40	-	-	12.3	245	12.0	235	11.5	225

PENETRATION 250 KIAS 50000 LB GROSS WT.	ANGLE OF ATTACK
	10.5

LANDING TRANSITION 200 KIAS	S.L. ANGLE OF ATTACK
	13

Figure 4-2A. Approximate Indicated Angle-of-Attack (Sheet 1)

APPROXIMATE INDICATED ANGLE-OF-ATTACK
AIRSPEED RELATIONSHIP
FOR USE ONLY IN THE EVENT AIRSPEED INDICATIONS ARE LOST

MODEL: RA-3B CAMBERED WING

	PRESSURE ALTITUDE ~1000 FT.	CLIMB KIAS	ANGLE OF ATTACK FOR GROSS WEIGHT ~1000 LB			
			80	70	60	50
MAX. RATE OF CLIMB	S.L.	380	9.4	9.0	8.6	8.3
	10	340	9.6	9.1	8.9	8.5
	20	300	9.9	9.5	9.0	8.6
	30	260	10.9	10.4	9.7	9.2
	40	225	-	-	11.5	10.7

	PRESSURE ALTITUDE ~1000 FT.	ANGLE OF ATTACK: KIAS FOR GROSS WEIGHT ~1000 LB							
		80		70		60		50	
MAX. RANGE	S. L.	10.0	330	10.0	315	9.9	295	9.5	290
	10	10.6	310	10.5	295	10.0	290	10.1	265
	20	10.2	315	10.3	295	10.5	270	10.7	245
	30	10.9	285	10.4	280	9.9	280	10.2	255
	40	-	-	12.8	225	11.5	230	10.9	225

	PRESSURE ALTITUDE ~1000 FT.	ANGLE OF ATTACK: KIAS FOR GROSS WEIGHT ~1000 LB							
		80		70		60		50	
MAX. ENDURANCE	S. L.	13.7	240	13.8	225	13.8	210	13.8	190
	10	13.5	245	13.6	225	13.6	210	13.7	190
	20	13.2	245	13.5	230	13.4	210	13.5	190
	30	12.6	250	12.8	235	13.0	215	13.2	190
	40	-	-	13.3	220	12.8	210	12.6	200

PENETRATION 250 KIAS 50000 LB GROSS WT.	ANGLE OF ATTACK
	10.3

LANDING TRANSITION 200 KIAS	S. L. ANGLE OF ATTACK
	12

Figure 4-2A. Approximate Indicated Angle-of-Attack (Sheet 2)

is negligible above 350 KIAS. Above this speed, lateral trim can be maintained by asymmetric power or rudder trim. Below this speed, lateral control can be substantially increased by combined use of the ailerons and rudder, and control will be sufficient to make satisfactory turns at low speeds; however, forces required will be high. Speeds in excess of 0.80 IMN should be avoided because of an occasional random wing-drop characteristic. If this characteristic develops, an immediate airspeed reduction will be required to maintain control. Large rudder inputs should be avoided in this speed range. During an approach in the landing configuration, moderate to heavy lateral-directional oscillations are inherent.

Note

The aileron power system cannot be reconnected in flight.

RUDDER-ELEVATOR

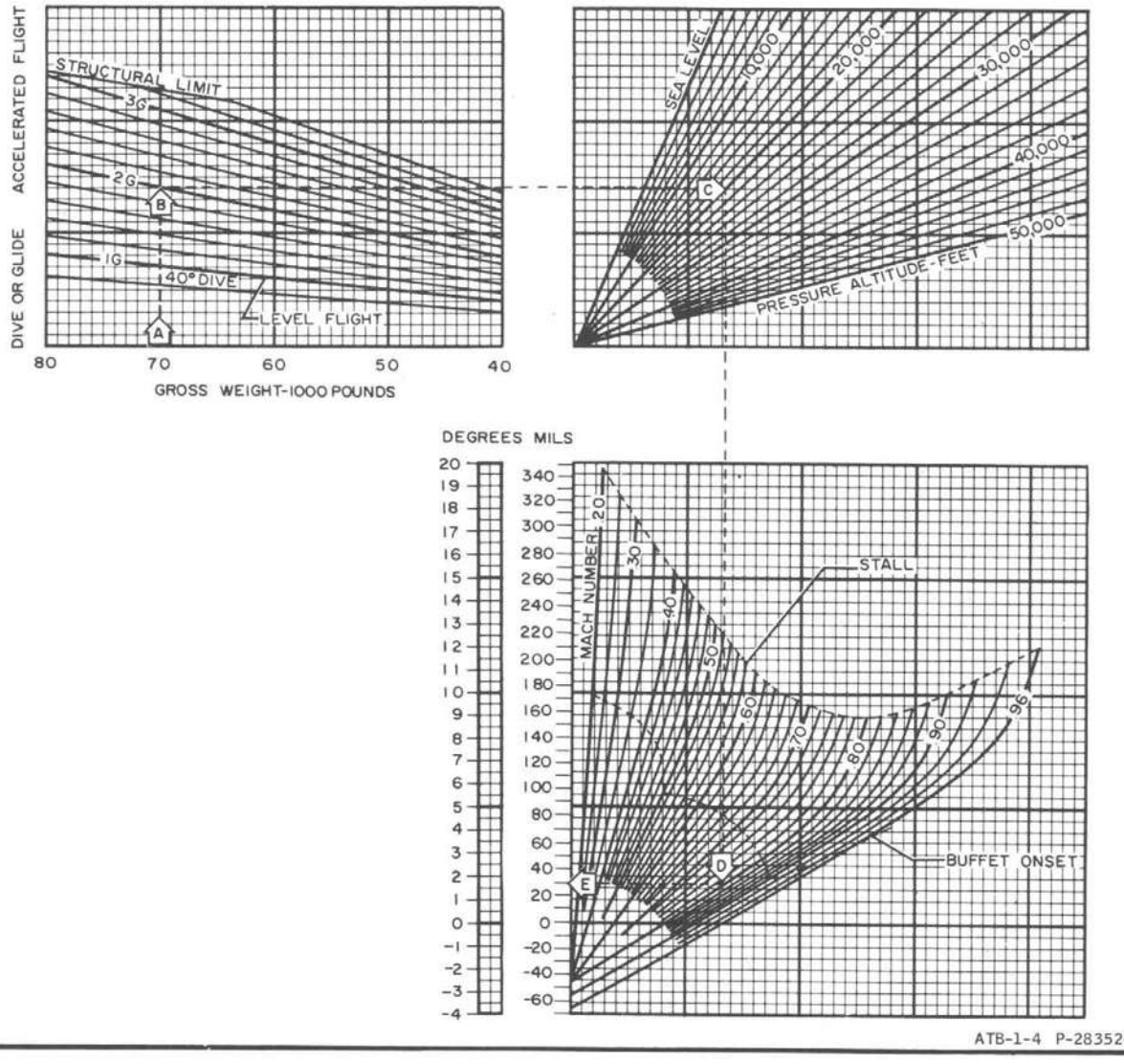
The rudder and elevators are supplied with hydraulic boost pressure from the surface control hydraulic system. The surface control hydraulic system can be disconnected from the flight controls linkage by pulling the rudder and elevator power boost release handle on the pilot's instrument panel—to provide direct mechanical control of the rudder and the elevators. Under normal conditions, an increase in elevator and rudder forces will be experienced during boost-off flight, but

ANGLE-OF-ATTACK RELATIONSHIP

SPEED BRAKES CLOSED

MODEL: RA-3B

ENGINES: (2) J57-P-10



REMARKS:

(1) One degree equals 17.5 navy mils.
(2) Mach numbers shown are true Mach numbers.

EXAMPLE:

For a gross weight of 70,000 pounds, a load factor of 2 G and an airspeed of .80 Mach at an altitude of 20,000 ft.:
Enter chart at (A) (70,000 pounds).
Proceed vertically to (B) (2 G load factor)
Move horizontally to the right to (C) (20,000 ft.)
Proceed vertically down to (D) (.80 Mach).
Move horizontally to the left and read the angle of attack of the fuselage reference line at (E) which is 30 Navy mils or 1.7 degrees.

DATA AS OF: 1 July 1956
DATA BASIS: Calculations

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure 4-3. Angle-of-Attack Relationship

extremely high rudder forces are required for directional control if a yaw condition exists. Directional control can be maintained adequately by the use of the rudder or rudder trim during normal flight. During an approach in the landing configuration, lateral-directional oscillations cannot be damped out by use of the rudder pedals due to high forces and sluggishness within the controls. Directional oscillations are of lesser magnitude at higher speeds, and at slower approach speeds wheel forces are noticeably lighter. During normal boost-off flight, longitudinal control can be adequately maintained by the use of the elevators. During a boost-off approach, longitudinal trim can be maintained easily by the horizontal stabilizer trim system if electrical power is available. Longitudinal trim should be maintained at all times.

Note

The rudder-elevator power boost system cannot be reconnected in flight.

Note

The yaw damper is inoperative under rudder-elevator boost-off conditions.

AILERON AND RUDDER-ELEVATOR

With both the aileron and the rudder-elevator boost systems inoperative, elevator control forces can be trimmed out if the horizontal stabilizer is operative (ac or dc power is available), and some elevator control is possible even though the rudder-elevator boost is inoperative but still connected. Aileron control will be lost and, hence, the primary problem will be one of maintaining, or returning to, wings-level flight. Small roll rates can be achieved by rudder deflection, rudder trim (if dc power is available) or use of asymmetric thrust. Unless loss of control occurs or is imminent, immediate pulling of the aileron power boost release handle is not recommended. If conditions permit, time should be taken to analyze the failure and attempts should be made to regain power. A limited amount of aileron control effectiveness can be regained by pulling the aileron power boost release handle; however, lateral control can be substantially increased by combined use of ailerons and rudder. With ailerons alone, the maximum rate of roll throughout the speed range of the airplane is six to eight degrees per second. This rate of roll requires a control column force of approximately 80 pounds. As airspeed is increased, control wheel forces become rather large for a small increase in rate of roll. If rudder only is used for lateral control, the maximum rate of roll under the same conditions can be raised to 20 or 30 degrees per second; however, the force on the rudder pedals required to achieve this rate of roll reaches 260 to 300 pounds, depending on which direction the rudder is deflected. With wheels and flaps extended, damping of the characteristic lateral-directional oscillation is virtually impossible; but with flaps retracted, damping, although still difficult, can be accomplished to a limited extent.

Note

Complete boost-out manual control is provided to make possible emergency landings at airfields or controlled ditchings at sea.

BOOST-OFF CARRIER LANDING

WARNING

Complete boost-out carrier landings shall not be attempted.

AILERON. Carrier landings can be safely accomplished following failure of one of the aileron tandem power control cylinders (one ATM). Following failure of both ATM's, however, carrier landings are unsafe because of excessively high lateral control forces and the loss of the rudder-elevator boost systems. The maximum rolling velocity attainable in the approach configuration at normal approach airspeed with 35 pounds of wheel force is approximately 6 degrees per second. Further increase in wheel force up to approximately 80 pounds will not significantly increase available rolling velocity. Small rudder inputs will greatly assist in maintaining the wings level. Conditions existing at the carrier and at the diversionary field should be considered as to their effect on landing with aileron boost inoperative.

RUDDER-ELEVATOR. Loss of the rudder-elevator boost system will result in high control forces for out-of-trim conditions. During an approach in the landing configuration, lateral-directional oscillations will be apparent which cannot be damped out by use of the rudder pedals. This is a result of high rudder pedal forces and sluggishness within the controls. Carrier landings will not, however, be appreciably complicated provided that longitudinal and directional trim controls are available. Abrupt power adjustments should be avoided during the final stages of approach because of pronounced trim changes resulting from thrust effects.

Note

The yaw damper is inoperative under rudder-elevator boost-out conditions.

BOOST-OFF AIRFIELD LANDING

AILERON. Lateral control forces are high during the approach to a landing with both aileron-boost systems

out. Sufficient controllability, however, is available to land the aircraft safely under normal operating conditions. Aileron boost-off (both) landings in light crosswinds (below 7 knots) and in light turbulence can be accomplished without difficulty. Landings are more difficult in higher crosswind components or increased turbulence. Depending upon the degree of turbulence, moderate to extreme lateral-directional oscillations will occur during the approach. The "dutch roll" characteristic is, however, less pronounced with flaps retracted. A no-flap approach to landing is recommended under conditions of excessive turbulence and when sufficient runway is available. With flaps retracted, an increase of 20 knots above normal approach airspeed is recommended. With flaps extended, there is no advantage to be gained with an increase in normal approach airspeed. Due to an over-all decrease in lateral control effectiveness with the boost inoperative, directional control is extremely marginal during landing rollout with crosswind components in excess of 7 knots. Landings in high crosswind components should be accomplished with drag chute or field arresting gear when available.

RUDDER-ELEVATOR. With rudder-elevator boost-out, field landings will not be appreciably complicated provided that longitudinal and directional trim controls are available. Abrupt power adjustments should be avoided during the final stages of approach due to pronounced trim changes resulting from thrust effects.

Note

The yaw damper is inoperative under rudder-elevator boost-out conditions.

AILERON AND RUDDER-ELEVATOR. In the power approach configuration, with complete boost failure, the aircraft is marginally controllable in moderate turbulence and essentially uncontrollable in severe turbulence. Where existing turbulence levels are moderate to severe, landings should be accomplished with landing flaps retracted and drag chute if possible. Landings in greater than 7-knot, 90-degree crosswinds should be avoided when practicable or accomplished with field arresting gear.

WARNING

Field landings in crosswinds of 7 knots or greater, or in moderate to severe turbulence, are hazardous and should not be attempted unless an alternate airport with more favorable weather is not available. If it is necessary to land under adverse conditions, then consideration should be given to utilizing field emergency arresting gear to shorten the landing run and assist in directional control.

To land on a short runway or to alleviate high elevator forces, lower the wing flaps and attempt to control the lateral-directional oscillations with the rudder. With flaps extended, use an approach speed of approximately 140 KIAS at 56, 000 pounds gross weight. Reduce fuel weight to 6000 pounds (see Section V). Sideslips not to exceed 5 degrees can be accomplished in this configuration with control wheel and rudder pedal forces of approximately 60 and 200 pounds, respectively. Should the horizontal stabilizer actuator fail in conjunction with complete failure of the flight control boost systems, the pilot can counteract control surface forces only by application of his flight controls. Because control forces are extremely high with the boost systems inoperative, a landing under this condition is difficult. The degree of difficulty will be increased if the stabilizer actuator should fail while the aircraft is trimmed for a nose-down attitude. In this situation, when airspeed is reduced for a landing, the back pressure on the control wheel necessary to counteract the heavy nose-down trim setting may be so excessive as to require an extremely fast approach speed. Extension of the wing flaps and speedbrakes will help to relieve the nose-heavy condition, since a noseup trim change results from use of these devices. However, damping of the lateral-directional oscillation is less effective with the flaps extended.

BOOST-OFF SINGLE-ENGINE LANDING

AILERON. Single-engine approach and landing can be safely accomplished with both aileron boost systems inoperative. For a landing gross weight of approximately 55, 000 pounds, it is possible to maintain steady straight flight at normal approach speeds with approximately 5 degrees of bank and 130-pounds rudder pedal force (full rudder with maximum available directional trim). A wheel force of approximately 50 pounds is required to maintain the required bank angle. At lighter landing weights the wheel force required to maintain straight flight is reduced. Any decision to wave-off should be made well out on final. The dynamic yawing maneuver resulting from application of thrust on the operating engine is extremely difficult to control because of the excessive lateral control force required to maintain straight flight. The landing gear and flaps should be retracted as soon as practicable and the airplane accelerated to at least minimum directional trim speed. Near sea level the minimum directional trim speed for stabilized level flight with landing gear and flaps retracted varies from 160 KIAS at 50, 000 pounds gross weight to 175 KIAS at 55, 000 pounds gross weight. (Refer to Section III, Part 3.)

RUDDER-ELEVATOR. Single-engine approach and landing can be safely accomplished with the rudder-elevator boost system inoperative. The normal technique of maintaining directional control, primarily with rudder, is impossible. Directional control can be maintained by sideslipping and banking (wing down toward operating engine) with zero rudder pedal force.

With high sideslip angles (high asymmetric power), stabilizing the airplane is complicated because of excitation of lateral-directional oscillations. For this reason, it is recommended that single-engine approaches with rudder-elevator boost inoperative be accomplished at light gross weights and 10 knots above normal approach airspeed.

Note

The yaw damper will be inoperative under rudder-elevator boost-out conditions.

Any decision to wave-off should be made well out on final. Upon application of power on the operating engine, directional control can be maintained with aileron alone; however, an extreme lateral-directional oscillation may result. This oscillation is mildly divergent and characterized by intermittent airframe buffet. The landing gear and flaps should be retracted as soon as practicable and the airplane accelerated to at least minimum directional trim speed.

AILERON AND RUDDER - ELEVATOR. Normal approach and landing procedures (gear and flaps down throughout the approach), will result in prohibitive control forces with the aileron and rudder-elevator boost systems inoperative. As a result of the prohibitive control forces and associated pilot fatigue factors, the following approach and landing procedure is recommended. The approach pattern should be flown with landing gear and flaps retracted, three miles abeam, with a two-mile final. Maintain airspeed at or near the directional trim speed. Extend landing flaps at a point, dictated by surface wind velocity and airspeed (or approximately 1.5 miles out on final), where there is no risk of landing short of the runway with the approach power setting. Care must be taken to avoid ballooning during flap extension. Therefore, a low approach is recommended. On approaching the runway threshold or landing area, gradually retard power and retrim airplane directionally. Touchdown should be accomplished at idle thrust.

Wave-off should not be attempted after the landing gear is extended unless utility system pressure is available and the landing gear can be retracted. Wave-off should also not be attempted after decelerating 15 knots below the minimum directional trim airspeed as determined with landing gear and flaps retracted. Under no circumstances should a wave-off be attempted after the landing gear is down and the flaps have been completely extended. The dynamic yawing and rolling manuever resulting from application of asymmetric thrust is virtually impossible to overcome.

FORMATION AND TACTICS

Although the missions of RA-3B squadrons require that most flights operate as a single plane unit, it is nevertheless a requirement for each pilot to be proficient in formation flying. Flyaways or other mass flights also require proficiency in formation flying. Formation practice will be scheduled while the squadron is shore-based. Formation flying is not difficult or hazardous, but lack of knowledge of proper procedures, inadequate briefing, and sloppy flying can make it extremely dangerous.

RENDEZVOUS

The rendezvous is potentially the most hazardous of all maneuvers since it involves relative motion on a constant bearing. Observance of established safety procedures is mandatory. Keep the aircraft ahead constantly in view. Keep the nose of the aircraft slightly ahead of the leader's with your speed equal to, or slightly in excess of, the leader's. As the wingman approaches the leader, he should ensure that he is aft the leader's beam to avoid overshooting; excess speed must be reduced before reaching the wing position. As necessary, the wingman should abort rendezvous by leveling his wings, sighting all aircraft ahead, and moving to the outside of formation. During rendezvous only enough stepdown should be used to ensure separation of the aircraft ahead. If one plane is "sucked" during rendezvous the pilot shall move to the outside of the leader. All relative motion should be stopped prior to joining up to the inside wing position. A cross-under to the outside can then be made. During a running rendezvous, caution must be observed in the final steps of joining up since relative motion is difficult to discern when approaching from the rear. The rendezvous will be conducted in one of four ways depending upon the circumstances involved.

THE CIRCLING RENDEZVOUS

The leader establishes an easy orbit around the rendezvous point and other aircraft cross the circle to effect the rendezvous. The wingman places himself well aft of the leader's beam and then puts the nose of his aircraft ahead of the leader, gains a slight speed advantage (10 to 25 knots), and slides into position. As the leader is closed, the speed advantage must be reduced by use of power levers and speedbrakes. Succeeding wingmen should make their rendezvous on the leader rather than the aircraft ahead. All aircraft ahead must be kept in sight or the rendezvous discontinued.

THE RENDEZVOUS AFTER TAKEOFF

If a number of planes take off together and rendezvous for a flight, the first aircraft airborne flies straight ahead for a period of one minute plus 20 seconds for each aircraft in the flight, climbing to the designated rendezvous altitude maintaining 275 knots. At the end of this leg, a 180-degree turn to the left or right is

made at a 20-degree bank and the leader flies the reciprocal of the outbound heading. Succeeding planes follow the leader until his turn is started. When the leader bears 30 to 45 degrees off the bow, a turn is started to place the nose slightly ahead of the leader. If the nose is kept in this position with a speed equal to the leader's, the plane will be drawn into the leader for the joinup. As the wingman nears the leader's position, he should ensure that he is aft of the leader's beam. A slight turn in the direction of the leader will move the line of bearing aft, at which time the nose of the aircraft should again be placed ahead of the leader.

RUNNING RENDEZVOUS

The first aircraft launched assumes temporary lead. When safely airborne, he will reduce fuel flow 1000 pounds below takeoff fuel flow, climbing on course or assigned vector for the mission and maintaining climb schedule airspeed. The other aircraft in the flight join using military power. The rates of closure thus developed are high and pilots must be alert to avoid overrunning the lead aircraft.

ON-TOP RENDEZVOUS

This rendezvous consists of individual climbs through the overcast, and an on-top joinup at a briefed altitude and TACAN position.

WING POSITION

A good wing position permits the leader to see all aircraft in the formation. It is close enough to make relative motion and signals easy to see. It should permit the wingman to follow the maneuver and permit relaxed flying. Stepdown should be sufficient to place the top of the wingman's fuselage below the bottom of the leader's fuselage. When the proper bearing is maintained, the leader's cockpit will be visible just ahead of the engine nacelle. If the formation is widened, it should be done by moving out on bearing, not by moving aft and out of the leader's sight.

BASIC FORMATION

The basic unit of formation flying is the two-plane section. Two sections operating together form a division. Two or more divisions comprise a flight. Squadrons use one of three types of formations discussed below:

THE PARADE FORMATION

The parade formation is used for all flight demonstrations and in the landing pattern around the ship. The position is fixed and crossunders are to be executed on signal from the leader. The distance between aircraft is close and aircraft dress on each other rather than flying a rigid bearing on the leader. The section leader flies a close wing position on the leader. The four-plane division or combination of divisions will be used unless special formations are prescribed. If only two divisions are involved, the second division flies to the unbalanced side of the first.

THE TACTICAL FORMATION

When flying the tactical or cruise formation, the section leader operates from a loose position and all aircraft are free to slide or crossunder as necessary to hold position with a minimum of effort. The section leader will always choose the side on which he wishes to cruise and the wingman is required to take the other. Though this formation is free and flexible, the proper bearing must be maintained to permit the leader to maintain visual contact.

THE ECHELON FORMATION

The echelon formation is one of special purpose and normally will only be used prior to breakup, rendezvous, or demonstrations. An echelon to the right or left will be signalled by the leader. If the leader's wingman is on the side on which the echelon is to be formed, the section will crossunder and join on him. If the section is on the side on which the echelon is to be formed, it will move out to make room for the wingman. Turns will never be made into the echelon.

NIGHT FORMATION FLYING

The same general rules for day rendezvous can be applied to night formation flying. It is difficult to determine relative motion at night and for this reason no abrupt maneuvers should be attempted and crossunders should be held to a minimum. Turns for rendezvous should be wide and closing speeds low. Aircraft will keep lights on BRIGHT during rendezvous. After rendezvous, the last aircraft in the formation will use bright lights and all others will place wing and taillights on DIM. At night, it is easier to fly close enough to see the outline of the aircraft ahead rather than attempt to fly position on the lights.

CLOUD FLYING

Normally, approaches and penetrations will be made by single aircraft; but should a formation enter a cloud, it can be kept intact if proper wing positions are maintained. If necessary to make a section instrument approach for any reason (lost radios, nav aids, etc.), the aircraft requiring assistance will assume the starboard wing position. The lead aircraft will advise the controlling agency of the situation. When the lead aircraft has the landing area in sight, he will pass the lead (day-hand signal; night-flash navigation lights) to the wingman, increase power, and waveoff to the left. The wingman will continue straight in and land. Should any aircraft lose sight of the plane ahead, a 30-degree turn away will be made and held for one minute prior to returning to base heading. Power settings will remain unaltered and, after leaving the cloud, the formation will be rejoined. The leader of the formation must concentrate on smooth instrument flying while maintaining base course. Penetrations involving more than one section will not be made.

ODD NUMBERS IN FORMATION

When all aircraft are not launched, it may be necessary to rearrange the formation to replace missing aircraft. This is done according to the following rules:

1. Fill in the first division from the wingman of the last division.

2. Fill in the first section using the wingman of the second section.

3. Maintain the integrity of the four-plane division.

4. No more than four aircraft will operate as a division.

5. When a division consists of less than four aircraft, it will continue to operate as if it were a full division with one plane acting as the second section.

MANEUVERING

The formation leader should avoid abrupt and violent maneuvers unless the aircraft in the formation are forewarned. No difficulty should be encountered in following any smooth, coordinated maneuver which the leader might make if each aircraft is free to slide and tail-in during steep, prolonged turns. The formation leader can make the wingman's job easier by observing the following rules:

1. Make all attitude changes smooth and coordinated, and use a constant power setting when possible.

2. Never use full power for climb or idle power with speedbrakes out for descent.

3. When possible, advise the flight by radio before operating the speedbrakes (signal - SPEEDBRAKES - NOW).

SIGNALS

Radio voice signals will normally be available to direct maneuvers in a formation. When voice signals are not available, visual signals contained in NWP-41(A), Chapter 6, will be used.

AIR REFUELING

REFUELING TACTICAL CONSIDERATIONS

To accomplish refueling with assurance of a full aft tank (for receiver capabilities, see figure 4-4), set gravity transfer to OPEN and wing tank transfer switch to WINGS (ALT WINGS) immediately after takeoff.

Note

This procedure maintains the aft tank fuel level above the 6500-pound (approx.) float switch by reducing wing fuel prior to receiving fuel from the tanker.

RECEIVER REFUELING PROCEDURES

RENDEZVOUS PROCEDURES

Normally the tanker aircraft should be at the prescribed rendezvous point 5 minutes prior to the time that refueling is scheduled to commence. Upon arrival at a designated static rendezvous point, the tanker aircraft should set up a left hand 30-degree bank orbit at 250 kts IAS. A running rendezvous may be performed if operationally necessary. The rendezvous point may be selected geographically or given with respect to radio navigation aids. A ship's CIC, early warning aircraft, or GCI stations may be used to expedite or control a static or running rendezvous. The ARA-25 and A/A TACAN should not be overlooked as a possible rendezvous aid when the rendezvous is being conducted without the aid of control stations.

Receiver aircraft (see figure 4-4) should rendezvous with the tanker and escort or tanker and other receiver aircraft in a loose right echelon (stand-by position).

Following join up, a refueling base course and altitude should be taken up.

ALTITUDES, AIRSPEEDS, AND MANEUVERING

The altitude for refueling may vary from sea level to more than thirty five thousand feet; however, the desirable minimum altitude is five thousand feet. Refueling may be performed at airspeeds of from 200 knots CAS to 300 knots CAS. The altitudes and airspeeds selected should be those best suited to the receiver aircraft and within the operating limitations given in Section I, Part 4. Weather and turbulence in the refueling area may require changes from briefed conditions.

A-3B to RA-3B air refueling is most comfortably accomplished at an altitude of twenty thousand feet and at an indicated airspeed of 250 knots. After the receiver aircraft is engaged and is receiving fuel, turns using thirty degrees of bank or less can be made and climbs and descents of 500 feet per minute can be performed comfortably. Following initial qualification and practice, engagements may be performed while the tanker aircraft is turning.

ENGAGEMENT PROCEDURES

WARNING

Do not engage drogue unless amber light is on. The reel response will be inoperative, no fuel will be transferred, and an engagement will damage both aircraft.

Following join up in right echelon, the first receiver aircraft in the stand-by position will observe the deployment of the drogue from the tanker aircraft. When the drogue is fully deployed, an amber light is visible on the drogue fairing assembly. In the event that the amber light is not on, the tanker aircraft will be so informed. If cockpit indications in the tanker aircraft are proper (amber light-ON, reel lock indicator-OUT), the receiver aircraft may be cleared to engage. In the event that the amber fairing light is out, the receiver aircraft will not engage the drogue without clearance from the tanker aircraft. All receiver aircraft should be cautioned to remain well clear of the area aft of the tanker aircraft during all drogue actuations. In the event that the reel malfunctions, the drogue and hose assembly may be carried away. Normal drogue deployment is rapid and smooth.

RECEIVER CHECKLIST

After observing the proper drogue deployment, the receiver pilot should place all forward looking radar on standby, position his helmet visor down, and position cockpit switches as follows:

1. IFR Switch . . . . . IFR
2. Fuel Dump Switch . . . . . OFF
3. Wing Tank Transfer Switch . . . . . OFF

The receiver aircraft will assume the ready position, approximately 50 feet behind and slightly below the drogue. The receiver aircraft should be stopped relative to the tanker and trimmed at this position prior to closing the drogue.

Note

At high altitudes, if the speeds of the receiver and tanker are about the same, the receiver should gain speed by a gradual dive to a level below that of the tanker; then engage the drogue at the end of a gradual climb. Engagement can be accomplished in the speed range of 220 to 300 knots IAS or 0.80 IMN, whichever is lower. Flaps may be used as desired to improve handling characteristics of the receiver at high altitudes.

The position of the drogue relative to the tanker aircraft should be noted in order that the receiver aircraft may assume the proper disengagement position following refueling.

A small amount of power should be added by the receiver pilot to commence a rate of closure with the drogue. The desired rate of closure is approximately equal to a walking pace. The vertical displacement of the probe to the drogue should be decreased smoothly in order that the last few feet of travel may be level. A positive rate of closure must be maintained until the drogue and probe are engaged and locked or until the decision is made to abort the attempt. Completely stopping the rate of closure a few feet from the drogue in the area of maximum turbulence is undesirable and will invariably result in over-controlled oscillation of the receiver aircraft, preventing a successful engagement.

DROGUE OSCILLATION

As the drogue is closed by the probe, the oscillation appears to become greater. The increase in motion of the drogue is due to the influence of the probe assembly. Small and slowly applied corrections to line up will generally lead to a good engagement. Turbulence behind the tanker aircraft may require the receiver aircraft to be flown in unbalanced flight during engagement. In the event that the drogue is overshot, or lineup corrections are out of phase, or if the receiver pilot is overcontrolling corrections, it is best to abort the attempt and reopen to about 30 feet aft of the drogue, using throttles and speedbrakes. The receiver pilot should stop all relative motion at this position and analyze the mistakes made prior to attempting another engagement. Generally, failure to engage properly results from errors made in closure rate or in overcontrolling lineup corrections.

Occasionally the locking mechanism on the probe will hang up on the lip of the drogue basket and continued

closure will cause the drogue to tilt on the probe. Some slack may be formed in the hose, and, unless the probe can be freed inside of the drogue immediately, it is best to withdraw completely and reclose the drogue.

DROGUE CLOSURE

Some pilots have found it helpful to commence closure using the tanker aircraft as reference and including the drogue in the peripheral scan. When within 6-10 feet, the pilot switches main reference scan to the drogue.

When the probe is firmly seated in the drogue, the rate of closure should be slowed by the use of throttles. The drogue must be pushed forward along its natural catenary until approximately five feet of hose are rewound on the hose reel. White stripes on the hose painted at one foot intervals from the fairing may be used to determine the amount of hose rewound.

Note

A probe light is provided for night refueling operations. The switch for the probe light is on the external lights panel.

REFUELING

When approximately five feet of hose are rewound, the amber fairing light will go off and if fuel is to be transferred the green fairing light will come on, indicating fuel transfer. The receiver aircraft should be flown in a trail position on the tanker with the hose maintained in its natural trail position (exclusive of the five feet of retracted hose). Minor throttle and control adjustments will be required to maintain position. During the transfer operation the receiver aircraft will require trim changes and throttle adjustments as gross weight and fuel distribution are changed. If refueling is commenced at high altitudes, descents during refueling may be required in order for the receiver to maintain adequate and comfortable control.

TANKER TRANSFER RATE

In the event that fuel is being received from an A-3B tanker aircraft and sufficient fuel is transferred to deplete the fuel in the auxiliary tank of the tanker, the green fairing transfer light will go off and the receiver aircraft must back out until the amber fairing light comes on or disengage completely. The refueling operation may recommence after a delay of approximately three minutes, during which time the tanker auxiliary tank will refill. For transfers of small amounts of fuel, the completion of transfer will be indicated to the receiver pilot by the green fairing light going off and the amber fairing light coming on.

The rate at which the receiver will accept fuel and the tanks into which fuel will be received is dependent upon the receiver fuel remaining and its distribution. A-3B tanker transfer rate is dependent on tanker fuel state and distribution.

DISENGAGEMENT PROCEDURES

CAUTION

The receiver aircraft must disengage slowly to prevent damage to the drogue.

To disengage from the drogue, the receiver pilot should first endeavor to return the drogue to the position at which it was first engaged and then establish a slow opening rate by use of throttles. The use of speedbrakes is not recommended. Backing out should be done slowly and directly aft of the above described position, with no vertical or lateral motion. A slight tug will be felt as the probe and drogue disengage, and some fuel may be sprayed back into the windshield of the receiver aircraft if fuel has been received. In the event that the receiver is not in the proper position to disengage, the drogue may whip violently and damage either the receiver or tanker aircraft. The receiver probe may be bent or broken or the tanker drogue may be damaged by improper disengagement techniques.

Following final drogue disengagement, the receiver aircraft should take up loose left echelon position. In the event that he is the last aircraft presently rendezvoused to receive fuel, the receiver pilot will observe the drogue while it is retracted and stowed prior to departing the tanker. All departures from the tanker will be made to port. Elements may depart from the tanker when refueling is completed and after joining in left echelon.

EMERGENCY DISENGAGEMENT PROCEDURES. Emergency breakaway action by the receiver aircraft may become necessary due to difficulties in either the tanker or the receiver aircraft. The action taken will be prompted by the nature of the emergency; however, if at all possible the receiver aircraft should make an expeditious return to the normal disconnect position and disengage without delay, using the normal disconnect procedures. If normal disconnect procedures are followed, disconnecting slowly, the complicating results of damage to the tanker and/or receiver aircraft are avoided. Possible damage that may occur to either the tanker and/or receiver due to improper disconnect procedures includes damaged fueling package, broken

hose or probe, and external airframe damage to either aircraft from whipping hose and drogue.

RECEIVER PROCEDURES FOR TANKERS OTHER THAN A-3B

In receiving fuel from tanker aircraft other than A-3B, the receiver procedures outlined herein will generally apply. In refueling from the wing pod of a GV-1or from the A-4C buddy store, cross trim conditions may have to be set up by the receiver aircraft, due to the aircraft control surfaces being in the wing tip vortex or jet exhaust of the tanker aircraft. In the event that the tanker airspeed is less than desired, partial flaps may be used by the receiver aircraft to improve aircraft stability and to operate in a more responsive engine operating range.

Following engagement of the drogue, the receiver aircraft may find it desirable to slightly displace the position of the drogue laterally or vertically away from the position at which it was engaged in order to maintain a more comfortable position during refueling. Care must be exercised by the receiver pilot in repositioning the drogue, since the effects of tanker jet exhaust and turbulence are unpredictable and any rapid movements of the receiver may become violent and uncontrollable due to these effects. Additional information concerning A-4C tanker and A-3B receiver inflight refueling is contained in the classified publication. Conduct Fleet Operational Investigation of a Multiple Delivery System (U) dated 11 April 1961 (VX-5 report).

RECEIVER PROCEDURES FOR RECEIVERS OTHER THAN A-3B

The procedures for receiver aircraft other than the A-3B receiving fuel from the A-3B tanker are basically those previously discussed. The receiver probe should be extended, receiver cockpit switches positioned as desired, forward looking radar placed off or standby and the receiver pilot's visor positioned down prior to assuming the ready position. The techniques for receiver engagement may vary in minor areas depending on aircraft performance and configuration.

COMMUNICATIONS AND SIGNALS

RADIO COMMUNICATIONS. The amount of active radio communications between aircraft in aerial refueling is dependent upon the degree of training which the participating pilots have experienced. During early training frequent radio transmissions are desirable; however after training has progressed to the point that pilots are proficient, frequent radio transmissions are unnecessary and undesirable.

All aircraft concerned with the air refueling evolution should rendezvous while guarding the assigned frequency for refueling. In the event that the rendezvous is assisted by a ground or airborne agency, the change to the assigned refueling frequency should be effected following rendezvous and prior to commencement of refueling. During initial training in air refueling, the following transmissions and reports are considered minimum:

Receiver Aircraft	Tanker Aircraft
Standby position (loose starboard echelon)	Drogue deployed
Drogue deployed Amber on	Drogue deployed Amber on
Ready position (stopped aft of drogue prior to closing)	
Closing (closing the drogue)	
Coupled Green on	Transferring Green on
Transfer complete	Transfer complete
Disengaging (disengaging the drogue)	Retracting drogue
Drogue inspection	Drogue stowed

Emergency Breakaway may be transmitted by tanker, receiver or observing aircraft when conditions warrant. The emergency breakaway transmission issued by the tanker aircraft should be backed up by turning on the red rotating beacon.

VISUAL SIGNALS. When proficiency in inflight refueling has been attained by all participating pilots, handsignals may be used to signal all drogue actuations. Radio transmissions concerning normal progress of the evolution may be omitted.

Receiver Aircraft	Tanker Aircraft
	Cupped hand moved vertically up and down. (drogue will be deployed)
Thumbs up (aft area clear for deployment)	
Erasing Motion (aft area not clear for deployment)	
Thumbs up (following deployment, deployment appeared normal)	

Receiver Aircraft	Tanker Aircraft
	Cupped hand moved forward and aft (drogue will be retracted)
Thumbs up (aft area clear for retracting)	
Erasing Motion (aft area not clear)	
Thumbs up (following retraction, retraction and stowage appeared normal)	

Note

Any emergency signals including the emergency breakaway signal should be retained as radio transmissions. During night operations with an A-3B tanker, radio transmissions should be used for all interplane communications.

FLIGHT TEST PROCEDURES

Pilots assigned for flight testing shall be highly experienced and be designated as test pilots in writing by the squadron Commanding Officer. Test flights shall be flown under VFR conditions for takeoff and landing with a minimum crew aboard (an additional crewman may be added when a test of special equipment is required). Aircraft for test will be fueled to provide for landing immediately after takeoff under less than maximum landing gross weight conditions.

Pages 4-19 through 4-29 deleted

TEST FLIGHT CHECKLIST

A/C BUNO _____ MARKING CODE DATE _____
PILOT _____ ACCEPTABLE MODEL _____
P/N _____ X NOT ACCEPTABLE **Note**
P/T _____ NR NOT REQUIRED USE REMARKS SECTION TO AMPLIFY CODE.

A. PREFLIGHT

CREW _____ (INITIALS) PILOT _____ (INITIALS)

B. PRESTART (External AC/DC Power on)

1. Oxygen

   a. Quantity 0 2 4 6 8 10 12 14 16 18 20
   (circle letters)

   b. Off/on control
   _____ Pilot _____ P/N _____ P/T _____ Walk-around Hose

2. Instruments and Warning Lights

_____ Altimeter (±50 Ft FBP) APN 22	_____ Flap Indicator
_____ Vertical Speed (0 ±100 ft)	_____ Fuel Flow
_____ Airspeed (0 or less)	_____ OAT
_____ VGI (degrees R/L)	_____ Standby Gyro (degrees R/L)
_____ RMI (slaves R/L)	_____ ID 249A
_____ Radio Alt (10 ft or less)	_____ Cabin Pressure
_____ Accelerometer (1 ±.2G's)	_____ Turn & Bank
_____ Standby Compass (±4 degrees)	_____ Flap Indicator
_____ Volt Ammeter	_____ Brake Pressure Gage
_____ Fire Warning Lights	_____ Other Press/Test Lights

Angle-of-Attack	Clocks	ATM Temperature
_____ Indicator	_____ Elapsed Time	_____ Port
_____ Indexer	_____ 8-Day	_____ Stbd

Aircraft Trim Ind.	ATM Frequency
_____ Aileron	_____ Port
_____ Rudder	_____ Stbd
_____ Elevator	

3. Fuel Quantity Check

Tank	Prior to Flight	After Flight
Fwd Tank	_____	_____
Wing Tank	_____	_____
Aft Tank	_____	_____
Total	_____	_____
Totalizer Reading	_____	_____

4. Communications and Navaids (check for loud and clear all stations)

_____ UHF (ARC 27)	_____ TACAN (ARN 21)	_____ PILOTS ICS
_____ VHF (ARC 1)	_____ OMNI (ARN 14)	_____ P/N ICS
_____ HF (ARC 38)	_____ LOW FREQ (ARN 6)	_____ P/T ICS
	_____ IFF (APX 6)	
	_____ SIF (APA 89)	

C. START ENGINES NOTE: ENSURE RH AND LH PYLON SHUTOFF VALVES IN OFF POSITION PRIOR TO STARTING ENGINES.

1. Engine Readings

Light off 20 sec	TPT max 610°	Idle TPT max 340°	Idle RPM 62% -3	Oil Press NORM	Fuel Boost NORM	Fuel Flow 1000 lbs -150 lbs	EPI	Fuel Flow Ind	Remarks

2. After Starting Engines Check Bleed Valve Operation

a. Place LH & RH ATM switches to ON

_____ ATM's should not start

b. Turn Air Conditioning Control Switch to AUTO

c. Place RH Pylon Shutoff Switch in ON Position

RESULTS:

_____ RH ATM Should Start

_____ LH ATM Should Not Start

_____ Air Conditioning Should Not Start

d. Place LH Pylon Shutoff Switch to ON Position

RESULTS:

_____ LH ATM Should Start

_____ Air Conditioning Unit Should Start

e. Place RH Pylon Shutoff Control Switch to OFF Position

_____ RH ATM Should Stop

f. Place RH Pylon Shutoff Control Switch to ON Position

_____ RH ATM Should Start

g. Turn AC & DC Generators ON

3. ATM, AC, DC Readings

	Max Amp	Warn Lite	On Line Max 30 sec's	ATM Temp Max 100°	AC Freq 400 - 20	A Phase 115 - 2.5	B Phase	C Phase	Amp Load Max 43 10-30 12-35	AC Warn Lite	DC Volts 28 - IV	Assume Load
PORT												
STBD												

REMARKS:

4. _____ Bus Tie Operations

5. _____ Flight Control Light Goes Out With Both ATM's on the Line

6. AC-DC Trim Check

Rudder	Aileron	Elevator	Elevator Override AC Over DC	Gang Bar to Off Circuit Breaker Operations Check
Yoke (AC)		__NU __ND	__NU __ND	__AC OFF
Ped'l (AC) __R __L		__NU __ND		__AC OFF
(DC)		__NU __ND		__DC OFF

Note: return circuit breaker switches to ON, ensure gang bar in UP position.
Note: check stabilizer movement when making elevator checks.

D. FUNCTIONAL CHECKS

_____ Entrance door

_____ Speedbrakes (oper/close 5 sec)

_____ Bomb bay doors (close 1.5 sec)

_____ Ditching hatch

BRAKES (CHECK TAXING)

_____ Equal

_____ Hydrol

_____ Hold full power

Slats	Pilots	P/N seat	P/T	NOSEWHEEL steering
__port	___ up	___ up	___ secure	_____ full throw
__stbd	___ down	___ down		_____ free 7 even control
	___ secure	___ secure		

E. SEXTANT CHECK

___ 1. External cover off
___ 2. Dome clean
___ 3. Desiccant indicators LIGHT BLUE
___ 4. Filters check free movement
___ 5. Lighting 7 positions 7 bubble
___ 6. Azimuth AZ HDG lever to AZ smooth 360 degree rotation
___ 7. Heading AZ HDG lever to HDG smooth 360 degree rotation
___ 8. Elevation moves smoothly thru range (-5 degrees +90 degrees)
___ 9. Bubble 20 minute warmup DIA 1 degree 30" ±20%
___10. Average time 2 min's ±4 sec's integrator & light
___11. Alignment ZN-180 horizontal stab tips 348 degrees, 13 degrees

F. GROUND CHECK AUTO PILOT

___ 1. WINGS spread
___ 2. Check controls
___ 3. Check electrical system (28 vdc & min 117 vac)
___ 4. Compass mode switch SLAVED

___ 5. Place Control pedestal along side pilots seat

___ 6. Ground test bar HOLD DEPRESSED

___ 7. Yaw damper switch PILOT (UP)

___ 8. Rudder, aileron, elevator trim indicators CENTERED

___ 9. AFCS switch ENGAGED

___10. OVERPOWER RIGHT RUDDER – observe autopilot rudder trim move to left.

___11. OVERPOWER LEFT RUDDER – observe autopilot rudder trim move to right.

___12. OVERPOWER the aileron function of the control wheel clockwise and observe the autopilot aileron trim indicator rotate counterclockwise.

___13. OVERPOWER the aileron function to the control wheel counterclockwise and observe the autopilot aileron trim indicator rotate clockwise.

___14. OVERPOWER the elevator function of the control wheel forward (nosedown) and observe the autopilot elevator trim indicator, the needle should deflect upward.

___15. OVERPOWER the elevator function of the control wheel aft (noseup) and observe the autopilot elevator trim indicator, the needle should deflect downward.

___16. To check the automatic longitudinal trim feature of the autopilot, overpower the elevator function to the control wheel aft. The longitudinal trim position indicator above the center console should move toward nosedown trim. Overpower the control wheel forward and observe for a noseup indication.

___17. Rotate the climb guides control knobs forward then aft. The control column should move fore and aft to indicate normal autopilot nosedown and noseup control.

___18. Rotate the aileron control knobs clockwise and counterclockwise and check for related movement in the control wheel.

___19. Rotate the turn control knob toward left and right to check coordination of the controls. For a left turn a control wheel should move counterclockwise and the left rudder pedal should move slightly forward. When the turn control knob is centered the control wheel will return to neutral but the rudder pedal should remain displaced. It is necessary to move the turn control in the opposite direction to return the rudder pedals to neutral.

___20. Altitude control switch to ALT CONTROL – There should be little or no elevator movement. Push FWD on yoke, trim should rise. Pull back on yoke, trim should lower.

___21. Compass mode switch FREE.

___22. Set heading knob, rotate RIGHT OR LEFT all autopilot switches should drop to the OFF position.

___23. AFCS switch to SERVO ENGAGE

___24. Set heading knob, rotate RIGHT OR LEFT

___25. Gyropilot release button DEPRESS

___26. Manually check all controls for freedom of movement.

G. TAKE/OFF, CLIMB

1. Set ASN-6 LAT_____ LONG_____ AVG WIND_____ (Record settings at takeoff)

2. ASN-6 reading over the field prior to landing LAT_____ LONG_____

ENGINE ACCELERATION, MAX POWER AT TAKEOFF

	TPT 650° 2 min 610°	RPM 105.2% Max	Press Ratio Desired Reading	Fuel Flow	Fuel Boost Press Norm	Oil Press Norm	ATM TEMP 100°	AC Freq 400 ±20	Eng Accel Time 10 sec
PORT									
STBD									

3. ENGINE PERFORMANCE IN CLIMBS

Alt 10M	EGT 650/2 610/30	RPM 105.2 Max	Press Ratio Reading	Fuel Flow	Fuel Boost Norm	Oil Press Norm	ATM Temp	AC Freq 400 ±20	Cabin Press Check	Cabin Alt Limits
PORT									Reading	
									Normal	8 ±.5
STBD									Reading	
									Combat	8 ±.5

20M	EGT	RPM	P/R	F/F	Boost	Oil	ATM/T	AC	Press	Limits
PORT									Reading	
									Normal	8 ±.5
STBD									Reading	
									Combat	10 ±1.0

30M	640/30	RPM	P/R	F/F	Boost	Oil	ATM/T	AC	Press	Limits
PORT									Reading	
									Normal	8 ±.5
STBD									Reading	
									Combat	17 ±1.0

4. IDLE

40M	EGT 100 min	RPM 70% min	P/R	F/F min 560	Boost	Oil	ATM/T	AC	Press	Cabin Alt Limits
PORT									Reading	
									Normal	10 ±1.5
STBD									Reading	
									Combat	22 ±1.5

ACCELERATION TO FULL POWER

40M	EGT 650/2 640/30	% RPM 3 ±1% T.O.	Accel 30ss Max	Fuel Flow	Oil Press Norm	Fuel Press Norm	Press Ratio	ATM Temp	AC Freq 400 ±20	Cabin Alt Press Limits
PORT										R
										N 10 ±1.5
STBD										R
										C 22 ±1.5

Smooth transition from idle to full throttle minimum 2 sec, max 5 sec, mild choo-choo acceptable provided EGT, acceleration, and throttle movement within limits. Severe engine bangs and excessive yawing unacceptable.

H. INFLIGHT CHECKS

___ 1. At 40M 18 mach, airspeed 245 ±5 KIAS

___ 2. Idle descent to 25M check in descent

___ A. Rudder trim indicator 0 to ±1/2 units

___ B. Speedbrake check NO YAWING 5 SECONDS OPEN TIME

___ 3. At 25M check

___ A. Single engine flight shutdown and relight in order

___ PORT

___ STBD

___ B. Pressurization constant, one engine above 85 percent

___ C. Autopilot inflight test

___ 1. 25,000 ft. 250 knts trim A/C

___ 2. Engine yaw damper and AFCS

___ 3. Check operation by abruptly displacing rudder right or left and releasing.

___ 4. Check operation of pilot release switch on yoke.

NOTE: If autopilot fails to release, perform no more tests.

___ 5. With autopilot engaged

a....check operation with climb guide wheel

b....check operation of aileron trim control

___ 6. Ensure MA-1 slaved in. Autopilot should keep A/C on heading.

___ 7. A/C should maintain altitude ±40 ft.

___ 8. 10 degrees glide for 30 sec's

___ 9. 10 degrees climb for 30 sec's

___ 10. Make 180-degree turn with 30-degree bank. Use pitch wheel for alt. control. Turn and bank should be within 1/2 ball centered.

___ 11. 10-degree breakaway

___ 12. Ensure each control can be overpowered manually.

INFO: FORCE REQUIRED

Aileron _____	Aileron 42 lbs ±15
Rudder _____	Rudder 115 lbs ±15
Elevator _____	Elevator 35 lbs ±15

D. Temp Control Valve

1. Automatic change (60 sec's)

___ cold

___ hot

2. Manual change (60 sec's)

___ cold

___ hot

3. CO_2 check

___ cockpit

___ photo compt

4. Windshield/foot defrost

5. Ram air valve

6. Anti-icing ON _____ note Pr drop

_____ return to OFF

E. Fuel transfer check

____wings ____wings aft
____wings emer ____wings emer aft
____gravity aft ____dump

F. ASB check

1. Voltages check

____28 volts ____±175 volts ____Mag cur
____105 volts ____±150 volts ____Mag freq
____300 volts ____XC1 ____Antenna pattern
____300 volts ____XC2

2. Freq change check

____AFC
____manual

3. Range markers

Fixed ____ (search)
Movable ____ (precision)

4. AZ marker _____

5. Antenna pattern

____150 degrees search ____ up
____25 degree search _____ down
____expanded 25
____expanded 25
____range line jump
____altitude/zero set

6. Radar definition

____200 mile
____120 mile
____60 mile
____Rec gain
____Video gain

NOTE: show actual range in blank

7. Gyros

____Roll
____Pitch
____Azimuth
____Slave

Gyro indicator

____Roll
____Pitch

8. Camera operation

____25 degree one shot
triple shot
____150 degree one shot
triple shot

9. Range marker lights

____5 mile
____10 mile
____20 mile
____40 mile

10. Contrast control

____P/N
____Aux Scope

11. PDI check

____manual

12. AZ check

____Relative
____True
____External

13. ASB remarks

_____
_____

I. VIEWFINDER/PHOTO SYSTEM CHECK

1. Pilot viewfinder check

____NAF ____NAV ____Drift
____WAF ____WAV ____Tag grid
____Filters ____STAB ____VGI

___ 2. P/N viewfinder check

___ NAF ____ NAV ____ Drift

___ WAF ____ WAV ____ Tag grid

___ Filters ____ STAB

___ 3. Pilots oblique V/F

___ 4. P/N oblique V/F

___ 5. Check drift control in V/F & mounts

___ 6. Set camera system vacuum at 20M

J. COMPASS CALIBRATION RECORD

Head	RMI	WB	SEXT	Head	RMI	WB	SEXT
000				000			
090				045			
180				090			
270				135			
				180			
				225			
				270			
				315			

NOTE.

_____Date new compass card installed in A/C

READING FOR COMPASS CALIBRATION CARDS

Head	RMI	Wet Bulb	Sextant
000			
030			
060			
090			
120			
150			
180			
210			
240			
270			
300			
330			

K. INFLIGHT INSTRUMENT CHECK

____Airspeed Indicator: smooth steady operation

____Gyro Horizon

____After 180-degree turn: 6-degree correct pitch

____After 3 minutes straight and level: 1 degree of correct pitch and roll

____Standby Gyro Horizon

____After 180-degree turn: 6-degree correct pitch

____After 3 minutes straight and level: 1 degree of correct pitch and roll Turn and Bank

NOTE: Momentary lag and reverse during high turn rates is normal due to the attitude of installation.

____90-degree turn in 60 ±15 seconds (one needle width)

____Right

____Left

____Rate of climb: Indicates rate of climb and descent within 330 ft min.

____Accelerometer

____ Indicates plus or minus G loads

____#2 and #3 needle stays at highest possible negative G's

____Pressure Altimeter

____ Smooth steady operation

____ Check low altitude warning flag on descent

____ID 249 Indicator

____ Off flags: not visible

____ Vertical bar and course window: normal operation with ARN-14 & 21

____ID 250 Indicator: normal operation (RMI)

____DME Indicator

____Face Bar: Not visible when ARN-21 is on and within range of selected station.

____Mileage Numbers: Rotate until ARN-21 locks on

____Mileage numbers after lock on: Indicates slant range in miles from TACAN station

L. INFLIGHT NAVIGATION AND COMMUNICATIONS SYSTEM

ARN-14 (OMNI)

____Power on, frequency set, comp slaved, select switch OMNI

____Turn to #2 needle bearing, fly towards station, set course knob on ID-249

____ID-249 vertical bar centers

____Zero reader centers to 12 o'clock position

____TO in ambiguity window

____Fly to station. AT station passage, Needle reverses _____

____Vertical bar oscillates then centers

____FROM replaces TO in ambiguity window

ARN-21 TACAN (start check 100 miles out)

_____Power on, Freq set, comp slaved, select switch TACAN

_____Turn to #2 needle bearing: Fly towards station, set course knob on ID-249

_____#2 needle points to relative bearing of station ±1 degree

_____DME slave range within ±. 5 mile

_____Off flag alarm out of sight

_____ID-249 vertical bar centers

_____Zero reader centers to 12 o'clock position

_____TO in ambiguity window

_____Fly to station. At station passage, needle reverses _____

____Vertical bar oscillates then centers

____FROM replaces TO in ambiguity window

____ DME holds alt above station

____ After station passage mileage inc.

____ Moderate maneuvers of the A/C do not cause prolonged dropout of the DME

ARC-27 (UHF)

____80nm loud and clear

____Channelization as per cond

____Squelch operation

ARC-38 (ADF)

____ 80nm loud and clear

____ Channelization as per cond

____Side tone normal

____ Antenna loading normal time

ARC-1 (VHF)

____80nm loud and clear

____Channelization as per cond

____Side tone normal

ARN-6 (ADF)

____80nm loud and clear

____Satisfactory volume control. Antenna position _____ voice _____ cw

____#2 needle homes in compass position

____Satisfactory volume control in compass position

TRANSPONDER CHECK (IFF) (SIF)

____ Mode three & codes

____Mode one & codes

____ Mode two

____Emergency

M. TRIM CHECK (descend to 15,000 ft)

Wing Flaps

____Up full (25 sec's)

____Down full (10 sec's)

Landing Gear

____Lower (max 12.5 sec's)

____Raise (max 12.5 sec's)

Speed	Gross Wt.	Flt Cond	Rudder ±1/2 unit	Elevator Readings	Aileron ±1 unit	Elevator Trim Units
300 IAS	50,000	clean				0 ±1 unit
180 IAS	50,000	clean				2.7 ±1 unit (900) 2.6 ±1 unit
130 IAS	50,000	gear & flaps dn.				(990) 3.2 ±1 unit 5.5 ±1 unit

RECORD ENGINE READINGS

	PR	FF	EGT	%RPM	Remarks
PORT					
STBD					

STALL WARNING GROSS WT 50,000 LBS.

Cond	Airspeed at Buffet On Set	Angle-of-Attack Buffet On Set	901-11 Reading		900 Reading		Remarks
Clean Idle Pwr			AS 145 ±5	AA 23 ±1.5	AS 134 ±5	AA	
Gear, Flaps, Speedbrakes, Power Approach			122 ±5	18 ±1.5	116 ±5		

ANGLE-OF-ATTACK DISPLAY

Cockpit	AA Units 901-911	AA Units 900	Actual Readings	Smooth OPS
V	36–30	15.0–30		
V O	15.5	14.5		
O	15.0	14.0		
O	14.5	13.5		
	14.0	14.5		

CHECK AA INDEXER LIGHTS

____Hook Down, ON

____Hook Up, OFF

____Check hook bypass switch lights to ON

N. EMERGENCY GEN CHECK

TURN OFF GENS.

Condition	Drop Out 5 sec max	AC Freq 350–460	DC Volts 28 ±4	AC Volts 113 ±11	DC Trim
200–250 kts Indicated					

O. TURN ON GENS UPON COMPLETION OF CHECK

DESCEND TO 10,000 ft for VMAX check

____ IAS 469 ±10 knts

____ AA 1.5 ±1

____ Fuel Flow

____ Pressure Ratio

____ EGT

____ % RPM

P. APN-22 (RADAR ALT) check

Pressure Alt	Pressure Alt 10,000	Pressure Alt 5000	Pressure Alt 1000	Pressure Alt 500	Pressure Alt 100	Limits ±5
APN-22						

____ Light on ±3 degrees of selected alt (needle is 5 degrees wide)

Q. DURING LANDING

Hytrol at 90 to 50 sec's

____ No skidding

____ Equal braking

____ Trail skag retracts after 15 sec's

____ Drag chute (deploys 3 sec's)

____ Releases

R. AFTER LANDING

____ Wing Fold

____ Gust Locks (button extends)

____ Wing Fold (30 sec's)

____ Bomb bay doors open (open 1.5 sec's)

____ Results of carbon monoxide gas test

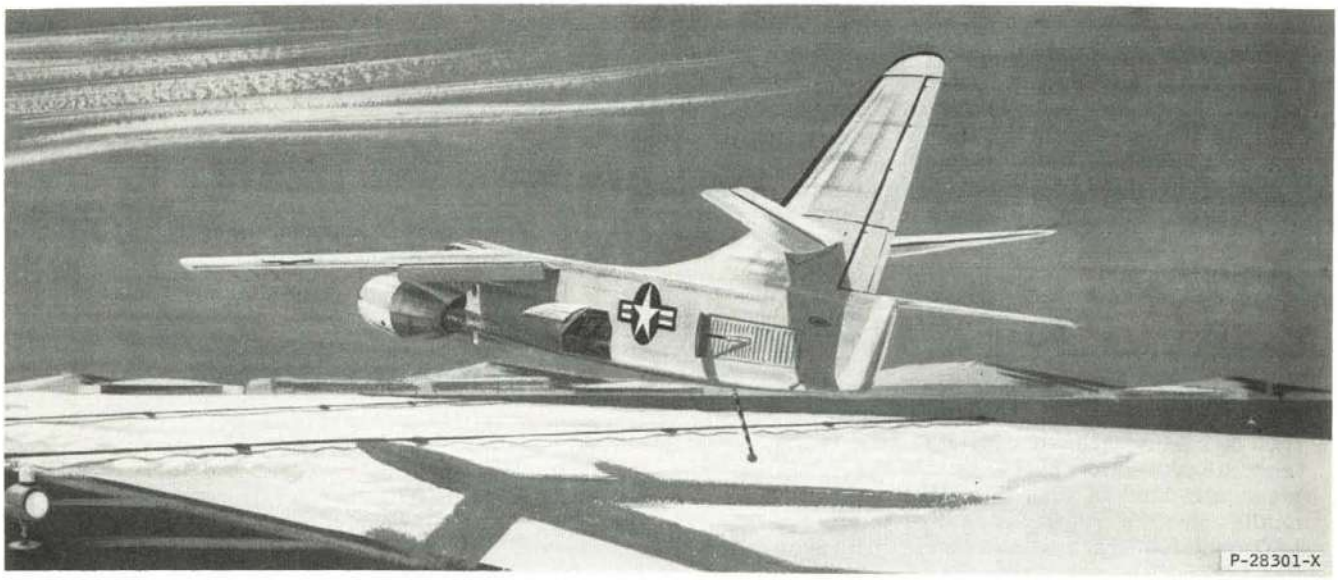
PILOTS EVALUATION

_____ ACCEPTABLE _____ RETEST

REMARKS: _____

_____

(PILOT'S SIGNATURE)



SECTION V

EMERGENCY PROCEDURES

INTRODUCTION

The course of action pilots and crewmembers will take when faced with an emergency situation is based upon their knowledge of the aircraft and emergency procedures. For this reason, initial training must be thorough in these areas, but should not be considered complete. Aircraft systems and procedures must be frequently reviewed on a regular basis. Periodic emergency drills in the Operational Flight Trainer are ideally suited for realistic simulation of almost all emergencies that may be experienced. Above all, the pilot must be able to recognize emergency situations, analyze the possible courses of action, select the best one, and then take the action necessary in accordance with the procedures of good airmanship.

1. NWP-41 (A) contains general considerations which are applicable in various emergency situations.

2. NWP-37 (A) discusses SAR organization and procedures.

3. The FLIP En Route Supplement covers current procedures for any emergency phase (uncertainty, alert, distress, lost), and procedures for use with a rescue interceptor, both day and night.

4. Operation plans and orders of carrier-force commanders and commanders of other forces employing aircraft contains provisions for handling aircraft in distress and for rescue of personnel.

5. When an emergency is experienced while operating in the continental limits of the United States, the IFF-function select knob will be placed in the EMERGENCY position, with mode-3 switch forward and mode-3 code 77 set on the SIF control panel, unless otherwise directed by competent authority.

This chapter contains the specific step-by-step procedures to be used for all emergencies likely to be encountered in the RA-3B. Use it as the primary guide for studying remedial procedures for various emergencies. The information contained in Section I, Part 2 and 2A, of this manual must be used to provide additional knowledge of systems operation and malfunctions. In general, the emergencies a pilot will encounter fall into one of four categories. These are: GROUND EMERGENCIES, TAKEOFF EMERGENCIES, and LANDING EMERGENCIES. It is likely that most emergencies will require some deviation from the procedure set forth for a simple failure, because of varied conditions: i. e., compounded emergencies, facilities available, weather factors, etc. Consequently, thoughtful analysis of each situation is necessary. The selection of the course of action to be taken rests with the pilot.

For the common understanding of all, it is necessary to define the meaning of failure, malfunction, and flameout as used in this section. Failure is considered to be the complete, non-regainable loss of function or performance of any component, unit, or system installed in the aircraft. Malfunction is defined as improper performance of the intended purpose of a device in one or more of three aspects; quality, quantity, or consistency. The definition of flameout is limited to loss of combustion due to external influences upon the engine, such as interruption of fuel or air supply.

Note

In instances where it is indicated that the proper procedure is: "Land, using short field arresting gear if available." It is intended that the pilot should exercise his judgement, and land as soon as conditions permit on the end of the runway or as directed by the LSO using the first available arrestment gear that is compatible with aircraft and arresting gear limitations.

GROUND EMERGENCIES

UNSATISFACTORY STARTS

WET START

1. Master engine switch . . . . . OFF
2. Throttle . . . . . OFF
3. Continue cranking engine . . . . 20-30 SECONDS

Note

Engine should be dried thoroughly by cranking, and/or swabbing out the tailpipe prior to attempting another start.

FALSE START

1. Throttle . . . . . OFF
2. Master engine switch . . . . . OFF
3. Continue cranking until TPT drops to normal.
4. Do not attempt RESTART until the cause of malfunction has been corrected.

HOT START

1. Throttle . . . . . OFF
2. Master engine switch . . . . . OFF
3. Continue cranking to extinguish fire.
4. If fire persists, abandon aircraft and use all available means to extinguish fire.

TAKEOFF EMERGENCIES

TAKEOFF PREPARATION

Before takeoff, the pilot must have firmly in mind the best actions to be taken should an emergency occur during takeoff. Before each flight, the pilot must obtain or compute:

1. Takeoff airspeed
2. Takeoff roll
3. Distance from liftoff point to arresting gear if applicable.
4. Line speed checks
5. Refusal speed, if applicable
6. Minimum single-engine control speed
7. Single-engine performance (see Section XI)
8. Surrounding terrain and obstructions altitudes.
9. Illuminant jettisoning considerations.

TAKEOFF ABORT PROCEDURES

1. Throttles . . . . . IDLE
2. Arresting hook . . . . . DOWN
3. Drag chute . . . . . DEPLOY
4. Braking . . . . . MAXIMUM

Note

- With arresting hook down, nosewheel steering will be centered.
- Raise arresting hook if the field arresting gear will not be needed to stop the aircraft on the runway.
- Do not raise the landing gear if the aircraft is going to overrun the runway.

ENGINE FAILURE DURING TAKEOFF ROLL

1. Use abort procedures above should an engine fail during takeoff roll before becoming airborne.

2. Continue single-engine takeoff if unsafe to abort and sufficient runway remains to get safely airborne using procedures listed below.

ENGINE FAILURE AFTER LIFTOFF

1. Landing gear . . . . . UP
2. Accelerate
3. Wing fuel . . . . . DUMP
4. Flaps . . . . . BLEED UP (as speed and altitude permits; see Section XI)
5. Throttle, affected engine . . . . . OFF

Note

- Maximum acceleration will be obtained by keeping the wings level and allowing the aircraft heading to drift, if field and terrain conditions permit.
- If heading must be maintained, an increase in bank angle is preferred over a reduction in power on the operative engine.

6. If no engine fire or other abnormal indications exists, attempt air start of secured engine. Jettison and/or consume fuel to reach a gross weight of 50,000 pounds or less.

7. Land, using both engines if available, but using single engine pattern, speed, and techniques.

RUNAWAY STABILIZER TRIM

In the event of runaway NOSEUP horizontal trim in takeoff or landing configuration at high power settings (waveoff), the following procedures shall be followed:

1. Landing gear . . . . . UP

2. Immediately roll into bank and reduce power while applying NOSEDOWN with console trim control. If trim does not immediately reverse, place the horizontal stabilizer gangbar down (EMERGENCY OFF).

3. Vary bank and power to establish a controlled climb.

4. When at sufficient altitude (8,000 to 10,000 feet) and if flight can be controlled, refer to HORIZONTAL STABILIZER TRIM MALFUNCTION, this section.

Note

Experience has shown that conditions of runaway NOSEDOWN horizontal stabilizer trim are controllable to maximum trim settings, at approach airspeeds in landing configuration.

INFLIGHT EMERGENCIES

ENGINE MALFUNCTION/FAILURES

Indication of impending engine failure will usually be in the form of unstable engine operation and may be manifested by one or a combination of symptoms. (Refer to Section 1, Part 2.)

AIR STARTING

Successful air starts may sometimes be obtained at any altitude or airspeed by taking advantage of the high airflow through the engine immediately following a flameout. The minimum rpm for successful air starts will vary with altitude and airspeed.

IMMEDIATE AIR START

The following procedure should be accomplished as quickly as possible.

1. Throttle inoperative engine.
   a. OFF

b. Outboard to start for ignition

c. IDLE position

CAUTION

If air start does not occur within 30 seconds after the THROTTLE has been moved to IDLE, or if an unsatisfactory start is indicated in any other way, retard the THROTTLE to OFF and allow the engine to windmill for 30 seconds minimum before attempting another start.

NORMAL AIR START

1. Throttle inoperative engine . . . . . OFF
2. Master engine switch . . . . . ON
3. Fuel pressure . . . . . NORMAL
4. Tachometer. 12-30%
5. Throttle . . . . . IGNITE, THEN IDLE

Note

- An air start may be attempted with no oil pressure indications. If indications do not return to NORM after air start, secure the engine.
- If fuel boost pressure reads OUT, position CROSSFEED switch to OPEN. If boost pressure does not return, place CROSSFEED switch to CLOSED and continue air start attempt.

CAUTION

During air start with the Emergency Generator the ONLY source of electrical power, ignition will be interrupted or unavailable in the following conditions.

1. Whenever the emergency horizontal stabilizer DC trim power supply switch is in the EMERGENCY position, electrical power is unavailable for ignition. (BuNo's 142668, 142669, 144825-144836)

2. When the horizontal stabilizer console trim knob is actuated during the ignition cycle, the ignition electrical power will be interrupted and will cease to function. (BuNo's 142256, 142666, 142667, 144837 and subsequent.)

SINGLE ENGINE FLAMEOUT/FAILURE

1. Throttle, operative engine . . . . . AS DESIRED
2. Throttle, inoperative engine . . . . . OFF
3. Master engine switch, inoperative engine . . . . . OFF
4. Retrim
5. Attempt airstart if conditions warrant

DUAL ENGINE FLAMEOUT/FAILURE

HIGH ALTITUDE (ABOVE 10,000 FEET)

1. Emergency generator . . . . . EXTEND
2. Immediate aircraft. . . . . IF POSSIBLE
3. IFF . . . . . EMERGENCY
4. Transmit . . . . . MAYDAY

Note

- If conditions permit, reduce altitude and attempt additional air start.
- When necessary to maintain control of the aircraft, pull AILERON and RUDDER/ELEVATOR BOOST RELEASE.

5. If air start unsuccessful, bailout prior to 10,000 feet.

MEDIUM ALTITUDE (BETWEEN 3,000 AND 10,000 FEET)

1. Emergency generator . . . . . EXTEND
2. Trade airspeed for altitude, attempt one air start each engine, at pilot's discretion.
3. IFF emergency
4. Transmit . . . . . MAYDAY
5. If airstart is unsuccessful . . . . . BAILOUT

LOW ALTITUDE (3,000 AND BELOW)

1. Emergency generator . . . . . EXTEND
2. Trade airspeed for altitude and BAILOUT.

Note

Ditch aircraft if safe bailout altitude (1,000 feet) cannot be reached.

MAXIMUM GLIDE

Maximum glide performance is obtained by use of a constant glide speed in the clean configuration. Should a dual engine failure occur, establish optimum glide speed. Gross weight has no appreciable effect on maximum glide distance. In the clean configuration (50,000 pounds gross weight), the optimum glide speed is 190 KIAS for CLE aircraft and 210 KIAS basic wing aircraft. At this speed, the glide distance under no-wind conditions is approximately 13 nautical miles for each 5,000 feet of altitude lost. Refer to the DESCENT charts in Section XI.

FIRE WARNING INDICATIONS (LIGHTS ON)

NORMAL FLIGHT CONDITIONS

1. Engine and instruments . . . . . CHECK
2. Power, affected engine . . . . . REDUCE
3. Do not secure engine without further evidence of engine fire.

CRITICAL FLIGHT CONDITIONS

During takeoff, climb-out under instruments conditions, or approach/GCA. No power reduction shall be made until the aircraft is under full control, and minimum single-engine control speed can be maintained.

ENGINE FIRE

If above safe single engine speed, shutdown the engine:

1. Throttle . . . . . OFF
2. Master engine switch . . . . . OFF
3. Bleed air switch inoperative engine . . . . . OFF
4. Do not attempt an airstart.
5. If fire persists, bailout or land immediately using short field arresting gear if available.

WING FIRE

1. Wing lights . . . . . OFF
2. Wing tanks . . . . . PURGE
3. Bleed air switch, affected side . . . . . OFF
4. If fire persists, and if above safe single engine airspeed, shut down the appropriate engine.
   a. Throttle . . . . . OFF
   b. Master engine switch . . . . . OFF
   c. If fire persists, bailout or land immediately using short field arresting gear if available.

FUSELAGE FIRE

No system for extinguishing a fuselage fire is provided. If the fire is accessible, use any means available to extinguish.

ELECTRICAL FIRE

KNOWN ORIGIN

1. Secure applicable equipment or isolate by circuit breaker.
2. If fire persists, treat as fire of UNKNOWN ORIGIN.

UNKNOWN ORIGIN

1. Emergency generator . . . . . EXTEND
2. Oxygen masks . . . . . ON
3. AC and dc generators . . . . . OFF

Note

This removes electrical power from all busses except ac and dc essential busses. Do not secure ac generators until aircraft is fully under control, as all radios, navigation aids, and instrument lights, except floodlights, will be lost.

4. Keep upper and lower hatches closed.
5. Attempt to isolate cause by first securing all electrical equipment and pulling associated circuit breakers.

6. Systematically restore electrical power, one piece at a time.

Note

If ac generator restart is desired, bus tie switch must be placed in OPEN.

7. If cause cannot be isolated and fire persists, bailout or land immediately using short field arresting gear if available.

LANDING GEAR SOLENOID FAILURE

If the landing gear control handle solenoid fails, an excessive amount of smoke is invariably emitted from the center console. When this failure is suspected, proceed as follows:

1. RETRACT RELEASE circuit breaker. . . PULL (C/B located on pilots DC bus C/B panel)

Note

Once this circuit breaker has been pulled, the following will be affected in the manner indicated:

a. Power will be removed from the landing gear solenoid.

b. Landing gear solenoid may extend.

c. Oil cooler door will close, and no longer function.

d. The angle-of-attack indexer and approach lights will be inoperative.

e. Tail skag may not be in proper sequence with landing gear.

f. Autopilot will be inoperative.

2. If any of the above items are required for landing, reset retract release circuit breaker just prior to landing.

HOT AIR LEAKS

Note

- Hot air leaks are usually indicated by progressive deterioration of electrical and communications system, i.e., loss of ICS and/or radios, popped circuit breakers, erratic engine instruments indications, rising ATM temperatures, fire warning light coming on, etc.
- The reduction in pressure and temperature within the hot air system is significant with a reduction in power.

ATM COMPARTMENT FIRE OR HOT AIR LEAK

1. Throttles . . . . . RETARD TO MINIMUM REQUIRED FOR SAFE FLIGHT.

2. AC generator affected side . . . . . OFF

3. If temperature does not return to normal, bleed air switch affected side . . . . . OFF

CAUTION

If the left-hand bleed air switch is closed, pressurization and air conditioning will be lost.

5. Monitor the ATM compartment temperature. If the temperature continues to rise:

a. Emergency generator . . . . . EXTEND

b. Bleed air switch operative side . . . . OFF

6. Refer to BOOST-OFF FLIGHT.

7. If temperature rise cannot be controlled, bailout, or land immediately, using short field arresting gear if available.

WARNING

ATM temperature of 230°C is dangerously close to the auto ignition point of hydraulic fluid. ATM compartment temperature above 100°C and rising is an emergency situation, which may, at the discretion of the pilot, necessitate abandonment of the aircraft.

NOSEWHEEL WELL HOT BLEED AIR LEAK

Indications are about the same as for the ATM hot air leaks, except that both ATM temperatures will rise slowly. Proceed as follows:

1. Throttles . . . . . RETARD TO MINIMUM REQUIRED FOR SAFE FLIGHT.

2. Oxygen masks . . . . . ON

3. Emergency generator . . . . . EXTEND

4. Bleed air switches . . . . . .BOTH OFF

5. ATM switches . . . . . .BOTH OFF

6. If above procedure is effective:

   a. Left-hand bleed air switch . . . . . ON

   b. Left-hand ATM switch . . . . . ON

   c. Be alert for recurrence of hot bleed air leak indications.

   d. Right-hand ac generator . . . . . OFF

Note

Leave the right-hand bleed air shutoff switch OFF, this isolates almost the entire length of the hot bleed air crossover line located in the nosewheel well.

7. If Item 6 above is successful:

   a. Emergency generator . . . . . RETRACT

8. Land as soon as practicable.

9. If the situation cannot be controlled, bailout or land immediately utilizing short field arresting gear, if available.

AFT COMPARTMENT HOT AIR LEAK

An aft compartment hot air leak will be evidenced by a noticeable rise in temperature felt by crewmembers in the aft compartment. Crewmembers must immediately notify the pilot from which side the hot air is emitting. The pilot shall immediately:

1. Throttles . . . . . RETARD TO MINIMUM REQUIRED FOR SAFE FLIGHT.

2. Oxygen masks . . . . . ON

3. Bleed air switch, applicable side . . . . . OFF

4. Affected ac generator switch . . . . . OFF

5. Land . . . . . AS SOON AS PRACTICABLE.

If the location of the aft compartment hot air leak is not evident to the crewmembers and the heat rise is severe:

1. Throttles . . . . . RETARD TO MINIMUM REQUIRED FOR SAFE FLIGHT.

2. Emergency generator . . . . . EXTEND

3. Bleed air switches . . . . . .BOTH OFF

4. Alternately position the bleed air switches from OFF to ON, and then to OFF to determine the bleed air ducting affected.

5. Land . . . . . AS SOON AS PRACTICABLE

6. Keep hatches closed until on short final. The upper escape hatch may be opened at this time. Utilize short field arresting if available.

AIR CONDITIONING TURBINE FAILURE

If the air conditioning unit cooling turbine fails, the cabin air temperature may become excessively high, and operation of the MAN COLD position of the cockpit temperature selector knob will be ineffective. In this event, place the cockpit temperature selector knob in the OFF position.

WARNING

Placing the C'PIT TEMP knob in the OFF position depressurizes the cabin. Aircraft flight altitude should be reduced to one which will assure crew safety and comfort, and to avoid possible harmful decompressioning effects. The pilot shall insure that all crewmembers are wearing oxygen masks prior to depressuring.

Refer to Air Conditioning and Pressurization System I, Part 2 and 2A for other malfunctions.

SMOKE AND FUME ELIMINATION

Smoke and fume may be eliminated from the cabin area by turning the C'PIT TEMP knob on the pilot's left-hand console OFF, which will depressurize and ventilate the cabin area with ambient ram air. Except as a last resort, the upper hatches, or escape chute should not be opened for the purpose of smoke elimination.

WARNING

The AIR COND and C'PIT TEMP system shall not be turned OFF at altitudes in excess of 43,000 feet because of the oxygen system limitations.

UTILITY HYDRAULIC FAILURE

Failure of the utility hydraulic system results in the loss of speedbrakes, nosewheel steering, jato jettison, wing fold, tail bumper and the ability to raise the landing gear and arresting hook. The hydraulic hand pump must be used to sustain brake operation. Wing flaps and landing gear can be extended pneumatically using procedures established below, but require extra time for actuation.

When operating aboard ship, careful consideration should be given to the availability of divert fields, deck, weather, inflight refueling capabilities and other conditions, prior to pneumatic extension of flaps and landing gear. When utility system failures require the use of pneumatic system, extend and check the flaps DOWN before extending the landing gear.

No particular difficulty will be encountered except that the approach will be made without speedbrakes. The aircraft will have to be towed from the landing area with the hook tied up and the wings spread. Insert the landing gear ground safety pins prior to moving the aircraft.

A landing on a runway will always be made into the "short field" arresting gear if available. An LSO should assist the pilot in picking up the "short field" gear. Crosswinds and/or braking problems may make directional control difficult on rollout if a short field arrestment is not made.

ANTISKID shall be OFF prior to touchdown. In the event of ineffective braking, continue with brake failure emergency procedures.

CAUTION

- Tail skag will not be available and nose-high landings must be avoided.
- Do not attempt to use the nose gear steering system under this condition, as shimmy dampening will be lost.

WING FLAP EMERGENCY OPERATION

EMERGENCY WING FLAP EXTENSION

1. Slow aircraft . . . . . .180 KIAS OR LESS
2. Flap handle . . . . . RECYCLE DOWN
3. Emergency flap handle . . . . . DOWN

CAUTION

Following extension of the flaps by emergency air pressure, do not actuate the normal flaps control lever until the emergency flaps lever is first returned to the UP position for a 20-second interval, thus exhausting air from the line. Failure to observe this sequence can cause a rupture of the utility hydraulic system reservoir.

Note

Flaps may begin to blowback to trail position 10 to 15 minutes after being extended pneumatically.

EMERGENCY WING FLAP RETRACTION

CAUTION

Whenever the emergency flap handle is returned to the UP position, flaps may immediately fair, as all restrictions have been bypassed.

1. Hydraulic failure prior to pneumatic extension.
   a. Emergency flap handle . . . . . UP
   b. Flap handle . . . . . UP

Note

Subsequent emergency air pressure extension of the flaps is possible, but may result in only partial extension, since the pressure remaining in the flaps emergency pneumatic bottle may not be great enough to overpower the air load against the flaps. It is recommended that the flaps not be extended by the emergency system until a successful landing is assured.

2. Hydraulic failure after normal (hydraulic) extension:
   a. Flap handle . . . . . UP

LANDING GEAR EMERGENCY OPERATION

1. Slow to minimum safe airspeed.

2. Landing gear handle . . . . . RECYCLE DOWN

3. Emergncy landing gear handle . . . . . .DOWN (this handle is interlocked with landing gear handle)

Note

In the event a main mount is down but unlocked, yawing, positive G's, or slowing the aircraft to buffet airspeed may help lock gear down.

CAUTION

Following emergency gear extension, do not place the landing gear handle in the UP position prior to bleeding air from the system. Failure to observe this sequence can cause rupture of the utility system hydraulic reservoir.

ARRESTING HOOK EMERGENCY OPERATION

1. Arresting hook handle . . . . . RECYCLE DOWN

2. Pull arresting hook latch control cable in aft compartment.

WHEELBRAKE OPERATION AFTER UTILITY FAILURE (NO SHORT FIELD ARRESTING GEAR AVAILABLE)

1. Hydraulic brake pressure gage . . . . 3,000 PSI

2. ANTISKID . . . . . OFF

3. Drag chute . . . . . DEPLOY

CAUTION

Do not use nosewheel steering unless absolutely necessary as shimmy dampening will be lost.

4. Use normal braking by having the right seat occupant maintain brake pressure by means of the hydraulic handpump. If unable:

5. Emergency airbrake handle . . . . . PULL

Note

Apply pedal force gradually until desired braking effect is obtained. Avoid pumping the brakes to prevent rapid depletion of the air supply. Once the emergency airbrake handle has been pulled, success in attempting to regain the use of the brakes by use of the hydraulic handpump is doubtful.

6. Insert landing gear pins and have aircraft towed to the line.

ATM MALFUNCTIONS/FAILURES

LEFT HAND ATM MALFUNCTION/FAILURE

1. Left-hand ac generator . . . . . OFF

2. Left-hand dc generator . . . . . OFF

3. Recycle left-hand ATM control switch . . . . ON

4. If ATM restarts, generators . . . . . ON

5. If ATM does not restart, ATM switch . . . OFF

6. Continue flight or land, as determined by existing conditions.

Note

Rudder and elevator boost will be lost if the left-hand ATM cannot be restarted. Pull the RUDDER/ELEVATOR BOOST release handle if necessary to maintain control of the aircraft.

RIGHT-HAND ATM MALFUNCTION/FAILURE

Follow procedures established under left-hand ATM MALFUNCTION/FAILURE except that the right-hand ATM components will be affected.

Note

The spoilers and one-half the AILERON BOOST will be inoperative if the right-hand ATM cannot be restarted. Maximum crosswind component is 7 knots with spoilers inoperative.

DOUBLE ATM MALFUNCTION/FAILURE

Double ATM failure will result in complete electrical utility hydraulic and flight control boost system failure. Limited essential power will be available only through the emergency drop out generator. Airspeed should be limited to less than 250 KIAS. With double ATM failure, proceed as follows:

1. Emergency generator . . . . . EXTEND
2. AC and dc generator switches . . . . . OFF
3. ATMS . . . . . ATTEMPT RESTART
4. Pull boost disconnects only when necessary to maintain control of aircraft.
5. Continue flight as necessary and land as soon as possible. Refer to BOOST-OFF FLIGHT.

ELECTRICAL SYSTEM MALFUNCTION/FAILURE

DC GENERATOR MALFUNCTION/FAILURE

SINGLE DC GENERATOR MALFUNCTION/FAILURE

1. Apply dc load or cycle operable generator to check for non-parallel.
2. If load is not sustained, applicable generator switch . . . . . .OFF.

Note

Safe flight is possible since one generator is more than adequate.

DUAL DC GENERATOR MALFUNCTION/FAILURE

1. Emergency generator . . . . . EXTEND
2. DC generator switches . . . . . OFF
3. Non-essential electrical equipment . . SECURE
4. Attempt restart, if successful emergency generator . . . . . RETRACT

CAUTION

During generator retraction, the brake pedals should be depressed to prevent air entrapment in the brake lines.

5. If restart unsuccessful, keep radio transmissions to minimum.

Note

For aircraft equipped with horizontal stabilizer dc trim power supply switch, position switch as required. If dc stabilizer trimming is required, this switch must be placed in EMERG to trim aircraft.

CAUTION

This procedure secures dc power to all other units with switch in EMERG. Return to NORMAL after trimming has been accomplished. With this switch in EMERG, drag chute deployment will not be possible.

AC GENERATOR MALFUNCTION/FAILURE

LEFT-HAND AC GENERATOR MALFUNCTION/FAILURE

Malfunction or failure of the left-hand ac generator will primarily be indicated by VGI warning flag, left-hand ac frequency meter zero or extreme fluctuation. Proceed as follows:

1. Left hand ac generator switch . . . . . OFF
2. If VFR, attempt restart of the generator (BUS TIE-OPEN)
3. If the generator does not restart, affected generator switch OFF BUS TIE-AUTO.
4. Continue flight or land as determined by existing conditions.

RIGHT-HAND AC GENERATOR MALFUNCTION/FAILURE

Malfunction or failure of right-hand ac generator will primarily be indicated by RH frequency meter zero/extreme fluctuation.

Procedures for malfunction or failure of the right-hand ac generator are the same as the left-hand except the right-hand components are affected.

DUAL AC GENERATOR MALFUNCTION/FAILURE

1. Emergency generator . . . . . EXTEND

2. AC generator switches . . . . . BOTH OFF

3. Unnecessary ac electrical equipment. . . . . SECURE

4. Attempt restart of both generators.

5. If unsuccessful, land as soon as possible.

COMPLETE AC AND DC GENERATOR FAILURE

1. Emergency generator . . . . . EXTEND

2. All generator switches . . . . . OFF

3. Land as soon as possible.

COMPLETE AC AND DC FAILURE, INCLUDING EMERGENCY GENERATOR

1. If VFR, continue flight. Land as soon as possible.

2. If IFR, and if control of the aircraft is in question, bailout.

HORIZONTAL STABILIZER TRIM MALFUNCTION

Should the horizontal stabilizer trim become erratic, or runaway:

1. Autopilot . . . . . OFF

2. Control the horizontal stabilizer with the control wheel trim switch or the console trim knob. If this does not immediately reverse the direction of trim:

   a. Horizontal stabilizer trim gangbar . .EMERGENCY OFF (DOWN)

3. Raise horizontal stabilizer emergency dc switch to ON and attempt retrimming with center console trim control. If trim is regained, with dc control, do not re-engage ac trim system. If it is determined that the dc system caused the runaway, attempt to retrim using ac trim.

4. Land as soon as practicable.

5. If normal trim conditions can be regained, proceed in normal flight and land as soon as practicable.

6. If malfunction continues and aircraft can be controlled, perform simulated approaches at altitude to determine the feasibility of safely landing the aircraft.

7. Carrier landings in out-of-trim conditions will not be attempted, if divert field is available.

OIL SYSTEM MALFUNCTION/FAILURE

The only indications of oil system malfunction/failure will be HIGH, OUT, or fluctuation of the oil pressure indicator. Visually inspect the engine for external leaks or oil cooler door open due to high oil pressure. If the word HIGH appears in the oil pressure window, operate the indicated engine at some lower rpm. If the gage fluctuates, or the word OUT appears in the oil pressure window, proceed as follows:

1. Increase the rpm on the affected engine.

2. Visually check the engine for leaks and position of the oil cooler doors. If OUT still appears in the window and visual inspection confirms a malfunction of the system: secure affected engine.

3. If visual inspection reveals nothing, consider the possibility that malfunction of the gage, transmitter, or circuitry may be causing erroneous reading. If further attempts to regain pressure by throttle adjustments fail, and OUT remains in the window: secure the engine and treat as a single engine failure.

4. Land as soon as practicable.

FUEL SYSTEM MALFUNCTION/FAILURE

BOOST PUMP FAILURE

1. Crossfeed. . . . . OPEN

2. If NORM is not indicated for both engines, return switch to original position.

3. Check fuel system (dc) and boost pump (ac) circuit breakers . . . . . IN

Note

Continue necessary flight as engine performance is not affected by loss of one boost pump.

CAUTION

Dual boost pump failure may require a decrease in altitude to obtain maximum thrust. At high altitude, compressor stall may occur.

FORWARD FUEL TANK TRANSFER PUMP FAILURES

1. Forward fuel tank switch breakers .CHECK ON

2. Gravity transfer switch. . . . . OPEN

3. When all available fuel is transferred aft, return the gravity transfer switch to NORMAL.

4. Transfer wing fuel to aft cell by placing the wing transfer switch . . . . . TO EMERG WINGS OR EMERG WINGS ALT.

EMERGENCY FUEL TRANSFER BY GRAVITY

The following precautions should be observed during gravity transfer operations:

1. Open the gravity transfer valve only when the aircraft attitude is noseup and:

   a. The forward tank fuel quantity exceeds the aft quantity by 2,000 pounds, or

   b. The aft tank fuel quantity is less than 2,000 pounds.

2. Operate the aircraft at the lowest practicable engine power setting to provide maximum fuel availability.

Note

When the aircraft is flown at maximum endurance power settings, approximately 750 pounds of fuel in the forward tank is unavailable. However, to provide for variations in pilot technique, 2,000 pounds should be considered unavailable for range calculations.

3. Prior to any prolonged flight in a nosedown attitude:

   a. Determine that aft tank fuel quantity is sufficient reserve.

   b. Close the gravity transfer valve prior to starting the descent, as fuel can be transferred aft to forward.

   c. Re-open the gravity transfer valve only when the conditions set forth in precaution number 1 are satisfied.

AFT TANK FUEL LEVEL CONTROL VALVE FAILURE

VALVE OPEN

Valve failed in open position will be indicated by aft cell level rising steadily above the 6,800 pounds level.

1. Manually control aft tank level by alternately turning fwd tank switch breakers ON and OFF.

VALVE CLOSED

Indicated by aft tank level dropping below 6,800 pounds level, proceed as follows:

1. Gravity transfer forward fuel to aft tank.

2. Transfer wings to AFT tank by using EMERG WINGS or EMERG WINGS ALT position.

Note

Refer to pocket checklist for APPROACH AIRSPEED VERSUS GROSS WEIGHT for fuel quantity estimate.

FUEL VENT ICING

While operating in moderate to heavy icing conditions, the pilot should be alert for fuel vent icing. When the fuel vent is obstructed, the aft fuel cell will collapse as fuel is pumped to the engine. Symptoms of fuel vent icing may be:

1. Total fuel quantity/total readouts greater than predicted fuel consumed over a specific period.

2. Loss or erroneous aft fuel quantity indications.

Recommended Action:

1. Obtain a warmer flight level.

2. Maintain nose-high attitude.

3. Land as soon as possible.

SPEEDBRAKE CONTROL MALFUNCTION

In the event of a speedbrake switch or solenoid valve failure, the speedbrake override knob, located on the aft bulkhead of the camera compartment, may be used to open or close the speedbrakes.

EMERGENCY ILLUMINANT JETTISON

The decision to jettison illuminants during an emergency situation shall in all cases be the responsibility of the pilot. The decision to jettison should include consideration of the following:

1. Nature and seriousness of the emergency.

2. Injury to persons or property on the ground.

3. Illuminant type and load.

HUNG-ORDNANCE LANDING PROCEDURES

Under normal operating conditions, landing with cartridges aboard is permissible; however, it is mandatory that every effort be made to jettison flash bombs. If flash bombs cannot be jettisoned, the ship or station must be notified prior to the landing, so that all hung-ordnance procedures can be complied with.

In extreme emergency, raise the guard on the SALVO/SAFE switch, and then raise the emergency gang bar located on the bomb release panel. This actuates the bomb bay door sequence switches and the salvo switch simultaneously and provides fully automatic jettisoning. Use of the gang bar is not recommended for normal operations, since the doors will close automatically before a visual inspection can be made of the bomb bays.

LANDING EMERGENCIES

SINGLE ENGINE LANDINGS

WARNING

- A successful single engine waveoff at slow airspeeds with landing gear and full flaps down is marginal and should not be attempted unless absolutely necessary.
- A successful single engine waveoff with landing gear and half flaps down is possible up to maximum gross landing weights provided the airspeed is not below minimum single engine control speed.
- Immediate retraction of the landing gear will reduce drag and increase the margin of safety during a waveoff.

SINGLE ENGINE FIELD LANDINGS

Time, weather, and engine operating conditions permitting, jettison and/or consume fuel until reaching a gross weight of 50,000 pounds or less. If possible, plan a straight-in mirror and/or GCA approach (see figure 5-1.) Consider a short field arrestment, if available.

Note

When poor field conditions exist, such as wet runway, high crosswinds, or short runway (6,000 feet or less), a short field arrestment is recommended.

Note

When gross weights exceed 50,000 pounds, and/or landing on a short runway, consider extension of full flaps prior to glide slope to reduce landing speed/ground roll or arresting gear engagement speed.

Proceed as follows:

1. Slow aircraft . . . . . 200 KIAS OR LESS
2. Half flaps . . . . . DOWN
3. Landing gear . . . . . DOWN (PRIOR TO GLIDE SLOPE OR AT THE 180 DEGREE POSITION)
4. Arresting hook . . . DOWN (FOR SHORT FIELD ARRESTMENT)
5. Speedbrakes . . . . . IN (MAY BE ACTUATED OUT FOR SHORT PERIODS TO CONTROL AIRSPEED)
6. Fly angle of attack . . . . . 15 UNITS
7. Do not slow below minimum single engine control speed until landing is assured.
8. After touchdown
   a. THROTTLE. . RETARD SLOWLY TO IDLE
   b. Drag chute . . . . DEPLOY IF NOT SHORT FIELD ARRESTED

CAUTION

- Be alert for a swerve on reduction of power.
- Braking and/or control problems may occur if ATM rpm decreases due to low power settings. A very slight power increase is usually sufficient to restore normal ATM operation.

SINGLE ENGINE CARRIER LANDINGS

Use the above listed procedures, with the exception of Item 8. Maximum gross weights, engagement speeds and wind over deck (WOD) must be observed.

TYPICAL SINGLE ENGINE LANDING AND WAVEOFF PATTERN

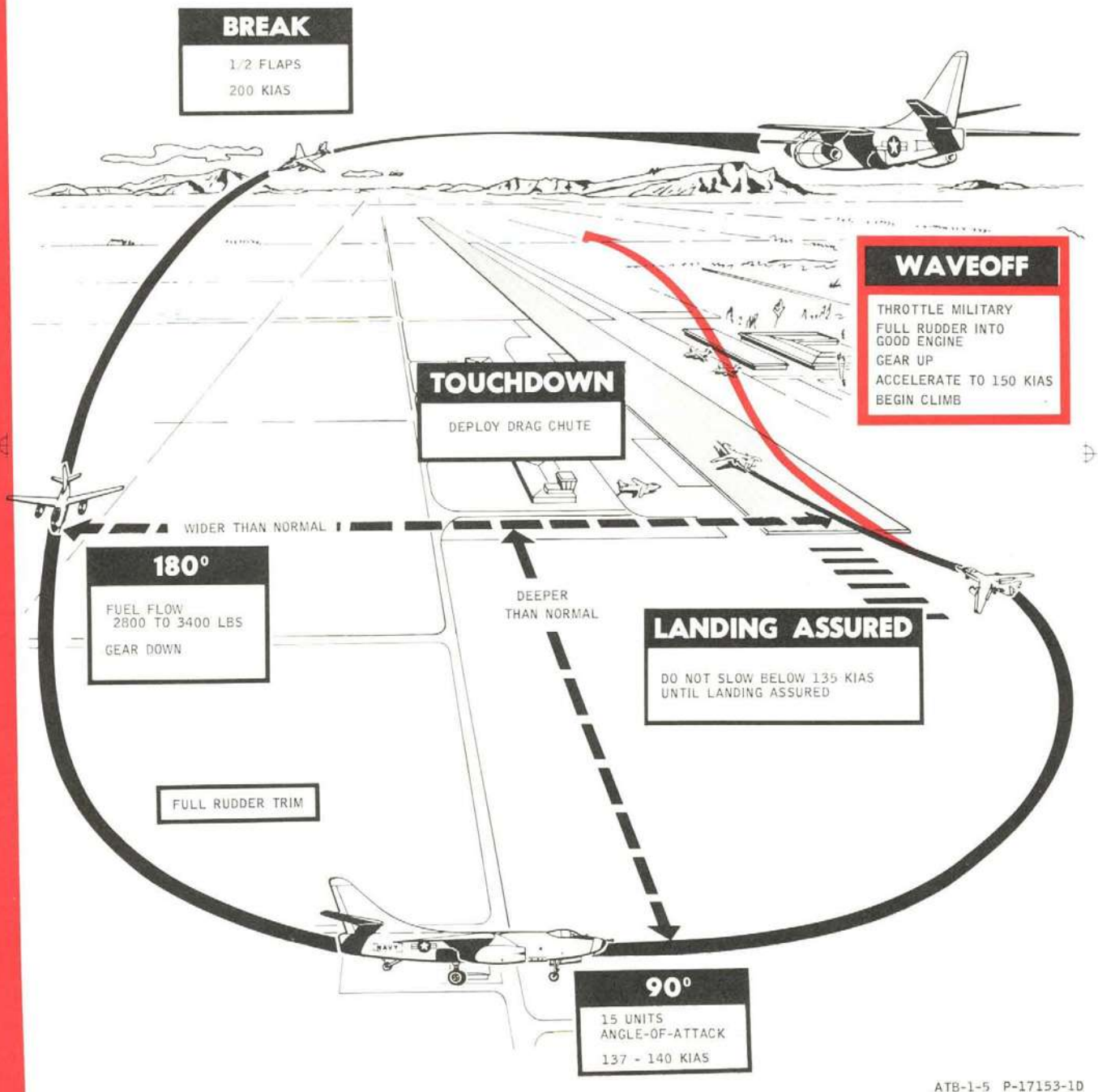


Figure 5-1. Single-Engine Landing and Waveoff Pattern (Typical)

NO-BOOST FIELD LANDINGS

Time and weather permitting, jettison and/or consume fuel until reaching a gross weight of 50,000 pounds or less. Plan a straight-in approach to a short field arrestment, if available. Landing should be made in minimum crosswind conditions to reduce lateral control oscillations.

WARNING

Directional control with loss of spoilers is marginal when crosswind components are in excess of 7 knots. If short field arrestment is not available, divert to a suitable field. If neither short field arrestment nor suitable divert field are available, a no-flap landing is recommended.

Proceed as follows:

1. Attempt to regain boost, pull AILERON AND/OR RUDDER/ELEVATOR BOOST release handles only if control forces are excessive.
2. Slow aircraft . . . . . 200 KIAS OR LESS
3. Wing flaps. . . . . DOWN
4. Landing gear . . . . . DOWN
5. Arresting hook . . . . . DOWN
6. Speedbrakes . . . . . OUT, IF POSSIBLE
7. Fly angle of attack/airspeed . . . . . 15 UNITS OR NORMAL APPROACH
8. Expect high control pressures when damping lateral directional oscillations during final approach.
9. Drag chute . . . . . DEPLOY IF NOT SHORT FIELD ARRESTED.

CAUTION

If no flap approach is made, use above listed procedure except approach should be 17 to 20.5 units angle of attack or 20 KIAS above normal. Deploy drag chute after landing and make a long field arrestment.

CAUTION

If stabilizer actuator should fail with the aircraft trimmed for nosedown attitude, consider extension of wing flaps, and speedbrakes if possible, in order to reduce approach speed and amount of back pressure required. A high landing speed may be required to lower the pull force to a manageable amount. As fuel is consumed below 6,800 pounds, the aircraft cg moves rapidly forward, further increasing the pull force required to maintain the desired flight attitude. Jettisoning of illuminants will permit landings with higher fuel weights and create a more favorable cg condition.

NO BOOST CARRIER LANDING

WARNING

Carrier landings shall not be attempted when both aileron and rudder/elevator boosts are not available.

NO FLAP FIELD LANDINGS

Weather and fuel permitting, practice no flaps flight in landing configuration at altitude. Jettison and/or consume fuel until reaching a gross weight of 50,000 pounds or less. Plan a straight-in approach, on the longest suitable runway, to a long field arrestment. Proceed as follows:

1. Slow aircraft . . . . . 180 KIAS OR LESS
2. Landing gear . . . . . DOWN
3. Fly angle of attack/airspeed . . . . . 17-20.5 UNITS OR 20 KIAS ABOVE NORMAL
4. After touchdown
   a. Drag chute . . . . . DEPLOY
   b. Arresting hook . . . . . DOWN, PRIOR TO LONG FIELD ARRESTING GEAR.

NO FLAP CARRIER LANDINGS

WARNING

No flap carrier landings shall not be attempted.

NO SLAT FIELD LANDINGS

Note

The nomenclature for slat location is outer wing outboard, outer wing inboard, center wing outboard, and (on cambered wing only) center wing inboard. Division point between outer wing and center wing is the wing fold.

Partial or no extension of the wing slats may be experienced during the approach due to icing, binding, etc.

If CENTER WING slats fail to extend, a mild pitchup and slight buffet will be experienced, but controllability will be only slightly affected. Normal approach speed should be increased about 10 KIAS to remain above the buffet or pitchup zone.

If the OUTER WING OUTBOARD AND/OR OUTER WING INBOARD slats fail to extend, a severe pitchup prior to buffet warning will be encountered. Increased drag and loss of airspeed develop quite rapidly, and controllability will be extremely marginal. If any outer wing slats fail to extend, normal approach speed should be increased about 35 KIAS (basic) or 26 KIAS (CLE). This should correspond to an angle of attack of approximately 4 units for basic and 10 for CLE aircraft.

If BOTH CENTER WING AND OUTER WING slats fail to extend, aircraft characteristics will be essentially the same as with the outer wing slats only in the retracted position. If it is suspected that the slats are sticking or will not fully extend, proceed as follows:

1. Continue to destination if approach can be executed VFR. If not, divert to suitable VFR alternate. If neither, then selection of the field should be made consistent with weather, runway length, arresting gear, etc.

2. Avoid abrupt transition to approach configuration.

3. Monitor wing slats as much as possible during the approach, particularly when transitioning to landing configuration.

4. Do not slow below normal approach speed plus 35 KIAS (basic) or 26 KIAS (CLE) or 4/10 units on angle-of-attack unless it can be determined that all outer wing slats are beginning to extend. If outer wing slats fail to extend, slats function may be checked on pulsing elevators before reducing airspeed. A moderate momentary back pressure should cause slats to extend far enough for a visual check. If slats still do not extend, continue approach (at 160 KIAS in basic and 152 in CLE – i.e., 50,000 pounds gross weight). Continued flight in temperatures above 32°F should free frozen slats.

CAUTION

These approach speeds and angles-of-attack are for clean airfoils; thus, if wing ice is present, buffet and pitchup will be experienced at appreciably higher airspeeds and lower angles-of-attack.

5. Be alert for porpoise on touchdown. If practicable, make touch-and-go landings. Icing may break on touchdown, allowing normal landing on next approach.

NO SLAT CARRIER LANDINGS

Arrested carrier landings will not be attempted when a divert field is available, if outer wing slats fail to extend. If possible, touch-and-go landings should be made in an attempt to free slats. If this fails, divert to suitable field. If divert field is not available, decision to attempt barricade engagement will depend on WOD and limitations on specific ship's barricade equipment. A successful barricade engagement in this condition is considered extremely marginal and decision to attempt it or bailout will rest with the pilot. Limited experience (shore-based) has been used to develop above procedures and has been projected for carrier procedures.

WHEELBRAKES EMERGENCY

In the event of wheelbrake failure on landing, with the throttles at IDLE and the drag chute deployed, proceed as follows:

1. Arresting hook . . . . . DOWN

2. Remove pedal pressure and turn antiskid . . . . . OFF IF BRAKING STILL INEFFECTIVE

3. Actuate airbrakes as last resort.

Note

- Apply pedal force gradually until the desired braking effect is obtained. Avoid frequent pedal pumping to prevent rapid depletion of the air supply.
- Antiskid detection is not available with the emergency brake control system.
- Do not attempt to use nosewheel steering.

4. Insert landing gear pins and have aircraft towed to line.

CAUTION

Do not return system to normal control until hydraulic pressure is restored in the brakes. In order to prevent air from entering the brake lines through the shuttle valves, depress the brake pedals and generate hydraulic pressure in the system with the handpump. Hold brake pedals depressed until all air is exhausted from the system; then return emergency brake handle to the normal position.

BAILOUT/DITCHING DOCTRINE

UNCONTROLLED FLIGHT

If the aircraft becomes uncontrollable, it shall be abandoned prior to reaching 10,000 feet above the terrain.

DUAL-ENGINE FAILURE LOW ALTITUDE/LOW AIRSPEED

In the event of dual engine failure, at or below 3,000 feet above the terrain and below 250 KIAS the crew will immediately abandon the aircraft. After dual flameout, the rapid rate of descent coupled with engine acceleration lag, makes a successful recovery improbable.

LOW LEVEL, TAKEOFF, AND LANDING

Airspeed should be traded for altitude whenever possible. If a safe bailout altitude cannot be reached, the standard ditching procedures should be followed.

Note

Safe bailout altitude is 1,000 feet above the terrain with the aircraft in a level or climbing altitude. If below 1,000 feet and unable to climb, the aircraft should be ditched.

BAILOUT/DITCHING PROCEDURES

CONTROLLED BAILOUT

1. Reduce airspeed to 250 KIAS (220 KIAS with hook extended) or below. Head aircraft to crash clear of the force or any populated areas. If situation and time permit, obtain an altitude between 8,000 and 10,000 feet. Crewmembers shall bailout in the following order: fourth crewman (when aboard), photo/technician, photo/navigator, and pilot. In a controlled bailout, the command "PREPARE TO BAILOUT" shall be issued by the pilot.

2. The pilot shall: (Prior to issuing the command "BAILOUT" or sounding BAILOUT HORN)

   a. Transmit . . . . . ON APPROPRIATE FREQUENCIES
      (1) MAYDAY, MAYDAY, MAYDAY
      (2) Identification
      (3) Position
      (4) Situation
      (5) Intentions
   b. Secure . . . . COCKPIT PRESSURIZATION
   c. Actuate . . . . . EMERGENCY ESCAPE CHUTE HANDLE

3. The photo/navigator shall:
   a. Select IFF . . . . . EMERGENCY-MODE 3 CODE 77
   b. Position seat . . . . . FULL AFT
   c. If directed by the pilot:
      (1) Transmit . . . .MAYDAY (as 2a above)
      (2) Actuate . . . . EMERGENCY ESCAPE CHUTE HANDLE

4. The photo/technician shall:
   a. Turn on . . . . . COCKPIT WHITE DOME LIGHT (NIGHT)

b. If directed by the pilot:

(1) Operate .... EMERGENCY ALTERNATE ESCAPE TREADLE

5. Each crewmember shall check the following:

a. Helmet ..... TIGHT

b. Rocket fittings ..... TIGHT

c. Torso harness ..... TIGHT

d. Barometric release ..... HOOKED UP

6. At the command "BAILOUT" issued by the pilot and/or when the bailout horn is sounded, each crewmember shall:

a. Actuate ..... BAILOUT BOTTLE

b. Pull ..... HARNESS RELEASE HANDLE

c. Lower ..... HELMET VISOR

d. Bailout ..... IN ORDER

7. Escape through escape chute should be made:

a. Feet first facing aft

b. Legs together

c. Arms tight to the body

d. Hands grasping parachute harness at the D RING

e. Head turned to side

EMERGENCY BAILOUT

In an emergency situation requiring immediate bailout

1. The pilot shall:

a. Actuate ..... EMERGENCY ESCAPE CHUTE HANDLE (IF ABLE)

b. Command .. "BAILOUT-NOW", OR SOUND "BAILOUT" HORN

2. The photo/navigator shall:

a. Select IFF ..... EMERGENCY-MODE 3 CODE 77

b. If directed by the pilot:

(1) Actuate .... EMERGENCY ESCAPE CHUTE HANDLE

3. The photo/technician shall:

a. If directed by the pilot, operate emergency alternate escape treadle.

4. Each crewmember shall:

a. Actuate ..... BAILOUT BOTTLE

b. Pull ..... HARNESS RELEASE HANDLE

c. Bailout ..... IN ORDER, WITHOUT FURTHER COMMAND FROM PILOT.

5. If ICS is lost:

a. Command "BAILOUT-NOW" shall be given by sounding bailout horn or pointing down escape chute or by using UHF/VHF if available.

6. Tests have shown the best method of departing the seat without fouling personal gear to be as follows:

a. Fourth seat crewman:

(1) Come forward and bailout through escape chute feet first facing aft.

b. Photo/technician

(1) Grasp overhead assist handle and rise from seat.

(2) Slide down escape chute.

c. Photo/navigator

(1) Grasp centerline assist handle with right hand and roll into aisle.

(2) Crawl to escape chute.

d. Pilot:

(1) Grasp centerline assist handle with left hand and roll into aisle.

(2) Crawl to escape chute.

Note

Parachutes equipped with the bailout lanyard and barometric actuator deploy within 3 seconds after the actuator is armed. (Refer to Parachute Lanyard in Section II.)

BAILOUT ESCAPE ROUTES

1. Primary exit .. EMERGENCY ESCAPE CHUTE

2. Alternate exit ..... UPPER ESCAPE HATCH

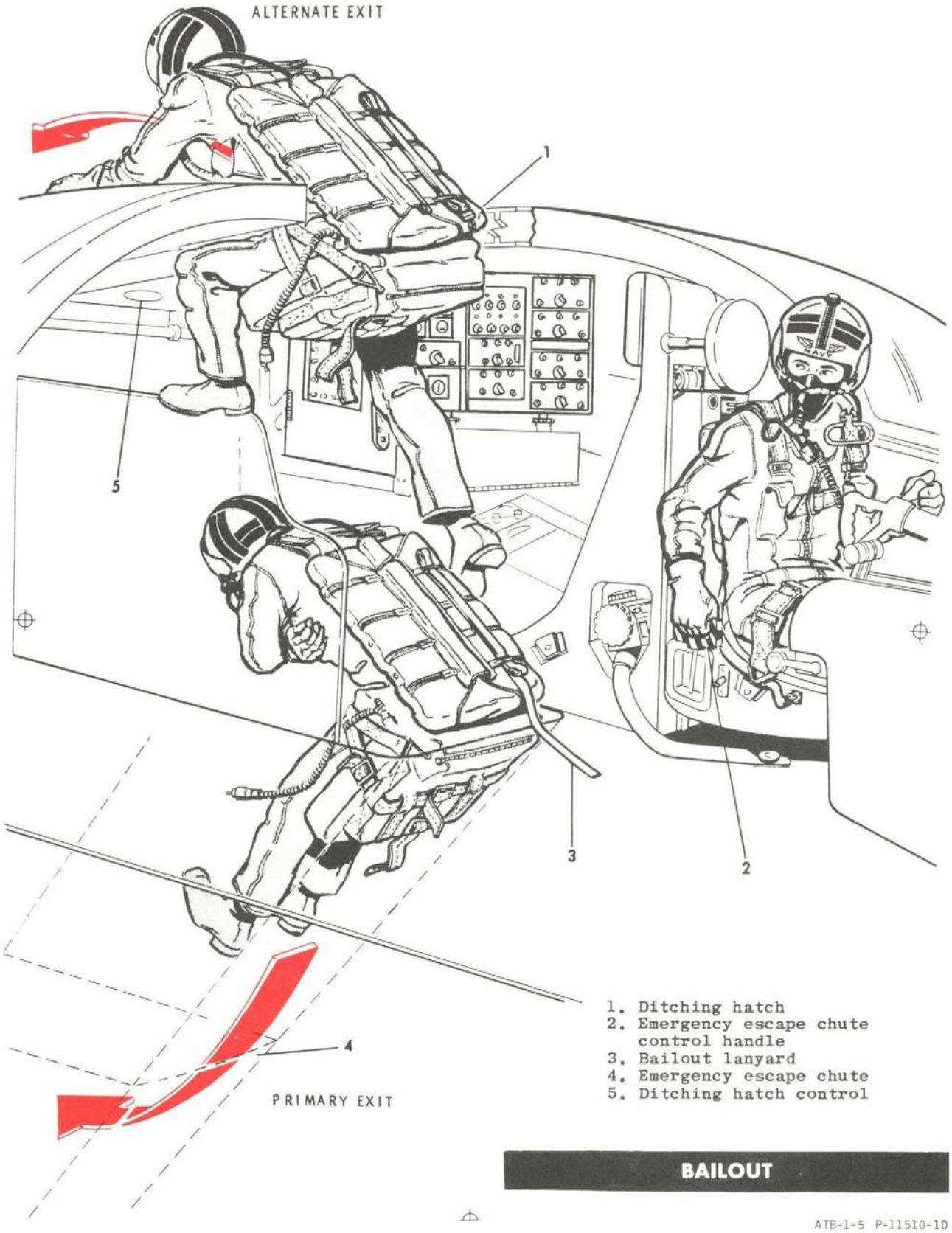


Figure 5-2. Emergency Exits

a. Use alternate exit if:

(1) Emergency escape chute fails to open when actuated.

(2) Bomb bay doors are open and cannot be closed.

b. Proceed as follows:

(1) Upper hatch . . . . . OPEN

(2) Bailout . . . . . ALONG RIGHT SIDE OF FUSELAGE

WARNING

Alternate exit has been used successfully but should only be used in an extreme emergency.

EMERGENCY DITCHING – LAND

WARNING

Ditching should not be attempted if altitude is available for safe bailout.

Proceed as follows:

1. Maintain . . . . FLYING SPEED AND HEADING
2. Torso harness . . . . . CHECK TIGHT/LOCKED
3. Lower seat . . . . . AS FAR AS POSSIBLE
4. Disconnect . . . . . BAROMETRIC RELEASE LANYARDS
5. Wing flaps . . . . . DOWN
6. Landing gear . . . . . DOWN
7. Arresting hook . . . . . DOWN
8. Upper hatch . . . . . OPEN
9. Land wings level on approach speed/angle-of-attack sink rate 200-300 FPM optimum.
10. After touchdown (if possible)
    a. Drag chute . . . . . DEPLOY
    b. Throttles . . . . . OFF
    c. Master engine switch . . . . . OFF
11. Do not pull harness release until forward movement of aircraft has stopped.

EMERGENCY DITCHING – SEA

Follow the procedures listed for EMERGENCY DITCHING – LAND except:

1. Do not . . . . . LOWER LANDING GEAR
2. Do not . . . . . DEPLOY DRAG CHUTE

EMERGENCY LANDING-DIVERSION RECOMMENDATIONS

1. Emergency landing diversion recommendations are listed in table 5-1.

2. These recommended actions are based on statistical data and are of an advisory nature. Deviations by the "on-the-scene" commander are authorized if sufficient time is available for an on-the-spot analysis of the emergency and the attendant conditions of landing the facilities, weather, seastate, and pilot ability.

3. These recommendations should be used as a guide.

4. Fouled deck data for endurance or diversion are contained in Section XI, Performance Data.

5. A field will be considered VFR with 1,000 feet broken or better cloud coverage and visibility 3 miles or greater. Approach to the field should be possible under visual flight rules.

6. The decision to divert an aircraft to a suitable field for an emergency landing or to arrest it on board rests with the operational commander. It is recommended that a suitable divert field meet the following criteria:

a. Sufficient length to effect a landing with antiskid only

b. Hard-surface of macadam, concrete, or compacted coral (gravel surfaced runways not acceptable).

c. Crash crews available, preferably English speaking.

d. Either foam or arresting gear available.

e. Weather above minimum compatible with NAVAIDS available in the aircraft and at the field.

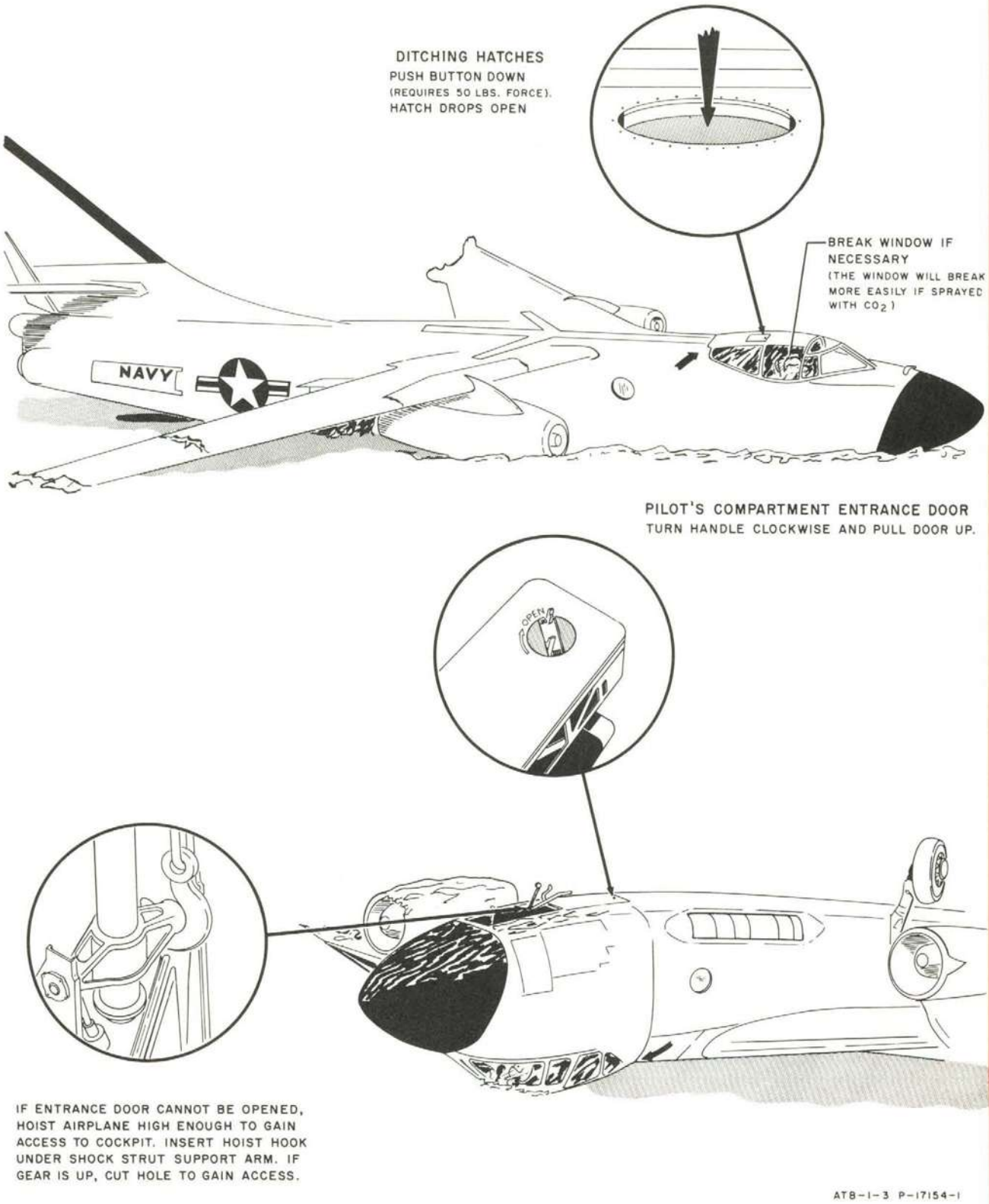


Figure 5-3. Emergency Entrance

TABLE 5-1. EMERGENCY LANDING/DIVERSION RECOMMENDATIONS

Configuration	Shore Based and/or Divert Field Available	Action if Carrier Based and No Divert Field Available	Remarks
1. NO HOOK			
*a. All gear down	Normal Landing	Barricade	
*b. One main wheel	Land (foam if available)	Barricade	Remove wires.
*c. Nosewheel missing, nose mount up or down & unlocked	Land (foam if available)	Barricade	
d. All gear up	Land (foam if available)	Bailout	
*e. Nose & one main mount down, other mount up or locked	Land (foam if available)	Barricade	
f. Nosewheel only down	Land (foam if available)	Bailout	At field deploy drag chute just prior to touch down.
g. One main mount down	Bailout	Bailout	
h. Both ATM's failed	Land	Bailout	Land ashore under ideal conditions.
**i. Single engine	Land	Bailout	
j. No flaps	Land	Bailout	
k. Left-hand ATM failed	Land	Barricade	
2. HOOK DOWN			
*a. One main wheel gone	Land in arrest gear and foam if available	Barricade	Remove all wires aft of the barricade.
b. All gear up	Land in arrest gear and foam if available	Bailout	
c. Nosewheel missing, nose up or down and unlocked.	Land in arrest gear and foam if available	Barricade	Attempt normal carrier landing if entire strut is down and locked (i.e., wheel only missing).
*d. Nose & one main mount down, other mount up or down and unlocked.	Land in arrest gear and foam if available	Barricade	
e. Nosewheel only down	Land in arrest gear and foam if available	Bailout	At field deploy drag chute just prior to touch down.
f. One main mount only down	Bailout	Bailout	
g. Both ATM's failed	Land in arrest gear	Bailout	
**h. Single engine	Land	Land	Refer to BINGO FUEL in Section III, Part 4.
i. No flaps	Land	Bailout	
j. Left-hand ATM failed	Land	Land	

*If pilot performance or deck conditions are marginal, consider bailing out.

**Where question of survival due to sea state and water conditions appear marginal, consider barricade arrestment.

RECOMMENDED RUNWAY FOAMING PROCEDURES

FACILITIES

Based upon the availability of 3000 gallons of water and 250 gallons of foam, producing 160,000 square feet of WET foamed runway, the following information is provided as a guide for runway foam patterns.

CONDITIONS AND BACKGROUND

Experience with arrestment and landings of A-3 aircraft indicates that the maximum rollout following arrestment has not exceeded 2200 feet. One A-3 unarrested landing, nose gear missing, resulted in a 4000 feet rollout. It is concluded that this is the best planning figure for an A-3 unarrested landing with less than three landing gear extended.

ARRESTED LANDINGS

The foaming patterns for arrested landings depend primarily upon aircraft landing configuration. Namely, the aircraft landing configuration will allow a straight rollout, when both main gear are retracted and/or the nose gear is missing, while a swerve will result when only one main gear is extended. One of three patterns should be used:

a. Centerline

b. Right of centerline

c. Left of centerline.

Based upon maximum rollout, all patterns should extend 2200 feet from the arresting gear cross-deck pendant. The left and right patterns should be parallel to the centerline for approximately 1200 feet and then angled to the runway edge an additional 1000 feet. The width of the standard pattern should be 50 feet.

UNARRESTED LANDINGS

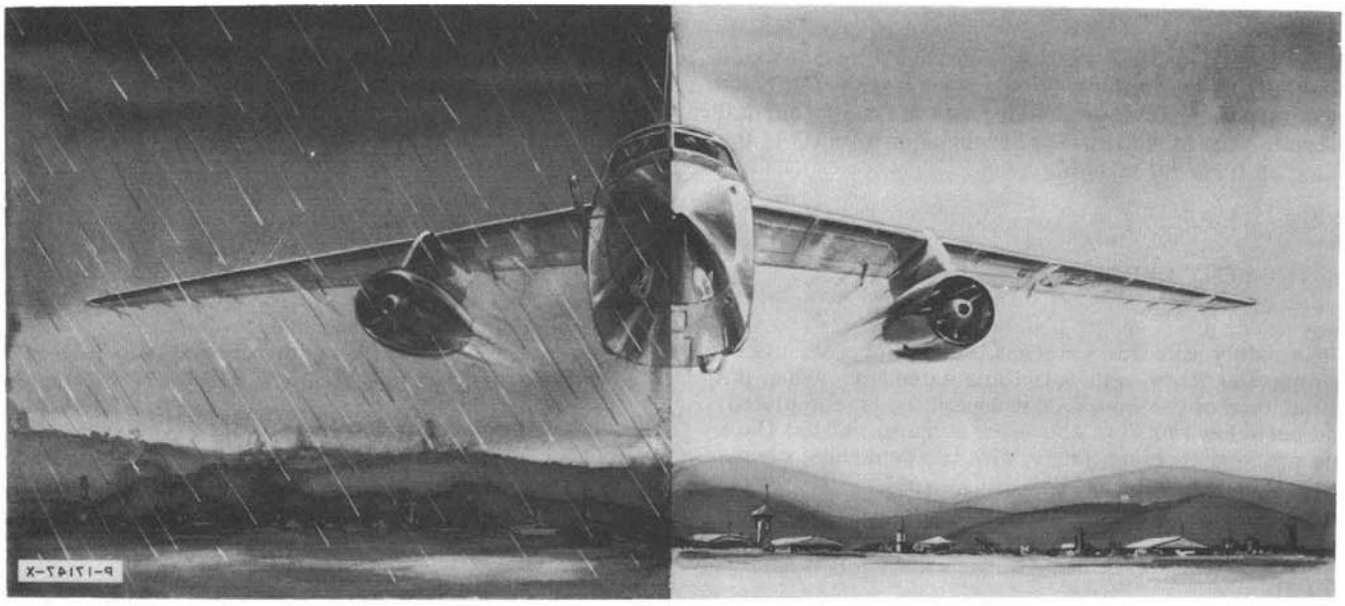
Three patterns are recommended depending upon the aircraft landing configuration. These three patterns are:

a. Centerline

b. Right of centerline

c. Left of centerline.

Based upon a maximum of 160,000 square feet of foam available, the three patterns should be 4000 feet long and 40 feet wide. Foaming should commence 1000 feet from the approach end of the runway. The left and right patterns should be parallel to the centerline for the first 2000 feet and then angled to the runway edge.



SECTION VI

ALL WEATHER OPERATION

INTRODUCTION

This section contains detailed procedures for conducting instrument flight and operating instructions for all climates and weather conditions; and are in addition to normal procedures contained in Section III.

SIMULATED INSTRUMENT FLYING

Simulated instrument flights shall be scheduled for pilots preparing for their annual instrument flight check. A qualified (instrument qualified) aviator or crewmember will be assigned to fly in the photo-navigator's seat as pilot observer and lookout. A qualified flight crewmember will be assigned to fly in the number three seat.

PILOT INSTRUMENT PROFICIENCY

Pilots must maintain instrument proficiency by requesting practice instrument departures, penetrations, and controlled approaches on all normal training flights. Flight crews must be aware of the importance of good lookout doctrine during climbouts and descents. During this portion of the flight, high-density traffic is normally encountered. The pilot must refer to his instruments frequently, even though flying contact; therefore, he must rely upon the crewmembers to act as lookouts.

INSTRUMENT FLIGHT PROCEDURES

Since standard jet instrument procedures will be used; only those procedures will be discussed which require special precautions or are peculiar to this aircraft. For instrument clearance purposes, the RA-3B is a multipiloted aircraft. Standard speeds and procedures are as follows:

Note

If any possibility of rain is anticipated during the time of takeoff and/or approach and landing, ensure that the aircraft has an operating windshield wiper.

INSTRUMENT TAKEOFF

Because the RA-3B is a single-control aircraft, hooded takeoffs shall not be practiced. The pilot should, however, practice simulated hooded takeoffs during normal takeoff. The takeoff speed and technique for ITO is the same as for VFR takeoff.

INSTRUMENT DEPARTURES

When safely airborne, retract the landing gear maintaining 180 KIAS with full flaps extended. When the initial turn of the instrument departure is completed, and not below 1000 feet above the terrain, retract flaps and proceed in compliance with the departure clearance.

CLIMB

The normal climb schedule shall be adhered to during a climb under instrument conditions. Radar monitored track-out should be used where available as an aid in selecting areas of minimum turbulence.

CRUISING

Cruising procedures and techniques are the same under instrument conditions as when VFR. In thunderstorm areas, the radar and/or Flight Advisory Service will be used whenever possible as an aid in circumnavigation.

HOLDING

An IAS of 230 knots will be used for holding patterns unless gross weight and/or altitude require higher speed.

AIR CONDITIONING SYSTEM OPERATION

Actuate the anti-icing system prior to entering clouds or other visible moisture. Icing conditions should be anticipated, as this system is primarily an anti-icing system rather than a deicing system. If anti-icing is working properly, a noticeable drop in pressure ratio readings can be observed when the anti-icing switch is turned ON and oil temperature readings will be higher than normal. For climbs and descents in warm, humid climates and in other situations when necessary, place the air conditioning switch to HOT (not manual hot) and the manual defrost knob to the windshield.

PENETRATION

The predescent checklist shall be completed prior to commencing penetration. (In warm humid climate place temperature control to HOT, defrost switch ON).

Standard jet penetrations will be performed at 250 knots with speedbrakes out and engines at 1500 lbs fuel flow. This configuration should produce a rate of descent of about 4000 ft per minute. The radio altimeter may be set at the leveloff altitude. At the appropriate fix, full flaps and gear shall be extended, the aircraft reduced to approach speed, and the landing checklist completed.

Note

- The photo-navigator should monitor radar during descent and approach for terrain clearance.
- During any letdown, the right seat crew member will monitor the altitude and call out passing each 5000 feet of altitude. Below 5000 feet MSL, he will call out passing each 1000 feet. Each altitude check will be confirmed by the pilot.

TRANSITION FROM PENETRATION

When transitioning to level flight and desiring to maintain descent airspeed:

1. Retract speedbrakes 1000 feet above leveloff altitude.
2. Leave throttles at 1500 lbs per hour, and maintain 250 KIAS by smoothly raising nose.
3. As aircraft reaches leveloff altitude, add power to maintain desired airspeed.

Note

Rate of descent should never exceed actual altitude above terrain.

When transitioning to level flight and desiring to change to the landing configuration:

1. Commence raising nose smoothly 1000 feet above leveloff altitude with speedbrakes out.
2. As IAS drops to 200 knots, lower flaps. Lower gear after flaps are down.
3. Continue descent and add power, as required, to level off at desired altitude. Maintain at least 135 knots until intercepting glide slope or on final.

Proceeding inbound to the final approach fix, aircraft speed/configuration shall be determined as follows:

1. For TACAN approaches, airspeed will be 250 KIAS and aircraft clean until reaching fix corresponding to TEN MILE GATE on CCA approach.

2. For VOR or ADF approaches when final approach fix and runway are at least ten nautical miles apart, airspeed will be 250 KIAS and aircraft clean until reaching fix.

3. For VOR or ADF approaches where final approach fix and runway are less than ten nautical miles apart, aircraft will be placed in landing configuration and slowed to 135 KIAS when inbound out of penetration turn.

CCA APPROACHES

(See Section III, Part 4)

GCA APPROACHES

GCA approaches will be utilized whenever possible, even in visual weather. Communications will be established prior to commencing penetration.

The GCA pattern will be flown at 135 knots in the landing configuration until on final, when the aircraft will be slowed to normal approach speed.

Waveoffs will be as directed by the GCA controller; however, conditions permitting, the aircraft will climb straight ahead to 1000 feet prior to commencing turn. The aircraft will normally remain in the landing configuration while in the GCA pattern.

CHANGING RADIO CHANNELS

The pilot will not change radio channels below 2500 feet while on instruments or at night, unless required by the mission (and then only in level flight). However, the photo-navigator may change radio channels at any altitude when so directed by the pilot.

WEATHER CONSIDERATIONS

ICE

The aircraft is not equipped to fly continuously in icing conditions; and flights shall be planned to avoid such areas. (Avoid premature descents into known icing conditions, e.g., radar vector enroute descents).

The rate of climb and descent are great enough that icing should be encountered for only a short time. The pitot heat and bleed air heat to the engine inlet guide vanes are anti-icing equipment, not deicing equipment and must be turned on prior to entering the area where icing is expected. If a considerable amount of ice does build up on the wings and other areas, it is important to maintain proper airspeed. If ice is encountered during the penetration, a higher approach speed and shallow turns should be used due to increased stalling speed.

THUNDERSTORM PENETRATION

Power and attitude are the key to good thunderstorm flying. If necessary to penetrate a thunderstorm, the following procedures shall apply:

The storm should be penetrated at 220 - 250 KIAS and at an altitude where the least turbulence is to be expected. If this is not possible, it should be penetrated at an altitude as high as practicable, yet where good control can be maintained. It is much better to penetrate at 35,000 feet where control is positive and extra thrust is available than to penetrate at 40,000 feet where the aircraft is just above the buffet. The aircraft shall not be flown on autopilot during penetration. The attitude gyro and gyro compass should be used to maintain pitch attitude and heading. The possibility of icing always exists in a thunderstorm whether at high altitude or low; therefore, the anti-icing switch will be turned on prior to penetration. Instrument lights will be turned on bright.

The pilot's viewfinder gyro horizon indicator, powered by the ASB-1B gyros, will be utilized and turned up bright.

ICING OF PITOT-STATIC INSTRUMENTS

Icing may sometimes result in loss of static pressure to the instruments. This may be recognized by simultaneous failure of airspeed, altimeter, and rate of climb.

COLD WEATHER OPERATION

The majority of cold weather operating difficulties are encountered on the ground. Extreme diligence must be exercised by both ground and flight personnel if operations are to be successful. The procedures presented herein are intended to supplement those outlined for normal operations in Section III.

ICE, SNOW, AND RAIN

Ice, snow, and rain may be encountered both in flight and on the ground. Ground protection consists mainly of a thorough postflight inspection and the provision of adequate cover for the aircraft. The aircraft is not

equipped to prevent ice formation on the wings or fuselage and should not be flown in areas where heavy icing is likely to be encountered. Rain and dry snow present no particular problem except that of restricted vision. The aircraft is equipped with engine anti-icing equipment, and pitot and angle-of-attack probe heat for the prevention of ice formation during normal operation; however, this equipment is not sufficient protection should prolonged exposure to icing conditions become necessary. The engine anti-icing system uses hot air bled from the engine compressor section, and the amount of heat available is dependent upon engine rpm. In the event the system is required at altitude, it is recommended that altitude be reduced rather than rpm increased, since the engine rpm necessary to offset the thrust loss due to operation of this equipment can result in a considerable loss in range.

GROUND CREW

Ground crew personnel must ensure that the following preflight is performed:

1. Drain fuel tanks of all water prior to fueling.

2. After fueling allow sufficient time for entrapped water to settle (optimum time 8 hours); drain again prior to flight.

3. If the aircraft is fueled with fuel 40 degrees Fahrenheit or below, ice formation is slight due to the small amount of dissolved water, assuming steps 1 and 2 have been followed.

BEFORE ENTERING AIRCRAFT

In addition to a thorough preflight inspection by the ground crew, the following checks should be made:

1. See that all protective covers and plugs are removed.

2. Check engine intakes for evidence of ice. Make sure the compressors are free to rotate; engine heat on shutdown melts ice accumulated during the previous flight, and the moisture may refreeze in the lower sections of the low-pressure compressor blades. Apply external heat if necessary, and start the engines as soon as possible after they are free.

3. Check fuel tank vents, pitot tube, angle-of-attack probe, temperature sensing element, fuselage and wing drainage and vent outlets, and remove all evidence of ice.

4. Make sure fuel sumps have been drained. Check lines and shutoffs.

5. Clean dirt and ice from struts and exposed actuating cylinder pistons.

6. Thoroughly check control surfaces and hinges.

7. Check the entire aircraft for freedom from frost, snow, and ice. Remove frost or snow by light brushing, ice by application of heat.

CAUTION

Ensure that ice melted by external heat does not reform. Recheck control hinges thoroughly. Do not scrape or chip ice from any surface.

8. Check landing gear and struts for freedom from ice, snow, or dirt. Inspect limit switches and fairing door hinges, actuating cylinder pistons, and wheels.

9. Check landing flap hinges, rollers, and limit switches.

10. Actuate camera window sliding doors.

11. Use external power for operating and ground checking all electrical and radio equipment.

ON ENTERING AIRCRAFT

1. Check operation of upper and lower escape hatches.

2. Make a thorough check of the controls, both by feel and visually.

BEFORE STARTING ENGINES

Make certain wheels are securely chocked to prevent slippage during the start.

STARTING AND WARMUP

1. Start the engines using normal starting procedure. Heating of jet engines is seldom required unless external power source is weak. If necessary, apply external heat to accessory section to reduce starter loads.

2. Check oil pressure for indication within 30 seconds. Pressure may exceed maximum limits temporarily during extreme cold weather starts.

3. Turn on necessary electrical equipment only after positive indication of generator operation.

4. Check all instruments for normal operation and indications within allowable limits.

5. Recheck hydraulic system. Each control should be operated through its complete cycle several times for assurance of proper pressure and operation.

TAXIING

1. exercise extreme caution when passing other aircraft, buildings, and other obstructions when ice is present. Fast turns or heavy crosswinds can cause skidding. Brakes are ineffective on ice.

2. Be particularly careful in maneuvering near other aircraft, since exhaust heat and blast will blow melted snow and slush which will refreeze on contact.

3. Avoid taxiing in deep snow or slush. Steering will be more difficult and brakes, gear, and flaps may freeze after takeoff.

BEFORE TAKEOFF

1. Windshield defogging shutoff valve – OPEN.

WARNING

Do not attempt takeoff with frosted windshield, or with snow, ice, or frost formation on wings or control surfaces.

2. Recheck nosewheel steering if takeoff is not begun immediately after taxiing.

3. Pitot heat, if required – ON.

TAKEOFF

1. Apply brakes and advance throttles to MILITARY. If aircraft starts to skid, release brakes and begin takeoff run. Continue engine check during early part of takeoff run. If takeoff must be aborted, use brakes lightly.

2. After takeoff from a snow or slush-covered runway, operate landing gear and flaps through several cycles to prevent their freezing in the up position.

3. Watch closely for signs of icing. Engine icing will be indicated by excessive tailpipe temperatures and loss of thrust.

CAUTION

At low outside air temperatures, turbine outlet temperatures may exceed operating limits at a lower engine rpm than a normal OAT, and flight instruments may be inaccurate. Maintain a reasonable margin of safety on all indicators.

DURING FLIGHT

Under certain atmospheric conditions it is possible for fog to accumulate in the cabin while pressurized, causing a serious restriction to visibility. Turn the cabin temperature rheostat to the full increase position or the momentary MAN HOT position. After the cabin has cleared, readjust the temperature control rheostat to a temperature higher than the original. If a comfortable temperature cannot be maintained without fogging, depressurize the cabin until more favorable atmospheric conditions exist. Refer to Section I, Part 2, Air Conditioning and Pressurizing System.

DESCENT

Follow the normal procedure for letdown. Operation of engine anti-icing equipment will require an increase in engine rpm to offset the resulting loss of thrust.

LANDING

WARNING

When slowing to approach speed following a penetration through icing conditions, failure of the outboard slats to extend may cause a severe pitchup.

Follow normal landing procedures, exercising extreme caution at touchdown. All drift must be eliminated to prevent blowing the tires during the landing roll. Refer to Section III, Part 3, Wheel Brakes.

SHUTDOWN AND POSTFLIGHT

1. Follow normal procedure for shutdown.

2. See that wheels are securely chocked.

3. Have aircraft serviced and fuel sumps drained.

4. See that all covers and plugs are securely installed and that aircraft is tied down.

HOT WEATHER AND DESERT OPERATION

Proper protection of the aircraft while on the ground is of primary importance during hot weather operation. The following procedures supplement the normal operating procedure outlined in Section III.

BEFORE ENTERING AIRCRAFT

CAUTION

Metal surfaces exposed to the sun are often hot enough to cause serious burns. It is advisable to use gloves when contact with these surfaces is necessary.

1. Check tires and struts for proper inflation, as high temperatures may cause overinflation.

2. Check thoroughly for accumulation of sand or dust.

3. Check for fuel, oil and hydraulic leaks which may have been caused by expansion of valves or packing.

4. In locations where high humidity is encountered, nonmetallic equipment is subject to corrosion, fungus, and moisture absorption. See that such equipment is completely dry and in operating condition.

5. Cool cabin with a portable cooler, if available.

6. Actuate camera window sliding doors.

ON ENTERING AIRCRAFT

If necessary, apply heat to dry instruments and controls which may be damp with condensation moisture.

STARTING ENGINES

Use normal starting procedures. Engines will accelerate to idle much more slowly than on a normal or cold day.

TAXI AND TAKEOFF

1. Use brakes as little as possible during taxi and takeoff.

2. Hold taxi time to a minimum and watch turbine outlet temperatures closely.

3. Stalling speeds are increased in extremely hot weather. Strict adherence to recommended takeoff and climbing speeds is necessary, as takeoff distances are considerably increased in hot weather. The total impulse provided by JATO, however, is not affected significantly.

CLIMB

Extremely high OAT has a considerable effect on climb performance. On a very hot day, military rated thrust may be required to give the same rate of climb as normal rated thrust on a standard day. However, since fuel vaporization losses are high during rapid climbs to altitude, the rate of climb should be held as low as practicable.

CAUTION

Thunderstorms occurring during hot weather are extremely hazardous and should be avoided if at all possible. If penetration cannot be avoided, follow instructions in this section under Thunderstorm.

DESCENT AND LANDING

Use normal letdown and landing procedure. True airspeed will be higher than normal for a given indicated airspeed, and touchdown speed will be higher than usual. Turbulence during the final approach and flareout may be expected, and the landing roll will be considerably longer.

POST FLIGHT

1. Have wheels securely chocked.

2. See that protective covers and plugs are installed.

3. Leave ditching hatch and emergency escape chute doors open on calm days to provide ventilation. If sandstorms or other foul weather is anticipated, close hatches and doors, and moor aircraft (see figure 1-41).

4. Have aircraft serviced. Fuel tanks must not be topped since excessive heat will cause the tanks to overflow, thereby creating a fire hazard.

5. In dusty or sandy areas, interior equipment should be covered.

Pages 6-4 through 6-8 deleted

but it may be diluted, if required for spraying, up to the proportion of one part water to two parts fluid. It should be noted, however, that dilution decreases the ice or frost-melting efficiency of the fluid.

ANTI-ICING, DEICING, AND DEFROSTING FLUID

(For use below 10°.)

MATERIAL

For preventing the formation of and for removing deposits of frost, ice, etc., on the exterior surfaces of aircraft on the ground at temperatures below 10°F, use should be made of lithium chloride base anti-icing, deicing, and defrosting fluid, Stock No. RM6850-577-4752-G500. The material is very efficient at temperatures down to -15°F, and is effective down to -65°F, but its rate of ice-melting decreases as the temperature decreases. For anti-icing, it should be applied prior to expected ice or snow conditions. As noted, this fluid should be used for temperatures below 10°F, but it may be used between 32°F and 10°F, when MIL-D-7946, deicing-defrosting fluid, is not available.

ANTI-ICING, DEICING, AND DEFROSTING FLUID APPLICATION

The fluid is supplied ready-mixed for use and may be applied by swabbing or brushing. If wind conditions permit, the fluid may also be applied by high-pressure spray equipment. If required, for low-pressure spraying, it may be diluted up to the proportion of one part of water to two parts of fluid. It should be noted, however, that dilution decreases the ice or frost-melting efficiency of the fluid. For information, an applied film thickness of 0.003 inch will cover approximately 500 square feet of surface per gallon of fluid. This thickness will suffice for most purposes. During service evaluation, four pints of fluid removed one-half inch of ice from one wing of a fighter-type aircraft in thirty minutes at 17°F, and twelve pints removed one-quarter inch of ice from one wing of a patrol-type aircraft in twenty minutes at -5°F.

CAUTION

Although the above defrosting and anti-icing and deicing fluids are nonflammable, nontoxic, noncorrosive, and will not injure fabric, they contain a solid ingredient. Therefore, care shall be exercised to avoid coating engine surfaces; to avoid penetration into air ducts leading to carburetors, oil coolers, etc. and to avoid coating the surfaces of transparent materials where visibility through the materials might be impaired.

If the above fluids are not available, anti-icing fluid (isopropyl alcohol), Stock No. R-51F-516/-519, or specially denatured alcohol, Stock No. R51-A-1946/-1947, may be used, instead. However, these alcohols are volatile, and protection to aircraft surfaces will not be afforded for an extended period after application; whereas, the lithium chloride base fluids are considerably less volatile, and protection to aircraft surfaces will be afforded for an extended period after application; that is, up to twenty-four hours, depending on the rate of dilution caused by melting ice, snow, etc. (Refer to previous paragraphs for method application of the alcohols.)

WARNING

- Care shall be taken to keep these alcohols away from fire, sparks, etc., since they are flammable, and are known to have caused fires when trapped in engine nacelles. Care shall also be taken to ensure that they do not contact acrylic plastic (plexiglas or Lucite) turret domes, canopies, etc., since they will cause cracking or crazing of the transparent plastic material. These alcohols are toxic and shall not be taken internally, and care shall be taken to avoid breathing the vapors to excess.
- All of these fluids have an irritating effect on the eyes, throat, nasal passages, etc., and care shall be taken to prevent contact with mucous membranes, especially if sprayed. Personnel applying these fluids shall wear an approved type of respirator and eye protector.

HOT WEATHER AND DESERT OPERATION

Proper protection of the aircraft while on the ground is of primary importance during hot weather operation. The following procedures supplement the normal operating procedure outlined in Section III.

BEFORE ENTERING THE AIRCRAFT

CAUTION

Metal surfaces exposed to the sun are often hot enough to cause serious burns. It is advisable to use gloves when contact with these surfaces is necessary.

1. Check tires and struts for proper inflation, as high temperatures may cause overinflation.

2. Check thoroughly for accumulation of sand or dust.

3. Check for fuel, oil and hydraulic leaks which may have been caused by expansion of valves or packing.

4. In locations where high humidity is encountered, nonmetallic equipment is subject to corrosion, fungus and moisture absorption. See that such equipment is completely dry and in operating condition.

5. Cool cabin with portable cooler, if available.

ON ENTERING THE AIRPLANE

1. Check for stowage of appropriate equipment and survival gear.

2. If necessary, apply heat to dry instruments and controls which may be damp with condensation moisture.

STARTING THE ENGINES

Cover as much of the preflight inspection as possible before starting the engines. Use normal starting procedures. Engines will accelerate to idle much more slowly than on a normal or cold day.

TAXI AND TAKE-OFF

1. Use brakes as little as possible during taxi and takeoff.

2. Hold taxi time to minimum and watch turbine outlet temperatures closely.

3. Stalling speeds are increased in extremely hot weather. Strict adherence to recommended takeoff and climbing speeds is necessary, as takeoff distances are considerably increased in hot weather. Total thrust provided by JATO, however, is not affected significantly.

CLIMB

Extremely high OAT has a considerable effect on climb performance. On a very hot day, military rated thrust may be required to give the same rate of climb as normal rated thrust on a standard day. However, since fuel vaporization losses are high during rapid climbs to altitude, the rate of climb should be held as low as practicable.

DURING FLIGHT

CAUTION

Thunderstorms occurring during hot weather are extremely hazardous and should be avoided if at all possible. If penetration cannot be avoided, follow instructions in this section under the heading Flight in Turbulence.

DESCENT AND LANDING

Use normal letdown and landing procedure. True airspeed will be higher than normal for a given indicated airspeed, and touch-down speed will be higher than usual. Turbulence during the final approach and flare-out may be expected, and the landing roll will be considerably longer. Deploy the drag chute. Minimize the use of brakes.

POSTFLIGHT

1. Wheels securely chocked.

2. See that protective covers and plugs are installed.

3. Leave ditching hatch and emergency escape chute doors open on calm days to provide ventilation. If sandstorms or other foul weather is anticipated, close hatches and doors and moor aircraft.

4. Have airplane serviced. Fuel tanks must not be topped since excessive heat will cause tanks to overflow, thereby creating fire hazard.

5. In dusty or sandy areas, interior equipment should be covered.

OPERATING INSTRUCTIONS

BEFORE ENTERING AIRCRAFT

In addition to a thorough preflight inspection by the ground crew, the following checks should be made:

1. See that all protective covers and plugs are removed.

2. Check engine intakes for evidence of ice. Make sure compressors are free to rotate; engine heat on shutdown melts ice accumulated during previous flight, and moisture may refreeze in lower sections of low pressure compressor blades. Apply external heat if necessary, and start engines as soon as possible after they are free.

3. Check fuel tank vents, pitot tube, angle-of-attack probe fuselage and wing drainage, and vent outlets. Remove all evidence of ice.

4. Make sure fuel sumps have been drained. Check lines and shutoffs.

5. Clean dirt and ice from struts and exposed actuating cylinder pistons.

6. Thoroughly check control surfaces and hinges.

7. Check entire aircraft for freedom from frost, snow, and ice. Remove frost, ice, or snow by light brushing, or by application of chemicals.

CAUTION

Make sure ice melted by chemicals does not reform. Recheck control hinges thoroughly. Do not scrape or chip ice from any surface.

8. Check landing gear and struts for freedom from ice, snow, or dirt. Inspect limit switches and fairing door hinges, actuating cylinder pistons and wheels.

9. Check landing flap hinges, rollers and limit switches.

10. Use external power for operating and ground checking all electrical and radio equipment.

ON ENTERING THE AIRCRAFT

1. Check for stowage of appropriate equipment and survival gear.

2. Check operation of the ditching hatch.

3. Make thorough check of controls, both by feel and visually.

4. Actuate camera window sliding doors.

BEFORE STARTING ENGINES

Make sure wheels are securely chocked to prevent slippage during the start.

STARTING AND WARM-UP

1. Start engines, using normal starting procedure. Heating of jet engines is seldom required unless external power source is weak. If necessary, apply external heat to accessory section to reduce starter loads.

2. Check oil pressure for indication within 30 seconds. Pressure may exceed NORM temporarily during extreme cold weather starts.

3. Turn on necessary electrical equipment only after positive indication of generator operation.

4. Check all instruments for normal operation and indications within allowable limits.

5. Recheck hydraulic system. Each flight control should be operated through complete cycle several times for assurance of proper pressure and operation.

TAXIING

1. Exercise extra caution when taxiing on ice.

2. Be particularly careful in maneuvering near other aircraft, since exhaust heat and blast will blow melted snow and slush which will refreeze on contact.

3. Avoid taxiing in deep snow or slush. Steering will be more difficult and brakes, gear, and flaps may freeze after takeoff.

4. Take shortest possible route to the takeoff position. Snow and ice increase taxi time, and ice fog caused by prolonged ground operation could delay takeoff.

BEFORE TAKEOFF

1. Windshield defrost switch . . . . . ON

WARNING

Do not attempt takeoff with frosted windshield, or with snow, ice or frost formation on wings or control surfaces.

2. Recheck nosewheel steering if takeoff is not begun immediately after taxiing.

3. Anti-icing switch, if required . . . . . ALL or PITOT ONLY or ON

TAKEOFF

1. Apply brakes and advance throttles to MILITARY. If aircraft starts to skid, release brakes and begin takeoff run. Continue engine check during early part of takeoff run. If takeoff must be aborted, deploy drag chute, use brakes lightly. Let aircraft roll to stop, if space permits.

2. After takeoff from snow or slush-covered runway, operate landing gear and flaps through several cycles to prevent their freezing in UP position.

CAUTION

Observe landing gear and flap airspeed limitations.

3. Watch closely for signs of icing. Engine icing will be indicated by excessive tailpipe temperatures and loss of thrust.

CAUTION

At low outside air temperatures (OAT), turbine outlet temperatures may exceed operating limits at a lower engine rpm than at normal OAT, and flight instruments may be inaccurate. Maintain a reasonable margin of safety on all indicators.

DURING FLIGHT

Under certain atmospheric conditions, it is possible for fog to accumulate in the pressurized cabin, causing a serious restriction to visibility. For climbs and descents in humid climates, turn the cockpit temperature knob to the full WARMER (not the MAN HOT) position. After the cabin has been cleared, readjust the temperature control to a setting higher than the original. If a comfortable temperature cannot be maintained without fogging, depressurize the cabin until more favorable atmospheric conditions exist. Refer to Section I, Part 2, Air Conditioning and Pressurizing System.

DESCENT

Follow the normal procedure for letdown. Operation of engine anti-icing equipment will require an increase in engine rpm to offset the resulting loss of thrust, and may necessitate a gear-down descent.

WARNING

After descent through icing conditions the pilot/crew should be alert for stuck outer wing slats when transitioning to landing configuration. If the outer wing outboard slats fail to extend severe pitchup will be encountered. (For no-slats flight characteristics, refer to WING SLATS in Sections IV and V.)

LANDING

1. Follow normal landing procedures.

2. Deploy drag chute if snow or ice are on runway.

3. Use antiskid brake system. Use brakes lightly at wheel speeds under 70 knots. Refer to Wheelbrakes in Section I.

4. If space permits, let airplane roll to stop.

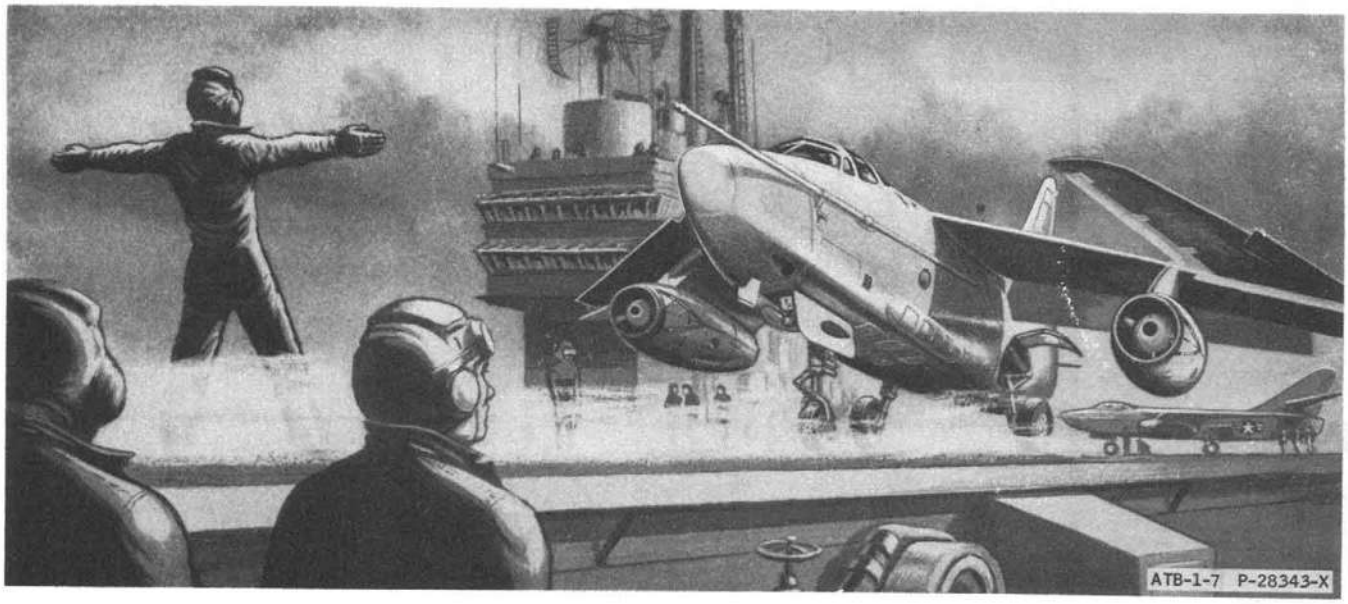
SHUTDOWN AND POSTFLIGHT

1. Follow normal procedure for shutdown.

2. See that wheels are securely chocked.

3. Have aircraft serviced and fuel sumps drained.

4. See that all covers and plugs are securely installed and aircraft tied down.



SECTION VII

COMMUNICATIONS PROCEDURES

INTRODUCTION

This section contains detailed communications procedures (refer to tables 7-1 thru 7-8), encompassing pilot responsibility, radio discipline, emergency communications, radio communications equipment, electronic navigation equipment, visual communications and deck and ground handling signals (see figure 7-1).

PILOT RESPONSIBILITY

It is the responsibility of the pilot to ensure that all radio and electronic transmissions from his aircraft are in compliance with applicable directives. It is imperative that all crew members be thoroughly and properly indoctrinated in all communications equipment installed in the RA-3B.

RADIO COMMUNICATIONS

AIR-TO-GROUND COMMUNICATIONS

The pilot may delegate communication functions to his crewmembers except when directed by radio from external sources i.e., approach control, GCA, etc. In such instances it is essential that the pilot personally acknowledge instructions received from the controlling agency.

RADIO DISCIPLINE

Adherence to the following instructions will ensure the desired degree of radio discipline:

1. Do not interrupt another transmission.
2. Keep all transmissions brief and concise.
3. Use phonetic alphabet and approved phraseology; be familiar with use of Fighter Director Vocabulary, ACP-135.
4. Be familiar with communications sections of Flight Planning Document.
5. Maintain listening watch on GUARD frequencies at all times (121.5 and 243.0 mc); do not transmit on GUARD except in actual emergency.

EMERGENCY COMMUNICATIONS

(Refer to table 7-7.)

Comply with OPNAV Instructions and the steps on the inside back cover of the FLIP, En Route Supplement. The steps are repeated below for convenience:

1. MAYDAY (or PAN, as applicable) three times. This is followed by aircraft call sign (three times) and frequency on which transmission is being made (243.0 UHF or 121.5 mc VHF).
2. Type of aircraft
3. Position and time

Figure 7-1. Deck and Ground Handling Signals (Sheet 1)

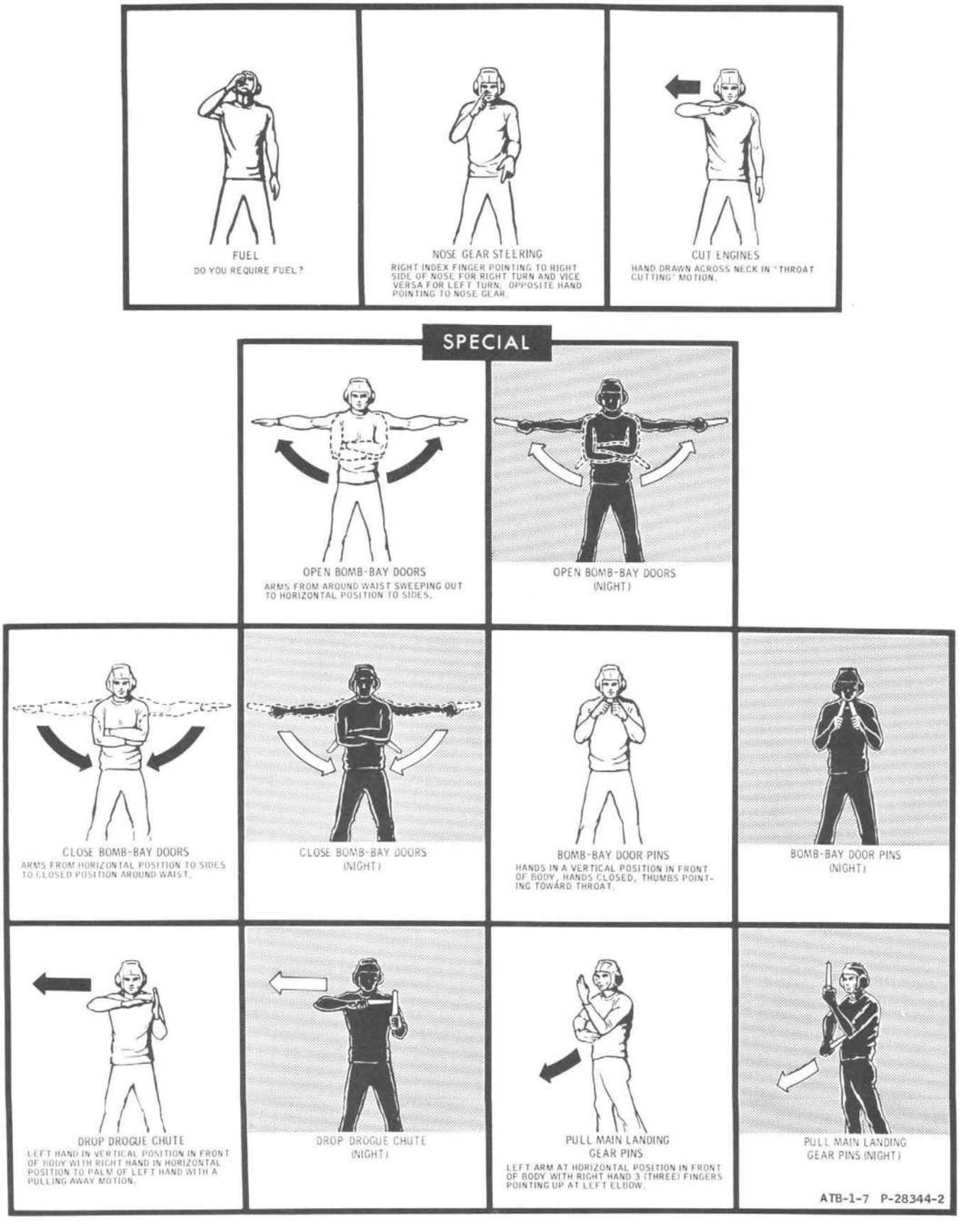


Figure 7-1. Deck and Ground Handling Signals (Sheet 2)

4. Heading
5. True airspeed
6. Altitude
7. Fuel remaining (in hours and minutes)
8. Nature of emergency
9. Pilot's intentions (bailout, etc.)
10. Assistance desired.

RADIO COMMUNICATIONS EQUIPMENT

1. UHF is primary means of voice communications in RA-3B. All aircraft will have current frequency plan for UHF, VHF, and HF.

2. VHF is secondary means of communications.

3. Aircraft is equipped with AN/ARC-38A HF radio for long range voice and cw communications which gives additional communicating capabilities. The operation of all communications equipment as well as UHF-VHF is described in Section I, Part 2.

ELECTRONIC NAVIGATION EQUIPMENT

The aircraft contains three electronic aids to navigation in addition to ASB-IB radar. They are:

UHF Direction Finder or Direction Finder (ADF)

VOR

TACAN

IFF/SIF PROCEDURES

1. Aircraft operating within continental U.S. will operate IFF/SIF equipment to conform with OPNAV/FAA regulations unless otherwise directed by competent authority. During carrier operations, all aircraft will operate IFF as prescribed by appropriate directives.

2. When aircraft is lost or has an inflight emergency, and is unable to obtain assistance by other means. The IFF will be placed in EMERG and the SIF set on MODE 3, CODE 77.

VISUAL COMMUNICATIONS PROCEDURES

The visual communications section of NWP 41 must be reviewed and practiced by all pilots and crew members. For ease of reference, visual signals applicable to flight operations in RA-3B aircraft are contained in figure 7-1.

TABLE 7-1. GENERAL CONVERSATION

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Thumbs up, or nod of head.	Flashlight moved vertically up-and-down repeatedly.	Affirmative. ("Yes," or, "I understand.")	
Thumbs down, or turn of head from side to side.	Flashlight moved horizontally back-and-forth	Negative. ("No," or, "I do not understand.")	
Hand cupped behind ear as if listening.		Question. Used in conjunction with another signal, this gesture indicates that the signal is interrogatory.	As appropriate.
Hand held up, with palm outward.		Wait.	
Hand waved back and forth in an erasing motion in front of face, with palm turned forward.	Letter N in code, given with external lights.	Ignore my last signal.	

TABLE 7-1. GENERAL CONVERSATION (Continued)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Hand held up, with thumb and forefinger forming an O and remaining fingers extended.		Perfect, well done.	
Employ fingers held vertically to indicate desired numerals 1 through 5. With fingers horizontal, indicate number which added to 5 gives desired number from 6 to 9. A clenched fist indicates 0. (Hold hand near canopy when signaling.)		Numerals as indicated.	A nod of the head ("I understand"). To verify numerals, addressee repeats. If originator nods, interpretation is correct. If originator repeats numerals, addressee should continue to verify them until they are understood.

TABLE 7-2. TAKEOFF, CHANGING LEAD, LEAVING FORMATION, BREAKUP, LANDING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. With two aircraft on runway. Takeoff leader raises either forearm to vertical position		1. I have completed my takeoff checklist and am ready for takeoff.	1. Stands by for reply from wingman, holding arm up until answered.
2. Wingman raises forearm.		2. I have completed my takeoff checklist and am ready for takeoff.	2. Wingman lowers arm and stands by for immediate takeoff.
3. Leader lowers arm.		3. Takeoff path is clear, I am commencing takeoff.	3. Execute section takeoff. Ten-second interval.
1. Leader pats self on the head, points to wingman.		Leader shifting lead to wingman.	1. Wingman pats head and assumes lead.
	2. Leader shines flashlight on hard-hat then shines light on wingman.		2. Wingman shines flashlight at leader, then on his hard-hat. Turns external lights to DIM/STDY and assumes lead.
Leader pats self on head and holds up two or more fingers.		Leader shifting lead to division designated by numerals.	Wingman relay signal; division leader designated assumes lead.
Pilot blows kiss to leader.		I am leaving formation.	Leader nods ("I understand") or waves goodby.
Leader blows kiss and points to aircraft.		Aircraft pointed out leave formation.	Wingman indicated blows kiss and executes.

TABLE 7-2. TAKEOFF, CHANGING LEAD, LEAVING FORMATION, BREAKUP, LANDING (Continued)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Leader points to wingman, then points to eye, then to vessel or object.		Directs aircraft to investigate object or vessel.	Wingman indicated blows kiss and executes.
Division leader holds up and rotates two fingers in horizontal circle, preparatory to breaking off.		Section break off.	Wingman relays signal to section leader. Section leader nods ("I understand") or waves goodby and executes.
Leader describes horizontal circle with forefinger.	Series of "I's" in code, given by external lights.	Breakup (and rendezvous).	Wingman take lead, pass signal after leader breaks, and follow.
Landing motion with open hand: 1. Followed by patting head. 2. Followed by pointing to another aircraft.		Refers to landing of aircraft, generally used in conjunction with another signal. 1. I am landing. 2. Directs indicated aircraft to land.	 1. Nods. ("I understand") or waves goodby. 2. Aircraft indicated repeats signal, blows a kiss and executes.

TABLE 7-3. FORMATION SIGNALS

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Open hand held vertically and moved forward or backward, palm in direction of movement.		Adjust wing-position forward or aft.	Wingman moves in direction indicated.
Open hand held horizontally and moved slowly up or down, palm in direction of movement.		Adjust wing-position up or down.	Wingman moves up or down as indicated.
Open hand used as if beckoning inboard or pushing outboard.		Adjust wing-position laterally toward or away from leader.	Wingman moves in direction indicated.
Hand opened flat and palm down, simulating dive or climb.		I am going to dive or climb.	Prepare to execute.
Hand moved horizontally above glareshield, palm down.		Leveling off.	Prepare to execute.
Head moved backward.		Slow down.	Execute.

TABLE 7-3. FORMATION SIGNALS (Continued)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Head moved forward.		Speed up.	Execute.
Head nodded right or left.		I am turning right or left.	Prepare to execute
Thumb waved backward over shoulder.	Series of 00's in code, given by external lights.	Take cruising formation or open up.	Execute.
1. Holds up right (or left) forearm vertically, with clenched fist of single wing-dip.	1. Single letter R (or K) in code, given by external lights.	1. Wingman cross under to right (or left) echelon or in direction of wing-dips.	1. Execute.
2. Same as above, except with pumping motion or double wing-dip.	2. Series of RR's (or KK's) in code, given by external lights.	2. Section cross under to right (or left) echelon or in direction of wing-dips.	2. Execute.
Triple wing-dip.		Division cross under.	Execute.
	Series of VV's in code, given by external lights.	Form a Vee or balanced formation.	Execute.
Series of zooms.	Series of XX's in code, given by external lights.	Close up or join up; join up on me.	Execute.
Rocking of wings by leader.		Prepare to attack.	Execute preparation to attack.
Rocking of wings by any other member of flight.		We are being, or are about to be, attacked.	Standby for and execute defensive maneuvers.
Lead plane swishes tail.		All aircraft in this formation form step-down column in tactical order behind column leader.	Execute. Leader speeds up slightly to facilitate formation of column.
Shaking of ailerons.	Long dash, given with external lights.	Execute signal; used as required in conjunction with another signal.	Execute last signal given.

TABLE 7-4. ELECTRONIC COMMUNICATIONS AND NAVIGATION

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Tap earphones, followed by patting of head, and point to other aircraft.		Take over communications.	Repeat signals, pointing to self, and assume communications lead.
Tap earphones, followed by patting of head.		I have taken over communications.	Nod ("I understand").

TABLE 7-4. ELECTRONIC COMMUNICATIONS AND NAVIGATION (Continued)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Tap earphones and indicate by finger-numerals, number of channel to which shifting.		Shift to radio frequency indicated by numerals.	Repeat signal and execute.
Tap earphones, extend forearm vertically, and rotate fingers, formed as if holding a grapefruit, followed by 4 numbers.		Manually set up ARC-27 on frequency indicated.	Repeat signal and execute.
Tap earphones, followed by question signal.		What channel (or frequency) are you on?	Indicate channel (or frequency) by finger-numerals.
Tap earphones and point to aircraft being called, followed by finger-numbers indicating frequency.		You are being called by radio on channel indicated by finger numbers.	Repeat numbers. Check receiving frequency and switch to channel indicated by originator. Dial in manually, if necessary.
Vertical hand, with fingers pointed ahead and moved in a horizontal sweeping motion, with four fingers extended and separated.		What is bearing and distance to the TACAN station?	Wait signal, or give magnetic bearing and distance with finger-numerals. The first three numerals indicate magnetic bearing and the last two or three, distance.
Vertical hand, with 4 fingers extended and separated, pointed ahead in a fore-and-aft chopping motion, followed by a question signal.		What is bearing to TACAN station?	Repeat signal and give bearing in three digits.
Arm and vertical hand, with 4 fingers extended and separated, moved ahead in a fore-and-aft circular motion, followed by question signal.		What is distance to TACAN station?	Repeat signal and give distance in two or three digits.
TACAN bearing or distance signal, followed by thumbs up or down.		TACAN bearing or distance, up or down.	Thumbs up or nod ("I understand").
TACAN bearing signal, followed by finger-numerals.		Switch to TACAN station indicated.	Repeat and execute.
Hand held up. First and fourth fingers extended, moved in fore-and-aft chopping motion, followed by: 1. 4 numbers		1. Set up UHF/ADF on frequency indicated.	1. Repeat signal and execute.

TABLE 7-4. ELECTRONIC COMMUNICATIONS AND NAVIGATION (Continued)

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
2. Question signal. 3. Up or down signal.		2. What is UHF/ADF bearing? 3. My UHF/ADF is up or down.	2. Repeat chopping motion, followed by wait, or three numerals indicating magnetic bearing. 3. Thumbs up or nod ("I understand").
Two fingers pointed toward eyes (meaning IFF/SIF signals), followed by: 1. "CUT". 2. 3-digit numerals.		 1. Turn IFF/SIF to STANDBY. 2. Set mode and code indicated: first numeral-mode, second and third numerals - code.	Repeat, then execute.
1. Open hand held up, fingers together, moved in fore-and-aft chopping motion (by leader). 2. Followed by question signal. 3. Followed by three-finger numerals.		1. Course to be steered is present compass heading. 2. What is your compass heading? 3. My compass heading is as indicated by finger-numerals.	1. Nod of head ("I understand"). 2. Repeat signal and give compass heading in finger-numerals. 3. Nod or clarify, as appropriate.

TABLE 7-5. AIRCRAFT AND ENGINE OPERATION

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Raise fist with thumb extended in drinking position.		How much fuel have you?	Repeat signal, then indicate fuel in hundreds of pounds by finger-numbers.
Rotary movement of clenched fist in cockpit as if cranking wheels.	Letter W in code, given by external lights.	Lower or raise landing gear and flaps, as appropriate.	Repeat signal. Execute when leader changes configuration.
Leader lowers hook.	Letter H in code, given by external lights.	Lower arresting hook.	Wingman lower arresting hook. Leader indicate wingman's hook is down with thumbs-up signal.
Open and close four fingers and thumb.		Extend or retract speedbrakes, as appropriate.	Repeat signal. Execute upon head-nod from leader or when leader's speedbrakes extend/retract.

TABLE 7-6. AIR REFUELING

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
One finger turn-up signal.		By receiver: start turbine and extend drogue.	Tanker execute. Receiver gives thumbs-up when turbine starts.
Form cone-shape with hand, all fingers extended aft (make signal close to canopy). 1. Cone moved aft. 2. Cone moved forward.		1. By receiver: extend drogue. 2. By receiver: retract drogue.	Tanker execute. Receiver give thumbs-up if: 1. Drogue extends properly. 2. Drogue retracts fully and air turbine feathers.
Make hand into cupshape, then make repeated pouring motions.		By tanker: I am going to dump fuel.	By receiver: Nod. Give thumbs-up when fuel dumping commences.
Slashing motion of index finger across throat.		By tanker: I have stopped dumping fuel.	By receiver: Give thumbs-up if fuel dumping has ceased.

TABLE 7-7. EMERGENCY SIGNALS BETWEEN AIRCRAFT*

SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
Arm bent across forehead, weeping. 1. Followed by HEFOE signal and code. 2. Followed by landing signal.	1. HEFOE signal and code. 2. HEFOE signal and code, followed by wheels-signal.	I am in trouble. 1. I am having trouble with indicated system. 2. I must land immediately.	Excort disabled plane, assuming lead, if indicated and return to base or nearest suitable field.
MALFUNCTIONING OF EQUIPMENT (HEFOE CODE)			
Clenched fist held to helmet-visor and then indicating by finger-numbers 1 to 5 the affected system.	Flashlight held close to top of canopy, pointed toward wingman, followed by 1 to 5 dashes to indicate system affected.	Number of fingers or dashes means: 1. Hydraulic system. 2. Electric system (including TACAN and flight instruments). 3. Fuel system. 4. Oxygen system. 5. Engine.	Day: Nod, or thumbs-up ("I understand"). Night: Vertical movement of flashlight. Pass lead to disabled plane or assume lead, if indicated.

*Refer to NWP-41(A) for all emergency Aircraft to Carrier and Carrier to Aircraft signals.

TABLE 7-8. ARMING AND DEARMING SIGNALS

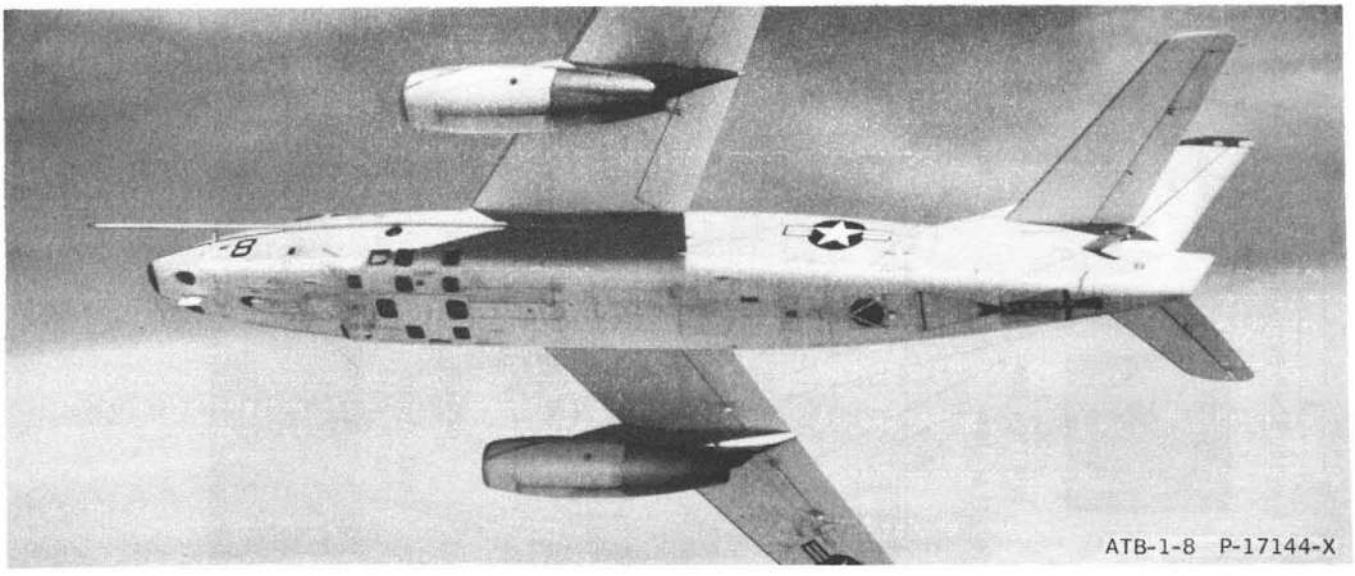
SIGNAL		MEANING	RESPONSE
DAY	NIGHT		
1. Arming supervisor: Pistol cocking motion with either hand.	Same	Pilot: Check all armament switches OFF and SAFE.	Pilot: Execute. Raise both hands to view of arming supervisor of checking switch positions. (Hands remain in view during check and hookup.)
2. Arming supervisor points at crewmember (used if applicable).	Same.	Crew: Perform stray voltage checks.	Arming crew: Execute. Give arming supervisor thumbs up if no stray voltage exists.
3. Arming supervisor: Raises fist, thumb extended upward, to meet horizontal palm of other hand.	Same.	Arming crew: (as applicable) arm circuit.	Arming crew: Execute. Give arming supervisor thumbs up when arming completed and clear immediate area.

TABLE 7-9. JATO PROCEDURES

Note

If an emergency situation arises not covered by the below procedures, a crossed arms signal will be given by person(s) involved. Upon receipt of this signal, the pilot will shutoff all JATO switches. The safety officer will proceed to the Aircraft and verbally communicate with the pilot.

CREW CHIEF	PILOT	ACTION/RESPONSE
POSITIVE ELECTRICAL VOLTAGE TEST		
Hand horizontal	Both hands in view	JATO master ON JATO master switch ON JATO arming light ON
	Thumb down	JATO arming light not ON
Clenched fist		Rotate catapult lever down Depress & hold firing button
Point to JATO Crew		JATO crew conduct voltage test
Fingers clenched thumb horizontal		Release firing button
	Both hands in view	Firing button released
NO VOLTAGE ELECTRICAL TEST		
Point to JATO Crew		JATO crew conduct NO voltage test
Grasp thumb & pull rearward		Rotate catapult lever UP JATO master switch off JATO arming light OFF Hold brakes HARD
	Both hands in view	Catapult lever UP JATO master switch OFF JATO arming light OFF Brakes being held HARD
CONNECTION OF JATO IGNITERS		
Thumb extended up into palm of other hand	Both hands in view	JATO Crew connect igniters
THUMBS UP		JATO plug-in completed JATO crew clear of aircraft



SECTION VIII

WEAPONS SYSTEMS
PHOTOGRAPHIC SYSTEM

INTRODUCTION

The RA-3B weapons system is the photographic system which consists of twelve camera positions with associated cameras and camera mounts, two photo-navigational viewfinders, electrical components and connectors necessary to operate the cameras, and night photographic capabilities using photoflash bombs and cartridges. The photographic control system is designated NCCS-4a, a modification of the camera control system NCCS-3, -4, and some of the operating components are not interchangeable with similar components from aircraft using the NCCS-3, -4 system. The heart of the system is the central computer and the system relay unit, which are essential to the operation of the system; this photographic system will not function even in part after the removal of these two units. Remote control of all cameras is possible from the cockpit by either pilot or photo-navigator, except the position 2 camera, which is controlled by the pilot only. The cameras and electrical components are located in the camera compartment. The pressurized camera compartment has twelve camera positions and sixteen camera windows. The windows are made of precision, optically-ground glass, and are protected by metal sliding doors, manually operated by hand cranks located near each window. Three racks for extra film magazine storage are provided, one on the left-hand side and two on the right-hand side of the compartment.

The electrical components are mounted on two equipment racks, one on the right-hand side of the compartment and the other on the left-hand side. The viewfinder electronic package, containing the circuitry necessary for viewfinder operation, is located in the right-hand ATM compartment. (For the location of the components of the photographic system, see figure 8-1.) A block diagram of the power distribution of the camera control system is shown in figure 8-18. A diagram of the camera vacuum system is shown in figure 8-14.

The ASB-1B radar, radar recording camera, and the night illuminant system are included in the weapons system of the RA-3B. Equipment description, operating procedures, and illuminant drop tables (tables 8-15 through 8-18) provide the information necessary to operate these systems.

Detailed technical information on the photographic system, radar recording camera, and the night illuminant system may be found in the HMI, NAVAER 01-40ATB-2-8. Technical information on the ASB-1B radar is found in NAVAER 01-40ATB-2-9.

The photographic system uses standard aerial cameras: the CA-3-2 (CA-3-2B), CA-13, CA-14, KA-40A, KA-46A, KA-47A, and the KA-53A; and two

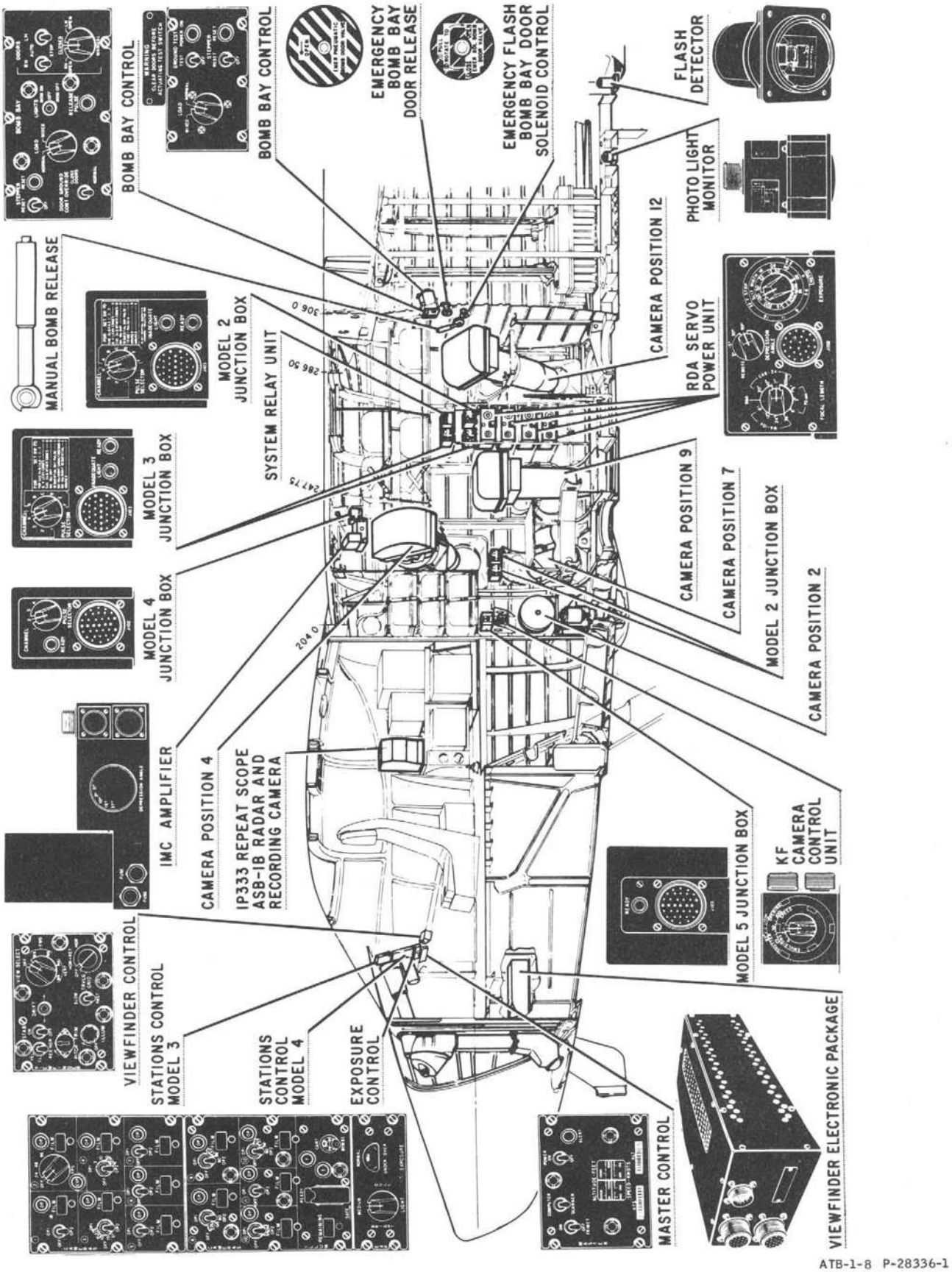


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Figure 8-1. Photo Control Equipment Arrangement Right-Hand Side (Sheet 1)

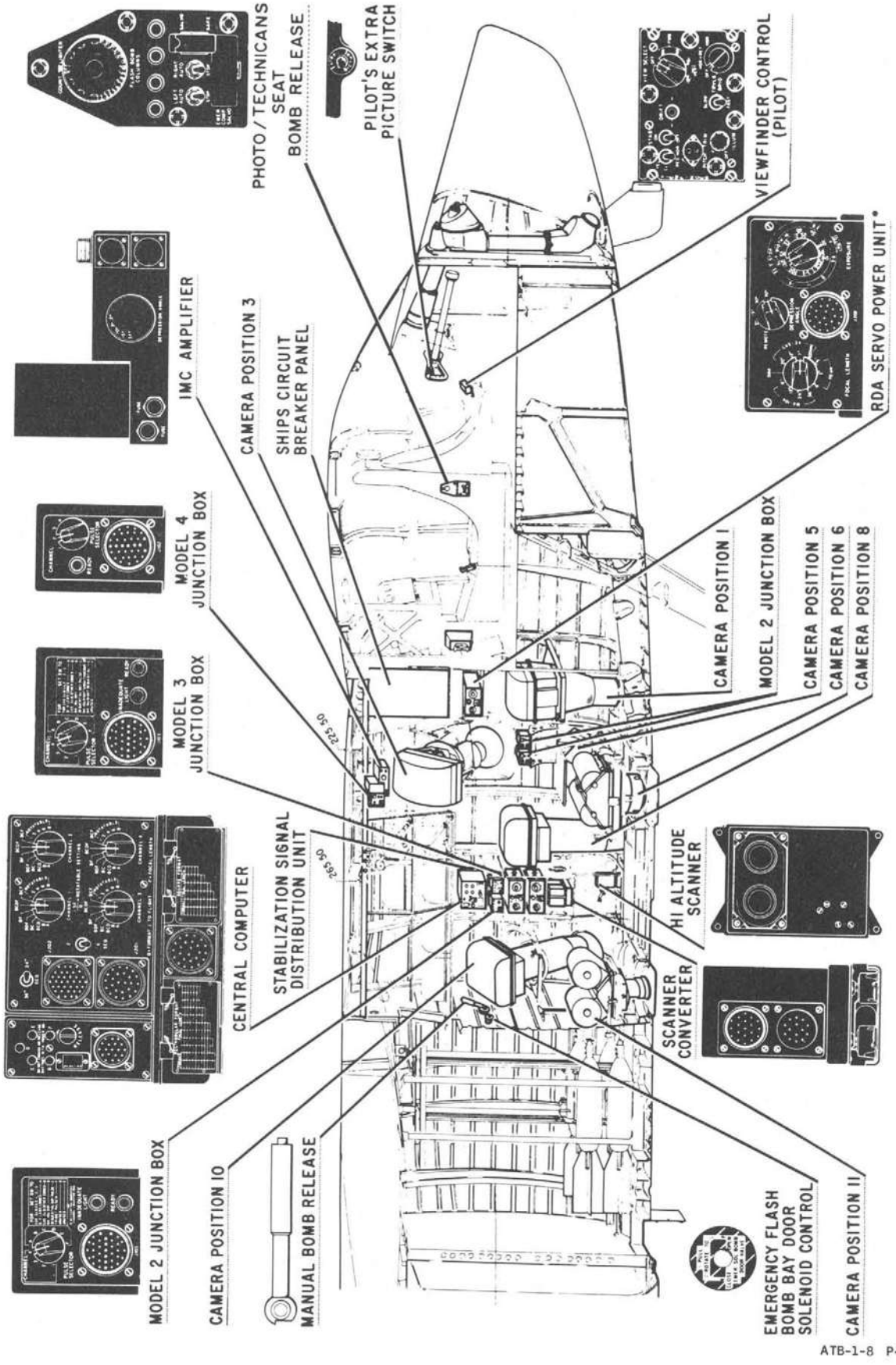


Figure 8-1. Photo Control Equipment Arrangement Left-Hand Side (Sheet 2)

special cameras for forward oblique photography, the modified CA-13 and the KF-8 with mirror assembly lens housing. Special support structures are combined with specially designed camera mounts. In addition to supporting the cameras rigidly at the proper depression angles, some mounts also provide azimuth corrections to compensate for aircraft drift, stabilization in pitch and roll, and image motion compensation.

The photo-navigational viewfinders provided for the pilot and photo-navigator have a dual function. They are used for terrain viewing during photographic flight, and for determining aircraft drift. Rotating the viewfinder reticles, permits measurement of drift against a drift scale at the top of the observed field of view. This measurement of drift in degrees is what is meant by the term "drift determination."

When the viewfinder reticles are rotated to determine drift, the azimuth correcting camera mounts are simultaneously rotated the same number of degrees in the same direction. The centerline of the film format is then correctly aligned with the actual ground track of the aircraft, effectively accomplishing a drift correction at the camera mounts, even though no aircraft drift correction has been made. Then, when the heading of the aircraft is changed to put it back over the desired ground track, no further compensations at the camera mounts need be made; the film format is correctly aligned with the actual and the desired ground track. This rotation of the camera mounts, slaved to the rotation of the viewfinder reticles, is what is meant by the terms "mount drift corrections" or "mount drift compensations." In general, drift determinations are made with the viewfinders, which simultaneously accomplish a camera mount drift compensation. Then, by changing heading, an aircraft drift correction is made. Power for the photographic system is obtained when the master control power switch is moved to ON. The switch should be turned on approximately five minutes prior to photographic operation. It should not be turned on prior to takeoff, nor left on after completion of photography. If the switch is left on during the entire flight, the service life of the central computer and scanner will be drastically reduced. Camera configurations and positions are determined by the mission to be flown. The mission configurations and positions used are:

Mission configuration	Position
1. General Reconnaissance	All positions
2. Tri-camera	1, 5, 6, 7, 8A, 9A 10A, 11, 12A
3. Oblique Reconnaissance	2, 3, 4, 5, 7, 8A, 9A, 10A, 12A
4. Cartographic Vertical	6, 11
5. Cartographic Tri-metrogon	5, 6, 7
6. Day Sequential	8, 9, 10, 12
7. Beach Reconnaissance	5, 6, 7, 8, 9, 10, 11, or 12
8. Night simultaneous	8, 9, 11
9. Night Sequential	8, 9

A cover, which can be raised or lowered and latched in position, is provided at position 11. This cover protects the camera and mount when a crew member is viewing through the window in the aft bulkhead; it also protects him against snagging his gear on the mount when he moves about the camera compartment. The cover is raised to permit camera and magazine adjustment, and should be left down at all other times.

PHOTOGRAPHIC EQUIPMENT

Data on the following equipment items are summarized in table 8-1.

Cameras
- CA-14, 6"
- KA-40A, 3"
- KA-46A, 6"
- KA-47A, 12"
- KA-53A, 12"

Body Drive
- CA-3-2
- CA-3-2B
- CA-13

Magazines
- MA-8
- MA-9
- MA-9A
- MA-10A

Lens Cones
- CA-3-2, 6"
- CA-3-2B, 6"
- CA-3-2, 12"
- CA-3-2B, 12"
- CA-3-2B, 24"
- CA-13, 24"
- CA-13, 36"

Information in the following paragraphs supplements data in table 8-1:

1. When preselected, the -189 mounts at positions 1, 8, 9, 10. and 12 receive automatic azimuth corrections for vertical depression angles only from the viewfinders, and IMC data from the camera control system. The azimuth switch must be turned to OFF when the -189 mounts are at any position other than vertical. The mounts are manually adjustable for pitch and depression angles. When oblique cameras are used at positions 8, 9, 10, and 12, the oblique windows are referred to as 8A, 9A, 10A, and 12A. (See figure 8-2.)

2. The mounts at positions 6 and 11, when preselected, receive automatic azimuth corrections from the viewfinders. These mounts may be stabilized in pitch and roll, or fixed and manually adjusted for pitch. The mount at position 11, when preselected, receives IMC data from the camera control system. The -188 stabilized vertical short focal length mount is used at position 6, while the -187 stabilized vertical mount is used at position 11.

3. The forward oblique mounting structure at position 2 is fixed. Compensation for different length

TABLE 8-1. PHOTOGRAPHIC EQUIPMENT

POSITION	CAMERA OR BODY DRIVE	LENS CONE	MAGAZINE	MOUNT AND CAPABILITY
1. LH Vertical	CA-13 CA-3-2 CA-3-2B KA-47A KA-46A KA-53A	36" or 24" 12" or 24" 12" 12" 6" 12"	MA-8 MA-9, MA-10A MA-9, MA-10A MA-9, MA-10A Cassette Cassette	189 Mount - Azimuth, mount IMC for CA-13 only. Film IMC with MA-10A magazine or with KA-46A and KA-53A cameras.
2. Fwd. Oblique	CA-13 KF-8	Bent Lens Cones 36" 24" Mirror assemblies 2" 4" 6"	MA-8 Integral	Fixed mounting support structure, accepting only the two modified cameras. Depression Angles are: 5 deg 7 deg 36" 24" 6" 2" 4"
3. LH Side Oblique	CA-13 KA-46A KA-53A KA-47A	24" 36" 6" 12" 12"	MA-8 Cassette Cassette MA-10A, MA-9	Special mounting structure, used with IMC amplifier and actuator to provide mount IMC. Rotatable to change format direction. Used at 3, 10, 30, 15, and 37 degrees depression angles. Mount IMC for CA-13 cameras only. No mount IMC. IMC provided by film movement.
4. RH Side Oblique	The Position 4 installation is identical to Position 3			
5. LH Side Oblique (lower)	CA-14 CA-3-2 CA-3-2B KA-40A KA-46A KA-47A	Integral 6" 6" 6" 3" 6" 12"	Integral MA-9, MA-10A MA-9, MA-10A Cassette Cassette MA-9, MA-10A	Fixed mount structure, part of the special Tri-Metrogon mount for Positions 5, 6, 7. Depression angle fixed at 30 degrees. Mounting structure is manually adjustable for pitch.
6. Vertical	CA-14 CA-3-2 CA-3-2B KA-40A	Integral 6" 6" 6" 3"	Integral MA-9, MA-10A MA-9, MA-10A Cassette	188 Mount, supported as part of the special tri-metrogon mount. Azimuth corrections, pitch and roll stabilizations when used alone. Stabilization is locked out when Position 6 is used in the tri-metrogon program as the vertical position.
7. RH Side Oblique (lower)	The Position 7 installation is identical to Position 5.			

TABLE 8-1. PHOTOGRAPHIC EQUIPMENT (Continued)

POSITION	CAMERA OR BODY DRIVE	LENS CONE	MAGAZINE	MOUNT AND CAPABILITY
8. LH Side Oblique or Vertical	CA-13 CA-3-2 CA-3-2B KA-46A KA-53A KA-47A KA-40A	24" or 36" 12" or 24" 12" or 24" 6" 12" 12" 3"	MA-8 MA-9, MA-10A MA-9, MA-10A Cassettes Cassettes MA-9, MA-10A Cassettes	189 Mount. Fixed, Azimuth, mount IMC for CA-13 cameras only. Depression Angles available are 90, 72.5, 63.5, 53, 37, 30, 20, and 15 degrees. Internal film IMC provided by MA-10A magazine and the KA-46A and KA-53A cameras. Special adapter
9. RH Side Oblique or Vertical	The Position 9 installation is identical to Position 8.			
10. LH Side Oblique or Vertical	CA-13 CA-3-2 CA-3-2B KA-46A KA-53A KA-47A KA-40A	24" or 36" 12" or 24" 12" or 24" 6" 12" 12" 3"	MA-8 MA-9, MA-10A MA-9, MA-10A Cassette Cassette MA-9, MA-10A Cassettes	See specifics for Sta. 8 Special adapter
11. Vertical	CA-13 CA-14 CA-3-2 CA-3-2B KA-46A KA-40A KA-53A KA-47A	24" or 36" Integral 6" 6", 12", or 24" 6", 12", or 24" 6" 3" 12" 12"	MA-8 Integral MA-9 MA-9A, MA-10A Cassettes Cassettes Cassettes MA-9, MA-10A	187 Mount. Fixed or Stabilized. Azimuth, mount IMC for CA-13 only. Film IMC is provided with MA-10A magazine, KA-40A, KA-46A, and KA-53A Cameras
12.	The Position 12 is identical to Position 10.			

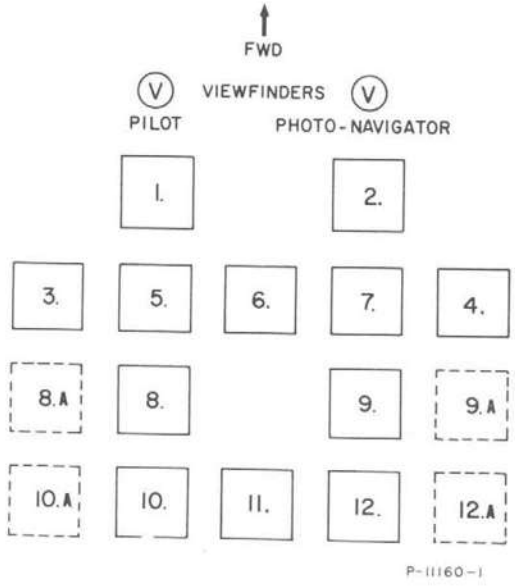


Figure 8-2. Camera Positions

cameras is accomplished by proper installation of cameras.

4. The mounts at positions 3 and 4 are manually adjustable for the depression angles, 3 degrees, 10 degrees, 15 degrees, and 37 degrees; and are manually rotatable to set the 18-inch axis of the 9-inch x 18-inch format either along or across the flight line. Before the cameras are rotated to change the format direction, the mounts must be placed in the 3-degree position. The mounts, when preselected, receive IMC data from the camera control system. When the 18-inch axis of the format parallels the flight direction, the IMC function must be locked out at the mount.

5. The cameras at positions 5, 6, and 7 are supported in a special tri-metrogon mounting structure. Positions 5 and 7 are fixed at 30-degree depression angles. These positions may be used with position 6 as a tri-metrogon configuration, and manually adjusted for pitch, or used as independent side oblique positions. When position 6 is used as the vertical position of the tri-metrogon configuration, it is not stabilized and the mount should be set at 0 degree; when used independently for vertical cartography, it is stabilized and the support for positions 5 and 7 should be adjusted to 0 degree pitch.

CAMERA POSITIONS 8, 9, 10, and 12

The cameras at positions 8, 9, 10, and 12 are used with the 189 mount and provide for corrections in azimuth and a manual pitch control. Mount IMC is provided for the CA-13 cameras only. Depression angles of 15, 20, 30, 37, 53, 63.5, 72.5, and 90 degrees are available.

The CA-13 cameras with focal lengths of 24" and 36" are provided with mount IMC at selected depression angles of 37, 53, 63.5, and 90 degrees. The CA-13 36-inch cannot be used at depression angles of 72.5 and at less than 30 degree depression angles, this is due to the support arms of the 189 mount and the aircraft structure.

The CA-3-2 and CA-3-2B cameras with focal lengths of 12" and 24" may be used at all available depression angles. There is no IMC provided for these cameras in the 189 mount, however, the MA-10A magazine may be used to compensate by utilizing film IMC rate.

The KA-46A, KA-47A, and KA-53A cameras may be used at all available depression angles. The availability of depression angles is limited only by the RDA Serve Power Unit settings which control film IMC rate in these cameras and in the MA-10A magazine.

CAMERAS

CA-3-2, CA-3-2B

The CA-3-2 and the CA-3-2B are designed for daytime reconnaissance and charting. The cameras are electrically or manually operated and may be used for vertical, oblique, and between vertical and oblique photography. Both cameras are provided with separate and interchangeable lens cone assemblies:

CA-3-2	CA-3-2B
6 inches f/6.3	6 inches f/6.3
12 inches f/7.0	12 inches f/4.0
24 inches f/6.0	24 inches f/6.0

The CA-3-2 and CA-3-2B cameras use the standard MA-9 or MA-9A film magazines with a 9" x 9" negative format size. The MA-10A magazine may also be used with these cameras to provide image motion compensation. The cameras are then installed at positions 1, 8, 9, 10, 11, and 12, with the IMC function locked out. When the MA-10A magazine is used, the pulse interval and image motion compensation are provided to the magazine through the RDA servo power unit.

The main difference between these cameras is the shutter. The CA-3-2B is equipped with a Rapidyne shutter – a between-the-lens type, consisting of two sets of shutter leaves rather than just one set, as in conventional units, permitting higher and more accurate shutter speeds. The two leaf assemblies are called the A-leaves and the B-leaves. Prior to an exposure, one set of leaves is closed and the other is wound open. Tripping the shutter opens the closed

leaf assembly, permitting the exposure to be made, and then closes the second open leaf assembly. Shutter rewind returns the leaf assemblies to their original closed and open position. This shutter is used with many different types of aerial cameras.

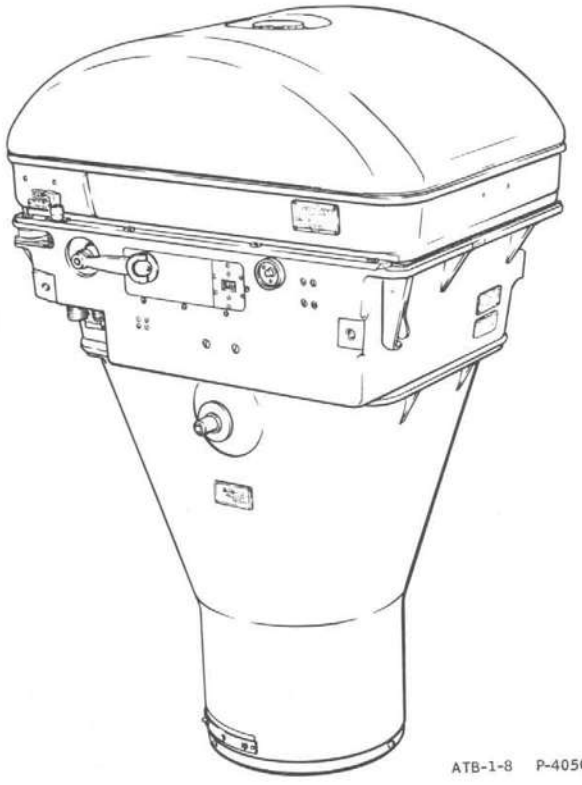


Figure 8-2A. CA-13 Camera, With MA-8 MAG 24", Focal Length f6.0, and 9 x 18 Format

CA-13

The CA-13 camera, with its associated lens cones (see figures 8-2A, and 8-3) is operated either manually or automatically and is designed for daylight high altitude reconnaissance and large scale plotting. The lens cones provided for use with the CA-13 camera body are:

24" focal length f/6.0

36" focal length f/8.0

The camera is used with an MA-8 magazine having a negative format size of 9 x 18 inches. Standard shutters are used with speeds of 1/50, 1/100, and 1/150. Recycle time of the CA-13 is 1.6 seconds.

The CA-13 provides no image motion compensation. Instead, it is mounted in image motion compensating mounts, the 189-90189 mount, or the 187-90187 mount.

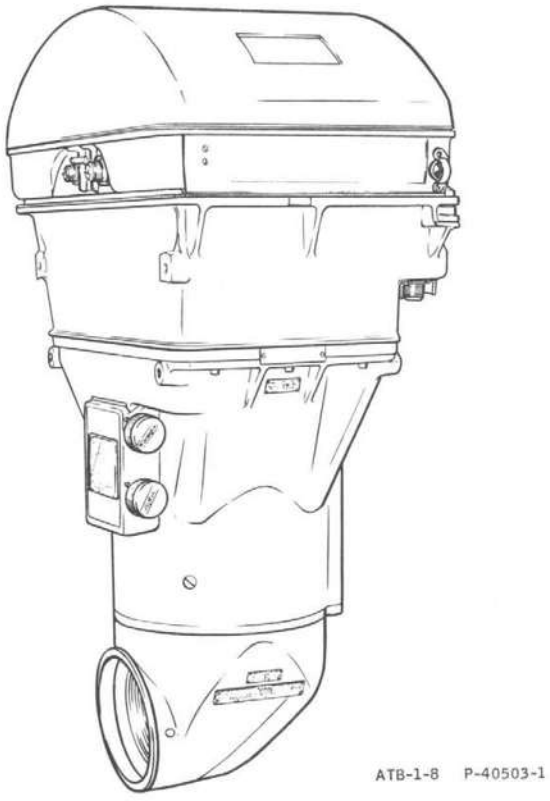


Figure 8-2B. CA-13 (Bent Lens Cone) Camera, With MA-8 MAG 24", Focal Length f8.0, 9 x 18 Format, and Forward Firing

POSITION 2 CA-13 CAMERA WITH BENT LENS CONES ASSEMBLIES

Forward oblique photography is possible at Position 2 using a standard CA-13 camera body with an MA-8 film magazine and the special design bent lens cone assembly (see figure 8-2B), which permits forward oblique photography from the vertically installed camera. Two bent lens cone assemblies are provided, 24-inch and 36-inch focal length.

Table of Particulars

Type	(24")	(36")
Optical system	24-inch f/8 Topenar, Series II	36-inch f/8 Topenar, Series I
Focal length	24 inches	36 inches
Format	9" x 18"	9" x 18"
Shutter speeds	1/50, 1/100, 1/150	1/50, 1/100, 1/150

Type	(24")	(36")
Diaphragm stops	f/8, f/11, f/16	f/8, f/11, f/16
Weight (except case)	42.75 lb.	40.75 lb.
Filters	yellow, red	yellow, red

The bent lens cone assembly consists of a camera cone assembly with a mirror housing assembly securely attached to its lower end. The camera cone assembly contains the necessary linkage and gearing for the diaphragm and shutter speed control knobs, which are mounted on the front of the cone to the right of the nameplate. The control knobs, labeled DIAPHRAGM and SHUTTER, are manually operated and permit selection of the available diaphragm apertures and shutter speeds.

Note

The mirror system results in a reverse image on the exposed film and therefore ALL NEGATIVES MUST BE PRINTED THROUGH BASE.

CA-14

The CA-14 camera (see figure 8-2C) is an integral pulse-type camera used for precision cartographic photography.

The CA-14 has a lens system composed of a two cell f/6.3, 6-inch Metrogon lens assembly mounted in a lens cone casting integral with the camera body. In addition, two Waterhouse stops (detachable diaphragm adapters) may be used with either the Metrogon or Planigon lens to provide diaphragm openings of f/8 or f/11.

The shutter used is a Rapidyne shutter mounted between the lens cells in the lens cone assembly. Shutter speeds from 1/10 to 1/500 second are provided.

To aid in producing the precise photographs necessary for making topographic maps, the CA-14 records the following information on the film outside the 9-inch by 9-inch negative format: lens serial number, calibrated focal length, exposure counter reading, time of flight, flight pressure altitude, data card notations with camera serial number, vacuum on recording light, calibrated focal length marks, and fiducial marks. The exposure counter, recording clock, altimeter, and data card may be preflight adjusted by removing the recording chamber door, located on the camera base assembly.

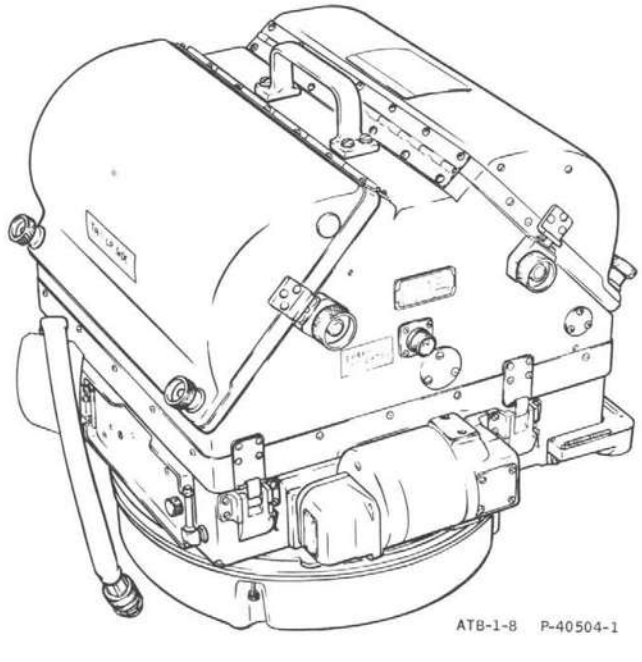


Figure 8-2C. CA-14 Camera, With MAG 6", Focal Length f/6.3, 490 Exposures, and 9 x 9 Format

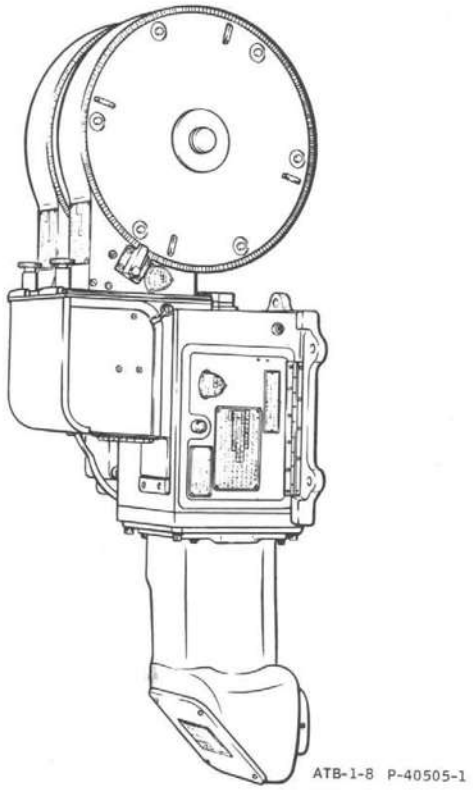


Figure 8-2D. KF-8 35 M/M Motion Picture Camera, Forward Firing, and 1000' MAG

KF-8

The KF-8 camera is a 35-mm high speed (see figures 8-2D, and 8-4) intermittent movement motion picture camera used in position 2 for forward oblique photography. Although the camera is mounted vertically, special mirror assemblies are used to adapt it for forward photo firing. The camera is designed to take motion pictures at speeds of 24, 48, and 96 frames per second and has a film capacity of 1, 000 feet in a split self-contained magazine. The mirror assemblies replace the housing around the standard lens cones and are of the following sizes:

	Lens Cones	
f/2.3	50 mm	2 inches
f/2.3	100 mm	4 inches
f/2.7	152 mm	6 inches

The camera shutter may be manually adjusted from 170° to fully closed and, when adjusted along with the various camera speeds, provides an effective shutter exposure time.

A film footage and frame counter window is installed on the camera. The first three digits on the counter indicates exposed film footage. The fourth digit indicates each exposed frame.

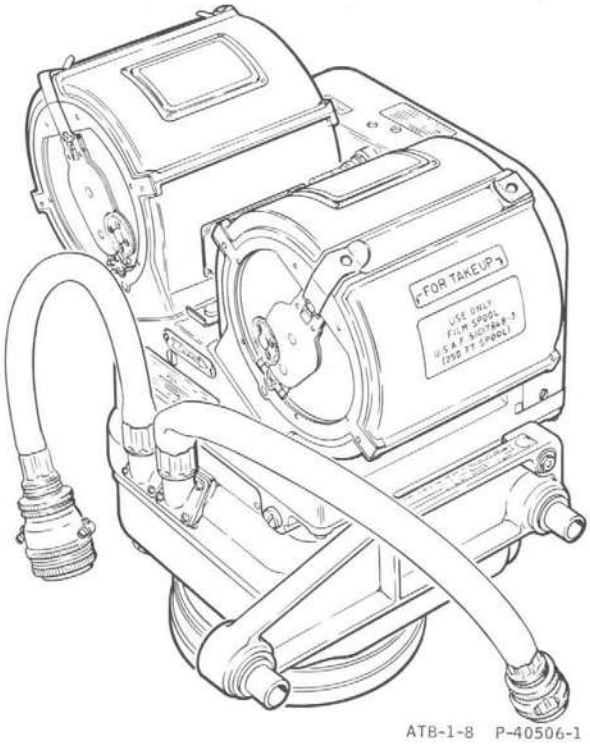
The KF-8 camera is used in conjunction with an iris regulator control unit mounted on the equipment rack above position 2. Camera shutter opening, film emulsion speed, and filter factors are set in at this unit (see figure 8-12).

The light monitor provides the terrain brightness data required to operate the KF-8. The correct exposure is indicated on the exposure control panel on the photo-navigator's instrument panel, and the corrections for an over- or under-exposure condition can be made on this panel.

Light control is accomplished through the lens iris diaphragm opening and the adjustable camera shutter. Lens iris openings are further modified by the filter factor knob of the iris regulator box (the KF control unit), the shutter opening and emulsion speed scales having been set according to the actual camera shutter opening and emulsion speed of the film used.

Note

The light monitor accepts light vertically from the ground to the bottom of the aircraft. When using the KF-8 camera, compensate the shutter opening by stopping down approximately 2 f stops for the increased amount of light available to the camera lens. When the light monitor is used with KF-8, KA-46A and KA-40A cameras installed, and with film of equal speed, always adjust the KF-8 camera 2 stops less exposure.



ATB-1-8 P-40506-1

Figure 8-2E. KA-40A Camera, 3" Focal Length, Auto Exposure Control, 4-1/2 x 4-1/2 Format, and 600 Exposures

KA-40A

The KA-40A camera provides for both day and night (see figure 8-2E) photography. The KA-40A has a 4-1/2- by 4-1/2-inch format with a 3-inch f/4. 5 lens and shutter speeds up to 1/800 second. With casette, the film load holds a maximum of 250 feet of film, providing 600 exposures.

The KA-40A camera is capable of operating in four different modes. They are Pulse with IMC, Pulse without IMC, Autocycle, and Nite.

In the Pulse without IMC mode, the camera operates as a pulse type camera; in the Pulse with IMC mode, the film is moved at IMC speed during the exposure.

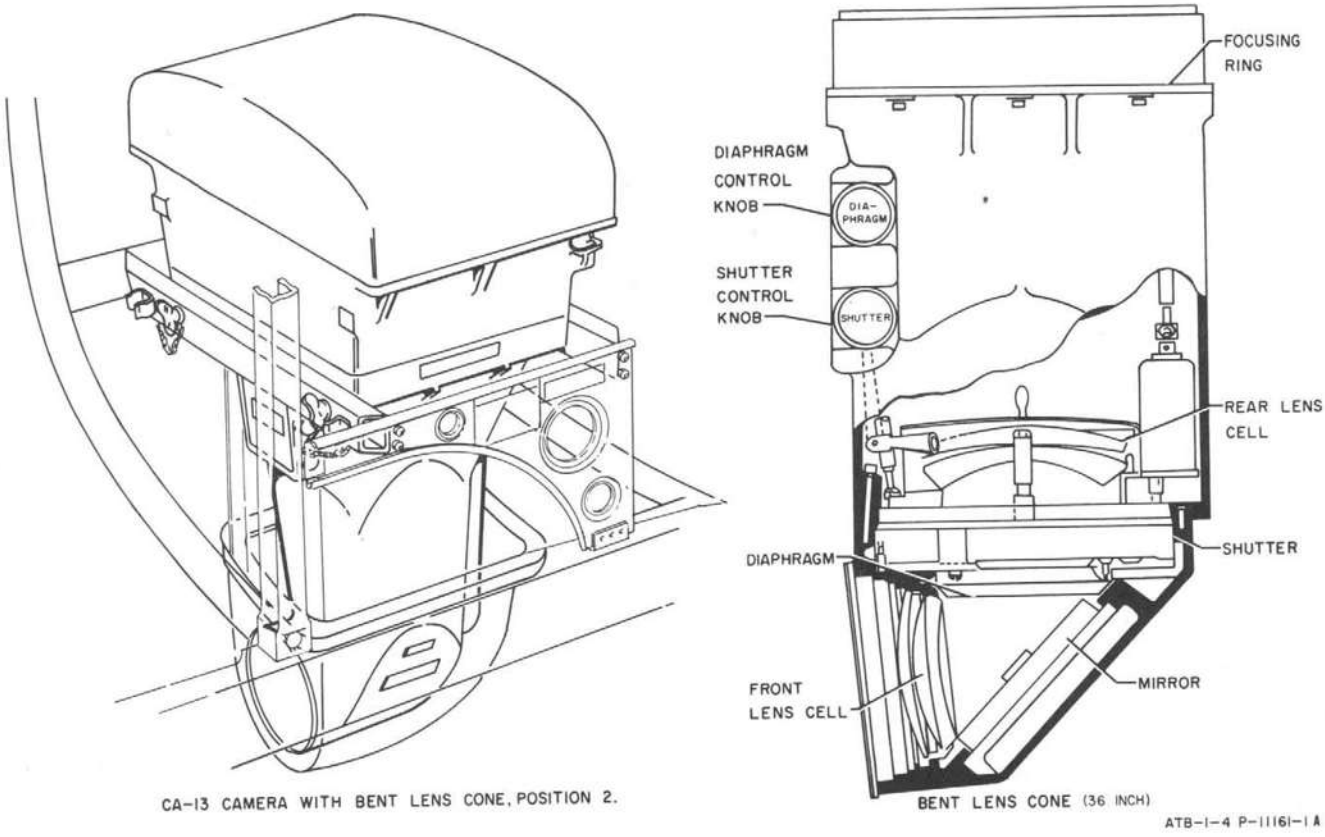


Figure 8-3. CA-13 Camera Installation, Position 2

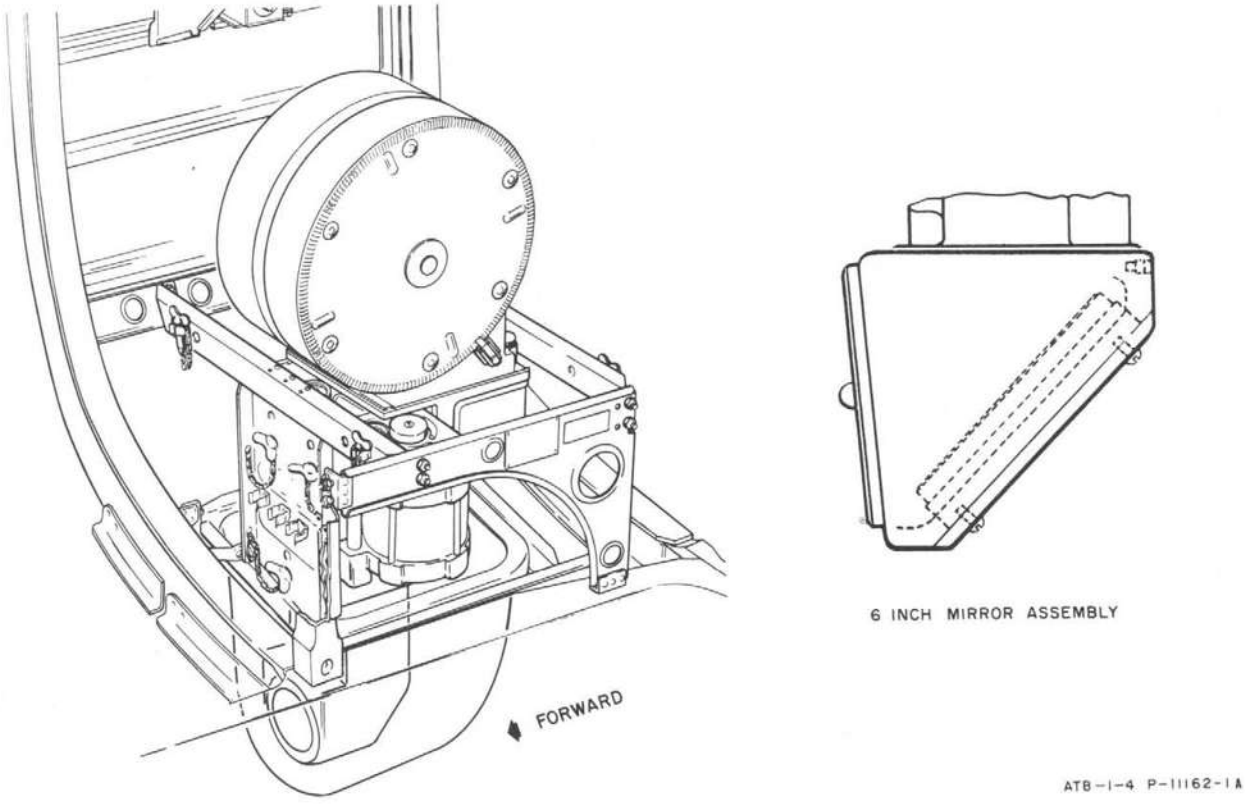


Figure 8-4. KF-8 Camera Installation, Position 2

Autocycle mode exposures are made automatically at IMC rate with 60 percent overlap.

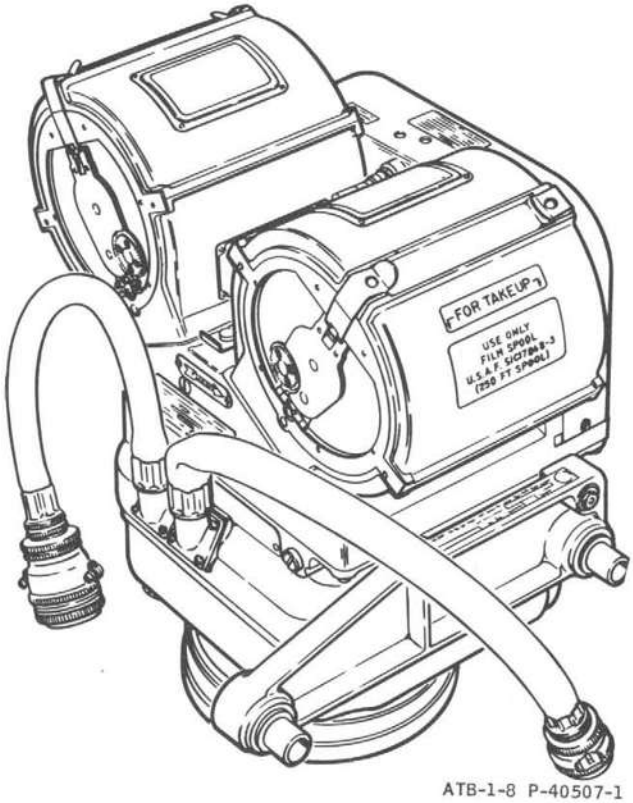
The Nite mode of operation is the same as Pulse with IMC operation, except that the shutter is open and the film moves at IMC rate prior to exposure. After an illuminant burst, a shutter-close pulse initiated by the flash detector in the control system closes the shutter, film is recycled, the shutter reopens, and the film slows down to IMC rate until another illuminant burst starts the next cycle. The KA-40A camera can be operated in stations 5, 6, 7, and 11.

When the KA-40A and KA-46A cameras are used, the RDA servo power unit must be modified as follows:

1. Remove log linear amplifier from RDA for camera position in which KA-40A camera is installed.

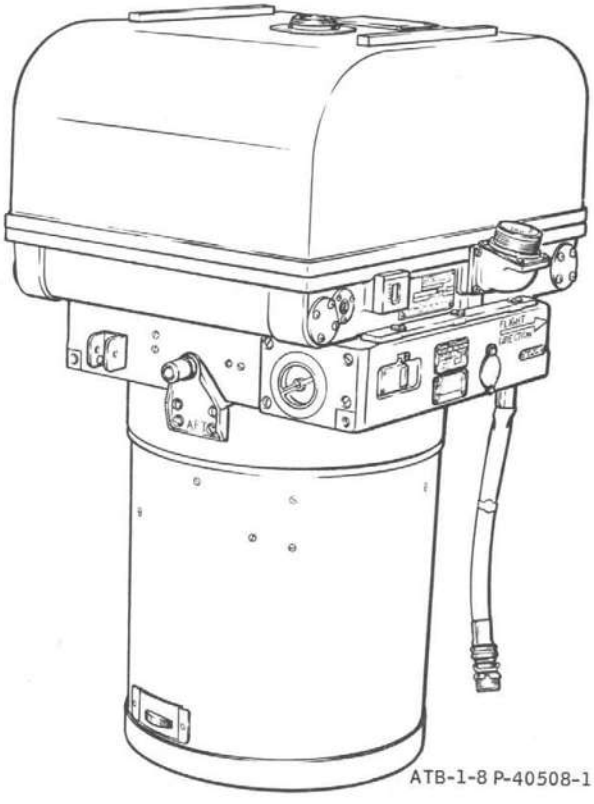
2. Disconnect aircraft wiring cable to RDA for the camera position.

3. Install special purpose cable assembly P/N 2949-200, supplied with KA-40A and KA-46A cameras, between aircraft wiring and position RDA.



ATB-1-8 P-40507-1

Figure 8-4A. KA-46A Camera, 6" Focal Length, Auto Exposure Control, 4-1/2 x 4-1/2 Format, and 600 Exposures



ATB-1-8 P-40508-1

Figure 8-4B. KA-47A Camera, with MA-10A MAG 12", Focal Length f 2.5, and 9 x 9 Format

KA-46A

The KA-46A camera (see figure 8-4A) is identical in operation to the KA-40A camera except for the lens focal length and f/stop, which is a 6-inch f/2.8 lens and a maximum shutter speed of 1/400 second.

Note

The KA-40 and KA-46 have automatic exposure control capabilities, utilizing the aircraft light monitor and exposure control.

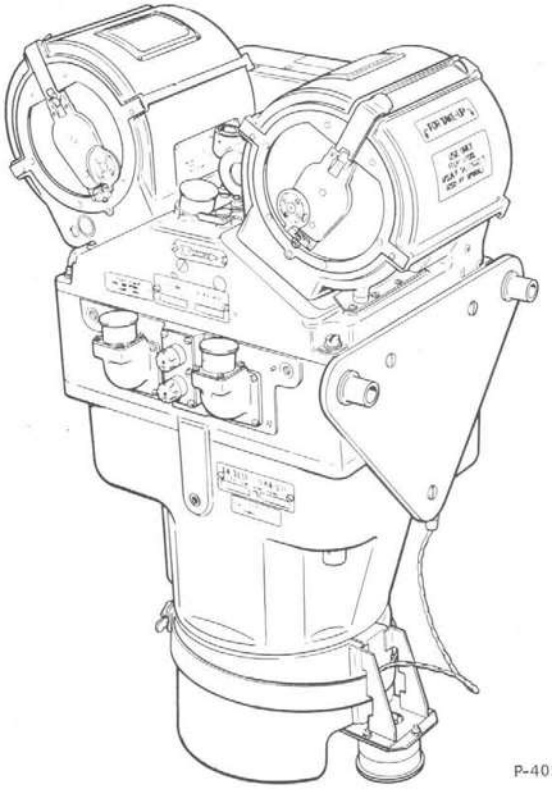
KA-47A

The KA-47A camera (see figure 8-4B) provides for both night and day photography. The camera has a 9- by 9-inch format and uses the MA-10A magazine for image motion compensation. The MA-9 magazine and some other 9- by 9-inch format magazines can be used for operation without IMC in day mode.

The day photography mode is available by means of a diaphragm between the elements of a 12-inch, f/2.5 lens, a shutter speed timer mounted in the camera body, and a DAY/NIGHT switch to permit selection of the proper mode. The circuitry is designed so that the internal shutter speed timer controls the shutter speeds only when the DAY/NIGHT switch is in the DAY position. The shutter recycle rate is two cycles per

second. Shutter speeds of 1/25, 1/50, 1/100, 1/200, and 1/250-second are available with the internal shutter speed timer for day mode. The diaphragm is normally used only during the day photography mode for aperture settings from f/25 to f/11 are manually set.

During the night photography mode, the camera operates effectively as if it did not contain the shutter timer. With the DAY/NIGHT switch in the NIGHT position, the capping shutter mode of operation is used, in which both shutter leaf assemblies are wound open between exposures. A pulse from the control system is used for illuminant release: When the flash detector senses the flash bomb or cartridge burst, an electrical pulse is sent to the KA-47A camera, which then closes the shutter leaf assemblies, initiates magazine rewind, and then rewinds both shutter leaf assemblies to the open position. In the night photography mode, the diaphragm is normally set to its largest opening to permit the maximum amount of light to pass through the lens. The KA-47A camera in the NIGHT mode may be used sequentially in stations 8 and 9 or simultaneously in stations 8, 9, and 11.



P-40509-1

Figure 8-4C. KA-53A Camera, 12" Focal Length, Auto Exposure Control, 4-1/2 x 4-1/2 Format, and 600 Exposures

KA-53A CAMERA

The KA-53A camera provides for both day and night photographic operations. It has a 4-1/2 x 4-1/2 film format and utilizes a 12-inch f/3.5 lens. Shutter speeds are variable from 1/60 second to 1/3000 second using a focal plane type shutter. A built in light sensor automatically sets exposure by monitoring terrain brightness and sending a reference voltage to the lens cone. Using the reference voltage, the camera strives to use a maximum shutter speed at the proper f/stop. When seeking new exposure levels from the reference voltage, the diaphragm progresses through the f/stops from widest to smallest. If the new exposure level is not found, the shutter speed will either increase or decrease depending upon the exposure requirements. When the speed of the shutter has changed, the diaphragm search cycle commences again. This cycle repeats itself until the maximum shutter speed and correct f/stop is found.

Film for the KA-53A is supplied and taken up in two LA-141A cassettes, this cassette will contain a maximum of 250 feet of 5-inch film or 600 exposures. Five modes of operation are utilized in the KA-53A, these being AUTOCYCLE, PULSE, IMC PULSE, NIGHT ELECTRONIC FLASH, and NIGHT OPEN SHUTTER. The manner in which these modes operate are:

AUTOCYCLE. In the autocycle mode of operation, exposures are made automatically at IMC film speed with 60 percent overlap. Film movement is continuous at 2.7 IMC rate; during exposure, the IMC rate is reduced to normal IMC rate. The shutter speeds and diaphragm settings are variable throughout the camera exposure range and are automatically set according to terrain brillance as monitored by the light sensor.

NIGHT ELECTRONIC FLASH. This mode operates the same as for AUTOCYCLE except that a camera actuated switch in the camera body triggers an electronic flash circuit in the aircraft camera system to produce flash illumination in the interval during which the focal plane shutter is opened fully across the focal plane. Exposure is made using the slowest shutter speed and the diaphragm fully opened.

PULSE. In the pulse mode operation, an exposure is made each time a cycle pulse from the aircraft camera system is applied to the camera. The film remains stationary and is taken up by subsequent pulses. Variable overlap is obtained through the Central Computer. Exposure settings are made automatically.

IMC PULSE. In this mode of operation the principals are the same as in Pulse mode; however, during the exposure period, the film is moved at IMC rate.

NIGHT OPEN SHUTTER. By turning the Shutter Latch Switch to the OPEN position, a capping shutter action will result. This action also automatically sets in the lowest shutter speed and widest f/stop. The film travels across the focal plane at IMC speed. A pulse from the 501 box on the Central Computer releases a flash cartridge. When the cartridge explodes, the illumination is detected by the flash detector which initiates a pulse to the Night Timer, the night timer sends a shutter-close pulse to the camera. When the shutter closes a circuit is completed and the camera recycles and readies for the next flash.

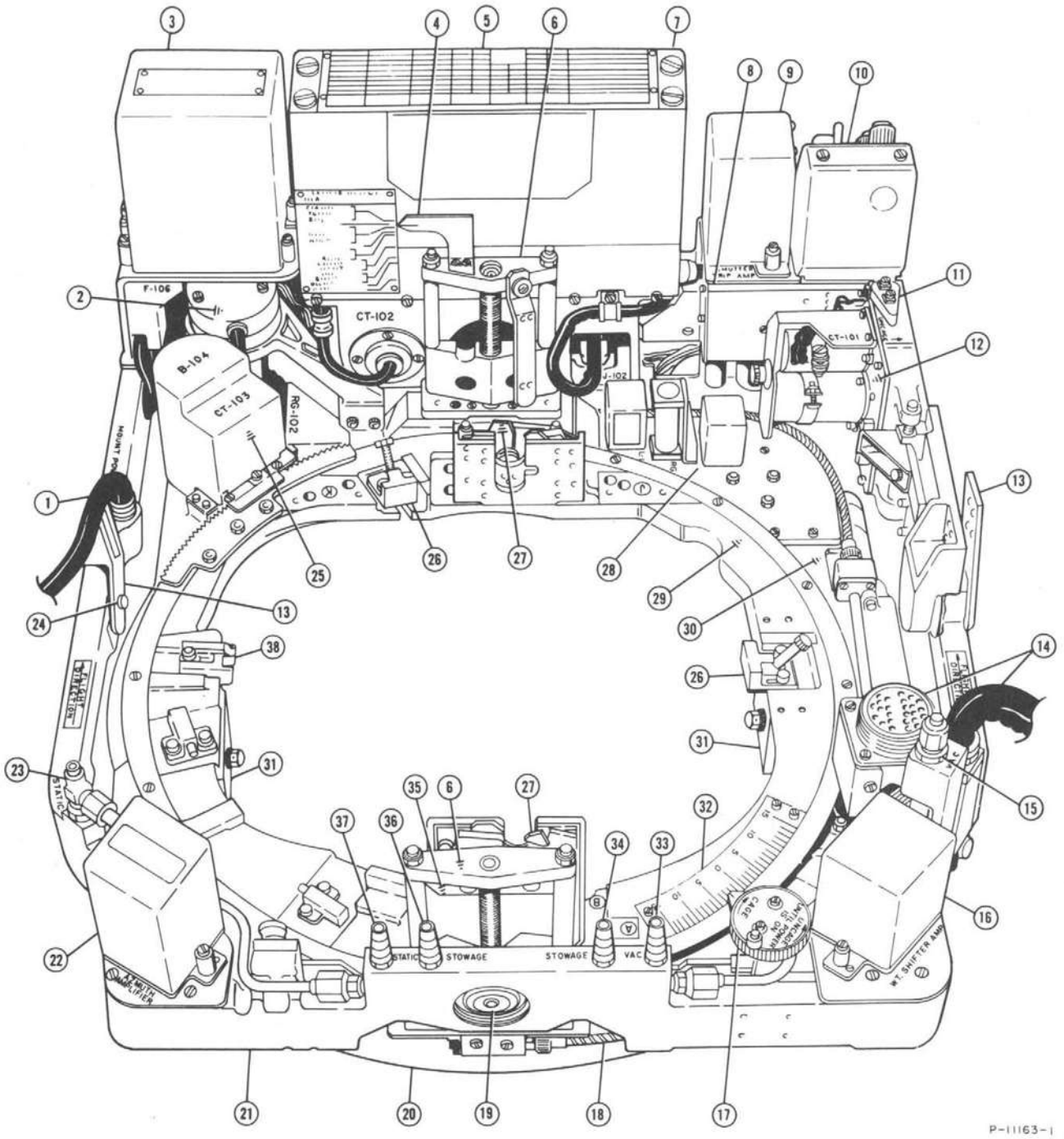
CAMERA MOUNTS

The basic function of the camera mount is to provide rigid support for the camera at a predetermined depression angle. In addition, the mounts, depending upon the type, may also provide image motion compensation, azimuth corrections to compensate for aircraft drift, and stabilization to compensate for aircraft pitch and roll. Four types of mounts are used in the aircraft.

187-90187 STABILIZED VERTICAL MOUNT

The -187 mount (see figure 8-5) is used at position 11 only, accepting the CA-3-2, CA-3-2B, CA-13, CA-14, CA-17A, KA-40A, KA-46A, and KA-47A cameras. The mount provides stabilization in pitch and roll and azimuth corrections for aircraft drift compensation. Image motion compensation is provided for the CA-13 camera only. Stabilization information is provided by the ASB-1B radar system. The limits of stabilization are 8 degrees in roll and +5 degrees noseup to -2 degrees nosedown in pitch. Azimuth correction limits are ±15 degrees.

The mount consists of a two-gimbal mounting surface which provides rate gyro stabilization in roll and pitch, and image motion compensation in the pitch axis for the CA-13 cameras only. Gimbal locks are provided to lock out azimuth, pitch, and roll mechanically. The mount components are either assembled to its structure or are quick-disconnect, plug-in type units. Switches are provided to select the desired mount functions. When the switches are in the OFF position they control only the indicated function, since



1. Power cable
2. Roll-rate gyro
3. Roll-torquer amplifier
4. Balance indicator
5. Clamp-adjustment data plate
6. Lift mechanism (2)
7. Roll torquer
8. Shutter-trip amplifier
9. IMC amplifier
10. Control chassis
11. Pitch-drive caging knob
12. Pitch-drive assembly
13. Mount hanger (2)
14. Camera cable and receptacle
15. Vacuum-supply fitting
16. Weight-shifter amplifer
17. IMC caging knob
18. Lift-mechanism connecting shaft
19. Roll-stabilization pivot (2)
20. Weight and weight-shifter assembly
21. Pitch-stabilization gimbal
22. Azimuth amplifier
23. Static pressure-supply fitting
24. Pitch-stabilization pivot
25. Azimuth drive assembly
26. Camera clamps (2)
27. Trunnion clamps (4)
28. Roll-stabilization electronic assembly
29. Azimuth ring
30. Roll-stabilization gimbal
31. Snubber assembly (2)
32. Azimuth scale
33. Vacuum fitting
34. Vacuum stowage fitting
35. Trunnion spacer blocks (2)
36. Static-pressure stowage fitting
37. Static-pressure fitting
38. Camera keying block

Figure 8-5. 187-90187 Mount

electrical power is applied to the mounts at all times to permit the various gyros to always be up to speed when the mounts are placed in operation. The azimuth loop is an open loop servo system deriving its input from the viewfinder system. A synchro receiver in the mount receives the transmitted position data from the viewfinder system, and in turn applies a position error signal to the azimuth servo amplifier whose output is connected to the control phase of the azimuth drive motor. The motor, through the appropriate gearing, drives the azimuth ring and the synchro receiver until the position error signal is essentially zero.

The roll loop consists of a receiver synchro, a torquer amplifier, a rate gyro, and a torquer. The roll position signal, received from a transmitter synchro, is applied to the receiver synchro in the mount. The synchro rotor voltage is applied to the torquer amplifier where it is mixed with the rate gyro output, amplified, and fed to the gimbal torquer drive, which positions the gimbal about vertical. To compensate for film takeup and differences in center of gravity, an automatic weight shifter has been provided for the roll axis. The weight shifter amplifier input is derived from the torquer current and the output of the amplifier is fed to the weight shift motor, which is linked through a gear drive to the weight. The weight shifter when properly positioned minimizes the torquer current. The roll gimbal compensates for camera center of gravity differences in the vertical direction by means of a gimbal vertical lift mechanism. The manually actuated vertical lift switch sets in motion the vertical lift motor, which controls the lift mechanism. Two switches at the gimbal vertical travel limits control the motor power when the gimbal has reached the stops.

The pitch axis is designed for two modes of operation. It acts as a rate gyro stabilized circuit before a pulse is inserted. The pitch position signal is fed to the pitch receiver synchro and then to the pitch amplifier where it is mixed with the pitch rate gyro output, and with the E V/H signal, which has been converted to a 400 cycle per second voltage. The pitch amplifier output is connected to the pitch drive motor, which is connected to the drive arm through a gear drive. The pitch receiver synchro also supplies the input voltage to the shutter control amplifier. At the proper phase and amplitude of input signal, the amplifier conducts and activates the shutter trip relay which trips the camera shutter. The mount must be in the IMC mode of operation for the shutter control amplifier to operate.

The mount is switched to the IMC mode of operation when an inserted pulse activates the mode relay. This applies 115-volt, 400 cycle per second power to the shutter control amplifier, removing the pitch receiver synchro output from the pitch amplifier, and placing the pitch axis into the IMC mode. The gimbal is rotated in IMC by the pitch drive motor, and speed control results from the E V/H signal and the rate gyro output. The shutter control amplifier receives the input signal from the pitch receiver synchro and activates the shutter trip relay, tripping the camera shutter. The ground circuit of the mode relay is completed through the camera which, when operated, breaks the ground. This relay, being a slow-break type, remains closed long enough to initiate camera operation and for shutter operation. When it opens, the relay returns the mount to the position mode, and the camera returns to its initial position.

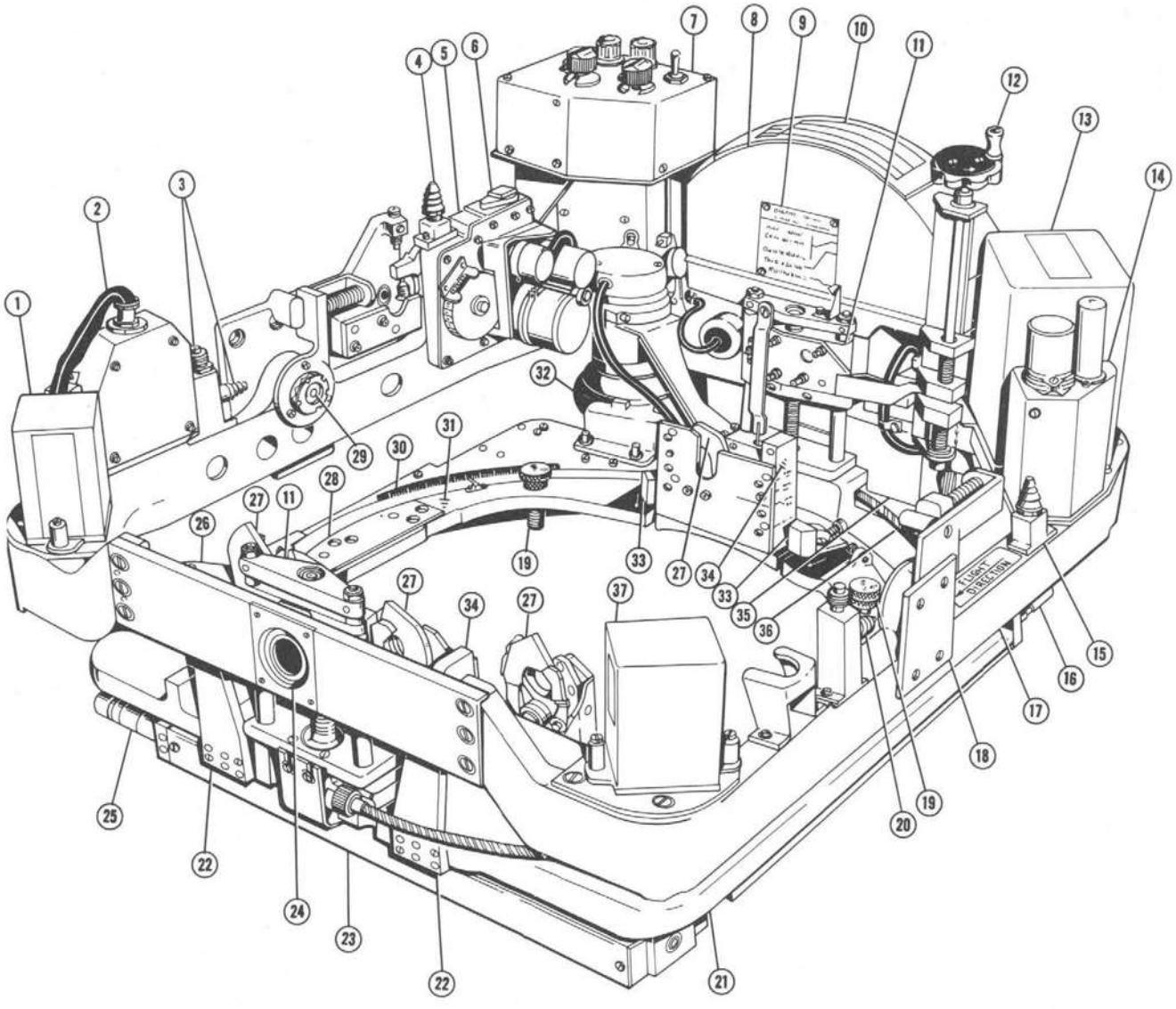
188-90188 STABILIZED VERTICAL SHORT FOCAL LENGTH MOUNT

The -188 mount (see figure 8-6) is used at position 6 only, and is supported as the vertical installation of the special tri-metrogon mounting structure. It accepts the CA-3-2, CA-3-2B, CA-14, KA-46A, and KA-40A cameras. The mount provides a two-gimballed mounting surface for the cameras, which is rate gyro stabilized in pitch and roll, the stabilization limits being the same as those for the -187 mount at position 11. No IMC is provided at the -188 mount.

Remote azimuth positioning of the camera is provided to compensate for aircraft drift. Gimbal locks are provided to lock out both the azimuth correction and stabilization functions, when desired. Mount components are either assembled to its structure, or are quick-disconnect plug-in units. Switches are provided to lock the various functions of the mount and they must be turned on before input power can be applied. A flag-type indicator signals when the roll circuit is energized.

The azimuth loop is an open loop servo system deriving its input from the viewfinder system. The transmitted position data is received at the mount by the receiver control transformer, which applies a position error signal to the azimuth servo amplifier, whose output is connected to the control phase of the azimuth drive motor. This motor, through the necessary gearing, drives the azimuth ring and the synchro receiver until the position error signal is essentially zero.

The roll loop consists of a receiver control transformer, a torquer amplifier, a rate gyro, and a torquer. The roll position signal, which is received from a transmitter control transformer, is applied to the receiver in the mount. The synchro rotor voltage is applied to the torquer amplifier where it is mixed with the rate gyro output, amplified, and fed to the gimbal torquer drive which positions the gimbal about the vertical. The roll axis is provided with a weight shifter to compensate for center of gravity differences and for film takeup. The weight shift amplifier input is derived from torquer current and the output of the amplifier is fed to the weight shift motor, linked through a gear drive to the weight. The roll gimbal compensates for camera center of gravity differences in the vertical direction by means of a gimbal vertical lift



1. AZIMUTH AMPLIFIER
2. POWER INPUT CABLE
3. VACUUM FITTINGS
4. VACUUM STOWAGE FITTING
5. PITCH DRIVE ASSEMBLY
6. PITCH-DRIVE CAGING KNOB
7. CONTROL CHASSIS
8. ROLL TORQUER
9. BALANCE INDICATOR
10. CLAMP-ADJUSTMENT DATA PLATE
11. LIFT MECHANISM (2)
12. ROLL-STABILIZATION CAGING
13. ROLL-TORQUER AMPLIFIER
14. RELAY CHASSIS
15. STATIC-PRESSURE STOWAGE FITTING
16. LIFT DRIVE MOTOR
17. PITCH-STABILIZATION GIMBAL
18. MOUNT HANGER (2)
19. SNUBBER (2)
20. STATIC-PRESSURE FITTING
21. ROLL-STABILIZATION FITTING
22. ROLL-GIMBAL STOPS (2)
23. WEIGHT
24. ROLL-STABILIZATION PIVOT (2)
25. WEIGHT-SHIFTER SYNCHRO MOTOR
26. AZIMUTH DRIVE
27. TRUNNION CLAMP (4)
28. TRUNNION-CLAMP STOWAGE
29. PITCH-STABILIZATION PIVOT (2)
30. AZIMUTH SCALE
31. AZIMUTH RING
32. ROLL-RATE GYRO
33. CAMERA CLAMP (4)
34. TRUNNION-CLAMP SPACER BLOCK (2)
35. PITCH AMPLIFIER
36. LIFT-MECHANISM CONNECTING SHAFT
37. WEIGHT-SHIFTER AMPLIFIER

P-11164-1

Figure 8-6. 188-90188 Mount

mechanism. The manually operated vertical lift switch actuates the vertical lift motor. Two switches are provided at gimbal vertical travel limits to control motor power when the gimbal reaches the stops.

The pitch stabilization loop consists of the pitch control transformer, rate gyro, pitch amplifier, and the pitch drive motor. The position signal is fed to the control transformer and then to the amplifier, where it is mixed with the rate gyro output. The amplifier output is connected to the pitch drive motor, which is connected to the drive arm through a gear drive.

189-90189 AZIMUTH IMC MOUNT

Camera positions 1, 8, 9, 10, and 12 are supported by the -189 mount (see figure 8-7). The mount has corrections for Azimuth and a manual pitch control. Mount IMC is provided for CA-13 cameras only. Depression angles of 15, 20, 30, 37, 53, 63.5, 72.5, and 90 degrees are available.

The CA-13 cameras with focal length of 24" and 36" are provided with mount IMC at selected depression angles of 37, 53, 63.5, and 90 degrees. The 36" CA-13 cannot be used at depression angles of less than 30 degrees due to -189 mount support arms and parts of the aircraft structure.

The CA-3-2 and CA-3-2B cameras with focal lengths of 12" and 24" may be used at all available depression angles. There is no IMC provided for these cameras in the -189 mount; the MA-10A magazine may be used to compensate for this, however.

The KA-47A, KA-46A, and KA-53A cameras may be used at all available depression angles. The availability of IMC is limited only to RDA Servo Power Unit settings which control film IMC rate in these cameras and in the MA-10A magazine.

The azimuth loop is an open-loop servo system, deriving its input from a remote synchro transmitter in the viewfinder electronic package. The transmitted position data is brought to a synchro receiver in the mount. The position error signal of the receiver is transmitted to the azimuth servo amplifier whose output is connected to the control phase of the azimuth drive motor. The motor drives the azimuth ring and the synchro receiver until the position error signal is essentially zero.

The IMC circuit consists of a rate circuit, a position circuit, and the IMC amplifier which controls the IMC motor. A tachometer, or dc generator, is mechanically coupled to the motor and provides feedback voltage to the IMC circuit to maintain constant speed at any given signal input.

There are two modes of IMC servo operation. In the position mode, the camera is moved to an angular position forward of vertical. The angle is determined by the signal input voltage multiplied by the setting of the obliquity control and cannot exceed 2 degrees. The mount remains in the position mode until a pulse causes relay contact. This pulse begins the IMC cycle and the camera begins to move in the aft direction. When the camera reaches vertical a cam-operated switch completes the camera shutter trip circuit for taking the picture, and at the same time breaks the ground circuit of the IMC relay. The relay is a slow-break type, which remains closed long enough to being camera operation and permit shutter operation. When the relay opens, it reverses the IMC motor direction, and, in the position mode, returns the camera to its initial offset position. It will remain in this position until another pulse causes the IMC cycle to repeat. Because of the operating characteristics of the CA-13 camera, the mount will not react to pulses arriving at intervals less than .25 seconds plus camera recycle time, which varies from approximately 1.5 to 1.75 seconds.

POSITION 3 AND 4 OBLIQUE MOUNT

The -189 IMC amplifier and actuator are combined with a specially designed mounting structure at positions 3 and 4 to provide a mounting surface for the CA-13 cameras with 24-inch or 36-inch lens cones used in the oblique. The mounts are mechanically adjustable for depression angle, focal length, and rotation about the optical axis. Image motion compensation is provided when the camera is installed with the 18-inch axis of the film format across the flight direction.

Note

To preclude the occurrence of holidays in a photo run requiring high cycling rates, when using the CA-13 camera and IMC mounts, determine slowest (camera plus mount) recycle time by pressing extra picture switch and timing ten pulses. Dividing this time by 10 will give fastest recycle time useable.

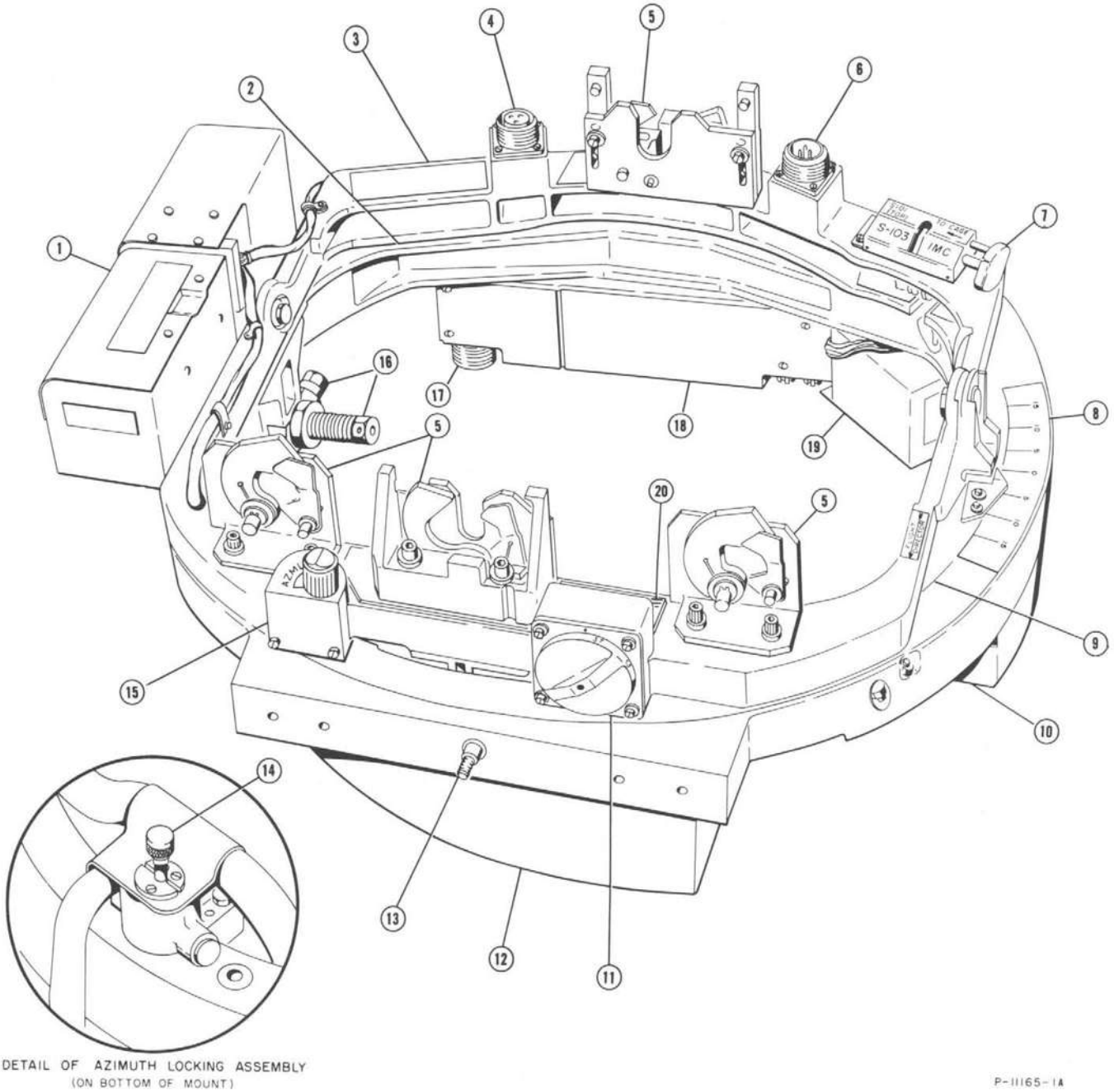
POSITIONS 5, 6, AND 7 TRI-METROGON MOUNTING STRUCTURE

A specially designed mounting structure is used at positions 5, 6, and 7 to provide a tri-metrogon program. The structure supports the cameras at positions 5 and 7 at fixed 30-degree depression angles. At position 6 the structure utilizes the -188 mount in the vertical position. During tri-metrogon operation the pitch and roll stabilization functions of this mount are locked out. Manual pitch adjustment is provided at the support during tri-metrogon operation.

STABILIZATION SIGNAL SOURCE

Strict adherence to the following information on the ASB-1B radar gyro platform must be maintained to obtain accurate verticality during photographic missions.

The pitch and roll stabilization signals for the viewfinder, viewfinder VGI instrument, and the 187 and



DETAIL OF AZIMUTH LOCKING ASSEMBLY
(ON BOTTOM OF MOUNT)

P-11165-1A

1. IMC amplifier
2. Support ring
3. IMC gimbal
4. Output receptacle to CA-13 camera
5. Trunnion clamps
6. Power-input and pulse-to-camera receptacle
7. IMC caging knob
8. Azimuth-motion calibration plate
9. Azimuth ring
10. Azimuth drive assembly
11. Obliquity control
12. IMC drive assembly
13. Mounting trunnions (2)
14. Azimuth lock
15. Azimuth control switch
16. Adjustable snubbers (2 pairs)
17. Power supply receptacle
18. Electronic chassis
19. Azimuth amplifier
20. Trunnion clamp adjusting plate

Figure 8-7. 189-90189 Mount

188 camera mounts are derived from the ASB-1B radar system and distributed through the stabilization distribution box. The stabilization distribution box will not function until the ASB-1B selector switch is placed in the STAND-BY mode. This distribution box also automatically returns and holds the mounts and viewfinder reticles to a position of approximately 6 degrees of roll when the aircraft exceeds 7-1/2 degrees of roll. The stabilized roll signal becomes available again when the aircraft returns to less than 6 degrees of roll attitude.

The ASB-1B radar gyro platform does not provide caging for the gyros and therefore must be kept on during the entire flight to prevent possible damage to the gyro gearings. The ASB-1B selector switch must remain in the GYRO ON position for three minutes before being switched to the STAND-BY or SEARCH modes. The gyro platform has a pendulum mechanism, called bails, that continually erects the gyros to vertical, thereby correcting for earth's gravity and normal gyro drift. Whenever a dynamic force other than gravity, (1/30g for 4 seconds, 1/15g for 2 seconds, 1/7.5g for 1 second, etc.) is applied, accelerometers sense the dynamic force and cause the bails to lock. This removes the pendulum effect and allows the gyros to become free gyros unaffected by dynamic force. A timer inside the ASB-1B platform keeps the bails locked for a period of four minutes. At the end of the four minute period, the bails unlock and the pendulum exerts its corrective torques on the gyros as required.

Note

- The four minute time interval is the recommended setting for the timer. Any setting shorter than that recommended will have the effect of reducing the bail lock time and/or increasing the sequence of events that occur in the gyro platform during flight maneuvers.

- The time difference between dynamic force application and locking of the bails may allow the gyros to be 1/10 degree maximum from vertical. After the bails are locked the free gyros have a level gyro drift rate of 3 degrees per hour plus the apparent precession due to the earth's rotation. During normal flight conditions, and the 4-minute time interval, the gyro will not deviate from vertical by more than 1 degree.

During flight maneuvers that involve a change from level flight to turns (less than 65-degree bank angles) and back to level flight, which are executed in 4 minutes or less, the gyro platform stabilization signals represent a vertical axis perpendicular to the aircraft horizontal reference plane when the aircraft is flying with wings level and at zero angle-of-attack. Failure to adhere to the following precautions will result in very erratic stabilization erection times of up to 45 minutes or more and may damage the gyro platform.

CAUTION

- Turning the ASB-1B selector switch immediately to STAND-BY or SEARCH mode without waiting the 3-minute interval in the GYRO ON position may cause serious damage to the antennas.

- Turning maneuvers with bank angles less than 65 degrees and longer than 4 minutes, allow the bails to unlock during a turn. This results in having the dynamic forces of both gravity and centrifugal force act upon the bail pendulum, and causes the gyros to precess to a false dynamic vertical that will not be perpendicular to the airplane horizontal reference plane when the aircraft returns to a level attitude. The false dynamic vertical will be away from true vertical by a number of degrees, depending upon the length of time and magnitude of the dynamic forces acting upon the pendulums. Four minutes after the aircraft is returned to level attitude, the gyros will erect to vertical at a rate not less than 1^{o} per minute.

- At any time that bank or pitch angles exceed 65^{o}, a complete loss of stabilization will be experienced. This condition is a result of one gyro gimbal being against its stops, creating a torque about the opposite gimbal, which then accelerates the other gyro into its stops. Such drastic movement will either shorten the life of the gyro platform or cause immediate failure due to high shock loads. If failure of the gyro platform has not occurred, returning the aircraft to horizontal flight will create a lack of verticality for periods of 10 to 45 minutes or longer.

It is recommended that all turning maneuvers be kept to less than 65-degree bank angles and less than 4 minute duration. If a turning maneuver longer than 4 minutes is required, proceed as follows:

1. Execute turn with bank angle less than 65.
2. Hold turn for approximately 3-1/2 minutes.
3. Return to level flight.
4. Hold level flight 1 minute to permit bails to unlock and gyros to erect to true vertical.
5. Continue with steps 1, 2, 3, 4 until desired heading is attained.

STABILIZATION SIGNAL DISTRIBUTION UNIT

The stabilization signal distribution unit is located on the top shelf of the left hand equipment rack in the camera compartment, outboard of the central computer (figures 8-1 and 8-10). The stabilization signal

distribution unit receives two synchro input signals proportional to the pitch and roll of the aircraft from the ASB-1B radar system. It modified these signals as necessary, and supplies the proper electrical signals to -187 and -188 mounts to maintain camera optical centerline verticality and to two viewfinders to maintain image (pitch) and reticle (roll) stability. The unit also supplies pitch and roll signals to the attitude indicator in the viewfinder system. The operating range of the unit for optimum accuracy is ±8° roll, and +5-degree nose up, -2-degree nose down in pitch for all outputs, except the attitude indicator which has a range of ±30-degree pitch and roll.

The stabilization signal distribution unit provides an electrical caging of those units stabilized in roll (the viewfinder reticles and the stabilized mounts) whenever aircraft roll exceeds 7-1/2 degree, to prevent excessive unbalancing of the camera mounts during extended turns. The caging effect can be observed in the viewfinders by a slight movement or jump of the reticles back toward center whenever the aircraft exceeds 7-1/2-degree of roll. The viewfinder reticles will then hold at approximately 6-degree roll position until the aircraft passes through the 7-1/2-degree roll position on its return to the level flight attitude.

GYROSCOPE CONTROL (C-3816/ASB)

The gyroscope control operates in conjunction with Displacement Gyroscope CN-502 and Attitude Indicator ID-945 in the ASB-1B system. The gyroscope

functions to establish the horizontal as the reference plane, and, in conjunction with the two compass elements that sense the direction of the earth's magnetic field, to establish magnetic north as the reference direction. With respect to the two established references, the gyroscope measures aircraft rotation about the roll, pitch, and azimuth axes. The derived electrical roll, pitch, and azimuth data are used to stabilize the AN/ASB-1B and photographic systems.

The gyroscope control provides the system with the following capabilities:

1. Monitoring the outputs of the CN-502 roll and pitch gyros on the attitude indicator ID-945.

2. Caging the CN-502 roll and pitch gyros when they have precessed from the aircraft vertical.

3. Fast-slewing the CN-502 azimuth gyro when the gyro has precessed from magnetic north.

4. Disabling the CN-502 roll and pitch bails as a function of the airspeed turning rate to prevent precession during a turn.

The attitude indicator ID-945 receives roll and pitch data from the gyroscope control. The vertical needle of the attitude indicator indicates the position of the roll gyro in increments of 5 degrees; the horizontal needle indicates pitch in increments of 5 degrees.

CAUTION

Roll and pitch indicator readings are inaccurate above 20 degrees.

IMAGE MOTION COMPENSATION

Image motion is movement of the image at the focal plane during exposure. Some loss in resolution (blurring) of the film will always occur because of the physical inability to photograph at sufficiently rapid shutter speeds. Therefore, some method of image motion compensation (IMC) at the focal plane is desirable and effective, since it permits photography at decreased aircraft altitude and increased ground speed. Image motion compensation is accomplished through use of moving mounts and IMC film magazines. Both methods of image motion compensation are used in this photographic system.

IMC MAGAZINES

When using certain pulse-type cameras (CA-3-2, KA-47A, CA-3-2B), IMC is provided through the use of the MA-10A film magazine. This magazine compensates for image motion, during day operation, by moving both the film and platen during the exposure interval at a speed coincident with the image motion caused by aircraft forward movement. During night operation the film is moved continuously across the platen until exposure occurs. The magazine can be used with vertical cameras, of all available focal lengths, at a ground speed range of 175 to 450 knots and an altitude range of 100 to 50,000 feet. It is used with the KA-47A for night photography.

The magazine cycles automatically, providing the proper 60 percent overlap (day operation), powered and operated by the camera control system. During night operation the cycling is controlled by the illuminant burst and flash detector. Cycling rates of 2 per second (day) and 1 per second (night) are possible, with film transport speed controlled in a range of 0.15 to 7.2 inches per second, in accordance with factors of focal length, camera depression angle, ground speed, and altitude. Focal length and depression angle factors are set into the system at the remote drive amplifier (RDA) servo power units during the preflight; altitude and ground speed factors are put into the system at the central computer during flight (either manually at the master control panel, or automatically, through the scanner converter).

Note

Proper positioning of the day-night lever, located at the rear corner of the left side of the magazine base, is necessary for correct operation. This lever must not be rotated when the magazine is operating.

IMC MOUNTS

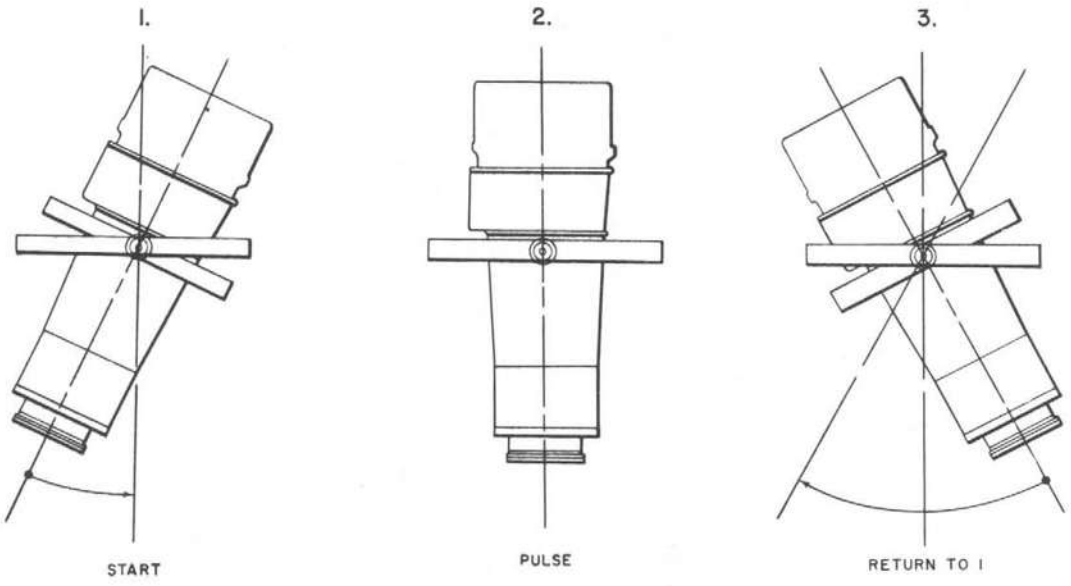
(See figure 8-8)

IMC mounts compensate for image motion by swinging or moving the camera through a fore-and-aft arc at a speed coincident with image motion; the camera is pulsed, taking a photograph, when the optical axis of the camera coincides with that mount axis that is perpendicular to the camera mount mounting plane. (See figure 8-8.) For vertical photography this is when the camera is vertical, if the pitch attitude is zero. Two mounts, 189-90189 and 187-90187, provide IMC at the following camera positions: the -189 mount at positions 1, 8, 9, 10, 12, and the -187 mount at position 11 only. IMC Mount useable with CA-13 cameras only.

EQUIPMENT RACKS

(See figure 8-9)

Two equipment racks are installed in the camera compartment, one between camera positions 8 and 10 on the left-hand side, the other between positions 9 and 12 on the right-hand side. The two racks provide mounting surfaces for the various electrical and electromechanical units necessary to channel power for



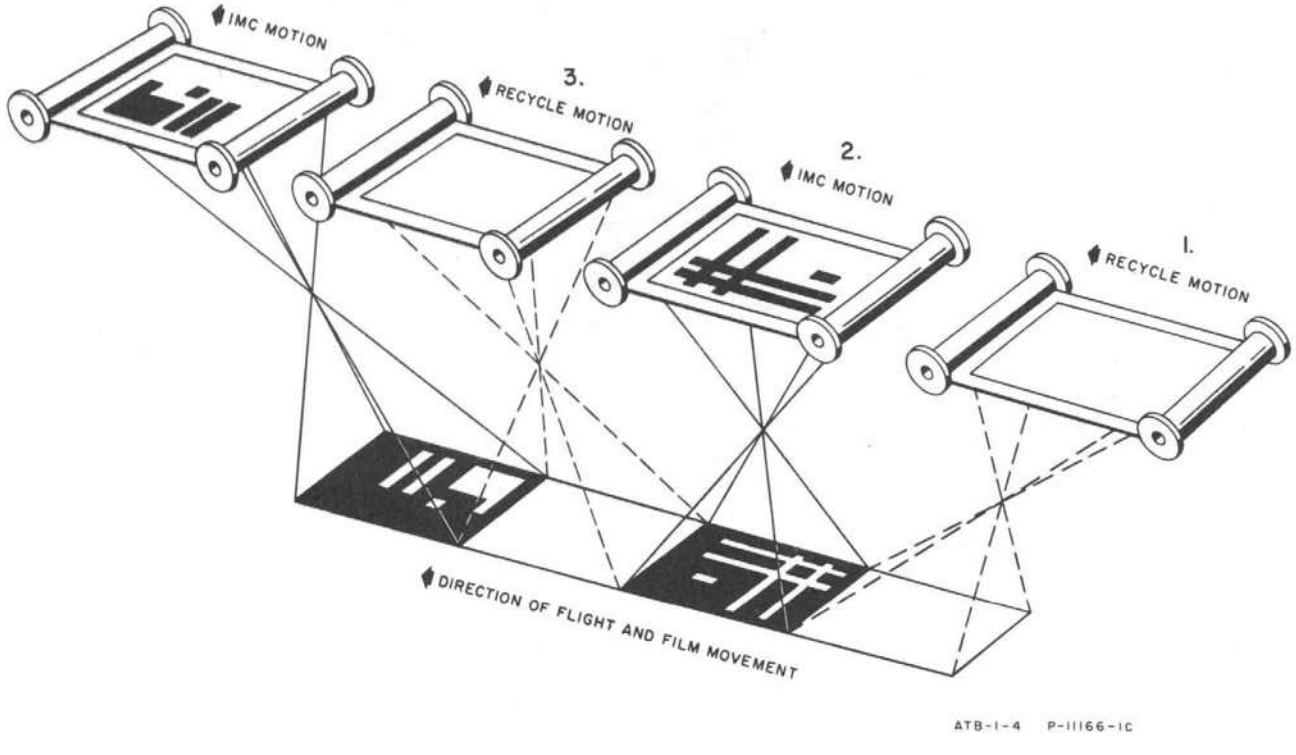


Figure 8-8. IMC Mount Operation and Moving Film Principle

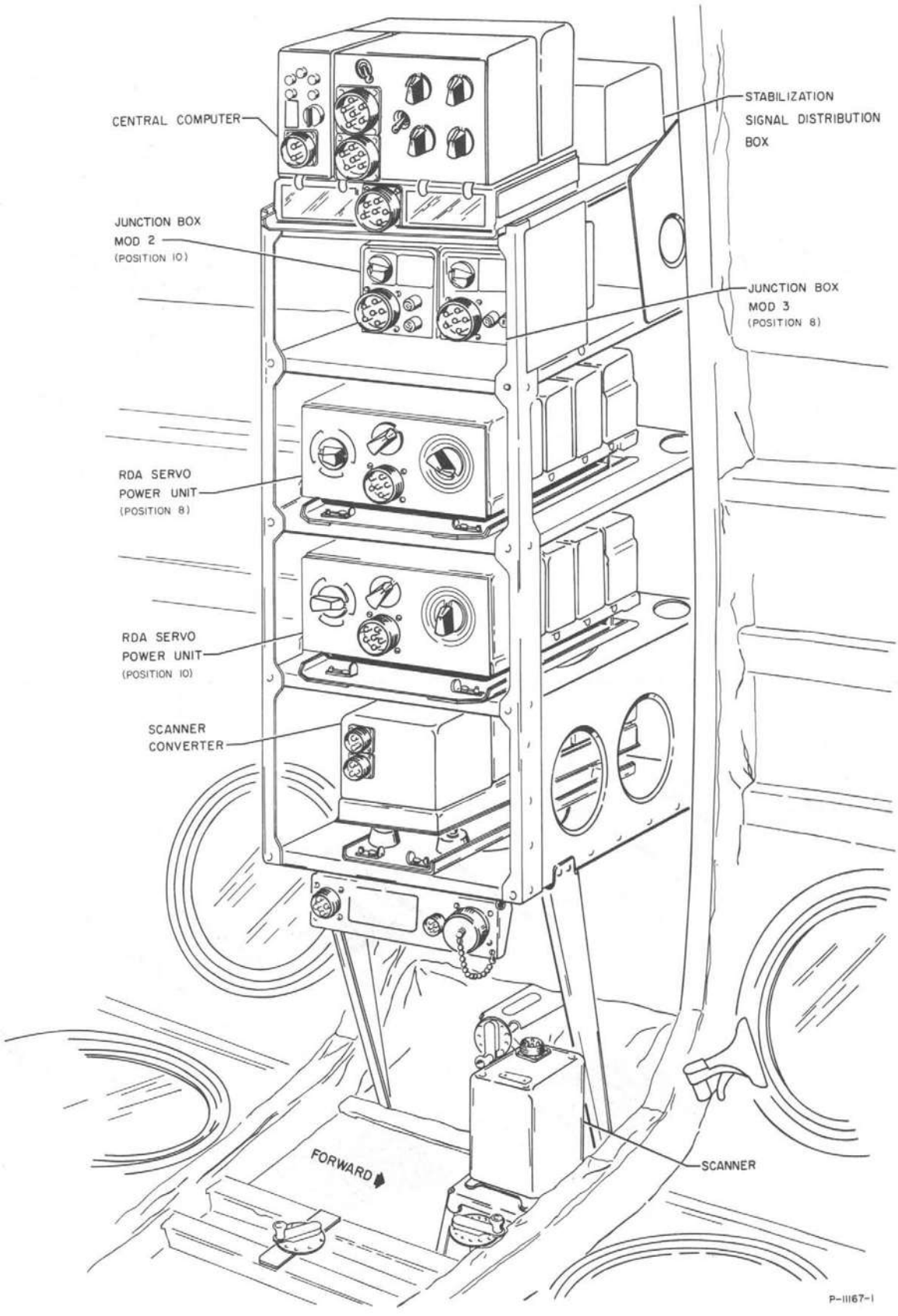


Figure 8-9. Equipment Rack (Sheet 1)

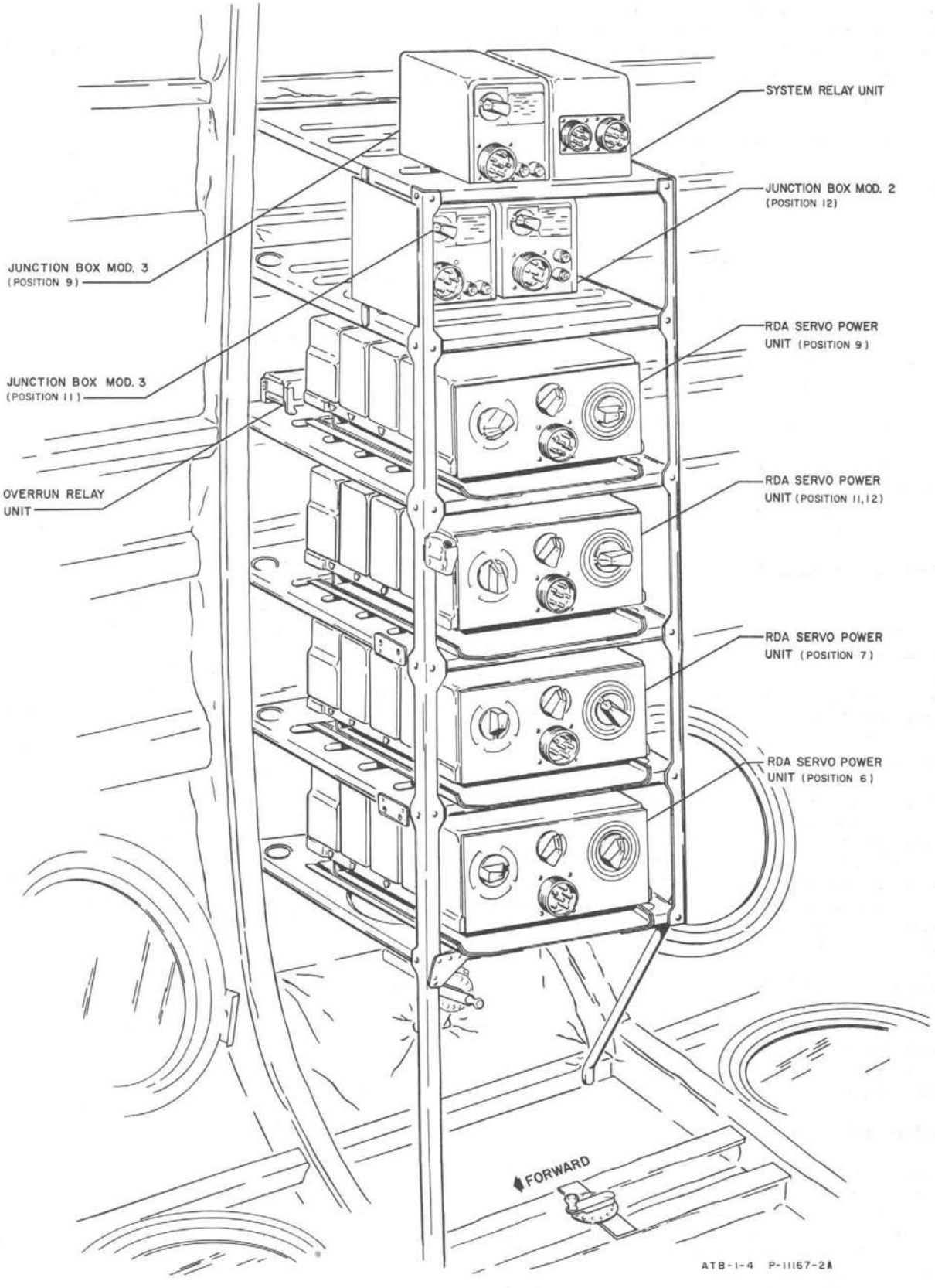


Figure 8-9. Equipment Rack (Sheet 2)

camera system control and operation. The left-hand rack contains the central computer, the stabilization signal distribution unit, the junction boxes and RDA servo power units for camera positions 8 and 10, and the scanner-converter. The scanner is mounted below the equipment rack.

The right-hand equipment rack contains the system relay unit, the overrun relay unit, the junction boxes for positions 9, 11, and 12, and the RDA servo power units for positions 6, 7, 9, 11, and 12.

Note

Only one RDA servo power unit is provided for use at positions 11 and 12, and cameras requiring the use of the RDA cannot be programmed and operated simultaneously at these positions.

(For locations of units on racks, see figure 8-9.)

The other junction boxes and RDS servo power units are mounted at various locations throughout the camera compartment. (For locations, see figure 8-1.)

CENTRAL COMPUTER

The central computer (see figure 8-10) is composed of an amplifier unit and two station computers mounted on a base assembly. The computer is located in the camera compartment on the top shelf of the left-hand equipment rack. (For its general location, see figure 8-1.) The face of the central computer is shown in figures 8-1 and 8-10.

The purpose of the central computer is to supply timed trip pulses necessary to operate the cameras and the night armament release system, and to provide the synchro data necessary to operate the traveling grid of the viewfinder. These pulse and synchro outputs are proportional to V/H, and are put into the camera control system through the various junction boxes and the system relay unit.

Image motion (V/H) data as supplied by the scanner or master control panel, is modified by the central computer for factors of percent of overlap, formal size, focal length and depression angle. All pulses from the computer are +28 volt dc and of 85 ± 25 milliseconds duration.

AMPLIFIER UNIT

The amplifier unit of the central computer contains the circuitry necessary to control the speed of the drive motor in the computer base and to establish a +150 volt dc reference voltage. This reference voltage is then supplied to the master control and the impedance coupler in the system relay unit. These two units use the +150 volt dc reference voltage to establish the system control voltage, called E V/H, that is supplied when computer mode is selected on the master control panel.

STATION COMPUTER (501-400-4)

This computer is an electro-mechanical unit which provides timed pulse and synchro data output. Mounted on the base assembly, it is driven by the drive-motor. The adjustments of the gear ratios of its gear trains are varied to modify the output pulse intervals as required by format size, percent of overlap, focal length, and depression angle. This is done through the use of push-button gear shifters and two solenoids. The gear shifters may be manually depressed only when the master control power switch is OFF. This unit supplies the pulses for camera position 2 on daytime missions and to the illuminant release system on night missions. For night missions, the proper shifters (BC) have their gear trains engaged automatically by solenoids, since only vertical cameras are configured in this aircraft. It is recommended that shifters BC always be manually depressed to preclude aborting a flight due to failure of the solenoids.

STATION COMPUTER (1470-200)

This computer is an electromechanical unit which provides four independent modes of camera operation, Channels 1, 2, 3, and 4. It also provides for sequential operations of 24-inch and 36-inch focal length cameras. Drive power for the station computer is supplied by the base assembly drive motor.

Channel output pulse intervals are manually varied by selection from eight cam-actuated switches. Each switch has a different pulse interval which is determined by the gear ratio of the cam which actuates it. The appropriate pulse interval is selected by manually setting the channel switches to the proper position, according to instructions on the base assembly data plates. Cam actuation of the selected switches feeds a dc pulse to the channel relays, energizing the relays and causing a dc power flow through the proper connectors and circuitry maintaining a constant +28 V dc pulse width (85 + 25 milliseconds). Sequential operation is independent of channel operation. The focal length sequence selector switch is labeled SEQ and can be positioned for either a 24-inch or a 36-inch focal length camera operating sequentially in positions 8, 9, 10, and 12. The camera pulse sequence selector switch labeled SEQ 2, 4 is used to determined the type of sequential pulsation to be used. Position 2 of the switch is used to pulse camera positions 8 and 9 or positions 10 and 12 sequentially. When position 4 of the switch is used, the four cameras are programmed together and pulse in the sequential order of 8, 10, 12, 9.

BASE ASSEMBLY

The base assembly contains the drive motor which drives the various gear trains located within the station computers. This assembly also serves as a junction box for various systems whose electrical control

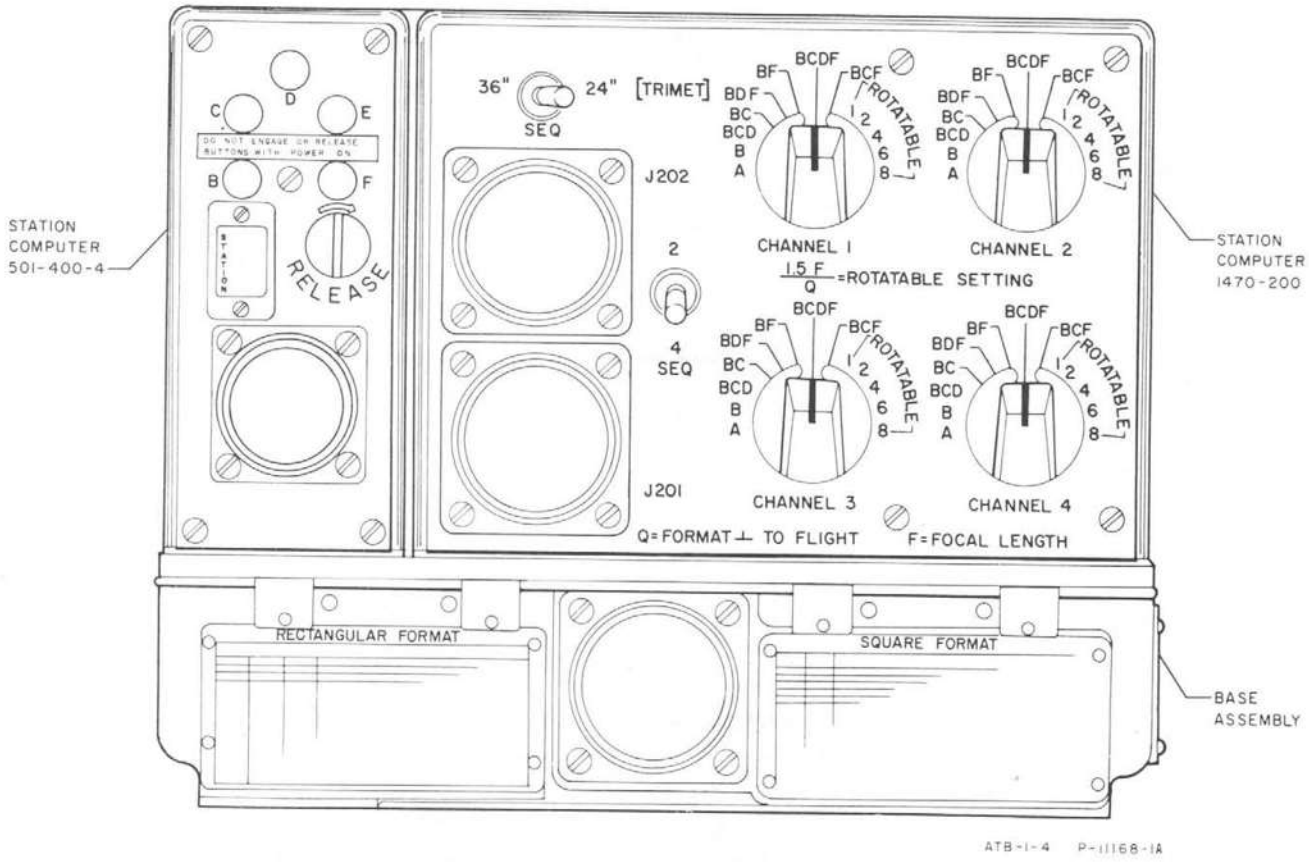


Figure 8-10. Central Computer

signals are used by the computer amplifier. The main function of the base assembly components and of the electrical signals received are:

1. Receives E V/H voltage to control drive motor speed proportional to V/H.

2. Receives high altitude grounding signal, from either master control panel or scanner converter, used to change gear ratios on drive motor by factor of 10:1. Change in gear ratio is required when V/H ratios are small and resulting E V/H voltage values would be too low to maintain accuracy of image motion data.

3. Drive motor, gears and line shaft that drive gear trains in two station computers.

4. Synchro transmitter which is mechanically coupled to drive motor and rotates at velocity proportional to V/H. Synchro output controls velocity of viewfinder's traveling grid.

5. Control relay that protects drive motor from improper application of control voltages.

6. Relay to prevent extra picture pulses through camera operate switches during night photographic missions. Turning camera operate switches to OFF allows extra picture pulse to be generated through relay.

SQUARE FORMAT

FORMAT	FOCAL LENGTH				
2 1/4	12	9	6	3	1 1/2
4 1/2	24	18	12	6	3
9	48	36	24	12	6

A	3°	4°	6°	11°	90°
B	2° 11°	2° 15°	4° 23°	7° 90°	90°
BCD	5° 20°	7° 27°	12° 45°	24°	
BC	9° 29°	12° 41°	19° 90°	90°	
BDF	16° 52°	22° 90°	37°		
BF	24° 90°	34°	90°		
BCDF	42°	90°			
BCF	90°				

USE GREEN FOR MINIMUM 60% OVERLAP.

USE RED FOR MINIMUM 10% OVERLAP.

SELECT CHANNEL POSITION OR PUSH BUTTONS WHOSE ANGLE EXCEEDS THE DEPRESSION ANGLE BY THE SMALLEST AMOUNT.

WHEN USING STATION COMPUTER 501-400 SERIES WITH REMOTELY POSITIONED CAMERA: PUSH BUTTONS FOR 60% OVERLAP, 90° DEPRESSION ANGLE, EXCEPT "B" BUTTON. POSITION "A" ON STATION COMPUTER 501-400 SERIES IS WITH NO BUTTONS DEPRESSED. OBLIQUE OVERLAP BASED ON FOREGROUND COVERAGE.

RECTANGULAR FORMAT

FORMAT	FOCAL LENGTH									
2 1/4 X 4 1/2	12		9		6		3		1 1/2	
4 1/2 X 2 1/4		12		9		6		3		1 1/2
9 X 18	48		36		24		12		6	
18 X 9		48		36		24		12		6

A		2° 11°		3° 14°		4° 23°		7° 90°	90°	90° 90°
B	15°	9° 29°	7°	12° 41°	11°	19° 90°	90°	90°	90°	
BCD	13°	16° 52°	19°	23° 90°	32°	37°	1°			
BC	3° 22°	24° 90°	4° 32°	37°	10° 90°	90°	90°			
BDF	10° 46°	43°	15° 90°	90°	24°					
BF	18° 90°	90°	26°		90°					
BCDF	36°		90°							
BCF	90°									

SEE SQUARE FORMAT INFORMATION PLATE FOR INSTRUCTIONS.

P-11169-1

Figure 8-11. Central Computer Format Data Plates

CENTRAL COMPUTER FORMAT DATA PLATES

Two data plates are attached to the base assembly of the central computer to determine the proper channel and pushbutton selection on the two station computers (see figure 8-11).

The plates are labeled SQUARE FORMAT (9" x 9") and RECTANGULAR FORMAT (9" x 18"). The instructions on the square format plate apply to the rectangular format plate also. The plates are divided into four sections; format size, focal length, camera depression angle, and channel selection or pushbutton. The depression angle columns are divided into two sections; the left-hand numbers, colored green, are to be used when 60 percent minimum overlap is desired, and the right-hand numbers, colored red, are to be used when 10 percent minimum overlap is desired.

To use the plates: Enter line, upper left hand column, which shows proper format size for camera used. Follow line to right side and find correct focal length. Then follow down same focal length column and enter depression angle section. In this same column find value which exceeds depression angle of camera by smallest amount, according to desired minimum overlap. Follow this line back to left hand column to find proper pushbutton or channel position.

For example, a CA-13, 24-inch, camera with an MA-8 magazine, 9" x 18" format, is mounted at 3 degrees. Desired minimum overlap is 60%. From 9" x 18" format on the rectangular format plate, read to the right horizontally to the 24 inch focal length column. Read down vertically to 10, colored green, which exceeds the desired depression angle by the least amount. Then follow this line horizontally to the left to the resulting proper channel setting value, BC, which is the correct setting of the station computer channel switch.

Note

Any of the four rotary channel switches may be used to set the station computer. The junction box for the camera position used must be set to agree with the channel selected.

REMOTE DRIVE AMPLIFIER (RDA) SERVO POWER UNIT

The RDA servo power unit (see figures 8-1, 8-9, and 8-12) supplies a controlled signal to a camera position for exposure modification or film drive power. The signal is applied for IMC drive power (KA-40A, KA-46, and MA-10A).

One RDA servo power unit supplies power to a single camera position. The unit consists of six detachable components mounted on and interconnected electrically by the base assembly. The units are:

1. Computation and switching unit
2. Long-linear amplifier
3. Long-linear converter
4. Power supply
5. Variable gain amplifier
6. Drive amplifier.

There are two servo loops, one for film drive, and the other for exposure control. In each of these loops a variable input is added to a feedback from controlled equipment. The resultant command error is used to increase or decrease the drive voltage of the controlled unit, or to accomplish a positioning function, until the feedback is equalized with the input.

The computation and switching unit is the main switching and relay component of the unit. Three rotary selector switches are provided for setting in focal length, depression angle, and exposure factors. The exposure dials are not used in this aircraft.

The depression angle knob has settings of 5, 15, 30, and 90 degrees by which E V/H voltage is fed through modifying resistors and sent to the focal length selector switch, to the variable gain amplifier when a mount actuator is installed, or to the film drive amplifier.

The focal length selector knob is set to the appropriate focal length of the installed camera. It is divided into four positions; MA-10A, SMA, CAS-2A, and 70 mm. The SMA and CAS-2A positions are not used on this aircraft. The MA-10A section accommodates cameras using the MA-10A magazines with focal lengths of 6 inch, 12 inch, 24 inch, and 36 inch. The 70 mm section accommodates the KA-40A, KA-46A, and KA-53A cameras.

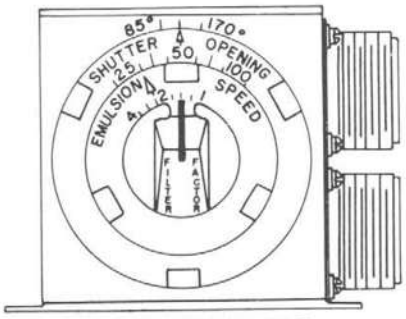
JUNCTION BOXES

The camera control system contains five types of junction boxes (figures 8-1 and 8-12), models 2, 3, 4, 5, and a KA-40 system adapter. Each camera position utilizes a junction box, whose common purpose, regardless of type, is to:

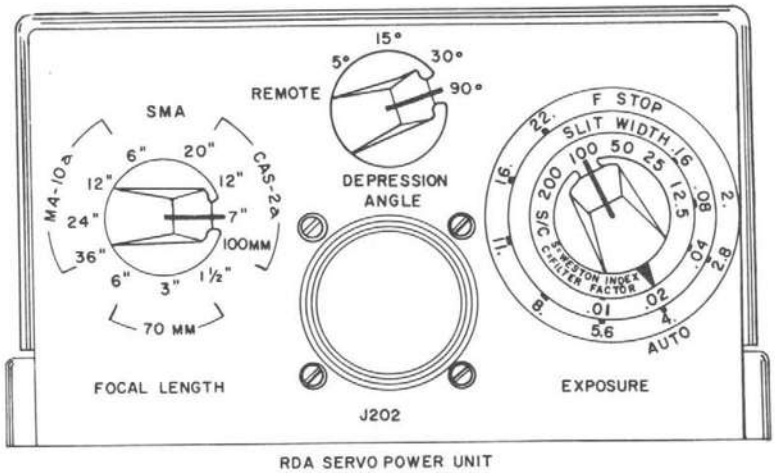
1. Supply power.
2. Permit camera operation in the manner selected.
3. Allow the use of specific cameras.
4. Provide indications of correct operation.

In addition, the separate types of junction boxes serve certain particular functions, which are:

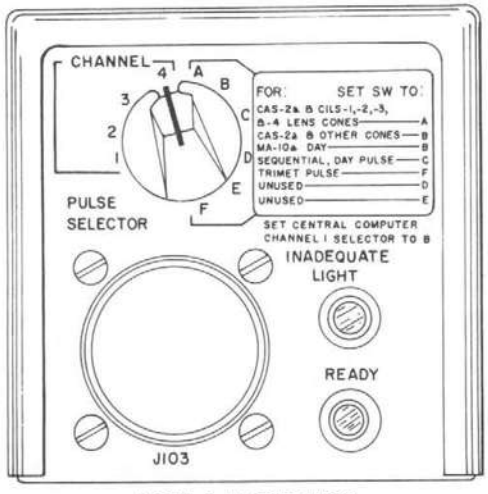
1. J-Box, Model 2
   a. Serves positions 1, 5, 6, 7, 10, 12.



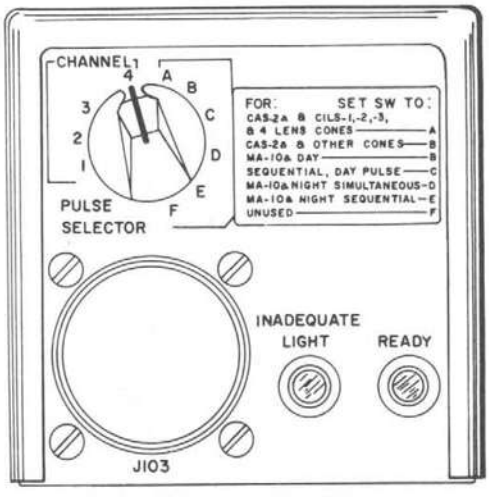
KF CAMERA CONTROL UNIT



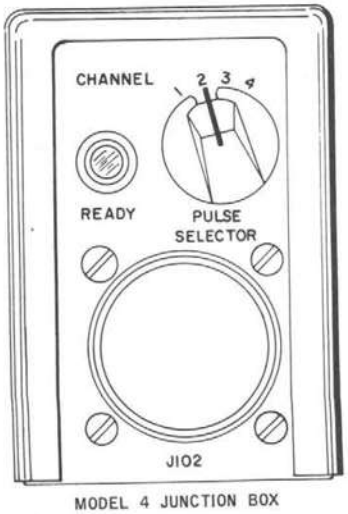
RDA SERVO POWER UNIT



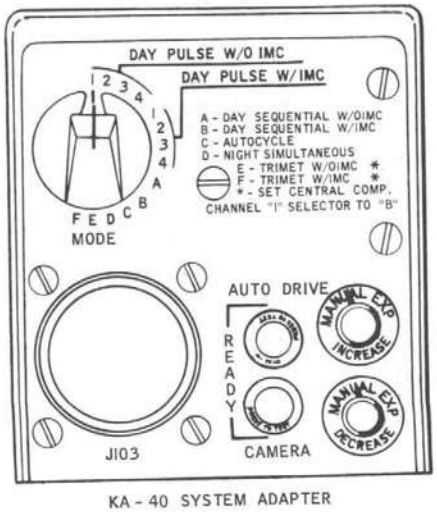
MODEL 2 JUNCTION BOX



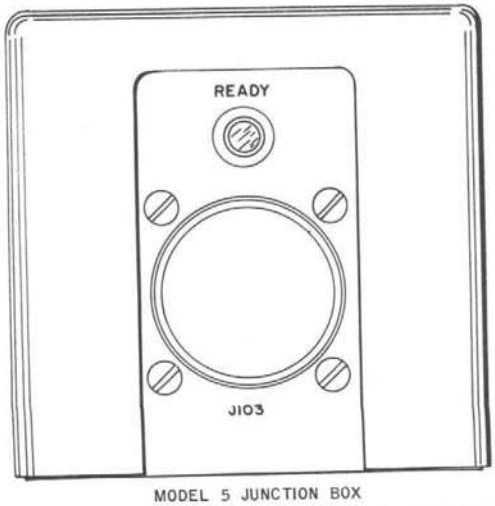
MODEL 3 JUNCTION BOX



MODEL 4 JUNCTION BOX



KA - 40 SYSTEM ADAPTER



MODEL 5 JUNCTION BOX

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Figure 8-12. Junction Boxes, RDA Servo Power Unit, KF Control Unit, and KA-40 Adapter

b. For tri-metrogon operation.

c. Day sequential operation for positions 10 and 12.

d. Gives alert indication preceding camera cycling in tri-metrogon mode of operation.

2. J-Box, Model 3

a. Serves positions 8, 9, 11.

b. For night operation either sequential or simultaneous.

c. Day sequential operation positions 8 and 9 only.

3. J-Box, Model 4

a. Serves positions 3, 4.

b. Accommodates pulse-type cameras only.

4. J-Box, Model 5

a. Serves position 2 only.

b. Accommodates only the special forward oblique cameras, the modified CA-13 and the KF-8.

5. System Adapter, KA-40A

a. Serves positions when KA-40A or KA-46 cameras are installed.

b. Is installed in place of J-box normally used for position.

c. For tri-metrogon operation.

d. Gives alert indication preceding camera cycling for tri-metrogon mode.

The J-Box, Model 2 and Model 3 both contain a channel selector switch, a data plate, an electrical connector, an inadequate light, and a ready light. J-Box, Model 4 contains a pulse selector switch, a ready light, and an electrical connector. J-Box, Model 5 contains only a ready light and an electrical connector. KA-40A system adapter contains a mode selector switch, a data plate, ready lights, switches to test exposure control servo loop, and electrical connectors.

SYSTEM RELAY UNIT

The system relay unit, located on the top shelf of the right-hand equipment rack (figures 8-1 and 8-9), is a key unit in the camera control system, providing the necessary position isolation capabilities incorporated in the camera system. Position isolation allows the deletion of one or more camera positions, and associated components, from the camera control system without affecting the operation of the remaining camera positions, which will continue to function normally.

The system relay unit has four primary functions:

1. Provides necessary control circuitry between various units in photographic system.

2. Supplies 115 volt, 400 cycle, and 28-volt dc power to system.

3. Provides contact closures for illuminant salvo, and contains necessary relays for night operation.

4. Provides isolation of E V/H signal at master control COMPUTER setting from leads to central computer, IMC mounts, and RDA servo power units.

The system relay unit contains the following relays:

1. MASTER POWER RELAY: Energized from 28-volt dc bus through master power switch on master control panel, this relay supplies 28-volt dc power to the trimet relay, and 115 volt, 400 cycle power to the Z-coupler, scanner, and other components.

2. TRIMET RELAY: Energized by master power relay through trimet interlock circuit, when trimetrogon operation is desired. Power is transferred from normal operate system to trimet system, by switching the operate ground from camera operate

circuits to trimet circuit. The trimet relay is also the PAPI transfer relay.

3. NIGHT TRANSFER RELAY: Energized by 28-volt dc lead through interlock circuits of positions 8, 9, and 11, it transfers position 2 computer pulse, computer operate, and 28-volt dc power from forward oblique to flare relay for night operation, and supplies ground to the night extra picture relay.

4. NIGHT EXTRA PICTURE RELAY: Energized by 28-volt dc power from the extra picture switch, this relay supplies power to night extra picture lead and overrun control, and supplies night 28-volt dc extra illuminant lead to flare relay.

5. SALVO RELAY: This relay is energized by salvo switch 28-volt dc power, and provides four channels for cartridge salvo or one pulse channel for flash bomb salvo.

6. Z-COUPLER: Provides isolation between the E V/H signal from master control and E V/H signal to central computer, RDA servo power units, and IMC mounts. The Z-Coupler is fuse protected in case +150-volt dc power is applied before 115-volt ac power.

HIGH ALTITUDE SCANNER

The high altitude (HA) scanner (figures 8-1 and 8-13) is a unit containing a dual optical and photoelectric system used to generate an output signal of a frequency proportional to V/H (the ratio of ground speed over altitude), together with a preamplifier, mounted in a gyro-stabilized cradle between camera positions 8 and 10 on the bottom fuselage. Gyro stabilization is caged whenever 28-volt dc power is not being supplied to the system, or when 5-degree pitch limits are exceeded.

The photoelectric cells and lens elements are mounted along a fore and aft line which is parallel to the longitudinal axis of the aircraft. Terrain images therefore are formed on one cell before being formed on the other. Each photocell is covered by a grating, which consists of a series of transverse opaque lines etched on glass. These grids are phased so that an image falling on the clear portion of the forward photocell grid will fall on the opaque portion of the aft photocell grid. Thus the light values produced on the forward lens increases at the same time the light values produced on the aft lens decreases. This system generates a signal which is a function of image velocity. Since the lens systems are 180 degrees out-of-phase and in a push-pull circuit, changes in ambient light are cancelled and the signal amplitude is doubled. The result is that the scanner automatically produces electrical pulses with a frequency proportional to the ratio of ground speed to altitude above terrain (V/H). These pulses are then amplified and fed to the scanner converter, where they are used to establish an output reference voltage (E V/H) proportional to the pulse frequency. This voltage is used to regulate the automatic IMC of the photographic system, and as a reference for exposure interval determination for non-IMC cameras.

SCANNER-CONVERTER

The scanner-converter (figure 8-1) is an integral part of the scanner system whose purpose is to convert the signal frequency received from the scanner into a dc reference voltage proportional to the ratio of ground speed in knots to altitude above terrain, or E V/H. The scanner system operates throughout a V/H range of 0.006 to 4.5. (E V/H is an output reference voltage which is proportional to the input signal frequency, V/H.) The unit, which is mounted on the left-hand equipment rack in the camera bay, consists of a shock mounted base plate mounting a chassis, which contains the connecting circuitry for ten hermetically sealed, plug-in units mounted on it. These units are:

3 operational amplifiers

2 power supply regulators

power supply unit (not hermetically sealed)

precision multivibrator

conversion amplifier

holding amplifier

automatic range amplifier.

Briefly, these units have the following functions:

1. The operational amplifiers are used as input-output and bypass amplifiers.

2. The power supply unit receives 115-volt 400-cycle power from aircraft power supply, and provides four output voltages, two at 250-volt dc and two at 6.3-volt 400-cycle ac for filament supply.

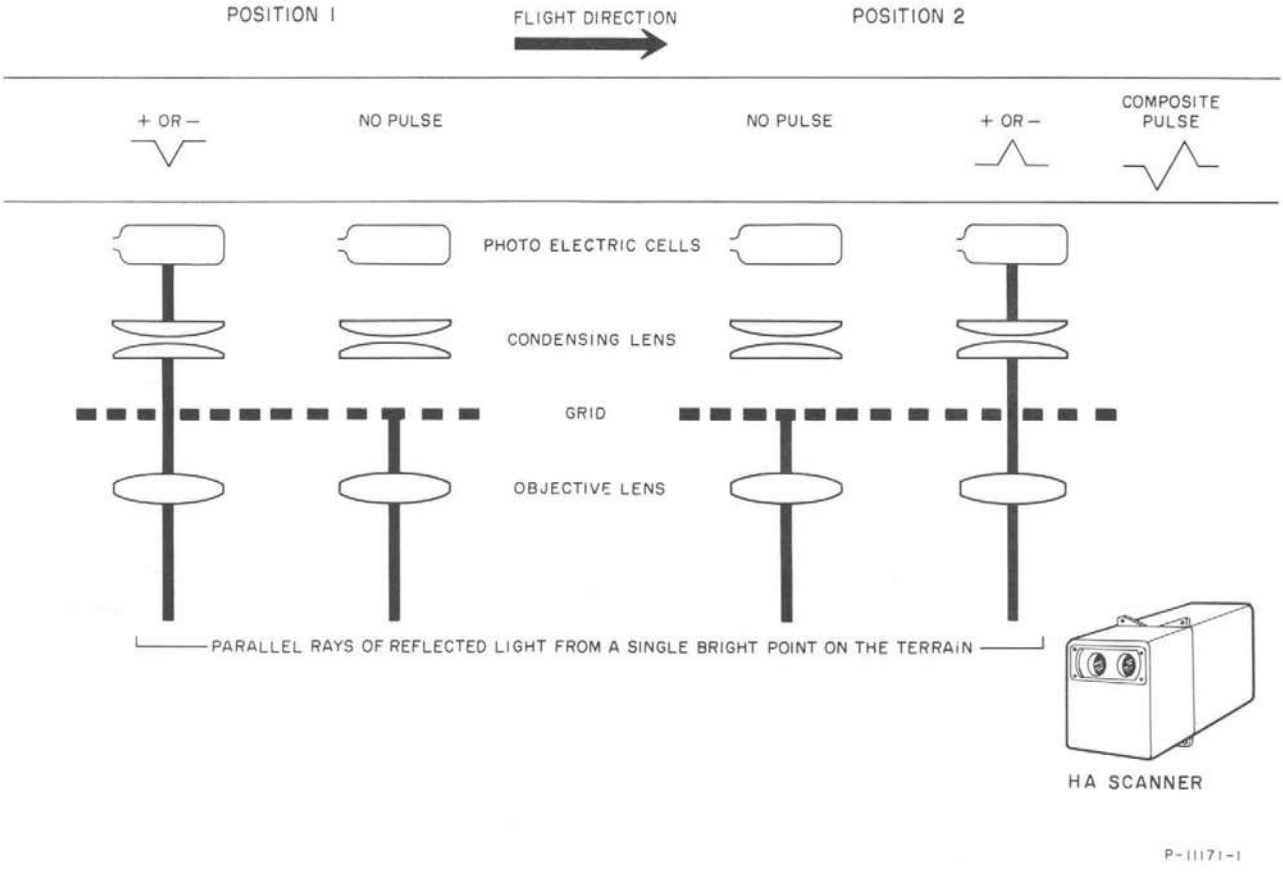


Figure 8-13. Scanner Operation

3. The two power supply regulator units each receive 250-volt dc from power supply unit; the output of positive unit is plus 150-volt dc, while the output of negative unit is minus 150-volt regulated dc. The positive unit supplies voltage for the 86-volt dc regulator in power supply unit. The input operational amplifier receives signal from the scanner, transmits it to a precision multivibrator, which shapes it to the desired wave form.

To be accurate the output voltage must be a function of frequency only; the resultant signal, after amplification, differentiation, and shaping, is a precision pulse, 150 volts in amplitude, with a pulse width of approximately 80 micro-seconds, and a frequency twice that of the scanner input.

The conversion amplifier works in combination with the output and the bypass amplifiers to establish a useful dc output signal proportional to V/H; producing an average dc voltage level from the output operational amplifier which varies directly with the frequency of the input signal and establishes the desired E V/H proportional to scanner signal frequency.

The automatic range amplifier is used to increase the accuracy of control to units using the E V/H signal. When the V/H ratio decreases as a result of low ground speeds or high altitudes, the corresponding output voltage, E V/H, becomes proportionately small. When the output voltage drops below a predetermined level, the automatic switch raises it by a factor of ten. At the same time the circuitry in the controlled units is automatically adjusted to compensate for this rise in voltage. In the same way, if the V/H ratio increases until the E V/H voltage rises above a predetermined level, the low gain circuit is switched in automatically, and the controlled units circuitry again compensates.

When the camera system is operating in the scanner mode, however, the switchover to the proper voltage range will not occur automatically. Instead the system will continue to operate with increasing unreliability. The camera system must be turned off, at both camera operate switches, to allow the switchover to occur. In the computer mode of operation, the V/H ratio has been set into the system manually, with the

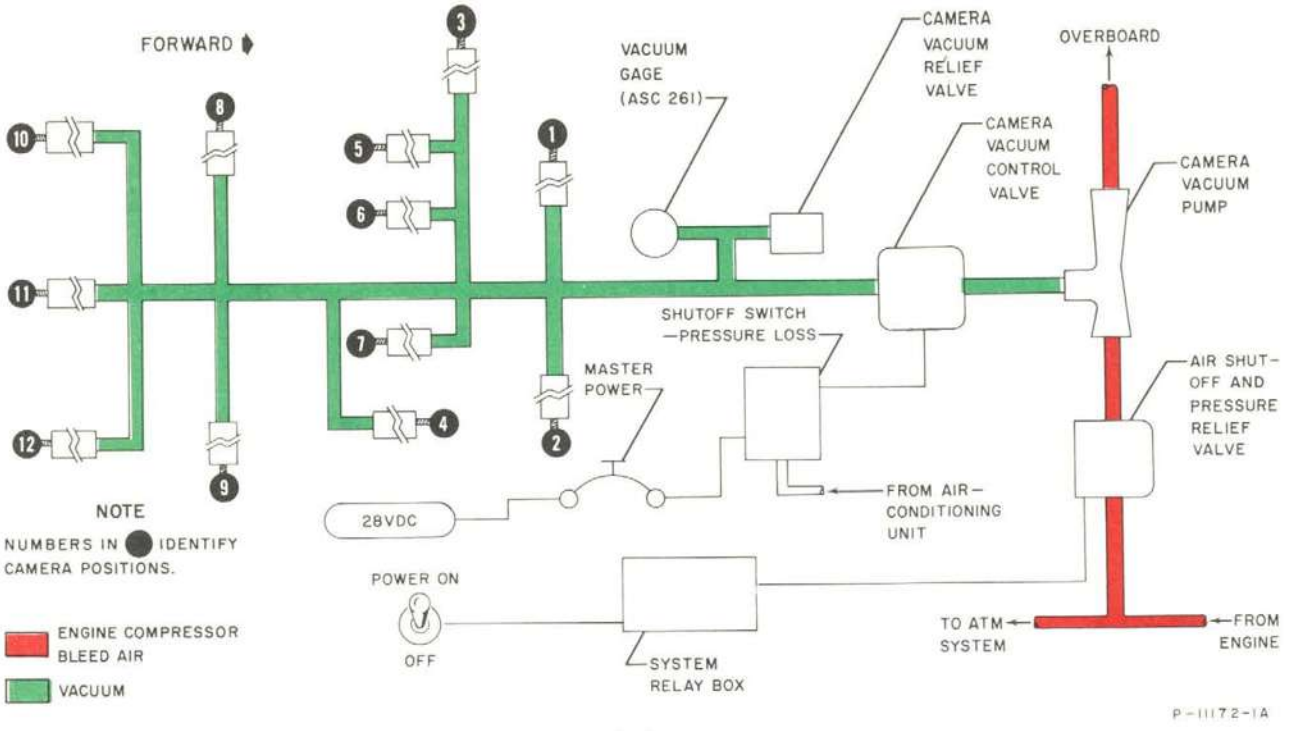


Figure 8-14. Camera Vacuum

altitude and knots thumb wheels on the master control panel, and will maintain whatever ratio has been set in.

CAUTION

The scanner cages whenever aircraft attitude is more than 5 degrees noseup or nosedown. To minimize scanner wear, turn off the master power switch during nonphotographic phases of the flight.

Note

During most normal photographic flights, terrain heights will not vary to such a great extent that the scanner will be operating in the wrong altitude range. When photographing terrain whose heights vary drastically, if the traveling grid and/or camera pulse rates become erratic when operating in scanner mode, the camera operate switches should be turned OFF momentarily and then ON, to permit the scanner system to make the switchover to the proper altitude range.

The holding amplifier protects the system from receiving an erroneous signal in case of temporary obstruction to the light path, such as clouds. When the signal voltage drops below a certain working level, a relay is energized to open the signal input circuit, and the output voltage is stabilized at the last reliable signal level received. This holding output continues until the signal input returns in reliable, working form. The scanner signal circuit to the output operational amplifier is then closed.

PRECISION AUTOMATIC PHOTOGRAMMETRIC INTERVALOMETER (PAPI)

The camera control system incorporates provisions for the installation of a precision automatic photogrammetric intervalometer (PAPI) as an alternate installation to the scanner converter. The PAPI is installed in the same location as the scanner converter, on the bottom shelf of the left-hand equipment rack in the camera compartment. The scanner-converter must be removed to install PAPI; the scanner remains in place and supplies the necessary V/H data to the PAPI.

LIGHT MONITOR

The light monitor (see figure 8-1) is used during day operation of the system only, in conjunction with the KF-8, KA-40A, and KA-46 cameras. It is mounted on the lower center structure between the bomb bay doors. The unit contains a lens and photoelectric cell, used to provide a signal proportional to terrain brightness. The brightness signal is used with the exposure control to control the operation of the KF-8, KA-40A, and KA-46 cameras. The light monitor operates in a brightness range of 6.25 to 1600 foot lambert, within 45 degrees of vertical.

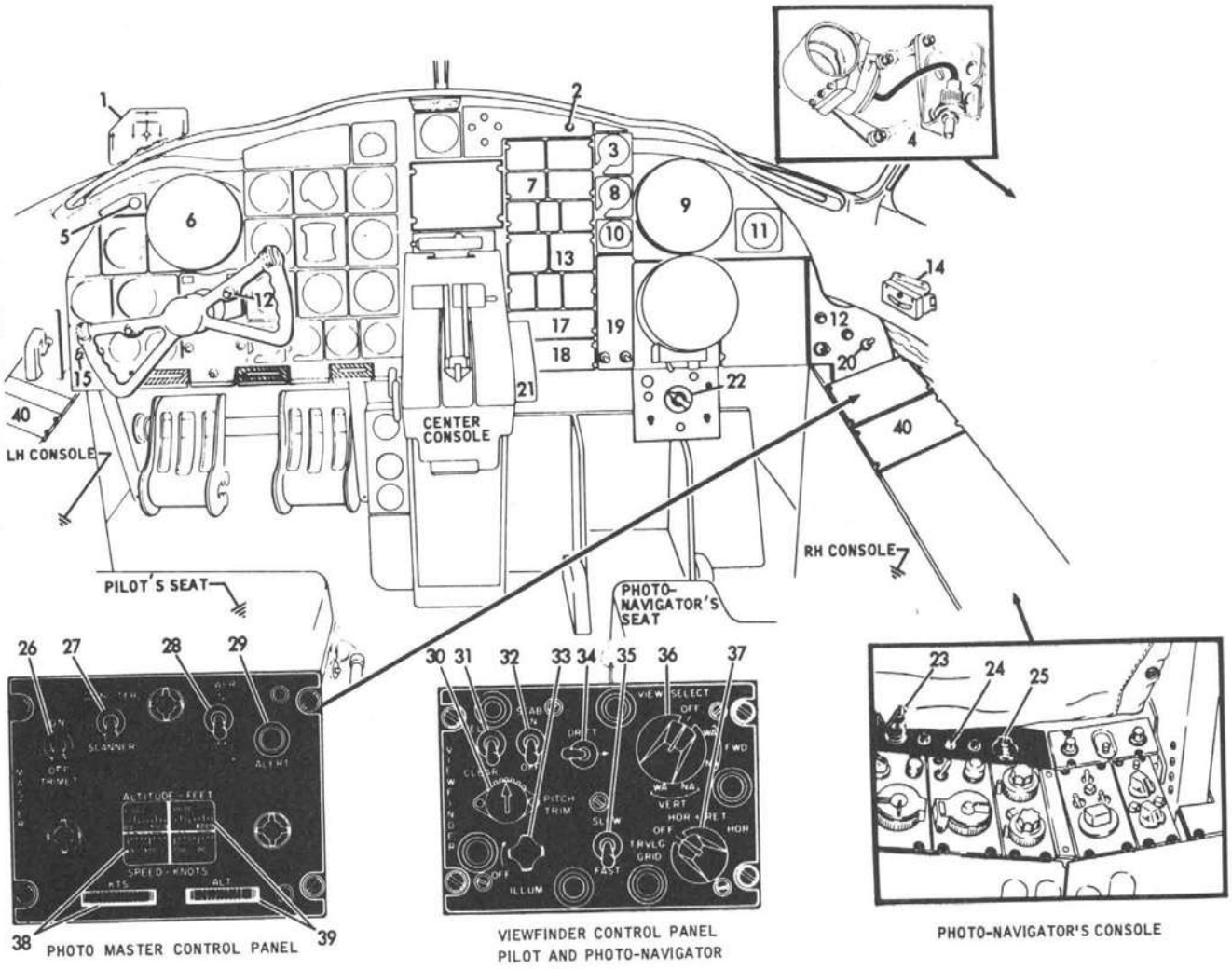
EXPOSURE CONTROL

The exposure control (see figures 8-15 and 8-16) provides a means of continuously monitoring the light level of the terrain in relation to the camera f stop setting, allowing for remote control of the exposure settings of the KF-8, KA-40A, and KA-46 cameras. The unit, which is mounted on the photo-navigator's instrument panel below the camera control panels, consists of an exposure meter used in conjunction with an autotransformer. Light levels detected by the light monitor are read on the exposure meter and reflects the relative exposure as determined by the setting of the exposure control knob. This knob, labeled LIGHT, has nine positions. It is rotated to correct the meter indication to the NORMAL range in the center of the scale (correct exposure) or to any relative exposure desired. The exposure meter has OVER, NORMAL and UNDER labeled about the dial, and an exposure range of 2 stops under to 2 stops over can be read on the meter.

PHOTO CONTROLS

MASTER CONTROL PANEL

The master control panel (see figures 8-1 and 8-15) is located on the photo-navigator's right-hand console.



1. Forward oblique sight
2. Bomb doors open light
3. 8-day elapsed time clock
4. Side oblique sight (typical)
5. Trimet camera indicating light
6. Viewfinder, pilot
7. Stations control panel, Model 3
8. RH AC frequency meter
9. Viewfinder, photo-navigator
10. LH AC frequency meter
11. Gyro monitor indicator
12. Extra picture switches
13. Stations control panel, Model 4
14. Inclinometer
15. Camera operate switches, pilot
16. Deleted
17. Illuminant control panel
18. Exposure control panel
19. Camera operate switches, photo-navigator
20. Aerial radar photo switch
21. Skid turn control
22. ASB-1B gyro control
23. Extra picture extension switch
24. Oblique sight illumination switch
25. Radar exposure counter
26. Trimet camera operate switch
27. Mode selector switch
28. Photo system master power switch
29. Master power switch alert light
30. Pilot's V/F VG1 pitch-trim knob
31. Filter selector switch
32. Stabilization switch
33. Illumination knob
34. Drift switch
35. Traveling grid speed switch
36. View selector switch
37. Presentation selector switch
38. Ground speed thumb wheel and scale
39. Altitude thumb wheel and scale
40. Viewfinder control panel

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Figure 8-15. Cockpit Photo Controls, Pilot and Photo-Navigator

It supplies power to the photographic system to operate all cameras and provides the selection, either manually or automatically, of the ground speed and altitude factors (V/H) necessary to system operation. The panel contains:

MASTER POWER SWITCH. A two-position toggle switch that supplies exposure voltage, and, by completing the ground leg, supplies power to the photographic system from the aircraft electrical system.

SCANNER-COMPUTER MODE SWITCH. A two-position toggle switch that permits the selection of either the scanner or master control panel as a source of V/H data to the camera control system. When the switch is in the SCANNER position, V/H data is fed to the control system automatically by the scanner. With the switch in the COMPUTER position, V/H data must be supplied to the system manually, through the V/H selection dials.

TRIMET CAMERA OPERATE SWITCH. A two-position toggle switch used to operate cameras in positions 5, 6, and 7, when they are programmed simultaneously for use as a tri-metrogon installation.

Note

The tri-metrogon program operation is independent of the camera operate switches. When positions 5, 6, and 7 are operated as a tri-metrogon program, the other cameras may be programmed as OP 1 and OP 2, thus permitting three programs of operation.

ALERT LIGHT. A light used to indicate an approaching pulse to the tri-metrogon cameras. The light comes on in advance of the camera operation at a time interval of 15 percent of the cycling time.

V/H DATA SELECTION DIALS. Two rotatable thumb wheels are provided to allow manual input of V/H data into the camera system when operating in computer mode. The thumb wheels are labeled ALT and KTS. Above the thumb wheels there are two scales, one showing altitude above the terrain and the other showing ground speed in knots. The approximate altitude and ground speed values are set into these scales by the dials. In computer mode, the scales remain fixed at whatever values have been set into them, maintaining

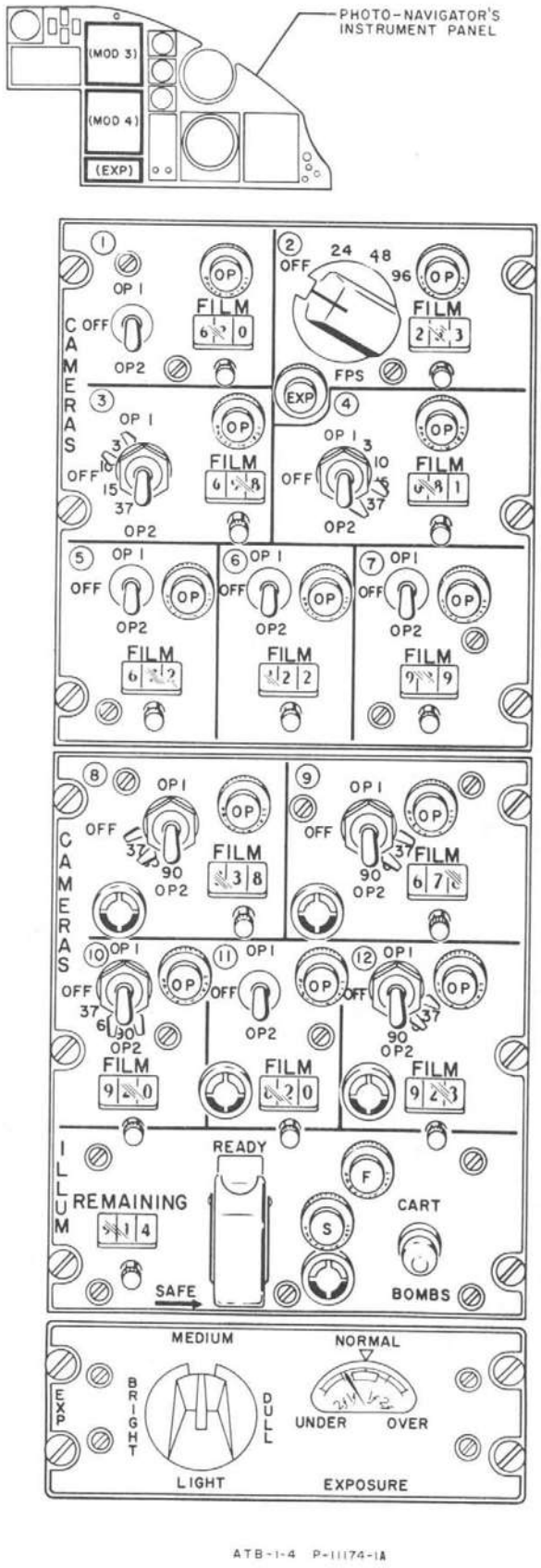


Figure 8-16. Cameras, Illuminants, and Exposure Control Panels

a constant preset V/H ratio. However, the altitude scale may be remotely controlled by using the fast-slow switch on the viewfinder control panels, and adjustments in the V/H ratio may be made in this way.

CAMERA CONTROL PANELS

The camera control panels (see figures 8-1 and 8-16) are located in the center of the instrument panel to the right of the master control panel, and are accessible to both pilot and photo-navigator. Their purpose is to provide the programming capability of the various camera positions prior to the initiation of camera operations by the camera operate switches, to provide indications of proper operation, power or film failure, inadequate light, amount of film remaining, frames per second for the KF-8 camera, and camera depression angles at the oblique positions.

CAMERA CONTROL PANEL MODEL 3. This panel controls camera positions 1 through 7. The control panels for positions 1, 3, 4, 5, 6, and 7 are identical in function. Each contains a camera programming switch, a camera operation indicator light, and a film remaining indicator. The six camera programming switches control the master power and the operate power to their respective camera positions. With the master control panel master power switch in the ON position, and the programming switches in the OP 1 and OP 2 position, camera operation is accomplished through the use of either the pilot's or navigator's camera operate switches. The master control panel master power switch must be ON and the camera operate switches must correspond before camera operation can be accomplished.

The camera programming switches for positions 3 and 4 are equipped with camera depression angle indicators which provide a visual reminder of the depression angle at which the cameras in these positions are installed.

Each position control panel is equipped with a film counter which indicates the amount of film remaining, in either feet or exposures, as determined by the particular camera used. The film counters are three digit, subtractive, and resettable. The reset buttons are located beneath the counters on each control panel; pressing and turning the button resets the counters. The film remaining counters should be set at the time the cameras are loaded to agree with the number of exposures or feet of film loaded in the camera magazines, and flight crews should check the film counters to be sure they have been properly set.

Note

The KF-8 camera carries a full load of 1000 feet of film. The film counter for position 2 should read 000 (zero) when a full load is installed; the counter will then read 999 after the first foot of film has been exposed. Flight crews should be aware that a zero reading may indicate a full film load or an empty load.

The camera programming switches permit programming of any camera configuration by the pilot or photo-navigator. By preselecting a camera or sequence of camera positions, a particular program may be set up before the target is reached, or during the dry run of a target area. Once on target, camera operation may be initiated by actuation of either the pilot's or photo-navigator's camera operate switches to the ON position.

Each camera position control panel is equipped with a red, press-to-test type camera operation indicator light which indicates both camera operation and film failure. The light flashes once for each operating cycle, or pulse, of the camera. It remains steadily on to indicate film or power failure, that the end of the film has been reached, or that an inadequate light condition exists for the KF-8 camera in position 2. All camera operation indicator lights may be dimmed by the photo-navigator through the rotary instrument lights switch located on the interior lights panel on the photo-navigator's console.

Camera control panel Model 3 is not night-lighted. Night-lighting is provided for the camera control panel, which contains night positions 8, 9, and 11.

Position 2 is used for forward oblique photography, mounting either the KF-8 35mm movie camera with the special mirror lens cones adapters, or the modified CA-13 pulse camera. Either camera is operated by the pilot only with his forward oblique camera operate switch, which is located below the control wheel. The frames per second selector knob on the stations control panel for position 2 is used to select the desired frames-per-second rate for the KF-8. The knob has four positions: OFF, 24, 48, and 96. Any position except OFF must be used when the modified CA-13 camera is installed. This frames-per-second rate is selected first to program the camera, and operation of the camera is accomplished by the forward oblique camera operate switch.

CAUTION

Do not operate the camera without film above 24 frames per second.

Position 2 also includes a red, press-to-test type incorrect exposure indicator light marked EXP. This light indicates incorrect exposure for the KF-8 camera and will light when the camera diaphragm reaches minimum or maximum aperture.

CAMERA CONTROL PANEL MODEL 4. This panel provides the programming capability for camera positions 8, 9, 10, 11, and 12. In addition to these position control panels, an illuminant control panel is included. When illuminants are used, this panel permits the selection and readying of the cartridge or bomb

release system. The camera control panels, positions 8, 9, 10, 11, and 12, are similar both in function and in indications to the control panels, for positions 1, 3, 4, 5, 6, and 7. Camera depression angle indicators are provided for positions 8, 9, 10, and 12.

Note

The camera depression angle indicators provide a visual reminder of the angles at which the oblique cameras are mounted. They can neither fix nor change the depression angle automatically. The only way the depression angles may be changed is by manually readjusting the mounts in the camera compartment.

EXPOSURE CONTROL PANEL

This panel marked EXP (see figure 8-16), is mounted directly below the illuminant control panel. Similar in function to a light meter, it provides a means of continuously monitoring the light level of the terrain and camera exposure, permitting correct exposure settings for the KF-8, KA-40A, and KA-46A cameras. The panel includes an exposure indicator and a rotary, nine-position light exposure control knob. Terrain light levels detected by the light monitor are read on the exposure indicator, and over or under exposure corrections of one or two f-stops are made with the light exposure control knob. When the proper factors of exposure have been set on the KA-40A and KA-46A cameras, exposure indicator is adjusted to read NORMAL by the light exposure control knob to modify the camera aperture and shutter speed to provide the correct exposure. If the pointer indicates either OVER or UNDER, the camera exposure is incorrect for the existing light levels, and a readjustment must be made by using the light exposure control knob to return the pointer to the midscale NORMAL position, and thus readjust the camera aperture and shutter speed.

FORWARD OBLIQUE SIGHT

The forward oblique sight (1, figure 8-15) is installed on the glareshield, and is used by the pilot to view targets when photographing with either camera installed at position 2. The sight is furnished as loose equipment. To install the sight for use:

1. Pull out glareshield sliding panel.
2. Press sight into the sockets in the sliding panel.
3. Align ball peep.

For target viewing, the sight plate is used in conjunction with a ball peep, which is permanently mounted on top of the glareshield. The sight plate bears engraved aligning indexes for only the formats of the KF-8 camera used with a 6-inch lens cone, and of the CA-13 camera used with a 36-inch lens cone. However, the 6-inch format may also be used to center the field of a 2- or 4-inch lens cone; the 36-inch format, to center the field of a 24-inch lens cone. The ball peep has two adjustable height positions to compensate for the different depression angles. For a 7-degree depression angle, adjust the ball peep to its lowest position by pressing and rotating into the slot provided. For a 5-degree depression angle, raise the ball peep and rotate into the necessary slot. For proper viewing through the sight, the pilot should sit in a normal, erect position and align the center of the sight and the ball peep with the right eye. The correct distance for viewing and format framing is approximately 30 inches, the same as for the viewfinder; sighting at distances closer than 30 inches will deceptively frame a larger portion of the terrain through the sight.

SIDE OBLIQUE SIGHTS

Both the pilot and photo-navigator are provided with side oblique sights (4, figure 8-15) for viewing targets being photographed from positions 3 and 4. The sights aid in determining the line of sight angle from horizontal of a target located on a vertical plane perpendicular to the aircraft's flight line, which passes through the eyepiece of the sight.

The sights are mounted on the left and right forward cockpit frame assemblies, and are manually adjustable. They are pulled forward for use and manually adjusted to the proper depression angle, and pushed back to the stowed position when not in use. The sights are identical in design, each containing a lens mounted in a metal frame. Each lens contains a reticle presentation which is illuminated by the oblique light switch located on the rear of the photo-navigator's right-hand console (24, figure 8-15). The sights are adjustable to correspond to the depression angle at which the camera is installed. Target angle indices of 3, 10, 15, and 37 degrees are provided at the base of each sight to permit adjustment to the proper detent. The reticle presentation (see figure 8-15) covers the forward half of a 24-or-36 inch 9" x 18" format (9 inch in direction of flight). The presentation consists of a long horizontal line, representing the centerline of the photograph, crossed by three short vertical lines, which represent the format leading edges and common target center. The forward vertical line represents the leading edge of the format for the 24-inch lens cone. The center vertical line represents the leading edge of the format for the 36-inch lens cone. The aft vertical line represents the center point for both formats. The long horizontal line may be used as a guide for making slight corrections in the attitude of the aircraft when photographing a long oblique strip target, such as a beach.

Correct viewing distance for the sight is approximately 7-1/2 inches. The sight is binocular, requiring the use of both eyes. When the viewer has the target center located with one eye, without moving his head he may close that eye and sight the format's leading edge with the other eye. The pilot will view the format center mark (aft vertical line in the reticle) with his right eye, and sight the format's leading edge (center or forward vertical line in the reticle) with his left eye. The reverse is true for the photo-navigator, who sights target center with his left eye and target leading edge with his right eye. For both sights the viewer may establish target center line by moving his eyes forward and aft, sighting along the horizontal line in the reticle.

PHOTO CONTROL SWITCHES

CAMERA OPERATE SWITCHES

The camera control system may be operated by either the pilot or photo-navigator with the two operate switches. The pilot's switches are located on his instrument panel below the control wheel (15, figure 8-15). The photo-navigator's switches are located on his instrument panel to the right of the exposure control panel (19, figure 8-15). These switches are labeled OP 1 and OP 2, and are two-position toggle switches; each with an ON and an OFF position. The switches are used to operate the camera positions that have been programmed at the camera control panel as either OP 1 or OP 2. One method of operation might be the programming of a series of camera positions (at the camera control panels) as OP 1, to be operated by the pilot with the OP 1 camera operate switch on his instrument panel, and the programming of another series of camera positions as OP 2 (at the camera control panels), to be operated by the photo-navigator through the OP 2 camera operate switch located on his instrument panel. Operating cameras from the master control panel as a tri-metrogon installation at positions 5, 6, and 7 adds a third possible program to the system.

FORWARD OBLIQUE CAMERA OPERATE SWITCH

A third camera operate switch available to the pilot is the forward oblique camera operate switch (16, figure 8-15), located below the control column on the instrument panel, and is used to operate the cameras mounted in position 2. The cameras, either the KF-8 or modified CA-13, must first be programmed at the camera control panel. Actuate the forward oblique camera operate switch to the ON position, then operate the camera as a fourth program.

AERIAL RADAR PHOTOS SWITCH

The aerial radar photos switch (20, figure 8-15) is used to allow the position 6 camera pulse to initiate the operation of the radar recording camera. All functions of the ASB-1B radar system, except the train-one shot switch, are used in their normal manner. The position 6 camera pulse operates the radar recording camera in the same manner as the one shot mode, and either NORMAL or TRIPLE gain pictures may be taken. With the ASB-1B properly installed and functioning and power applied to the camera control system through the master power switch of the master control panel, turn the aerial radar photos switch to the ON position. Then turn the trimet or camera operate switch to ON. This initiates the operation of both the position 6 camera and the radar recording camera by allowing the pulse sent to the position 6 camera to also go to the radar recording camera.

EXTRA PICTURE SWITCH

Three extra picture pushbutton switches (13, figure 8-15) are provided to permit the taking of extra pictures or for taking pinpoint photographs. The pilot's extra picture switch is located at the right-hand side of the control column. The photo-navigator is provided with two switches: one located at the extreme right-hand side of the photo-navigator's instrument panel, the other provided with a flexible cord and stored on the right-hand cockpit rail immediately above the right-hand console (see figure 8-15). By depressing the switch momentarily any camera (except the KF-8 and cameras with the MA-10A magazine) that has been programmed at the camera control panel may be operated for one exposure. Holding the button in operates the pulse type cameras at runaway speed, during day operation.

During day operation the switch may be used for extra picture operation regardless of the position of the camera operate switches; they may be ON or OFF. During night photography the dual overrun relay operates in conjunction with the extra picture switch. Before the extra picture switch can function at night the camera operate switch must be turned OFF. In the night mode the extra picture switch provides only one pulse at a time. It will not operate the release system at runaway speed, as it will the cameras in the day mode.

The extra picture switch does not affect MA-10A magazine operation during either day or night operation. In the day mode the switch provides extra pulses to the pulse type cameras, and at night it provides extra pulses to the illuminant release system.

INDICATOR LIGHTS

ALERT LIGHT. This light (29, figure 8-15) is used in connection with the tri-metrogon configuration installed in positions 5, 6, and 7. It flashes prior to the operation of the cameras, at a time interval 15 percent in advance of the cycling time of these cameras. It is located on the master control panel.

CAMERA OPERATION INDICATOR LIGHTS. The twelve camera operation indicator lights are red, press-to-test, nondimming lights mounted on each position control panel of the camera control panel (figure 8-16). The light flash momentarily to indicate camera operation, and stay on to indicate film or power failure or end of film roll.

BOMB DOORS CYCLING INDICATOR LIGHT. The light, marked S, located on the illuminant control panel, is on when the bomb bay doors are in cycle, and is out when the bomb bay doors are closed, or when they are open and circuitry has been readied for an illuminant release.

ILLUMINANT RELEASE – COMPLETE LIGHT. A light, labeled F, located on the illuminant control panel (figure 8-16) comes on when the electrical release sequence is complete and all illuminants have been dropped.

BOMB DOORS OPEN WARNING LIGHT. This light is located on the photo-navigator's instrument panel (2, figure 8-15). It comes on when power is applied to the system and the bomb bay doors are not completely closed, or when the cartridge ejectors are not completely seated. The light is labeled bomb doors open.

PHOTO CIRCUIT BREAKER PANEL 106.

The photo circuit breaker panel 106 (figures 1-27 and 8-18) is located on the left hand side of the companionway leading to the camera compartment (figure 8-1) and contains all the circuit breakers necessary to the successful operation of the photographic system. The flight crew, particularly the photo-technician, should thoroughly familiarize themselves with this panel and the system circuits it protects.

CAUTION

Do not use the camera and illuminant release system circuit breakers as switches to operate the system. Improper positioning of the circuit breakers could result in only partial system operation and control, reducing camera coverage.

INCLINOMETER

An inclinometer (14, figure 8-15) is mounted above the right-hand console to give the photo-navigator an additional visual indication of the attitude of the aircraft to allow adjustment of the camera mounts. The inclinometer consists of a ball moving freely in a race, similar to that of the standard turn and bank indicator.

VIEWFINDER SYSTEM

The viewfinder system (see figure 8-23) is provided to aid the pilot and photo-navigator in determining exposure interval, ground speed, drift, and in maintaining track line flight. The viewfinders are of primary importance during photographic flight. They may also be used as navigational driftmeters during normal flight. The system consists of two periscope type optical viewfinders, two control panels, an electronics package containing the circuitry necessary to operate the viewfinders, two viewing scopes (final lenses) protruding through the instrument panel, and a data plate and ground speed computer supplied as loose items with each viewfinder. Each viewfinder

contains a single integrated optical system, with illuminated reticle projection of four fields of view, filters, a traveling grid presentation for image motion determination, an attitude indicator presentation (for the pilot only), and pitch and roll gyro stabilization in all fields of view. Stabilization signals are provided by the ASB-1B radar system through the stabilization signal distribution box and the electronic package.

Note

The reticles are stabilized in roll while the optics are stabilized in pitch. Stabilization limits are:

Roll: ±8 degrees

Pitch: 5 degrees noseup, 2 degrees nosedown

Separate gyro stabilization is provided for the attitude indicator presentation, from the ASB-1B radar system, with stabilization limits of 30 degrees in both pitch and roll.

VIEWFINDER SCOPES

Two viewfinder scopes (see figure 8-15), or final lenses, protrude through the instrument panel in front of the pilot and photo-navigator. The viewfinders are approximately 5-1/2 inches in diameter and may be viewed throughout the whole field of view from a normal sitting position. Protective covers are provided for each scope when not in use. The viewfinders contain a binocular optical system, which requires that both eyes be used for proper viewing within an exit pupil approximately four inches in diameter. One eye alone may be used for viewing, with some resultant discomfort being experienced by the other eye, but it is recommended that both eyes be used normally. The proper viewing distance is approximately 30 inches from the viewing scope.

CAUTION

The viewing scopes are precision optically ground lenses, and must be treated with the same care as any photographic lens. They must not be scratched, touched, or allowed to get dirty.

CONTROL PANELS

Independent control panels are provided with each viewfinder. The pilot's control panel is located in the center of the left-hand console; the photo-navigator's panel is located on the right-hand control console (see figures 8-1 and 8-15). The control panels are identical in appearance and function, except that only the pilot's has an attitude indicator presentation. The switches affecting this presentation are inoperative on the photo-navigator's control panel. Each control panel affects only its associated viewfinder and provides viewing selection and choice of field, azimuth corrections for aircraft drift, reticle illumination, filter selection, traveling grid selection and control for image motion determination, gyro stabilization, and attitude indicator presentation.

Note

View selection and control in one viewfinder is independent of the other. However, drift corrections in the viewfinders are not independent, but are slaved together, and corrections made on one viewfinder will affect the other, and will show in all fields of view. Drift corrections will also automatically correct the azimuth mounts at position 1, 6, 8, 9, 10, 11, and 12. The traveling grids are also slaved together, and corrections made in one viewfinder will affect the other. Reticle rotation for drift determination and traveling grid adjustment (when in computer mode of operation) may be made by either the pilot or photo-navigator.

The switches have the following functions:

VIEW SELECTOR SWITCH– The view selector switch (36, figure 8-15) serves as the master control switch for each viewfinder (see figure 8-19) and also allows the selection of the desired field of view. The switch has five positions: OFF, WA FWD, NA FWD, NA VERT, and WA VERT (figures 8-20 and 8-21).

DRIFT SWITCH– The drift switch (34, figure 8-15) is a momentary toggle switch providing azimuth corrections for 15 degrees left and 15 degrees right drift. The switch is moved either to the left or the right, as indicated by the arrows on either side of it, causing the field of view to rotate so that the drift may be determined by noting the place at which the track line crosses the drift scale. Rotation of the reticles to determine drift also applies the same azimuth corrections to the azimuth correcting camera mounts, at positions 1, 6, 8, 9, 10, 11, and 12, when the mounts are programmed for azimuth control, realigning the film format centerline with the ground track of the aircraft.

PRESENTATION SELECTOR – The rotary four-position presentation selector switch (37, figure 8-15) is used to select the desired special presentation in addition to the particular field of view. The positions are marked HOR, HOR + RET, TRVLG GRID, and OFF. The attitude indicator presentation and one of the four fields of view are selected with the knob positioned to HOR + RET, while the attitude indicator

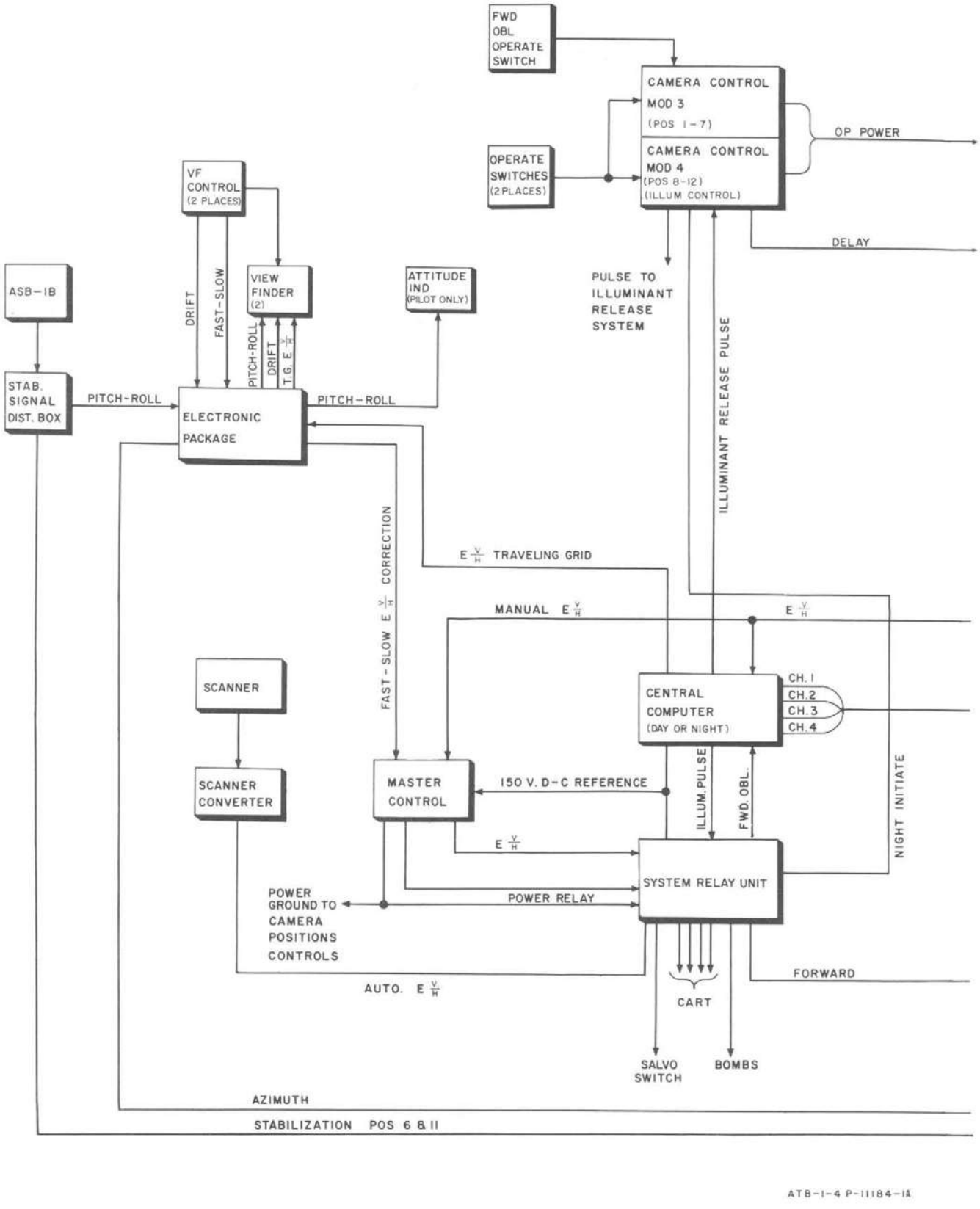


Figure 8-18. Block Diagram, Photo System (Sheet 1)

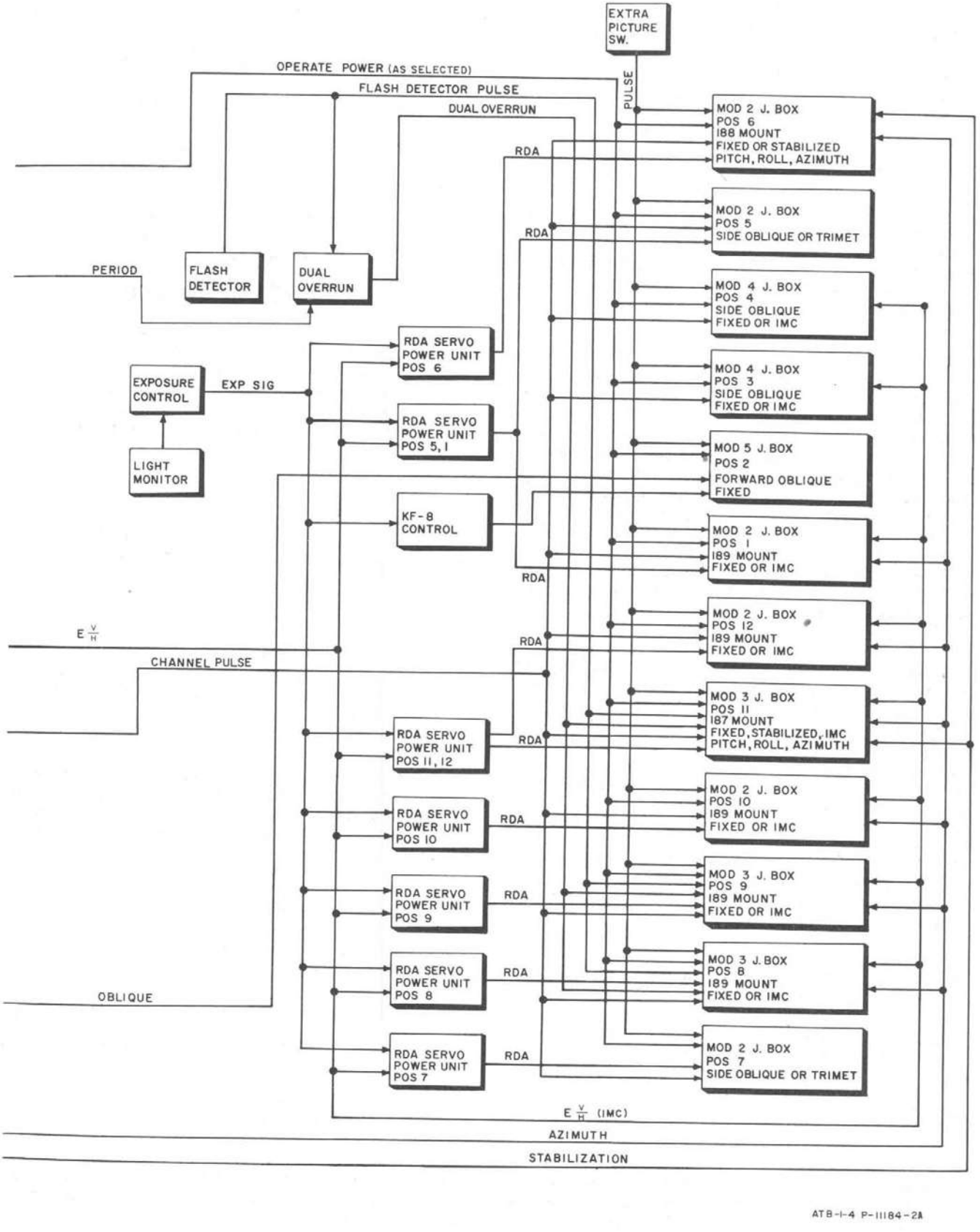


Figure 8-18. Block Diagram, Photo System (Sheet 2)

alone is selected by the HOR position. The traveling grid presentation is selected by the TRVLG GRID position, for use with the WA VERT field of view.

TRAVELING GRID SPEED SWITCH – The traveling grid speed switch (35, figure 8-15) is a momentary two-position toggle switch marked FAST and SLOW, which allows the E V/H voltage to be varied by the operator when the camera system is functioning in COMPUTER mode. Movement of the switch will increase or decrease the rate of movement of the traveling grid independently of the ground speed values that may be set at the master control panel. The switch does not function during SCANNER mode of operation. The viewfinder must be in NARROW ANGLE VERTICAL mode to monitor FAST or SLOW switch actuations.

STABILIZATION SWITCH – The stabilization switch (32, figure 8-15) is a two-position toggle switch marked ON and OFF. It is used to apply stabilization to the viewfinder system, using stabilization signals from the ASB-1B radar system routed through the stabilization signal distribution unit and the viewfinder electronic package. The optics of the viewfinder are gyroscopically stabilized in pitch only, while the reticles are stabilized in roll only. Stabilization may be locked out when desired, by positioning the switch to OFF, but the viewfinder stabilization should be used whenever stabilized camera mounts are operating. The view selector and stabilization switches need not be on at the pilot's control panel to permit use of the attitude indicator presentation.

ILLUMINATION CONTROL – The illumination knob (33, figure 8-15) controls a rotary switch with an OFF position, that is used to vary the amount of illumination seen in the viewing scope. The knob should be positioned to the lowest possible illumination level for night use. The red lighting in the pilot's viewfinder is turned on by the photo-navigator with the instrument switch on his interior lights panel.

PITCH-TRIM – The pitch-trim knob (30, figure 8-15) controls a rotary switch used to position the movable horizon with respect to the fixed aircraft in the attitude indicator presentation of the pilot's viewfinder.

FILTER SELECTOR SWITCH – A two-position toggle switch (31, figure 8-15) is provided to permit the selection of a filter for viewing. The switch has two positions, YEL and CLEAR, permitting the selection of either a yellow filter, or a clear view.

FIELDS OF VIEW

Four reticle presentations provide four fields of view, individually selected at the viewfinder control panels; two narrow angle fields which are 30 degrees wide and two wide angle views which are 85 degrees wide. The reticles are projected into the viewfinder image display as a series of illuminated lines superimposed on the moving terrain image. The reticle patterns aid the operator in determining:

1. Amount of aircraft drift.
2. Field coverage for various cameras.
3. Overlap for various formats.
4. Ground speed, when altitude is known.

WARNING

The reduction in terrain image size as seen in the viewfinders is a ratio of approximately 7 to 1 in the wide angle fields of view, and 3 to 1 in the narrow angle fields of view. This reduction in image size should be kept in mind when using the viewfinders at high speeds and low altitudes or dangerous target fixation might result.

The four fields of view are shown in figure 8-19. Their relative coverage is shown in figure 8-20.

Note

Drift determinations and corrections should be made before any overlap determinations are made.

WIDE ANGLE FORWARD. The wide angle forward field of view is 85 degrees wide, covering from 10 degrees below the horizon to 95 degrees below the horizon, and including nadir. Included in the WA FWD field are:

1. Single track line.
2. Nadir marks on the track line with 2-degree roll reference marks.
3. Field coverage indications for:
   a. Vertical 6-inch focal length camera with a 9" x 9" format.
   b. Vertical 12-inch focal length camera with a 9" x 9" format.
4. Index points for 60-percent overlap determination for 6-inch and 12-inch focal length cameras are located on the track line. An object, serving as a reference point, is followed as it moves down the track line. The time (in seconds) required for the reference point to move from the 6- or 12-inch index point to

nadir is the time interval that will result in 60 percent overlap when used as the exposure interval. If a 6-inch focal length or a KA-40 camera is installed, the 6-index point is used; the 12-index point is used with 12-inch focal length and KA-46A cameras. Proper 60 percent overlap may also be established when photographing a strip, or making pin point photographs, using the extra picture switch (see figure 8-15). A ground reference point is chosen (see figure 8-21) and followed as it moves down the track line. When the reference point reaches the index point, the cameras are tripped by the extra picture switch. The cameras are again tripped when the reference point reaches the nadir. A second reference point is immediately found at the index point and followed down the track line. When this reference point reaches the nadir, the cameras are tripped a third time by the extra picture switch. This method produces three photographs, overlapping each other by 60 percent, with the desired target properly centered in the middle photograph.

5. Drift scale at the top of the field of view. This scale shows 15-degree right and 15-degree left drift; however, the scale is vignetted to show only about 6 degree left and right of the track line at any time. Actuation of the drift switch, on the viewfinder control panel, will rotate the track line; the drift scale remains fixed.

WIDE ANGLE VERTICAL. The wide angle vertical field of view is 85 degrees wide and covers from 47-1/2 degrees below the horizon to 20 degrees aft of nadir, where the view is vignetted because of aircraft structure. The wide angle vertical field includes:

1. Single track line.
2. Field coverage indications for:
   a. Vertical 12-inch focal length camera with a 9" x 9" format.
   b. Vertical 36-inch focal length camera with a 9" x 18" format.
3. Nadir marks.
4. Drift scale.
5. 2-degree roll reference marks.
6. Traveling grid presentation, as desired, for image motion monitoring. The traveling grid is a roller-driven, endless, opaque belt with narrow horizontal slits cut at predetermined intervals throughout its length. An illumination system projects light through the slits into the viewfinder optical system. The traveling grid appears in the viewfinder as a series of parallel, horizontal, broken lines moving with the terrain image from top to bottom of the view. When the rate of speed of the traveling grid is correctly regulated, the grid lines and terrain image points are synchronized as to speed. To compensate for terrain image motion, synchronization may be accomplished by the use of the fast-slow switch on the viewfinder control panels, providing a visual monitoring of the V/H ratio or a method of manual control of this ratio. The knots dial on the master control box (figure 8-15) may be used to provide E V/H signals. When in COMPUTER mode of operation, the traveling grid moves at a velocity dependent upon the V/H ratio set in the system at the master control panel. Using the momentary fast-slow switch or master control dials varies the E V/H signals in the camera control system, regardless of the ratio that has been preestablished at the master control panel.

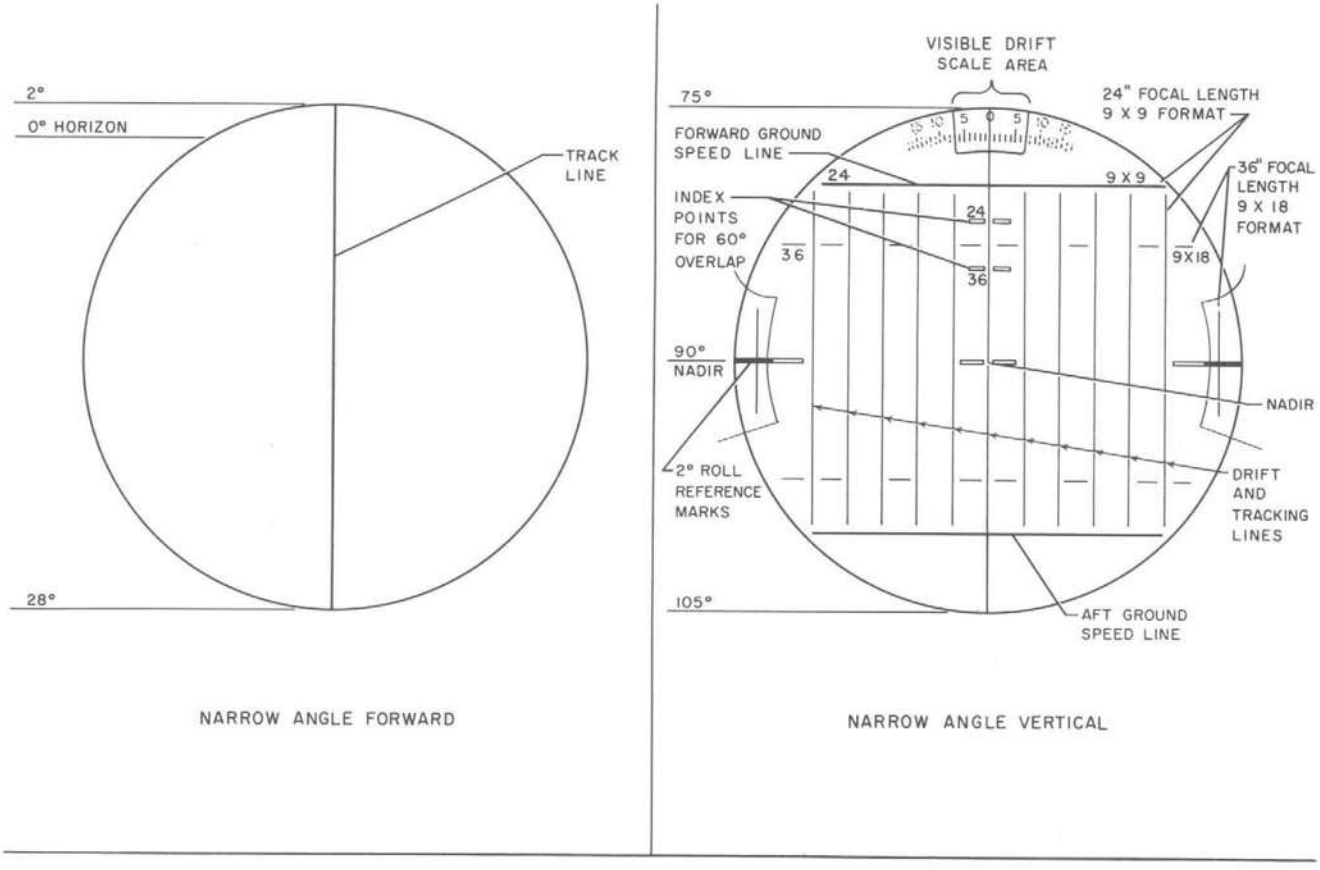
Note

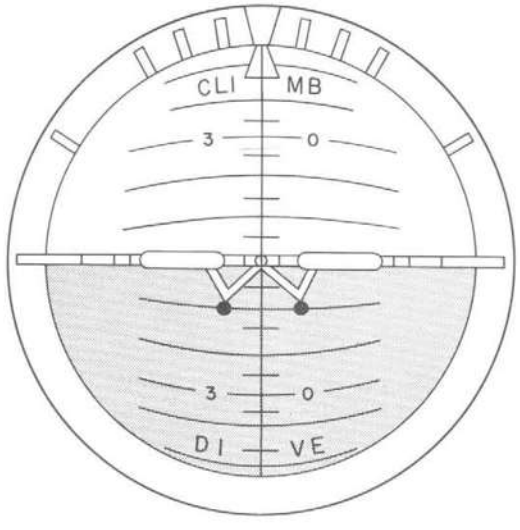
- When the fast-slow switch is used to establish synchronization, the altitude dial on the master control panel will move. This indicates that the correct V/H ratio is being established. It does not mean that a new and correct altitude value is being found. Even when the proper V/H ratio has been established and the traveling grid movement is properly synchronized with ground reference point movement, the resulting altitude value on the altitude dial may be incorrect.
- The fast-slow switch does not function in the SCANNER mode of operation. When in SCANNER mode of operation, the traveling grid will be moving in synchronization with terrain image automatically. The traveling grid presentation is shown with the wide angle vertical field of view only.

NARROW ANGLE FORWARD. The narrow angle forward field of view is 30 degrees wide and covers from 2 degrees above the horizon to 28 degrees below the horizon. The field of view includes only a single track line. It does not include either nadir or a drift scale.

NARROW ANGLE VERTICAL. The narrow angle vertical field of view is 30 degrees wide and covers from 75 degrees below the horizon to 15 degrees aft of nadir. It includes:

1. A center track line and ten equally spaced drift lines, parallel to track line. The drift lines also function as track lines, and ground reference points may be followed on any of the lines to determine drift. When drift determination is being made with the drift switch, the center track line, and the ten drift lines rotate simultaneously.
2. Nadir.
3. Field coverage indications for:
   a. Vertical 24-inch focal length camera with a 9" x 9" format.
   b. Vertical 36-inch focal length camera with 9" x 18" format.
4. Drift scale.





ATTITUDE INDICATOR PRESENTATION

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Figure 8-19. Viewfinder Fields of View (Sheet 1)

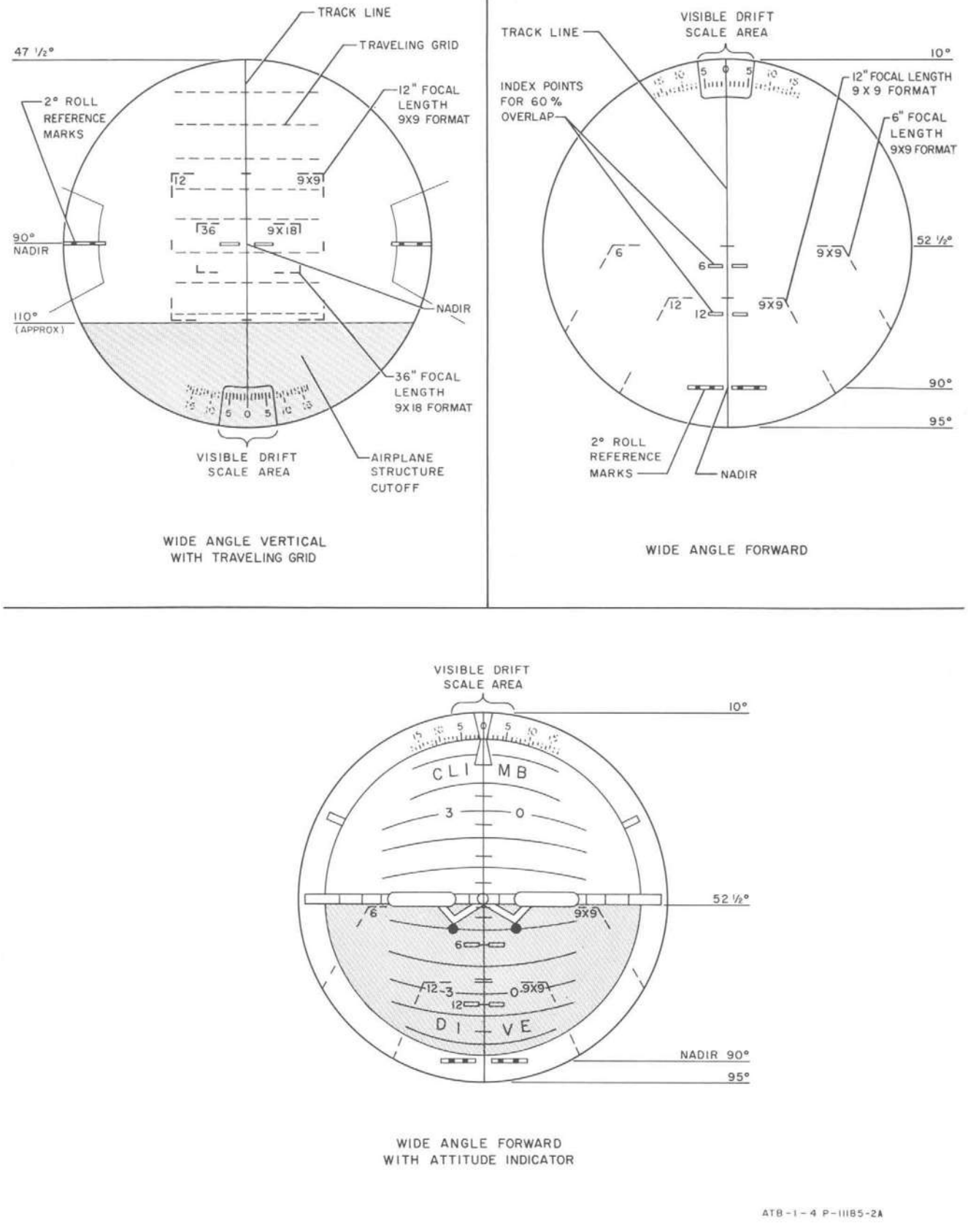
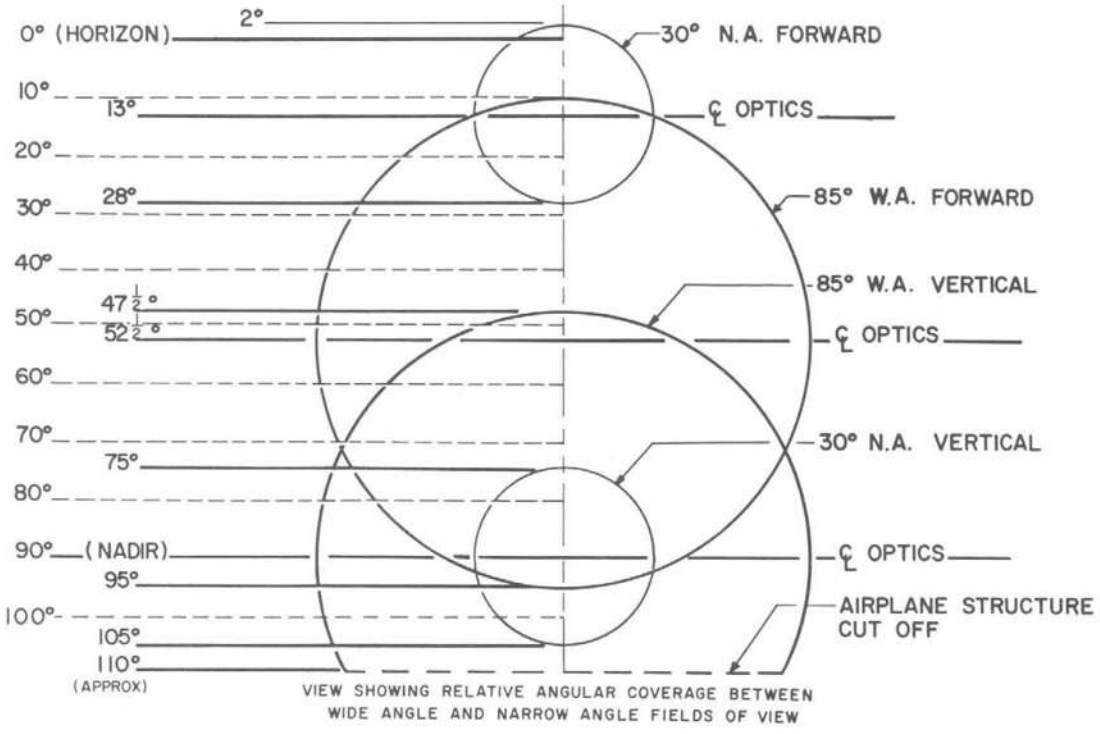


Figure 8-19. Viewfinder Fields of View (Sheet 2)



VIEW SHOWING RELATIVE ANGULAR COVERAGE BETWEEN WIDE ANGLE AND NARROW ANGLE FIELDS OF VIEW

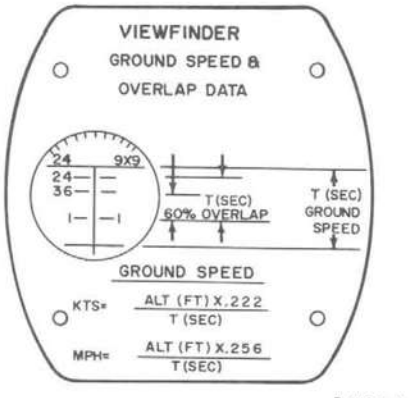


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Figure 8-20. Viewfinder Relative Fields of View

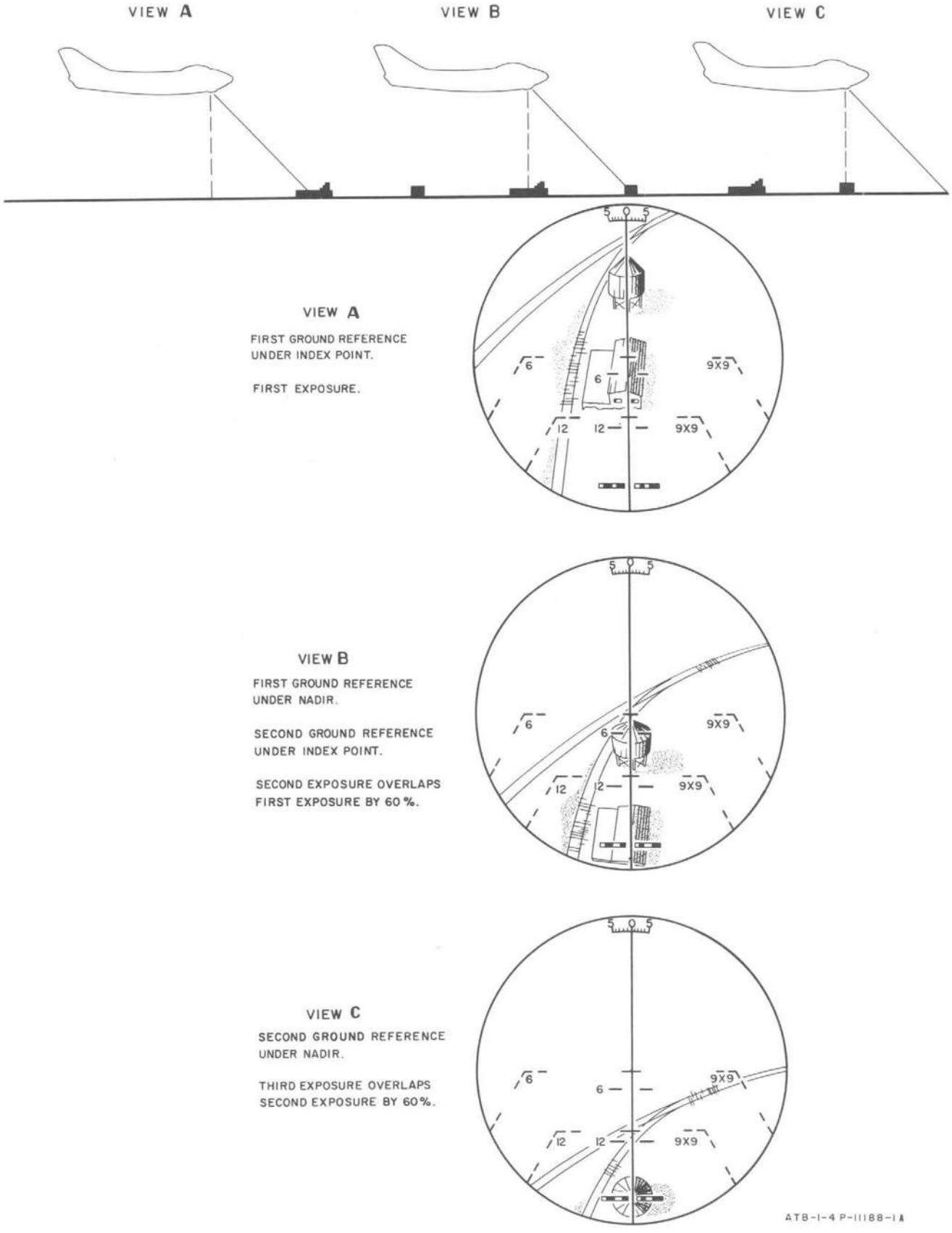

Figure 8-21. Viewfinder Overlap Diagram

5. Index points for 60 percent overlap determination for 24-inch and 36-inch focal length cameras.

6. A forward and an aft ground speed determination line, to be used to establish ground speeds, in miles per hour or knots, in conjunction with the ground speed computer and data plate (see figure 8-20). The outer drift lines and the forward and aft ground speed determination lines coincide with format lines for the 24-inch focal length camera with a 9" x 9" format. To establish ground speed:

a. Correct for drift, using drift scale with center track line and ten drift lines.

b. Record time in seconds required for ground reference point to move from forward ground speed determination line to aft line.

c. On ground speed computer on inner scale, marked SECONDS, set time opposite altitude above terrain on outer scale.

d. On outer scale, opposite either the 0.222 or 0.256 extended line, read ground speed in knots or miles per hour.

Note

The ground speed computers and associated data plates are installed as loose items. The photo-navigator's will be stowed in his navigation case. The pilot's will be stowed in special holders which are mounted above the left-hand console.

ATTITUDE INDICATOR

A standard attitude indicator (figure 8-19) presentation is included in the pilot's viewfinder, and may be selected for use with any of the four fields of view or may be used alone. The attitude indicator is a standard presentation, approximately 5 inches in diameter, and consists of a fixed aircraft and a movable horizon. The position of the horizon can be adjusted with the pitch-trim knob on the viewfinder control panel. The attitude indicator presentation allows the pilot to monitor the viewfinder continuously when flying photographic runs, eliminating the necessity of cross checking his flight instruments or the outside horizon to maintain the proper aircraft attitude during photography. Stabilization limits for the attitude indicator are 30 degrees for both pitch and roll.

STABILIZATION

A stabilization system is incorporated into the viewfinder system to nullify image displacement resulting from aircraft pitch and roll. Correction signals originating in the ASB-1B radar system are channeled through the stabilization signal distribution box. Different signals and modes are used to stabilize for pitch and roll; roll stabilization is accomplished by stabilizing the reticles, while pitch stabilization is optical stabilization, accomplished at the entrance prism of the viewfinder. Similar stabilization signals are transmitted to the stabilized camera mounts.

PITCH STABILIZATION. Pitching, or rotation around the lateral axis of the aircraft, causes fore and aft displacement of the viewfinder image. Stabilization is accomplished by automatically rotating the viewing prism on its lateral axis so that a constant angle is maintained between the optical axis and the surface of the earth; the viewer will see no apparent motion of any terrain image due to aircraft pitching. Stabilization limits are from 5 degrees noseup to 2 degrees nosedown.

ROLL STABILIZATION. Rolling, or rotation about the longitudinal axis of the aircraft, causes lateral displacement of the viewfinder image. Without stabilization it would be difficult for the viewer to distinguish between roll and drift unless great deviations from track line were made; and this distinction is essential for successful photographic flight, and for determining drift in ordinary flight. Roll stabilization is accomplished by automatically moving the reticles laterally. The reticles follow the terrain movement in roll, and roll movement is thus visible to the viewer, but track line flight can be successfully maintained. The viewer sees exactly what the stabilized cameras see. Stabilization limits are 8 degrees left and right. When the aircraft rolls beyond 8 degrees left or right, a slight jump or movement of the reticles back toward the center of the viewfinder will be noticed. When the aircraft's roll reaches 7-1/2 degrees the stabilization signal distribution unit provides an effective electrical caging which senses this roll and cages the viewfinders and stabilized camera mounts back to 6 degrees until the aircraft returns to an attitude less than 7-1/2 degrees.

VIEWFINDER OPERATION

Following are suggested procedures to be followed in operating the viewfinders, by each operator. They are general suggestions rather than exact procedures, and should be adapted in accordance with squadron policies concerning crew duties and photographic procedures.

Note

- Due to the manner in which the viewfinder is constructed and mounted in the aircraft, the exit pupil, or area of viewing (figure 8-22), is limited vertically from the centerline of the viewing lens to approximately 4 inches above, with lateral movement being restricted to approximately 1-1/2 inches for proper viewing with both eyes. The exit pupil is located approximately 30 inches from the face of the eyepiece.

- For daylight use of the viewfinder, make certain that the photo-navigator's instrument panel night lighting switch is OFF, otherwise the reticle in view finder will not be visible.

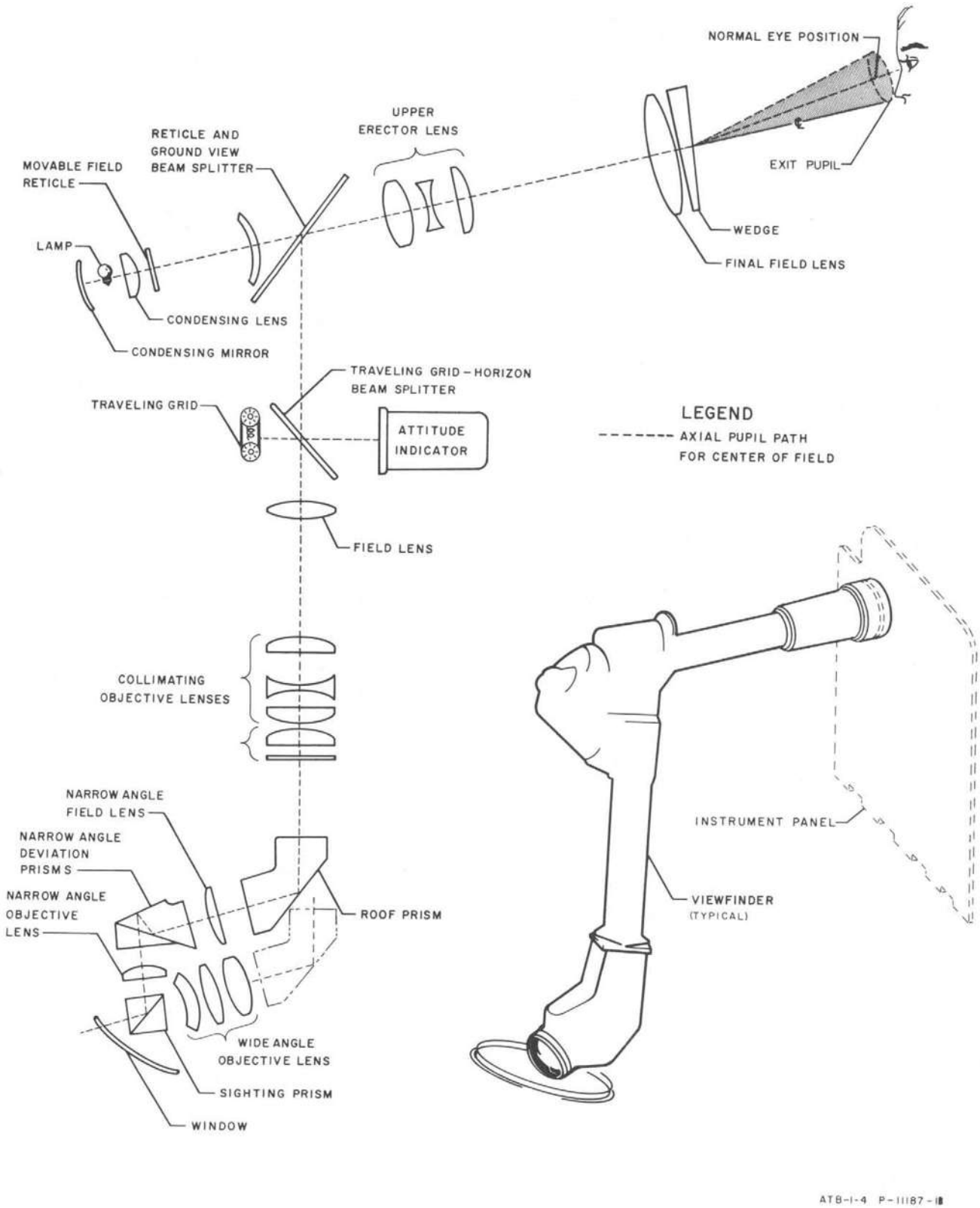

Figure 8-22. Viewfinder Optical Diagram

1. With view selector knob turn viewfinder ON, and check all four fields of view for proper operation. Check proper rotation of reticle in each field of view with drift switch. Check to see that drift corrections made for one viewfinder affect other equally. Then select desired field of view.

2. When wide angle vertical view is selected, turn presentation selector switch to TRVLG GRID. Check speed control by holding traveling grid speed switch momentarily in each position or by rotating the knots dial.

3. Turn stabilization switch ON, as required.

CAUTION

Turn viewfinder stabilization off when climbing or descending during nonphotographic flight to prevent exceeding stabilization limits and damaging the system.

4. Check correct operation of filter position with filter selector switch, then select desired view.

5. Adjust illumination knob to desired level of reticle illumination.

6. Pilot only: Rotate display knob to HOR + RET and check that attitude indicator presentation appears superimposed on whatever field of view has been selected. Then rotate knob to HOR position and check that reticle image disappears while attitude indicator presentation remains.

7. Adjust horizon with pitch-trim knob.

Note

For night use of the pilot's viewfinder, when the available terrain light permits, the red lighting is selected and controlled by the interior lights switch on the photo-navigator's console, with the viewfinder presentation selector switch in either the HOR + RET or the HOR position.

The following fields of view are recommended:

Pilot:

1. Primary: Narrow angle forward. The apparent horizon will always be visible, depending upon the altitude and aircraft attitude. Horizon reference points can be viewed to establish track line flight.
2. Secondary: Wide angle forward. Used to maintain aircraft on flight line.

Photo-navigator:

1. Narrow angle vertical view should be used first to determine drift. When this has been accomplished, this field of view becomes secondary.
2. Primary: Wide angle forward. Used for successful track line flight.
3. Secondary: Wide angle vertical to monitor, or when in computer mode, to adjust traveling grid in order to establish correct E V/H signal.

VIEWFINDER AND SKID-TURN OPERATION

Use of the skid-turn mode in conjunction with the autopilot and the viewfinder systems (see figure 8-23) facilitates moving the aircraft over a given ground track line of check points. After skid-turn engagement, if the flight line is to the left of the ground track line, the skid-turn knob should be turned LEFT slowly (20-degree per second maximum). Initial rotation of the knob introduces a 2- to 4-degree sideslip before the turn is initiated. The viewfinder will present an apparent aircraft heading change along the same flight path. Further rotation of the skid-turn knob results in a flight-path change and a skid turn of constant rate. The flight line crosses the ground track line, and the aircraft moves over the check point. If the skid-turn knob is then returned slowly to detent, the aircraft will stop turning and assume a new heading 2 to 4 degrees to the left of the maximum right heading reached during the turn. Since the new flight path may carry the aircraft across the track line, some RIGHT turn may be required with the skid-turn knob to blend the flight line into the track line.

Since the pilot makes the skid-turn corrections from viewfinder observations, he must set in drift corrections prior to flying a track line with skid-turn control.

SKID-TURN PRETARGET CALIBRATION

The following skid-turn pretarget calibration should be performed at the approximate airspeed and altitude of the photographic run:

1. Engage autopilot and check that residual roll oscillation, as observed through unstabilized narrow angle vertical viewfinder, is less than 1-1/2 degrees.

Note

A residual roll in excess of 1-1/2 degrees will not be reduced by engagement of the skid turn; and should be reported as an autopilot flight discrepancy.

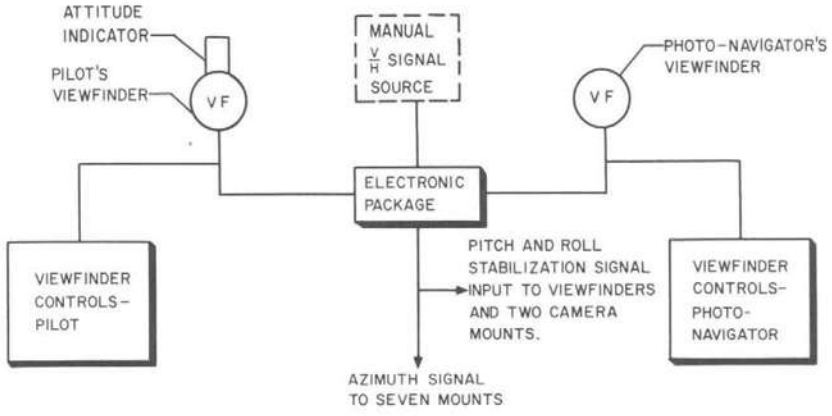

Figure 8-23. Viewfinder System

2. Engage skid turn, making heading correction with skid-turn knob, and note direction of roll, if any, through viewfinder. Return knob to detent and rotate skid-entry outside wing trim knob in direction required to minimize initial roll angle. Repeat skid-entry and skid-exit checks and outside wing trim adjustments until 20-degree per second rotation of skid-turn knob results in less than 4-degree (peak to peak) roll. This calibration procedure is desirable as fine adjustment of rudder-aileron program for improved performance during selected photographic run.

SKID-TURN OPERATION DURING PHOTOGRAPHIC RUN

Prior to arriving at the check point, set the drift correction into the viewfinder system and engage the autopilot. With the aircraft on the track line, as observed in the stabilized wide-angle forward viewfinder, engage the skid-turn and switch to the stabilized narrow-angle vertical viewfinder. With the skid-turn knob, make the heading corrections required to fly over the track line. Heading errors should be corrected when they are still small enough to permit correction while the check point passes through the view field. Excessive corrections should be avoided, since maximum roll angles and rates occur during entry and exit. The slower the motion of the skid-turn knob, the lower will be the roll rate and, as a result, the better will be the photographic system resolution. The limiting rate of motion may be determined by observing the allowable roll angle on the unstabilized narrow angle vertical viewfinder.

SKID-TURN FLIGHT CALIBRATION

A skid-turn flight calibration is required following installation of the skid-turn system. It may also be required if pilot observation or analysis of photographic quality has indicated unsatisfactory skid-turn performance.

Note

A ground checkout, as outlined in NAVWEPS 01-40ATB-2-8 should always be completed prior to the flight checkout.

The 5813756 test set must be installed in the aircraft. The tap-switch cover on the right-hand side of the skid-turn controller should be removed before flight. A screwdriver is required to adjust the rudder and aileron tap switches. Because some of these switches are inaccessible when the aircraft interior is in the flight configuration, the following tap-switch adjustments must be accomplished prior to scheduled takeoff:

SYMBOL	FUNCTION	SETTING
S5	Integrator excitation	OFF
S4	Roll attenuator	3
(S2)	Skid-turn knob	DETENT
(S3)	Skid-entry knob	CENTERED
(S4)	Lateral trim	3
(S5)	Rudder program	3

The flight checkout should be conducted with the aircraft in a normal cruise configuration at 20,000 feet and 0.65 IMN.

SKID-ENTRY ADJUSTMENT. The skid-entry adjustment consists of selecting the lateral-trim tap-switch setting which results in minimum roll transients in the interval during which the desired skid-turn rate is being established. This interval is the time during which the skid-turn knob is in motion plus an additional period of approximately 4 seconds during which the initial transients damp out. Make the following preliminary

autopilot performance evaluation before engaging the skid-turn:

1. Engage autopilot in altitude-hold mode. Check that amplitude of any residual roll oscillation, as indicated on roll meter of test set, is less than 1-1/4 degrees, peak to peak; and that any residual roll is centered within ± 1/2 degree on roll attitude meter.

2. Apply rigid body pulses in each axis by overpowering autopilot and releasing controls after any transients have damped out. Check that amplitude is damped to one half in one cycle.

If autopilot performance is within these limits, continue with the skid-entry adjustment:

1. With autopilot in altitude-hold mode, actuate skid-turn engage switch to ON, and check that no objectionable engagement transient occurs.

2. Practice few skid entries, using skid-turn knob. Note particularly effect of rate of knob rotation on initial roll transients. Vary time required to rotate knob from detent to stop – between 4 and 16 seconds. Use unstabilized vertical viewfinder to improve "feel" for roll amplitudes involved.

3. With skid-entry outside wing trim adjustment centered, adjust lateral-trim tap switch (S4) to obtain essentially flat skid entry. If outside wing is up during skid entry, adjust tap switch toward INCREASE; if down, toward DECREASE.

INTEGRATOR-AMPLIFIER GAIN ADJUSTMENT. The integrator-amplifier gain adjustment consists of selecting the highest integrator gain setting which does not degrade residual roll performance. After setting the integrator excitation switch S5 in the 5813756 test set to ON, proceed as follows:

1. Engage autopilot in altitude-hold mode. Turn skid-turn engage switch on and check that no objectionable transient occurs.

2. Decrease test set roll input attenuator setting (3 to 2 to 1 to 0 to -1) until residual roll oscillation, as indicated on test set roll-angle meter, is noticeably aggravated. Record this attenuator setting for use during the postflight adjustment. Do not change this setting.

3. Using varying rates of skid-turn knob rotation, make series of right- and left-skid turns. Each turn should be held at least 2 minutes. If turning rate is less than 5 degrees per minute, increase rudder program tap switch setting; then repeat procedure under SKID-ENTRY ADJUSTMENT in this section.

Note

The integrator excitation switch S5 on the test set should be off during the readjustment; but should be turned on prior to final evaluation of turning rate.

ALTERNATE SKID-TURN FLIGHT CALIBRATION

The following procedure, which does not require installation of the 5813756 test set, can be substituted for the one under SKID-TURN FLIGHT CALIBRATION in this section:

INTEGRATOR-AMPLIFIER GAIN AND OUTPUT ADJUSTMENT. Make the following preflight and inflight adjustments:

Preflight

1. Relocate skid-turn integrator from airframe mount to vibration-isolated mount that is accessible for inflight adjustment.

2. Make the following adjustments:

SYMBOL	FUNCTION	SETTING
S2	Skid-turn knob	DETENT
-	Integrator gain	1
-	Output gain	1

3. Close all autopilot and skid-turn circuit breakers.

Inflight

1. Engage autopilot and check that amplitude of any residual roll oscillations, as observed through narrow-angle vertical viewfinder is less than ±1-1/2 degrees.

2. Level aircraft in roll with aileron trim knob.

3. Turn on skid-turn engage switch. Check that no objectionable transient occurs and that residual roll amplitude does not increase.

4. Make tap-switch adjustments in following sequence until residual roll increases; then back up one step in sequence:

SEQUENCE	INTEGRATOR GAIN	OUTPUT LEVEL
1	1	1
2	2	1
3	3	1
4	3	2
5	3	3

RUDDER-AILERON PROGRAM ADJUSTMENT. Make the following preflight and inflight adjustments:

Preflight

1. Remove cover plate from side of skid-turn controller and make following settings:

SYMBOL	FUNCTION	SETTING
S2	Skid-turn knob	DETENT
S3	Skid-entry knob	CENTERED
(S4)	Lateral trim	3
(S5)	Rudder program	3

2. Open phase-B skid-turn circuit breaker on panel 106 to prevent integrator interaction.

Inflight

1. Engage autopilot in altitude-hold mode and turn on skid-turn engage switch.

2. Make few practice skid turns, using skid-turn knob. Note effect of rate of knob rotation on roll transients during skid entry and skid exit. Knob should be rotated approximately 10 degrees per second (14 seconds from detent to stop).

3. Adjust lateral-trim tap switch S4 to minimize roll transients during skid entry. If outside wing is up during skid entry, adjust tap switch toward INCREASE; if it is down, toward DECREASE.

4. Close phase-B skid-turn circuit breaker to activate roll integrator.

5. Using varying rates of skid-turn knob rotation, make series of right- and left-skid turns. Each turn should be held at least two minutes.

If the turning rate is less than five degrees per minute, increase the rudder program tap-switch setting (S5), open phase-B skid-turn circuit breaker, then repeat steps 1 through 5.

HIGHER TURNING RATES

Higher turning rates are possible if the rudder program is set at higher values. However, higher turning rates aggravate the turn-entry and turn-exit transient problem, and necessitate more cautious handling of the skid-turn knob. To minimize roll transients, use the skid-entry outside wing trim knob for fine adjustment of the aileron program. If this knob reaches the end of its travel, reset the lateral trim tap switch (S4) as follows:

DIRECTION OF ROTATION OF SKID-ENTRY KNOB	ADJUSTMENT OF LATERAL TRIM TAP SWITCH
Clockwise	Increase one tap
Counterclockwise	Decrease one tap

SKID-TURN PERFORMANCE

Skid-turn performance should meet the following specifications:

1. Peak roll angles should not exceed 2 degrees from vertical on roll-angle meter, or as shown on unstabilized vertical viewfinder, and should usually be less than 1-1/2 degrees.

2. Steady-state roll angle should be less than 1/2 degree from vertical.

3. Aircraft heading must change at least 5 degrees during final minute of skid turn, when skid-turn knob is fully deflected.

RADAR RECORDER CAMERA

The radar recorder camera has an F/4 lens and uses 70mm film. The recorder simultaneously photographs the radar presentation and a data chamber. The data chamber contains a clock, range markers, exposure counter, and a slate for pencil entries. The recorder is mounted on the azimuth and range indicator and is located just aft of the photo-navigator's position. Scope adjustments for photography are made by the photo-technician.

BOMB DIRECTOR CONTROL PANEL. Controls for the camera are found on the bomb director control panel (see figure 8-24). The TRAIN/ONE SHOT switch is a 3-position switch that operates the camera. The ONE SHOT position is a spring-loaded position which programs one radar photograph. The switch returns to off when released. When the switch is placed in TRAIN, the recorder automatically makes photographs at regular intervals.

The TRIPLE/NORMAL switch controls the two modes of operation. With the switch in NORMAL position, single photos are made at regular intervals. With the switch in the TRIPLE position, 3 photographs are made at regular intervals. The three photographs are of HIGH gain, NORMAL, and LOW gain presentation. HIGH and LOW gain adjustments for photography are made with the TRIPLE GAIN SET controls.

Cleanliness of the recording equipment is especially important, since foreign material on the mirror or film will appear as target returns when the film is developed.

Note

Since radar photography is made from a mirror, the film is viewed through the emulsion side to see the proper presentation.

SEARCH RADAR SET AN/ASB-1B

The AN/ASB-1B equipment as used in the aircraft is primarily a search radar system for navigation, reconnaissance and radar photographic purposes. The system also supplies stabilization signals for camera mounts. All operating controls for the system are located on the following components: ASB-1B radar control panel C-1712/ASB-1B, indicator control C-1711/ASB-1B, azimuth and range indicator IP-333/ASB-1B (aft of the photo-navigator's seat), and auxiliary indicator IP-187/ASB-1.

CONTROL PANEL C-1712/ASB-1B

Controls located on the C-1712/ASB-1B panel (see figure 8-24) and their function are listed below.

METER. The meter indicates the current or voltage of circuits selected by the meter switch.

METER SWITCH. The 12-position rotary knob selects the circuit in which the voltage or current is to be measured by the meter. On ANT PAT position, the meter indicates the type of antenna beam pattern selected by the antenna pattern switch. On MAG CUR position the average current passing through the magnetron is indicated on the meter. On BEACON and XTAL CUR 2 position, the crystal current of one of the crystals of the receiver or beacon mixer, selected by the beacon-manual knob, is indicated on the meter. The -300V, +150V, and +300V positions are marked as BLACK, and this marking indicates that the voltage from any of these supplies is of the proper magnitude when the reading lies within the black rectangular area located on the upper scale of the meter.

The +175V, -105V, and +28V positions are marked WHITE, and the voltage from any of these supplies is of proper magnitude when the reading lies within the white rectangular area on the lower scale of the meter. In addition to the readings normally provided, the meter supplies additional information necessary when the system is operated with tunable radar receiver-transmitter RT-170A/ASB-1; the additional positions are MAG FREQ and XTAL CUR 1.

ANTENNA PATTERN SWITCH. This three-position momentary-action toggle switch has positions marked HIGH ALT and LOW ALT. On HIGH ALT position the antenna reflector is driven vertically in a downward position to adjust beam pattern for higher altitudes. On LOW ALT position the antenna reflector is driven vertically in an upward direction to adjust the beam pattern for lower altitudes. If the meter switch is set at ANT PAT position when the antenna pattern switch is used, the meter indicates the motion and position of the reflector.

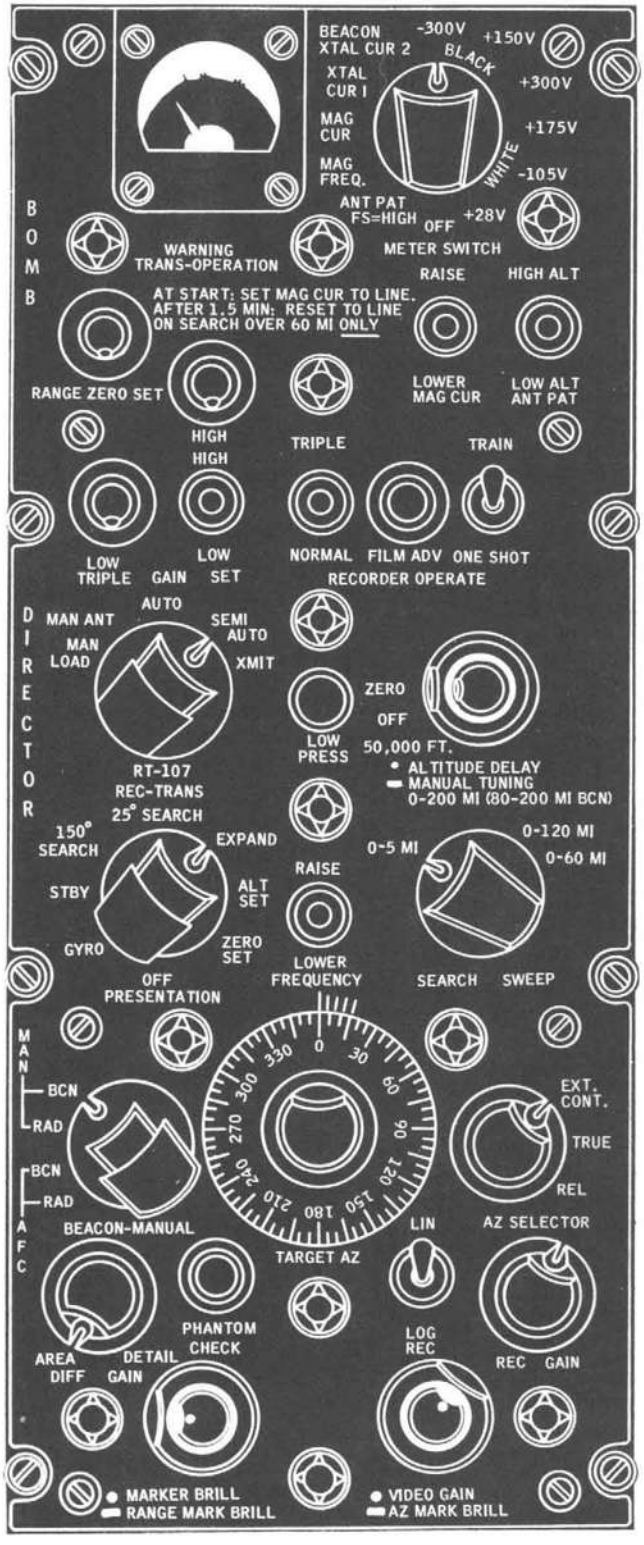

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Figure 8-24. Bomb Director Control C-1712/ASB-1B

MAGNETRON CURRENT SWITCH. This three-position momentary-action toggle switch has positions marked RAISE and LOWER. When the switch is held in the RAISE position the amplitude of the high-voltage pulses applied to the magnetron increases, causing the average current drawn by the magnetron to increase. When the switch is held in the LOWER position, the opposite is true. The magnetron current can be read on the meter by placing the meter switch at the MAG CUR position.

CAUTION

This switch, once set, should not be operated except to restore operation after the high power has failed and it is imperative to continue operation.

RADAR RECORDER CONTROLS. This group of controls consists of two toggle switches. When the train one shot switch is set at the TRAIN position, continuous photographs will be taken in accordance with the range of the presentation in use. If the scope is set up for more than sixty miles, one exposure will be taken every 24 seconds. Between 25 and 60 miles, one exposure will be taken every 12 seconds. At less than twenty-five miles, one exposure will be taken every 6 seconds. When the train one shot switch is momentarily held at the ONE SHOT position and the triple normal switch is set at NORMAL, the recorder takes one picture. When the train one shot switch is momentarily held in the ONE SHOT position and triple normal switch is set at TRIPLE, the recorder takes the following three pictures, the first with medium receiver gain, the second with low receiver gain, and the third with high receiver gain.

FILM ADVANCE LAMP. This indicator lamp, when lighted momentarily, provides a positive indication of proper operation of the film-advance circuitry. When lighted continuously this lamp indicates that the recorder film magazine is exhausted or that a break in the film has occurred.

TRIPLE GAIN SET SWITCH, TRIPLE GAIN SET HIGH, TRIPLE GAIN SET LOW. This group of three controls, consisting of a two-position switch and two potentiometers, is used for presetting the high and low receiver gains, for recording purposes.

RECEIVER-TRANSMITTER SWITCH

The REC/TRANS switch has five positions, one of which is spring-loaded. The positions and their functions are:

MAN-LOAD -- in which all energy is absorbed by a dummy load and nothing is emitted.

AUTO -- in which energy is emitted and scope presentation is normal except when changing frequency. When the RAISE-LOWER frequency switch is depressed in either direction, radar energy will not be emitted or received. When the switch is released, energy is emitted and scope presentations return to normal.

SEMI-AUTO -- provides the same features as the AUTO position except that the REC/TRANS switch must be momentarily moved to the spring loaded position before the presentation will appear on the scope.

MANUAL TUNING POTENTIOMETER. This potentiometer has a dual purpose. When the beacon-manual knob is set at MAN-BCN position, the manual tuning potentiometer tunes the frequency of the beacon local oscillator; however, when the beacon-manual knob is set at MAN-RAD position, the manual tuning potentiometer tunes the frequency of the search local oscillator.

SEARCH SWEEP SWITCH AND POTENTIOMETER. The combination rotary switch and potentiometer selects the scale of the radar presentation range sweep, and provides for selection of the markers in the range marker generator unit. It is continuously variable between the 0 to 5 MI and 0 to 60 MI positions. For range sweeps less than 25 miles, 5-mile markers are selected. From this point to the 0 to 60 MI position, 10-mile markers are selected. On 0 to 200 MI (80 to 200-mile beacon), a fixed position of the switch, the range sweep is 0 to 200 miles for normal radar operation or 80 to 200 miles for beacon operation, and 40-mile markers are selected for both. On 0 to 120 MI, also a fixed position of the switch, the range sweep is 0 to 120 miles for both radar and beacon, and 20-mile markers are selected.

ALTITUDE DELAY SWITCH. The control consists of a potentiometer and a rotary snap switch. The potentiometer provides a continuously variable sweep delay time as the knob is turned between the ZERO and the 50,000 FT positions. The delay can be introduced only when operating on the 0 to 5 and 0 to 60 mile search ranges. The control is normally adjusted to introduce the proper delay for eliminating the "hole" in the center of the indicator presentations.

AZIMUTH SELECTOR SWITCH. The control consists of a two-section three-position rotary knob. On TRUE position the azimuth reading obtained on the target azimuth dial indicates the angle between magnetic north and the target line of sight. On REL position, the azimuth reading indicates angle between the heading of the aircraft and the target line of sight. On EXT CONT, azimuth is controlled by the antenna azimuth control of the indicator control.

TARGET AZIMUTH CONTROL. The control consists of a differential transmitter, with calibrated azimuth dial, which controls the positioning of the antenna azimuth platform relative to either magnetic north or the aircraft heading. The calibrated dial indicates the azimuth angle between magnetic north and the target line of sight or between the airplane heading and the target line of sight, depending upon the setting of the azimuth selector control.

RECEIVER GAIN POTENTIOMETER. The potentiometer regulates the gain of the receiver i-f amplifier in linear or log operation, which in turn controls the strength of the received radar or beacon signals.

RECEIVER SWITCH. The two-position toggle switch has positions marked LIN and LOG. In the LOG position the intermediate-frequency amplifier is placed in logarithmic operation.

Note

Logarithmic operation is available only on the radar positions of the beacon-manual switch. When beacon positions are used, linear i-f operation is automatically selected, regardless of the position of the receiver switch.

VIDEO GAIN POTENTIOMETER. The potentiometer controls the over-all intensity of the following: video signals, selected precision or search range line, 5-, 10-, 20-, or 40-mile range markers, and IFF markers (when IFF auxiliary equipment is used).

AZIMUTH MARKER BRILLIANCE POTENTIOMETER. The potentiometer adjusts the intensity of the azimuth line on the cathode-ray-tube screens.

MARKER BRILLIANCE POTENTIOMETER. The potentiometer controls the over-all intensity of the following: selected precision range line or search range line, selected 5-, 10-, 20-, or 40-mile range markers, and IFF marker signals (when auxiliary IFF equipment is used).

RANGE MARKER BRILLIANCE POTENTIOMETER. The potentiometer controls the intensity of the selected 5-, 10-, 20-, or 40-mile range markers (depending on the range) on the cathode-ray-tube screens.

DIFFERENTIAL GAIN POTENTIOMETER. The potentiometer controls the differential gain of the video amplifier, to emphasize details or areas of radar reflection.

PHANTOM CHECK SWITCH. The pushbutton switch reduces the modulator prf, to eliminate possible second-round (phantom) echoes. It is operative only with expanded presentation under 25 miles.

BEACON-MANUAL SWITCH. The one-section four-position rotary knob has positions marked MAN-BCN, MAN-RAD, AFC-BCN and AFC-RAD. The MAN-BCN position provides manual control of the beacon local oscillator, when using the manual tuning control. The MAN-RAD position provides manual control of radar local oscillator when using the manual tuning control. The AFC-BCN position provides automatic control of beacon frequency due to operation of receiver afc circuits. The AFC-RAD position provides automatic control of radar frequency by receiver afc circuits.

FREQUENCY SWITCH. The three-position momentary-action (RAISE and LOWER) toggle switch is used only with the tunable receiver-transmitter to control the magnetron frequency.

PRESENTATION SWITCH. The three-section rotary knob has positions marked ALT-SET, ZERO SET, EXPAND, 25° SEARCH, 150° SEARCH, STBY, GYRO and OFF. ALT SET and ZERO SET are identical positions because no altitude setting is provided in this system. On ALT SET or ZERO SET, the antenna scans at ten looks per second, presentation is type B, with transmitter pulse and range line representing zero range of the system. Zero set is obtained by calibrating range line to transmitter pulse. On EXPAND, the antenna scans a 25-degree sector at two or ten looks per second, centered about azimuth line, presentation is rectangular or trapezoidal type B, with range and azimuth lines intersecting at center of presentation; this operation is used for close examination of flare-dropping areas. On 25° SEARCH the antenna scans a 25-degree sector at two looks per second, centered about azimuth line, PPI sector type presentation. On the 150° SEARCH position, the antenna scans a 150-degree sector at 1/2 look per second, centered about the aircraft centerline (±12.5 degrees), PPI sector type presentation. On the GYRO position, power is supplied to erect the gyros, stabilized platform is leveled, azimuth gyro is oriented to magnetic north, gyro hours clock is energized, and bails are unlocked after erection.

MANUAL TUNING. Manual tuning is used for testing the equipment or when afc fails during flight. If the afc is working properly during flight, manual tuning should not be used, as variations in magnetron frequency cannot be followed.

RANGE ZERO SET POTENTIOMETER. The potentiometer sets the calibration of the range line on the indicator, to bring the range line and the transmitter pulse into coincidence when the presentation control is in the ZERO SET position.

INDICATOR CONTROL C-1711/ASB-1B

C-1711/ASB-1B controls, on the photo-navigator's instrument panel, and their function are listed below.

ANTENNA AZIMUTH CONTROL. This control knob is connected by a gear train to the rotor of a synchro differential transmitter. It controls the position of the antenna azimuth line of sight when the azimuth selector switch is set at EXT CONT. One revolution of the knob produces approximately a five-degree change in relative bearing.

DRIFT CONTROL. This control knob is connected by a gear train to the rotor of a synchro control transformer and to a drum of a drift angle indicator which is graduated in increments of 2.5 degrees from 45 degrees left to 45 degrees right. One revolution of the drift control knob produces approximately 30 degrees of drift correction when the azimuth selector switch is set at EXT CONT. The drift correction is also applied to the PDI indicator if installed.

DRIFT ANGLE CONTROL LEFT RIGHT INDICATORS. When the PDI switch is set at ON the drift angle drum on the front panel indicates the amount of drift compensation being made. The counter values read from 45 degrees left to 45 degrees right.

PILOT'S DEVIATION INDICATOR (PDI) SWITCH. This two-position ON-OFF toggle switch directs the signals produced by rotating the DRIFT and/or antenna azimuth controls to the PDI indicator when at the ON position. When at the OFF position, it directs the signal to a matching resistance load, thus allowing the operator to search without sending the pilot a turn signal on the PDI.

SLANT RANGE CONTROL. The slant range control is comprised of a handcrank, two potentiometers, and two slant range counters. Rotation of the handcrank varies the radar range line on the indicator. One revolution of the handcrank represents a slant range of 3000 feet.

SLANT RANGE FEET÷1000 INDICATOR. This counter on the lower left corner of the front panel, consists of four numbered drums and indicates values from 000.0 to 150.0 representing slant ranges from zero to 150,000 feet.

SLANT RANGE MILES 25-200 INDICATOR. This counter on the left of the front panel, consists of four numbered drums and indicates slant ranges from 25 to 200 miles and fractions of miles.

LOCK. Locks the control position of both the antenna azimuth and drift controls

AZIMUTH AND RANGE INDICATOR IP-333/ASB-1B

Controls located on the IP-333/ASB-1B indicator and their function are listed below.

RANGE LIGHT BRILLIANCE POTENTIOMETER. This potentiometer varies the intensity of the range-marker lamps.

CONTRAST POTENTIOMETER. This potentiometer varies the intensity of the presentation on the cathode-ray-tube screen.

AUXILIARY INDICATOR IP-187A/ASB-1B

Controls located on the IP-187A/ASB-1B indicator and their function are listed below.

CONTRAST POTENTIOMETER. This potentiometer varies the intensity of the presentation on the cathode-ray-tube screen.

AUXILIARY INDICATOR PULL – MAIN INDICATOR PUSH. This two-position toggle switch is not used in AN/ASB-1B system.

ASB-1B PRELIMINARY CONTROL SETTINGS

BOMB DIRECTOR CONTROL C-1712/ASB-1B.

1. Meter switch . . . . . OFF
2. Recorder operate train/one shot switch . . . . . OFF
3. Recorder operate triple/normal switch . . . . . NORMAL
4. Film advance lamp . . . . . PRESS TO TEST
5. Triple gain set switch . . . . . OFF
6. Triple gain set high knob . . . . . FULLY COUNTER-CLOCKWISE
7. Triple gain set low knob . . . . . FULLY CLOCKWISE
8. Manual tuning knob . . . . . FULLY COUNTER-CLOCKWISE
9. Search sweep switch . . . . . 0-200 MI (80-200 BCN)
10. Altitude delay switch . . . . . OFF
11. Azimuth selector switch . . . . . EXT CONT
12. Target azimuth control . . . . . 0^{o}
13. Receiver gain knob . . . . . FULLY COUNTER-CLOCKWISE
14. Receiver switch . . . . . LOG
15. Video gain knob . . . . . FULLY COUNTER-CLOCKWISE
16. Azimuth marker brilliance knob . FULLY COUNTER-CLOCKWISE
17. Marker brilliance knob . . . . . FULLY COUNTER-CLOCKWISE
18. Range marker brilliance knob . . FULLY COUNTER-CLOCKWISE
19. Differential gain knob . . . . . DETAIL
20. Beacon-manual knob . . . . . AFC-RAD
21. Presentation switch . . . . . OFF
22. Receiver-transmitter knob RT-170
23. Range zero set knob . . . . . FULLY COUNTER-CLOCKWISE

INDICATOR CONTROL C-1711/ASB-1B.

1. Antenna azimuth control knob . . . . . CENTER
2. Antenna drift control knob . . . ROTATE UNTIL DRIFT ANGLE DRUM INDICATES 0^{o}
3. Pilot's deviation indicator switch . . . . . OFF
4. Slant range control . . . . . ADJUST THIS CONTROL SO THAT THE SLANT RANGE FEET ÷ 1000 COUNTER INDICATES 100

AZIMUTH AND RANGE INDICATOR IP-333/ASB-1B.

1. Range light brilliance thumb wheel . . . . . FULLY COUNTER-CLOCKWISE
2. Contrast thumb wheel . . . . . FULLY COUNTER-CLOCKWISE

ASB-1B OPERATION CHECKLIST

COCKPIT (IF EXTERNAL AC POWER IS TO BE USED.)

1. Gyro horizon dc Circuit Breaker . . . PULLED
2. DC generators . . . . . OFF
3. Throttles and engine masters . . . . . FULL AFT/OFF
4. Bus tie . . . . . OPEN
5. External power switch . . . . . OFF
6. AC generators . . . . . OFF
7. ASB function switch . . . . . OFF
8. IFF . . . . . OFF
9. Fuel dump switch . . . . . OFF
10. Apply power.

PRESTART

1. P/N circuit breakers . . . . . IN
2. Contrast (both indicators) . . . . . OFF
3. Marker; range marker brill . . . . . CCW
4. Video, AZ marker brill . . . . . CCW
5. Diff gain . . . . . AREA
6. Rec . . . . . LIN
7. Rec gain . . . . . CCW
8. Beacon . . . . . MANUAL - AFC-RAD
9. Target AZ . . . . . ZERO
10. AZ selector . . . . . REL
11. Presentation . . . . . OFF
12. Search sweep 0-60
13. Waveguide . . . . . MAN LOAD
14. Alt delay . . . . . OFF

PRETAXI (AC AND DC POWER CHECKED)

1. Presentation . . . . . GYROS
2. 28 Volts . . . . . CHECK
3. After approx 3 minutes, presentation to . . . . . STANDBY
4. After approx 30 seconds, 175 volts . . . CHECK

PRIOR TO TAKEOFF

1. Presentation . . . . . 25^{o} SECTOR
2. All voltages . . . . . CHECK
3. Meter switch . . . . . MAG CUR
4. When MAGNETRON fires, X-Tals . . . . . CHECK
5. Waveguide . . . . . AUTO
6. Contrast . . . . . SET
   (AUX scope . . . . . SWEEP JUST DISAPPEARS)
   (Main scope . . . . . SLIGHTLY HIGHER)
7. Triple gain . . . . . SET
8. Markers, video, reg gain . . . . . SET

9. All search sweeps and scope presentations . . . . . CHECK

10. Waveguide . . . . . MANUAL LOAD

TAKEOFF

1. 25° Sector. . . . . SET
2. Ant Pat . . . . . SET
3. AZ Sel . . . . . REL
4. Search sweep. . . . . BELOW 60

AFTER CLIMB

1. Zero set. . . . . COMPLETED
2. Altitude set. . . . . COMPLETED

PRE-LANDING

1. AZ Sel . . . . . REL
2. Ant Scan 25
3. Range. . . . . UNDER 25 MILES
4. Waveguide . . . . . MAN LOAD
5. Ant Pat - .7 . . . . . SET

SHUTDOWN

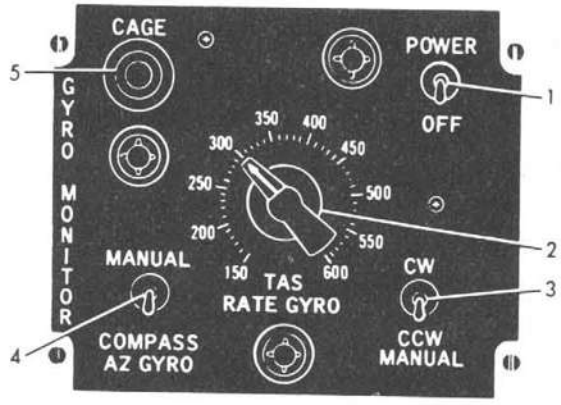
1. All scope controls . . . . . CCW
2. In the chocks presentation . . . . . OFF

AN/ASB-1B GYRO MONITOR CONTROLS

During ASB-1B operation, the CN-502 gyros are monitored by the gyro monitor controls (see figure 8-25 and table 8-2). When POWER switch is on, pitch and roll are automatically indicated on the ID-945/ASB attitude indicator. If roll and/or pitch gyros precess from aircraft vertical, depress the CAGE button momentarily. The cage light remains on until gyros are returned to normal.

CAUTION

Roll and pitch attitude indications are inaccurate above 20 degrees.



1. Gyro power switch
2. Azimuth gyro alignment control
3. True airspeed selector
4. Azimuth gyro control selector
5. Gyro caging button

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Figure 8-25. AN/ASB-1B Gyro Monitor Controls

TABLE 8-2. AN/ASB-1B GYRO MONITOR CONTROL FUNCTIONS. (See figure 8-25.)

CONTROL	FUNCTION
POWER/OFF switch	Connects 115-volt ac and 28-volt dc power to gyro monitor control.
CAGE	Provides 28-volt dc signal for caging roll and pitch gyros.
AZ GYRO switch	Compass position: connects 28-volt dc to K5901 displacement gyro compass relay to provide signals to precession coils. Manual position: permits fast slewing of azimuth (compass) gyro with MANUAL switch.
MANUAL 3-position toggle switch	Fast-slews azimuth gyro clockwise or counterclockwise to magnetic north.
TAS RATE GYRO (potentiometer)	Controls roll and pitch bail locks as function of aircraft speed.

GYRO MONITOR OPERATION

With the AZ GYRO switch (figure 8-25) at COMPASS, any deviation of the azimuth gyro from magnetic north will be compensated for automatically. If any change in heading or excessive acceleration causes a large deviation from magnetic north, fast slewing of the azimuth gyro and slaving to the magnetic compass may be accomplished as follows:

1. Az selector (ASB control panel) . . . . . TRUE
2. Target AZ control (ASB control panel). . . . . AIRCRAFT HEADING (Magnetic)
3. Presentation switch (ASB control panel). . . . . 150° SEARCH
4. AZ GYRO switch (figure 8-25) . . . . MANUAL
5. Hold MANUAL switch in either CW or CCW until sweep on radar scope is relatively centered.
6. AZ GYRO switch . . . . . COMPASS

Note

The azimuth gyro should now be aligned with the aircraft magnetic compass.

The MANUAL (CW or CCW) switch position requiring the smaller compensation for gyro deviation (determined by sweep position during alignment) should be selected. The CW position compensates for westerly deviation; the CCW, for easterly deviation.

CAUTION

The AZ GYRO switch must be returned to COMPASS after fast slewing and alignment; otherwise the azimuth gyro will drift.

Before a turn is started, the TAS RATE GYRO potentiometer should be set to correspond to the true airspeed. Once the potentiometer is set, circuit operation for disabling the roll and pitch bails during a turn is automatic. After the turn is completed, bails are released automatically.

INFLIGHT RADAR MALFUNCTIONS

The following procedure is recommended for inflight radar malfunctions:

1. Check circuit breakers.
2. Check voltages.
3. If antenna sticks, change scan rate.
4. Loss of magnetron current:
   a. Change frequency.
   b. Change PRF.
   c. Recycle radar.
5. Magnetron current arcing:
   a. Decrease current until it stabilizes.
   b. Increase current; then decrease to level where it stabilizes.
6. Loss of AFC:
   a. Change frequency.
   b. Adjust MAN TUNE for maximum crystal current and peak for maximum targets.
7. Loss of sweeps: change PRF.

DAY CAMERA CONFIGURATIONS PHOTOGRAPHY

The procedures and settings necessary to operate the camera system in its specific day configurations are shown in tables 8-3 through 8-13. The specific configurations need not be followed exactly, but may be simplified or used in combination with each other, according to the nature of the target and mission requirements. For example, the tri-camera and trimetrogon configurations may be combined, or used separately.

In each configuration the cameras have been listed with only a suggested focal length for the lens cone. No attempt has been made to list or designate each possible lens cone with a camera in a configuration. Letter designations refer to the various control panels, although for convenience, a switch or indicator may be designated by a letter. This means the switch will be found on the panel called out by the letter. Junction box settings are made with the pulse selector knob, to either a pulse channel position or a letter position. Central computer settings are made with a channel selector knob to pulse letter positions.

The FPS selector knob on the camera control panel, position 2, should be considered as a programming switch, not as an operating switch. When the KF-8 camera is used, the desired frames-per-second rate is selected with this switch. When the CA-13 camera is installed, it may be programmed by positioning the switch to any of the three available positions, although in the operating diagrams the switch is illustrated in the 24 position. Whichever camera is installed at position 2 is operated by the forward oblique camera operate switch on the pilot's instrument panel.

TABLE 8-3. GENERAL RECONNAISSANCE OPERATION

PREFLIGHT

a. Install cameras according to following table, remove lens covers.

Position	Camera	Magazine	Focal Length	Dep. Angle
1.	CA-13	MA-8	36"	90°
2.	KF-8 or CA-13 mod, as desired			fixed fwd. obl.
3.	CA-13	MA-8	36"	10° 30'
4.	CA-13	MA-8	36"	10° 30'
5.	CA-14	Integral	6"	30°
6.	CA-14	Integral	6"	90°
7.	CA-14	Integral	6"	30°
8.	CA-13	MA-8	36"	37°
9.	CA-13	MA-8	36"	37°
10.	CA-13	MA-8	36"	63° 30'
11.	CA-3-2, CA-3-2B	MA-10A	24"	90°
12.	CA-13	MA-8	36"	63° 30'

b. Adjust camera mount functions, cage for takeoff:

(1) IMC at positions 1, 3, 4, 8, 9, 10, 12.

(2) Azimuth at position 11.

(3) Stabilization at position 11.

c. Set junction boxes, central computer, RDA servo power units as follows: (items D, E, F, G, H, J).

Position	Junction Box	Central Computer	RDA
1.	Mod 2, Ch. 2	BCDF Ch. 2 knob set according to figure 4-33A for CA-13, or set KF-8 control unit, as required.	
2.	Mod 5, no setting		
3.	Mod 4, Ch. 4	BDF Ch. 4 knob	
4.	Mod 4, Ch. 4	BDF Ch. 4 knob	
5.	Mod 2, F	B Ch. 1 knob	
6.	Mod 2, F	B Ch. 1 knob	
7.	Mod 2, F	B Ch. 1 knob	
8.	Mod 3, Ch. 2	BCDF Ch. 2 knob	
9.	Mod 3, Ch. 2	BCDF Ch. 2 knob	
10.	Mod 2, Ch. 2	BCDF Ch. 2 knob	
11.	Mod 3, B	No setting	FOCAL LENGTH selector knob: MA-10A 24" DEPRESSION ANGLE knob: 90°
12.	Mod 2, Ch. 2	BCDF Ch. 2 knob	

TABLE 8-4. GENERAL RECONNAISSANCE VERTICAL OPERATION

PREFLIGHT

a. Install cameras according to table, remove lens covers.

Position	Camera	Magazine	Focal Length	Dep. Angle
6.	KA46A	LA141A Cassette	6"	90°
11.	KA46A	LA141A Cassette	6"	90°

TABLE 8-4. GENERAL RECONNAISSANCE VERTICAL OPERATION (Continued)

b. Adjust camera mounts, cage for takeoff.

(1) Trimet cradle to 0° pitch.

(2) Check stab and balance stations 6 and 11. (Special camera adapters required.)

(3) Stations 6 and 11 to 0° pitch.

(4) Cage roll stabilization stations 6 and 11.

c. Set system adapter boxes, central computer and RDA as follows:

Station	System Adapter Boxes	Central Computer	RDA
6.	As required for pulse Ops.	NA	90° 3" 70mm
11.	As required for pulse Ops.	NA	90° 3" 70mm

TABLE 8-5. GENERAL RECONNAISSANCE OBLIQUE OPERATION

PREFLIGHT

a. Install cameras according to table, remove lens covers.

Position	Camera	Magazine	Focal Length	Dep. Angle
5.	KA46-A	LA141A Cassette	6"	30°
7.	KA46-A	LA141A Cassette	6"	30°

b. Adjust camera mounts and cage for takeoff.

(1) Set trimet cradle to 0° pitch.

c. Set system adapter boxes, central computer and RDA as follows:

Station	System Adapter Boxes	Central Computer	RDA
6.	As required for pulse Ops.	NA	30° 3" 70mm
11.	As required for pulse Ops.	NA	30° 3" 70mm

TABLE 8-6. GENERAL RECONNAISSANCE TRI-CAMERA OPERATION (CA-13)

PREFLIGHT

a. Install cameras according to the following table, remove lens covers:

Position	Camera	Magazine	Focal Length	Dep. Angle
1.	CA-13	MA-8	24", 36"	90°
8.	CA-13	MA-8	24", 36"	53°, 63° 30'
9.	CA-13	MA-8	24", 36"	53°, 63° 30'
10.	CA-13	MA-8	24", 36"	53°, 63° 30'
11.	CA-13	MA-8	24", 36"	90°
12.	CA-13	MA-8	24", 36"	53°, 63° 30'

TABLE 8-6. GENERAL RECONNAISSANCE TRI-CAMERA OPERATION (Continued)

b. Adjust camera mount functions as follows, cage for takeoff:

(1) IMC at all positions.

(2) No azimuth or stabilization functions.

c. Set junction boxes, central computer (items D, E, H) as follows:

Position	Junction Box	Central Computer: 24" f.l.		36" f.l.
1.	Mod 2, Ch. 2	(all settings with Ch. 2 switch)	BF	BCDF
8.	Mod 3, Ch. 2		BF	BCDF
9.	Mod 3, Ch. 2		BF	BCDF
10.	Mod 2, Ch. 2		BF	BCDF
11.	Mod 3, Ch. 2		BF	BCDF
12.	Mod 2, Ch. 2		BF	BCDF

Note

Either 24" or 36" lens cones may be used for the two tri-camera programs. All cameras of the same focal lengths utilize the same central computer channel.

TABLE 8-7. GENERAL RECONNAISSANCE OBLIQUE PHOTOGRAPHY

PREFLIGHT

a. Install cameras (item A) according to the following table, remove lens covers:

Position	Camera	Magazine	Focal Length or Lens Cone	Dep. Angle
2.	CA-13	MA-8	24" or 36" bent lens cones	fixed fwd obl
	KF-8	Integral	mirror assemblies as desired	fixed fwd obl
3,4.	CA-13	MA-8	24", 36"	10°
5,7.	CA-3-2B	MA-9	6"	30°
8,9.	CA-3-2	MA-9, MA-9A	24"	37°
	CA-13	MA-8	24", 36"	37°
10,12.	CA-3-2	MA-9, MA-9A	24"	53°
	CA-13	MA-8	24", 36"	53°, 63°30'

b. Adjust camera mount functions, cage for takeoff. IMC at positions 3, 4, 8, 9, 10, 12. No azimuth stabilization.

c. Set junction boxes, central computer, RDA servo power units (items D, E, F, G, H, J) as follows:

Position	Junction Box	Central Computer	RDA
2.	Mod 5 – no setting 501	Push buttons as indicated for CA-13. No setting for KF-8.	none
3,4.	Mod 4, Ch. 2	BC on Ch. 2 knob (24")	none
		BDF on Ch. 2 knob (36")	none
5,7.	Mod 2, Ch. 1	B	none
8,9.	Mod 3, Ch. 3	BDF, Ch. 3 knob (CA-3-2, 24")	none
		BF, Ch. 3 knob (CA-13, 24")	none
		BCDF, Ch. 3 knob (CA-13, 36")	none
10,12.	Mod 2, Ch. 4	BF, Ch. 4 knob (CA-3-2, 24")	none
		BF, Ch. 4 knob (CA-13, 24")	none
		BCDF, Ch. 4 knob (CA-13, 36")	none

TABLE 8-8. STABILIZED VERTICAL OPERATION

PREFLIGHT

a. Install cameras (item A) according to the following table, remove lens covers:

Position	Camera	Magazine	Focal Length	Dep. Angle
6.	CA-14	Integral	6"	90°
	CA-3-2 (CA-3-2B)	MA-10A (Day)	6"	90°
11.	CA-14	Integral	6"	90°
	CA-3-2 (CA-3-2B)	MA-10A (Day)	6"	90°

b. Adjust camera mount functions, cage for takeoff:

(1) Azimuth at both positions.

(2) No IMC.

c. Set junction boxes, central computer, RDA servo power units (items D, E, F, G, H, J) as follows:

Position	Junction Box	Central Computer	RDA
6.	Mod 2, Ch. 1	B on Ch. 1 switch	none (CA-14)
	Mod 2, B	none	focal length selector knob: MA-10A-6" depression angle knob: 90°
11.	Mod 3, Ch. 1	B on Ch. 1 switch	none
	Mod 3, B	none	focal length selector knob: MA-10A-6" depression angle knob: 90°

TABLE 8-9. GENERAL RECONNAISSANCE TRI-CAMERA OPERATION (KA40A)

PREFLIGHT

a. Install cameras according to following table, remove lens covers.

Position	Camera	Magazine	Focal Length	Dep. Angle
5.	KA40A	LA141A Cassette	3"	30°
6.	KA40A	LA141A Cassette	3"	90°
7.	KA40A	LA141A Cassette	3"	30°

b. Adjust camera mounts, cage for takeoff.

(1) Position 6 0° pitch.

(2) Roll stab. caged position 6.

(3) Trimet cradle 0° pitch.

c. Set system adapter, central computer and RDA.

Position	"J" Box	Central Computer	RDA
5.	F	Channel 1 on "B"	30° 1-1/2" 70mm
6.	F	Channel 1 on "B"	90° 1-1/2" 70mm
7.	F	Channel 1 on "B"	30° 1-1/2" 70mm

TABLE 8-10. TRIMET CRADLE OPERATION

PREFLIGHT

a. Install cameras (item A) according to the following table, remove lens covers:

Position	Camera	Magazine	Focal Length	Dep. Angle
5.	CA-14	Integral	6"	30°
	CA-3-2 (CA-3-2B)	MA-9, MA-9A	6"	
6.	CA-14	Integral	6"	90°
	CA-3-2 (CA-3-2B)	MA-9, MA-9A	6"	
7.	CA-14	Integral	6"	30°
	CA-3-2 (CA-3-2B)	MA-9, MA-9A		

b. Adjust camera mount functions, cage for takeoff:

No azimuth, IMC, or stabilization.

c. Set junction boxes, central computer (items D, E, H) as follows:

Position	Junction Box	Central Computer
5.	Mod 2, F	B on Ch. 1 knob
6.	Mod 2, F	B on Ch. 1 knob
7.	Mod 2, F	B on Ch. 1 knob

Note

Only the CHANNEL 1 switch of the central computer may be used.

TABLE 8-11. GENERAL RECONNAISSANCE 5-CAMERA FAN OPERATION

PREFLIGHT

a. Install cameras according to table, remove lens covers.

Position		Camera	Magazine	Focal Length	Dep. Angle
5. * connected to station 1 "J" Box	Special mount adapter required	KA47A (Day)	MA10A (Day)	12"	30°
7. * connected to station 6 "J" Box		KA47A (Day)	MA10A (Day)	12"	30°
8.		KA47A (Day)	MA10A (Day)	12"	53°
9.		KA47A (Day)	MA10A (Day)	12"	53°
11.		KA47A (Day)	MA10A (Day)	12"	90°

b. Adjust camera mounts, cage for takeoff.

(1) All mounts to have IMC caged

* These station controls are cross connected to permit MA10A operation in camera stations 5 and 7.

TABLE 8-11. GENERAL RECONNAISSANCE 5-CAMERA FAN OPERATION (Continued)

c. Set "J" Boxes, Central Computer, and RDA as follows:

Position	"J" Box	Central Computer	RDA
1. * connected to station 5 camera	B MA10A Day	-	30° 12" MA10A
6. * connected to station 7 camera	B MA10A Day	-	30° 12" MA10A
8.	B MA10A Day	-	30° 24" MA10A
9.	B MA10A Day	-	30° 24" MA10A
11.	B MA10A Day	-	90° 12" MA10A

* These station controls are cross connected to permit MA10A operation in camera stations 5 and 7.

TABLE 8-11A. LOW LEVEL, HIGH SPEED, RECONNAISSANCE (500' to 3, 000')

a.

Position	Camera	Magazine	Focal Length	Dep. Angle
2	CA-13	MA-8	24"	7°
5	KA-40A	CASS.	3"	30°
6	KA-40A	CASS.	3"	90°
7	KA-40A	CASS.	3"	30°
11	KA-40A	CASS.	3"	90°
1	KA-47A	MA-10A	12"	90°
8	KA-47A	MA-10A	12"	53°
9	KA-47A	MA-10A	12"	53°

b. Adjust all camera mount functions, cage for take off, and close all camera windows.

c. Set junction boxes, central computer, RDA servo power units.

Position	"J" Box	Central Computer	RDA
2	Mod 5	501 - BCDF	
5	F	Ch. #1 on B	30° 1-1/2", 70mm
6	F	Ch. #1 on B	90° 1-1/2", 70mm
7	F	Ch. #1 on B	30° 1-1/2", 70mm
11	F	Ch. #1 on B	90° 1-1/2", 70mm
1	B-MA-10A Day		90° 12", MA-10A
8	B-MA-10A Day		30° 12", MA-10A
9	B-MA-10A Day		30° 12", MA-10A

TABLE 8-12. GENERAL RECONNAISSANCE 2-CAMERA VERTICAL OPERATION

PREFLIGHT

a. Install cameras according to table, remove lens covers.

Position	Camera	Magazine	Focal Length	Dep. Angle
1.	KA47A (Day)	MA10A or MA9	12"	90°
8.	KA47A (Day)	MA10A or MA9	12"	90°
9.	KA47A (Day)	MA10A or MA9	12"	90°
10.	KA47A (Day)	MA10A or MA9	12"	90°
11.	KA47A (Day)	MA10A or MA9	12"	90°
12.	KA47A (Day)	MA10A or MA9	12"	90°

b. Adjust camera mounts, cage for takeoff.

(1) Cage IMC

(2) Set pitch to 0°

c. Set "J" Boxes, Central Computer, and RDA's as follows:

(1) with MA10A magazine day mode

Position	"J" Box	Central Computer	RDA
1.	B	-	90° 12" MA10A
8.	B	-	90° 12" MA10A
9.	B	-	90° 12" MA10A
10.	B	-	90° 12" MA10A
11.	B	-	90° 12" MA10A
12.	B	-	90° 12" MA10A

(2) with MA9 magazine

1.	Channel # 2	Channel # 2 BC	- - -
8.	Channel # 2	Channel # 2 BC	- - -
9.	Channel # 2	Channel # 2 BC	- - -
10.	Channel # 2	Channel # 2 BC	- - -
11.	Channel # 2	Channel # 2 BC	- - -
12.	Channel # 2	Channel # 2 BC	- - -

TABLE 8-12A. LOW-MED., HIGH SPEED, RECONNAISSANCE (3, 000' to 10, 000')

a. Install cameras according to the following table; remove all lens covers and filters.

Position	Camera	Magazine	Focal Length	Dep. Angle
2	CA-13	MA-8	24"	7°
6	KA-40A	CASS.	3"	90°
10	KA-53A	CASS.	12"	72.5°
11	KA-53A	CASS.	12"	90°
12	KA-53A	CASS.	12"	72.5°
1	KA-47A	MA-10A	12"	90°
8	KA-47A	MA-10A	12"	53°
9	KA-47A	MA-10A	12"	53°
3	CA-13	MA-8	24"	10°, 25°, 37°
4	CA-13	MA-8	24"	10°, 15°, 37°

b. Adjust camera mount functions, cage for take off, and close all camera windows.

c. Set junctions boxes, central computer, and RDA servo power units.

Position	"J" Box	Central Computer	RDA
2	Mod 5	501 - BCDF	
6	F	Ch. #1 on B	90° 1-1/2", 70mm
10	Ch. #2 Pulse	Ch. #2 on BDF	
11	Ch. #2 Pulse	Ch. #2 on BDF	
12	Ch. #2 Pulse	Ch. #2 on BDF	
1	B MA-10A Day	-	90° 12", MA-10A
8	B MA-10A Day	-	30° 24", MA-10A
9	B MA-10A Day	-	30° 24", MA-10A
3	Mod 4 Ch. #3	BF	
4	Mod 4 Ch. #3	BF	

TABLE 8-13. DAY SEQUENTIAL OPERATION

PREFLIGHT

a. Install cameras (item A) according to the following table, remove lens covers:

Position	Camera	Magazine	Focal Length	Dep. Angle
8.	CA-13	MA-8	24", 36"	90°
9.	CA-13	MA-8	24", 36"	90°
10.	CA-13	MA-8	24", 36"	90°
12.	CA-13	MA-8	24", 36"	90°

b. Adjust camera mount functions, cage for takeoff:

(1) IMC at all positions

(2) Azimuth at all positions

(3) No stabilization

c. Set junction boxes, central computer (items D, E, H) as follows:

Position	Junction Box	Central Computer
8.	Mod 3, C	Camera sequence switch to 2 or 4 Focal length sequence switch to 24 or 36
9.	Mod 3, C	Camera sequence switch to 2 or 4 Focal length sequence switch to 24 or 36
10.	Mod 2, C	Camera sequence switch to 2 or 4 Focal length sequence switch to 24 or 36
11.	Mod 2, C	Camera sequence switch to 2 or 4 Focal length sequence switch to 24 or 36

Note

A camera sequence switch and a focal length sequence switch are available on the central computer for day sequential photography. One switch permits the programming of either two or four cameras in the sequential mode, the other permits the choice of either a 24" or 36" focal length. These two switches are not used during night sequential operation. All cameras must have lens cones of the same focal lengths.

DAY PHOTO CHECKLISTS

PREFLIGHT

1. Camera/scanner/light monitor/viewfinder windows . . . . . CLEAN
2. Camera/scanner doors . . . . . CLOSED
3. Master power . . . . . OFF
4. OP 1/OP 2/VF STAB/radar recorder . . . OFF

4a. Camera program switches . . . . . NEUTRAL

5. Central computer . . . . . SET
6. Station J boxes . . . . . SET
7. RDA/KF Camera control unit . . . . . SET
8. Mounts
   a. Depression angle . . . . . SET
   b. Potentiometers . . . . . SET
   c. Azimuth . . . . . LOCKED
   d. Stabilization . . . . . CAGED
   e. IMC . . . . . LOCKED
   f. Cables . . . . . FREE
9. Cameras
   a. Shutter speed/diaphragm . . . . . SET
   b. Magazine . . . . . SEATED
   c. Vacuum hoses . . . . . CONNECTED

d. Cables . . . . . TIGHT

e. Data chambers . . . . . COMPLETE

10. P/N panel film counters . . . . . SET

11. Charts/data cards . . . . . ABOARD

PRE-TARGET

1. VF stabilization (gyros up) . . . . . ON

2. Master power (5 min prior use) . . . . . ON

3. Vacuum gauge . . . . . 3-4"

4. Mounts . . . . . FREE/UNCAGED

5. Shutter speeds/diaphragm . . . . . CHECKED

6. Camera program switches OP1/OP2

7. Interval/IMC/advance lights/ counter . . . . . MONITOR

a. Set computer 300 KTS/20, 000'

1) 6" - 24 SECS

2) 12" - 12 SECS

3) 24" - 6 SECS

4) 36" - 4 SECS

8. Azimuth . . . . . FOLLOWS DRIFT

9. Viewfinder alignment . . . . . CHECKED

10. Data chambers . . . . . COMPLETE

11. Camera/scanner doors . . . . . OPEN

12. Traveling grid . . . . . ON

13. Radar camera recorder . . . . . CHECKED

14. Radar altitude . . . . . SET

15. Oblique sights . . . . . AS DESIRED

16. E V/H . . . . . SET

TARGET

1. Master power (5 min prior to use). . . . . ON

2. Camera program switches OP1 OP2

3. Computer/ scanner . . . . . AS DESIRED

4. Drift . . . . . CHECKED SET

4A. Stabilization . . . . . CHECKED

5. Traveling grid . . . . . MONITOR

6. Radar camera . . . . . ON

7. Camera operate switches OP1/OP2

8. Interval/IMC/stabilization/ exposure . . . . . MONITOR

9. Camera operate switches . . . . . OFF

10. Photo data cards . . . . . COMPLETE

11. Take ups . . . . . COMPLETE

SECURE

1. Camera OP switches . . . . . OFF

2. Program switches . . . . . NEUTRAL

3. Mounts . . . . . LOCKED AND CAGED

4. Camera/scanner doors . . . . . CLOSED

5. Viewfinders/stab/trvl grid . . . . . OFF

6. Master power . . . . . OFF

INFLIGHT MALFUNCTION

1. Stabilization failure

a. Depress gyro cage on gyro. . . . MONITOR

b. Lock stabilization . . . . . OFF

c. Viewfinder stabilization . . . . . OFF

d. Continue mission

2. Erratic interval

a. Check cables . . . . . TIGHT

b. Check computer/J-box settings

c. Continue mission. Use EXTR-PIC button or set up V/H which gives desired interval

3. Magazine failure

a. Check seating . . . . . SECURE

b. Check cables . . . . . TIGHT

c. Change magazine, continue mission

4. Camera failure

   a. CA-13 check coupling shaft clutch

   b. Check cables . . . . . TIGHT

   c. Use backup camera, continue mission

NIGHT PHOTOGRAPHY

Night photography is accomplished either sequentially or simultaneously, using vertically installed cameras at positions 8, 9, and 11. Artificial illumination is supplied by the illuminant release system, using either photoflash bombs or cartridges, or a mixed load configuration of both bombs and cartridges. Bombs are used primarily for high altitude photography, and cartridges for low altitude photography.

During night photography the camera control system does not operate the cameras directly as is done in day photography. Instead, the camera control system, through the camera operate switches, channels the pulse from the central computer to the illuminant release system. The illuminant release circuitry selection is available through the illuminant system selector switch. The illuminant system ready switch controls the opening and closing of the bomb bay doors through the release system circuitry, which releases bombs or cartridges at predetermined intervals. These illuminants burst after a preset time interval, at a specified distance below and behind the aircraft, and with a specific light intensity.

The light rays from illuminant bursts are received by the photoflash detector, a unit containing a photoelectric cell located on the bottom surface of the airplane aft of the bomb bay. The light rays are converted into an electric pulse by the photoflash detector and sent to the camera to initiate shutter trip and magazine recycle. The photoflash detector is capable of controlling from one to three night cameras. The camera exposure interval is 75 to 150 milliseconds after illuminant burst, and is set by the photoflash detector.

NIGHT CAMERAS

The cameras used for night photography are the KA-47A, KA-40A, KA-46A, and KA-53A. All cameras operate on the capping shutter principle (see figure 8-26). In the night mode the cycle of operation starts with the shutter open. The photoflash detector generates a pulse that closes the shutter. At this stage, film is advanced, and the shutter reopens for the next illuminant burst.

Note

- The film moves between exposures at a rate proportional to V/H. This IMC movement results in a gap between pictures on the film. This gap is wide for small V/H ratios; narrow (1/2 inch min.), for large V/H ratios.
- Even though the shutter is open between exposures, existing terrain light is insufficient to record a terrain image on the film moving between exposures. However certain strong terrain lights, such as spotlights, vehicle headlights, and fires, will register on the film and may be a valuable aid to plotting the film strip.
- The KA-40A camera should be installed in position 6, since its field of view will include the open bomb bay doors if it is installed in position 11. (It is still operated through position 11 controls.)
- For night photography with the MA-10A magazine, the day-night lever must be placed in the NIGHT position to prevent malfunction.

FLASH DETECTOR

The flash detector is used in night photography with night cameras. The unit is mounted on the lower center fuselage structure immediately aft of the bomb bay. It is basically a photoelectric cell which detects the light generated by a cartridge or bombs and transmits a pulse to the cameras.

DUAL OVERRUN RELAY

The dual overrun relay is a hermetically sealed unit located on the outboard side of the second shelf of the right-hand equipment rack (figure 8-9). It provides the means of holding the night cameras in operation after the camera operate switches are placed in the OFF position to allow time for the last bomb or cartridge burst. The holding time interval is approximately 6 seconds for cartridges and 60 seconds for bombs.

ILLUMINANT SYSTEM

BOMB BAY

CAUTION

Under normal operating conditions, landing with cartridges aboard is permissible; however, it is mandatory that every effort be made to jettison flash bombs. If flash bombs cannot be jettisoned, the ship or station must be notified prior to the landing, so that all hung ordnance procedures can be complied with.

The bomb bay (figures 8-1, 8-27, 8-28) is divided into two sections by a center structure to reduce the area of the opening, reduce the size of the doors, decrease the buffet effect on the aircraft when the doors are open, and eliminate the tendency of a bomb to hang or float in the bay when released. Each side of the bay is protected by a set of doors. Each set is actuated by its own hydraulic cylinder from a single actuating valve. If electrical power is not available, the doors can be manually controlled and hydraulically actuated. If neither electrical nor hydraulic power is available, the doors can be opened with compressed air, but cannot then be closed in flight. The doors are normally opened and closed from the cockpit, from the camera compartment, or externally from the left-hand wheelwell. During normal or salvo operations when a full load of bombs or a mixed load of bombs and cartridges are carried, the doors can be operated in sequence, the left-hand doors opening and closing and then the right-hand doors opening and closing. However, both sets of doors operate simultaneously when a full cartridge load is carried, or when they are operated pneumatically.

ILLUMINANT INSTALLATION

Each side of the bomb bay contains four permanently installed rails between which the removable bomb

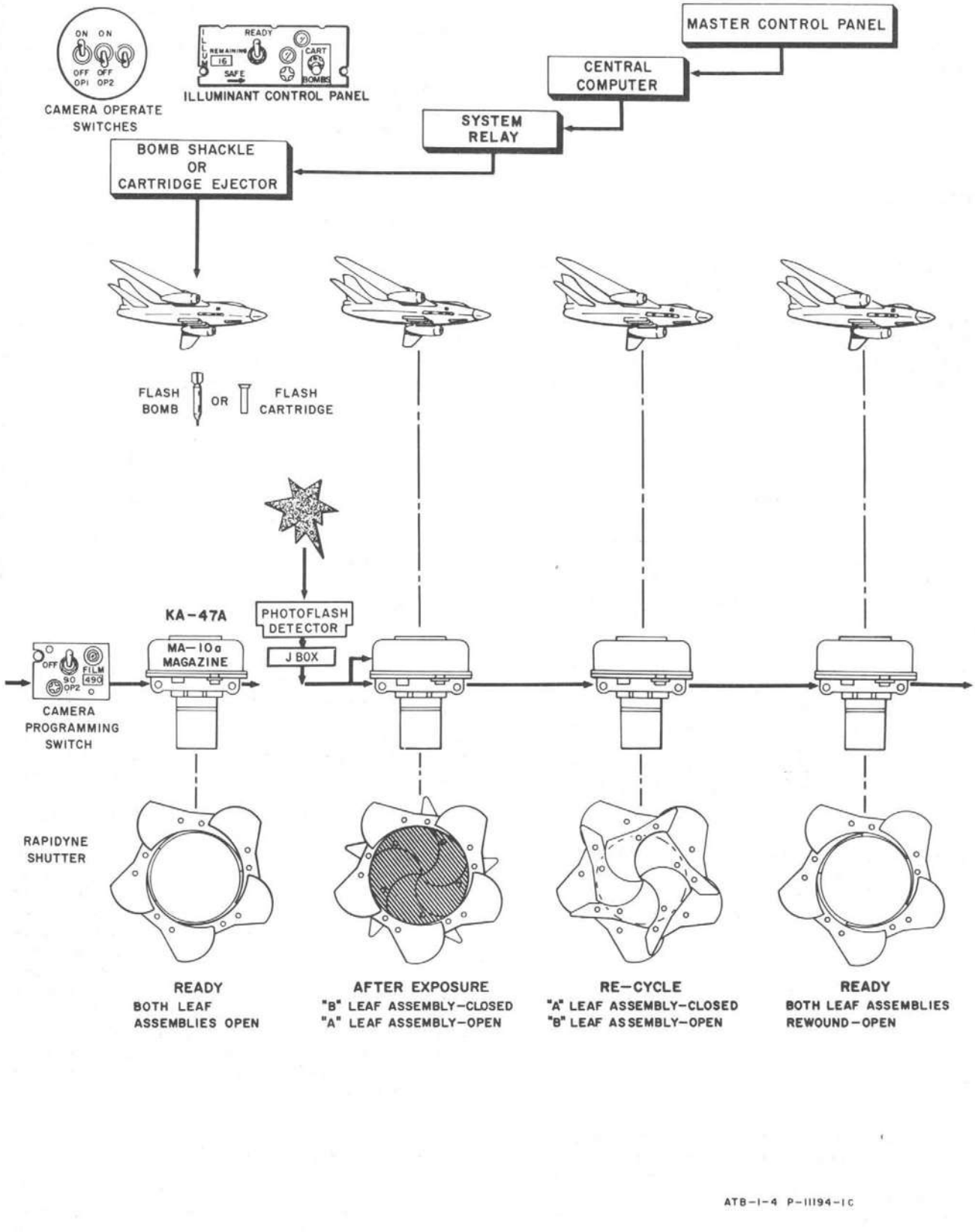
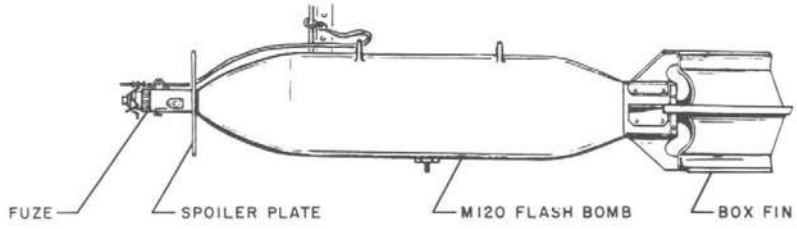


Figure 8-26. Capping Shutter Operation (Typical)



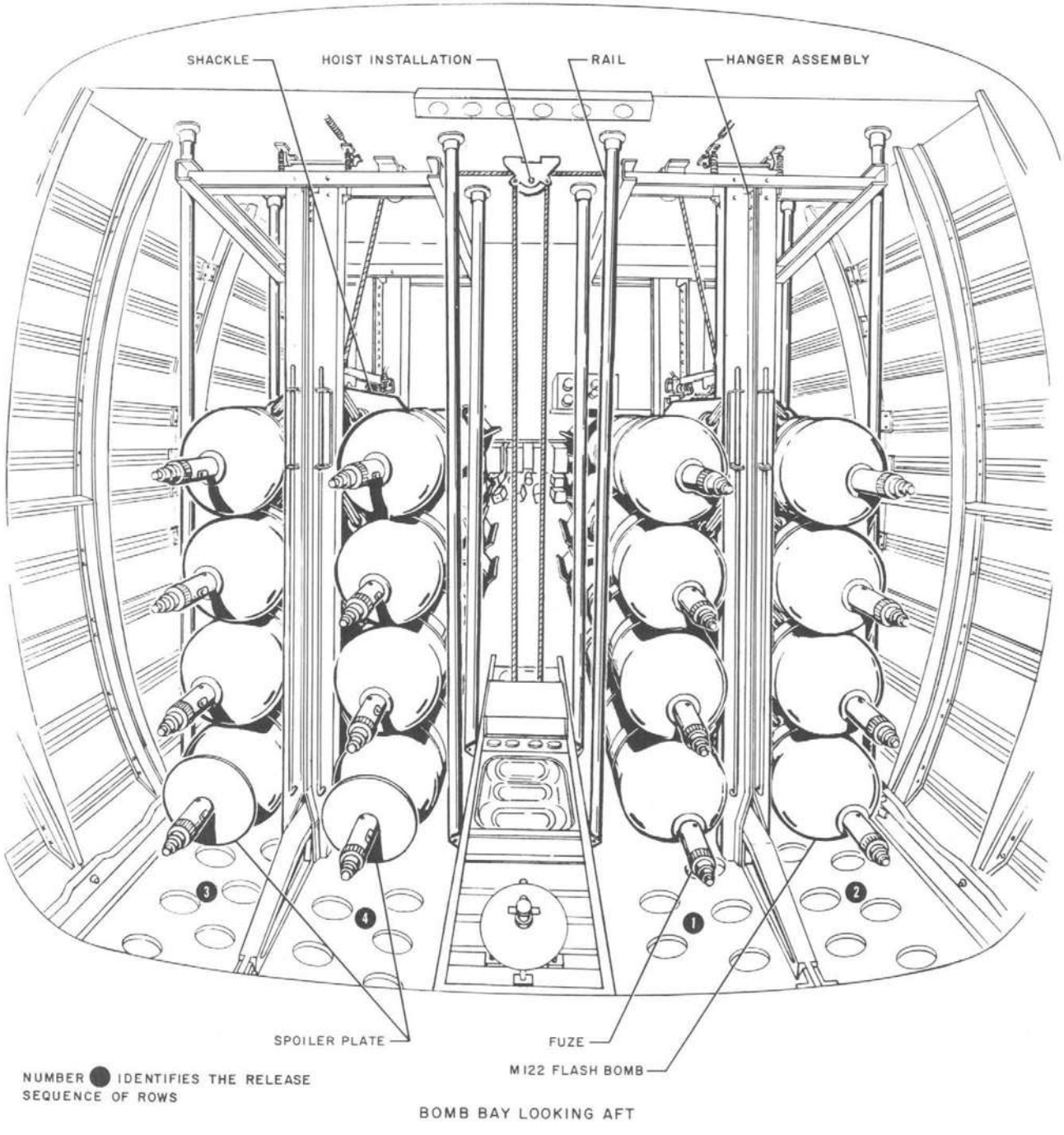


Figure 8-27. Flash Bomb Installation

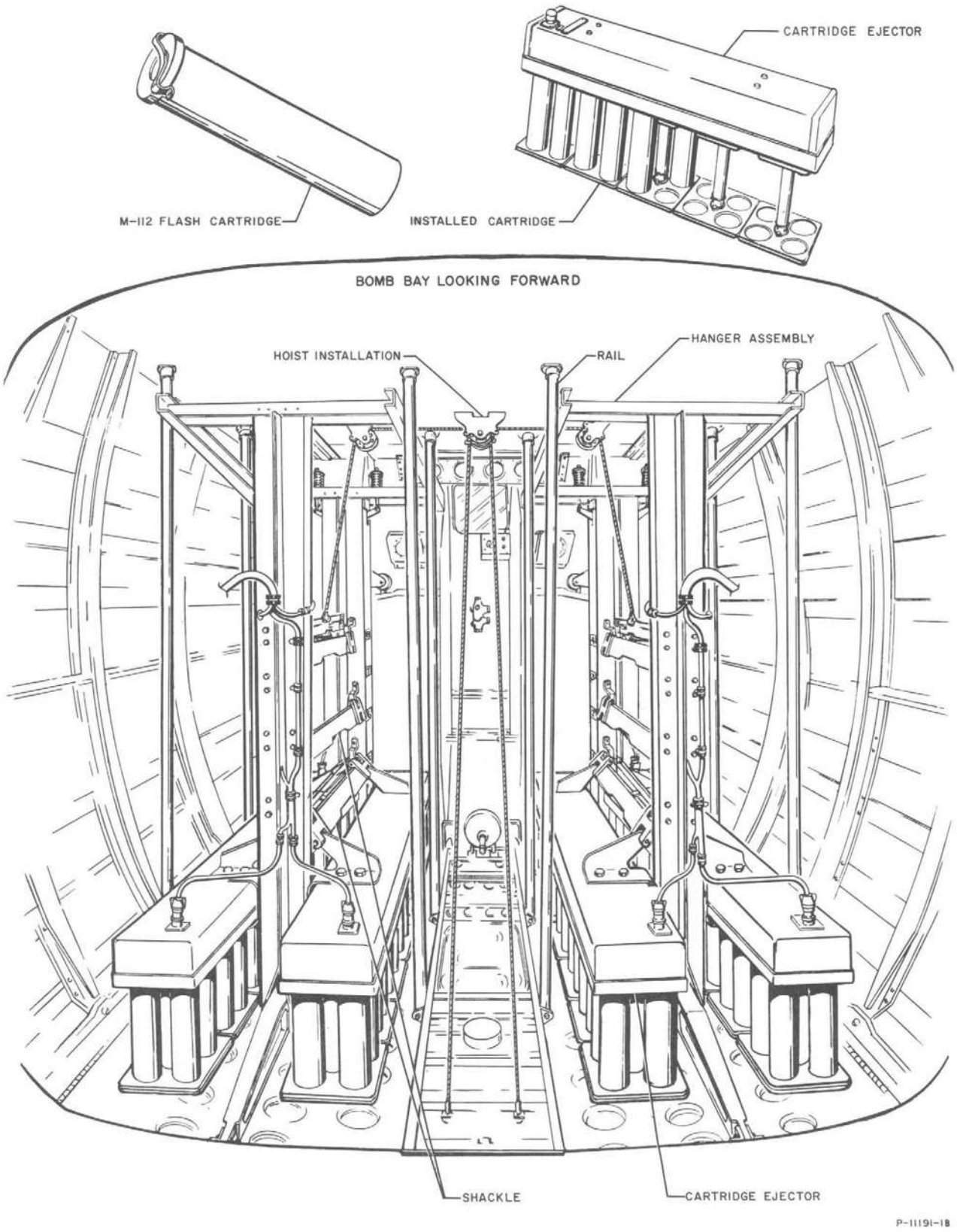


Figure 8-28. Cartridge Ejector Installation

hangers are installed. There are two hangers, each containing eight modified MK-8 Mod 4 shackles, four to each side of the hanger. The bombs or cartridge ejectors are attached to the hangers, safety pins are installed in all shackles, the arming wires are attached to the hangers, the necessary electrical connections are made, and then the loaded hangers are raised into the bay with a hoist and attached to the aircraft structure (figures 8-27, 8-28). When the loaded hangers are hoisted into the bay, the bombs are unarmed and remain unarmed until they clear the bomb bay doors on release. The cartridge ejectors are attached to the second shackle from the bottom on each hanger and, because of their size, effectively block out the bomb bay opening when the doors are open, reducing possible buffet effects.

CAUTION

When the aircraft is ready for takeoff, remove the safety pins from the shackles carrying bombs, but not from the shackles carrying cartridge ejectors. Jettisoning of ejectors is not recommended because, if ejector electrical connections fail to separate, ejectors may remain suspended in the bomb bay door opening.

ILLUMINANTS CONFIGURATIONS

Several illuminant configurations are possible: all bombs, all cartridges, or mixed loads of both. A complete bomb load consists of sixteen bombs, eight to a hanger, four on each side, or row. A full cartridge configuration consists of four cartridge ejectors, two to a hanger. A standard mixed load configuration consists of eight bombs in the left side of the bay and two cartridge ejectors in the right side. The bombs are released electrically and fall from the aircraft at predetermined time intervals. They are armed when they leave the bay. The cartridges are fired from the ejectors electrically at a speed of approximately 143 feet per second. The following types of bombs, cartridges, and ejectors are carried:

Flash bombs	Flash cartridges	Cartridge ejectors
M-120 M-120A1	M-112	Manufacturer's part no. A-6 (52 M-112 cartridge capacity)
M-122	M-123	Manufacturer's part no. B-4 (20 M-123 cartridge capacity)

Note

- Cartridge ejectors, manufacturer's part number LE-1230, and manufacturer's part number LE-1800, can be used only if the internal circuitry of the ejector is modified.
- Release of M-120, M-120A1 and M-122 photoflash bombs must not be attempted at airspeeds exceeding 425 knots, since the arming mechanism has failed at higher airspeeds, causing premature ignition. This limitation applies to all RA-3B aircraft, and is to remain in effect until removed by BuWeps authorization.

CAUTION

- The use of M-124 Cartridges is not permitted, since the 2-11/16-inch diameter metal disc of the cartridge separates on ejection and strikes the lower fuselage and bomb bay area, endangering hydraulic lines and electrical wiring.
- If both the A-6 and B-4 cartridge ejectors are used, the A-6 ejector must be installed in the right-hand inboard row. A complete salvo cannot be accomplished if the LE-1834-1 ejector is installed in that row and LE-1200-1 ejectors are installed in any other row.

ILLUMINANT RELEASE SEQUENCE

The illuminant release sequence is the same for all illuminant configurations. The camera control system sends a pulse to the illuminant release system, which releases the four rows in the following sequence: left inboard row, left outboard row, right outboard row, right inboard row. If a bomb fails to release, the next pulse is immediately sent to the next available row in the sequence. If a cartridge fails to release, the next pulse is transferred to the next available cartridge in the ejector. After the normal electrical release is completed, the hung bombs are mechanically jettisoned. The cartridge ejectors cannot be jettisoned, and any cartridges which fail to fire are retained in the ejector.

NIGHT SYSTEM CONTROLS MASTER CONTROL PANEL

The master control panel (see figure 8-15) is used in night photography to supply power to the camera control system with the master power switch, and to supply the necessary V/H data. The scanner-computer mode switch is used in the COMPUTER position, and the altitude and knots thumb wheels are used to insert true altitude and ground speed values into the system.

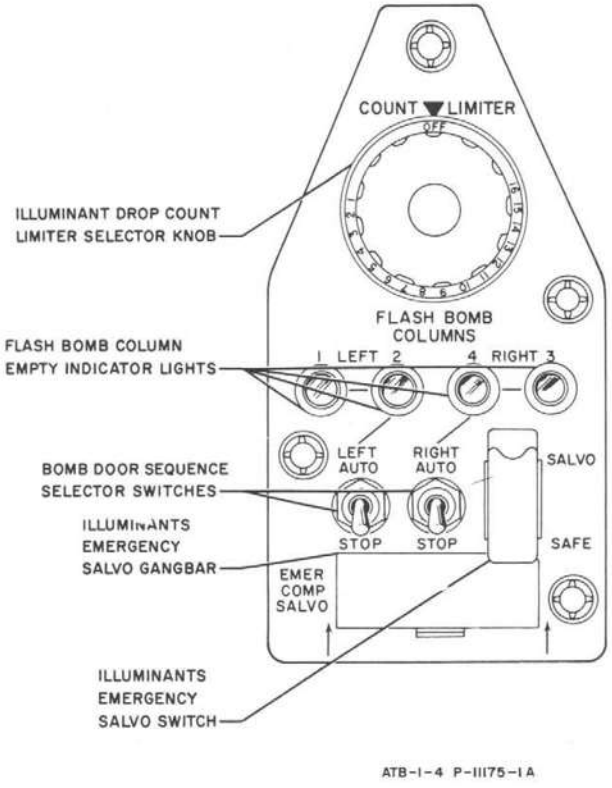


Figure 8-28A. Bomb Release Panel, Photo-Technician's Seat

ILLUMINANT CONTROL PANEL

The illuminant control panel, located directly below the camera control panels on the photo-navigator's instrument panel (see figure 8-16) is used to control the opening of the bomb bay doors, select the desired type of illuminant for release, and provide indications for the door cycling and illuminant release. The panel contains:

1. The illuminant system ready switch, a guarded two-position toggle switch which functions as a master armament switch. Actuation of the switch to the READY position opens the bomb bay doors and readies the illuminant release system circuitry.

2. The illuminant selector switch, a two-position lever locking toggle switch with positions marked CART and BOMB. This switch selects the type of illuminant to be released, either flash cartridges or bombs.

3. The bomb doors cycling indicator light, labeled S, a red press-to-test light, which comes on when the bomb bay doors are in cycle and goes out when the doors are either fully open and the release system circuitry is ready for a drop, or when the doors are fully closed.

4. The illuminant release-complete light, labeled F, a red press-to-test light which comes on to indicate that the last illuminant has been released from the bomb bay. The light goes out when the illuminant system ready switch is returned to the SAFE position.

5. The illuminant remaining counter, a subtractive resettable counter which is set to the total number of cartridges or bombs carried and shows the number of illuminants remaining during a release.

CAMERA CONTROL PANELS

Camera control panels, positions 8, 9, and 11, are used to program the cameras for night operation. Up to three positions may be used for night simultaneous photography; positions 8 and 9 are used for night sequential photography. The cameras are used at 90-degree depression angles only. When KA-40A or KA-46 cameras are used in night mode, exposure control must be turned full clockwise to DULL to assure full-open camera exposure.

CAMERA OPERATE SWITCHES

The camera operate switches are used to supply camera control system power to the illuminant release system after it has been readied by the illuminant system ready switch. Bomb or cartridge release is accomplished by actuating the desired operate switch to the ON position. The night positions used should all be programmed as the same mode, either OP 1 or OP 2 as desired

PHOTO-TECHNICIAN'S SEAT BOMB RELEASE PANEL

The bomb release panel (figures 8-1 and 8-28A), located on the inboard side of the photo-technician's seat, is used to control a normal bomb release and for emergency salvo of bombs or cartridges. The panel contains an illuminant drop count limiter selector, two bomb door sequence selector switches, an illuminants emergency salvo switch, an illuminants emergency salvo gang bar, and four flash bomb column empty indicator lights.

BOMB DROP COUNT LIMITER SELECTOR. The illuminant drop count limiter selector is a rotary selector knob with an OFF position and positions 1 through 16, permitting the selection of the desired number of bombs or cartridges to be released. If release is initiated when the illuminant drop counter limiter selector is in the OFF position, a full release of bombs or cartridges will occur, depending upon the type of illuminants installed and the position of the bomb door sequence selector switches.

FLASH BOMB COLUMNS EMPTY INDICATOR LIGHTS. The four flash bomb column empty indicator lights are red press-to-test lights which go out when the last, or top, bomb in each row is released to indicate that the row is empty.

BOMB DOOR SEQUENCE SELECTOR SWITCHES. The left bomb door sequence selector and right bomb door sequence selector switches are two-position toggle switches, with positions AUTO and STOP. The switches permit the selection of either a fully automatic release or a semi-automatic release of bombs only. If the switches are positioned to AUTO, acutation of the release system opens the left doors, releases the illuminants from the left side of the bay, then simultaneously closes the left doors and opens the right doors automatically, and at the same time transfers the release pulse to the right side of the bay. When the illuminants have been released from the right side of the bay the right doors close automatically. During a semi-automatic release with the switches in the STOP position, the left doors will open, illuminants will be released from the left side of the bay, and the left doors remain open and the release stops. Positioning the left bomb door sequence selector switch to AUTO then closes the left doors, opens the right doors, and transfers the release pulse to the right side and continues the release until all illuminants have been released from the right side of the bay. The right doors remain open until the right bomb door sequence selector switch is placed in the AUTO position. The use of a semi-automatic release permits the stationing of a crewmember in the camera compartment to observe the release through the window and to operate the manual bomb release controls in case any bombs fail to clear the airplane.

CAUTION

The bomb door sequence selector switches on the bomb release panel and station 306 are in parallel electrically. An automatic release can be made only when all switches are in the AUTO position. A switch in the STOP position at station 306 cannot be over-ridden by the AUTO position on the bomb release panel. Conversely, a switch in the STOP position on the bomb release panel cannot be over-ridden by the AUTO position at station 306.

ILLUMINANT EMERGENCY SALVO SWITCH. The illuminants emergency salvo switch is a guarded two-position toggle switch permitting either fully automatic or semiautomatic electrical salvo of illuminants in emergencies. With the bomb door sequence selector switches in AUTO a fully automatic salvo is accomplished by raising the guard and placing the switch in the SALVO position. With the bomb door sequence selector switches in the STOP position a semiautomatic salvo is made by positioning the switch to SALVO.

ILLUMINANTS EMERGENCY SALVO GANGBAR. This gangbar, located beneath the bomb door sequence selector and illuminants emergency salvo switches, permits the fully automatic salvoing of both sides of the bomb bay. After the illuminants emergency salvo switch guard is raised manually, the illuminants emergency salvo gangbar is raised, actuating both bomb door sequence selector and illuminants emergency salvo switches simultaneously.

CAMERA COMPARTMENT BOMB BAY CONTROL PANEL

The bomb bay control panel (figures 8-1 and 8-29) is located on the aft bulkhead of the camera compartment directly below the observation window and contains various switches used to control the illuminant release system and operate the bomb bay doors. The panel includes a stepper switch reset switch, stepper switch reset indicator light, bomb load selector knob, bomb door ground control override switch, bomb bay interior lights switch, illuminant release pulse indicator light, two illuminant door sequence selector switches, and the bomb doors manual control switch.

STEPPER SWITCH RESET SWITCH. The stepper switch reset switch (8, figure 8-29) is a two-position toggle switch used to reset the cartridge ejector or flash bomb release system relays prior to any ground test or inflight operation of the illuminant release system. The relays are reset by placing the switch in the RESET position. This switch, located below the observation window, is duplicated for ground crew use on the bomb bay control panel in the bomb bay.

STEPPER SWITCH RESET INDICATOR LIGHT. The stepper switch reset indicator light (9, figure 8-29) comes on when the stepper switch reset switch is placed in the RESET position and the relays have been reset. When the switch is released the light goes out, even though the relays are reset. This light is duplicated on the control panel in the bomb bay.

WARNING

It is imperative that the release system be reset before takeoff, since reset is impossible after extension of the landing gear oleos upon takeoff. Failure to reset the system makes illuminant release impossible, results in a mission abort, and also makes electrical salvo impossible, since the salvo pulse is channeled through the stepper relays.

ILLUMINANT LOAD SELECTOR KNOB. The illuminant load selector knob (7, figure 8-29) is a rotary two-position switch, with NORMAL and MIXED positions, used to select the desired load condition in the bomb bay. The knob is mechanically interconnected with the illuminant load selector knob on the control panel in the bomb bay, and is normally preset by the ground crew at the time the bomb bay is loaded. The NORMAL position is selected when the bomb bay illuminant load is all of one type, either all bombs or all cartridges. The MIXED position is selected when a mixed load is installed. The correct position of the knob should be checked as part of the normal photographic preflight check.

BOMB DOOR GROUND CONTROL OVERRIDE SWITCH. The bomb door ground control override switch (12, figure 8-29) is a two-position toggle switch, with positions labeled NORMAL and CLOSE DOORS. The switch is used by the flight crew to close the bomb bay doors in case the ground crew has failed to do so with the door operate switch in the left-hand wheelwell.

WARNING

The bomb door ground control override switch can be used to close the bomb bay doors from the camera compartment. The switch must not be used unless it is certain that all personnel are clear of the doors.

BOMB BAY INTERIOR LIGHTS SWITCH. The bomb bay interior lights switch (13, figure 8-29) is a three-position lever-locking toggle switch used to control the red lighting inside the bomb bay for inflight observation. The switch is labeled MOM-ON for momentary operation of the lights, OFF, and STAY ON for continuous light operation.

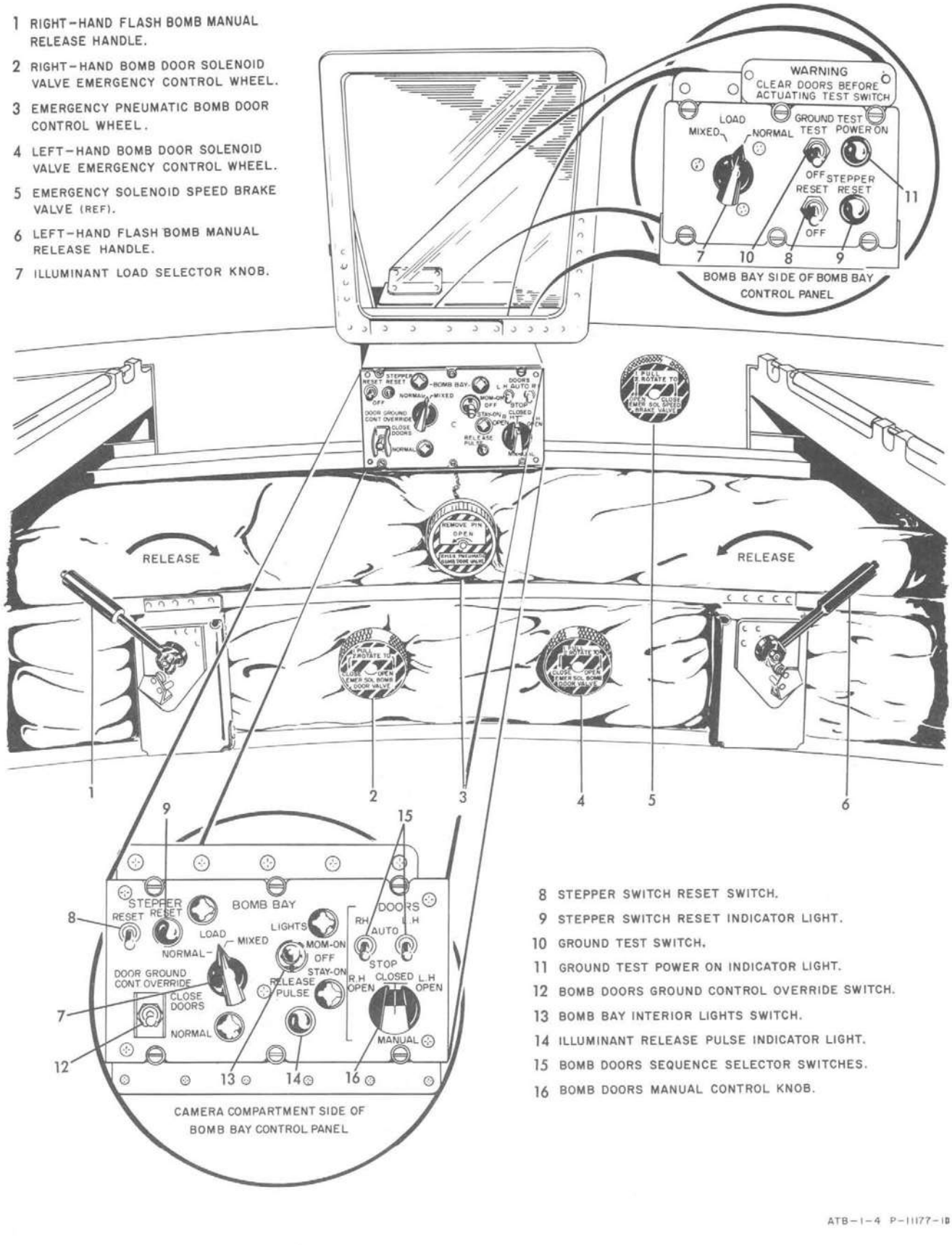


Figure 8-29. Camera Compartment Aft Bulkhead Panel Installation

ILLUMINANT RELEASE PULSE INDICATOR LIGHT. The illuminant release pulse indicator light (14, figure 8-29) comes on to indicate that a pulse has been sent to the system for illuminant release. It does not indicate that a bomb has been dropped, but only that a release pulse has been sent to the system. Visual observation through the window and monitoring of the flash bomb columns empty indicator lights are necessary to insure that all bombs have released.

BOMB BAY CONTROL PANEL, DOORS SECTION. The doors section of the bomb bay control panel includes two bomb door sequence selector switches (15, figure 8-29) and the manual door switch (16, figure 8-29).

BOMB DOORS SEQUENCE SELECTOR SWITCHES. The right-hand bomb door sequence selector and the left-hand bomb door sequence selector switches (15, figure 8-29) duplicate the functions of the bomb door sequence selector switches on the photo-technician's seat bomb release panel, and are intended for use by the observer stationed in the camera compartment during illuminant release to control the mode of operation of the bomb bay doors.

Note

The positions of the bomb door sequence selector switches on the bomb bay control panel are reversed from those on the photo-technician's seat bomb release panel. The crew must be aware that the left-hand switch is the right-hand bomb door sequence selector switch and the right-hand switch is the left-hand bomb door sequence selector switch before attempting to operate them in flight.

BOMB DOORS MANUAL CONTROL SWITCH. This is a rotary three-position switch (16, figure 8-29), labeled RH OPEN-CLOSED-LH OPEN, which allows the crew manually to open and close the bomb bay doors electrically for mechanical jettison of a hung bomb.

WARNING

Verify that the bomb doors manual control knob is in the CLOSED position prior to flight, to prevent inadvertent automatic opening of the doors upon becoming airborne.

BOMB BAY EMERGENCY CONTROLS

The controls for emergency bomb jettison and door operation are located on the aft bulkhead of the camera compartment below the bomb bay control panel (see figure 8-29). The controls are two flash bomb manual release handles, two bomb door solenoid valve emergency controls, and the emergency pneumatic bomb door control knob.

FLASH BOMB MANUAL RELEASE HANDLES. The flash bomb manual release handles (1 and 6, figure 8-29) are used to jettison mechanically any bombs which have failed to release electrically. When the bomb bay doors have been opened, the handles are rotated to release the bombs. The handles are mechanically detented to prevent inadvertent rotation, and pushbuttons on the ends must be depressed before the handles can be rotated. Each lever actuates two rows of bombs, jettisoning any that remain attached to the shackles. The handle on the right side of the aft camera compartment bulkhead controls the same side of the bay; the left handle controls the same side of the bay.

WARNING

The flash bomb manual release handles will release bombs regardless of the position of the bomb bay doors. It is imperative that the proper bomb bay doors be opened before the respective manual release handle is actuated.

Note

If the handles fail to rotate because of malfunction of the push buttons, reach below the lever mounting plate and release the locking arm from its notched detent.

BOMB BAY DOOR SOLENOID VALVE EMERGENCY CONTROL. Two rotary wheels (2 and 4, figure 8-29) are located on the aft camera compartment bulkhead below the observation window. The wheels are used to open and close the bomb bay doors when electric power is not available, but utility hydraulic pressure is still available. These control wheels are labeled 1. PULL, 2. ROTATE TO, CLOSE, OPEN. Manual actuation of the wheels operates the solenoid valves controlling the hydraulic operation of the doors. The wheel at the right controls the right set of doors; the left-hand wheel controls the left doors.

EMERGENCY PNEUMATIC BOMB DOOR CONTROL. If neither electrical nor hydraulic power is available the bomb bay doors may be opened with the emergency pneumatic bomb door control wheel (3, figure 8-29). Removal of a safety pin, located directly behind the knob, permits counterclockwise rotation of the valve

to the OPEN position and opens both sets of doors with 3000 psi of compressed air.

WARNING

The bomb bay doors cannot be closed in flight after being opened pneumatically, and must remain open until the aircraft has landed and the air has been bled from the system. To prevent decrease in range, aircraft buffet, and faulty bomb separation because of all four doors being open, the aircraft must be close to the base and slowed to a maximum of 250 KIAS before pneumatic door operation is attempted.

BOMB BAY CONTROL, BOMB BAY

The bomb bay control panel for ground crew use is located on the forward bulkhead of the bomb bay directly below the observation window (figures 8-1 and 8-29). The panel is part of the same unit structure as the bomb bay control panel in the camera compartment, and is wired in parallel with it. The panel contains an illuminant load selector knob, stepper switch reset switch, stepper switch reset indicator light, ground test switch, and a ground test power-on indicator light.

WARNING

Because of the complexities of the illuminant release system and its inherent hazards, it is imperative that both flight and ground crews be thoroughly familiar with all switches connected with the system, regardless of their primary use. Flight crews must be familiar with the functions of the ground crew bomb bay control panel, since, under certain conditions described later, an inadvertent illuminant release may occur if power is applied to the aircraft or camera control systems.

ILLUMINANT LOAD SELECTOR SWITCH. This switch is mechanically interconnected with the illuminant load selector switch in the camera compartment, and has the same functions. It is set to the proper load configuration after the illuminants are installed in the bay.

STEPPER SWITCH RESET SWITCH. This switch is electrically in parallel with the stepper switch reset switch in the camera compartment and has the same functions. It is used to reset the relays after ground test operations.

STEPPER SWITCH RESET INDICATOR LIGHT. This light is wired in parallel with its counterpart in the camera compartment, and has the same function.

GROUND TEST SWITCH. The ground test switch is a momentary toggle switch, labeled GROUND TEST-OFF, which is used to bypass the landing gear interlock system so that inflight operation of the illuminant release system may be simulated by the ground crew as a test of the system before illuminants are installed.

WARNING

- The bomb-bay doors must be clear of personnel and closed with the wheelwell switch before the ground test switch is actuated.
- The ground test switch is to be used only for test purposes of the system. The switch must under no circumstances be actuated after illuminants have been installed in the bay.

Since the ground test switch is spring loaded to OFF, it must be held in the GROUND TEST position by ground crew personnel. A crewmember stands on the center structure inside the bomb bay to operate the switch, and at the same time monitors the cycling of the bomb bay doors and the clicking of the empty bomb shackles or cartridge ejectors to test system operation.

WARNING

The ground test switch should be manually operated. It must never be wired or secured in any manner into the GROUND TEST position, because of the possibility of forgetting it, and the subsequent hazards which can occur when power is applied to the aircraft. Flight and ground crews must ensure that this switch is in the OFF position before entering the aircraft.

GROUND TEST POWER ON INDICATOR LIGHT. The ground test power on indicator is a red warning light located next to the ground test switch. The light warns personnel that the illuminant release system is in a ready condition and will start operating immediately upon actuation of the ground test switch. The ground

test switch should never be actuated, nor should illuminants be loaded, until the power on light is off.

WARNING

- If the power on indicator light is on, check that switches are positioned as follows:

  Illuminant system ready switch .... SAFE

  Master control power switch ..... OFF

  Camera operate switches ..... OFF

  Camera program switches, positions 8, 9, and 11 ..... OFF

  Salvo switch ..... SAFE

- With all cockpit release system switches in OFF or SAFE position, ground test power on indicator light off, and bomb bay doors previously opened with door operate switch in the left wheelwell, actuation of ground test switch places release system in an inflight condition and doors will immediately close. Door closing speed is approximately 1-3/4 seconds, and any personnel not clear of doors would receive fatal injuries.

- With all cockpit release system switches in OFF or SAFE position, bombs or cartridges loaded in the bay, and salvo-safe switch in SALVO position, actuation of the ground test switch will open doors and immediately salvo all illuminants.

- With illuminant system ready switch in the READY position and bomb bay doors closed with left wheelwell door operate switch, actuation of ground test switch will open doors, injuring any personnel not clear of them.

- If bomb bay doors are open, safety locks must be installed before entering bomb bay to check its condition or to operate the ground test system.

- When ground test power on indicator light is on, extreme care must be taken to avoid inadvertent operation of the ground test switch. Loading or unloading of illuminants must not be attempted when this light is on.

BOMB BAY DOORS OPEN LIGHT

A series of switches are provided on the bomb bay doors to operate the bomb doors open light. This light is located on the photo-navigator's instrument panel directly above the stations control panels. It lights when power is applied to the aircraft to indicate that the bomb bay doors are not completely closed, or that the cartridge ejectors are not properly seated.

BOMB BAY DOORS SWITCH LEFT HAND WHEELWELL

With electrical and hydraulic power available to the aircraft, the bomb bay doors can be opened from the ground using the bomb bay doors switch, located in the left-hand wheelwell (see figure 8-30). The switch is a guarded two-position toggle switch installed in the left wheelwell inboard of the left main gear door limit switch.

NORMAL ILLUMINANT RELEASE

NORMAL BOMB RELEASE

FULLY AUTOMATIC. After all necessary preflight and pretarget adjustments have been made, as described previously, the bomb door sequence selector switches are placed in the AUTO position before reaching the target. The left bomb bay doors are opened with the illuminant system ready switch, and the bomb release is begun with the camera operate switches. The bombs are released at the time interval preset at the central computer control panel, the left inboard row first and then the left outboard. As each row of bombs is released, its corresponding flash bomb column empty indicator light goes off. When the left side of the bay is empty, the left doors will close, and simultaneously the right doors will open. As the right doors open, the release pulse is transferred to the right outboard row, beginning bomb release. During door cycling the bomb doors cycling indicator (S) light comes on, then goes off when the right doors are fully open. When the right outboard row then the right inboard row of bombs are empty, their corresponding flash bomb column empty indicator lights go off, the right doors close automatically, and the illuminants release-complete (F) light comes on. If all bombs have successfully released, the shutdown procedures described previously are followed. If a bomb fails to release, the pulse immediately transfers to the next row of bombs, and the release sequence continues normally, from left to right. During fully automatic drops the normal sequence continues until all available rows of bombs have been dropped, regardless of any hung bombs. If hung bombs remain in the bay after completion of the normal release sequence, the doors are opened with the bomb doors manual control knob, or by one of the emergency methods, and the bombs are jettisoned mechanically.

SEMIAUTOMATIC. After all necessary preflight and pretarget adjustments have been made, the bomb door sequence selector switches are positioned to STOP and the left doors are opened with the illuminant system ready switch. The camera operate switches initiate bomb release from the left inboard row then the left

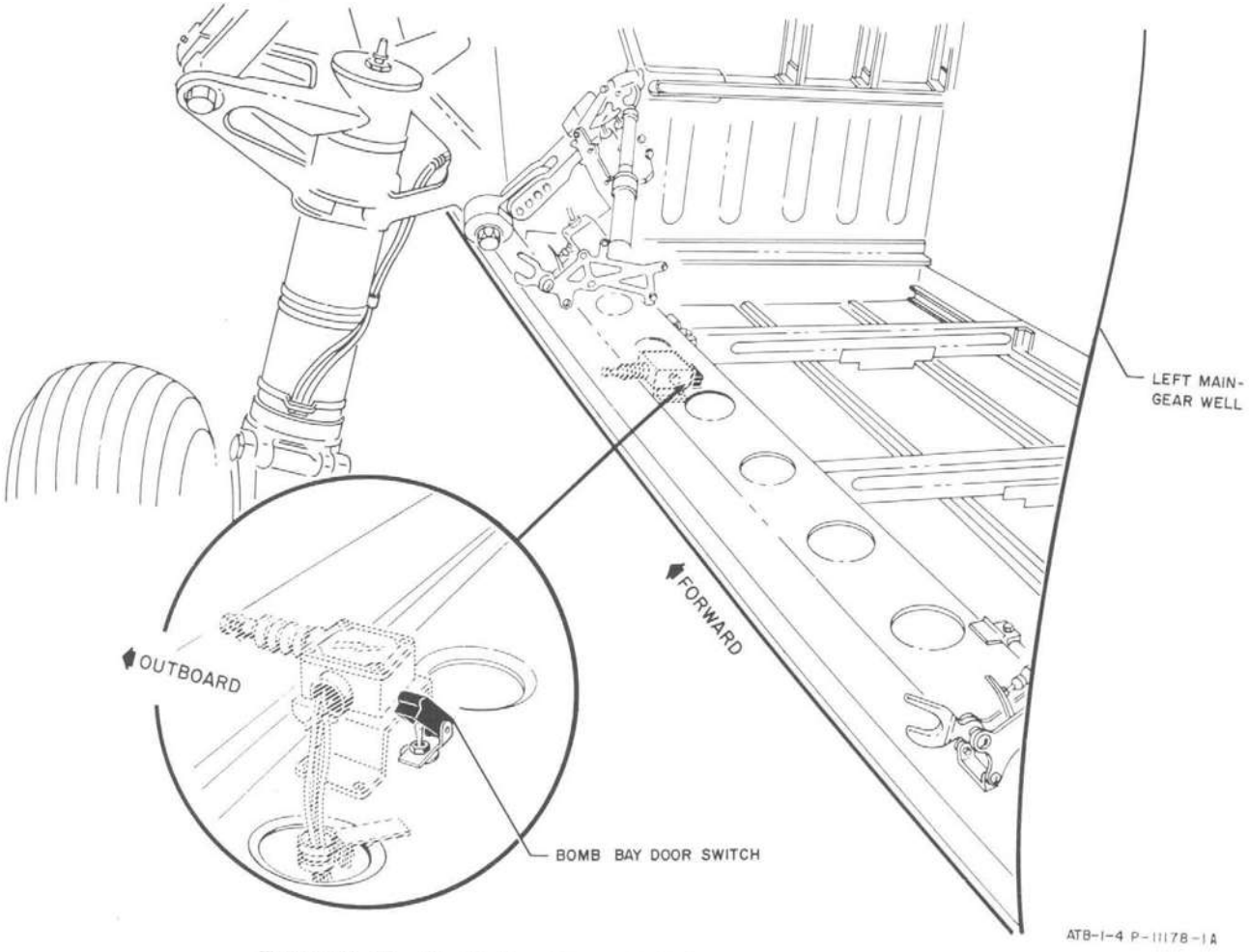


Figure 8-30. Bomb-Bay Doors Switch, Left-Hand Wheelwell

outboard row. After all bombs have been released from the left side of the bay the release stops and the left doors remain open. The left bomb door sequence selector switch is then placed in the AUTO position, which closes the left doors, opens the right doors, and transfers the release pulse to the right side of the bay. When all bombs have been dropped from the right side of the bay the right doors remain open until the right bomb door sequence selector switch is positioned to AUTO. The right doors close and, if no hung bombs remain, normal shutdown procedures are followed.

Note

During a semiautomatic bomb release, actuation of the left bomb door sequence selector switch to AUTO must be accomplished between pulses to avoid clipping a pulse and causing a bomb to hang up and reducing camera coverage. Normally, if the left bomb door sequence selector switch is actuated immediately after the last bomb clears the left side of the bay, the transfer will be accomplished between pulses.

If a bomb hangs up in the left side of the bay during a semiautomatic release, the crew has two options. The release can be continued into the right bay by the method described above until it is completed, and the hung bomb released mechanically. A second method is for a crew member, stationed at the aft bulkhead of the camera compartment, to jettison the hung bomb before allowing the release to continue into the right side of the bay. Hung bombs in the right side of the bay can be released either before the right doors are closed with the right bomb door sequence selector switch, or after the release sequence is complete, by the same method used during a fully automatic release.

NORMAL CARTRIDGE RELEASE

The necessary preflight and pretarget settings are made in the same manner as for a bomb release, except that the illuminants selector switch must be placed to CART. The photo-technician's seat bomb release panel is not used, except for the illuminants emergency salvo switch. The illuminant system ready switch is positioned to READY to open the doors, and, during

a cartridge release, all four doors open simultaneously. Cartridge ejection is initiated with the camera operate switches and the cartridges are fired in train at the predetermined time intervals. The firing sequence is the same as for bombs; left inboard ejector, left outboard ejector, right outboard ejector, and right inboard ejector. When all cartridges have been fired, the doors close automatically, and the normal shutdown procedures are followed. If a cartridge fails to fire, the next release pulse transfers to the next available cartridge in the ejector, and the normal sequence continues. The illuminant remaining counter on the illuminant control panel indicates the number of cartridges remaining in the bay. Cartridge ejection can be stopped at any time before the release is complete by turning the camera operate switches OFF. The doors do not close automatically, but must be closed by returning the illuminant system ready switch to SAFE.

Note

Unlike a bomb release, it is not possible to determine whether a cartridge has failed to fire during cartridge ejection. The flash bomb column empty indicator lights are inoperative when cartridge ejectors are installed, and visual observation is ineffective. Operational experience indicates that those cartridges that fail to eject will remain in the ejectors in a safe condition.

MIXED LOAD NORMAL RELEASE

The preflight settings and adjustments made for bombs and cartridges apply to a mixed load configuration, except that the illuminant load selector knob must be positioned to MIXED. The left side of the bomb bay is loaded with bombs, while two cartridge ejectors are contained in the right side.

The illuminant selector switch is positioned to either CART or BOMB, whichever is to be released first. The bomb door sequence selector switches are positioned to AUTO or STOP, as desired. The count limiter is set to the desired number of illuminants to be dropped. Actuation of the illuminant system ready switch to READY opens the left-hand doors with the illuminant selector switch at the BOMB positions, or the right-hand doors with the switch positioned to CART. Actuation of the camera operate switches to ON begins the release sequence, which continues in the normal manner. The bomb release may be either fully automatic or semiautomatic.

EMERGENCY ILLUMINANT RELEASE

ELECTRICAL BOMB SALVO

Electrical bomb salvo procedures provide the means for jettisoning the bombs rapidly and without jeopardizing successful return and landing. Electrical bomb salvo may be either fully automatic or semiautomatic. The count limiter is bypassed during salvo operations.

AUTOMATIC SALVO

1. Illuminant load selector knob . . . . . NORMAL

2. Illuminant selector switch . . . . . BOMB

3. Raise guard on illuminants emergency salvo switch.

4. Raise illuminants emergency salvo gangbar to full up position. Two bomb doors sequence selector switches and illuminant emergency salvo switch will be actuated simultaneously.

Note

The illuminants emergency salvo switch can be actuated manually rather than with the illuminants emergency salvo gangbar. When this is done, both bomb doors sequence selector switches must then be positioned to AUTO to accomplish a fully automatic salvo.

5. Normal door opening sequence is followed, left doors first then right doors. Bombs are released at approximately 200 millisecond intervals.

Note

A delay is provided after the release of the last bomb in either side of the bay to allow the bomb to clear the aircraft before the doors close. The time required for a complete automatic salvo is approximately 10 seconds.

6. Return illuminants emergency salvo switch to . . . . . SAFE

SEMIAUTOMATIC SALVO

1. Illuminant load selector knob . . . . . NORMAL

2. Illuminants selector switch . . . . . BOMB

3. Bomb doors sequence selector switches. STOP

4. Raise guard on illuminants emergency salvo switch.

5. Actuate illuminants emergency salvo switch manually to . . . . . SALVO

6. Left doors open, bombs are salvoed at 200 millisecond intervals, left doors remain open.

7. Left bomb doors sequence selector switch . . . . . AUTO

8. Left doors close, right doors open, bombs are salvoed from the right side, and the right doors remain open.

9. Right bomb doors sequence selector switch . . . . . AUTO

10. Right doors close.

11. Return illuminants emergency salvo switch to . . . . . SAFE

BOMB RELEASE FAILURE DURING SALVO

If a bomb fails to release during the fully automatic electrical salvo sequence, it is jettisoned after the entire salvo sequence has been completed, following the manual bomb release procedures. If a bomb fails to release from the left side of the bay during semi-automatic salvo, it may be jettisoned manually before the salvo sequence is continued into the right side of the bay, or it may be jettisoned after the entire salvo sequence has been completed.

Note

Salvo time will be greatly increased by the amount of time required to jettison hung bombs manually.

ELECTRICAL CARTRIDGE SALVO

1. Illuminant load selector knob . . . . . NORMAL

2. Illuminant selector switch . . . . . CART

3. Raise guard on illuminants emergency salvo switch.

4. Illuminants emergency salvo switch . . SALVO

Note

The illuminants emergency salvo switch may be actuated either manually or with the illuminants emergency salvo gangbar.

5. All four doors will open simultaneously, cartridges will be fired in rapid train from the ejectors, following the usual left-to-right ejection sequence. When salvo is complete all four doors will close automatically.

6. Return illuminants emergency salvo switch to . . . . . SAFE

MIXED LOAD SALVO

1. Illuminant load selector knob . . . . . MIXED

2. Illuminant selector switch . . . CART or BOMB

3. Left bomb doors sequence selector switch . . . . . AUTO

4. Illuminants emergency salvo switch . . SALVO

WARNING

Loads of M112 photoflash cartridges may not be salvoed except under emergency flight conditions.

Note

The use of the bomb doors sequence selector switches is unnecessary during the cartridge ejection portion of a mixed load salvo, as it is during normal cartridge release. However, the left bomb doors sequence selector switch must be actuated to control the left doors when the illuminants emergency salvo switch is actuated. The use of the illuminants emergency salvo gangbar to actuate the bomb doors sequence selector switches and the illuminants emergency salvo switch will provide a more rapid method of automatic mixed load salvo.

5. Left doors open, bombs are salvoed, left doors close and right doors open, cartridges are salvoed in rapid train, both ejectors operating simultaneously. Right doors close automatically when salvo is complete.

6. Return illuminants emergency salvo switch to . . . . . SAFE

SALVO DURING NORMAL MIXED LOAD RELEASE, BOMB PORTION

If the left bomb doors sequence selector switch is actuated to AUTO and the illuminants emergency salvo switch to SALVO during the bomb release portion of a mixed load release, the release pulses increase to about five per second, and the remainder of the sequence follows the usual mixed load salvo sequence.

SALVO DURING NORMAL MIXED LOAD RELEASE, CARTRIDGE PORTION

If the salvo procedure is initiated during the cartridge ejection portion of a normal mixed load release, the

cartridge ejection stops, the right doors close, and the left doors open. Bombs are then released from the left side of the bay at approximately five per second. When the left side of the bay is empty the left doors close, the right doors open, and the cartridges are ejected from both ejectors simultaneously in rapid train. When all the cartridges have been ejected, the right doors close automatically. The illuminants emergency salvo switch and the illuminants system ready switch are both returned to the SAFE position, and the camera operate switches are turned OFF.

MANUAL BOMB RELEASE

Any bombs which fail to release during a normal bomb or mixed load release are mechanically jettisoned with the manual bomb release handles located on the aft bulkhead of the camera compartment. The handles are mechanically detented and the pushbuttons on the ends of the handles must be depressed to release the handles from their detents. The handles are then rotated to release the bombs from their shackles. Manual bomb release may be accomplished after the completion of the full normal release or, during a semiautomatic release, after the release from the left side of the bay before the release continues into the right side. Manual bomb release procedures are as follows after completion of release:

1. Illuminants system ready switch . . . . . SAFE

2. Determine through observation window which row contains hung bombs.

3. Open applicable set of doors, using either bomb doors manual control switch, bomb doors solenoid valve emergency control wheel, or emergency pneumatic bomb doors control wheel, depending on situation.

4. Depress pushbutton and rotate manual bomb release handles fully.

5. When all hung bombs have been released, close the doors.

Note

If doors have been opened pneumatically, they cannot be closed.

If mechanical jettisoning of bombs is desired during a semiautomatic release, the illuminants system ready switch is not returned to SAFE, since the positioning of the left bomb doors sequence selector switch to STOP keeps the left doors open and stops the normal release.

WARNING

The manual flash bomb release levers will release bombs regardless of the position of the bomb bay doors. It is imperative that the proper bomb bay doors be opened before the respective manual release handle is actuated.

EMERGENCY DOOR OPERATION

With the normal release sequence completed and the illuminants system ready switch in the SAFE position, the bomb bay doors may be opened to jettison hung bombs by three methods. With both electrical and hydraulic power available, the doors are opened and closed with the three-position bomb doors manual control knob, on the camera compartment bomb bay control panel. The switch is labeled RH OPEN-CLOSED-LH OPEN. If only hydraulic power is available, the doors are opened and closed with the left or right bomb doors solenoid valve emergency control wheel. Rotation of these controls mechanically positions the solenoid-operated hydraulic door valves, when electrical power is not available.

CAUTION

During manual bomb release, when hung bombs are to be jettisoned from both sides of the bomb bay, the left- and right-doors should be opened separately, to decrease aircraft buffet and faulty bomb separation.

If neither electrical nor hydraulic power is available and hung bombs remain in the bomb bay, the doors must be opened pneumatically. Rotating the emergency pneumatic bomb doors control wheel to the OPEN position actuates an air bottle which applies 3000 psi of compressed air and opens both sets of doors simultaneously.

Note

When the doors are opened pneumatically they remain open for the remainder of the flight. To prevent excessive decrease in range, airplane buffet, and faulty bomb separation with all four doors open, the airplane should be slowed to a maximum airspeed of 250 KIAS, and be sufficiently close to the intended landing point to permit a successful return.

NORMAL NIGHT PHOTOGRAPHIC RUN WITH CARTRIDGES

The night pretarget check must be complete before the night photographic run is entered, as follows:

1. Acquire target with radar presentation in 150° SEARCH (see figure 8-24).

2. After acquisition and initial lineup, determine ground speed, set E V/H.

3. As soon as possible, switch presentation to 25° SEARCH.

4. Run slant range marker up to target.

5. When target is positively identified and range marker is on target, switch to EXPAND.

6. Program cameras develop target return, and decrease slant range continuously to keep target positioned in the scope.

7. From tables 8-14 through 8-18, determine drop point and number of cartridges that will be dropped.

Example: At 1000-foot altitude and for 400-knot, 10-exposure run with 2-second delay cartridges, drop point is 2700 feet (slant range distance) from target.

8. Approaching target, open bomb bay doors by setting READY/SAFE switch to READY.

Note

A 100-pound increase in fuel flow will normally compensate for drag of open doors (approximately 10-knot ground speed loss).

9. When slant range nears drop point, set drop point slant range distance in window (2.7 for item 7 Example).

10. In scope, observe target approaching range line.

11. Commence dropping when target return touches range line by actuating OP 1 or OP 2 switch.

CAMERA CONFIGURATIONS (NIGHT OPERATION)

The procedures and settings necessary to operate the camera and illuminant release systems in the specific night configurations are given in tables 8-19 through 8-24.

The procedures listed for night simultaneous operation apply to an all-bomb installation or a mixed load configuration equally. The procedures listed for night sequential operation apply to an all-cartridge installation, although the type of ejector used is not designated.

Preflight

1. Camera flash detector windows . . . . . CLEAN
2. Camera doors . . . . . CLOSED
3. Illuminant loading . . . . . COMPLETE
4. Master power . . . . . OFF
5. OP1/OP2/VF stab/radar . . . OFF
6. Illuminant control panel
   a. Ready/safe switch . . . . SAFE
   b. Illuminant counter . . . . SET
   c. Load selector switch . . CART/BOMBS
7. Bomb release panel
   a. Count limiter . . . . . OFF
   b. Salvo/safe switch . . . . . SAFE
   c. Auto/stop switch . . . . . AUTO/STOP
8. Bomb bay control panel
   a. Load selector switch . . AS DESIRED
   b. Manual door control . . . CLOSED
   c. Auto/stop switches . . . . AUTO/STOP
9. Central computer 501-BC
10. "J" boxes . . . . . SEQUENTIAL/SIMULTANEOUS
11. RDA . . . . . SET
12. Mounts
    a. Depression angle . . . . . SET
    b. Potentiometer . . . . . SET
    c. Azimuth . . . . . LOCKED
    d. Stabilization . . . . . CAGED
    e. IMC . . . . . LOCKED
    f. Cables . . . . . FREE

TABLE 8-14. NIGHT PHOTO DROP DATA

ALTITUDE (FEET)	3000				4000				5000				6000				7000				8000				
EXPOSURES/RUN	1	3	5		1	3	5		1	3	5		1	3	5		1	3	5		1	3	5		
PERCENT OVERLAP				60				60				60				60				60				60	
																									GROUND SPEED (K)
	40.7	39.4	38.1	1.3	40.6	38.8	37.0	1.8	40.4	38.2	36.0	2.2	40.1	37.5	34.9	2.6	39.7	36.6	33.5	3.1	39.4	35.8	32.2	3.6	400
	43.1	41.7	40.3	1.4	42.9	41.0	39.1	1.9	42.7	40.4	38.1	2.3	42.4	39.6	36.8	2.8	42.1	38.8	35.5	3.3	41.7	38.0	34.3	3.7	380
	45.8	44.3	42.8	1.5	45.6	43.6	41.6	2.0	45.3	42.8	40.3	2.5	45.0	42.0	39.0	3.0	44.7	41.2	37.7	3.5	44.2	40.3	36.4	3.9	360
	48.7	47.1	45.5	1.6	48.5	46.4	44.3	2.1	48.2	45.6	43.0	2.6	47.9	44.8	41.7	3.1	47.5	43.8	40.1	3.7	47.0	42.8	38.6	4.2	340
	52.0	50.3	48.6	1.7	51.8	49.6	47.4	2.2	51.5	48.7	45.9	2.8	51.2	47.9	44.6	3.3	50.8	46.9	43.0	3.9	50.3	45.9	41.5	4.4	320
	55.7	53.9	52.1	1.8	55.4	53.0	50.6	2.4	55.2	52.2	49.2	3.0	54.8	51.2	47.6	3.6	54.3	50.2	46.1	4.1	53.8	49.1	44.4	4.7	300
	59.9	58.0	56.1	1.9	59.7	57.2	54.7	2.5	59.4	56.2	53.0	3.2	59.0	55.2	51.4	3.8	58.5	54.1	49.7	4.4	58.0	52.9	47.8	5.1	280
	64.8	62.8	60.8	2.0	64.6	61.9	59.2	2.7	64.3	60.9	57.5	3.4	63.9	59.8	55.7	4.1	63.4	58.6	53.8	4.8	62.8	47.3	51.8	5.5	260

NOTES

- Data for Mark 123 and Mark 112 flash cartridges, 4-second fuse, and time from 5 miles to target.
- With 2-sec. fuse, add 2 sec. to time to target.
- With 6-sec. fuse, subtract 2 sec. from time to target.
- Enter table with ground speed. Read elapsed time (from 5 miles to target) to drop point.
- Example: At 5000-foot altitude and for 300-knot. 5-exposure run, elapsed time is 49.2 seconds.

TABLE 8-15. CONVERSION DATA FOR NIGHT PHOTO RUN AT 1000 FEET

TIME BETWEEN 5 NM MARKERS	G/S	1 SEC. DELAY				2 SEC. DELAY				SLANT RANGE (X 1000 FEET)
		5EX	7EX	10EX	15EX	5EX	7EX	10EX	15EX	
72.1	250	1.4	1.7	1.9	2.7	1.8	2.0	2.3	3.1	
69.2	260	1.4	1.7	1.9	2.7	1.8	2.0	2.3	3.1	
66.7	270	1.5	1.7	1.9	2.7	1.8	2.1	2.3	3.2	
64.3	280	1.5	1.7	2.0	2.8	1.8	2.1	2.4	3.2	
62.3	290	1.5	1.7	2.0	2.8	1.9	2.1	2.4	3.2	
60.0	300	1.5	1.7	2.0	2.8	1.9	2.2	2.4	3.3	
58.2	310	1.5	1.7	2.0	2.8	1.9	2.2	2.5	3.3	
56.2	320	1.5	1.8	2.0	2.8	2.0	2.2	2.5	3.3	
54.5	330	1.5	1.8	2.0	2.8	2.0	2.3	2.5	3.4	
53.0	340	1.5	1.8	2.0	2.9	2.0	2.3	2.6	3.4	
51.5	350	1.6	1.8	2.1	2.9	2.0	2.3	2.6	3.4	
50.0	360	1.6	1.8	2.1	2.9	2.1	2.3	2.6	3.5	
48.7	370	1.6	1.8	2.1	2.9	2.1	2.4	2.6	3.5	
47.4	380	1.6	1.8	2.1	2.9	2.1	2.4	2.7	3.5	
46.2	390	1.6	1.9	2.1	2.9	2.2	2.4	2.7	3.6	
45.1	400	1.6	1.9	2.1	3.0	2.2	2.5	2.7	3.6	
44.0	410	1.6	1.9	2.1	3.0	2.2	2.5	2.8	3.6	
43.0	420	1.6	1.9	2.2	3.0	2.3	2.5	2.8	3.7	
42.0	430	1.7	1.9	2.2	3.0	2.3	2.6	2.8	3.7	
41.0	440	1.7	1.9	2.2	3.0	2.3	2.6	2.9	3.7	
40.0	450	1.7	1.9	2.2	3.0	2.3	2.6	2.9	3.8	

TABLE 8-16. CONVERSION DATA FOR NIGHT PHOTO RUN AT 2000 FEET

TIME BETWEEN 5 NM MARKERS	G/S	1 SEC. DELAY				2 SEC. DELAY				SLANT RANGE (X 1000 FEET)
		5EX	7EX	10EX	15EX	5EX	7EX	10EX	15EX	
72.1	250	2.6	3.0	3.5	5.0	2.9	3.3	3.8	5.4	
69.2	260	2.6	3.0	3.5	5.1	2.9	3.3	3.8	5.5	
66.7	270	2.6	3.0	3.5	5.1	2.9	3.4	3.9	5.5	
64.3	280	2.6	3.0	3.5	5.1	2.9	3.4	3.9	5.5	
62.3	290	2.6	3.0	3.5	5.1	3.0	3.4	3.9	5.6	
60.0	300	2.6	3.1	3.5	5.1	3.0	3.5	4.0	5.6	

TABLE 8-16. CONVERSION DATA FOR NIGHT PHOTO RUN AT 2000 FEET (Continued)

TIME BETWEEN 5 NM MARKERS	G/S	1 SEC. DELAY				2 SEC. DELAY				SLANT RANGE (X 1000 FEET)
		5EX	7EX	10EX	15EX	5EX	7EX	10EX	15EX	
58.2	310	2.6	3.1	3.5	5.1	3.0	3.5	4.0	5.6	
56.2	320	2.7	3.1	3.6	5.1	3.0	3.5	4.0	5.6	
54.5	330	2.7	3.1	3.6	5.2	3.1	3.5	4.0	5.7	
53.0	340	2.7	3.1	3.6	5.2	3.1	3.6	4.1	5.7	
51.5	350	2.7	3.1	3.6	5.2	3.1	3.6	4.1	5.7	
50.0	360	2.7	3.1	3.6	5.2	3.1	3.6	4.1	5.8	
48.7	370	2.7	3.1	3.6	5.2	3.2	3.7	4.2	5.8	
47.4	380	2.7	3.2	3.6	5.2	3.2	3.7	4.2	5.8	
46.2	390	2.7	3.2	3.7	5.3	3.2	3.7	4.2	5.9	
45.1	400	2.7	3.2	3.7	5.3	3.2	3.7	4.3	5.9	
44.0	410	2.8	3.2	3.7	5.3	3.3	3.7	4.3	5.9	
43.0	420	2.8	3.2	3.7	5.3	3.3	3.8	4.3	6.0	
42.0	430	2.8	3.2	3.7	5.3	3.3	3.8	4.3	6.0	
41.0	440	2.8	3.2	3.7	5.3	3.4	3.8	4.4	6.0	
40.0	450	2.8	3.3	3.7	5.4	3.4	3.9	4.4	6.1	

TABLE 8-17. CONVERSION DATA FOR NIGHT PHOTO RUN AT 3000 FEET

TIME BETWEEN 5 NM MARKERS	G/S	2 SEC. DELAY				4 SEC. DELAY				SLANT RANGE (X 1000 FEET)
		5EX	7EX	10EX	15EX	5EX	7EX	10EX	15EX	
72.1	250	4.0	4.6	5.4	7.8	4.6	5.3	6.1	8.5	
69.2	260	4.0	4.7	5.4	7.8	4.7	5.4	6.1	8.6	
66.7	270	4.0	4.7	5.4	7.8	4.7	5.4	6.2	8.7	
64.3	280	4.1	4.7	5.5	7.8	4.8	5.5	6.3	8.7	
62.3	290	4.1	4.8	5.5	7.9	4.8	5.6	6.3	8.8	
60.0	300	4.1	4.8	5.5	7.9	4.9	5.6	6.4	8.9	
58.2	310	4.1	4.8	5.5	7.9	4.9	5.7	6.4	8.9	
56.2	320	4.2	4.8	5.6	8.0	5.0	5.7	6.5	9.0	
54.5	330	4.2	4.9	5.6	8.0	5.0	5.8	6.6	9.0	
53.0	340	4.2	4.9	5.6	8.0	5.1	5.8	6.6	9.1	
51.5	350	4.2	4.9	5.6	8.1	5.1	5.9	6.7	9.2	
50.0	360	4.3	4.9	5.7	8.1	5.2	5.9	6.7	9.2	

TABLE 8-17. CONVERSION DATA FOR NIGHT PHOTO RUN AT 3000 FEET (Continued)

TIME BETWEEN 5 NM MARKERS	G/S	2 SEC. DELAY				4 SEC. DELAY				SLANT RANGE (X 1000 FEET)
		5EX	7EX	10EX	15EX	5EX	7EX	10EX	15EX	
48.7	370	4.3	5.0	5.7	8.1	5.3	6.0	6.8	9.3	
47.4	380	4.3	5.0	5.7	8.2	5.3	6.1	6.9	9.4	
46.2	390	4.3	5.0	5.8	8.2	5.4	6.1	6.9	9.4	
45.1	400	4.4	5.0	5.8	8.2	5.4	6.2	7.0	9.5	
44.0	410	4.4	5.1	5.8	8.3	5.5	6.2	7.1	9.6	
43.0	420	4.4	5.1	5.9	8.3	5.5	6.3	7.1	9.6	
42.0	430	4.4	5.1	5.9	8.3	5.6	6.4	7.2	9.7	
41.0	440	4.4	5.2	5.9	8.4	5.6	6.4	7.2	9.8	
40.0	450	4.5	5.2	5.9	8.4	5.7	6.5	7.3	9.8	

TABLE 8-18. CONVERSION DATA FOR NIGHT PHOTO RUN AT 4000 FEET

TIME BETWEEN 5 NM MARKERS	G/S	2 SEC. DELAY				4 SEC. DELAY				SLANT RANGE (X 1000 FEET)
		5EX	7EX	10EX	15EX	5EX	7EX	10EX	15EX	
72.1	250	5.2	6.0	6.9	10.1	5.7	6.6	7.6	10.8	
69.2	260	5.2	6.0	7.0	10.1	5.8	6.7	7.7	10.9	
66.7	270	5.2	6.0	7.0	10.1	5.8	6.7	7.7	11.0	
64.3	280	5.2	6.1	7.0	10.2	5.9	6.8	7.8	11.0	
62.3	290	5.2	6.1	7.0	10.2	5.9	6.8	7.9	11.1	
60.0	300	5.3	6.1	7.1	10.2	6.0	6.9	7.9	11.2	
58.2	310	5.3	6.1	7.1	10.2	6.0	7.0	8.0	11.2	
56.2	320	5.3	6.2	7.1	10.3	6.1	7.0	8.0	11.3	
54.5	330	5.3	6.2	7.1	10.3	6.1	7.1	8.1	11.4	
53.0	340	5.3	6.2	7.2	10.4	6.2	7.1	8.2	11.4	
51.5	350	5.4	6.2	7.2	10.4	6.2	7.2	8.2	11.5	
50.0	360	5.4	6.3	7.2	10.4	6.3	7.2	8.3	11.5	
48.7	370	5.4	6.3	7.3	10.4	6.3	7.3	8.3	11.6	
47.4	380	5.4	6.3	7.3	10.5	6.4	7.3	8.4	11.7	
46.2	390	5.5	6.3	7.3	10.5	6.4	7.4	8.5	11.7	
45.1	400	5.5	6.4	7.3	10.5	6.5	7.5	8.5	11.8	
44.0	410	5.5	6.4	7.4	10.6	6.5	7.5	8.6	11.9	

TABLE 8-18. CONVERSION DATA FOR NIGHT PHOTO RUN AT 4000 FEET (Continued)

TIME BETWEEN 5 NM MARKERS	G/S	2 SEC. DELAY				4 SEC. DELAY				SLANT RANGE (X1000 FEET)
		5EX	7EX	10EX	15EX	5EX	7EX	10EX	15EX	
43.0	420	5.5	6.4	7.4	10.6	6.6	7.6	8.6	11.9	
42.0	430	5.6	6.5	7.4	10.6	6.7	7.6	8.7	12.0	
41.0	440	5.6	6.5	7.5	10.7	6.7	7.7	8.8	12.1	
40.0	450	5.6	6.5	7.5	10.7	6.8	7.8	8.8	12.1	

TABLE 8-20. NIGHT SIMULTANEOUS OPERATION (KA-47A)

PREFLIGHT

a. Install cameras according to the following table; remove lens covers and filters.

Position	Camera	Magazine	Focal Length	Dep. Angle
8.	KA47A (Night)	MA-10A (Night)	12"	90°
9.	KA47A (Night)	MA-10A (Night)	12"	90°
11.	KA47A (Night)	MA-10A (Night)	12"	90°

b. Adjust cameras and mounts, cage for takeoff.

(1) Station 11 to 0° pitch.

(2) Station 11 roll stab. caged.

c. Set "J" boxes, central computer, RDA's as follows:

Position	"J" Boxes	Central Computer	RDA
8.	D	501 BC	12" @ 90° MA10A
9.	D	501 BC	12" @ 90° MA10A
11.	D	501 BC	12" @ 90° MA10A

TABLE 8-22. NIGHT SEQUENTIAL OPERATION (KA-47A)

PREFLIGHT

a. Install cameras according to the following table; remove lens covers and filters.

Position	Camera	Magazine	Focal Length	Dep. Angle
8.	KA47A	MA-10A	12"	90°
9.	KA47A	MA-10A	12"	90°

b. Adjust cameras, mounts, and cage for takeoff.

(1) All mounts to have IMC caged.

(2) Set pitch knob to 0°.

TABLE 8-22. NIGHT SEQUENTIAL OPERATION (KA-47A) (Continued)

c. Set junction boxes, central computer and RDA's as following:

Position	"J" Boxes	Central computer	RDA
8.	E	501 BC	12" @ 90° MA10A
9.	E	501 BC	12" @ 90° MA10A

TABLE 8-22A. HIGH-LOW NIGHT SIMULTANEOUS, MULTI-CAMERA

a. Install cameras according to the following table.

Position	Camera	Magazine	Focal Length	Dep. Angle
6	KA-40A	Cassette	3"	90°
8	KA-53A	Cassette	12"	90°
9	KA-47A	MA-10A	12"	90°

b. Adjust camera mount functions, cage for takeoff, close camera windows.

c. Set "j" boxes, central computer, RDA servo power units.

Position	Central Computer	RDA
6	501 - BC	90°, 6", 70mm
8	501 - BC	90°, 12", 70mm
9	501 - BC	90°, 12", MA-10A

TABLE 8-23. GENERAL NIGHT RECONNAISSANCE OPERATION (KA-40A)

PREFLIGHT

a. Install cameras according to the following table; remove lens covers and filters.

Position	Camera	Magazine	Focal length	Dep. angle
6 * connected to station 11 "J" box	KA40A	LA141A Cassette	3"	90°

b. Adjust camera mounts, cage for takeoff.

(1) Trimet cradle on 0° pitch.

(2) Station 6 0° pitch.

(3) Station 6 roll stab. caged.

(4) Cover outside perimeters of station 6 window to prevent flare in lens.

c. Set "J" boxes, central computer and RDA as follows:

"D" 501 BC 90° 1-1/2" 70 mm

Note

Position 11 is connected to station 6 camera. This station is crossconnected to provide night operation to station 6 and prevent lens flare.

TABLE 8-24. GENERAL NIGHT RECONNAISSANCE OPERATION (KA-46A)

PREFLIGHT

a. Install camera to the following table; remove lens covers and filters.

Position	Camera	Magazine	Focal Length	Dep. Angle
11.	KA46A	LA141A Cassette	6"	90^{O}

b. Adjust camera mounts; cage for take-off.

(1) Position 11 0^{O} pitch.

(2) Position 11 roll stab. caged.

c. Set "J" boxes, central computer, and RDA, as follows:

Position	"J" Box	Central Computer	RDA
11.	D	501 Computer B & C	90^{O} 3" 70 mm

13. Cameras
    a. Magazines ..... SEATED
    b. Vacuum hoses ..... CONNECTED
    c. Day/night switch (MA-10A) ..... NIGHT
    d. Cables ..... TIGHT
14. Charts/Data Cards ..... ABORT

Pre-Taxi

1. Stepper switch ..... RESET
2. Bomb bay lights ..... OUT
3. Bomb doors open warning light ..... OUT

Pre-Target

1. Master power (5 min. prior to use) ..... ON
2. Vacuum gauge ..... 3-4" HG
3. Camera doors ..... OPEN
4. Central computer ..... B.C.
5. J-Boxes ..... SEQUENTIAL/ SIMULTANEOUS
6. Computer/scanner ..... COMPUTER
7. Count limiter ..... AS DESIRED
8. Auto/stop switches ..... AS DESIRED
9. Exposure Control ..... FULL DULL

Target

1. Radar recorder ..... ON
2. Camera program switches OP1/OP2
3. Running lights ..... OFF
4. V/H ..... SET
5. Ready/safe switches ..... READY
6. Camera operate switch OP1/OP2
    a. Bomb drop/cartridge burst ..... MONITOR
7. Camera operate switch ..... OFF
8. Bomb bays ..... CLEAN
9. Ready/safe switch ..... SAFE (CHECK DOORS CLOSED)
10. Photo data cards ..... COMPLETE
11. Running lights ..... ON

Secure

1. Unused cartridges/bombs SALVO IN SAFE AREA
2. Check bomb bay doors ..... CLOSED
3. Camera program switches ..... OFF
4. Camera window ..... CLOSED
5. Master power ..... OFF

PHOTOGRAPHIC SYSTEM CAPABILITIES

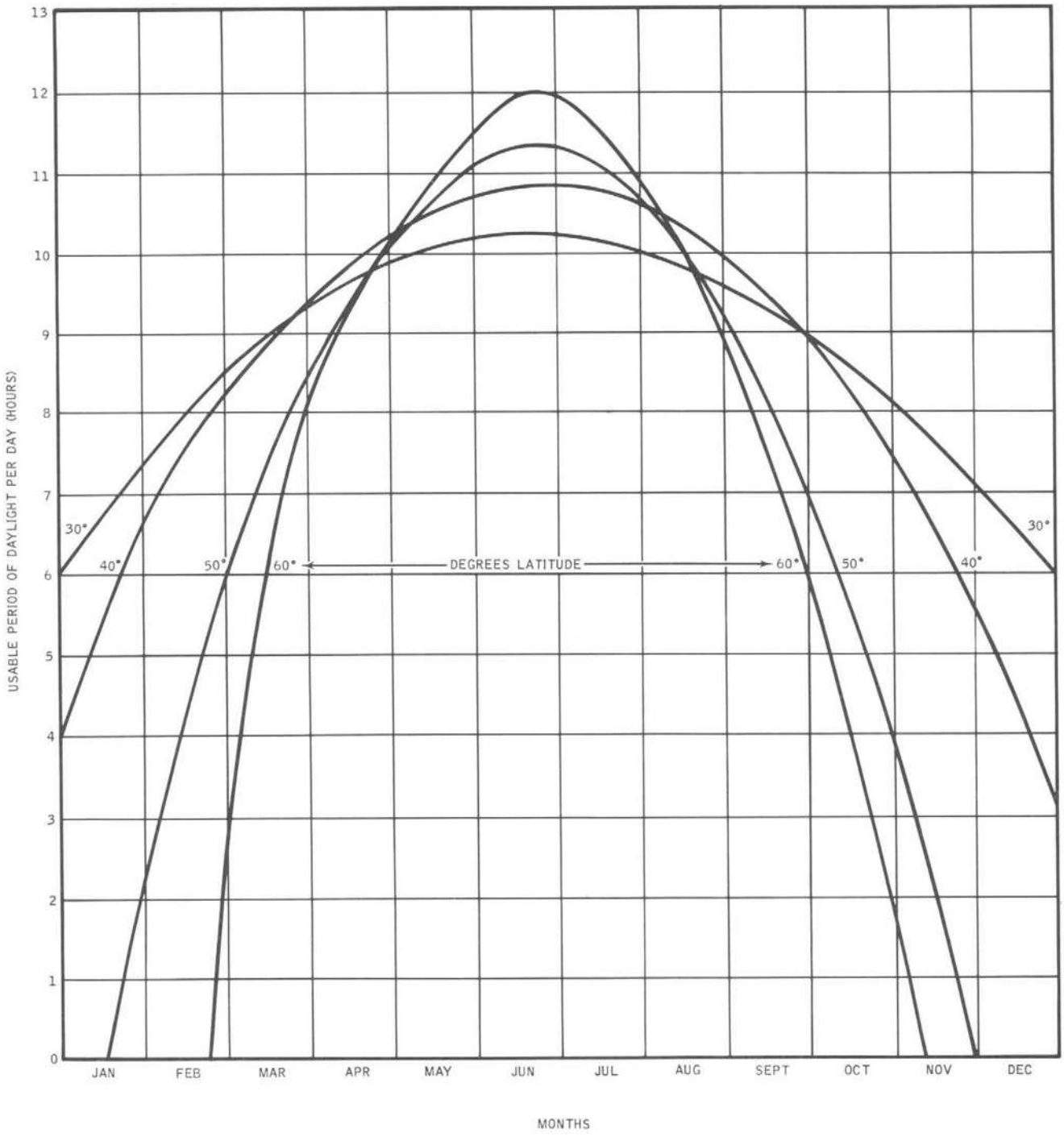
CAMERA PARAMETER NOMOGRAPHS

Camera parameter nomographs make possible the determination of such relationships as solar altitude (see figure 8-31), camera angular coverage, cycle time, overlap, and computer setting.

SHUTTER SPEED NOMOGRAPH

The shutter speed nomograph (figure 8-32), which is constructed for a filter factor of unity, expresses shutter speed as a function of film rating, aperture stop, terrain brightness, and lens transmission factor. Use the nomograph as follows:

Draw a horizontal line from ASA rating value to intersect oblique target brightness value line and establish vertical operating line. From any point on operating line, select aperture stop and shutter speed (for either K = 1 or K = 0.7) combination. Generally, if image motion permits, select an intermediate aperture stop. Larger apertures are more critical for lens abberations, vignetting, and lens-film distance (see figures 8-33 and 8-34, and table 8-25) variations; small apertures, due to diffraction effects, decrease resolution. If a transmission factor less than unity is used, the shutter speeds must be decreased proportionately. An average optical transmission factor scale (K = 0.7) is included on the nomograph to simplify interpolation. A filter factor greater than unity also requires decreased shutter speeds. Thus, if a shutter speed of 1/250 is determined from the nomograph, but a filter having a filter factor value of C = 2 is required, the shutter speed must be corrected to 1/125.



NOTE: SOLAR ALTITUDE GREATER OR EQUAL TO 20°

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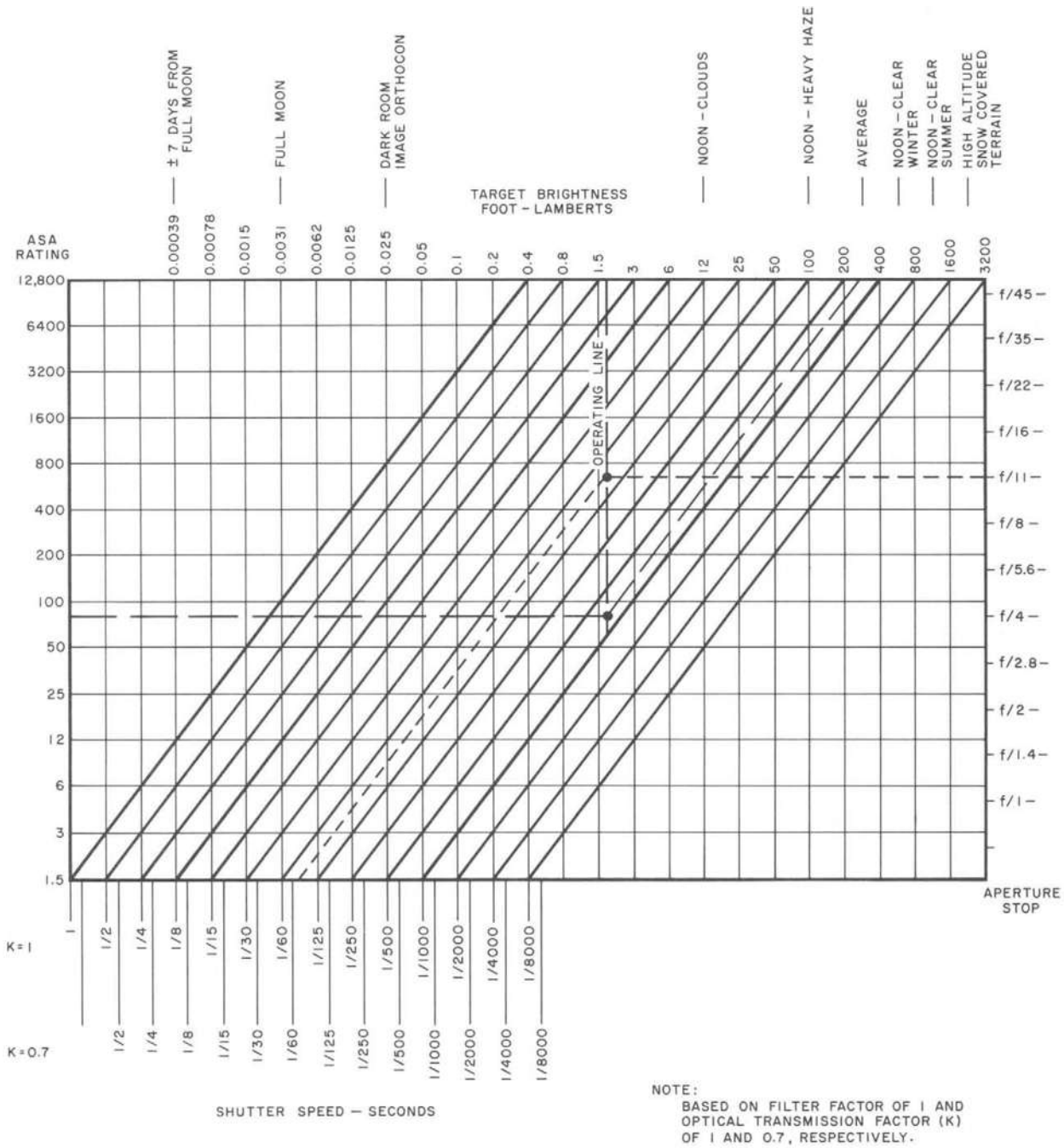
Figure 8-31. Hours of Usable Daylight for Photography



NOTE:
BASED ON FILTER FACTOR OF 1 AND OPTICAL TRANSMISSION FACTOR (K) OF 1 AND 0.7, RESPECTIVELY.

EXAMPLE:
ASSUME AN ASA RATING OF 80, AN AVERAGE BRIGHTNESS OF 270 FOOT-LAMBERTS, AND AN APERTURE STOP OF f/11. THE CORRESPONDING SHUTTER SPEED IS APPROXIMATELY 1/100 FOR K=1; 1/75 FOR K=0.7.

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Figure 8-32. Shutter Speed Nomograph

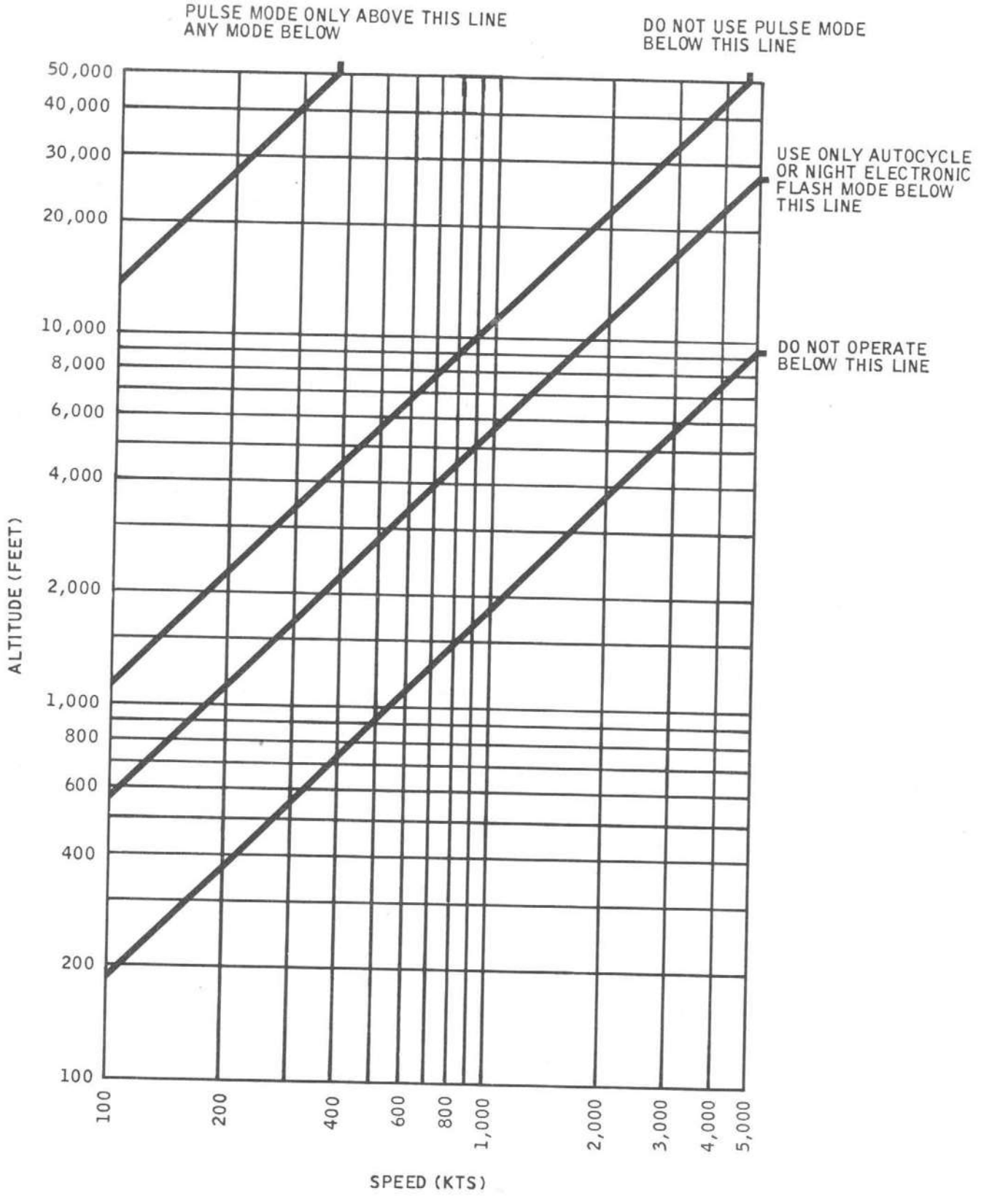


Figure 8-32A. KA-53A Camera Operational Limits

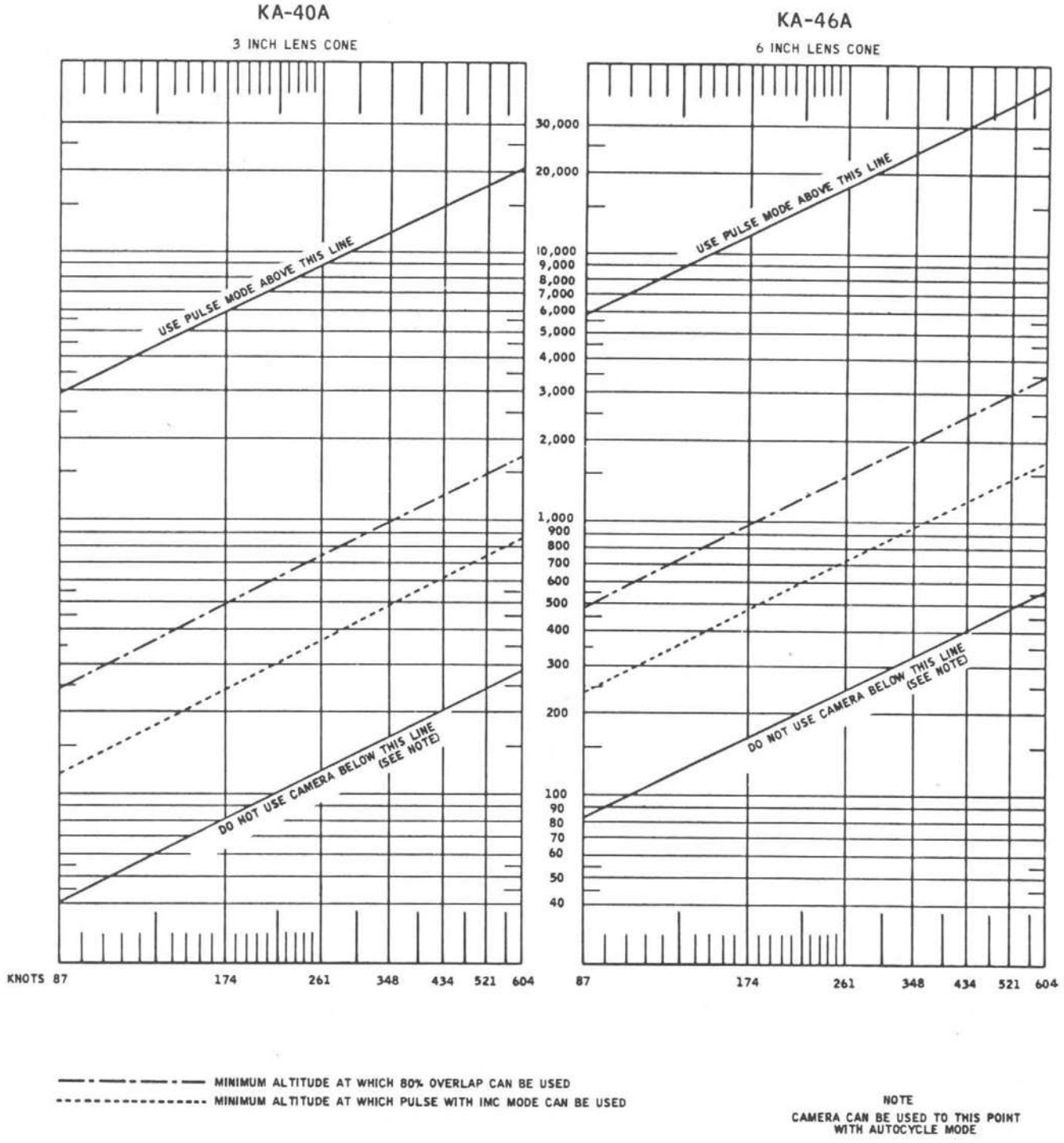


Figure 8-33. Camera Operating Range Limitations (250 FT Cassette Assemblies)

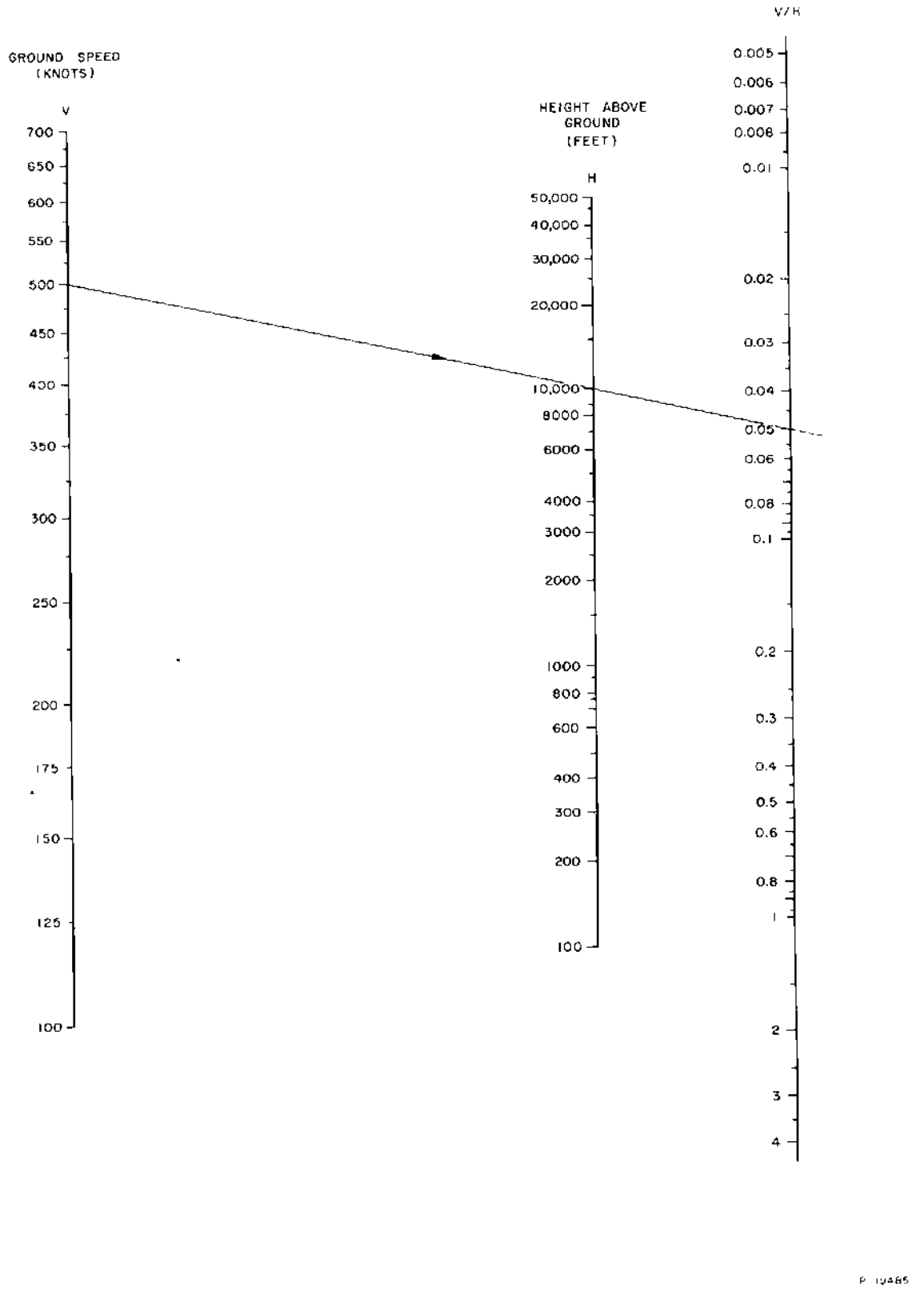


Figure 8-34. Cycle Time Nomograph for 60% Overlap, Vertical Cameras (Sheet 1)

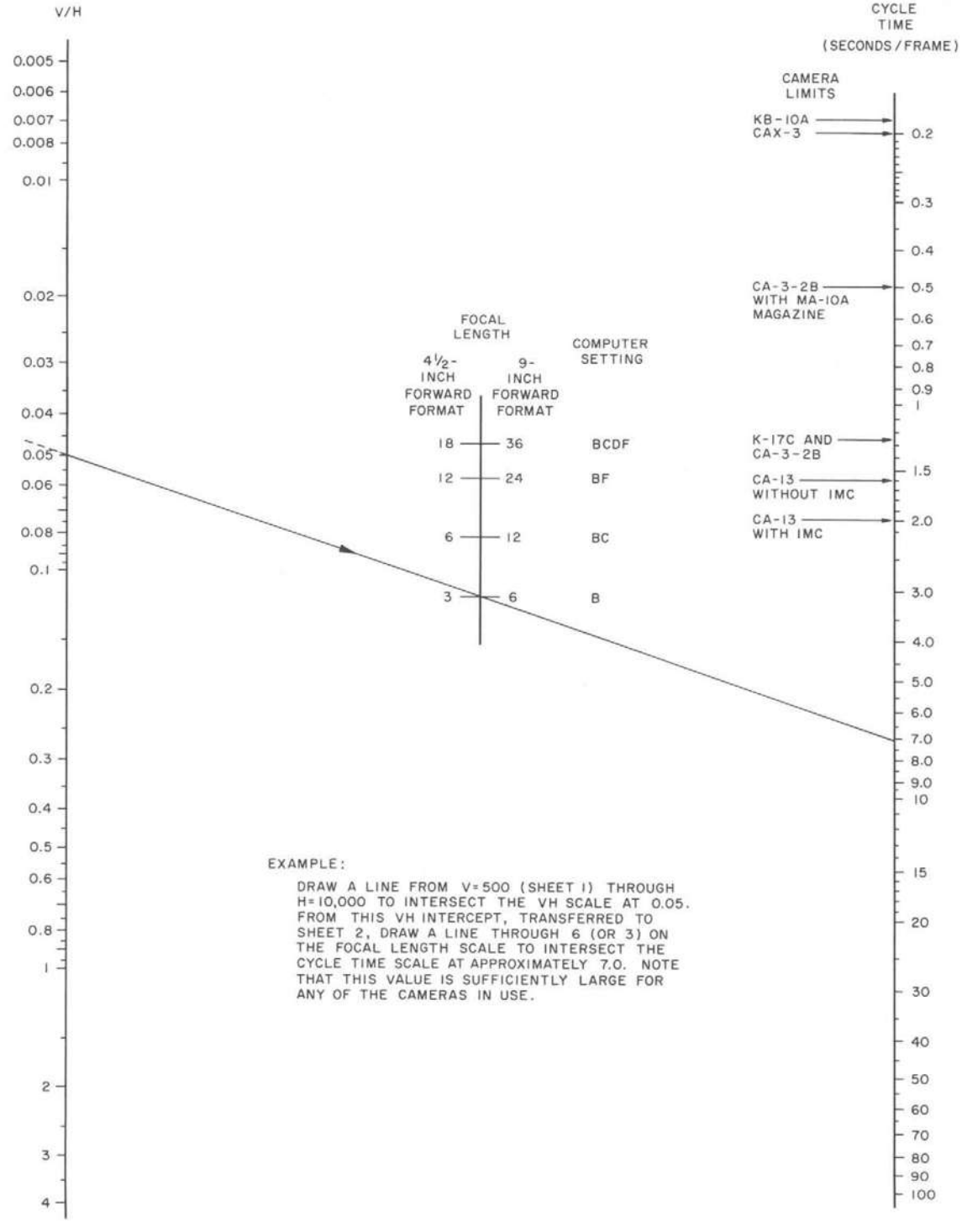


Figure 8-34. Cycle Time Nomograph for 60% Overlap, Vertical Cameras (Sheet 2)

TABLE 8-25. HYPERFOCAL DISTANCE IN FEET, AERIAL CAMERAS

		LENS APERTURES									
F.L.	1/mm	1	1.4	2	2.8	4	5.6	8	11	16	22
3"	30*	572'	408'	286'	204'	143'	102'	72'	52'	36'	26'
	50	938	669	468	335	235	167	117	85	59	43
6"	30	2,290	1,634	1,144	817	570	409	286	208	140	104
	50	3,750	2,680	1,876	1,340	940	670	468	341	234	171
12"	30	9,160	6,540	4,578	3,270	2,290	1,630	1,140	830	570	416
	50	15,000	10,710	7,500	5,360	3,760	2,680	1,870	1,360	937	683
24"	30	36,630	26,150	18,310	13,070	9,160	6,540	4,580	3,330	2,290	1,660
	50	60,020	42,850	30,010	21,430	15,030	10,710	7,490	5,450	3,750	2,730
36"	30	82,400	58,840	41,200	29,420	20,600	14,710	10,300	7,490	5,140	3,740
	50	135,040	96,420	67,520	48,210	33,830	24,100	16,850	12,270	8,440	6,140
40"	30	101,730	72,640	50,860	36,320	25,440	18,160	12,700	9,250	6,350	4,620
	50	166,720	119,040	83,360	59,520	41,760	29,760	20,800	15,150	10,420	7,580

* For 15 1/mm - X 0.5 For 25 1/mm - X 0.5 **Note**: Based on

60 1/mm - X 2.0 100 1/mm - X 2.0 30 1/mm - C. of C. = 1/763"

50 1/mm - C. of C. = 1/1250"

COMPUTER SETTING AND FOREGROUND OVERLAP NOMOGRAPH

The computer setting and foreground overlap nomograph (figure 8-35) expresses computer setting and foreground overlap as a function of V/H, cycle time, and airplane pitch angle for forward oblique photography with the CA-13 camera and with either the 60001 or 60002 lens cone. If the pitch angle is held constant, a particular computer setting assures a constant foreground overlap. A line drawn from the computer setting through the V/H value determines the exact cycle time, which may be used in the nomographs for forward oblique photography or to check photographic system synchronization.

FOREGROUND SCALE FACTOR NOMOGRAPH

The foreground scale factor nomograph (figure 8-36) expresses foreground scale factor as a function of ground speed (V) in knots, height (H) above ground in feet, optical axis depression angle Θ, and cycle time. Scale factor is the ratio of image sizes of a stationary object appearing in the foreground of two consecutive pictures; it is limited by the camera beam-width factor and the optical axis depression angle. Use the nomograph as follows:

Draw a line from the airplane pitch angle value through the depression angle value to the Θ scale. From this Θ value (transferred to the adjacent Θ scale) draw a line through the V/H value to reference line 1 (sheet 1). From this intercept (transferred to reference line 1, sheet 2), draw a line to the selected scale factor value to establish the cycle time value for the conditions indicated. To check that the scale factor selected can be realized, draw a line from this value (transferred to the adjacent scale factor scale) through the beam-width factor value to the Θ' scale. If the Θ' intercept is greater than the Θ intercept, the scale factor can be realized in the foreground of two consecutive pictures. Using a value of Θ' greater than the value established on the Θ scale assures foreground overlap

on the ground of at least 40 percent for the scale factor selected. Use the computer setting nomograph (figure 8-35) along with the established cycle time an V/H value to determine computer settings.

PICTURES PER MILE NOMOGRAPH

The pictures per mile nomograph (figure 8-37) relates cycle time, V/H, computer setting, height (H) above ground, and pictures per mile for the CA-13 camera in forward oblique. It is useable with either the 60001, or 60002 lens cone. The nomograph may be used two ways:

1. Pivot a straightedge on the V/H value (sheet 1) to be flown and select a discrete computer setting which assures operation above the minimum cycle time. Starting with this computer setting on sheet 2, extend the pictures per mile line through the height above ground value (H) to determine pictures per mile (M).

2. To establish M, draw a line from the selected M value through the H value to determine the computer setting. The nomograph shows that, once the computer setting and H are determined, V/H and cycle time may vary and still produce the selected M. For a constant M, use the scanner only if the flight is over level terrain; if it is over rolling terrain, set in constant speed and altitude manually.

Note

Use of the viewfinder traveling grid to monitor V/H over uneven terrain will produce an erroneous M.

SIDE OBLIQUE FOREGROUND OVERLAP NOMOGRAPH

The foreground overlap nomograph (figure 8-38) expresses side oblique foreground overlap as a function of focal length, depression angle, format size, and computer setting. It also relates computer setting, V/H, and cycle time. Since the percent of foreground overlap is not directly dependent on V/H and cycle time, a constant overlap can be held for any V/H and cycle time combination (broken line, sheet 2) which is within the cycle time limits of the camera used. Use the nomograph as follows:

From focal length and format size value (sheet 1), draw a line to depression angle on the Θ scale. From Ref. I scale intercept transferred to the Ref. II scale, draw line through the Θ' value transferred from the Θ scale. Continue, as indicated, through the Ref. III, Ref. IV, focal length, Ref. V, and format length scales to intersect Ref. VI scale (sheet 1). From same Ref. VI intercept transferred to sheet 2 draw line through discrete computer setting to intersect selected foreground overlap scale. This determination shows graphically that foreground overlap is independent of V/H when V/H computer input corresponds to actual value being flown. The value on Ref. IV scale indicated by "36-inch focal length, (18 x 9) -3 degree depression angle point" has no corresponding value (1.5) on Ref. III scale. Hence, if a camera configuration which leads to this value is used, enter the nomograph on Ref. IV scale at this indicated value.

Note

Regardless of the computer setting, cycle time, or percent overlap used, the true axis of IMC will always be at the equivalent IMC depression angle noted in table 8-4 of NAVWEPS 01-40ATB-2-8 for each camera depression angle.

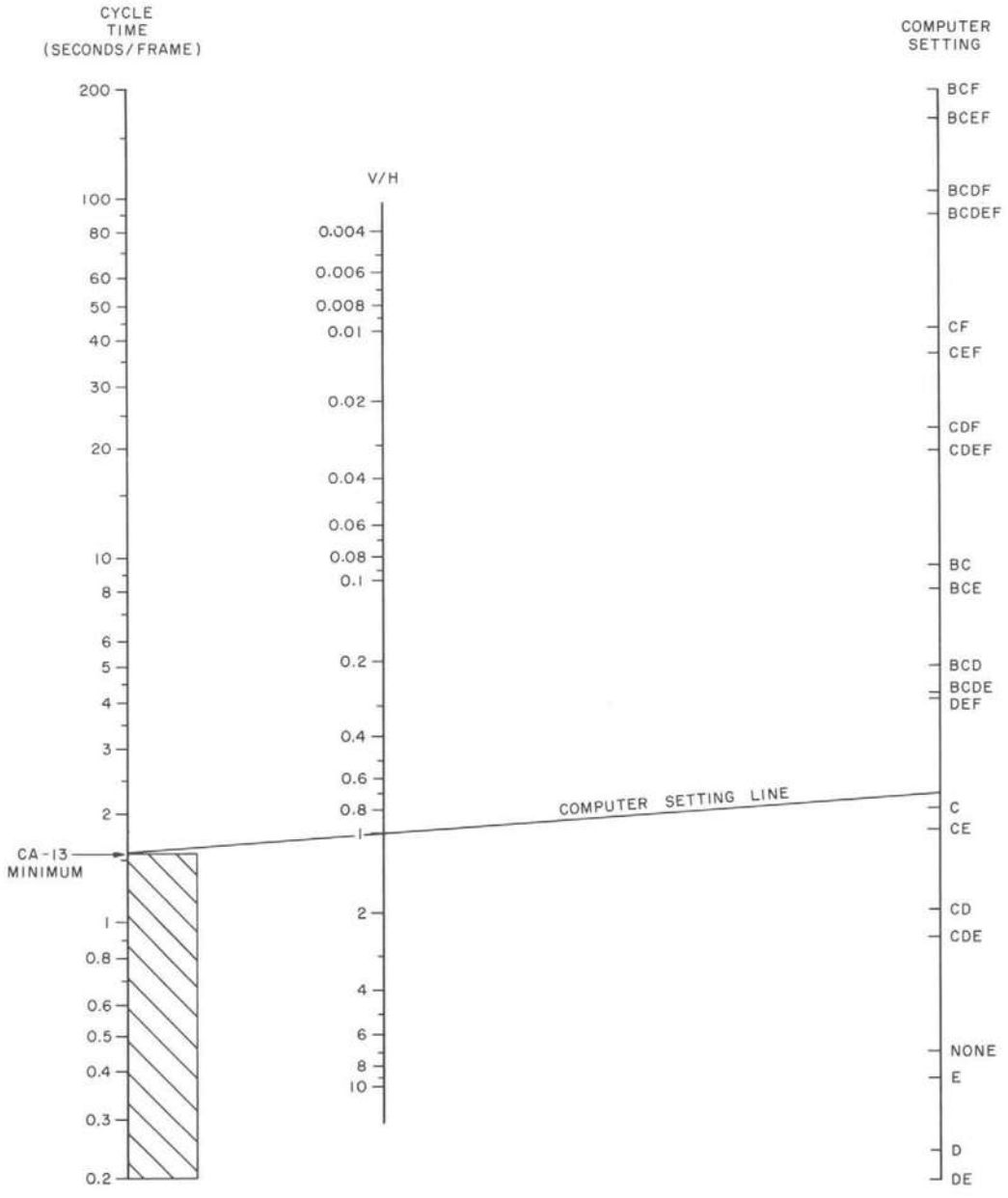
DISTANCE COVERED WITH OVERLAP AND SINGLE PICTURE GROUND COVERAGE NOMOGRAPH

The distance covered with overlap and single picture ground coverage nomograph (figure 8-39) expresses film footage as a function of ground speed, cycle time, format size, and, for exact determinations in vertical photography, of focal length and height above the ground. For a large number of consecutive pictures, the distance covered with (greater than 50 percent) overlap can be determined with acceptable accuracy from sheet 1 of the nomograph. For a small number of pictures, however, the single picture ground coverage (vertical cameras only) determined from sheet 2 must be added to avoid appreciable errors. This nomograph is not constructed for exact oblique photography determinations; but the error involved becomes less significant as the number of consecutive pictures taken becomes large. Moreover, the error is conservative; that is, more distance than is indicated will be covered. Use the nomograph as follows:

Draw line-A from the ground speed value through the cycle time value (see figures 8-34 through 8-37) to determine the distance advanced before the next picture. From the distance advanced intercept, draw line-B through the film available value to determine the distance covered (Scale I). If a vertical camera is used, draw lines-A and -B (sheet 2) as shown to determine single picture ground coverage (Scale II). Add the Scale II value to the Scale I value to obtain the exact distance covered with overlap. Note that, when the same ground speed and cycle time are used for both formats, the film used with a 4-1/2-inch format is half that used with a 9-inch format. However, the cycle time determined from figure 4-51A for a 4-1/2-inch format will differ from the cycle time for a 9-inch format when the 60 percent overlap is maintained.

CAMERA COVERAGE DIAGRAMS

Camera coverage is illustrated in figures 8-40 and 8-41.



EXAMPLE:

A STRAIGHT LINE FROM THE COMPUTER SETTING (C) THROUGH THE V/H VALUE (1) DETERMINES THE CYCLE TIME (1.7) TO BE USED.

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Figure 8-35. Computer Setting and Foreground Overlap Nomograph CA-13 Camera, Forward Oblique (Sheet 1)

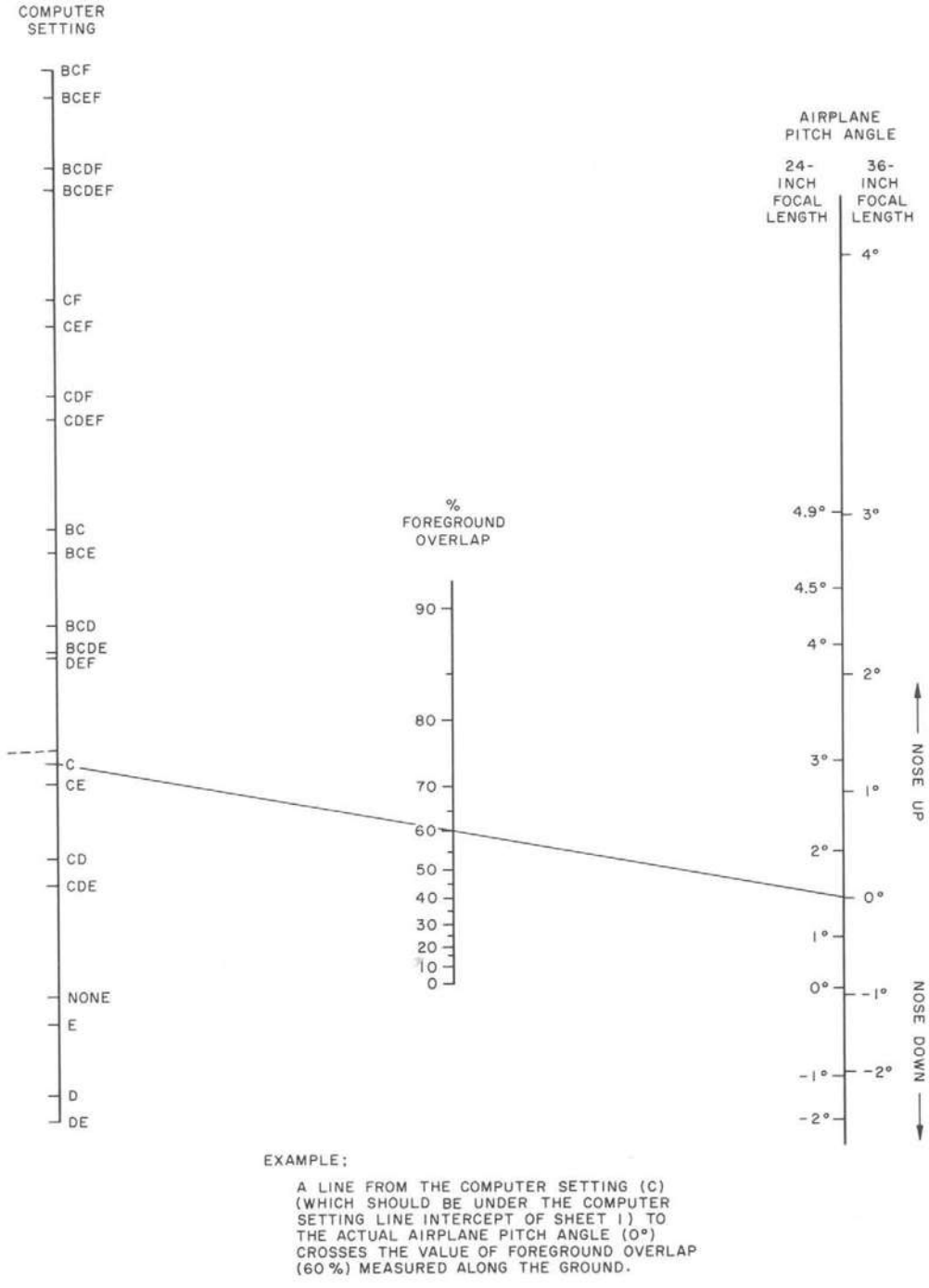


Figure 8-35. Computer Setting and Foreground Overlap Nomograph CA-13 Camera, Forward Oblique (Sheet 2)

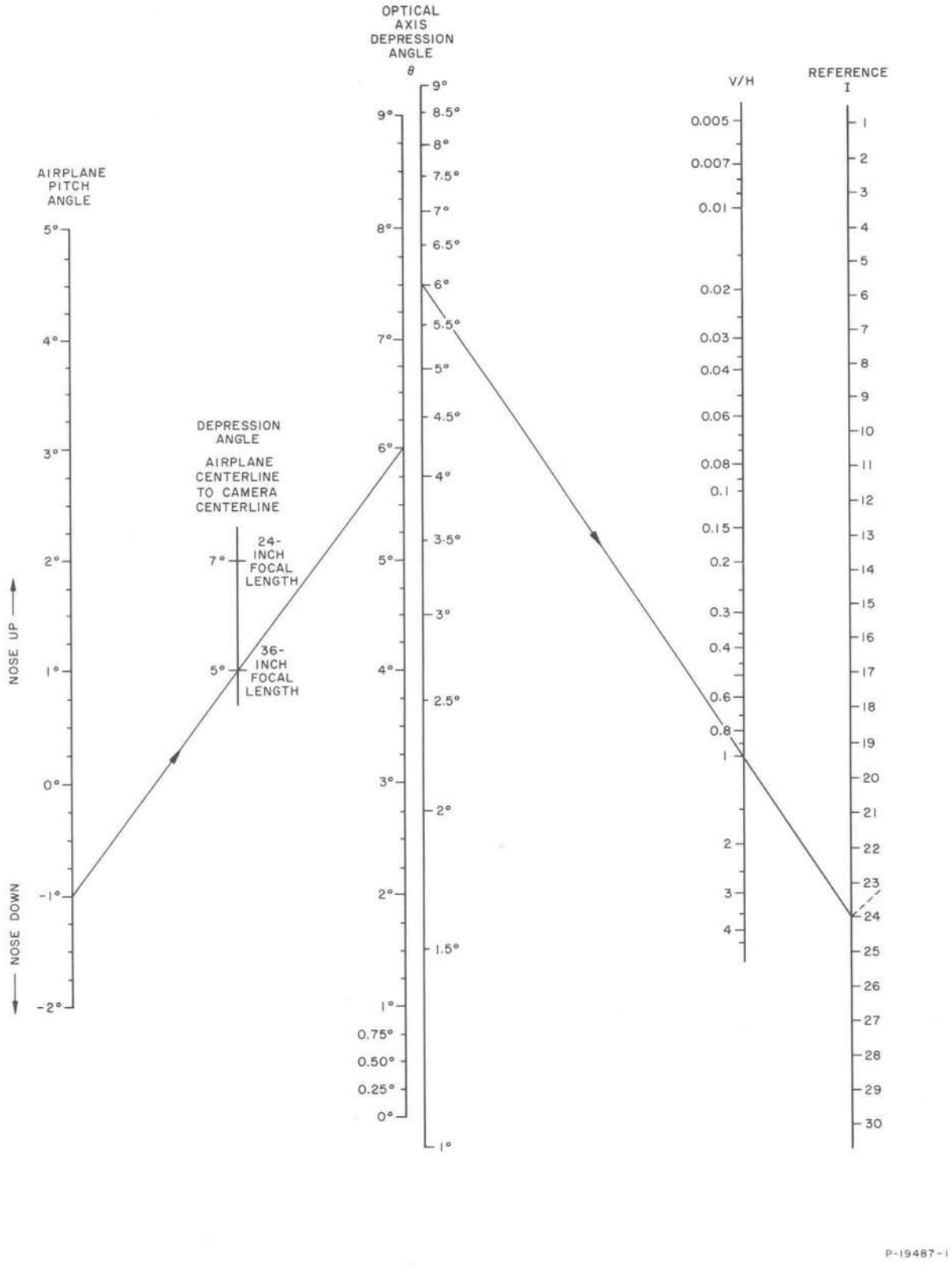


Figure 8-36. Foreground Scale Factor Nomograph – CA-13 Camera, Forward Oblique (Sheet 1)

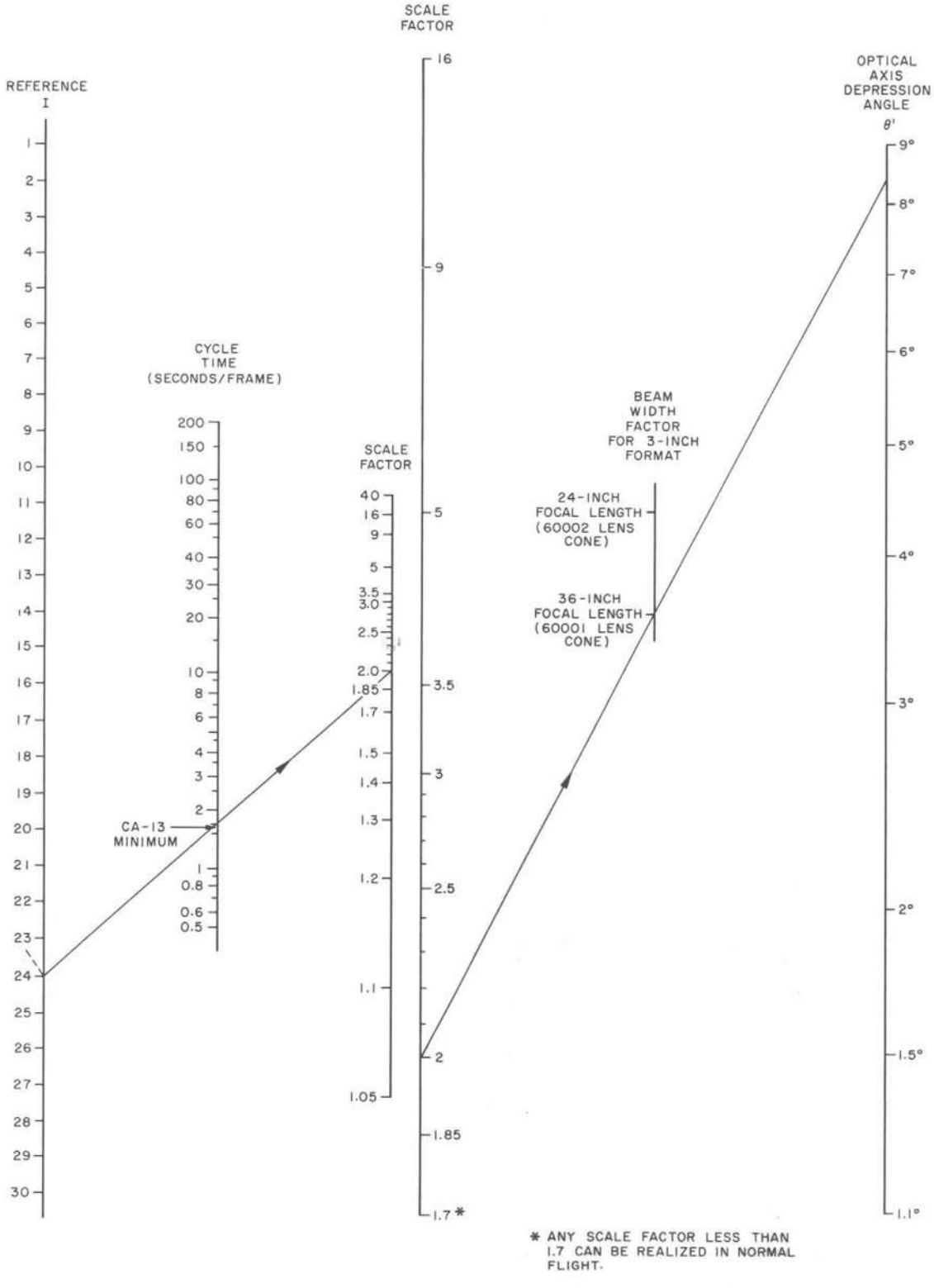


Figure 8-36. Foreground Scale Factor Nomograph – CA-13 Camera, Forward Oblique (Sheet 2)

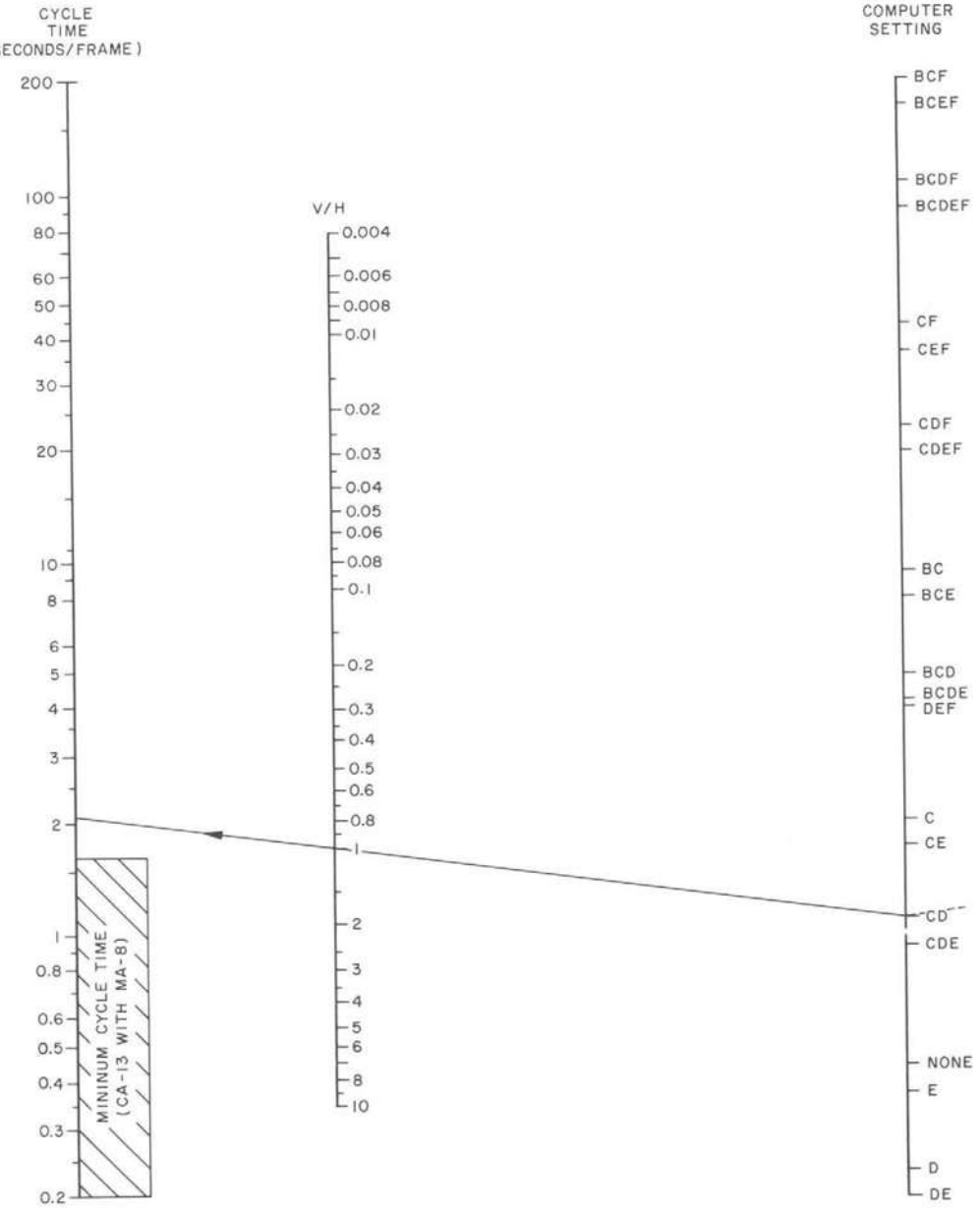
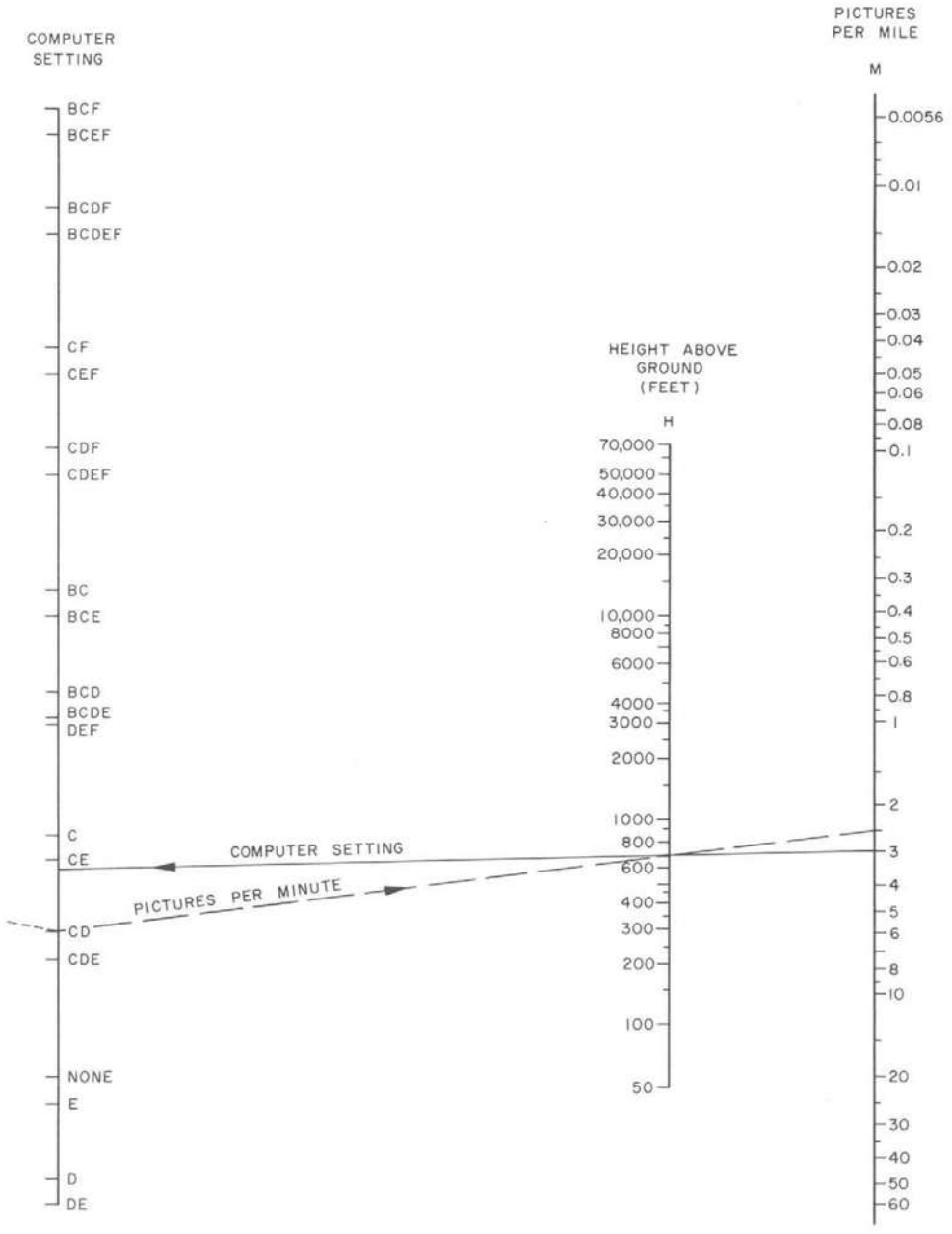


Figure 8-37. Pictures per Mile Nomograph CA-13 Camera, Forward Oblique (Sheet 1)



EXAMPLE:

ASSUME A GROUND SPEED (V) OF 700 KNOTS AND A HEIGHT (H) ABOVE GROUND OF 700 FEET. THEN V/H = 1. TO OBTAIN APPROXIMATELY 3 PICTURES PER MILE, SELECT COMPUTER SETTING (CD) UNDER INTERSECTION OF COMPUTER SETTING LINE. NOTE THAT LINE DRAWN FROM CD THROUGH V/H=1 VALUE INTERSECTS CYCLE TIME SCALE ABOVE MINIMUM VALUE (1.7).

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Figure 8-37. Pictures per Mile Nomograph – CA-13 Camera, Forward Oblique (Sheet 2)

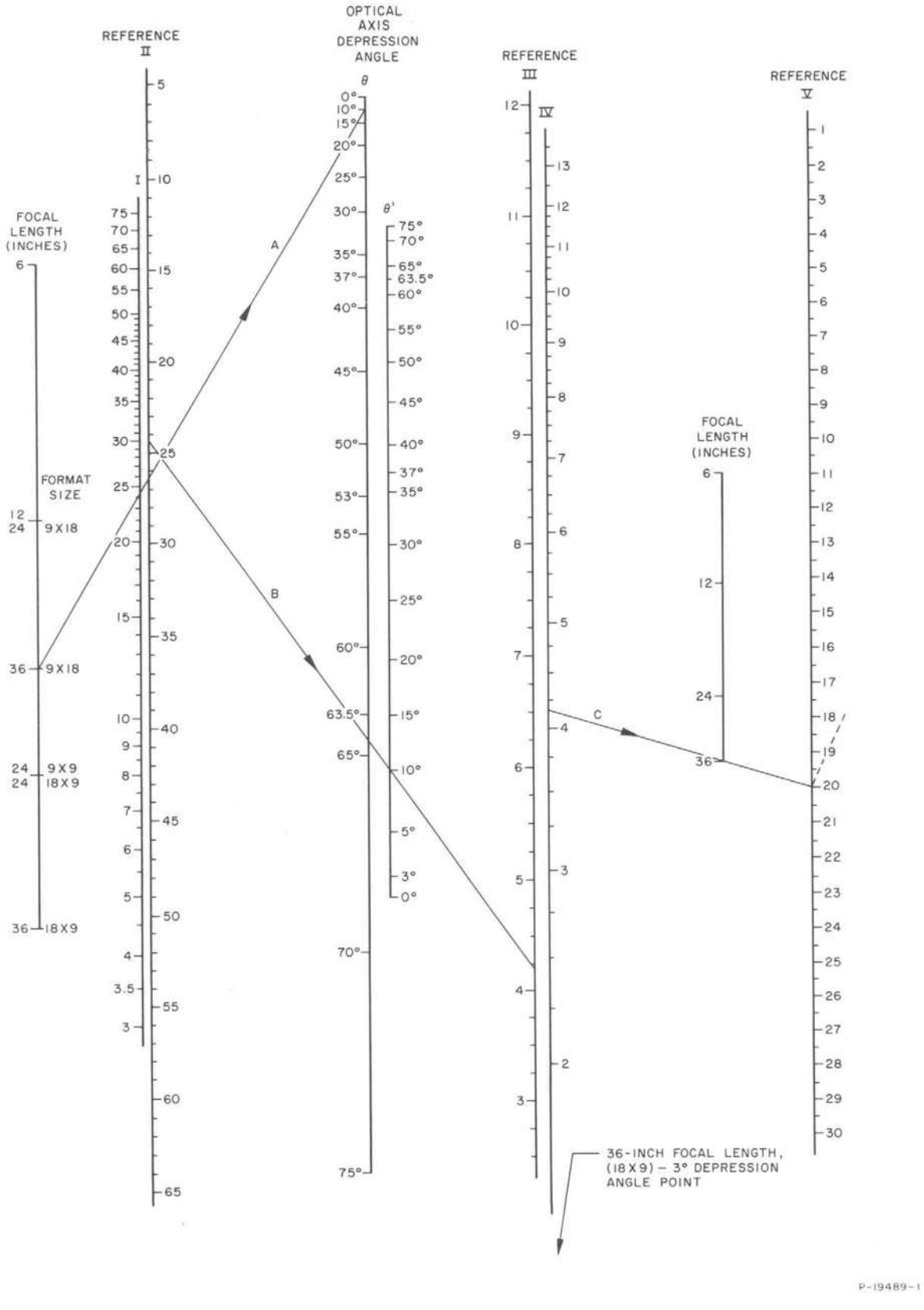


Figure 8-38. Side Oblique Foreground Overlap Nomograph (Sheet 1)

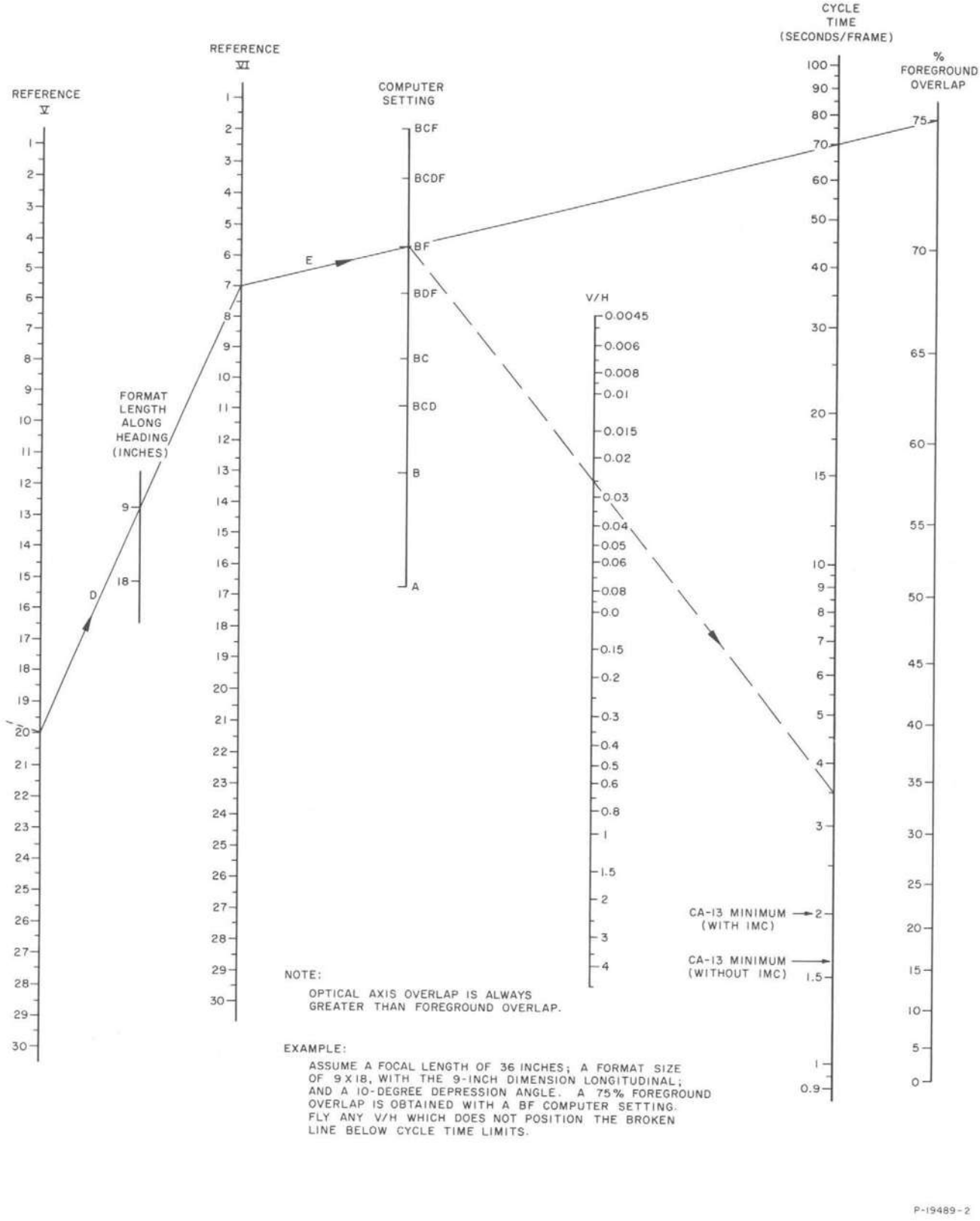


Figure 8-38. Side Oblique Foreground Overlap Nomograph (Sheet 2)

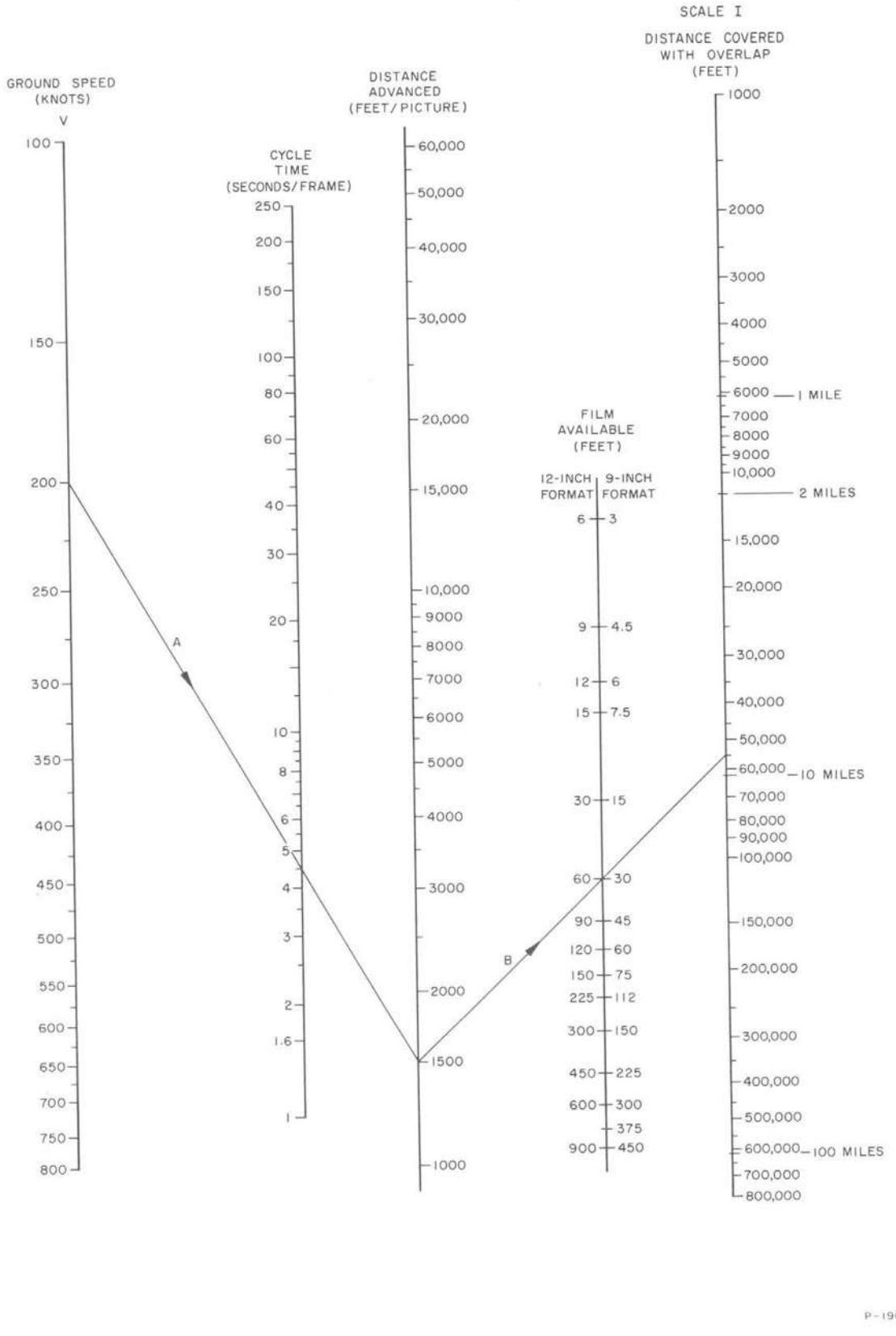


Figure 8-39. Distance Covered and Single Picture Ground Coverage Nomograph – Greater than 50% Overlap, Vertical Camera (Sheet 1)

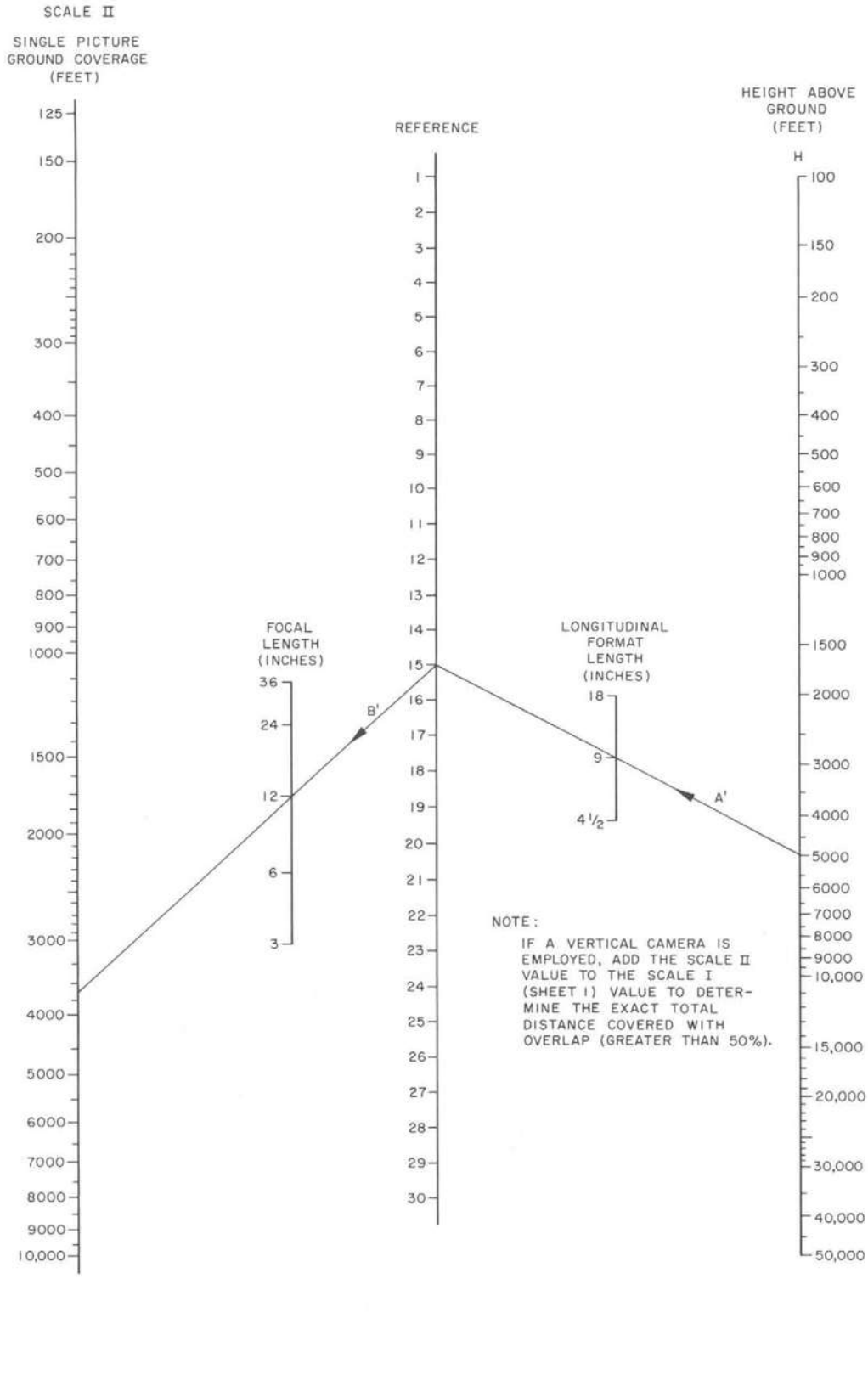


Figure 8-39. Distance Covered and Single Picture Ground Coverage Nomograph – Greater than 50% Overlap, Vertical Camera (Sheet 2)

FORMAT	Lens Half Angle ANGLE "A"	Angular Overlap ANGLE "B"	Angle between Optical Axis ANGLE "C"	TOTAL ANGULAR COVERAGE 1 Camera ANGLE "D_1"	2 Cameras ANGLE "D_2"	3 Cameras ANGLE "D_3"
2-1/4 x 2-1/4						
1-1/2-inch	36°52'	9°27'	64°17'	73°44'	138°01'	202°18'
3-inch	20°33'	4°18'	36°48'	41°06'	77°54'	114°42'
4-inch	15°43'	3°23'	28°03'	31°26'	59°29'	87°32'
6-inch	10°37'	2°19'	18°55'	21°14'	40°09'	59°04'
12-inch	5°21'	1°11'	9°31'	10°42'	20°13'	29°44'
4-1/2 x 4-1/2						
1-1/2-inch	56°19'	18°25'	94°13'	112°38'	206°51'	
3-inch	36°52'	6°37'	67°07'	73°44'	140°51'	
6-inch	20°33'	4°18'	36°48'	41°06'	77°54'	114°42'
7-inch	17°49'	3°47'	31°51'	35°38'	66°29'	99°20'
12-inch	10°37'	2°19'	18°55'	21°14'	40°09'	59°04'
18-inch	7°07'	1°35'	12°39'	14°14'	26°53'	39°32'
24-inch	5°21'	1°11'	9°31'	10°42'	20°13'	29°44'
9 x 9						
6-inch	36°52'	6°37'	67°07'	77°44'	140°51'	(See Tri-Met)
12-inch	20°33'	4°18'	36°48'	41°06'	77°54'	114°42'
24-inch	10°37'	2°19'	18°55'	21°14'	40°09'	59°04'
36-inch	7°07'	1°34'	12°40'	14°14'	26°54'	39°34'
40-inch	6°25'	1°25'	11°25'	12°50'	24°15'	35°40'
48-inch	5°21'	1°11'	9°31'	10°42'	20°13'	29°44'
60-inch	4°17'	0°57'	7°37'	8°37'	16°11'	23°48'
72-inch	3°34'	0°48'	6°20'	7°08'	13°28'	19°48'
84-inch	3°04'	0°38'	5°30'	6°08'	11°38'	17°08'
9 x 18						
12-inch	36°52'	3°11'	70°33'	73°44'	144°17'	(See Tri-Met)
24-inch	20°33'	2°07'	38°59'	41°06'	80°05'	119°04'
36-inch	14°02'	1°30'	26°34'	28°04'	54°38'	81°12'
48-inch	10°37'	1°10'	20°04'	21°14'	41°18'	61°22'
60-inch	8°32'	0°57'	16°07'	17°04'	33°11'	49°18'
72-inch	7°07'	0°48'	13°26'	14°14'	27°40'	41°06'
84-inch	6°07'	0°41'	11°33'	12°14'	23°47'	35°20'
96-inch	5°21'	0°35'	10°07'	10°42'	20°49'	30°56'
TRI-METROGON (Based on 30° depression requirement for oblique cameras, Tri-Metrogon Installation).						
(9 x 9) 6-inch	36°52'	13°44'	60°00'			193°44'
(9 x 18) 12-inch	36°52'	13°44'	60°00'			193°44'

*Based on 1/2" side overlap #Based on 1" side overlap

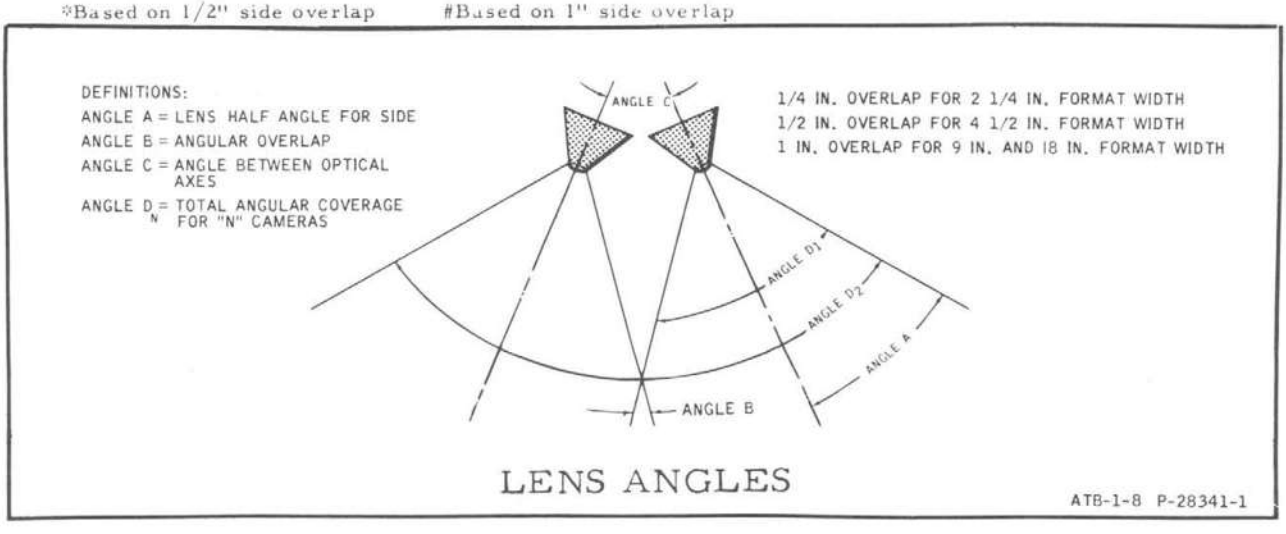


Figure 8-40. Camera Angular Coverage Table

CAMERA COVERAGE

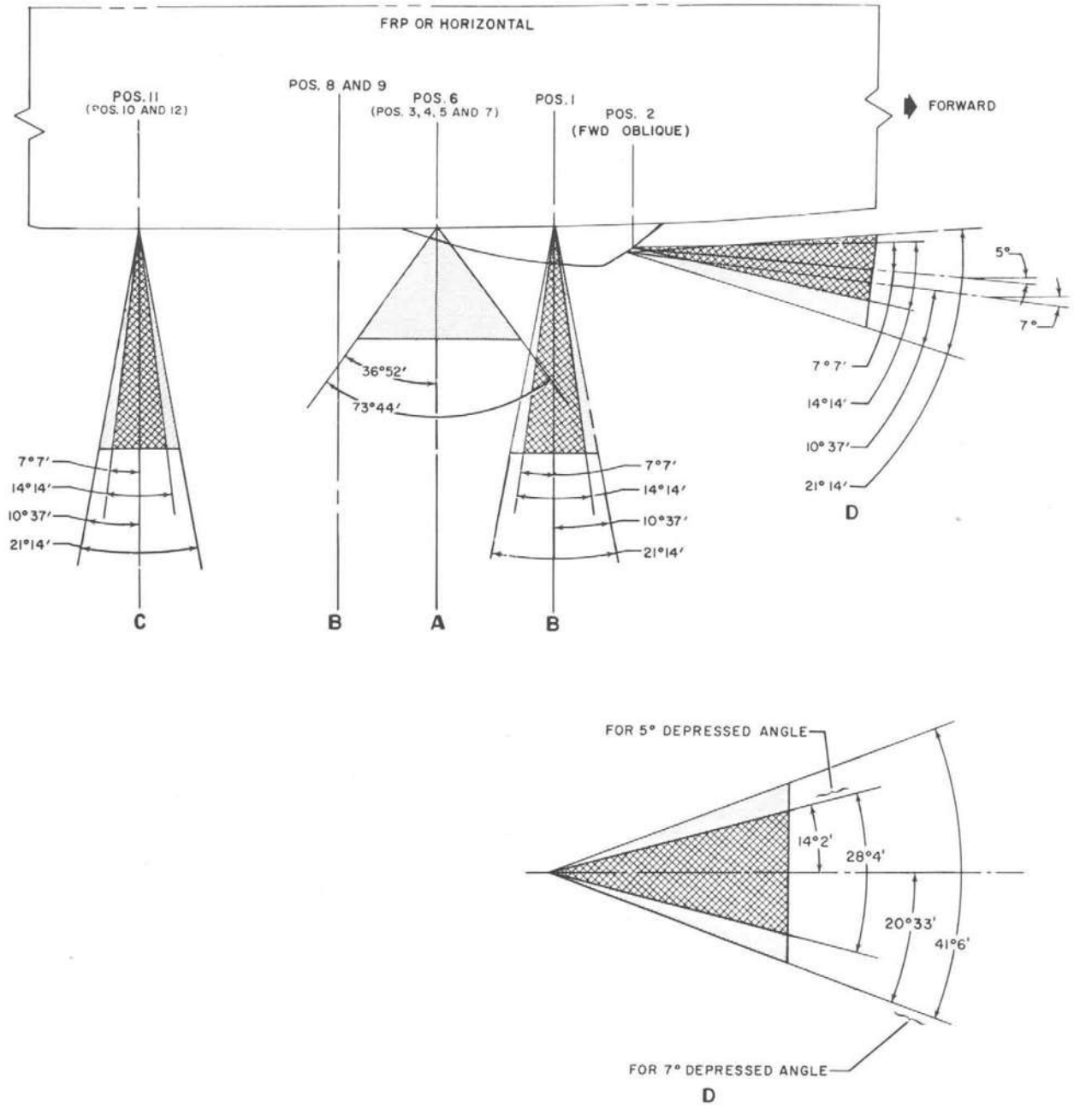


Figure 8-41. Camera Coverage Diagram – Forward Oblique and Vertical Coverage, Vertical Plane (Sheet 1)

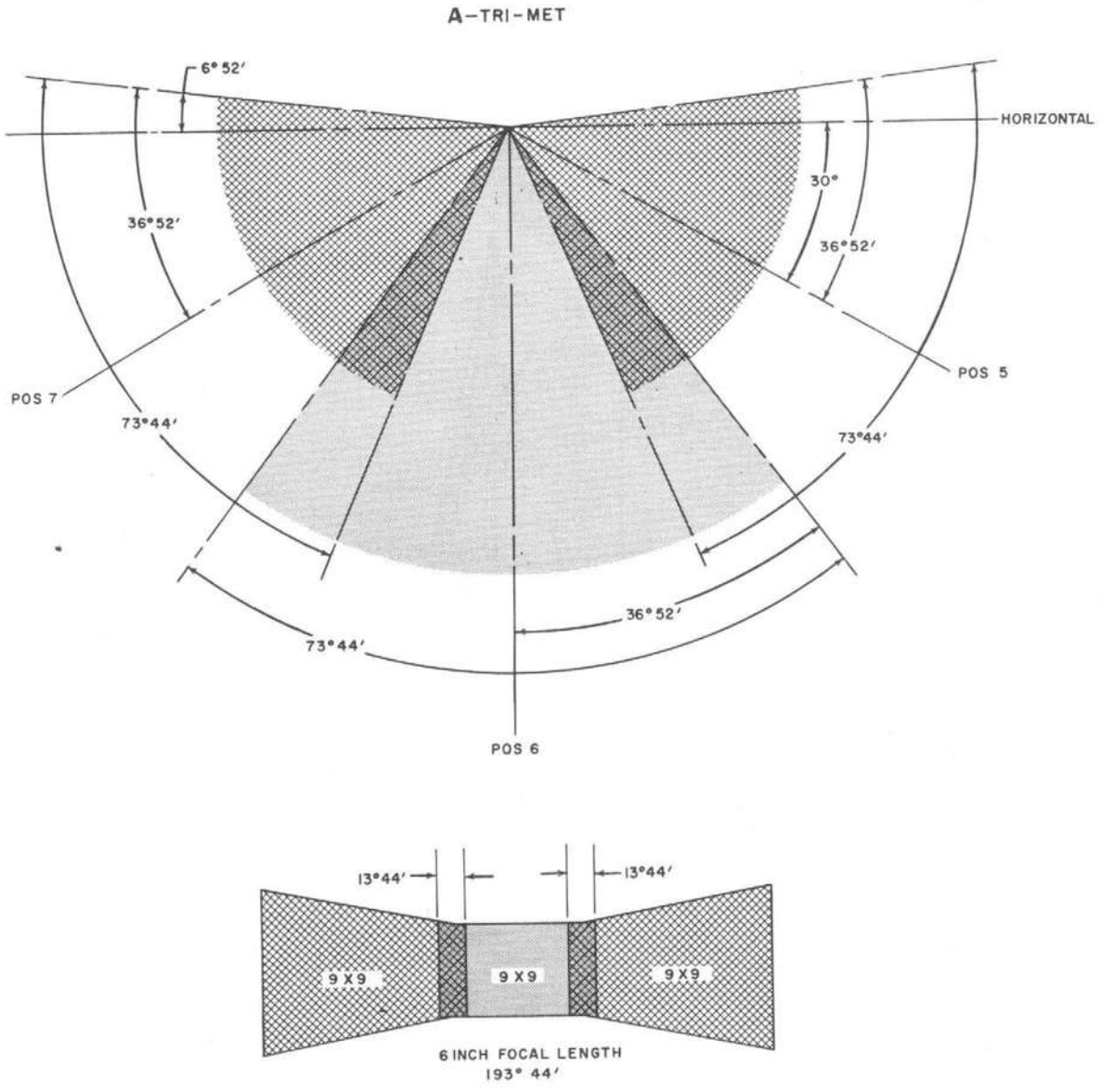


Figure 8-41. Camera Coverage Diagram – Trimet Coverage, Lateral Plane (Sheet 2)

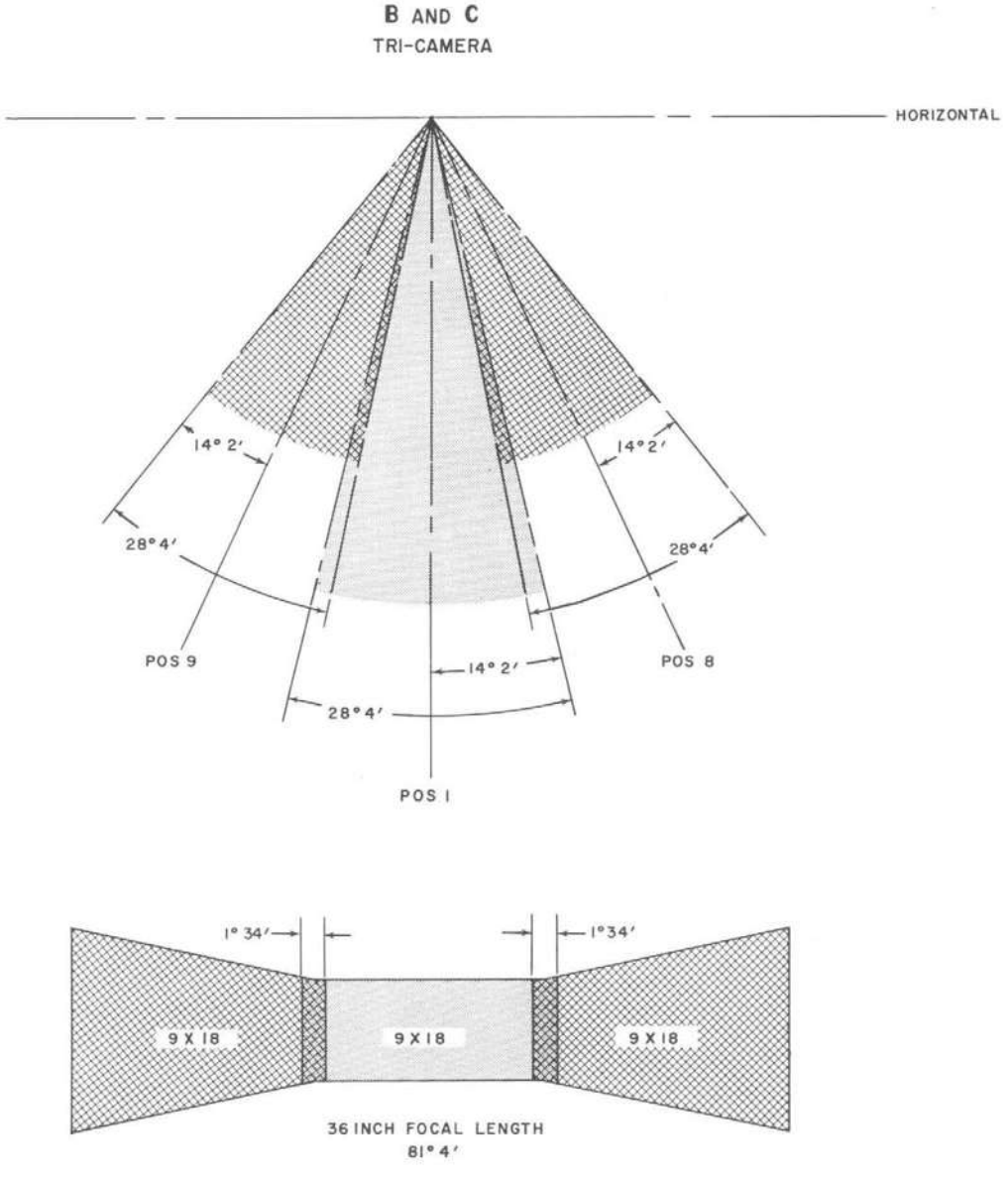


Figure 8-41. Camera Coverage Diagram – Tri-Camera Coverage, Lateral Plane (Sheet 3)

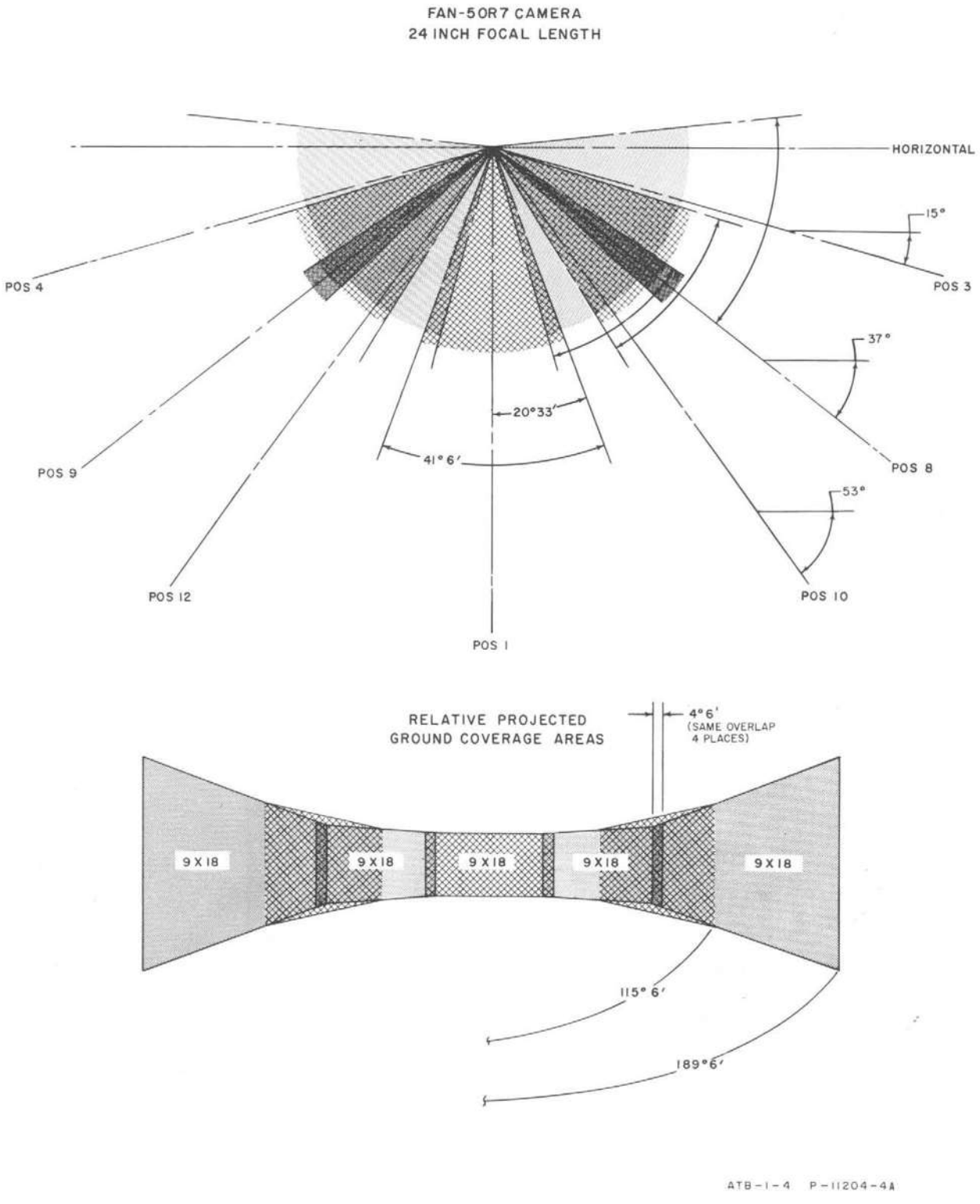


Figure 8-41. Camera Coverage Diagram – 5-Camera Fan (24"), Lateral Plane (Sheet 4)

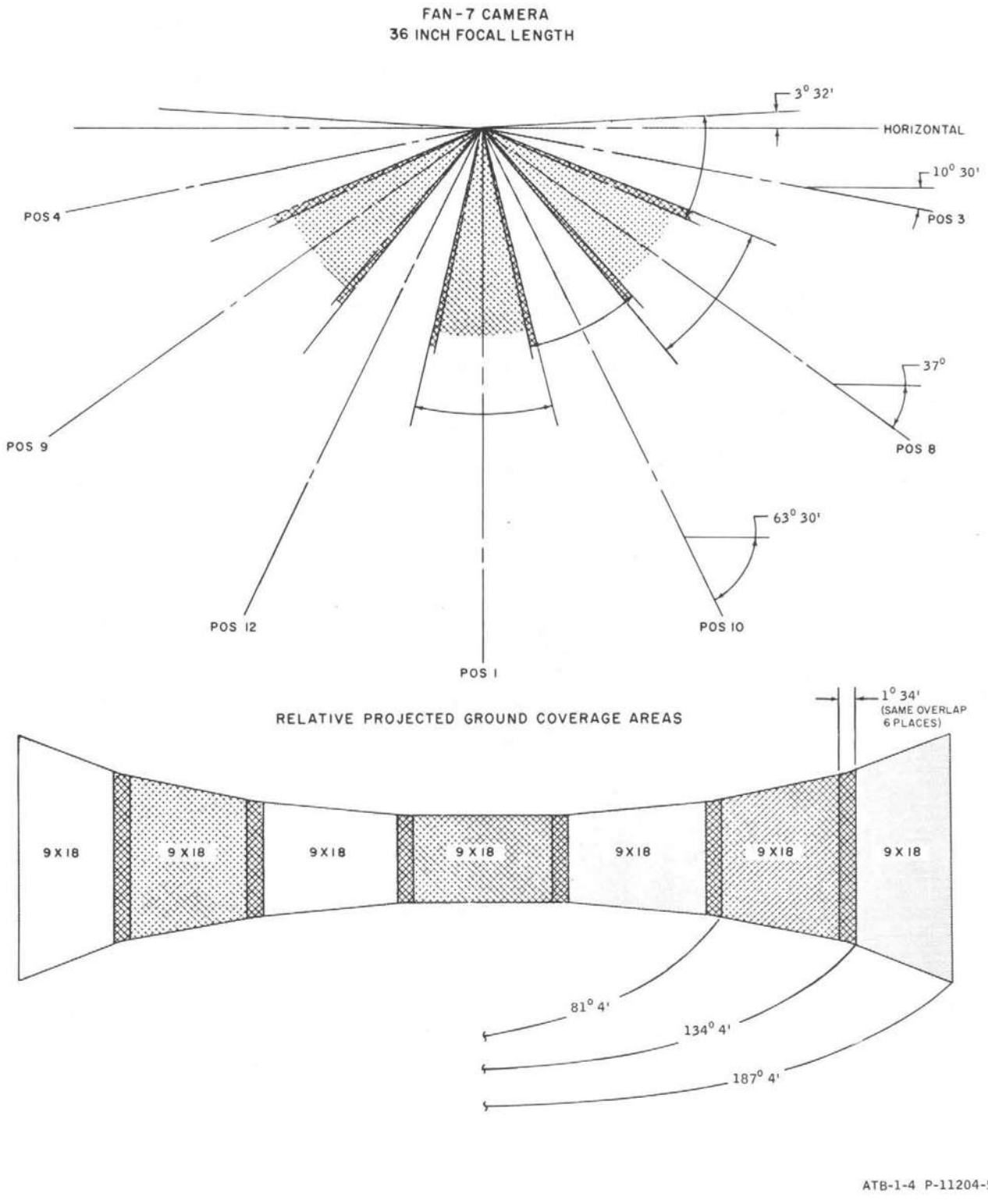


Figure 8-41. Camera Coverage Diagram - 7-Camera Fan (36"), Lateral Plane (Sheet 5)

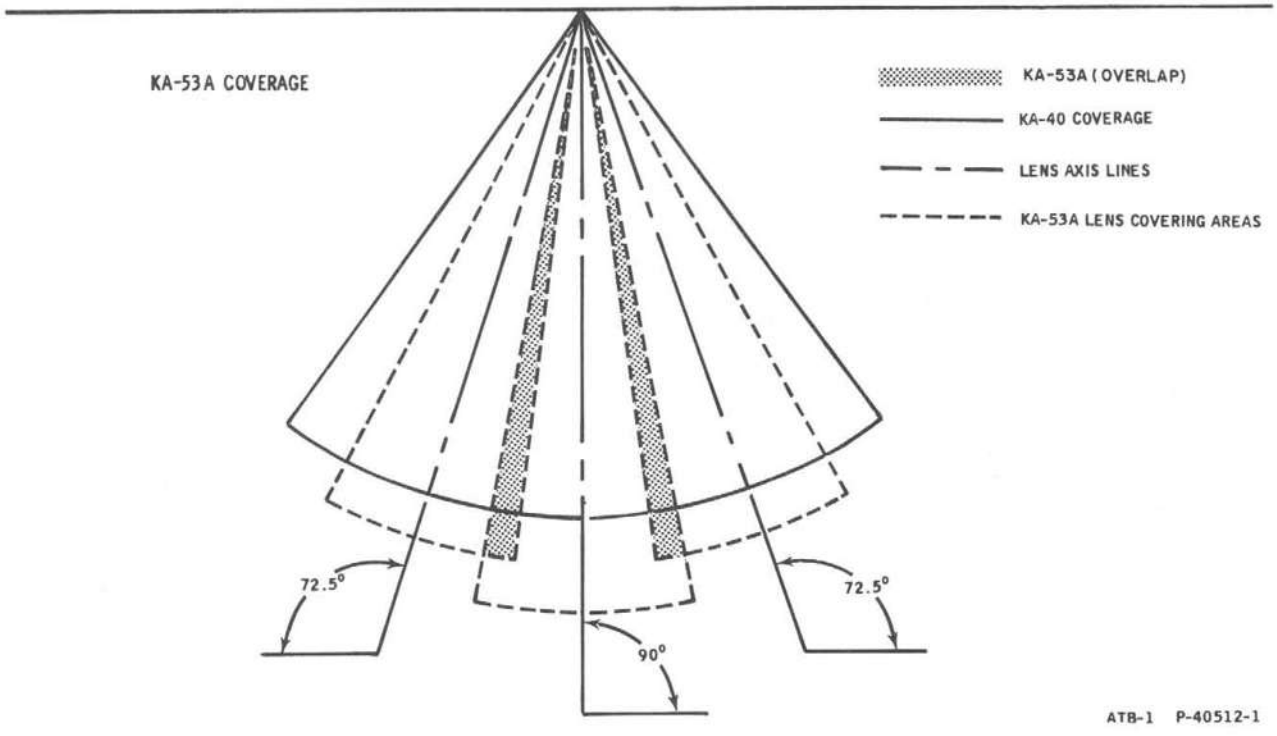


Figure 8-42. Low Level, High Speed, Reconnaissance (500' to 3,000') Overlap Diagrams -- KA-53A Tri-Camera Installation, With Single KA-40A

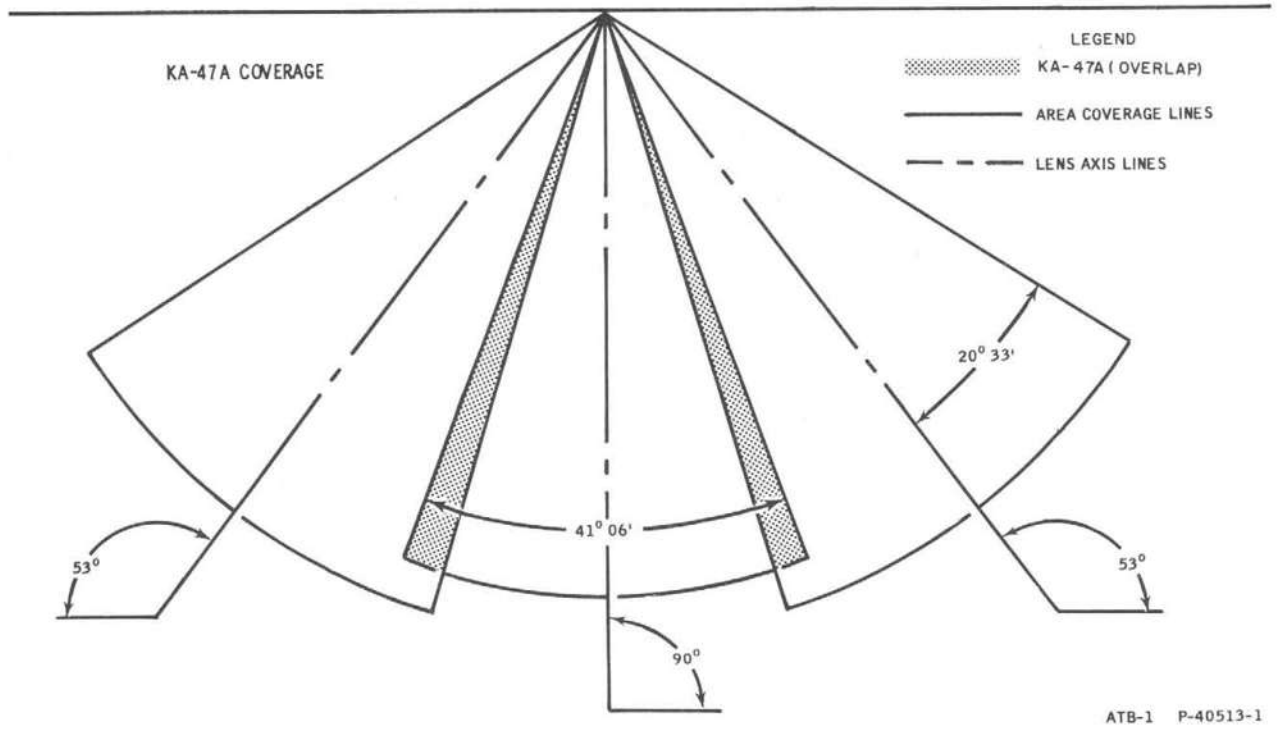


Figure 8-43. Low Level, High Speed, Reconnaissance (500' to 3,000') Overlap Diagrams -- KA-47A Tri-Camera Installations at Depression Angles of 90° and 53°

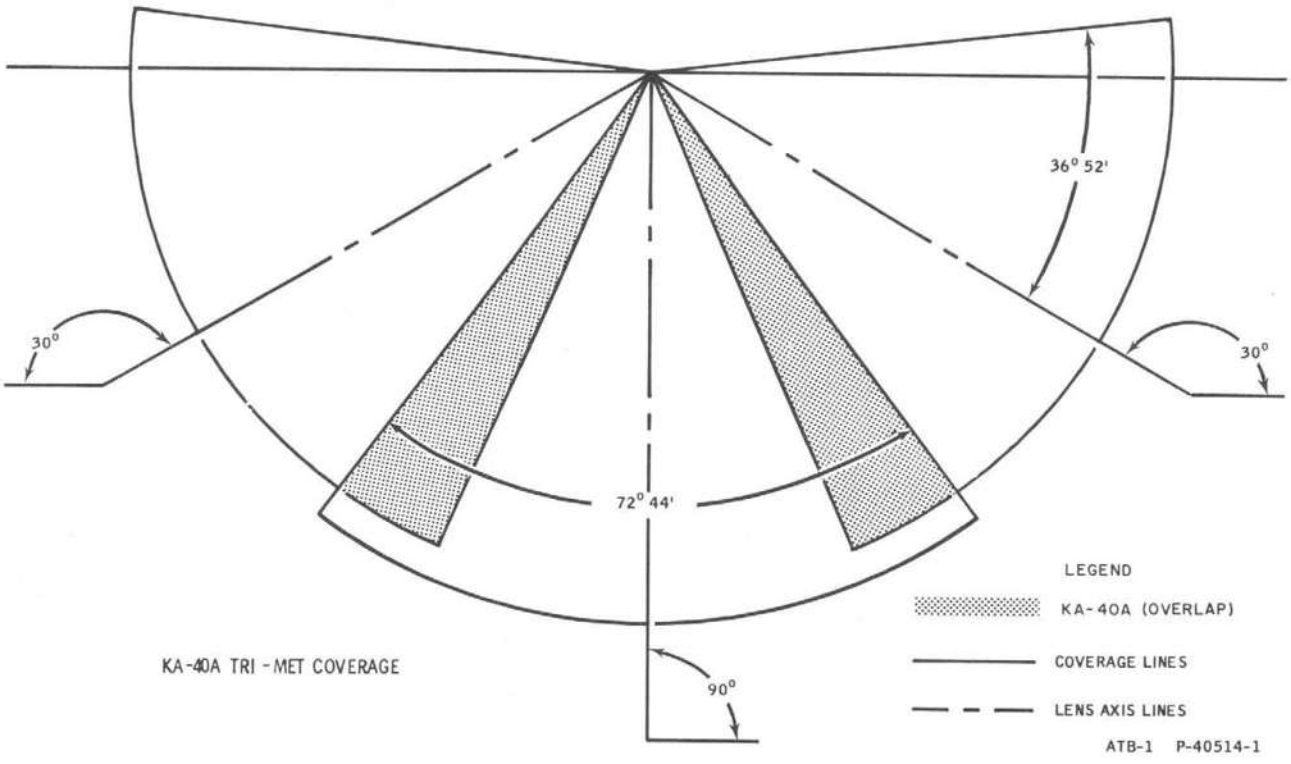


Figure 8-44. Low Level, High Speed, Reconnaissance (500' to 3,000') Overlap Diagrams -- KA-40A (Trimetrogon Installation)

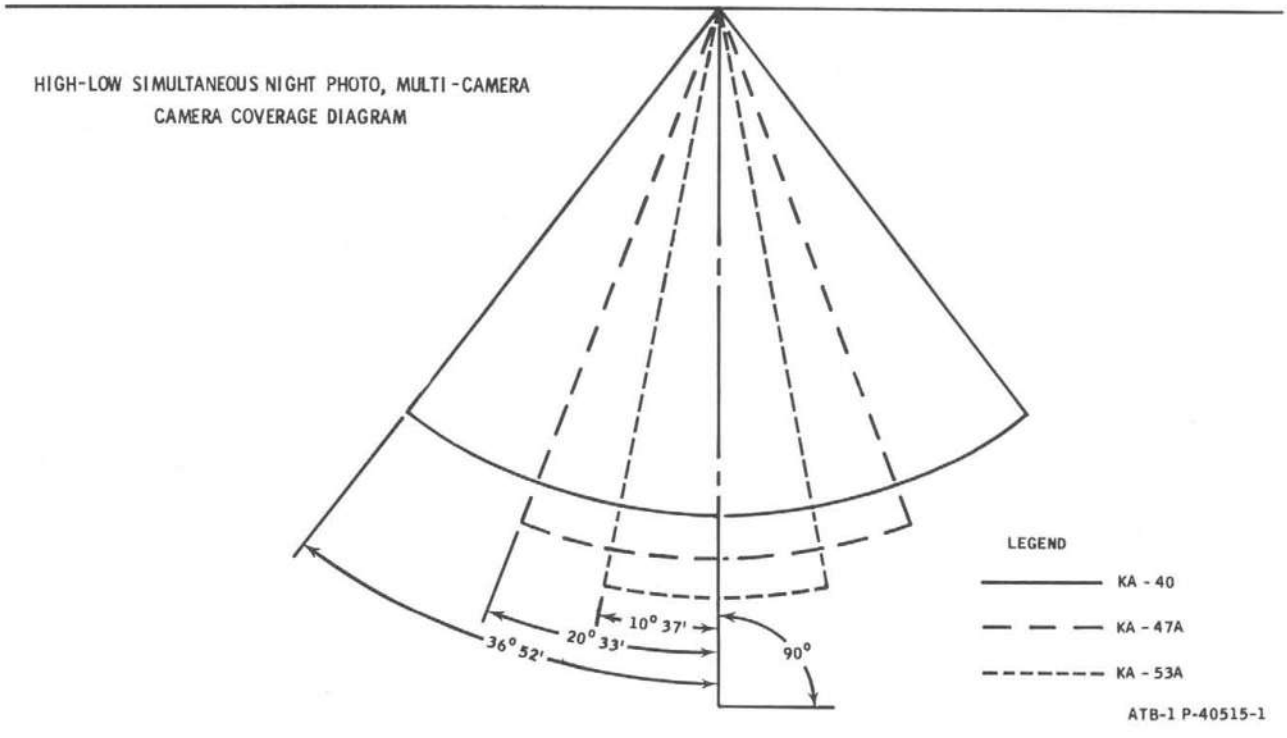


Figure 8-45. High-Low Simultaneous Night Photo, Multi-Camera Coverage Diagram -- KA-40/KA-47A/KA-53A Multi-Camera Coverage

GLOSSARY OF PHOTOGRAPHIC TERMS

This glossary is intended primarily to define terms used in the photographic section of the handbook, and to explain the use of equipment in the camera control system of this aircraft. Its secondary purpose is to serve as a ready reference for aerial photographic terms, whose complete definitions can be found in other glossaries. It is not intended to be a complete dictionary of photography, or as a reference for all aerial photographic systems; its scope is limited only to this aircraft and its photographic system.

AERIAL PHOTOGRAPH: A photograph of objects on the earth's surface taken from an aircraft. This term includes photographs of a radar-scope display.

APERTURE: The opening which controls the amount of light reaching the film through the lens. Its size is controlled by the diaphragm setting, and is expressed in f-numbers. The terms aperture, diaphragm, and stop are frequently used synonymously.

AZIMUTH: The angular difference in degrees between the longitudinal axis of the airplane and the flight path, measured in the horizontal plane.

BRIGHTNESS: The quantity of light emitted, reflected, or transmitted by an object. Terrain brightness refers to the quantity of light reflected from the earth's surface, measured in foot lamberts, and classified into the following ranges:

Dull:	6-25
Medium:	50-200
Bright:	400-1600

CAMERA: A device which records an image on photosensitive material by means of light focused through a lens.

CAMERA AXIS: The axis perpendicular to the plane of photographic lens and passing through its center.

CAMERA BODY: The part of an aerial camera connecting the magazine with the lens cone, and housing the various motors, mechanical drives, and controls which operate the magazine and shutter.

CAMERA CONTROL PANELS: Two panels, Mod 3 and Mod 4, containing the twelve individual positions controls panels. Mod 3 contains positions 1 through 7, Mod 4 contains positions 8 through 12.

CAMERA LENS CONE: The part of an aerial camera attaching to the camera body, and containing the lens assembly, diaphragm, and shutter.

CAMERA MAGAZINE: The part of an aerial camera containing the film on takeup and supply spools, and which moves it across the focal plane. The magazine attaches to the camera body.

CAMERA MOUNT: The device which holds an aerial camera in the aircraft at the desired depression angle. Mounts are of various types, and may be fixed, rotatable, or stabilized to compensate for changes in aircraft attitude or image motion.

CAMERA PORT: The aircraft window through which the camera photographs, also the glass mounted in the window. This glass is of optical quality and is protected from damage during ground operation by manually operated metal shutters.

CAMERA POSITION: The point in space occupied by the camera lens at the instant of exposure; also, the position, or location, of the camera or photographer in the aircraft.

CAMERA OPERATE SWITCHES: The switches used to begin camera operation after the cameras have first been programmed. These switches are the camera operate (OP 1, OP 2), the forward oblique operate (FWD OBL), the trimet operate (TRIMET), the aerial radar, and the extra picture switches.

CAPPING SHUTTER MODE: The method of using cameras at night, with both sets of shutter leaves wound open between exposures, their rewind cycles being initiated by illuminant bursts.

CARTOGRAPHY: The art and science of map construction; the graphic portrayal of the physical features of the surface of the earth. A map is more accurate than a chart, which is used primarily for marine and aerial navigation, and rarely includes all the detail of a map.

CASSETTES: The two detachable film magazines for the KA-40 and KA-46 cameras.

CENTRAL COMPUTER: The electronic unit which supplies timed trip pulses to operate the cameras and the night illuminant release system, and provides the synchro data necessary to operate the viewfinder traveling grid. It is composed of a base assembly, amplifier unit, and two station computers.

CENTRAL COMPUTER FORMAT DATA PLATES: The plates attached to the central computer, containing numerical information for determining the proper pushbutton or channel selection for setting the central computer.

CONE: See CAMERA LENS CONE.

CIRCLE OF CONFUSION: The image point on the film of an object being photographed. The diameter of the circle of confusion is a determining factor of photographic quality, 1/100 inch being the minimum diameter for clear photographs, 1/250 inch being the minimum military standard.

CONSTANT TILT: The condition by which all photographs in a strip are taken at a constant depression angle. An oblique strip.

DEFINITION: The degree of sharpness with which an image is brought out, or focused, by a lens. It is frequently used to mean the resolving power of a lens. See RESOLUTION.

DEPRESSION ANGLE: The angular difference between the optical axis of the camera and the horizontal reference plane of the aircraft, as distinguished from the camera Position. See CAMERA POSITION.

DEPTH OF FIELD: The distance between the nearest object in acceptably sharp focus and the farthest object in acceptably sharp focus.

DIAPHRAGM: The mechanical device which controls the size of the aperture. See APERTURE, STOP.

DRIFT: The horizontal displacement of an aircraft under the action of the wind from the track it would have followed in still air, or the angular difference between the heading of the aircraft and the apparent motion over the ground.

DRIFT COMPENSATION: See DRIFT CORRECTION.

DRIFT CORRECTION, AIRCRAFT: A change in aircraft heading to nullify or compensate for the effects of drift.

DRIFT CORRECTION, MOUNT: The automatic rotation of the azimuth correcting camera mounts to compensate or correct for drift and realign the photographic centerline of the film strip with the actual ground track. Viewfinder drift determinations and mount drift corrections are slaved together, occurring simultaneously the same number of degrees in the same direction.

DRIFT DETERMINATION: The visual measurement of drift, accomplished by rotating the viewfinder reticles and then noting the place at which the track line crosses the drift scale, at the top of the field of view.

DUAL OVERRUN RELAY: The electronic unit which provides the means for holding the night cameras in operation after the last illuminant is released to allow time for illuminant burst.

ELECTRONIC PACKAGE: The unit, not accessible to the crew in flight, which contains the circuitry necessary for viewfinder operation and for channeling ASB-1B stabilization information into the viewfinder system.

E V/H: The reference voltage which expresses the ratio of ground speed in knots to altitude above the terrain in feet.

EXPOSURE: The controlled application of light to photosensitive plate or material to make a photograph. Also, the time duration the light is applied. Also, the photograph itself.

EXPOSURE CONTROL PANEL: An instrument panel mounted unit containing an exposure meter and an autotransformer. It provides a means of continuously monitoring camera exposure and terrain light levels, as detected by the light monitor, and allows remote control of KF-8, KA-40, KA-46A and KA-53A camera exposure settings.

EXPOSURE DATA: The camera shutter and aperture settings, light intensity measurement, filter factors, and controls of light quantity and quality.

EXPOSURE INTERVAL: The time duration or time interval between exposures. In aerial photography, the exposure interval is a controlling factor in the determination of overlap, and is in turn dependent upon factors of altitude above terrain, focal length, ground speed, and the fore and aft format dimensions.

f NUMBER: The ratio of lens focal length divided by the diameter of the aperture. Most cameras arrange the f numbers, or stops, so that each successive stop divides the amount of light admitted by one half. As the f number increases, the amount of light decreases.

FLASH DETECTOR: The unit, basically a photoelectric cell, which reacts to light generated by illuminant burst and then transmits a pulse to operate the night cameras.

FIDUCIAL MARKS: Small markers rigidly attached to the camera to produce image marks on the negative. Also, the image in the center of each edge of a negative. Fiducial marks aid in determining the principal point of the photograph, the direction of film movement, and the first exposure. Frequently called collimating marks.

FIELD COVERAGE: The area on the earth's surface included in a photograph. Frequently used synonymously with negative or format. Coverage also means the extent to which a planned target, target strip, or target map is actually photographed, usually expressed in percent.

FOCAL LENGTH: The distance measured along the lens axis from the rear nodal point to the plane of best average definition over the entire field used in the camera. The distance along the lens axis from lens to focal plane.

FOCAL PLANE: The plane within the camera occupied by the film, and on which the image is focused by the lens.

FOCUS: The sharp definition of an image at the plane of the negative by the camera lens.

FORMAT: The area covered by a photograph. Also, the dimensions of the negative. See FIELD COVERAGE.

GROUND ADVANCE: The distance measured along a flight line between centers of successive photographs, comprising a strip. Also called internal distance. (See overlay.)

HA SCANNER: The High Altitude Scanner, containing a dual optical and photographic cell system. It continuously scans the terrain, and generates an output signal of a frequency proportional to V/H, the ratio of ground speed to altitude.

HYPERFOCAL DISTANCE: The distance from a camera lens to the nearest object in acceptably sharp focus with the lens focused to infinity for any given f stop. It is a function of focal length and aperture. The focus is usually measured by the diameter of the circle of confusion. In aerial photography the hyperfocal distance determines the minimum flight altitude with a given camera, focal length, and aperture.

ILLUMINANT CONTROL PANEL: The illuminant control panel, containing the switches necessary for the selection and readying of the illuminant release system.

IMAGE: The representation of an object formed by light rays passing through a camera lens. A photograph is a recorded image (an image recorded on photosensitive material).

IMAGE MOTION: The blur or loss of sharp detail in photographs resulting from movement of the image at the focal plane during exposure. Image motion is caused by movement of the aircraft or camera, and the inability of the camera to record the image quickly enough to stop motion.

IMAGE MOTION: Motion of photographic image at camera focal plane caused by motion of camera with respect to object.

IMAGE MOTION COMPENSATION: The nullification, through various means, of image motion during exposure. Among the methods used are special cameras, mounts, or magazines.

IMC: Image motion compensation.

INCLINOMETER: A ball-and-race unit which gives a visual indication of the pitch attitude of the aircraft for vertical photography.

INFINITY: That distance from the focal plane from which the light rays appear to reach the camera as parallel rays. For aerial cameras the distance is approximately 500 to 600 feet, depending on focal length.

JUNCTION BOXES: Units of four different models used with each camera to supply power, allow the use of specific cameras, permit camera operation in the manner selected, and provide indications of correct operation.

LENS: A piece of glass, with one or more curved surfaces, having the property of converging or diverging beams of light and forming images of objects.

LENS ASSEMBLY: A unit composed of various lens elements, diaphragm, and lens barrel.

LIGHT MONITOR: A unit containing a lens and photoelectric cell, used to supply a signal proportional to terrain brightness to the camera system.

MAP: The reproduction at an established scale of the physical features of part of the earth's surface, with some indicated means of orientation. Maps generally are of greater accuracy than charts.

MASTER CONTROL PANEL: The panel which supplies aircraft power to the camera control system and provides manual or automatic selection of the ground speed and altitude data necessary for system control and operation.

MOSAIC: An assembly of several overlapping aerial photographs into one photograph, pieced together by matching photographic detail.

NADIR: The point on the earth directly beneath the observer. The vertical plumb line beneath the aircraft. The opposite of zenith. Also, the marks in the viewfinder reticle images which indicate this point in each field of view.

NIGHT PHOTOGRAPHY: Vertical photography accomplished at night with terrain illumination supplied by photo illuminants, either flash bombs or cartridges.

NIGHT SEQUENTIAL: Camera positions 8 and 9 operated in alternate sequence, with illumination supplied by flash cartridges from low altitudes.

NIGHT SIMULTANEOUS: Camera positions 8, 9, and 11 operated simultaneously, with illumination supplied by flash bombs from high altitudes.

NIGHT RELEASE SEQUENCE: The sequence of releasing illuminants from the left side of the bomb bay first and then the right. The sequence is: left inboard row, left outboard row, right outboard row, right inboard row. The release sequence for bombs or a mixed load may be either fully automatic or semiautomatic.

FULLY AUTOMATIC: The left side of the bay releases first, then the release sequence continues automatically into the right side of the bomb bay.

SEMI-AUTOMATIC: The left side of the bay releases first then the release sequence stops. Repositioning of the bomb doors sequence selector switches is necessary to continue the release sequence into the right side of the bay.

NCCS: Navy Camera Control System, USN designation of UCCS.

NCCS-4a: The designation of the Navy Camera Control System in the aircraft.

OBLIQUE PHOTOGRAPHY: Aerial photography using camera depression angles less than 90-degree. Oblique photographic techniques produce photographs whose centers do not coincide with nadir.

FORWARD OBLIQUE: A photograph of the field of view forward of the aircraft, with the camera's optical axis either parallel to or depressed slightly from the longitudinal axis of the aircraft.

HIGH OBLIQUE: An oblique photograph which includes the horizon.

LOW OBLIQUE: An oblique photograph which does not include the horizon.

OBLIQUE STATION POSITION: Any aircraft station that permits oblique photography.

OVERLAP: The amount by which an aerial photograph duplicates the area covered by another. Forward overlap, or forelap, is the overlap between successive photographs on

a flight line. Side overlap, or sidelap, is the overlap between photographs on adjacent parallel flight lines. Overlap is usually expressed as a percentage.

PAPI: The precision automatic photogrammetric intervalometer, which may be used in place of the scanner-converter to channel pre-selected camera pulses to the photographic system for camera operation.

PARALLAX: The apparent displacement of the position of a body with respect to a reference point or system caused by a shift in the point of observation.

ABSOLUTE STEREOSCOPIC PARALLAX: Considering a pair of truly vertical photographs taken from equal flight altitudes, or a pair of rectified photographs; the absolute stereoscopic parallax of a point is the algebraic difference, parallel to the air base, of the distances of the two images from their respective principal points. The term parallax generally refers to absolute stereoscopic parallel in photogrammetry, since the above theoretical conditions are seldom attained. Linear parallax, X-parallax, horizontal parallax are synonymous with absolute stereoscopic parallax.

PARALLAX DIFFERENCE: The difference in the absolute stereoscopic parallaxes of two points imaged on a pair of photographs. Used in the determination of the difference in elevation of the objects. Y-parallax: The difference of the perpendicular distances of the two images of a point from the vertical plane containing the air base. The existence of Y-parallax is an indication of tilt in either or both photographs and/or a difference in flight altitude and will interfere with the stereoscopic examination of the pair. Also called "want of correspondence" or vertical parallax.

ANGULAR PARALLAX: The angle subtended by the eye base of the observer at the object viewed. Also called parallactic angle or angle of convergence.

PHOTO CIRCUIT BREAKER PANEL 106: The panel containing all the circuit breakers which protect the camera system circuitry.

PINPOINT: A single photograph or stereo pair of a specific target or object.

PLATEN: A flat piece of glass or metal at the focal plane against which the film is pressed during exposure.

PLUMB POINT: Vertical point. The point on an aerial photograph, or its extension, corresponding to the ground position vertically beneath the camera the instant of exposure. In a true vertical photograph the plumb point coincides with the principal point or center of the photograph, and with nadir.

POSITION: See CAMERA POSITION.

POSITION CONTROL PANELS: The twelve control panels, comprising the Mod 3 and Mod 4 Camera Control panels, which contain the switches and indicators necessary to program and monitor the operation of the twelve camera Positions.

PRESSURE PLATE: A locating plate that utilizes pressure to hold the film tight and smooth at the focal plane during exposure.

PRINCIPAL POINT: The geometric center point of an aerial photograph corresponding to a point on the perpendicular line through the axis of the lens.

PROGRAM: The arrangement of various camera positions to be used for a particular photo configuration.

PROGRAMMING: The selecting of a camera program at the positions control panels, with the camera programming switches.

RDA SERVO POWER UNIT: An electronic unit used to supply a controlled signal to a camera position for film drive power.

RECONNAISSANCE (AERIAL): Any photographic flight made for the purpose of obtaining photo intelligence information. Used in this sense, the term includes all types of aerial photography.

RECYCLE RATE: The speed at which a pulse type camera or magazine recycles. Camera recycle consists mainly of rewinding the shutter spring. Magazine recycle consists mainly of advancing the film. The combination of camera and magazine recycle rates determines the time between exposures.

REPRESENTATIVE FRACTION (RF): The expression of photographic scale. The ratio between a unit of measurement in a photograph or map, and the corresponding number of identical units on the ground. An RF of 1:5000 means that one foot in the photograph equals 5000 feet on the ground.

RESOLUTION: The ability of a camera or photographic system to record fine detail, measured in lines per millimeter. Often used to mean DEFINITION. (See DEFINITION).

RUNAWAY: Operation of a camera at its maximum recycle rate. Frequently used in forward oblique photography.

SCALE: The relationship between distance in a photograph and the corresponding distance in the subject. This ratio is expressed by the Representative Fraction. Scale is determined by lens focal length and altitude above terrain, and may be expressed S = F/A where:

S = scale in terms of image size to object size.
F = Focal length in feet.
A = Altitude above terrain in feet.

SCANNER CONVERTER: The unit which converts the scanner signal frequency into a dc reference voltage, or E V/H.

SEQUENTIAL PHOTOGRAPHY: The technique by which identical pulse-type cameras, identically mounted, are tripped alternately, to exceed the maximum recycle rate of a single camera.

SHUTTER: A mechanical device for controlling exposure time in cameras. Among the types of shutters used in aerial cameras are focal plane, between-the-lens (intra-lens), Rapidyne.

SKID-TURN: A turn accomplished with the aircraft in a wings-level attitude – to increase system capability during a photographic mission.

SKID ENTRY: The transition period when the aircraft heading is changing from a constant heading to a constant skid-turn rate.

SKID EXIT: The transition period when the aircraft heading is changing from a constant skid-turn rate to a constant heading.

STABILIZATION – gyroscopic (camera): The maintenance, by the use of gyroscopes, of a camera at a desired attitude within the aircraft. The continued maintenance of the camera at the desired preset depression angle, within certain limits, regardless of aircraft pitch and roll.

STABILIZATION – viewfinder: The nullification of the effects of aircraft pitch and roll as seen in the viewfinder image, utilizing signals from the ASB-1B radar system.

STABILIZATION SIGNAL DISTRIBUTION UNIT: The unit which receives pitch and roll information from the ASB-1B radar system and supplies this information as electrical signals to the viewfinder system and the camera mounts for pitch and roll stabilization control.

STEREO: The illusion of depth; third dimensional effect.

STEREO PAIR: Two photographs which show the same field of view but from slightly different angles will appear to have depth when seen through a stereo viewer. These photographs may be made with a special stereo camera, or with any aerial camera.

STOP: The size of the aperture which controls the amount of light passing through a lens. See DIAPHRAGM, APERTURE.

STRIP: Successive photographs along a flight line.

SYSTEM RELAY UNIT: An electronic unit controlling camera system circuitry and providing the necessary position isolation capabilities incorporated in the camera system.

TILT: The angular difference between the camera's optical axis and the horizontal reference plane of the aircraft.

X TILT: corresponds to aircraft roll
Y TILT: corresponds to aircraft pitch
Z TILT: corresponds to aircraft yaw

TRICAMERA: An arrangement or program of three cameras, all of the same type and focal length, one installed vertically and the other two installed as left and right-hand side obliques, to be pulsed simultaneously and provide greater ground coverage. The tricamera programs are at positions 1, 8, 9 and positions 10, 11, and 12 and may be used separately, together, or in conjunction with the trimetrogon program.

TRIMETROGON: An installation using three cameras equipped with metrogon lenses of the same focal length (usually 6") which provide complete horizon-to-horizon coverage. One camera is mounted vertically, the other two as right and left obliques with a fixed thirty-degree depression angle for each.

TELEPHOTO LENS: A lens designed to form relatively large images of distant objects. One whose focal length exceeds the diagonal dimension of the negative. A short focal length lens is one whose focal length is less than the negative diagonal dimension. A wide angle lens is a short focal length lens designed to give a greater field of coverage.

UCCS: Unified Camera Control System. The remote control and operation of aerial cameras through use of electronic and electromechanical equipment, controlled from the cockpit, or from any central location.

VACUUM: The pressure differential, usually measured in inches of mercury, which holds the film firmly against the platen within a camera during exposure.

VERTICAL PHOTOGRAPH: An aerial photograph made when the camera's optical axis is vertical, or nearly so. A true vertical photograph is rarely accomplished.

VIEWFINDERS: Two aerial sighting instruments, containing identical binocular optical systems, and various reticle patterns and presentations, used to scan or view terrain to obtain certain information necessary for aerial photography. Among the information that may be obtained are picture format area, target center, drift determinations, ground speeds, and exposure interval for overlap determination.

VIGNETTING: A restriction of the camera's acceptance of light. A cut-off of a portion of the photograph, resulting from interference caused by aircraft structure, camera windows, or shutters.

V/H: The expression of the ratio of ground speed in knots to altitude above the terrain in feet. E V/H is a reference voltage expressing this ratio electrically, as used in the camera control system.

SECTION IX

FLIGHT CREW COORDINATION

(General flight crew coordination requirements are defined by crew titles. Specific requirements are defined in applicable sections of this manual.)

SECTION X

STANDARDIZATION EVALUATION

INTRODUCTION

CONCEPT

The standard operating procedures prescribed in this manual represent the optimum method of operating the aircraft. The ground and flight evaluation is intended to check individual and squadron compliance with these procedures by observing and grading adherence to standard operating procedures on a continuing basis. The evaluation performed by the squadron Standardization Instructor or the RA-3B Standardization Evaluator is designed to aid the Commanding Officer in improving individual/squadron effectiveness and combat readiness through observation and constructive comments.

APPLICABILITY

The Standardization Evaluation shall be administered annually to pilots, photo-navigators and photo-technician.

IMPLEMENTATION

The standardization evaluation check shall be conducted as prescribed by the Type Commander; however, instruction in and observation of individual/squadron adherence to standard operating procedures must be on a day-to-day basis if maximum benefit is to be derived from the program.

DEFINITIONS

The following definitions are presented to provide a better understanding of the Standardization Evaluation procedures, and to ensure consistency in the interpretation of the terms used herein.

Grading Criteria – Information contained herein that prescribes the standards to be used in determining grades as a result of the performance observed or recorded during the standardization evaluation check.

Area – Routine flight preparation and inflight/post-flight procedures that are observed and graded during a standardization evaluation flight.

Sub-Area – That portion of an area which covers a specific single procedure or a particular aspect of maneuver performance and that is covered by a separate portion of the flight grading criteria, such as airspeed control on an instrument approach.

Critical Area – Any major area or sub-area that covers items of significant importance to the overall mission requirement or the marginal performance of which would jeopardize safe conduct of the flight. An unqualified rating in any critical area yields an overall grade of "unqualified."

Standardization Evaluation Recheck – A standardization evaluation check administered to a pilot/crewmember who has been placed in an unqualified status. Only those areas in which level of knowledge or adherence to prescribed procedures is unsatisfactory will be observed during this check.

Minor Discrepancies and/or Omissions – Minor discrepancies and/or omissions, as may be referred to in the grading criteria, are defined as those that would not adversely affect the successful completion of the mission, or jeopardize the safety of the crew and/or equipment.

Momentary Deviations – Very brief deviations from the tolerances set forth in the grading criteria which are momentary in nature, and which will not be considered in marking, provided the individual being checked is alert in applying corrective action and the deviation does not jeopardize the safety of the aircraft or crew, and does not exceed the limitations prescribed for a "Conditionally Qualified" grade. Cumulative momentary deviations however will result in downgrading.

Qualified (Q) – A very reliable pilot/crewmember who has understanding of standard operating procedures and a thorough understanding of aircraft capabilities and limitations.

Conditionally Qualified (CQ) – A pilot/crewmember who meets the minimum acceptable standards and is considered safe and is qualified to fly the aircraft solo/unchased; but needs more practice in specific areas to become qualified. Such flying may be of the self-practice type.

Unqualified (U) – A pilot/crewmember who fails to meet minimum acceptable standards as established herein. Such pilot/crewmember shall have supervised instruction until he has gained a "qualified" or "conditionally qualified" rating.

GROUND EVALUATION

The ground evaluation consists of a closed and open book examination, and an oral examination. The ground evaluation shall be completed with a grade of "Conditionally Qualified" or "Qualified" prior to commencement of the flight evaluation.

ORAL EXAMINATION

An oral examination for the pilot will be administered, covering emergency procedures only. Due to the extensive nature of, and time required to complete the standardization evaluation check, additional oral examination subjects need not be covered.

WRITTEN EXAMINATION

A bank of questions and answers shall be maintained by the replacement squadron for the purpose of compiling the written examination. Distribution of these examinations shall be limited to two copies per squadron and kept in the custody of the squadron NATOPS Instructor. The NATOPS Evaluator shall be responsible for the distribution, coordination and updating of questions and answers. The open and closed book examination shall consist of questions from the following source materials:

1. RA-3B NATOPS Flight Manual
2. Air Navigation Manuals VOL I and II, USAF
3. Local Station OPS Manual
4. Squadron Photographic Training Manual
5. Flight Planning Documents.

The open and closed book examination will be administered to all crewmembers.

OPEN BOOK EXAMINATION

The open book examination will consist of 50 questions for the pilot, navigator, and photo-technician.

CLOSED BOOK EXAMINATION

The closed book examination will consist of 50 questions for the pilot, navigator, and photo-technician.

OFT/WST PROCEDURES CHECK

(Not Applicable)

NAMT SYSTEMS CHECK

(Not Applicable)

FLIGHT EVALUATION

The Flight Evaluation is designed to measure, with maximum objectivity, the degree of standardization demonstrated by pilots/crewmembers. It is not intended to measure the proficiency and/or ability of those evaluated beyond a point necessary to assure safety of flight. Within reasonable limits, any individual evaluated should be able to attain a "Qualified" grade based upon demonstrated knowledge without regard to special proficiency or ability.

The process utilizes three integrated parts; the Flight Evaluation Worksheet, Flight Evaluation Grading Criteria, and the Evaluation Report Form.

The Flight Evaluation Worksheet is designed to enable the Evaluator/Instructor to record pertinent information for the purpose of a comprehensive postflight reconstruction and critique. Following completion of the evaluation the data from the worksheet are compared with the grading criteria to determine the numerical/adjectival equivalent for entry on the evaluation report form.

The Flight Evaluation mission(s) shall be adequate for Standardization Evaluation purposes. Only observed areas shall be graded.

MAJOR AREAS/SUBAREAS/ITEMS

Note

Asterisks indicate critical areas/sub-areas.

PILOT

I. Mission Planning
   - a. Target Planning
   - b. Flight Plan
   - c. Fuel Plan
   - d. Takeoff Computations
   - e. Crew Promptness
   - f. Personal Equipment

II. Preflight Inspection of Aircraft
   - a. Acceptance of Aircraft
   - b. Preflight Inspection
   - c. Prestart

III. Turn-Up and Taxi
   - a. Engine Start and Pretaxi
   - b. Taxi and Pretakeoff
   - c. Clearances/Communications

IV. Takeoff
   - a. Procedure and Technique
   - b. After Lift-off

V. Climbout – Level-Off
   - a. Climb Schedule
   - b. Checkoff Lists
   - c. Level-Off and Transition to Cruise

VI. Cruise
   - a. Aircraft Control
   - b. Inflight Checks
   - c. Position Reports

VII. Instruments
   - a. Track Planning
   - b. Departure
     - *(1) Clearance Compliance
     - (2) Climbout
     - (3) Check Lists, Level-Off
   - c. Holding and Pattern Entry
   - d. Penetrations
     - *(1) Procedures
     - *(2) Transition, Level-Off
   - e. Approach
     - *(1) Transition to Landing
     - *(2) Final
     - *(3) GCA/CCA Procedures
     - *(4) Missed Approach

VIII. Emergencies

IX. Photography
   - *a. Day VFR Photo Run
   - *b. Knowledge of Photo System

*c. Radarscope and/or Night Photography

X. Crew Coordination

XI. VFR Landing Pattern

a. Entry and Break

*b. Simulated Single Engine

*c. FMLP

*d. Normal Final Landing

XII. Postlanding and Shutdown

a. Taxi Procedures

b. Shutdown Procedures

XIII. Postflight Debrief

a. Yellow Sheet

b. Crew Debrief

PHOTO-NAVIGATOR

Note

Asterisks indicate critical areas/subareas.

I. Mission Planning

a. Navigation

b. Photographic

c. Personal Flying Equipment

d. Navigation Bag Contents

II. Prestart, Start, Pretaxi and Takeoff

III. Navigation

IV. Photographic Run

*a. Pretarget

*b. Target Area

V. Inflight Malfunctions

*a. Radar

*b. Photographic Equipment

VI. Airmanship

*a. Crew Coordination

b. Radio Telephone Procedures

c. Knowledge of Enroute Charts and Publications

VII. Prelanding, Taxi, Shutdown

VIII. Debrief

a. Equipment

b. Mission

PHOTO-TECHNICIAN

Note

Asterisks indicate critical areas/subareas.

I. Mission Planning

a. Assistance to Pilot and P/N

b. Celestial Precomputations

c. Personal Flying Equipment

II. Preflight

a. Yellow Sheets

b. Exterior

III. Pretaxi and Taxi

a. Photo Compartment and Companionway Check

b. Manning Upper Hatch

IV. Radio

a. Establishing Radio Contact on HF

b. Voice Reports

V. Navigation

*a. Use of Sextant

*b. Inflight Computations

*VI. Photographic Run

*VII. Inflight Malfunctions

VIII. Airmanship

*a. Crew Coordination

b. ICS and Lookout

c. Knowledge of Enroute Charts and Publications

IX. Check Lists

X. Post Landing

a. Taxi Procedures

b. Postflight

XI. Debrief

ORAL EXAMINATION GRADING CRITERIA

Grading of the oral examination will be as follows:

Q – Demonstrated thorough knowledge of proper cockpit emergency procedures and thorough familiarity with aircraft systems.

U – Indicated obvious lack of understanding of proper cockpit emergency procedures and lack of familiarity with aircraft systems.

WRITTEN EXAMINATION GRADING CRITERIA

Examination grades for the written examination shall be computed on a 4.0 basis and converted to an adjective grade of qualified or unqualified.

OPEN BOOK EXAMINATION: To obtain a qualified grade, the evaluee must obtain a minimum score of 3.5.

CLOSED BOOK EXAMINATION: To obtain a qualified grade, the evaluee must obtain a minimum score of 3.3.

OFT/WST GRADE DETERMINATION

(Not applicable)

NAMT SYSTEMS CHECK

(Not applicable)

PILOT FLIGHT EVALUATION GRADING CRITERIA

MISSION PLANNING (AREA I)

TARGET PLANNING (Subarea a.)

Q – Supervised and coordinated the planning of the flight route and mission profile. Ensured that the crew received adequate briefing for the mission assigned in accordance with governing directives.

CQ – Accomplished planning with minor errors or omissions that did not affect the ability of the crew to successfully complete the mission.

U – Accomplished planning with errors or omissions that precluded successful completion of the mission.

FLIGHT PLAN (Subarea b.)

Q – Completed Flight Plan and other applicable clearance forms without error or omission in accordance with governing directives. Considered weather factors, including departure, destination, and alternate weather in requesting flight clearance. Included other weather factors, such as cruise winds and severe weather warnings in route planning. Chose route with regard to warning, restricted, prohibited, or controlled areas. Reviewed flight Planning Document and NOTAM file for information which would affect the mission. Obtained copies of applicable IFR departure/routes.

CQ – Completed flight plan with errors or omissions that would not adversely affect successful completion of the mission or jeopardize safety.

U – Completed flight plan with errors or omissions that would preclude successful completion of the mission or jeopardize safety.

FUEL PLAN (Subarea c.)

Q – Prepared plan in accordance with current doctrine, to include bingo fuel, adequate checks, and sufficient fuel remaining at destination and alternates.

U – Failed to prepare fuel plan or prepared an inadequate fuel plan.

TAKEOFF COMPUTATIONS (Subarea d.)

Q – Computed all performance data within tolerances listed below:

U – Made computation errors exceeding tolerances listed below:

Data	Tolerance
Takeoff Roll	±500 feet
Takeoff Speed	±5 knots
Refusal Speed	±5 knots
Line Speed	±5 knots
Safe Single-Engine Speed	±5 knots

CREW PROMPTNESS (Subarea e.)

Q – Crew met scheduled briefing time.

U – Crew failed to meet scheduled briefing time.

PERSONAL EQUIPMENT (Subarea f.)

Q – Wore all items required (refer to table 2-1).

U – Lacked any item on required list.

PREFLIGHT INSPECTION OF AIRCRAFT (AREA II)

ACCEPTANCE OF AIRCRAFT (Subarea a.)

Q – Listed all entries on yellow sheet without errors. Properly inspected Section "B" of yellow sheet.

CQ – Filled out yellow sheet with errors or omissions that would not affect safety. Accepted aircraft with minor gripe not cleared up for flight.

U – Accepted aircraft with downing gripe. Failed to check Section "B" discrepancies on yellow sheet. Failed to list crew on Section "A".

PREFLIGHT INSPECTION (Subarea b.)

Q – Received plane captain's report of preflight, ordnance, fuel distribution, and equipment for mission. Completed preflight inspection with no errors or omissions.

CQ – Completed inspection with minor errors not affecting safety of flight.

U – Did not check crew about preflight. Missed major item affecting safety of flight.

PRESTART (Subarea c.)

Q – Completed all checklist items.

U – Checklist used improperly.

TURNUP AND TAXI (AREA III)

ENGINE START AND PRETAXI (Subarea a.)

Q – Used checklist properly.

U – Omitted items affecting safety of flight. Did not observe engine starting limitations.

TAXI AND PRETAKEOFF (Subarea b.)

Q – Commenced taxi in time to meet scheduled takeoff. Taxied prudently at all times. Used checklist properly.

CQ – Commenced taxi after minor pilot/crew caused delays. Omitted checklist items not affecting safety of flight.

U – Pilot/crew caused delay in excess of ten minutes of scheduled takeoff time. Taxied too fast and/or failed to observe proper precautions. Omitted checklist item affecting safety of flight.

CLEARANCES/COMMUNICATIONS (Subarea c.)

Q – Used proper voice procedures and initiated timely clearance requests.

CQ – Made minor errors in communications and/or untimely requests.

U – Failed to initiate clearance requests. Made gross errors in communications procedures.

TAKEOFF (AREA IV)

PROCEDURE AND TECHNIQUE (Subarea a.)

Q – Performed full power check. Maintained smooth control during takeoff roll. Performed line speed check. Rotated to takeoff attitude at computed takeoff speed.

CQ – Was rough on control without compromising safety. Had tendency to drift off takeoff heading. Failure to rotate at takeoff speed but rotated within ten knots after reaching computer takeoff speed.

U – Failed to perform full power check. Was erratic on control during takeoff roll, tending to compromise safety. Failed to perform line speed check. Overrotated takeoff.

AFTER LIFT-OFF (Subarea b.)

Q – Maintained smooth control. Established optimum climb attitude. Retracted wheels and flaps in accordance with established procedures.

CQ – Was rough on control without compromising safety. Unnecessarily delayed retraction of gear or flaps, but did not exceed limits.

U – Exceeded the gear and flap tolerance established in doctrine. Was erratic enough on control to compromise safety.

CLIMBOUT — LEVEL-OFF (AREA V)

CLIMB SCHEDULE (Subarea a.)

Q – Maintained climb schedule within 10 knots.

CQ – Maintained climb schedule within 15 knots.

U – Exceeded climb schedule more than 15 knots.

CHECKOFF LISTS (AFTER TAKEOFF, 23,500-FOOT LEVEL-OFF) (Subarea b.)

Q – Completed checklists in proper sequence without errors or omissions.

CQ – Completed checklists with errors or omissions not affecting safety of flight.

U – Completed checklists with errors or omissions affecting safety of flight.

LEVEL-OFF AND TRANSITION TO CRUISE (Subarea c.)

Q – Made smooth transition to cruise altitude and airspeed.

CQ – Leveled off more than 100 feet but less than 500 feet from assigned altitude and more than 10 but less than 20 knots off cruise airspeed.

U – Exceeded limits established for CQ. Made rough transition to cruise condition.

CRUISE (AREA VI)

AIRCRAFT CONTROL (Subarea a.)

Maintained airspeed, heading, and altitude within the following limits:

	Airspeed	Heading	Altitude
Q -	±10	±5°	±200
CQ -	±15	±10°	±300
U -	Exceeded CQ Limits	Exceeded CQ Limits	Exceeded CQ Limits

INFLIGHT CHECKS (Subarea b.)

Q – Performed complete inflight checks at least every 30 minutes.

CQ – Performed inflight checks with minor errors or omissions and/or within 40 minutes of previous check.

U – Failed to perform checks as required for CQ.

POSITION REPORTS (Subarea c.)

Q – Made timely reports, using proper procedures and exact phraseology.

CQ – Submitted reports as required but with procedures and phraseology containing minor errors.

U – Made improper or wrong report, or failed to make report.

INSTRUMENTS (AREA VII)

Note

The instrument area is quite detailed in nature, with its subareas broken down into items. This breakdown affords use as an instrument check, if desired.

COMPLETE MISSION PLANNING (Subarea a.)

Note

Omit here items graded in MISSION PLANNING (AREA I).

DEPARTURE (Subarea b.)

COMPLIANCE WITH CLEARANCE

Q – Complied with departure clearance with no navigation deviations in excess of ±5 degrees from assigned track or heading nor altitude deviations in excess of ±300 feet of assigned altitude(s). Made voice reports with minor errors or omissions not affecting safety of flight.

U – Did not meet criteria for Q.

CLIMBOUT

Q – Completed after takeoff checklist with no errors or omissions. Established climb schedule without delay and maintained it within 10 knots.

CQ – Completed after takeoff checklist with minor errors or omissions not affecting safety of flight. Established climb schedule with little delay and maintained it within 15 knots.

U – Did not meet criteria for CQ.

LEVEL-OFF PROCEDURES (SEE AREA V, b and c) Do not grade items here previously graded in AREA V.)

HOLDING AND PATTERN ENTRY (Subarea c.)

PATTERN ENTRY

Q – Entered and maintained position in accordance with governing directives.

CQ – Stabilized holding IAS late. Maintained position in pattern; but occasionally overcontrolled.

U – Did not comply with current directives entering pattern and/or deviated in excess of 300 feet from assigned altitude. Did not obtain holding IAS until after crossing fix. Constantly overcontrolled.

PENETRATION (Subarea d.)

PROCEDURES

Q – Completed descent checklist without error or omission prior to commencing descent. Complied with penetration clearance without error or omission. Remained within 5 degrees of penetration radial after initial interception. Maintained penetration IAS within ±5 knots and rate of descent within 500 fpm (where assigned).

CQ – Made minor deviations or omissions in descent checklist not affecting safety of flight. Completed checklist before penetration turn. Remained within 7.5 degrees of penetration radial after initial interception. Deviated from clearance, but not enough to affect traffic control or safety of flight. Maintained penetration IAS within 10 knots and rate of descent within 750 fpm (where assigned).

U – Exceeded limits specified for CQ.

TRANSITION TO LEVEL-OFF

Q – Made smooth transition to level flight in accordance with governing directives.

CQ – Made transition to level flight in accordance with governing directives, but occasionally overcontrolled. Maintained level-off altitude within limits of -100 to +300 feet.

U – Failed to follow current directives and/or constantly overcontrolled aircraft. Exceeded limits specified for CQ.

APPROACH (Subarea e.)

TRANSITION TO THE LANDING CONFIGURATION

Q – Completed smooth transition to landing configuration. Completed landing checklist to "speedbrakes" with minor variations or deviations not affecting safety of flight or ability to complete the approach. Deviated below minimum or assigned approach altitude by no more than 100 feet.

U – Continually overcontrolled aircraft during transition. Failed to complete landing checklist to "speedbrakes" or made major error or omission affecting safety of flight or ability to complete the approach. Exceeded 100 feet below minimum or assigned altitude. Exceeded aircraft limitations on flaps and gear.

FINAL

Q – Smoothly established and maintained approach airspeed. Made smooth transition to final descent

path without descending below minimum altitude until establishing visual contact. Completed landing checklist.

CQ – Occasionally overcontrolled and/or had difficulty maintaining final approach airspeed. Did not exceed 50 feet below minimum altitude.

U – Continually overcontrolled power and/or altitude during approach. Overlooked extending "speedbrakes", causing difficulty in controlling aircraft and resulting in a missed approach.

GCA/CCA PROCEDURES

Q – Made all required voice reports using proper procedures and phraseology. Following all instructions without delay or deviation. Maintained position on GCA/CCA final with minor deviations of assigned heading or altitude.

CQ – Made all necessary voice reports but with minor deviations or delays not affecting safety of flight or ability to complete the approach. Maintained position to GCA/CCA final with minor deviations that did not result in a missed approach.

U – Used improper voice procedures, resulting in a missed approach or endangering safety of flight, or failed to make a required report, or acknowledge, when so required. Failed to follow instructions received and acknowledged. Overcontrolled aircraft and/or power to the extent that a waveoff was given. Continued approach beyond minimums without visual contact.

MISSED APPROACH

Q – Recognized missed approach situation within 30 seconds of published position/time for initiating missed approach. Made required voice report using proper procedure and exact phraseology when executing missed approach. Made smooth transition to missed approach pattern with minor deviations in heading and altitude. Requested clearance to alternate (if required).

CQ – Recognized missed approach situation more than 30 seconds but not more than one minute from published position/time. Made necessary report with minor errors or omissions not affecting safety of flight. Occasionally overcontrolled during transition to missed approach pattern, but with no deviations affecting the safety of flight or traffic control.

U – Failed to recognize missed approach situation within one minute of published position/time. Failed to make required voice report executing approach and/or failed to request necessary further clearance. Overcontrolled aircraft to the extent that safety of flight or traffic control was endangered.

EMERGENCIES (AREA VIII)

Q – Recognized emergency situation with minimum delay. Took timely and appropriate action as specified by governing directives. Completed applicable check list without error or omissions.

CQ – Recognized emergency situation with delay not endangering safety of flight. Successfully coped with emergency situation, but with deviations from specified directives.

U – Failed to recognize situation. Used improper procedures or deviated from specified procedures to the extent of endangering safety of flight.

PHOTOGRAPHY (AREA IX)

Q – Successfully completed assigned photographic mission.

U – Failed to complete assigned photographic mission.

CREW COORDINATION (AREA X)

Q – The crew was well coordinated and the pilot was well aware of the responsibilities of each crew member. Crew performance as a team reflected pilot emphasis on conformance to standard procedures by all crew members.

CQ – The crew was coordinated and the pilot was generally aware of crew member responsibilities. Crew performance as a team reflected some lack of emphasis on conformance to standard procedures, but did not jeopardize safety of flight or ability to complete the mission.

U – The crew was not coordinated and the pilot was generally unaware of crew member responsibilities. Crew performance as a team reflected lack of emphasis on conformance to standard procedures to the extent that safety of flight and/or ability to complete the mission was jeopardized.

VFR LANDING PATTERN (AREA XI)

ENTRY AND BREAK (Subarea a.)

Q – Properly planned entry to the pattern on speed and altitude. Made proper voice report prior to entry and followed instructions received. Was aware of other traffic in the vicinity of the field. Smoothly executed break maneuver in accordance with specified procedure.

CQ – Made entry to pattern with slight deviations in speed and/or altitude; occasionally overcontrolled. Made late or incomplete voice report prior to entry but did not affect flight safety or traffic control.

U – Executed break maneuver with major deviations from specified procedure and/or exceeded aircraft limitations.

SIMULATED SINGLE ENGINE (Subarea b.)

Q – Followed applicable procedures as specified in governing directives without error or omission. Smoothly controlled aircraft at all times. Maintained safe single engine speed, pattern spacing, and altitude with minor deviations. Completed landing checklist as modified by single engine situation. Initiated waveoff at specified altitude and smoothly controlled aircraft throughout waveoff transition. Did not exceed aircraft limitations.

CQ – Followed applicable procedures as specified in governing directives with minor deviations or omissions not affecting safety of flight or ability to complete the landing. Occasionally overcontrolled with minor deviations not exceeding 300 feet below standard pattern altitude or 10 knots below safe single engine airspeed. Completed landing check list as modified by single engine situation but with additional deviations and/or omissions not affecting safety of flight/or ability to complete the landing. Occasionally overcontrolled during waveoff transition but did not exceed aircraft limitations.

U – Failed to follow applicable procedures as specified or made major deviations that endangered safety of flight or the ability to complete the landing. Continually overcontrolled or made major deviations in pattern spacing and/or altitude and/or airspeed exceeding the limits specified for CQ. Failed to complete the landing checklist as modified by the single engine situation or made major deviations or omissions which affected safety of flight or the ability to complete the landing. Delayed initiation of waveoff below the limits specified for CQ. Continually overcontrolled during waveoff transition and/or exceeded aircraft limitations.

FMLP (Subarea c.)

Q – Smoothly controlled aircraft throughout pattern in accordance with specified FMLP pattern procedures. Completed landing checkoff list without error or omission. Maintained pattern altitudes and airspeeds with minor deviations not to exceed ± 100 feet altitude and speeds with minor deviations not to exceed ±10 knots IAS until turning off the 180. (Speed deviation on final not to exceed ±2 units AA.) Did not lose meatball throughout final after initial sighting. Made touchdown in safe attitude and with centerline not outside of either main mount.

CQ – Occasionally overcontrolled aircraft in the pattern. Made minor deviations from specified procedures and/or landing checklist. Maintained pattern altitudes and airspeeds with deviations not to exceed ±150 feet and ±20 IAS until entering the final. Speed deviation on final did not exceed ±4 units AA but touchdown was made within ±2 units of approach setting. Lost meatball no more than one time on final after initial sighting, and recovered before reaching 300 feet.

U – Continually overcontrolled aircraft in the pattern. Made major deviations from specified procedures and/or landing checklist, jeopardizing safety of flight or ability to complete the landing. Exceeded altitude and/or airspeed limits specified for CQ. Made touchdown in unsafe attitude or with centerline outside of either main mount. Received technique waveoff.

NORMAL FINAL LANDING (Subarea d.)

Q – Smoothly controlled aircraft throughout pattern in accordance with specified landing pattern procedures. Completed landing checkoff list without error or omission. Maintained pattern altitudes and speeds with minor deviations not to exceed ±150 feet and ±10 IAS until entering the final. (Speed deviation on final not to exceed 2 units AA.) Made touchdown between 200 and 800 feet down the runway. Made touchdown in safe attitude and controlled the aircraft smoothly during the rollout.

CQ – Occasionally overcontrolled aircraft in the pattern. Made minor deviations from specified procedures and/or landing checklist. Maintained pattern altitudes and airspeeds with deviations not to exceed ±200 and ±20 knots until entering the final. (Speed deviation on final not to exceed ±4 units AA but touchdown must be made within ±2 units of approach setting.) Made touchdown on runway short of 200 foot mark or beyond 800 foot mark but within first 1000 feet, or took a waveoff. (If waveoff is taken to prevent landing short or long on the first pass, a maximum grade of CQ shall be assigned regardless of outcome of the second pass.) If touchdown is made short of the runway or beyond 1000 foot mark or an excessive sink rate is initiated to land within the 1000 foot mark, a grade of U shall be assigned.

U – Continually overcontrolled aircraft in the pattern. Made major deviations from specified procedures and/or landing checklist, jeopardizing safety of flight or ability to complete the landing. Exceeded airspeed or altitude limits specified for CQ. Made touchdown short of runway or beyond 1000 foot mark, with touchdown attitude and aircraft control during rollout unsafe. Failed to take waveoff following third divergent porpoise.

POST LANDING AND SHUTDOWN (AREA XII)

TAXI PROCEDURES (Subarea a.)

Q – Taxied aircraft smoothly to the parking area. Observed specified taxi techniques and procedures. Did not commence postlanding checklist until clear of the duty runway.

CQ – Was rough on control while taxiing to the parking area. Deviated slightly from specified taxi techniques and procedures.

U – Was rough on control while taxiing to the parking area, causing overstress of the nose gear or injury to personnel or taxiing of aircraft off taxi area. Failed to follow taxi instructions. Commenced postlanding checklist prior to clearing duty runway.

SHUTDOWN PROCEDURES (Subarea b.)

Q – Completed all items on the postlanding checklist without error or omissions, and did not proceed with shutdown checklist until in the chocks.

CQ – Completed shutdown checklist with minor deviations not affecting aircraft safety.

U – Failed to complete shutdown checklist or made major deviations affecting aircraft safety. Proceeded with shutdown checklist before being chocked.

POSTFLIGHT DEBRIEF (AREA XIII)

YELLOW SHEET (Subarea a.)

Q – Filled out yellow sheet without error or omission. Included clear, concise description of discrepancies.

CQ – Filled out yellow sheets with minor deviations or omissions not affecting pilot or aircraft record keeping. Wrote up in understandable manner.

U – Filled out yellow sheet with major discrepancies affecting pilot or aircraft record keeping. Wrote up aircraft discrepancies in ambiguous manner.

CREW DEBRIEF (Subarea b.)

Q – Debriefed crew, covering:

1. Mission accomplishment
2. Crew performance
3. Pertinent recommendations

Made debriefing, short, clear, and concise.

CQ – Made debriefing unnecessarily long and detailed. Included irrelevant material.

U – Failed to debrief crew or did not cover, even briefly, the three areas listed for Q.

PHOTO-NAVIGATOR FLIGHT EVALUATION GRADE CRITERIA

MISSION PLANNING (AREA I)

NAVIGATION (Subarea a.)

Q – Provided properly scaled charts for the type of mission flown. Plotted an accurate intended course, ticked for low level portion of flight. Plotted suitable enroute diversionary fields. Properly prepared flight plan and navigation log. Made weather information, as required for navigation and photography, available.

CQ – Prepared charts with minor errors that did not jeopardize success of mission.

U – Prepared charts with errors that materially jeopardized the mission. Grossly misplotted positions or courses and distances.

PHOTOGRAPHIC (Subarea b.)

Q – Made study of area to be photographed. Considered photographic requirements, using the best available target information. Entire crew attended photographic briefing on mission, and chart depicting flight line information and targets was available. A suitable precheck point and a camera on check point, easily recognizable visually or within the capabilities of the ASB-1B, was selected.

CQ – Completed study of the target area with minor errors or omissions that did not affect the successful completion of the mission.

U – Did not complete study of the target area. Crew did not attend briefing. The successful completion of the mission was adversely affected.

PERSONAL FLYING EQUIPMENT (Subarea c.)

Q – Crewman was equipped as required (refer to table 2-1).

U – Lacked equipment required for Q.

NAVIGATION BAG CONTENTS (Subarea d.)

Q – Navigation bag contained all required items, (refer to Section III, Part 2).

U – Lacked items required for Q.

PRESTART, START, PRETAXI AND TAKEOFF (AREA II)

Q – Completed prestart, start, pretaxi and takeoff checklists without error. Reported to the pilot each checklist completed by title. Reported to the pilot, "four gear up", after takeoff.

CQ – Made no more than one minor error on each checklist, with no error affecting aircraft safety.

U – Made more than one minor error on any one checklist.

NAVIGATION (AREA III)

Minimum navigational requirements for evaluation purposes are defined as follows:

1. For over water flights, comply with ICAO rules as set forth in current Flight Planning Documents.

2. For flight on U.S. airways or off-airways flights over the U.S., comply with FAA rules as set forth in current Flight Planning Documents.

3. For training and operational flights, minimum standards shall be those set forth by the controlling authority for the type of flight under evaluation.

4. The minimum standard for plotting is (a) DR be run 30 minutes ahead of position, (b) a DR position be plotted every 10 minutes, (c) and that a fix be obtained and plotted at least every 30 minutes.

Q – Met navigational requirements of the mission. Properly obtained, evaluated, and plotted navigational information.

CQ – Met navigational requirements of the mission; however, did not properly obtain, evaluate, and plot navigational information.

U – Did not meet navigational requirements of the mission.

PHOTOGRAPHIC RUN (AREA IV)

PRETARGET (Subarea a.)

Q – Completed pretarget checklist prior to reaching target area.

CQ – Made minor errors not adversely affecting accomplishment of the mission.

U – Made errors adversely affecting accomplishment of the mission.

TARGET AREA (Subarea b.)

Q – Completed target checklist.

CQ – Made minor errors not adversely affecting the mission.

U – Made major errors adversely affecting accomplishment of the mission.

INFLIGHT MALFUNCTIONS (AREA V)

RADAR (Subarea a.)

Q – Recognized ASB-1B equipment malfunctions and handled them in an orderly manner.

CQ – Recognized radar equipment malfunctions; did not, however, take the best corrective action.

U – Failed to recognize and take proper corrective action where radar equipment malfunctions existed.

PHOTO EQUIPMENT (Subarea b.)

Q – Recognized and corrected equipment malfunctions.

CQ – Recognized equipment malfunctions; did not, however, take the best corrective action.

U – Failed to recognize equipment malfunctions.

AIRMANSHIP (AREA VI)

CREW COORDINATION (Subarea a.)

Q – Coordinated crew effort. Anticipated demands upon his position. Enhanced overall performance of the crew by continual alertness.

U – Coordinated at a level sufficiently low to hinder crew performance. Was unfamiliar with crew member duties and/or was continually interrupting them to a degree that team work was definitely retarded and mission requirements were lost.

RADIO TELEPHONE PROCEDURES (Subarea b.)

Q – Demonstrated the ability to copy, understand, and read back FAA airways clearances in minimum time. Monitored frequencies and/or facilities at the appropriate time. Was familiar with communication equipment and facilities. Understood and correctly transmitted airways position reports.

CQ – Met the criteria for Q except for discrepancies or delays indicating lack of familiarity with procedures, equipment, or facilities.

U – Failed to transmit or receive mandatory reports through omission or lack of familiarity with equipment or procedures.

EN ROUTE CHARTS AND PUBLICATIONS (Subarea c.)

Q – Demonstrated complete familiarity with en route charts and publications. When inflight, was able to assist the pilot through proper use of en route charts and publications.

CQ – Generally understood the procedures for proper use of airways publications and charts. Was slow in rendering assistance required by the pilot.

U – Was unfamiliar with en route publications and charts. Gave the pilot no assistance in handling documents.

PRELANDING, TAXI AND SHUTDOWN PROCEDURES (AREA VII)

Q – Completed the prelanding (including securing photo system), taxi, and shutdown checklists in a timely manner. Did not commence taxi checklist until the aircraft was off the duty runway. Ensured that the ASB and photo systems were properly set up for landing and that proper shutdown procedures were used.

CQ – Completed checklists with minor errors or omissions not affecting aircraft safety or which would not normally affect future operation of the ASB or photo equipment.

U – Failed to complete checklists or made one error affecting aircraft safety or which would affect future operation of the ASB or photo equipment.

DEBRIEF (AREA VIII)

YELLOW SHEET (Subarea a.)

Q – Assisted pilot by providing a clear concise description of ASB and photo system discrepancies.

U – Either omitted equipment malfunctions from write-up or wrote them up improperly.

MISSION (Subarea b.)

Q – Completed all required debriefing forms, charts, cards and logs. Accurately recorded inflight data, so that it was possible to reconstruct the mission from available information.

CQ – Made minor errors in log keeping; without, however, making it impossible to reconstruct the mission from available information.

U – Filled out required forms, charts, cards, and logs, incompletely, so that it was impossible to reconstruct the mission from available information.

PHOTO-TECHNICIAN FLIGHT EVALUATION GRADING CRITERIA

MISSION PLANNING (AREA I)

ASSISTANCE TO PILOT AND P/N (Subarea a.)

Q – Assisted pilot and P/N in preparation of mission without supervision. Was familiar with all forms and checklists used in mission planning.

CQ – Assisted pilot and P/N in preparation of mission; but required some supervision.

U – Failed to assist pilot and P/N; or needed constant supervision. Was not familiar with most forms and checklists used in mission planning.

CELESTIAL PRECOMPUTATIONS (Subarea b.)

Q – Prepared celestial precomputations from DR positions and ETA's furnished by the P/N, with no supervision and made no errors in form and no arithmetical error affecting the reliability for each fix computed. Filled out form legibly and properly.

CQ – Prepared celestial precomputations from information furnished by the P/N; but required some supervision. Made minor errors in form and/or arithmetical errors that did not affect the reliability of the fix. Filled out form legibly.

U – Failed to prepare precomputations; or required constant supervision. Made errors in form or arithmetic. Filled out form illegibly.

DECM CONSIDERATIONS (Subarea c.)

Q – Assisted the pilot and P/N in preparation of a plan for the use of DECM equipment in accordance with mission profile. Showed understanding of ECM problem and DECM procedures.

CQ – Assisted the pilot and P/N in the preparation of a plan for the use of DECM equipment. Was sketchy on understanding of ECM problems and DECM procedures.

U – Failed to assist in the preparation of a plan for the use of DECM equipment. Showed no understanding of ECM problem or DECM procedures.

PERSONAL FLYING EQUIPMENT (Subarea d.)

Q – Reported for flight briefing in proper flight gear, including all items listed in table 2-1.

U – Reported for flight briefing lacking items listed in table 2-1.

PREFLIGHT (AREA II)

YELLOW SHEETS (Subarea a.)

Q – Checked yellow sheets before proceeding to the aircraft for preflight inspection.

U – Failed to comply with requirement for Q.

EXTERIOR (Subarea b.)

Q – Completed preflight inspection without error or omission 45 minutes prior to scheduled taxi time. Took timely and appropriate action regarding any discrepancies found.

U – Failed to complete preflight inspection. Made major errors or omissions affecting flight safety.

Note

In grading for time, the evaluator shall consider the time by which the inspection would have been completed if circumstances beyond crew member's control had not intervened.

PRETAXI AND TAXI (AREA III)

PHOTO COMPARTMENT AND COMPANIONWAY CHECK (Subarea a.)

Q – Completed photo compartment and companionway checks in accordance with governing directives.

U – Failed to complete photo compartment and companionway checks and/or failed to report discrepancies to pilot.

MANNING UPPER HATCH (Subarea b.)

Q – Manned upper hatch and established ICS contact with the pilot. Read control positions properly during control check. Was in position in the hatch before aircraft left the chocks. Kept vigilant lookout during taxi until clear of congested areas.

U – Failed to meet requirements for Q.

RADIO (AREA IV)

ESTABLISHING RADIO CONTACT ON ARC-38 (Subarea a.)

Q – Requested permission prior to transmitting. Used correct R/T procedure and phraseology in establishing radio contact and reported to pilot when contact was established.

CQ – Made minor errors in R/T procedure and/or phraseology.

U – Failed to obtain permission prior to transmitting and/or made serious errors in R/T procedures and/or phraseology. Failed to notify pilot when radio contact was established and/or of any difficulties encountered in operating the radio.

VOICE REPORTS (Subarea b.)

Q – Made HF voice reports using proper R/T procedures and phraseology (when directed to do so by the pilot).

CQ - Made minor errors in R/T procedures or phraseology when making voice reports.

U – Failed to meet requirements for CQ.

NAVIGATION (AREA V)

USE OF SEXTANT (Subarea a.)

Q – Operated Baird Atomic or Periscopic sextant properly. Quickly and correctly set sextant up for use. (A postflight reconstruction of the Navigation log showed an average error of no more than 20 NM from the reconstructed track.)

CQ – Same as Q except that error may exceed 20 but not 40 NM.

U – Exceed requirements for CQ.

INFLIGHT COMPUTATION (Subarea b.)

Q – Demonstrated ability to compute and shoot a three-star fix within 20 minutes or an LOP within six minutes, using generally accepted procedures. (Flow of information to the P/N was orderly and timely.)

CQ – Same as for Q except that 25 minutes for a three-star fix and seven minutes for an LOP are allowed. (Flow of information to the P/N could have been more orderly and timely, but was acceptable.)

U – Did not meet the standards for CQ.

PHOTOGRAPHIC RUN (AREA VI)

Q – Performed all items on the checklists in an orderly and timely manner immediately prior to reaching the target area. Kept pilot continuously informed of camera, mount (IMC), and stabilization operation. Made minor errors that did not affect the success of the photo run(s).

U – Made major errors that affected the mission adversely.

INFLIGHT MALFUNCTIONS (AREA VII)

PHOTOGRAPHIC (Subarea a.)

Q – Recognized equipment malfunctions and corrected them in a timely manner.

CQ – Recognized equipment malfunctions; did not, however, take the best corrective action.

U – Failed to recognize equipment malfunctions or failed to take proper corrective action when informed of a malfunction.

AIRMANSHIP (AREA VIII)

CREW COORDINATION (Subarea a.)

Q – Coordinated smoothly and effectively in all crew endeavors. Anticipated demands upon his crew position. Enhanced overall performance of crew by continual alertness in performing duties.

U – Coordinated at a level sufficiently low to hinder crew performance. Was unfamiliar with crew member duties and/or was continually interrupting them to a degree that team work was definitely retarded and mission requirements were lost.

ICS AND LOOKOUT PROCEDURES (Subarea b.)

Q – Was well qualified as an airborne lookout. Understood thoroughly established lookout doctrine and utilized accepted ICS procedures.

CQ – Generally understood established lookout procedures but was occasionally lax in following doctrine. Could have been better versed in proper ICS procedures.

U – Not up to the standards of CQ.

AIRWAYS CHARTS AND PUBLICATIONS (Subarea c.)

Q – Demonstrated complete familiarity with en route charts and publications.

When required, was able to assist the pilot through proper use of en route publications.

CQ – Generally understood the procedures for proper use of airways, publications, and charts. Was slow in rendering assistance required by the pilot when questions concerning the airways flights came up or when changes to the flight plan occurred.

U – Was unfamiliar with en route publications and charts. Gave the pilot no assistance in handling documents in flight.

CHECKLISTS (AREA IX)

Q – Used checklists with no errors or omissions. Did not interrupt radio communications. Initiated inflight checks at 30 ± 5-minute intervals.

CQ – Used checklists with minor errors or omissions not affecting flight safety. Initiated requests for inflight checks no later than 40 minutes after previous check.

U – Did not meet standards for CQ.

POSTLANDING (AREA X)

TAXI PROCEDURES (Subarea a.)

Q – Manned upper hatch and established ICS with the pilot expeditiously after turning off the duty runway. Kept pilot informed of obstructions and drag chute positions. Did not leave upper hatch until in the chocks unless called down by the pilot.

CQ – Delayed slightly in manning upper hatch but was not unsafe as lookout. Kept pilot informed of obstacles and drag chute position.

U – Delayed excessively in manning upper hatch and/or was unsatisfactory as lookout for pilot, (allowed aircraft to strike or come dangerously near an obstruction without forewarning pilot), or allowed drag chute to catch on an obstacle without forewarning pilot, and/or left upper hatch position before chocking or without clearance from the pilot.

POSTFLIGHT (Subarea b.)

Q – Conducted a visual postflight after shutdown and reported the result to the pilot.

U – Failed to conduct a visual postflight inspection after shutdown or failed to report the results of a postflight inspection to the pilot.

DEBRIEF (AREA XI)

Q – Attended crew debrief immediately after the flight and participated in discussion of mission accomplishment and crew performance.

U – Failed to attend crew debrief or failed to give information needed for pilot to evaluate performance.

FLIGHT EVALUATION FINAL GRADE DETERMINATION

CRITERIA

The Criteria are designed to enable the Evaluator/Instructor to grade objectively; however, it must be recognized that it is impossible to document all contingencies. Among these are items involving safety of flight. Violation of an official directive or general flight rule based upon safety of flight will constitute an automatic overall "Unqualified" grade. In addition, an "Unqualified" grade in a critical area or sub-area will constitute an automatic overall "Unqualified" grade. If an "Unqualified" grade is given for the above reasons, a complete descriptive statement will be included on the Standardization Evaluation Report Form. A standard for grading pilot/crewmember performance is established by these criteria; but does not relieve the Standardization Evaluator/Instructor from using good judgment based upon experience. In those instances where a pilot/crewmember fails to meet the minimums set forth in the grading criteria but the Standardization Evaluator/Instructor, through past experience and judgment, knows the error to be caused by contributing factors such as weather, turbulence, etc.; he may then place the pilot/crewmember in a passing status and note such action on the Standardization Evaluation Form. If the pilot/crewmember being evaluated consistently makes poor or wrong decisions, a statement to this effect will be included on the Standardization Evaluation Report Form regardless of whether the pilot/crewmember successfully completed the Standardization Evaluation. Unless an obvious unsafe act has been observed or an "Unqualified" grade has been assigned in a critical area or sub-area, the Standardization Evaluator/Instructor will not attempt to determine during the flight if the

pilot/crewmember passes or fails, or to what degree. The only way that areas of weakness or degree of performance of a pilot/crewmember can be accurately determined is by the use of the grading criteria.

NUMERICAL AND EQUIVALENT ADJECTIVE GRADES

Grades utilized in evaluating flight performance are assigned as follows:

QUALIFIED	4
CONDITIONALLY QUALIFIED	2
UNQUALIFIED	0

The overall numerical grade will be the average of the sub-area grades. To determine final (or area) numerical average, add all points scored and divide by the number of sub-areas graded. Convert the final numerical average to an adjective grade as follows:

3.0 - 4.0	QUALIFIED
2.2 - 2.99	CONDITIONALLY QUALIFIED
0 - 2.19	UNQUALIFIED

FORMS AND RECORDS

STANDARDIZATION EVALUATION

Kneepad size work sheets for use by the Evaluator/Instructor, to record preflight, inflight, and postflight data as it is observed, will be provided by the NATOPS Evaluator. The worksheets are designed for maximum flexibility of use while assuring a comprehensive observation. Written entries may be in the form of a check mark, specific values, brief written remarks, etc.

STANDARDIZATION/EVALUATION REPORT FORM

Standardization Evaluation Report Forms will be provided by the NATOPS Evaluator. The report form is designed to document results of the evaluation check and contains space for appropriate comments by the Evaluator/Instructor and the unit Commanding Officer as required. The Standard Report Form will be retained by the squadron for a minimum period of one year after completion or until a subsequent check has been completed. Upon successful completion of a Standardization Evaluation an appropriate entry to that effect will be made on the qualifications and achievements page of the pilot/crewmembers flight logbook. Enlisted crewmembers will have a similar entry made to the page 4, Navy Occupation and Training History Sheet of the enlisted crewmembers service record.

CRITIQUE

The critique is the terminal point in the Standardization Evaluation. The results of the evaluation are presented to the individual at this time. Critique preparation involves processing, reconstructing data collected and presentation of the Standardization Evaluation Report Form. The Critique will be given by the Evaluator/Instructor administering the check. Deviations from standard operating procedures will be covered in detail using all collected data and the worksheet as a guide. Upon completion of the Critique the pilot/crewmember will receive the completed copy of the Standardization Evaluation Report Form.

SECTION XI

PERFORMANCE DATA

TABLE OF CONTENTS

General.	Standard Data Applicable to All A-3 Aircraft
Part A.	RA-3B Basic Wing Performance Data
Part B.	RA-3B Cambered Wing Performance Data

GENERAL

The performance data in this section enables the pilot to realize the maximum performance capabilities of the aircraft. Use of the chart material for preflight planning and application of the prescribed procedures will result in optimum aircraft effectiveness. Section XI is divided into three subsections as follows: a general subsection presenting standard data applicable to all A-3 aircraft; and subsections A and B, presenting performance data applicable, respectively, to RA-3B Basic Wing and RA-3B Cambered Wing Aircraft. Each A and B subsection is further divided into eight parts, with performance data charts presented in proper sequence for preflight planning. Performance data based on flight test are presented in graphical and profile type charts for ICAO standard day conditions. When required, temperature corrections for nonstandard atmosphere are included. Descriptions of and instructions for using the charts are given at the beginning of each part. Examples indicate the steps required to find the proper values.

CRUISE CONTROL COMPUTER

A cruise control computer, available for use with this aircraft, provides a means for the rapid solution of mission planning problems and inflight problems involving the determination of range, endurance speed and time (REST) quantities. Operating instructions are packaged with each computer. A supply of REST computers is provided each Navy operating activity upon first procurement of each new design computer. Additional supplies may be ordered from Naval Supply Center under the following part number.

REST COMPUTERS

AIR-CRAFT	FEDERAL STOCK NO.	MFG. PART NO.	CONFIG-URATIONS
RA-3B	RM6605-703 -2499-V170	APN-71	(Basic wing)
RA-3B	RM6605-719 -5598-V170	APN-73	(CLE wing)

ABBREVIATIONS AND SYMBOLS

Symbols and abbreviations used in this section are listed and identified below:

IAS = Indicated airspeed (knots)

CAS = Calibrated airspeed (knots) ($= IAS + \Delta V_p$)

EAS = Equivalent airspeed (knots) ($= CAS - \Delta V_c$)

TAS = True airspeed (knots) ($= EAS \times 1\sqrt{\sigma}$)

ΔV_c = Compressibility correction (knots)

ΔV_ρ = Position error (knots)

ρ = Atmospheric density at any altitude in slugs per cubic foot

ρ_o = Atmospheric density at sea level in ICAO Standard Air (= 0.0023769 slug per cubic foot)

σ = Air density ratio ($= \rho\rho$)

P = Atmospheric pressure at any altitude ("Hg)

P_o = Atmospheric pressure at sea level in ICAO Standard Air (= 29.92" Hg)

P/P_o = Pressure ratio

"Hg = Inches of mercury

a = Speed of sound at any altitude (knots)

a_o = Speed of sound at sea level in ICAO Standard Air (= 661.8 knots)

M = Flight Mach number (= TAS/a)

TMN = True Mach Number

IMN = Indicated Mach Number

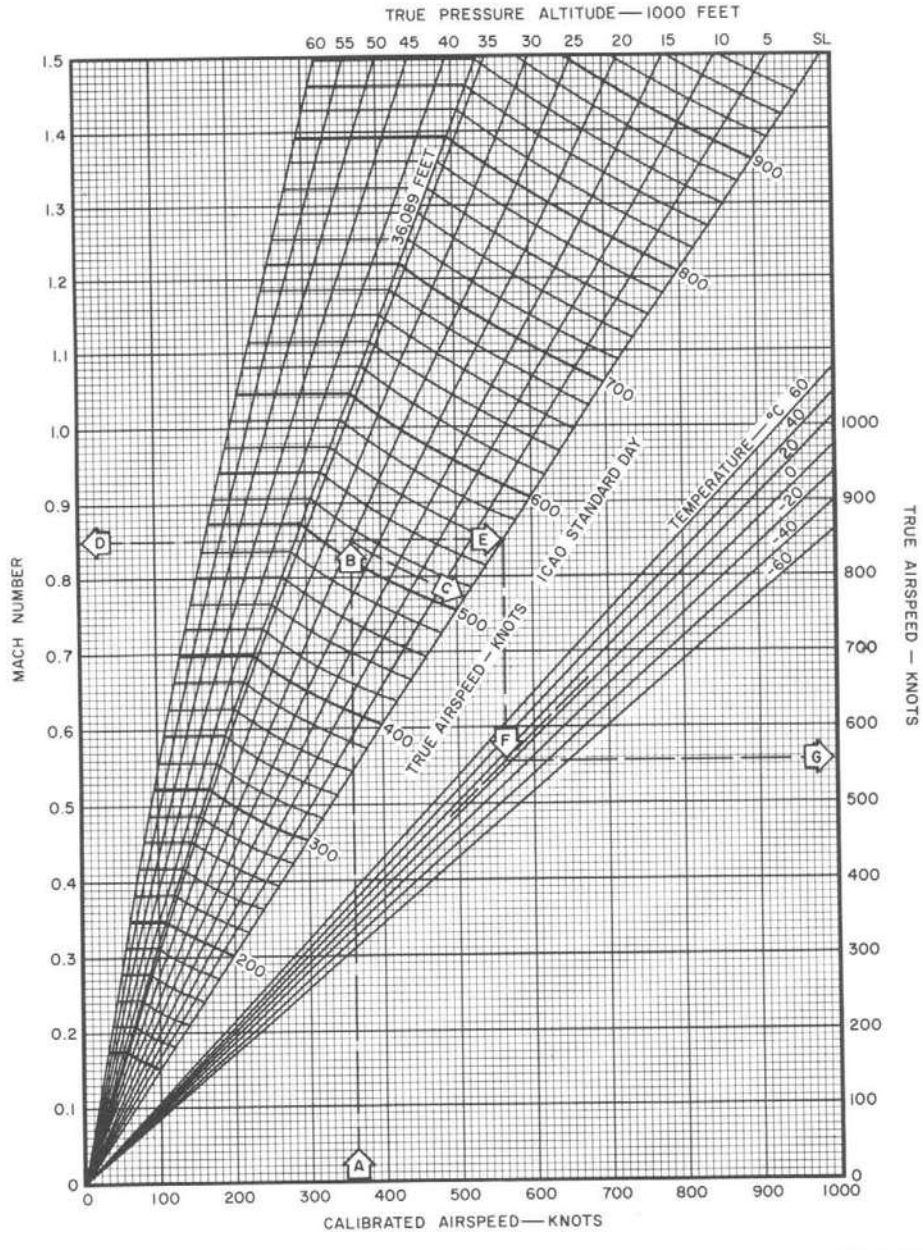
^oC = Degrees centigrade

t = Ambient temperature at any altitude (^oC)

t_o = Ambient temperature at sea level in ICAO Standard Air (= 15° C)

Δ = "Change in" (i.e., Δ gross weight)

AIRSPEED VS MACH NUMBER



EXAMPLE:

Assume airspeed is 360 knots CAS and pressure altitude is 25,000 feet.

(1) Enter chart at 360 knots (A). Sight upward to the 25,000 foot curve (B). Move right, paralleling closest guide line, and read TAS for standard day = 512 knots (C).

(2) To determine TMN: sight left horizontally from point (B) and read scale = 0.85 (D).

(3) To determine TAS for non-standard day (e.g. T = +10°C at 25,000 feet): sight right horizontally to sea level curve (reference only) (E). Sight downward vertically to the +10°C curve (interpolate) (F). Sight right horizontally and read scale = 556 knots (G).

Figure A-1. Airspeed vs Mach Number

TEMPERATURE CORRECTION FOR COMPRESSIBILITY

PRESSURE ALTITUDE FEET	CALIBRATED AIRSPEED - KNOTS										
	100	150	200	250	300	350	400	450	500	550	600
SEA LEVEL	1	2	4	7	10	13	17	21	26	32	38
5,000	1	3	5	8	11	15	19	24	30	36	42
10,000	1	3	6	9	13	17	22	28	34	41	48
15,000	2	4	7	10	15	20	25	32	39	46	54
20,000	2	4	8	12	17	23	29	36	44	52	
25,000	2	5	9	14	20	26	33	41	50		
30,000	3	6	11	16	23	30	38	47			
35,000	3	7	13	19	27	35	44				
40,000	4	9	16	24	32	42					
45,000	5	11	20	29	39						
50,000	7	14	24	35							

PS5823-1C

REMARKS:

(1) Based on 80% of full adiabatic temperature rise.

(2) Indicated temperatures read high.

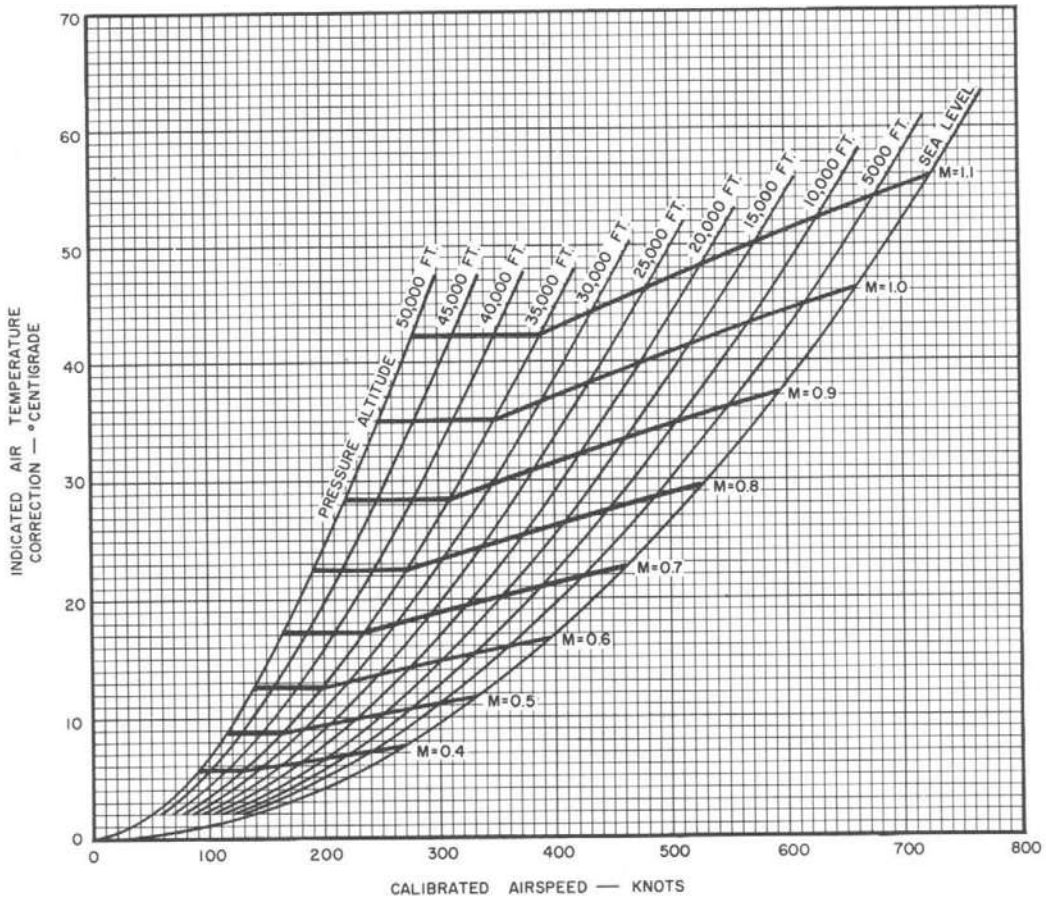
(3) Subtract correction from indicated air temperature (°C) to obtain free air temperature (°C).

DATA AS OF: 1 April 1954
DATA BASIS: Estimates

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 lb/gal

Figure A-2. Temperature Correction For Compressibility (Sheet 1)

TEMPERATURE CORRECTION FOR COMPRESSIBILITY



PS5823-2C

REMARKS:

(1) Based on 80% of full adiabatic temperature rise.

(2) Indicated temperatures read high.

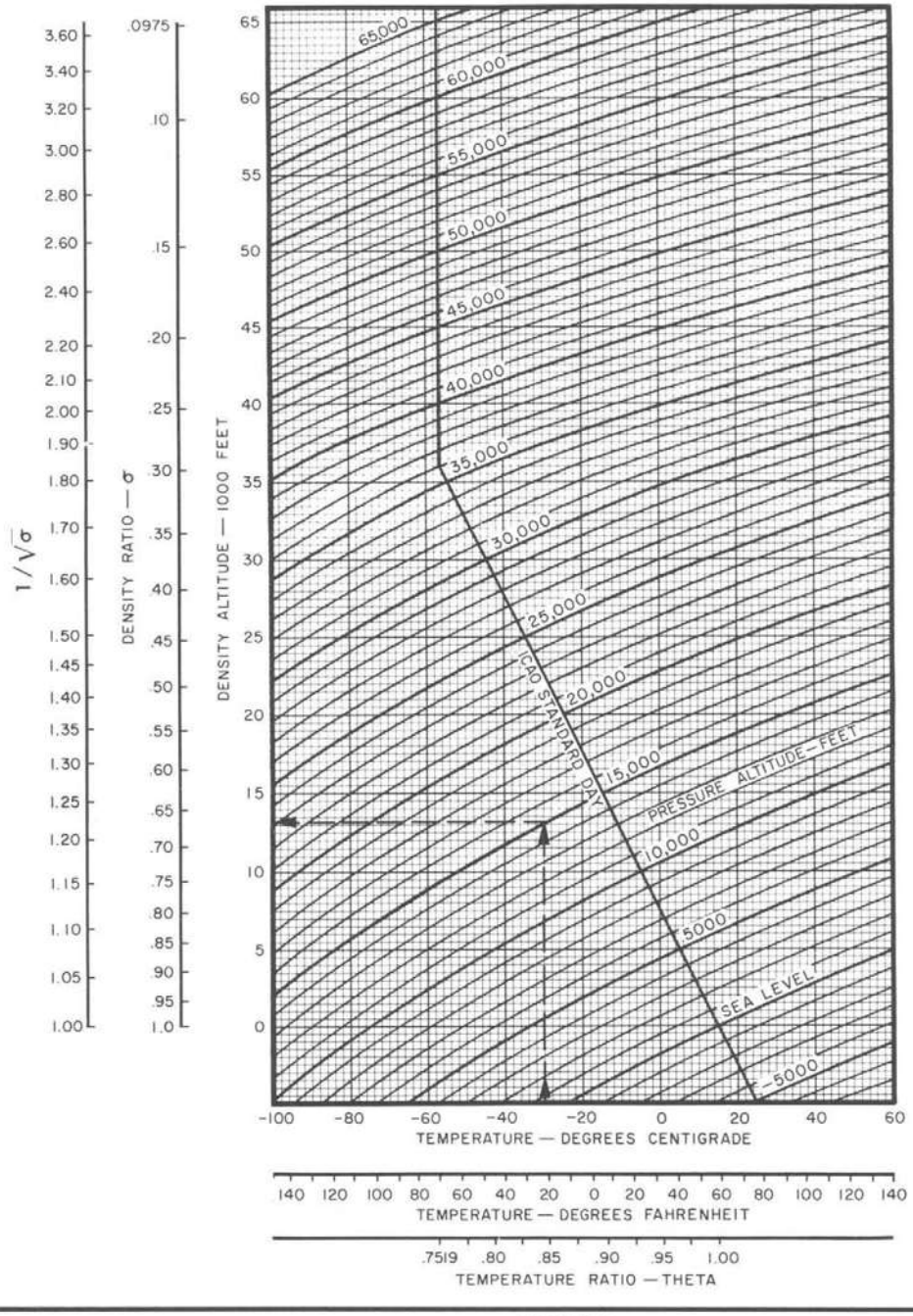
(3) Subtract correction from indicated air temperature (°C) to obtain free air temperature (°C).

DATA AS OF: 1 April 1954
DATA BASIS: Estimates

FUEL GRADE: JP-4
FUEL DENSITY: 6.5 lb/gal

Figure A-2. Temperature Correction For Compressibility (Sheet 2)

DENSITY ALTITUDE CHART



EXAMPLE:

If the temperature is —30°C and pressure altitude is 15,000 feet, the density altitude is 13,100 feet, the density ratio (σ) is 0.668, and $1/\sqrt{\sigma}$ is 1.222.

Figure A-3. Density Altitude Chart

ICAO STANDARD ALTITUDE TABLE

ALTITUDE FEET	DENSITY RATIO $\sigma = \rho/\rho_o$	$\frac{1}{\sqrt{\sigma}}$	TEMPERATURE DEG. C	TEMPERATURE DEG. F	SPEED OF SOUND RATIO a/a_o	PRESSURE IN. OF Hg	PRESSURE RATIO P/P_o
SEA LEVEL	1.0000	1.0000	15.000	59.000	1.000	29.921	1.0000
1000	.9711	1.0148	13.019	55.434	.997	28.856	.9644
2000	.9428	1.0299	11.038	51.868	.993	27.821	.9298
3000	.9151	1.0454	9.056	48.302	.990	26.817	.8962
4000	.8881	1.0611	7.075	44.735	.986	25.842	.8637
5000	.8617	1.0773	5.094	41.169	.983	24.896	.8320
6000	.8359	1.0938	3.113	37.603	.979	23.978	.8014
7000	.8106	1.1107	1.132	34.037	.976	23.088	.7716
8000	.7860	1.1279	−0.850	30.471	.972	22.225	.7428
9000	.7620	1.1456	−2.831	26.905	.969	21.388	.7148
10,000	.7385	1.1637	−4.812	23.338	.965	20.577	.6877
11,000	.7156	1.1822	−6.793	19.772	.961	19.791	.6614
12,000	.6932	1.2011	−8.774	16.206	.958	19.029	.6360
13,000	.6713	1.2205	−10.756	12.640	.954	18.292	.6113
14,000	.6500	1.2403	−12.737	9.074	.951	17.577	.5875
15,000	.6292	1.2606	−14.718	5.508	.947	16.886	.5643
16,000	.6090	1.2815	−16.699	1.941	.943	16.216	.5420
17,000	.5892	1.3028	−18.680	−1.625	.940	15.569	.5203
18,000	.5699	1.3246	−20.662	−5.191	.936	14.942	.4994
19,000	.5511	1.3470	−22.643	−8.757	.932	14.336	.4791
20,000	.5328	1.3700	−24.624	−12.323	.929	13.750	.4595
21,000	.5150	1.3935	−26.605	−15.889	.925	13.184	.4406
22,000	.4976	1.4176	−28.586	−19.456	.921	12.636	.4223
23,000	.4807	1.4424	−30.586	−23.022	.918	12.107	.4046
24,000	.4642	1.4678	−32.549	−26.588	.914	11.597	.3876
25,000	.4481	1.4938	−34.530	−30.154	.910	11.104	.3711
26,000	.4325	1.5206	−36.511	−33.720	.906	10.627	.3552
27,000	.4173	1.5480	−38.493	−37.286	.902	10.168	.3398
28,000	.4025	1.5762	−40.474	−40.852	.899	9.725	.3250
29,000	.3881	1.6052	−42.455	−44.419	.895	9.297	.3107
30,000	.3741	1.6349	−44.436	−47.985	.891	8.885	.2970
31,000	.3605	1.6654	−46.417	−51.551	.887	8.488	.2837
32,000	.3473	1.6968	−48.399	−55.117	.883	8.106	.2709
33,000	.3345	1.7291	−50.379	−58.683	.879	7.737	.2586
34,000	.3220	1.7623	−52.361	−62.249	.875	7.382	.2467
35,000	.3099	1.7964	−54.342	−65.816	.871	7.041	.2353
36,000	.2981	1.8315	−56.323	−69.382	.867	6.712	.2243
36,089	.2971	1.8347	−56.500	−69.700	.867	6.683	.2234
37,000	.2844	1.8753	−56.500	−69.700	.867	6.397	.2138
38,000	.2710	1.9209	−56.500	−69.700	.867	6.097	.2038
39,000	.2585	1.9677	−56.500	−69.700	.867	5.811	.1942
40,000	.2462	2.0155	−56.500	−69.700	.867	5.538	.1851
41,000	.2346	2.0645	−56.500	−69.700	.867	5.278	.1764
42,000	.2236	2.1148	−56.500	−69.700	.867	5.030	.1681
43,000	.2131	2.1662	−56.500	−69.700	.867	4.794	.1602
44,000	.2031	2.2189	−56.500	−69.700	.867	4.569	.1527
45,000	.1936	2.2728	−56.500	−69.700	.867	4.355	.1455
46,000	.1845	2.3281	−56.500	−69.700	.867	4.151	.1387
47,000	.1758	2.3848	−56.500	−69.700	.867	3.956	.1322
48,000	.1676	2.4428	−56.500	−69.700	.867	3.770	.1260
49,000	.1597	2.5022	−56.500	−69.700	.867	3.593	.1201
50,000	.1522	2.5630	−56.500	−69.700	.867	3.425	.1145
51,000	.1451	2.6254	−56.500	−69.700	.867	3.264	.1091
52,000	.1383	2.6892	−56.500	−69.700	.867	3.111	.1040
53,000	.1318	2.7546	−56.500	−69.700	.867	2.965	.0991
54,000	.1256	2.8216	−56.500	−69.700	.867	2.826	.0944
55,000	.1197	2.8903	−56.500	−69.700	.867	2.693	.0900
56,000	.1141	2.9606	−56.500	−69.700	.867	2.567	.0858
57,000	.1087	3.0326	−56.500	−69.700	.867	2.446	.0818
58,000	.1036	3.1063	−56.500	−69.700	.867	2.331	.0779
59,000	.09877	3.1819	−56.500	−69.700	.867	2.222	.0743
60,000	.09414	3.2593	−56.500	−69.700	.867	2.118	.0708
61,000	.08972	3.3386	−56.500	−69.700	.867	2.018	.0675
62,000	.08551	3.4198	−56.500	−69.700	.867	1.924	.0643
63,000	.08150	3.5029	−56.500	−69.700	.867	1.833	.0613
64,000	.07767	3.5881	−56.500	−69.700	.867	1.747	.0584
65,000	.07403	3.6754	−56.500	−69.700	.867	1.665	.0557

REMARKS:

(1) One in. of Hg. = 70.732 lb. per sq. ft.
= 0.4912 lb. per sq. in.

(2) ICAO Standard Sea Level Air
t_o = 15°C
P_o = 29.921 in. of Hg
a_o = 661.8 knots
ρ_o = .0023769 slug per cu. ft.

DATA BASIS: NACA Technical Note No. 3182

PS-11417-1C

Figure A-4. ICAO Standard Altitude Table

PART A

RA-3B BASIC WING AIRCRAFT PERFORMANCE DATA CHARTS

PART 1A

AIRSPEED AND ALTITUDE CORRECTIONS

AIRSPEED AND ALTITUDE CORRECTION CHARTS

AIRSPEED CORRECTIONS

In order to obtain true airspeed, several corrections must be applied to the airspeed indicator reading. Instrument error, which varies for each airspeed indicator as a result of manufacturing tolerances, is noted on the instrument calibration card. This error is usually small and normally may be disregarded, in which case the instrument reading is the actual indicated airspeed (IAS).

The position error correction, determined for each location of the static pressure source, is added to indicated airspeed to obtain calibrated airspeed (CAS). (See figure A-5.) A Mach meter correction for position error is incorporated in figure A-6.

True airspeed (TAS) and Mach number are read directly from figure A-1, using known calibrated airspeed, outside air temperature, and true pressure altitude. To obtain equivalent airspeed (EAS), true airspeed is multiplied by $\sqrt{\sigma}$ corresponding to pressure altitude and ambient temperature.

True ambient temperature is obtained by applying a temperature correction increment, which includes installation and compressibility error, to the cockpit temperature indicator reading (which is always high). This temperature correction increment may be obtained from figure A-2, Temperature Correction for Compressibility. Using the corrected temperature, the value for $\sqrt{\sigma}$ may then be obtained from figure A-3. Similar data may be obtained from the ICAO Standard Altitude Table, figure A-4, when standard atmospheric conditions are desired.

EXAMPLE. Assume the aircraft is at a pressure altitude of 20,000 feet, with an airspeed indicator reading of 460 knots and a temperature indicator reading of +37°C. Assuming zero instrument error, correct ambient temperature and true airspeed are then found as follows:

Airspeed indicator reading. . . . . .460 knots

Correction for instrument error . . . . . 0 knots

Indicated airspeed . . . . . .460 knots

Correction for position error (figure A-5). . . . . .-5 knots

Calibrated airspeed . . . . . .455 knots

Temperature indicator reading . . . . . .+37°C

Correction for instrument error 0

Indicated temperature . . . . . .+37°C

Correction for compressibility (figure A-2, sheet 2) . . . . . .-37°C

Ambient temperature . . . . . 0°C

Then Mach No. = 0.96 and true airspeed = 492 knots under standard day conditions (figure A-1).

At 20,000 feet pressure altitude with an ambient temperature of 0°C, true airspeed = 617 knots (figure A-1).

ALTITUDE CORRECTIONS

Instrument error and position error corrections similar to those applied for airspeed indicator readings must be added to the indicated altimeter readings to obtain true pressure altitude. Figure A-5, provides the correction necessary to compensate for the installation.

EXAMPLE. Assume the RA-3B basic wing aircraft is at an indicated pressure altitude of 20,000 feet, with an airspeed indicator reading of 460 knots. The true pressure altitude, assuming zero instrument error, is obtained by the following method:

Altimeter reading . . . . . .20,000 feet

Correction for instrument error (assumed) . . . . . 0 feet

Indicated airspeed . . . . . 460 knots

Altimeter correction for position error (figure A-5) . . . . . -600 feet

True pressure altitude . . . . . 19,400 feet

Conversely, the indicated pressure altitude required to establish a selected true pressure altitude can be determined by subtracting algebraically the position error correction provided by figure A-5, as follows:

EXAMPLE

Selected true pressure altitude . . . . . 20,000 feet

Instrument error (assumed) . . . . . 0 feet

Indicated airspeed . . . . . 450 knots

Altitude correction . . . . . 200 feet

Required indicated pressure altitude
20,000 - (-200) 20,200

MACH NUMBER CORRECTIONS

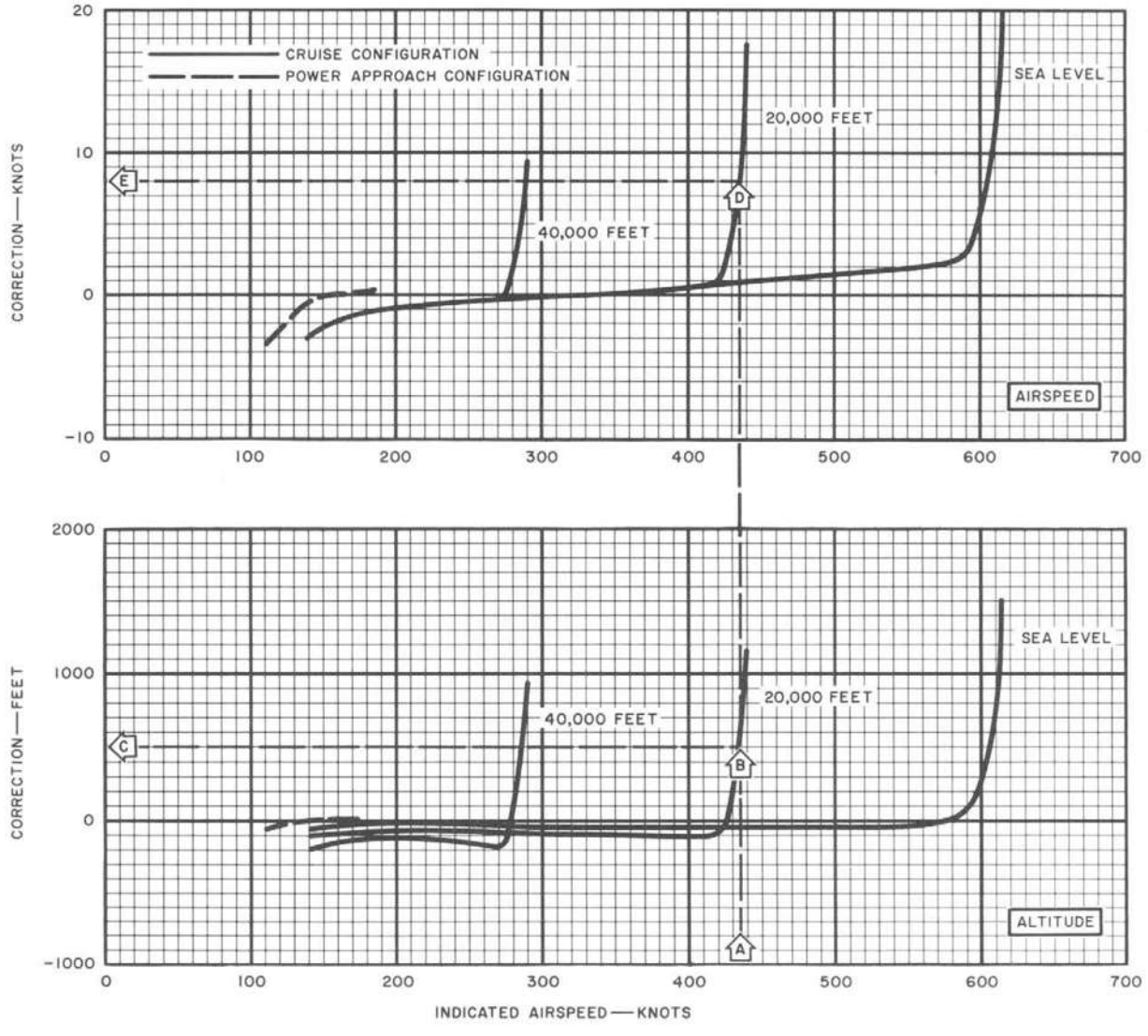
Instrument error and position error corrections must be applied to the indicated Mach number readings (IMN) to obtain a true Mach number reading (TMN). Figure A-6 incorporates the position error correction to make possible direct reading of true Mach number. For all flight in the permissible airspeed range, this correction is virtually zero.

AIRSPEED AND ALTITUDE CORRECTION FOR POSITION ERROR

CORRECTION TO BE ADDED ALGEBRAICALLY

PITOT STATIC SOURCE: CHANNEL AND BUMP AT STATION 76

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



PS-19753-1A

EXAMPLE:

Assume an indicated airspeed of 435 knots and an indicated pressure altitude of 20,000 feet.

(1) Enter chart at 435 knots IAS knots (A). Sight vertically upward to the 20,000-foot curve; altitude (B), or airspeed (D).

(2) Sight horizontally to the left from (B) to read altitude correction = +500 feet (C); or airspeed correction = +8 knots (E)

(3) True pressure altitude = (20,000 + 500 = 20,500) feet.

(4) Calibrated airspeed = (435 + 8 = 443) knots.

DATA AS OF: 15 March 1959
DATA BASIS: Contractor Flight Tests

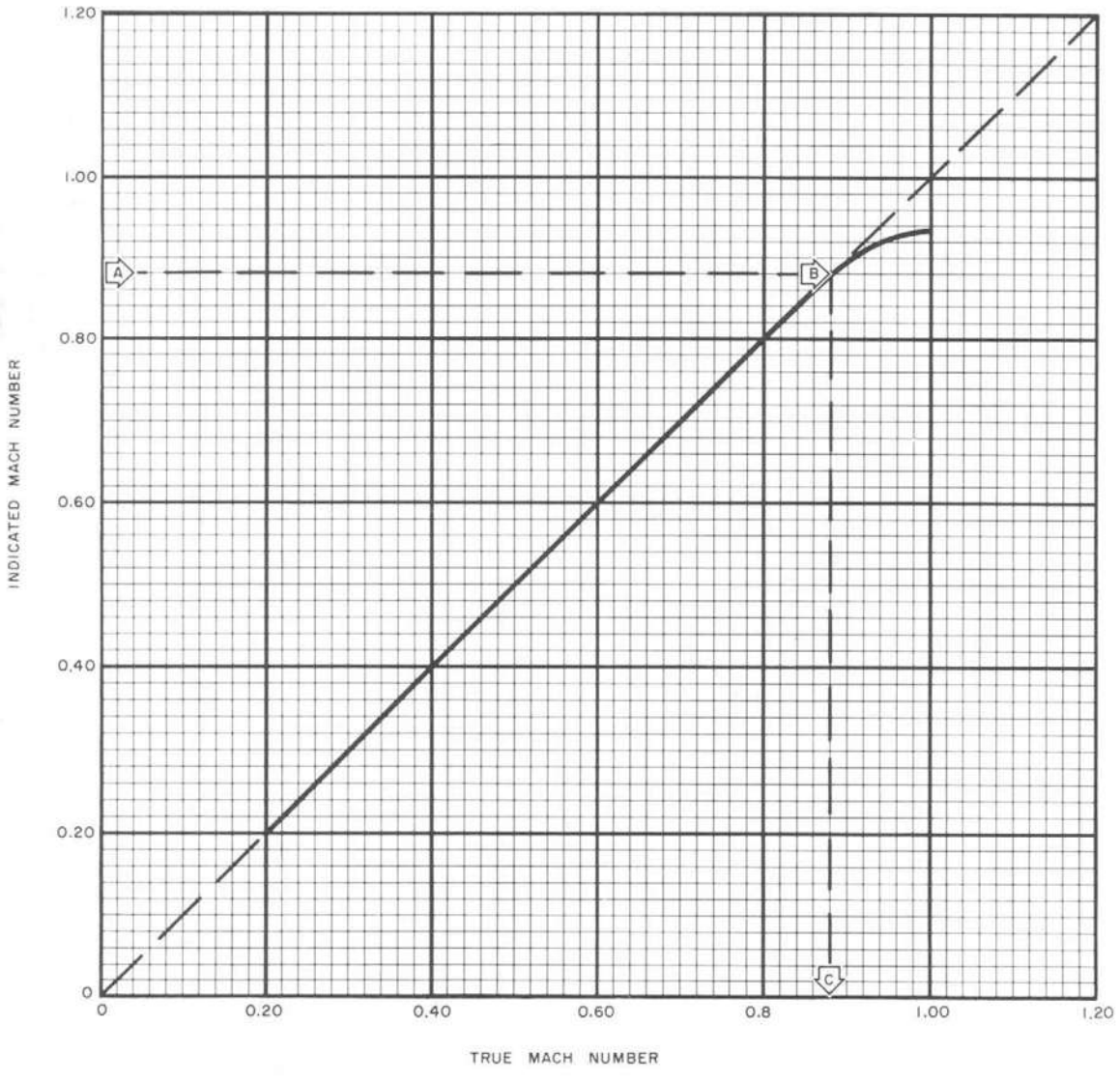
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-5. Airspeed and Altitude Correction for Position Error

MACH NUMBER CORRECTION FOR POSITION ERROR

PITOT STATIC SOURCE: CHANNEL AND BUMP AT STATION 76

MODEL: A-3B, EA-3B, RA-3B—BASIC WING **ENGINES:** J57-P-10



EXAMPLE:

Assume an indicated mach number of 0.88.

(1) Enter chart at 0.88 IMN [A]. Sight horizontally to (unbroken) mach number curve [B].

(2) Sight vertically downward to true mach number scale and read TMN = 0.88 [C].

DATA AS OF: 15 March 1959
DATA BASIS: Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-6. Mach Number Correction for Position Error

PART 2A

TAKEOFF

TAKEOFF CHARTS

The takeoff charts present the ground roll distance to clear a 50-foot obstacle, both with and without JATO assist, and for a hard surface runway with a zero runway gradient. The charts encompass such variables as takeoff weight, liftoff speed, ambient runway air temperature, runway pressure altitude, and headwind. Full flaps and MILITARY thrust are recommended for all takeoffs.

RECOMMENDED LIFTOFF SPEED – NO JATO

Liftoff speeds are based on operational NATC recommended data and are shown on figure A-7.

EXAMPLE. Given an aircraft having a takeoff weight of 70,000 pounds, a runway air temperature of 30°C, and a runway pressure altitude of 4000 feet:

1. Enter chart at 30°C (A). Sight vertically upward to 4000-foot pressure altitude line (B).

2. Sight horizontally to right from (B) to gross weight of 70,000 pounds (C).

3. Proceed vertically downward from (C) and read recommended liftoff speed of 146 KIAS (D).

TAKEOFF DISTANCE – NO JATO

Takeoff distance and total distance to clear a 50-foot obstacle, without JATO assist, is shown on figure A-8. The takeoff distances are based on operational NATC flight test data.

Note that there is a region in the temperature and altitude correction boxes where takeoff is marginal. This region represents an area where rate of climb after takeoff may be between 800 and 400 feet per minute and climbout capability is marginal. Since temperature and altitude are not independent, the boundary lines in these boxes are shown for extreme altitude-temperature combinations. In order to determine accurately if the rate of climb is less than 800 fpm, when operating in this region, see figure A-9. A more detailed explanation of the marginal region is given in the following paragraphs under MAXIMUM RECOMMENDED TAKEOFF WEIGHT.

The method of obtaining the ground roll distance, total distance to clear a 50-foot obstacle, and a linespeed check from the takeoff chart is described in the following examples:

EXAMPLE. Given an aircraft having a takeoff weight of 70,000 pounds, a runway air temperature of 30°C, and a runway pressure altitude of 4000 feet. To determine takeoff ground roll distance and total distance to clear a 50-foot obstacle proceed as follows:

1. Enter figure A-8 at 146 KIAS (D), as determined from figure A-7, and continue horizontally to right to line representing takeoff weight of 70,000 pounds (E).

2. Sight vertically downward to temperature baseline and follow parallel to guidelines to temperature of 30°C (F).

3. Continue vertically downward to pressure altitude baseline, then parallel to guidelines to pressure altitude of 4000 feet (G).

4. Proceed vertically downward to headwind baseline, then parallel to guidelines to headwind of 10 knots (H).

5. Proceed vertically downward and read ground roll distance of 7650 feet (J).

6. Note that in step 3, point (G) fell in region where takeoff is marginal. Therefore, check figure A-9 to see if rate of climb is less than 800 fpm. In making this check, note that for this temperature-altitude condition maximum takeoff weight at 800 fpm rate of climb is 68,800 pounds. Therefore, at gross weight of 70,000 pounds, rate of climb is less than 800 fpm and takeoff is marginal in this case.

LINE SPEED CHECK

EXAMPLE. To determine a line speed check at the 2000-foot runway marker:

1. Enter takeoff distance chart (figure A-8) at ground roll distance of 2000 feet and proceed vertically upward to headwind of 10 knots, then parallel to guidelines to headwind baseline.

2. Continue vertically upward to pressure altitude of 4000 feet, then parallel to guidelines to altitude baseline.

3. Proceed vertically upward to temperature of 30°C, then parallel to guidelines to temperature baseline.

4. Proceed upward to takeoff weight of 70,000 pounds, then horizontally to left and read line speed of 88 KIAS.

MAXIMUM RECOMMENDED TAKEOFF WEIGHT – NO JATO

The maximum takeoff weight shown on figure A-9 is given as a function of rate of climb after takeoff. The data basis for this chart assumes that the landing gear is fully extended, the aircraft is climbing out with MILITARY thrust and without the assist of ground effect.

A rate of climb of 800 fpm, which corresponds approximately to an excess thrust to weight ratio of 0.05, is considered as a minimum acceptable climb-out rate where obstacle clearance is required. Takeoff weight limitations and rates of climb less than 800 fpm are shown for conditions where the climbout is made over flat terrain or over the water. Note that in this region the additional horizontal distances to clear a 50-foot obstacle are 2000 to 3000 feet. If flat terrain condition exists at the end of the runway for a considerable distance, takeoffs may be extended into the marginal region. The required technique would be to lift the aircraft off the runway, accelerate and build up climbing speed while the gear is being retracted. After 10 to 15 seconds, the gear will be fully retracted and the reduced drag will permit a more reasonable climbout. Rates of climb of less than 400 fpm are considered insufficient for attempted takeoff.

EXAMPLE. Given a runway air temperature of 30°C, a pressure altitude of 4000 feet, and flat terrain at the end of the runway which would permit a minimum rate of climb after takeoff of 700 fpm.

1. Enter figure A-9 at temperature of 30°C (A) and sight vertically upward to pressure altitude of 4000 feet (B).

2. From 4000 foot pressure altitude line (B), continue horizontally to right to rate of climb baseline (C), represented by 800 fpm, then parallel to guidelines to point (D).

3. Point (D) is determined by entering at rate of climb of 700 fpm and proceeding vertically upward to intersection of imaginary line drawn in step 2.

4. From point (D) proceed horizontally to right and read maximum permitted takeoff weight, of 70,400 pounds.

5. Note that for rate of climb of 800 fpm (C) with same configuration, maximum permitted takeoff weight is 68,800 pounds.

MINIMUM SINGLE ENGINE CONTROL SPEED

Minimum single engine control speeds are shown on figure A-10. The indicated minimum control speed is the speed that a straight course can be maintained with a bank angle of 5 degrees or less, utilizing rudder as necessary to overcome the yaw due to asymmetric thrust.

CAUTION

Avoid permitting aircraft to overrotate upon firing of JATO units in order to preclude scraping drag chute doors.

TAKEOFF DISTANCE MINIMUM GROUND ROLL – 12 JATO UNITS

The optimum aircraft velocity at firing are given using 12 (MK 7 MOD 1, 5KS-4500) JATO units. The minimum ground roll distances shown in figure A-12, will be obtained by stabilizing the power on both engines with the throttles in "takeoff" position before releasing the wheel brakes. Fire the JATO units 5 seconds before actual takeoff. The JATO-firing speed can be determined from the JATO firing speed chart, figure A-11. The ground roll distance can be determined from the Takeoff Distance Minumum Ground Roll chart, see figure A-12.

TAKEOFF REFUSAL SPEEDS. Takeoff refusal speed (see figure A-13) is that speed at which the pilot can cut the power and still stop the airplane on a runway of a specified length.

EXAMPLE. Assume a takeoff is to be made from an airfield 6500 feet long (A) (dry concrete runway) at 70,000 pounds gross weight (B) under the following conditions: 4000 foot pressure altitude (C), 10° air temperature (D) and 28 knot headwind (E). To determine refusal speed enter chart (see figure A-12) at (A) 6500 foot runway length, proceed horizontally to (B) 70,000 pounds gross weight, then vertically downward to pressure altitude baseline. Follow guideline to point where it intercepts 4000 foot pressure altitude line (C). Proceed vertically downward to temperature baseline, then follow guideline up to intersection of 10°C air temperature line (D). Then downward again to headwind baseline, follow guideline to point where it intersects 28 knot headwind line (E). Proceed downward again to 111 knots refusal speed CAS (F). This is maximum speed that can be reached and still enable pilot to stop the aircraft on a 6500 foot runway.

REFUSED TAKEOFF STOPPING DISTANCE – NO JATO. The refused takeoff stopping distance is that distance required to stop an aircraft after it reached

a specified speed. The flight conditions to be taken into consideration are ground speed, gross weight, pressure altitude and air temperature. Two stopping distances can be obtained; one as the result of using a drag chute and the second distance without the use of the drag chute.

EXAMPLE. Assume a ground speed of 82 knots CAS (A) is reached, during takeoff, at a pressure altitude of 4000 feet (B) with an air temperature of 6°C (C), takeoff weight of 65,000 pounds (D) and a headwind of 10 knots (E). See figure A-14, and enter graph at refusal speed of 82 knots (A), follow guideline to 4000 foot pressure altitude (B), proceed horizontally to temperature baseline, follow guideline to point where it meets air temperature line of 6°C (C). Proceed horizontally once more to aircraft takeoff weight of 65,000 pounds (D) without drag chute, follow graph line down to headwind baseline, then follow guideline to where it intersects 10 knot headwind line (E). Follow graph line down to stopping distance of 2500 feet (F). The stopping distance with drag chute deployed is 2000 feet (G).

JATO FIRING SPEED

This chart (see figure A-11) enables the pilot to determine the exact moment for firing the JATO units. The pilot must have this knowledge to allow for complete burnout of the units by the time the aircraft reaches liftoff speed.

EXAMPLE. Assume a takeoff at 76,000 pounds gross weight (A), pressure altitude of 6000 feet (B) and air temperature of 6° C (C). Enter chart (see figure A-11) at 76,000 pounds (A), proceed horizontally to intersection of guideline and drop downward to pressure altitude baseline. Follow guideline down to where it intersects 6000 foot pressure altitude line from (B). From this point continue down to temperature baseline, then follow guideline up to where it meets 6° C air temperature from (C). Proceed down to JATO firing speed at bottom of graph and read 70 knots CAS (D). This is speed to fire JATO units to assure complete burnout at liftoff.

TAKEOFF DISTANCE MINIMUM GROUND ROLL – JATO

EXAMPLE. Assume a takeoff is to be made at 76,000 pounds gross weight (A) at a pressure altitude of 6000 feet (B) and at an ambient temperature of 6°C (C). Enter chart (figure A-12) at 76,000 pounds (A), proceed horizontally on graph to point where it intersects guideline. Sight horizontally from this point to where line would fall on liftoff speed scale and read 147 knots CAS. Return to guideline and proceed downward to pressure altitude baseline, follow guideline to point where it intersects 6000 foot pressure altitude line from (B). Continue down to temperature baseline, follow guideline up to where it intersects 6° C temperature line from (C). Move down graph to headwind baseline, follow guideline to where it intersects 12 knot headwind from (D). Drop downward on graph to distance for takeoff and read 1620 feet (E).

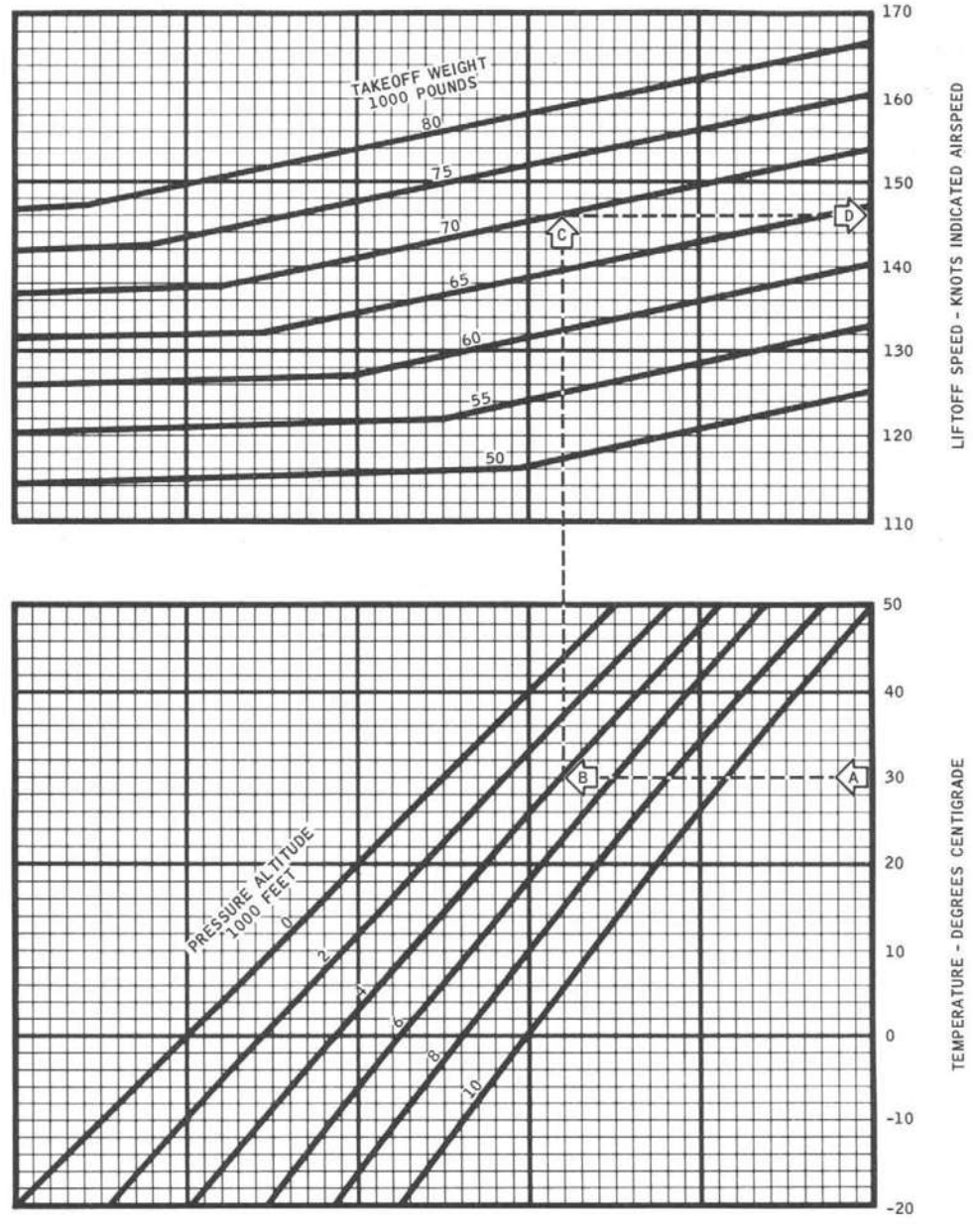
TWO ENGINE OPERATION

RECOMMENDED LIFTOFF SPEED

FULL FLAPS — MILITARY THRUST — NO JATO

MODEL: A-3B, EA-3B, RA-3B — BASIC WING

ENGINES: J57-P-10



REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

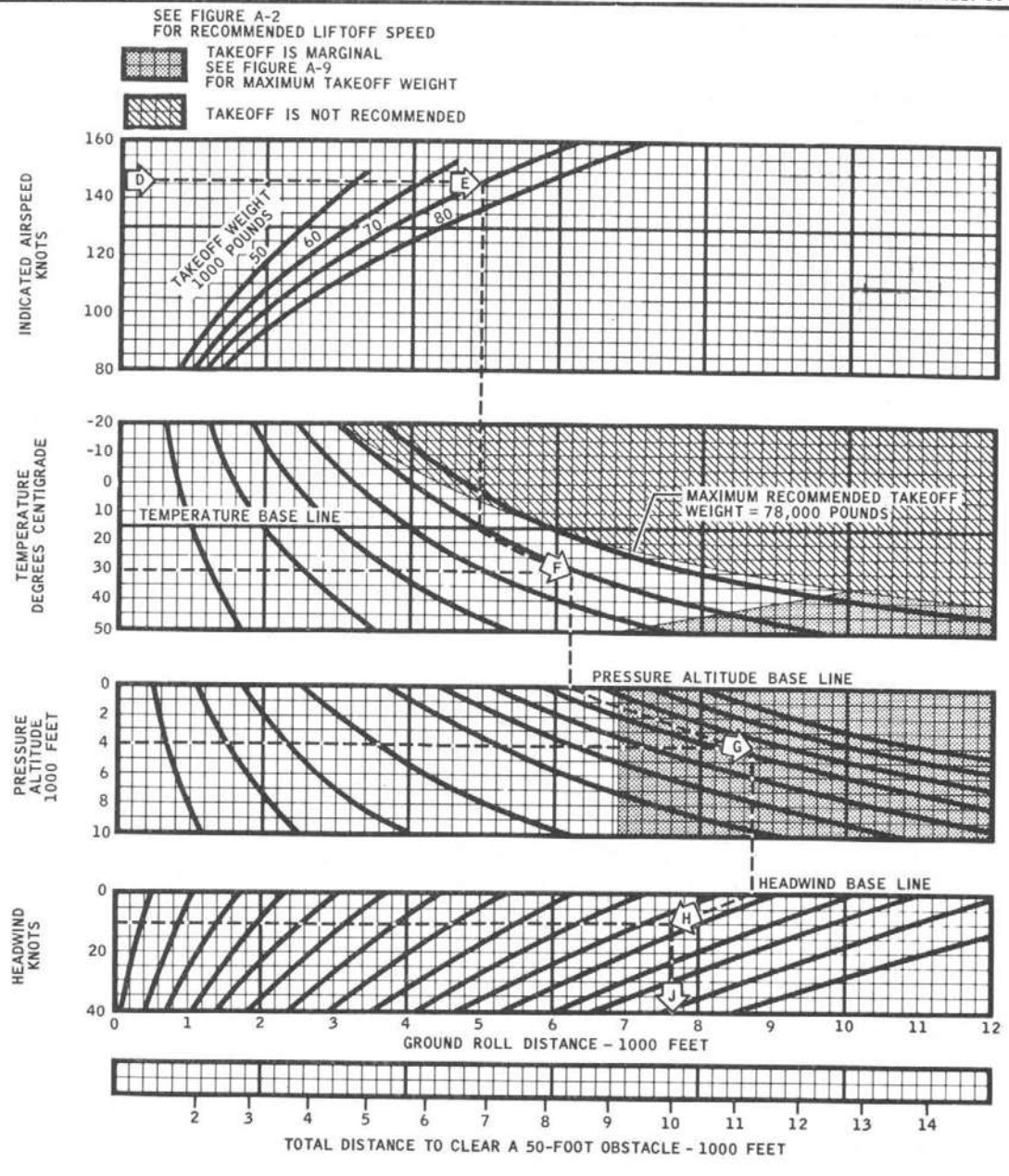
Figure A-7. Recommended Liftoff Speed

TWO ENGINE OPERATION

TAKEOFF DISTANCE

FULL FLAPS MILITARY THRUST NO JATO

MODEL: A-3B, EA-3B, RA-3B—BASIC WING **ENGINES:** J57-P-10



ATB-1-11 P-40516-1

REMARKS:

(1) Takeoff distances are based on engines delivering military thrust.

(2) For takeoff over a 50-foot obstacle, read total distance on scale below ground roll distance J.

EXAMPLE:

See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-8. Takeoff Distance

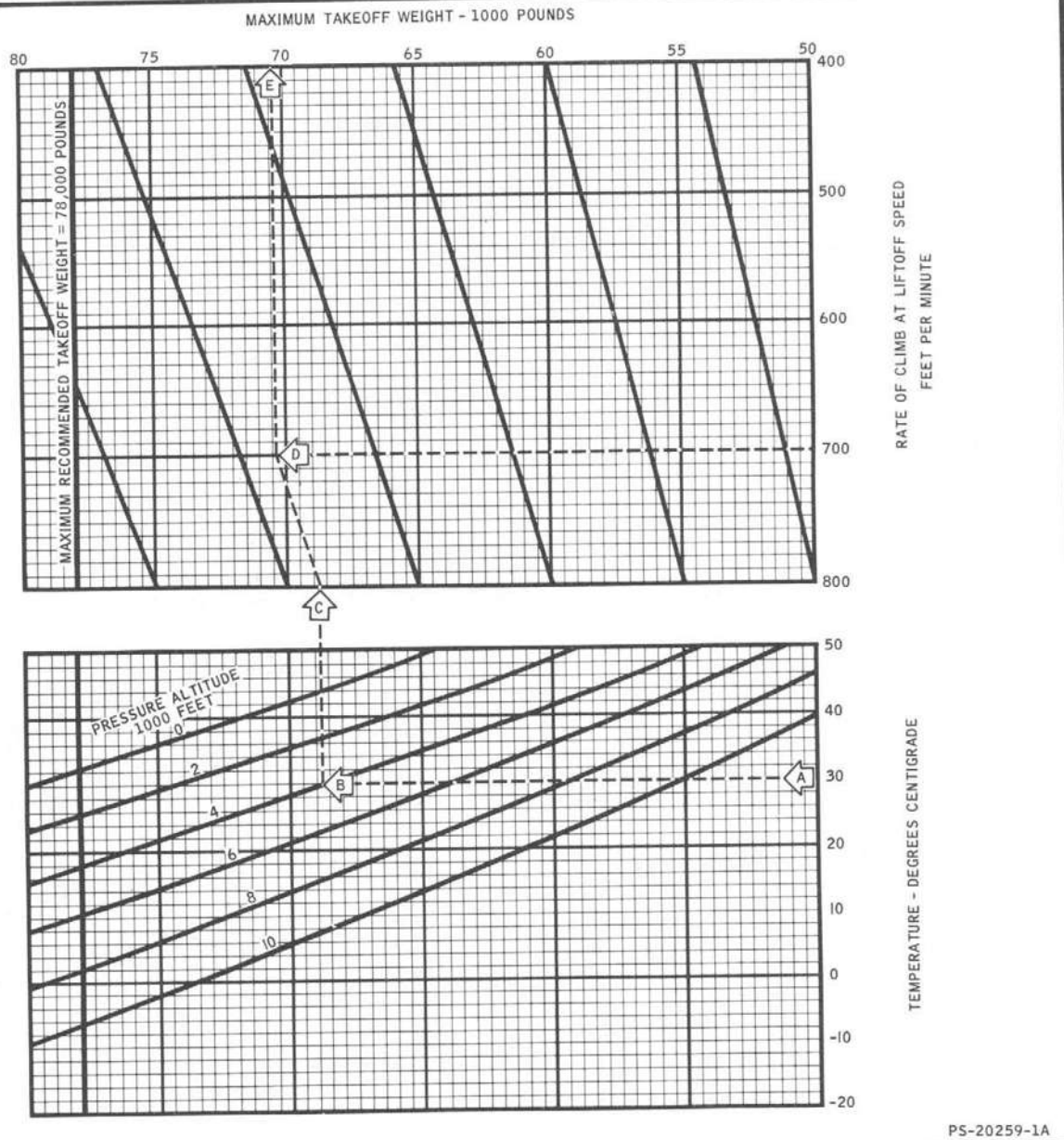
TWO ENGINE OPERATION

MAXIMUM RECOMMENDED TAKEOFF WEIGHT

FULL FLAPS — MILITARY THRUST — NO JATO

MODEL: A-3B, EA-3B, RA-3B — BASIC WING

ENGINES: J57-P-10



REMARKS:

For rates of climb less than 800 feet per minute, acceleration and climbout performance is marginal. Takeoff should not be attempted when obstacles require high climbout capabilities after takeoff.

EXAMPLE:

See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

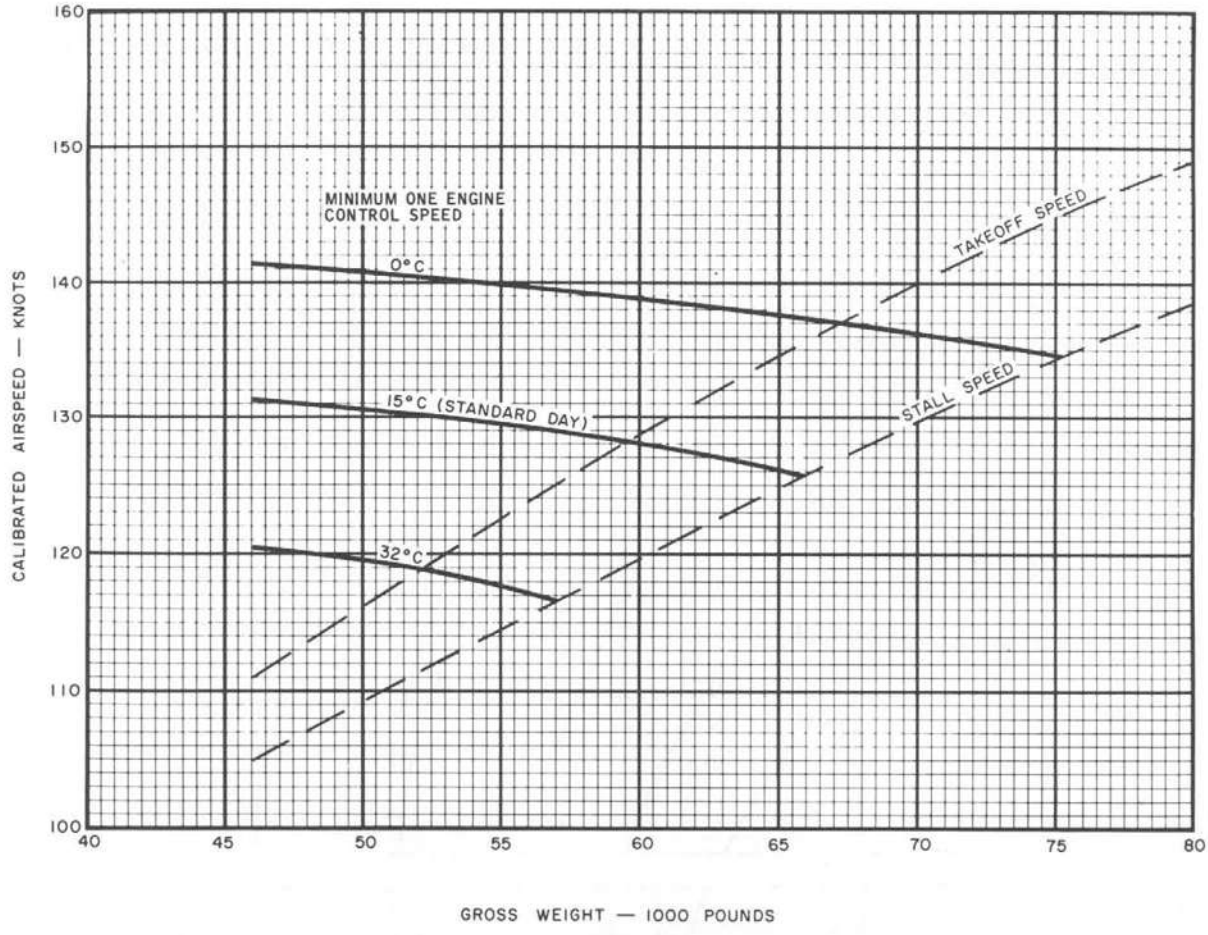
Figure A-9. Maximum Recommended Takeoff Weight

ONE ENGINE OPERATION

MINIMUM SINGLE ENGINE CONTROL SPEED

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINE:** J57-P-10



ATB-1-11 P-40517-1

REMARKS:

(1) Sea Level.

(2) Minimum one engine control speed based on holding constant heading with full rudder deflection and 5° bank angle.

(3) Military thrust *
0° C - 11,600 LBS
15° C - 10,500 LBS
32° C - 9,400 LBS

DATA AS OF: 1 July 1961
DATA BASIS: Estimated

* BASED ON P & W CURVE LESS DUCT LOSS.

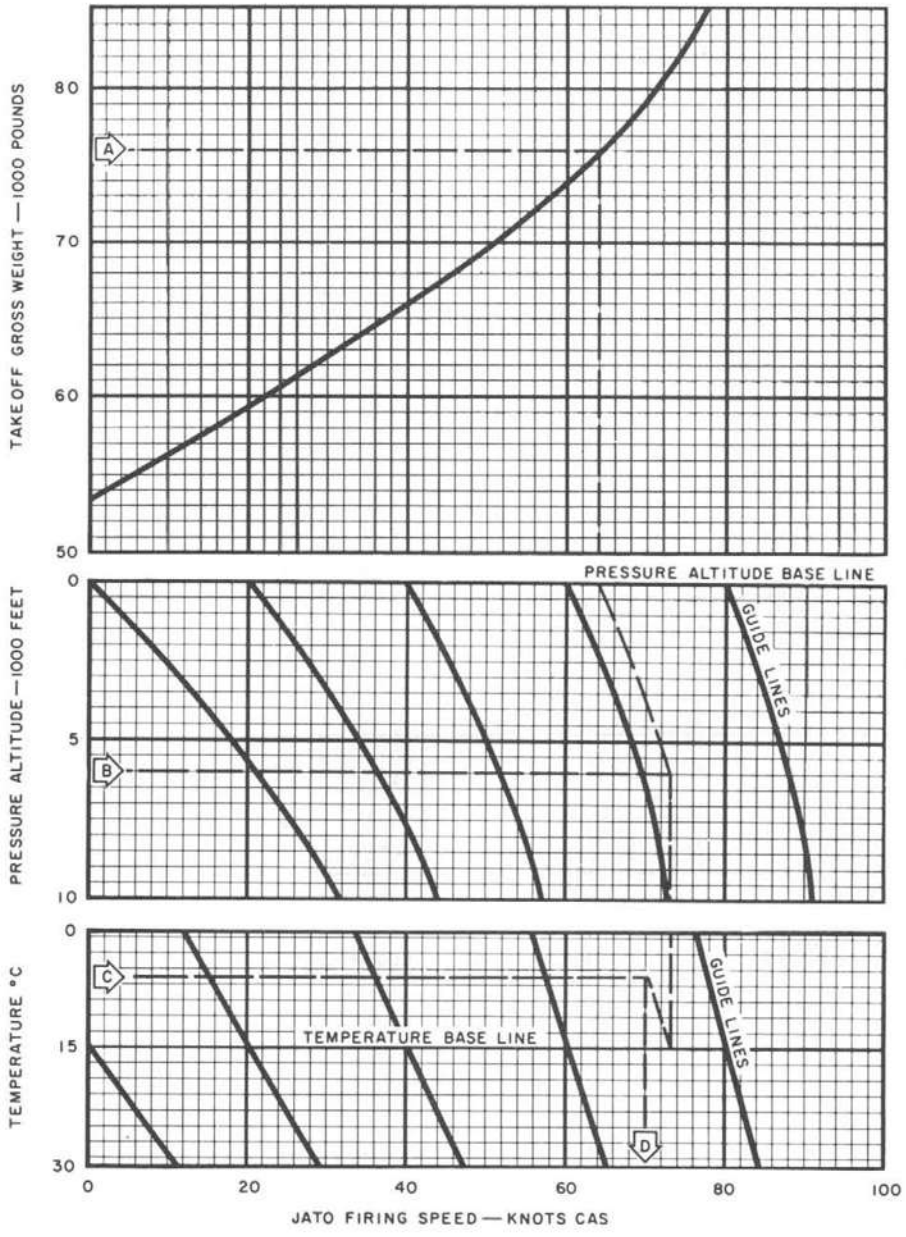
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-10. Minimum Single-Engine Control Speed

JATO FIRING SPEED

FULL FLAPS **12 JATO UNITS**

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



ATB-1-11 P-40518-1

REMARKS:

(1) JATO burning time is 5 seconds.

(2) JATO burns out at liftoff.

EXAMPLE:

Under the following conditions:

(a) Takeoff weight = 76,000 pounds (A)

(b) Pressure altitude = 6000 feet (B)

(c) Air temperature = 6°C (C)

Then:

The JATO firing speed for burn-out at liftoff is 70 knots (D)

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

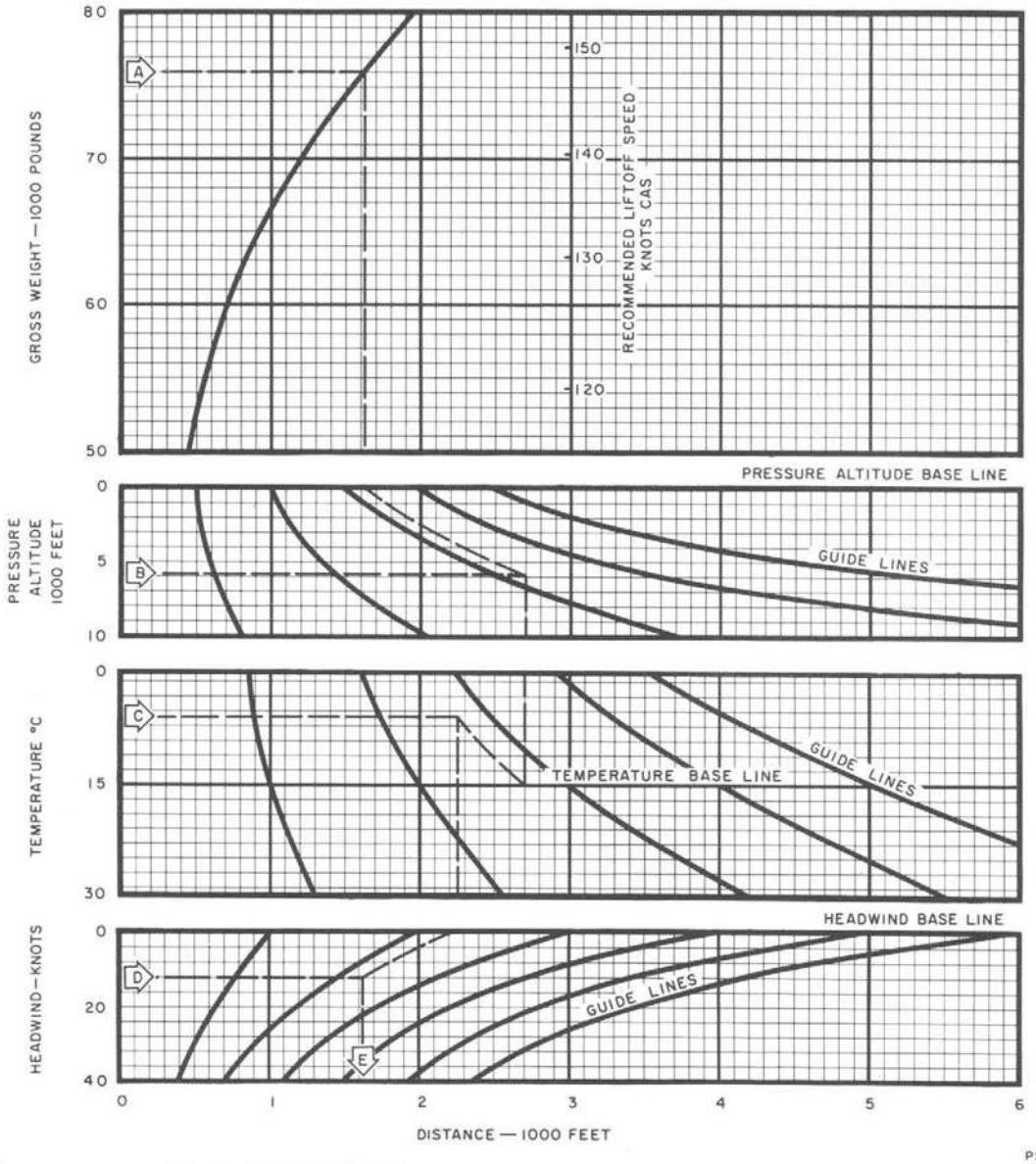
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-11. JATO Firing Speed

TAKEOFF DISTANCE MINIMUM GROUND ROLL

FULL FLAPS **12 JATO UNITS**

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



REMARKS:

(1) JATO burns out at liftoff if fired as shown on JATO FIRING SPEED chart.

EXAMPLE:

Under the following conditions:

(a) Takeoff weight = 76,000 pounds (A).
Liftoff speed = 147 knots CAS.

(b) Pressure altitude = 6000 feet (B).

(c) Air temperature = 6°C (C).

(d) Headwind = 12 knots (D).

Then:

The takeoff ground roll with 12 JATO units is 1620 feet (E).

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

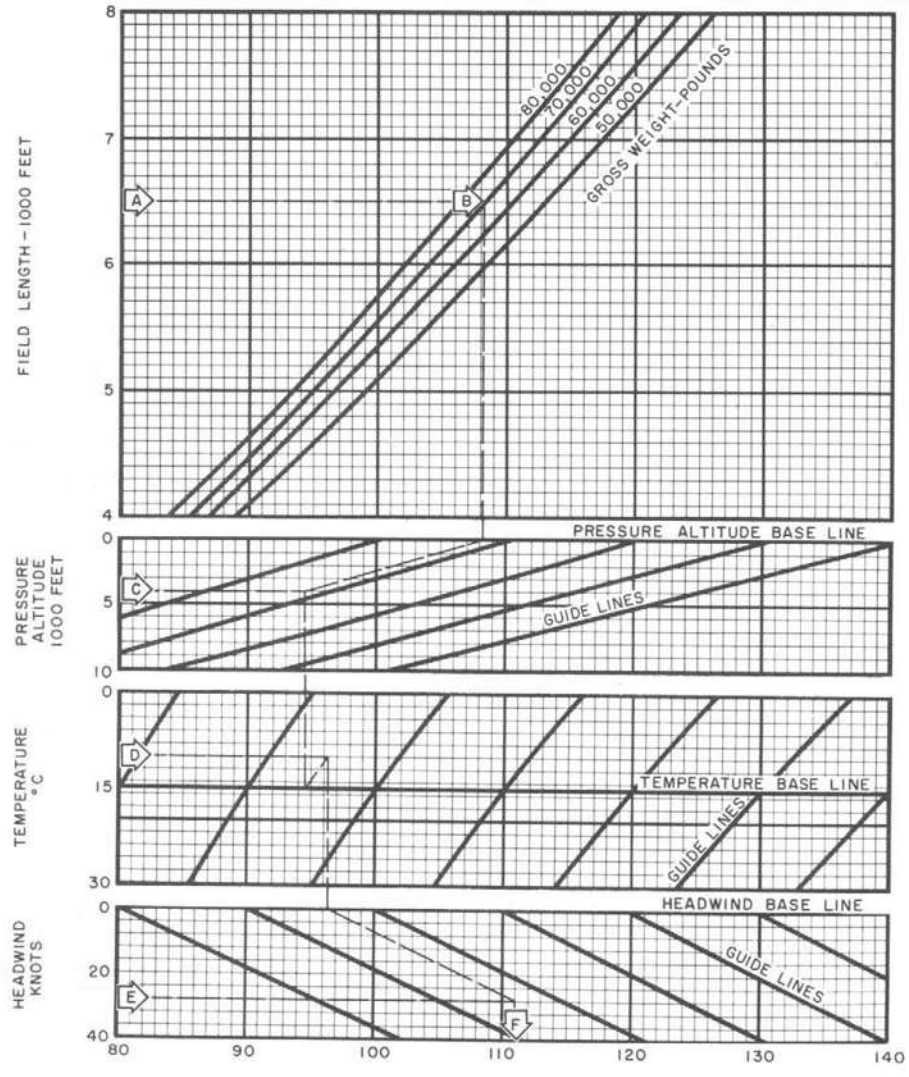
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-12. Takeoff Distance Minimum Ground Roll

TAKEOFF REFUSAL SPEEDS

FULL FLAPS **NO JATO**

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



REMARKS:

(1) Data includes distance covered in 5 seconds pilot reaction time.

(2) Maximum hytrol braking used for stopping.

EXAMPLE:

Under the following conditions:
(a) Field length = 6500 feet (A).
(b) Takeoff weight = 70,000 pounds (B).
(c) Pressure altitude = 4000 feet (C).
(d) Air temperature =10°C (D).
(e) Headwind = 28 knots (E).

Then:
The maximum refusal speed is 111 knots CAS (F).

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-13. Takeoff Refusal Speeds

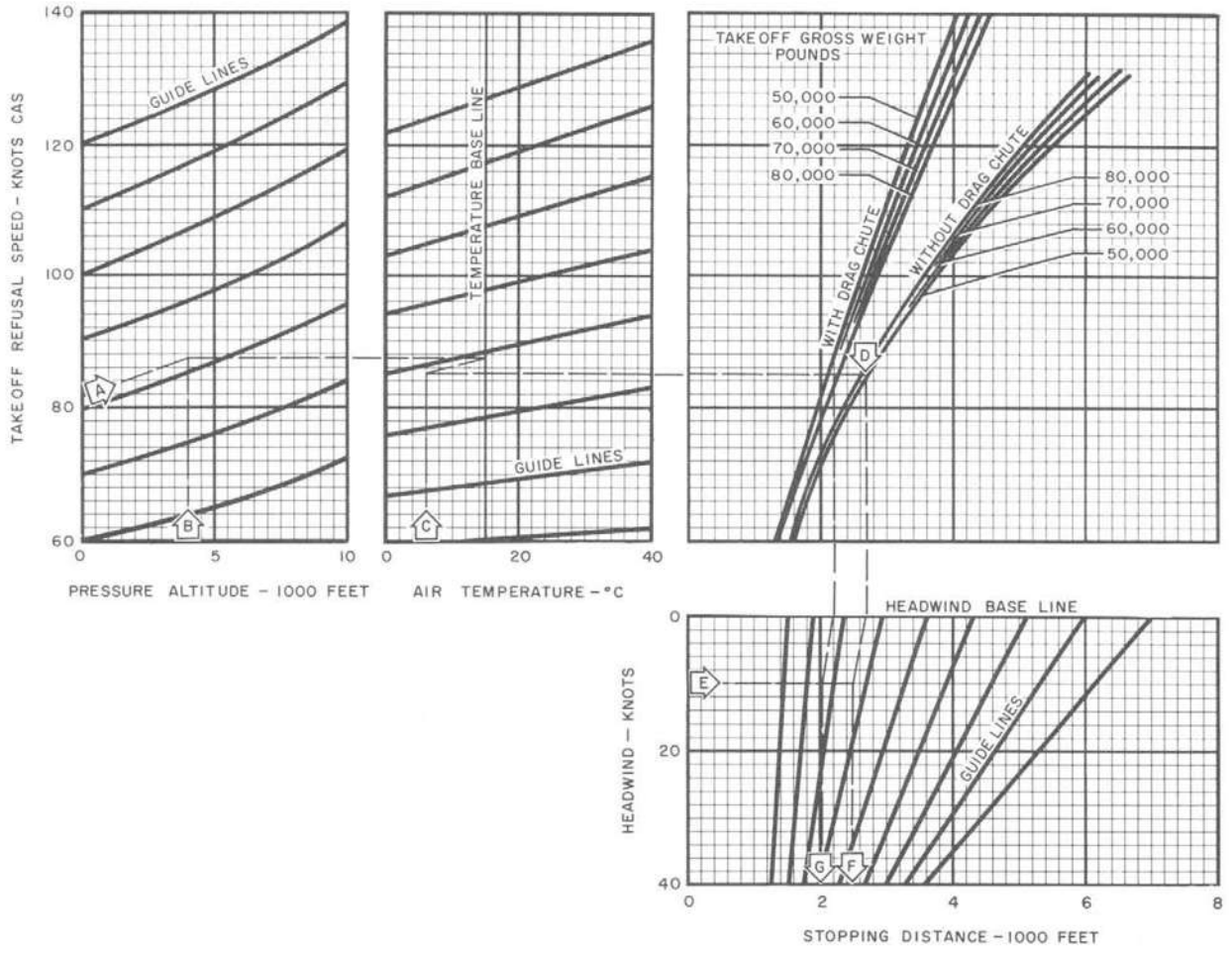
TWO ENGINE OPERATION

REFUSED TAKEOFF STOPPING DISTANCE

FULL FLAPS NO JATO

IDLE THRUST HYTROL BRAKING

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



REMARKS:

(1) Data includes 5 seconds pilot reaction time.

(2) Idle thrust, maximum hytrol braking (and drag chute) after refusal.

EXAMPLE:

Under the following conditions:

(a) Refusal speed = 82 knots CAS (A).

(b) Pressure altitude = 4000 feet (B).

(c) Air temperature = 6°C (C).

(d) Takeoff weight = 65,000 pounds (D).

(e) Headwind = 10 knots (E).

Then:

The stopping distance is 2500 feet (F).

If drag chute is deployed the stopping distance is 2000 feet (G).

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-14. Refused Takeoff Stopping Distance

PART 3A

CLIMB

CLIMB CHARTS

CLIMB PERFORMANCE AFTER TAKEOFF

Figure A-15 shows the climb characteristics of the aircraft immediately after takeoff at sea level pressure altitude and a takeoff gross weight of 70,000 pounds. These data show the effects of airspeed, flap position and landing gear extension on the maximum rate of climb with takeoff power. Rates of climb for each landing gear and flap configuration at airspeeds below the recommended airspeed are included.

Note

This chart shows maximum rates of climb available at zero acceleration (i.e., stabilized airspeed). Upon achieving a given climb airspeed, the pilot can obtain the corresponding rate of climb shown on the chart if he makes no attempt to increase the airspeed.

This chart shows graphically that the landing gear should be raised immediately after takeoff; and – from the airspeed, flap retraction time, and rate of climb relationships – that flap retraction should be initiated only after the aircraft has accelerated to an airspeed approximately 30 to 40 knots above the recommended takeoff airspeed.

Two additional curves are provided on the chart. The dashed line in the center of the grid can be used to estimate the loss of rate of climb should one engine fail immediately after takeoff. This curve shows the absolute necessity of increasing the forward speed of the aircraft as well as raising the landing gear and flaps before any attempt is made to gain altitude with one engine inoperative. The curve at the bottom of the grid can be used to estimate the effect on available rate of climb of deviations in ambient temperature from the standard temperature of 15°C at sea level. Note that, except at low takeoff airspeeds with full flaps (i.e., minimum ground roll), the aircraft has excellent climbout performance on two engines, even with ambient temperatures considerably above standard.

EXAMPLE. A field takeoff (full flaps) is to be made at 70,000 pounds gross weight with no wind, with sea level pressure altitude, and an ambient temperature of 5°C. Find rate of climb at 164 knots for a normal climbout; and for climbout following engine failure after the landing gear has been retracted.

1. Enter Climb Performance After Takeoff Chart, figure A-15, with 164 knots CAS (A); read vertically to intersection with solid line (full flaps and gear down). Opposite this point on left-hand scale (E), read approximately 2380 feet per minute available rate of climb for normal Standard Day operations. From temperature correction curve note that available rate of climb is increased by 400 feet per minute for each 10°C temperature decrease from Standard Day. The correction then is:

$$\left(\frac{15 - 5}{10}\right) \times 400 = 400 \text{ feet per minute.}$$

This results in:

2380 + 400 = 2780 feet per minute actual rate of climb. Assume landing gear is fully retracted at 175 knots CAS. From chart, rate of climb at this point is determined to be:

2875 + 425 = 3300 feet per minute.

2. Assume that with landing gear retracted and full flaps extended, one engine fails at 175 knots CAS. As shown on chart, loss in rate of climb due to failure of one engine at this airspeed is approximately 2425 feet per minute. If climb-out is continued, maximum available rate of climb of one engine then becomes:

3300 - 2425 = 875 feet per minute.

CLIMB PERFORMANCE AFTER WAVEOFF

Figure A-16, which uses the format of figure A-15, Climb Performance after Takeoff, shows climb-after-waveoff capability at a gross weight of 50,000 pounds and with military thrust.

ALTITUDE CLIMB PERFORMANCE

Clean configuration climb performance with respect to time, fuel, and distance from sea level to altitude may be determined from the data presented in three charts; (figure A-19) identified as Time to Climb, Climb Distance (figure A-18), and Fuel Consumed During Climb (figure A-17). Climbs may be made

with military thrust to cruise ceiling (that altitude at which the rate of climb is 300 feet per minute with normal thrust) at any operating gross weight up to 70,000 pounds without exceeding the engine operating time limit of 15 minutes. It is best to maintain the airspeed schedule shown in the table on each climb chart, although variations in climb airspeed up to ten knots above or below the scheduled airspeed will not materially affect climb performance, except at altitudes near the ceiling.

The Altitude Climb Performance charts may also be used to determine elapsed time, distance, and/or fuel used in climbing from one altitude to another in flight by taking the difference between the values at the initial and final altitudes, as illustrated on the charts.

EXAMPLE. Assume that a climb is required from 10,000 feet pressure altitude to 25,000 feet pressure altitude, with a momentary gross weight at 10,000 feet of 65,000 pounds. On time, fuel, and distance plots, read initial values at intersection of 65,000-pound gross weight line with 10,000-foot pressure altitude line. Next, determine final values at intersection of weight guideline with 25,000-foot pressure altitude line. From these data, the following computations are made:

Fuel used during climb = 1375 - 550 = 825 pounds (figure A-17)

Climb Distance = 39 - 12 = 27 nautical miles (figure A-18)

Climb Time = 5.7 - 1.8 = 3.9 minutes (figure A-19)

ONE-ENGINE RATE-OF-CLIMB

The one-engine rate of climb charts, figure A-20 and figure A-21, are presented for emergency usage in the event of engine failure on takeoff or during the initial climbout immediately after liftoff. Minimum one-engine control speeds, figure A-10, are shown on the graphs for the lower gross weights where control speeds are critical. Two-engine liftoff speeds, figure A-7, are shown on the higher gross weight curves where liftoff speed is higher than minimum one-engine control speeds. The figures include data for gear down and gear up, with the flaps positioned at full up, half, and fully extended. The figures indicate that the gear should be retracted immediately, but that the flaps should not be raised until sufficient airspeed is built up to produce a greater rate of climb with the flaps positioned at half or full up. Figure A-21 shows the effect of outside air temperature on rate of climb at sea level.

EXAMPLE. If the gross weight is 70,000 pounds the outside air temperature is 15°C (59°F), and the indicated airspeed is 150 knots, then the rate of climb in feet per minute is:

Using figure A-20

	Gear Down	Gear Up
Full Flaps	510	740
Half Flaps	-260	50
Flaps Up	-1460	-1220

Using figure A-21

If the outside air temperature is 25°C (79°F) reduce the above tabulated rates of climb by 185 feet per minute.

EMERGENCY CLIMB CHARTS

The Emergency Climb Charts, figures A-22 through A-24, are presented for use in emergency operation only (one engine windmilling).

The use of military thrust during a climb to altitude is restricted to 15 minutes, due to engine operating limitations. If the climb time will exceed 15 minutes, use military thrust during the early stage of the climb and normal thrust during the last stage.

Follow the airspeed schedule shown on the chart as closely as possible. Climb time and fuel and distance data for climbs with one engine operating on military thrust may be calculated by taking the difference between the time, fuel, and distance values at the initial and at the final altitudes.

EXAMPLE. Assume that a climb is made at 55,000 pounds gross weight on one engine with military thrust from 10,000 feet pressure altitude to 20,000 feet pressure altitude. As indicated on the Emergency Climb Chart:

Climb time = (15.1 - 5.9 = 9.2) minutes.

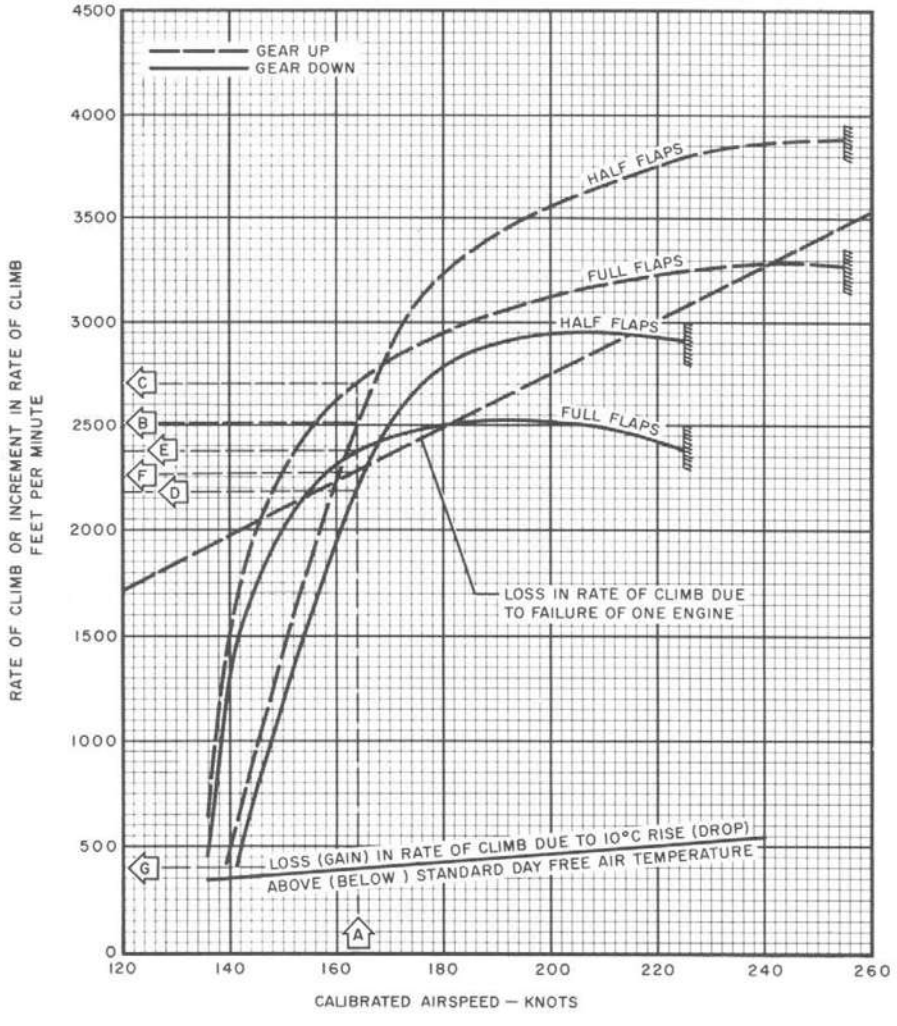
Climb distance = (76 - 28 = 48) nautical miles.

Fuel used during climb = (1700 - 760 = 940) pounds.

CLIMB PERFORMANCE AFTER TAKEOFF

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B — **BASIC WING** **WEIGHT:** 70,000 POUNDS **ENGINES:** J57-P-10



PS—17985—1C

REMARKS:

(1) Sea level pressure altitude.
(2) Speed limited to 225 knots CAS with gear down and 255 knots CAS with flaps down.

EXAMPLE:

After takeoff at 70,000 pounds on standard day conditions, at 164 knots CAS (A) the rate of climb will be:

Half flaps, gear up (B) = 2510
Full flaps, gear up (C) = 2700
Half flaps, gear down (D) = 2190
Full flaps, gear down (E) = 2380

In the event of an engine failure, the loss in rate of climb will be 2260 FPM (F). This must be subtracted from (B), (C), (D), or (E) as applicable, to show single engine rates of climb.

Temperature correction may be made by subtracting 400 FPM (G) for each 10°C rise in air temperature or adding 400 FPM for each 10° drop in temperature.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

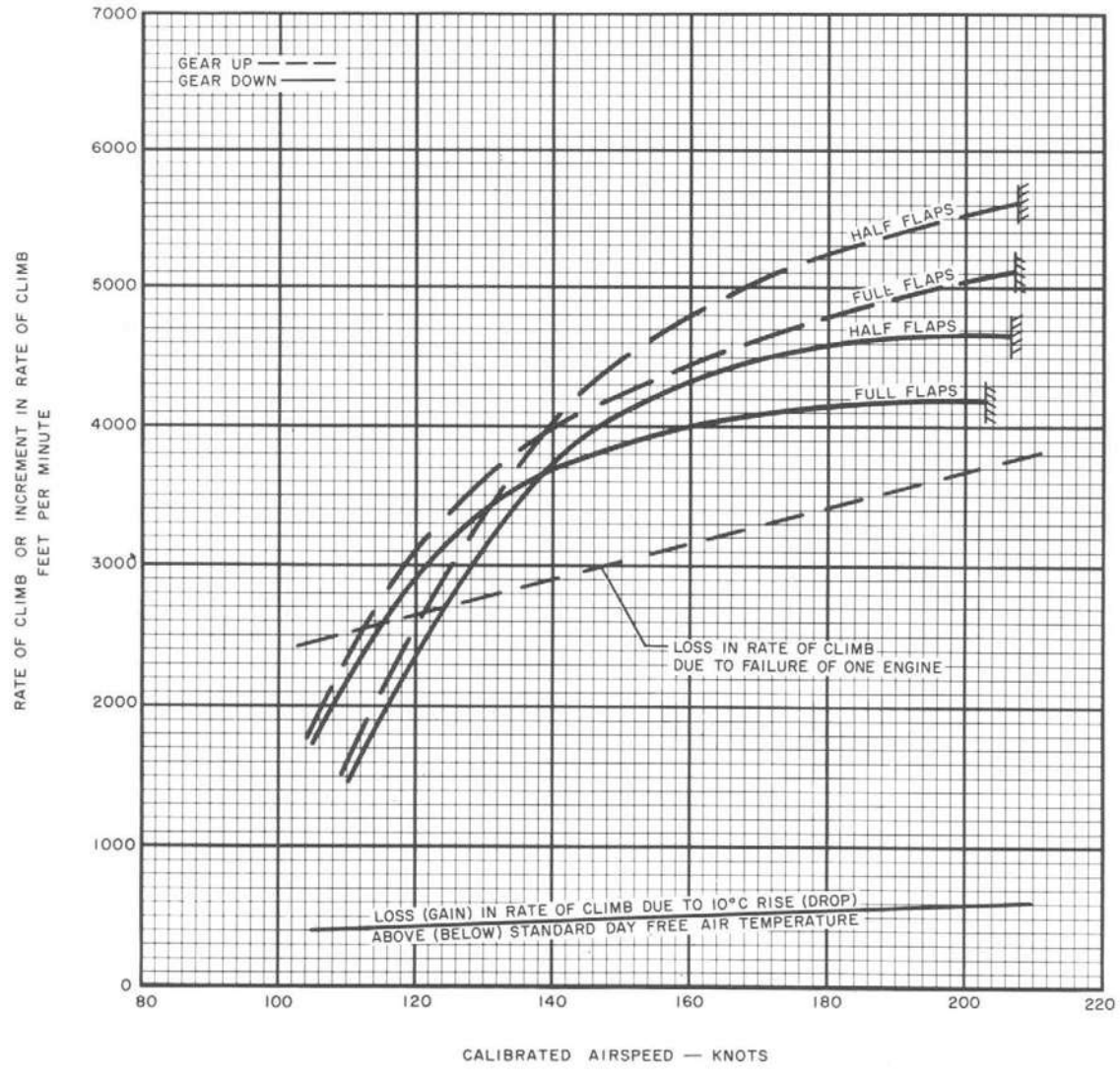
Figure A-15. Climb Performance After Takeoff

TWO ENGINE OPERATION

CLIMB PERFORMANCE FOR WAVEOFF

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **WEIGHT:** 50,000 POUNDS **ENGINE:** J57-P-10



REMARKS:

(1) Sea level.

(2) Speed brakes retracted.

DATA AS OF: 1 July 1961
DATA BASIS: NATC and Contractor Flight Test

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

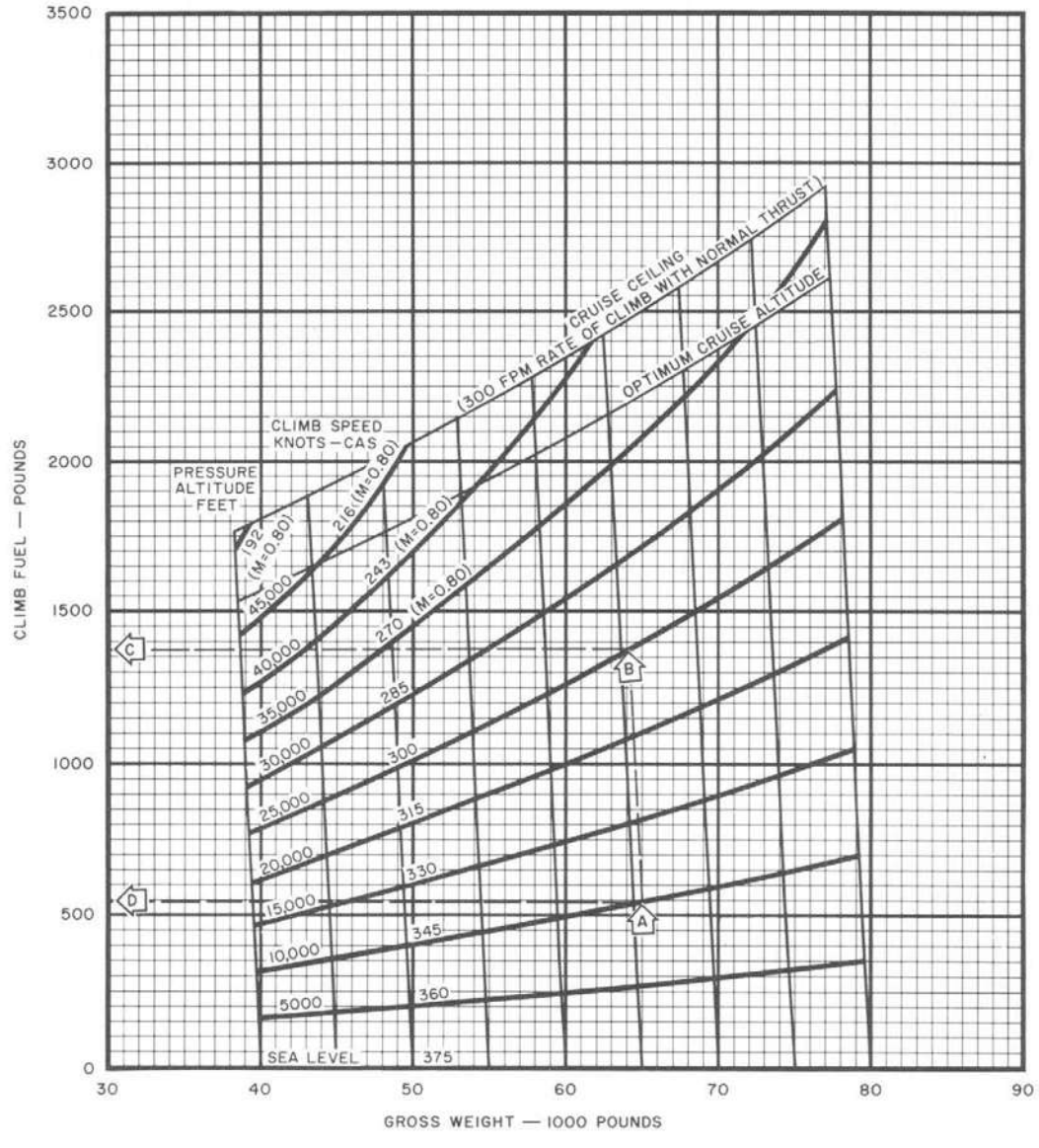
Figure A-16. Climb Performance for Waveoff

TWO ENGINE OPERATION

FUEL CONSUMED DURING CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



P-17988-IA

REMARKS:

(1) The effect on climb fuel of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to actual gross weight to enter chart.

(2) Add 600 pounds to climb fuel for takeoff and acceleration to climb speed.

EXAMPLE:

If gross weight is 65,000 pounds at 10,000 feet (A) and a climb is made to 25,000 feet (B), the fuel used during climb is 1375 pounds (C) minus 550 pounds (D), or 825 pounds.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

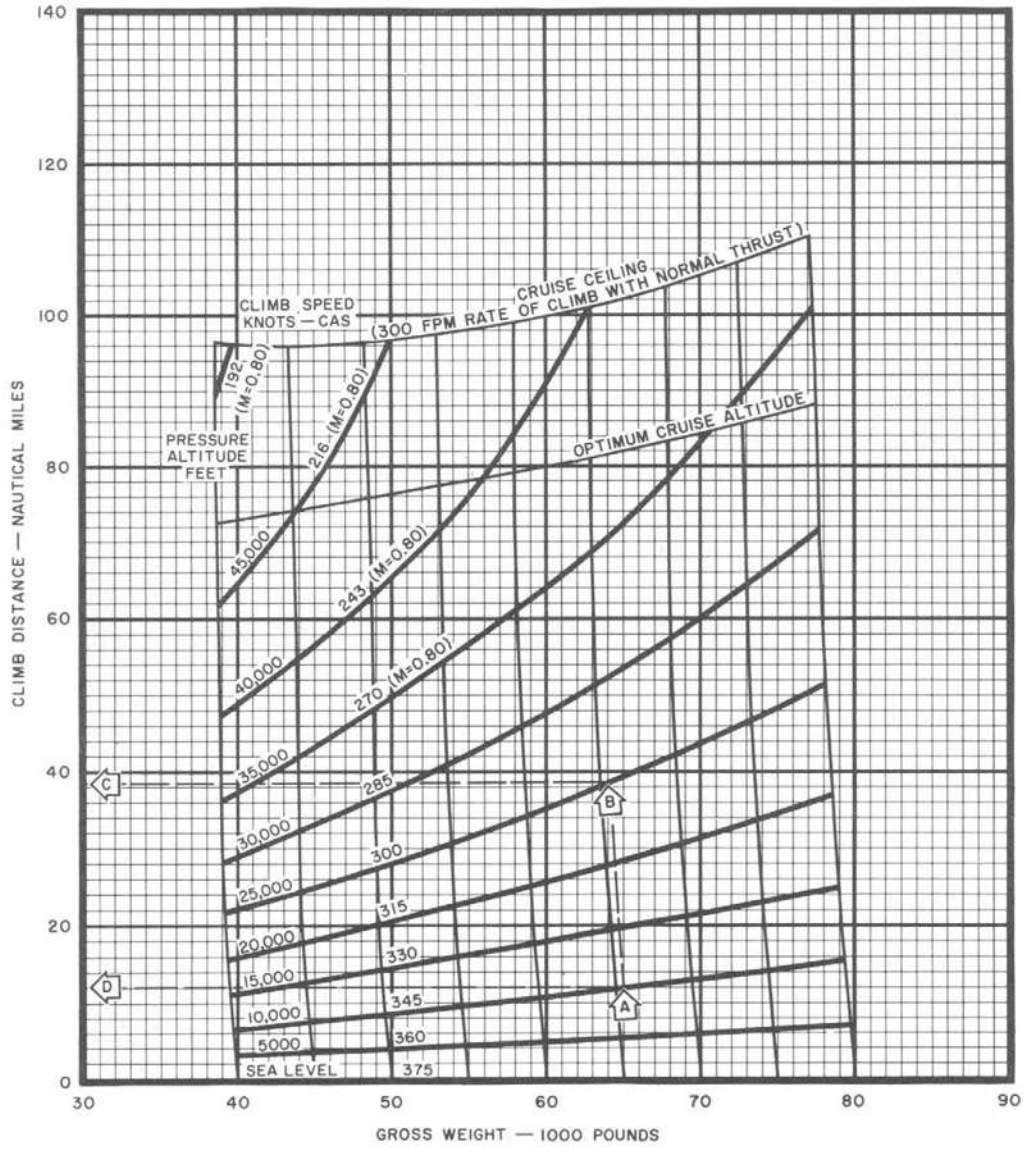
Figure A-17. Fuel Consumed During Climb

TWO ENGINE OPERATION

CLIMB DISTANCE

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



P-17987-1A

REMARKS:

(1) The effect on climb distance of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to actual gross weight to enter chart.

EXAMPLE:

If gross weight is 65,000 pounds at 10,000 feet (A) and a climb is made to 25,000 feet (B), the climb distance is 39 nautical miles (C) minus 12 nautical miles (D), or 27 nautical miles.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

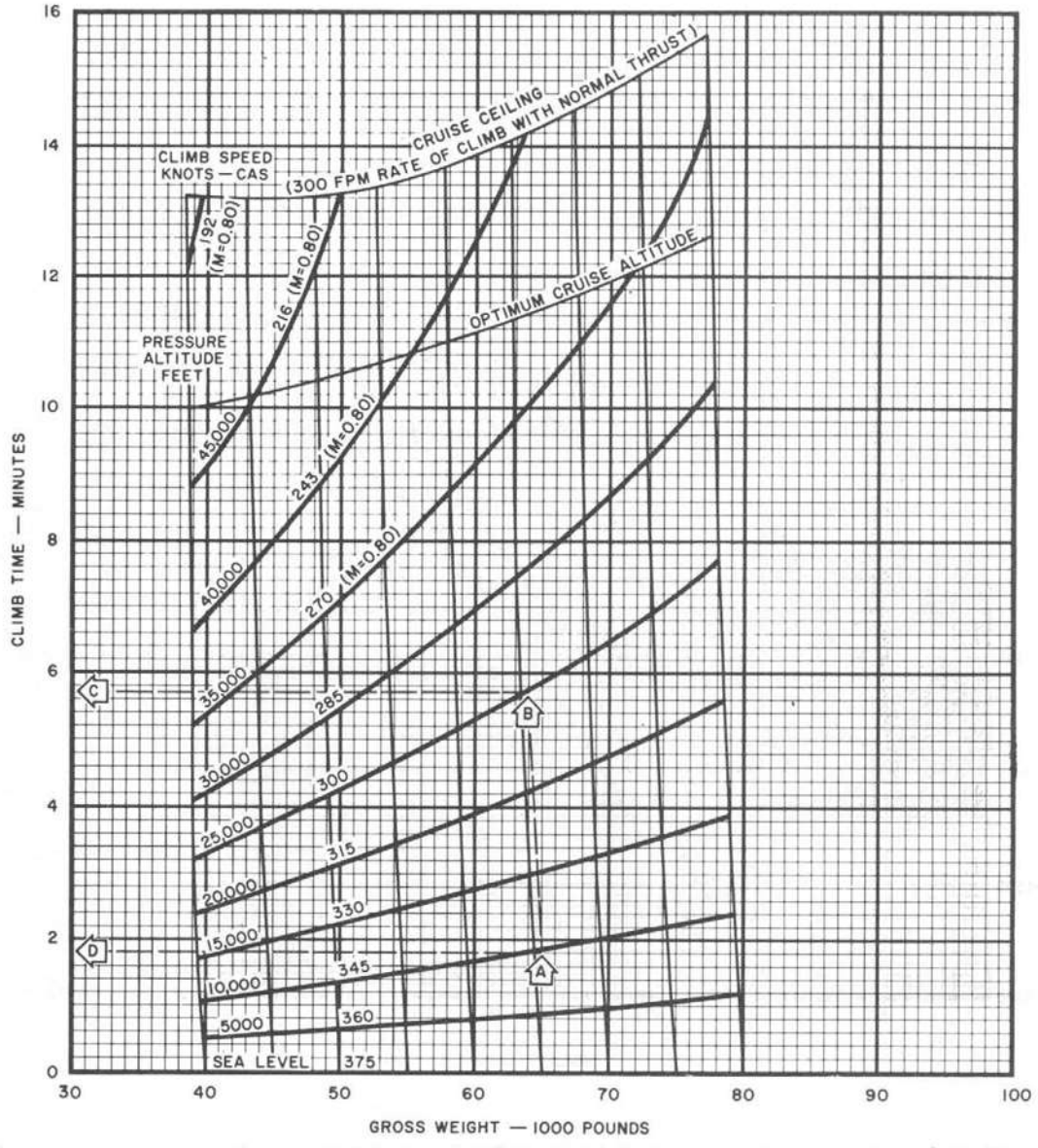
Figure A-18. Climb Distance

TWO ENGINE OPERATION

TIME TO CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B — **BASIC WING** **ENGINES:** J57-P-10



ATB-1-11 P-40519-1

REMARKS:

(1) The effect on climb time of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to actual gross weight to enter chart.

EXAMPLE:

If the gross weight is 65,000 pounds at 10,000 feet (A) and a climb is made to 25,000 feet (B) the climb time is 5.7 minutes (C) minus 1.8 minutes (D) or 3.9 minutes.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-19. Time to Climb

ONE ENGINE

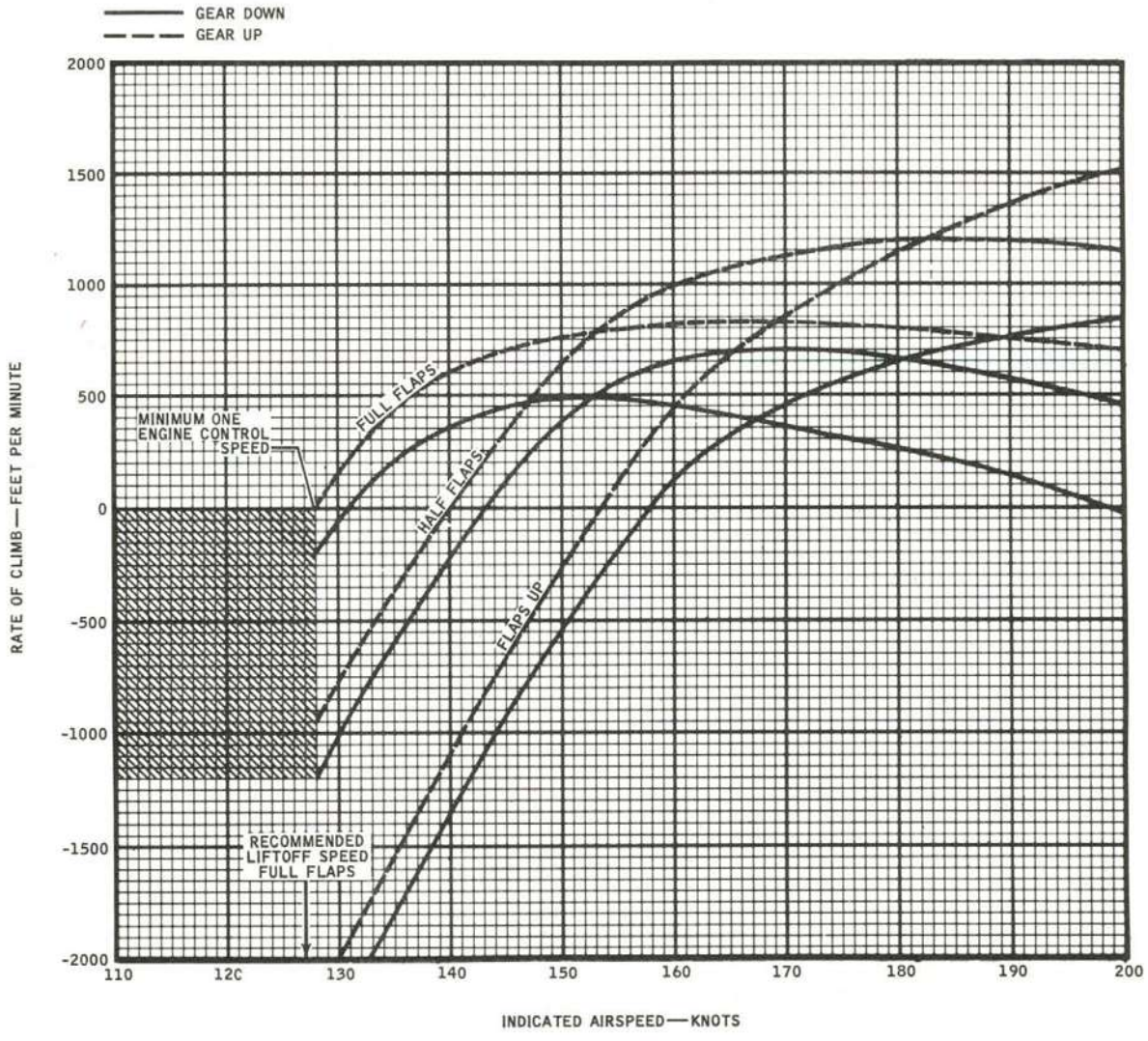
STANDARD DAY (15°C)
SEA LEVEL

RATE OF CLIMB

WEIGHT=60,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B—BASIC WING

ENGINE: J57-P-10



REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-20. One-Engine Rate-of-Climb -- 60,000 Pounds (Sheet 1)

ONE ENGINE

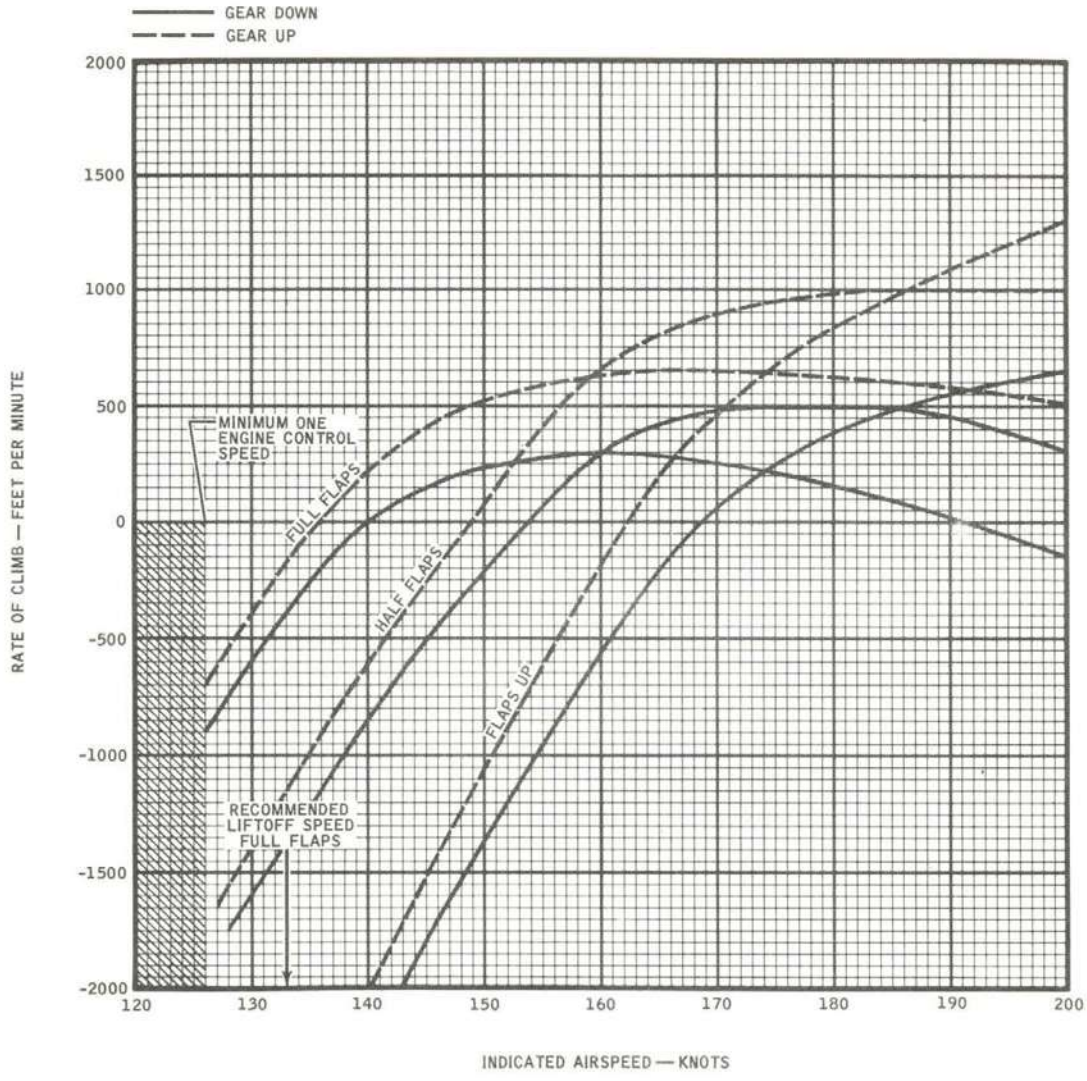
RATE OF CLIMB

STANDARD DAY (15°C)
SEA LEVEL

WEIGHT=65,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B RA-3B—BASIC WING

ENGINE: J57-P-10



P-28255-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-20. One-Engine Rate-of-Climb -- 65,000 Pounds (Sheet 2)

ONE ENGINE

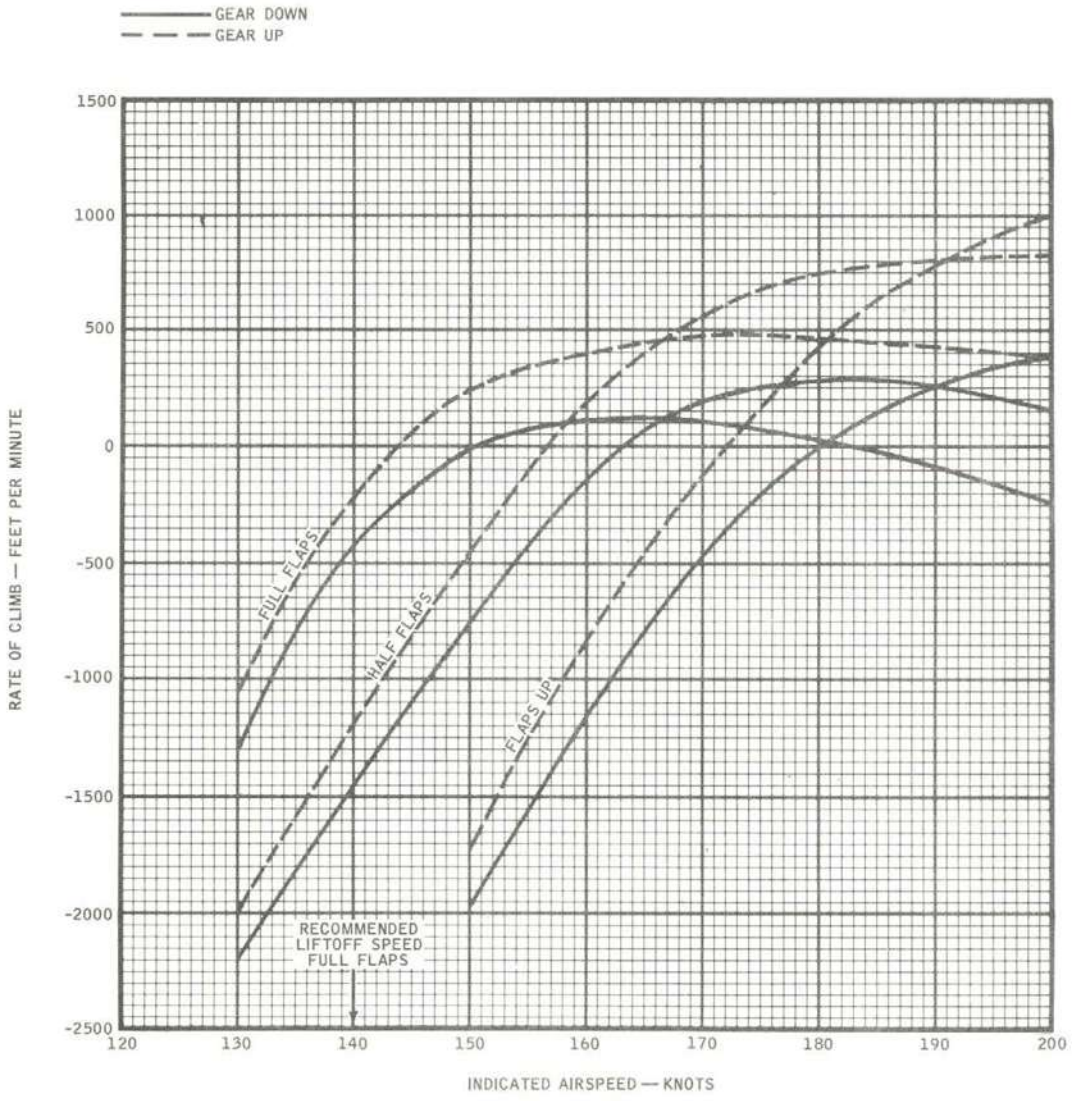
RATE OF CLIMB

STANDARD DAY (15°C)
SEA LEVEL

WEIGHT=70,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B—BASIC WING

ENGINE: J57-P-10



P-28256-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests.

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-20. One-Engine Rate-of-Climb -- 70,000 Pounds (Sheet 3)

ONE ENGINE

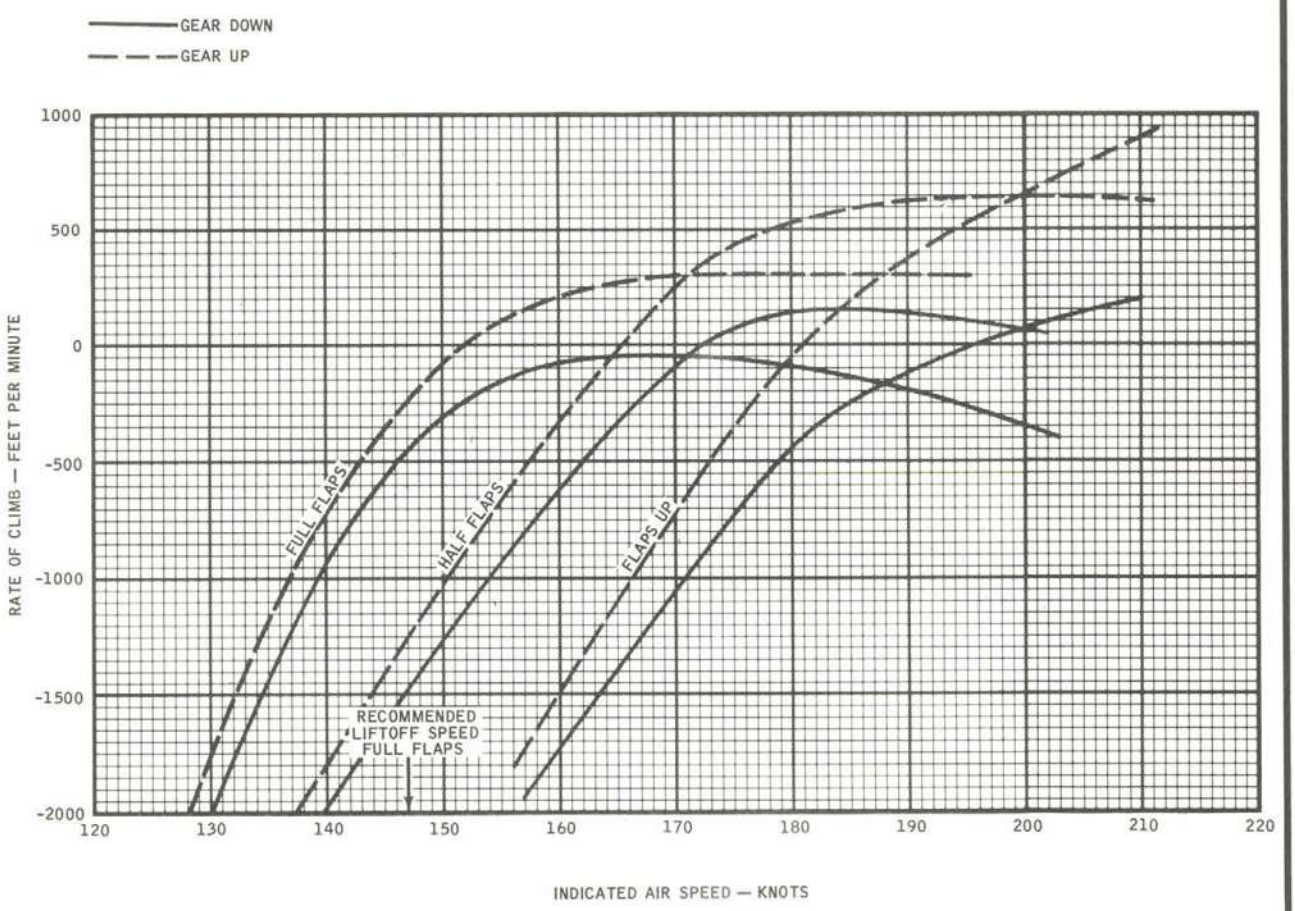
STANDARD DAY (15°C)
SEA LEVEL

RATE OF CLIMB

WEIGHT=75,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B — BASIC WING

ENGINE: J57-P-10



P-28257-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

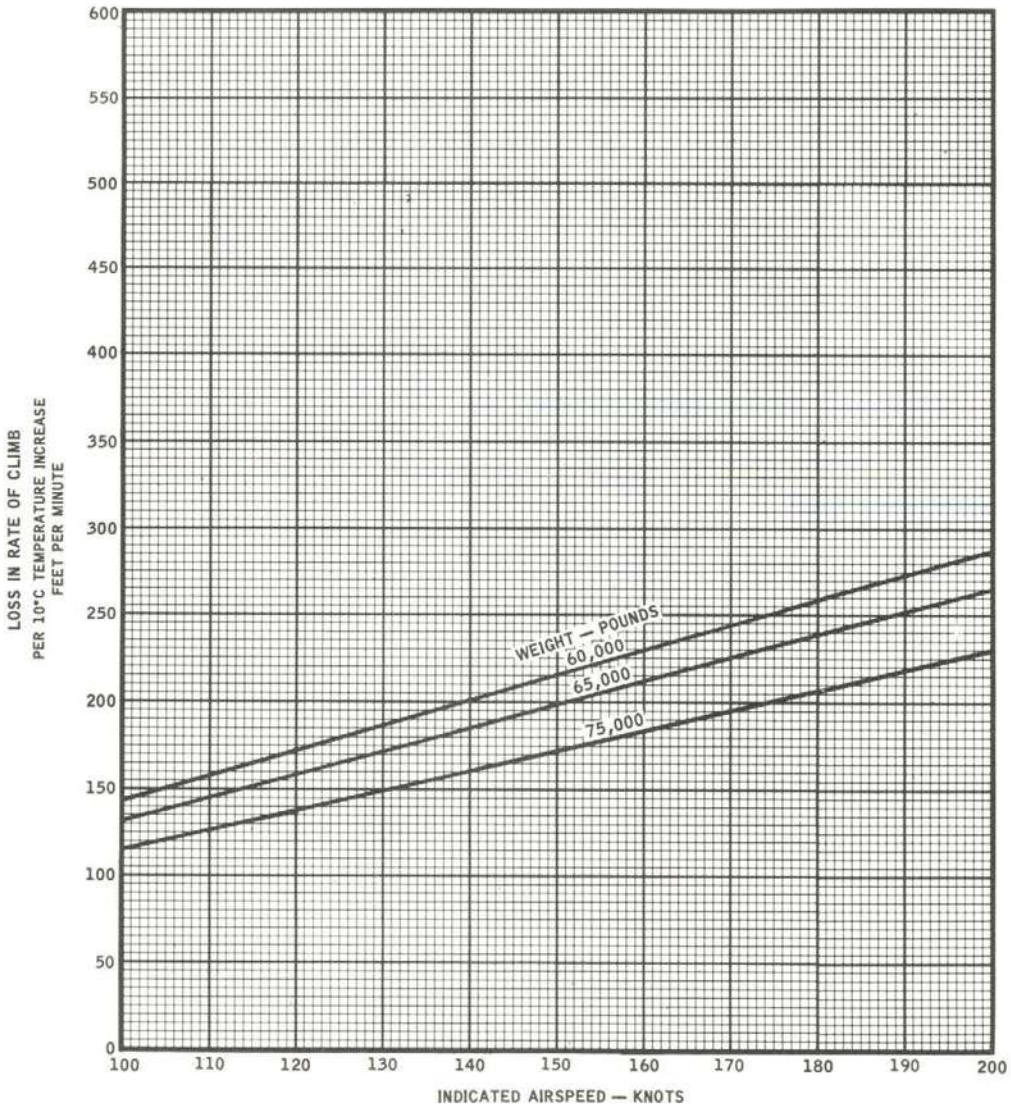
Figure A-20. One-Engine Rate-of-Climb -- 75,000 Pounds (Sheet 4)

ONE ENGINE

TEMPERATURE EFFECT ON RATE OF CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B — BASIC WING **ENGINE:** J57-P-10



P-28258-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

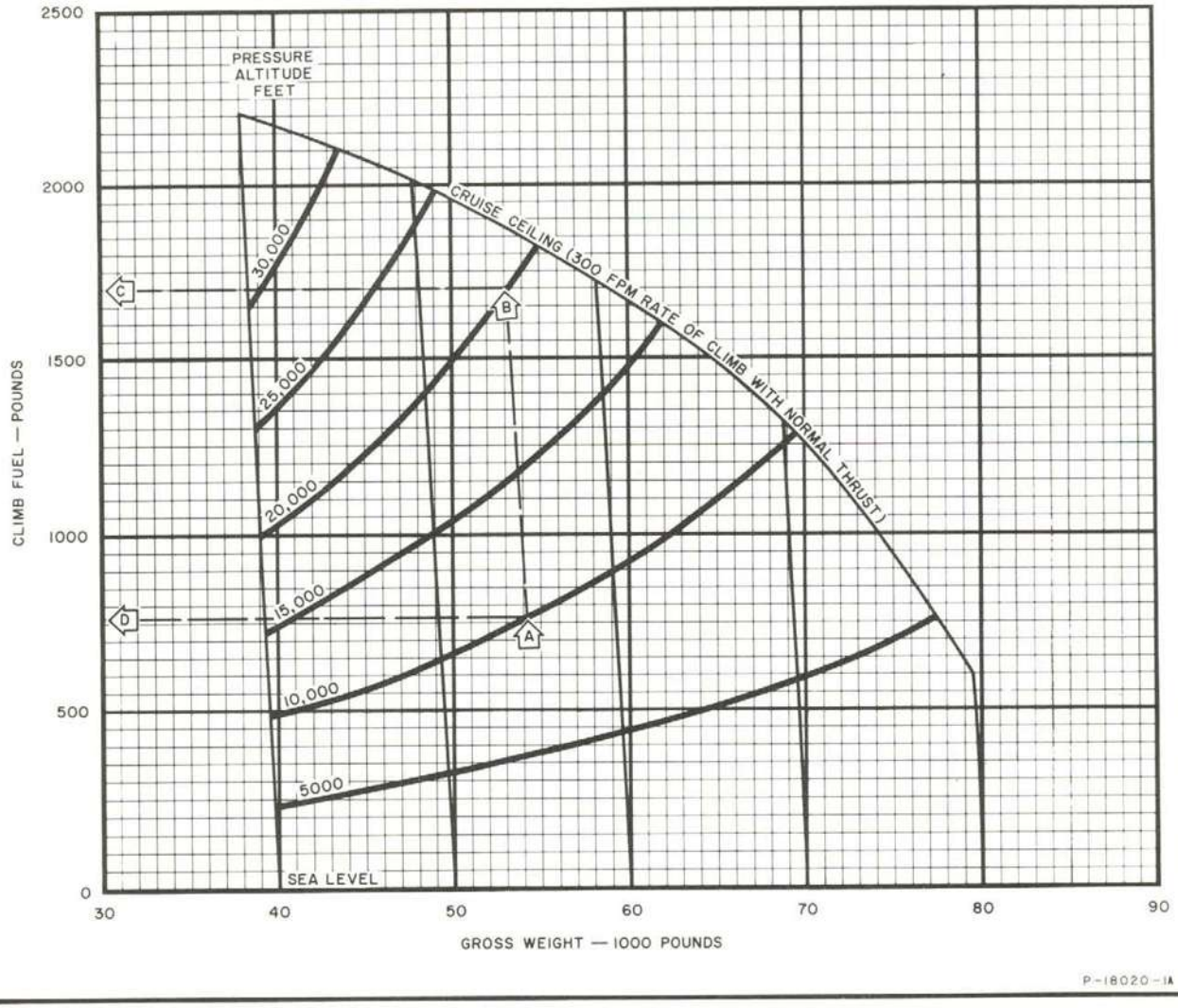
Figure A-21. Temperature Effect on One-Engine Rate of Climb

ONE ENGINE OPERATION

FUEL CONSUMED DURING CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



REMARKS:

(1) Inoperative engine windmilling.

(2) Climb speed is 280 knots CAS at sea level decreasing 2 knots per 1000-foot increase in altitude.

(3) The effect on climb fuel of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to the actual gross weight to enter chart.

EXAMPLE:

If gross weight is 55,000 pounds at 10,000 feet (A) and a climb is made to 20,000 feet (B) the fuel consumed is 1700 pounds (C) minus 760 pounds (D) or 940 pounds.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

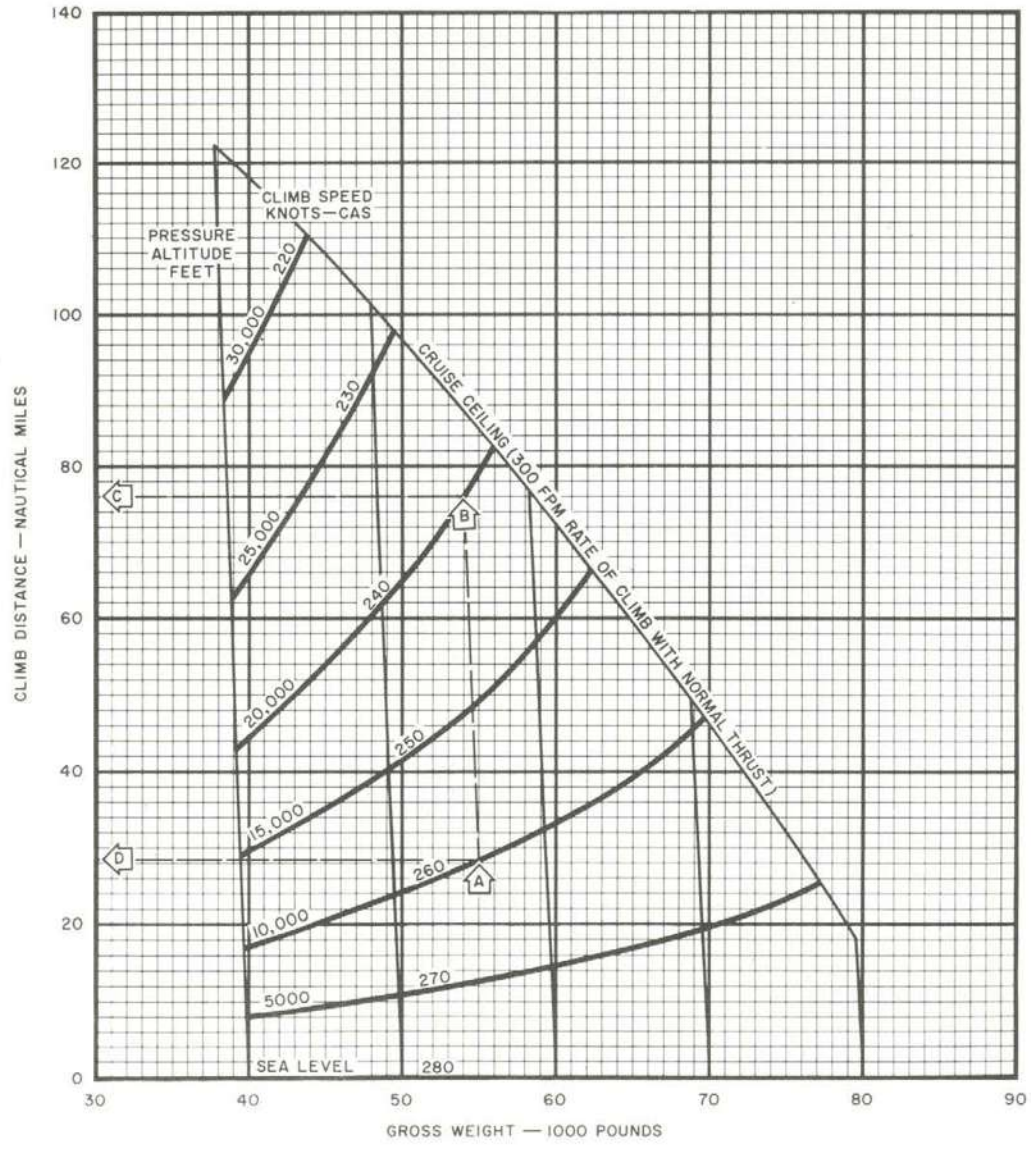
Figure A-22. Fuel Consumed During Climb

ONE ENGINE OPERATION

CLIMB DISTANCE

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



REMARKS:

(1) Inoperative engine windmilling.

(2) Climb speed is 280 knots CAS at sea level decreasing 2 knots per 1000-foot increase in altitude.

(3) The effect on climb distance of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to the actual gross weight to enter chart.

EXAMPLE:

If gross weight is 55,000 pounds at 10,000 feet (A) and a climb is made to 20,000 feet (B), the distance covered is 76 nautical miles (C) minus 28 nautical miles (D), or 48 nautical miles.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

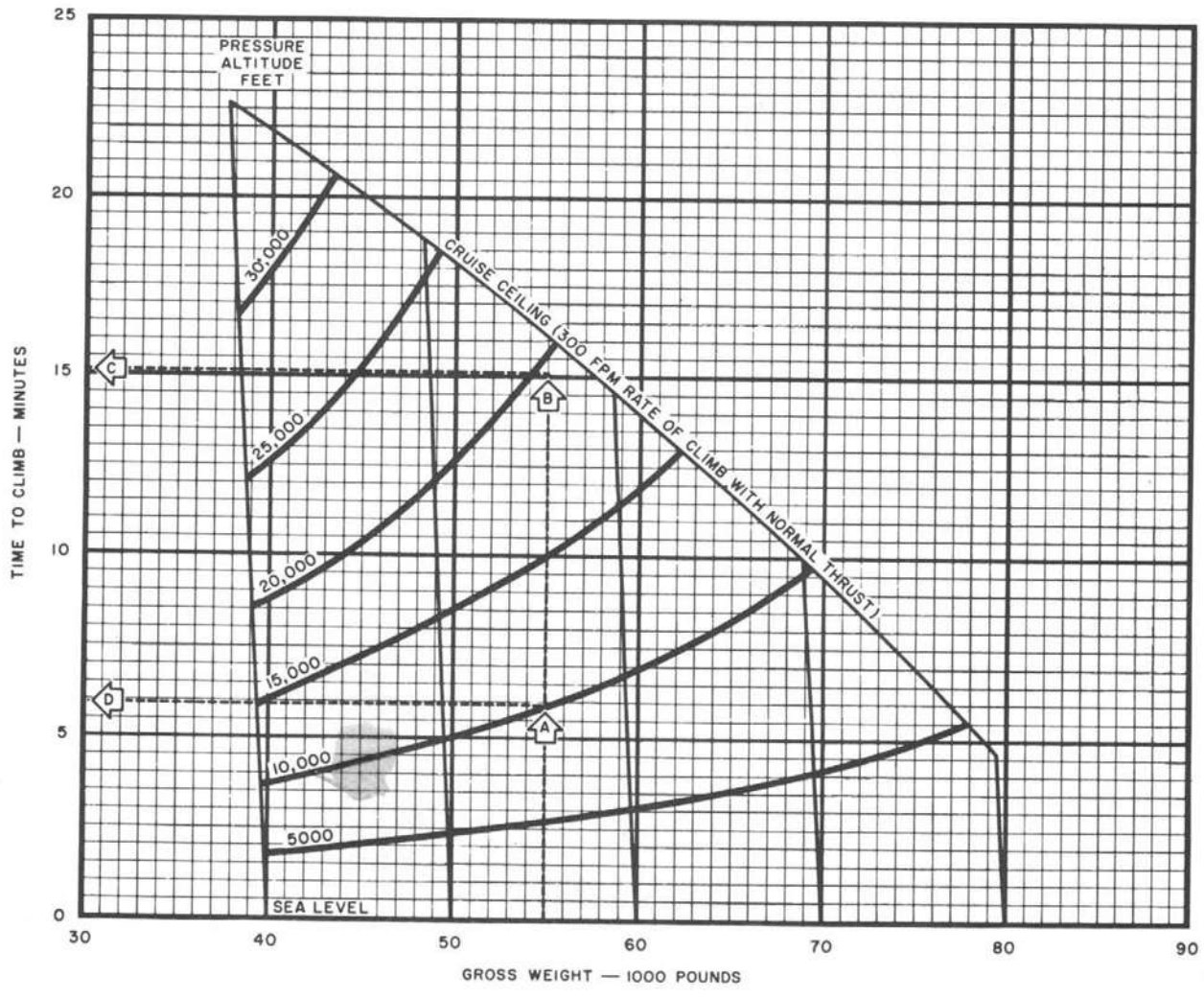
Figure A-23. Climb Distance

ONE ENGINE OPERATION

TIME TO CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



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REMARKS:

(1) Inoperative engine windmilling.

(2) Climb speed is 280 knots CAS at sea level, decreasing 2 knots per 1000-foot increase in altitude.

(3) The effect on time to climb of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to the actual gross weight to enter chart.

EXAMPLE:

If gross weight is 55,000 pounds at 10,000 feet (A) and a climb is made to 20,000 feet (B), the time to climb is 15.1 minutes (C) minus 5.9 minutes (D), or 9.2 minutes.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-24. Time to Climb

PART 4A

RANGE

RANGE CHARTS

Range data for RA-3B basic wing aircraft are presented as follows:

1. Fouled Deck Range ("Bingo Cards") (figures A-25 through A-31)

2. Maximum Specific Range vs Altitude (figure A-32)

3. Specific Range (figures A-33 and A-34)

4. Profile Charts (A-35 through A-37).

These range data are presented for the clean configuration and are representative of the cruise performance that may be obtained during normal service operation. All data are given for an ICAO standard day.

At a given altitude and gross weight, the maximum range is obtained at the recommended airspeed for maximum range. This airspeed should be established primarily by Mach number or CAS, since Mach number and CAS are directly related at a given altitude. If desirable at altitudes of 40,000 feet and below, the recommended cruise speed may be increased, provided that the range penalty is no greater than 1 percent. This increase in cruise speed will result in significant reduction in elasped time.

Note

The characteristics of the J57 engine are such that engine rpm cannot be used for cruise control. However, as an aid in establishing proper cruise control, engine pressure ratio and engine fuel flow data are provided.

A description of the four types of range presentation follows.

FOULED DECK RANGE ("BINGO CARDS")

The Fouled Deck Range Charts (figures A-25 through A-28 for two-engine operation and figures A-29 through A-31 for one-engine operation) are provided to indicate the available range, for low values of fuel remaining, at optimum cruise altitudes. Both VFR and IFR charts are included for one-engine and two-engine operation with the flaps and gear retracted. Also included, for two-engine operation, are VFR charts for gear down and gear and flaps down (full flaps). A one-engine sea level fouled deck range chart is also included.

Fuel allowances of 300 pounds for two-engine operation and 200 pounds for one-engine operation are included for raising the gear and flaps (where applicable), making a turn and accelerating to climb speed. A 3000-pound reserve fuel allowance is included at the point where descent is commenced for the VFR charts and at the approach fix for the IFR charts. The charts are based on a basic aircraft weight of 41,000 pounds with a percentage correction factor for additional fuel required at heavier basic weights. Climb, cruise, and letdown speed are provided together with the letdown time, fuel required, and distances, where applicable.

Figures are for a no-wind standard day. Add one percent for each 5 knots of head wind for rough calculations.

MAXIMUM SPECIFIC RANGE VS ALTITUDE

The maximum specific range characteristics are summarized for two-engine and one-engine operation in figure A-32. These data present as a function of altitude and gross weight the specific range that is attainable at the recommended speed for maximum range. Cruise Mach numbers corresponding to the recommended airspeed for maximum specific range are superimposed on these plots together with the corresponding fuel flow. Cruise ceilings are indicated for both two-engine and one-engine operation. The optimum cruise altitude is provided for two-engine operation.

SPECIFIC RANGE

The specific range charts, figure A-33, for two-engine operation and figure A-34 for one-engine operation, present the nautical miles per pound of fuel, or specific range, as a function of Mach number for every 5000 feet of altitude from sea level to 45,000 feet for two-engine operation and 30,000 feet for one-engine operation. The recommended airspeed for

maximum range is indicated on each of the charts. The Mach number corresponding to this speed should be used as the primary indication of proper cruise control. In addition, lines of fuel flow and engine pressure ratio are superimposed to provide additional checks on proper cruise control. At low power settings, the intercompressor bleed valves on the J57 engine are scheduled to open. This results in an increase in the fuel consumption at these power settings, and reduces the nautical miles per pound of fuel. Therefore, at the lower altitudes the specific range curves are presented to include this effect. The scheduled opening of these valves will vary from engine to engine and, therefore, the data in figure A-33 should be considered approximate. For flight planning purposes, however, it is recommended that these data be used to predict the cruise characteristics for these conditions. The specific range data are provided for speeds between the recommended speed for maximum endurance and maximum speed with maximum thrust. The specific range data obtained from these charts can be used for all ambient air temperatures as long as the specific range is determined for a given Mach number or CAS. The corresponding TAS, however, for nonstandard conditions must be obtained from figure A-1. Subscales on each chart show the relationship between Mach number and TAS for standard day conditions only. The relationship between Mach number and CAS is also provided, and is independent of ambient conditions.

EXAMPLE. A request is received to escort another aircraft returning from a mission at 20,000 feet pressure altitude and 300 knots CAS. If initial gross weight is 60,000 pounds, including 10,000 pounds of available cruise fuel after allowances for descent and/or reserve, determine range available and fuel consumption with no wind.

1. Enter 20,000 foot specific range (Nautical Miles Per 1000 Pounds of Fuel) chart for two engines operating (figure A-33, sheet 5) at 300 knots CAS. At 60,000 pounds initial cruising gross weight, specific range is 75 nautical miles per 1000 pounds of fuel. At final cruising gross weight,

$$60,000 - 10,000 = 50,000 \text{ pounds}$$

Specific range is 80 nautical miles per 1000 pounds of fuel.

2. Specific range during cruise, based on average gross weight of 55,000 pounds, is 77 nautical miles per 1000 pounds of fuel. By multiplying this number by available cruise fuel in thousands of pounds, range is:

$$77 \times \frac{10,000}{1000} = 770 \text{ nautical miles}$$

3. Initial fuel flow at 20,000 feet (at 60,000 pounds) is approximately 2700 pounds per hour per engine multiplied by two, or 5400 pounds per hour. During cruise, fuel flow will decrease due to decreasing gross weight, and at end of flight fuel flow will be approximately:

$$2 \times 2500 = 5000 \text{ pounds per hour}$$

4. True airspeed (also ground speed in this example) and Mach number are 400 knots and 0.65 respectively.

5. When large amounts of cruise fuel are considered, or when range is critical, greater accuracy may be obtained by computing range in steps, using above procedure. Degree of accuracy will depend on number of incremental values of fuel weight used.

For the purpose of determining whether operation on one engine would provide better maximum range performance, follow same procedure through specific range chart for one-engine operation, as follows:

EXAMPLE:

1. Enter 20,000 foot specific range (Nautical Miles Per 1000 Pounds of Fuel) chart for one-engine operation (figure A-34, sheet 5) at 300 knots CAS. At 60,000 pounds initial cruising gross weight, specific range is 70 nautical miles per 1000 pounds of fuel. At final cruising gross weight (50,000 pounds), specific range is 76 nautical miles per 1000 pounds of fuel.

2. Specific range during cruise, based on average gross weight of 55,000 pounds, is 73 nautical miles per 1000 pounds of fuel. By multiplying this number by available cruise fuel in thousands of pounds, range is:

$$73 \times \frac{10,000}{1000} = 730 \text{ nautical miles}$$

3. Comparison of one-engine specific range with that obtainable during two-engine operation reveals disadvantage in proceeding with one-engine shut down. For this reason, two-engine operation should be used for this particular flight.

MISSION PROFILE

The mission profile chart (figure A-35) presents the total available range on a one-way mission as a function of cruise altitudes from sea level to the optimum (cruise climb) altitude. The ranges are presented with a 3000-pound fuel reserve and with zero fuel remaining. A 1000-pound fuel allowance for start, taxi, and take off is included. Fuel used and elapsed time lines are included on the chart in order to provide check points during the mission. These range data are presented for takeoff weights of 73,000 pounds, with 28,900 pounds of fuel aboard (sheet 1); and for 77,230 pounds, with 33,130 pounds of fuel (sheet 2). No allowances are included for wind effects.

The heavy line to the left edge of shaded area shows distance traveled during a military-thrust climb from sea level to the desired cruise altitude. The climb should be conducted at the climb schedule shown on the chart. The heavy line at the top of the shaded area represents the optimum or cruise climb altitude. Cruise at the optimum cruise altitude is obtained by maintaining a constant cruise Mach number with an approximately constant throttle setting. The variation of altitude with distance results from the decrease in aircraft weight due to fuel usage during cruise. By use of the fuel usage and elapsed time lines, the optimum cruise altitude can be checked during the mission. Cruise at a fixed altitude should be conducted at the recommended cruise Mach numbers shown on the chart, and will require periodic reduction in throttle setting as fuel is consumed.

EXAMPLE. The chart may be entered with one or more of the four range factors: time, fuel, distance, and altitude. If the chart is entered with the known factors the other factors may be readily determined.

1. Determine maximum range with 25,000 pounds of fuel available for climb and cruise, with average 50-knot headwind.

   a. Enter A-35, sheet 1, at 25,000 pounds of fuel. Directly below the intersection of fuel and cruise climb line, read maximum still air range (air miles) . . . . . 2300 nautical miles

   b. Time required . . . . . 5 hours

   c. Wind effect (time x wind) . . . . . 250 nautical miles

   d. Maximum range with wind (2300 - 250) . . . . . 2050 nautical miles

2. Determine fuel required, elapsed time, recommended airspeed and Mach number to cruise 1500 nautical miles at 30,000 feet with headwind of 75 knots. To determine wind effect upon time, fuel, and distance, compute average true airspeed (distance ÷ time), no wind, and apply wind to TAS to obtain ground speed (GS). Then compute time with wind (distance ÷ GS). Reenter profile at cruising altitude and computed time with wind to determine fuel required with wind.

   a. Enter chart at 1500 nautical miles and proceed upward to 30,000 foot line to determine time (no wind) . . . . . 3 hrs. 30 min.

   b. Average TAS (1500 ÷ 3.5) . . . . . 430 knots

   c. Apply wind to obtain average ground speed (430 - 75) . . . . . 355 knots

   d. Calculate time with wind (1500 ÷ 355) . . . . . 4 hrs. 15 min.

   e. Reenter chart at intersection of cruise altitude and time with wind. Fuel required with wind . . . . . 23,000 lbs.

   f. Recommended tabular cruise speed . . . . . 275 CAS or 0.74 Mach

COMBAT RADIUS PROFILE

The combat radius profile (figure A-36) presents the radius capability of the aricraft for cruise altitudes from sea level to the optimum cruise altitude and for combat times of zero to 20 minutes. The radius is shown for a fuel reserve of 3000 pounds and for no fuel reserve. A fuel allowance of 1000 pounds is included for start, taxi, take off, and descent. Lines of fuel used are superimposed on the chart for flight checks during the mission. The profile data are based on a takeoff weight of 73,000 pounds, with 28,900 pounds of fuel aboard (sheet 1); and for 77,230 pounds, with 33,130 pounds of fuel (sheet 2).

The heavy line at left of shaded area shows distance traveled and fuel consumed during a military thrust climb from sea level to desired cruise altitude. The climb speed schedule is shown on the chart. The heavy line at top of shaded area represents optimum cruise out altitude. Cruise at a selected constant altitude should be conducted at the recommended cruise Mach numbers shown on chart and will require periodic reductions in throttle setting as fuel is consumed.

The heavy dashed lines show radius available for various combat times and for mission return at same constant altitude at cruise-out, or at optimum cruise-back altitude. Allowances for a military power climb from the optimum cruise out altitude to the optimum cruise back altitude are included.

The optimum cruise back altitude is shown as the uppermost heavy line on the chart and corresponds to a cruise climb conducted in the same manner as the optimum cruise-out altitude.

EXAMPLE. Assume a takeoff weight of 73,000 pounds and 28,900 pounds of fuel. Using military thrust, follow climb schedule (sheet 1) to 30,000 feet; then recommended cruise schedule. The radius, including 20 minutes of combat, is 955 miles. Cruise back at 30,000 feet and start idle-thrust descent at 93 miles out. For zero combat time at 30,000 feet, maximum radius for return with 3000 pounds of reserve fuel is 1090 miles. At takeoff weight of 77,230 pounds and 33,130 pounds of fuel (sheet 2), the radius, including 20 minutes of combat, is 1130 miles; for zero combat, 1255 miles.

MISSION RETURN PROFILE

Use of the mission return profile chart is illustrated on figure A-37 and by the following example.

EXAMPLE. Assume initial weight of 64,100 pounds and 20,000 pounds of fuel on board. Cruise back at 30,000 feet, following recommended cruise schedule. After one hour of cruise, distance covered is 425 miles, and fuel used is 4700 pounds. At 1590 miles, start idle-thrust descent to arrive at sea level at 1672 miles with 3000 pounds of reserve fuel. If cruise is maintained at 30,000 feet (beyond the reserve limit of 1590 miles) to 1905 miles, fuel exhaustion will necessitate flameout descent to sea level.

TWO-ENGINE OPERATION

FOULED DECK RANGE (VFR)

MODEL: RA-3B – BASIC WING

ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	3730	10	1	640	7	1	90	6	3000	328	7	165	27	9
60	3940	15	2	820	12	2	120	9	2520	302	10	240	39	13
80	4085	20	3	990	18	1	95	8	2140	275	13	310	54	16
100	4255	25	4	1165	24	1	90	9	1830	248	15	375	67	20
120	4400	30	5	1340	32	1	55	6	1720	240	18	430	82	24
140	4535	35	6	1525	41	0	10	1	1700	240	21	490	98	27
160	4705	35	6	1530	42	3	175	21	1700	240	21	490	98	30
180	4795	40	8	1725	55	1	70	9	1710	235	23	550	117	32
200	4950	40	8	1730	55	4	220	29	1710	235	23	550	117	35
220	5040	45	10	1965	74	1	75	10	1740	215	26	605	136	37
240	5200	45	10	1975	75	4	225	30	1740	215	26	605	136	40
260	5360	45	10	1985	75	6	375	49	1750	215	26	605	136	43
280	5520	45	10	1995	76	9	525	69	1750	215	26	605	136	45
300	5675	45	10	2000	76	12	675	89	1760	215	26	605	136	49
320	5840	45	11	2015	77	14	825	107	1760	215	26	605	136	50
340	6000	45	11	2020	77	17	980	128	1760	215	26	605	136	53
360	6155	45	11	2030	77	19	1125	147	1760	215	26	605	136	55
380	6315	45	11	2030	78	22	1285	167	1770	215	26	605	136	58
400	6490	45	11	2050	78	24	1440	187	1770	215	26	605	136	61

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SCHEDULE IS 370 KTS CAS AT SEA LEVEL DECREASING 30 KNOTS PER 10,000 FEET ALTITUDE TO 36,000 FEET. CLIMB AT M = .80 ABOVE 36,000 FEET.
4. IDLE DESCENT TO SEA LEVEL AT 220 KNOTS CAS.
5. BASIC AIRCRAFT WEIGHT IS 41,000 POUNDS.
6. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL DENSITY: 6.8 LB/GAL

Figure A-25. Fouled Deck Range – Two-Engine VFR

TWO-ENGINE OPERATION

FOULED DECK RANGE (IFR)

MODEL: RA-3B – BASIC WING

ENGINES: J57-P-10

			CLIMB			CRUISE					
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	TOTAL ETE
40	4145	10	1	640	8	5	505	32	3000	328	6
60	4470	15	2	820	12	8	650	48	2520	300	10
80	4705	20	3	990	18	10	715	62	2130	276	13
100	4950	25	4	1180	25	13	770	75	1830	248	17
120	5150	25	4	1185	25	17	970	95	1830	248	21
140	5345	30	5	1370	33	17	980	107	1750	242	22
160	5525	35	6	1360	42	17	965	117	1720	243	23
180	5700	35	6	1565	43	20	1135	138	1720	242	26
200	5865	35	6	1570	43	22	1295	157	1720	242	28
220	6040	40	8	1775	56	22	1270	164	1730	235	30
240	6200	40	8	1780	57	25	1420	183	1730	235	33
260	6365	40	8	1790	57	28	1575	203	1730	235	36
280	6525	40	8	1790	57	30	1735	223	1740	235	38
300	6690	40	8	1800	57	33	1890	243	1740	235	41
320	6855	40	8	1805	58	36	2050	263	1740	235	44
340	7020	40	8	1810	58	39	2210	283	1740	235	47
360	7185	40	8	1820	58	41	2365	302	1750	235	49
380	7350	40	8	1825	58	44	2525	322	1760	236	52
400	7510	40	8	1830	59	47	2680	342	1760	236	55

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT APPROACH FIX.. NO WIND CONDITIONS.
3. CLIMB SPEED SCHEDULE IS 370 KNOTS CAS AT SEA LEVEL DECREASING 30 KNOTS PER 10,000 FEET ALTITUDE TO 36,000 FEET. CLIMB AT M = .80 ABOVE 36,000 FEET.
4. BASIC AIRCRAFT WEIGHT IS 41,000 POUNDS.
5. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TEST

FUEL DENSITY: 6.8 LB/GAL

Figure A-26. Fouled Deck Range – Two-Engine IFR

TWO-ENGINE OPERATION

GEAR DOWN

FOULED DECK RANGE (VFR)

MODEL: RA-3B – BASIC WING

ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	4130	10	2	765	7	4	365	17	2655	209	5	130	16	11
60	4420	20	4	1260	18	2	160	9	2490	208	10	235	33	16
80	4725	25	6	1535	26	2	190	11	2445	204	12	284	43	20
100	5010	30	8	1845	37	2	165	11	2445	202	14	330	52	24
120	5340	30	8	1860	37	6	480	31	2465	203	14	330	52	28
140	5580	35	11	2235	54	4	345	24	2565	208	16	373	62	31
160	5885	35	11	2260	55	7	625	43	2570	208	16	373	62	34
180	6170	35	11	2280	56	10	890	62	2580	208	16	373	62	37
200	6490	35	12	2300	56	14	1190	82	2590	208	16	373	62	42
220	6800	35	12	2325	57	17	1475	101	2600	208	16	373	62	45
240	7100	35	12	2350	58	20	1750	120	2610	209	16	373	62	48
260	7410	35	12	2380	59	23	2030	139	2620	209	16	373	62	51
280	7720	35	12	2395	59	26	2325	159	2625	209	16	373	62	54
300	8022	35	12	2420	60	30	2600	178	2640	209	16	373	62	58
320	8335	35	12	2445	61	33	2890	197	2650	209	16	373	62	62
340	8646	35	13	2470	62	36	3175	216	2660	209	16	373	62	65
360	8965	35	13	2500	63	39	3465	236	2670	210	16	373	62	68
380	9284	35	13	2525	63	42	3755	255	2680	210	16	373	62	71
400	9609	35	13	2555	64	45	4055	274	2690	210	16	373	62	75

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR TRIM AND ACCELERATION AT END OF CLIMB.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SPEED IS 225 KNOTS CAS TO 15, 000 FEET DECREASING 15 KNOTS PER 10, 000 FEET ALTITUDE ABOVE 15, 000 FEET.
4. IDLE DESCENT TO SEA LEVEL AT 175 KNOTS CAS.
5. BASIC WEIGHT IS 41, 000 POUNDS.
6. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT INCREASE THE FUEL REQUIRED BY 1.1 PERCENT.

DATA AS OF: 1 MARCH 1964

DATA BASIS: NATC AND CONTRACTOR FLIGHT TEST

FUEL GRADE: JP-5

FUEL DENSITY: 6.8 LB/GAL

Figure A-27. Fouled Deck Range – Two-Engine Gear Down

TWO-ENGINE OPERATION
FOULED DECK RANGE (VFR)
GEAR AND FLAPS DOWN

MODEL: RA-3B – BASIC WING ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	4385	15	4	1230	12	2	155	6	2800	162	9	230	22	15
60	4905	20	6	1585	19	4	320	13	2720	157	12	290	29	22
80	5320	25	8	1970	28	4	350	15	2680	156	15	350	37	27
100	5730	30	12	2425	40	3	305	14	2710	156	18	405	46	33
120	6175	30	12	2465	41	8	710	33	2720	156	18	405	46	37
140	6560	35	18	3165	67	4	395	20	2810	157	20	460	54	43
160	7080	30	12	2535	43	17	1545	71	2750	157	18	405	46	47
180	7530	30	13	2570	44	21	1960	90	2770	158	18	405	46	52
200	8000	30	13	2620	45	26	2380	109	2780	158	18	405	46	56
220	8455	30	13	2660	46	30	2795	127	2800	158	18	405	46	61
240	8915	30	13	2695	47	34	3220	146	2810	159	18	405	46	65
260	9405	30	14	2740	48	39	3665	166	2830	159	18	405	46	70
280	9875	30	14	2780	49	43	4095	185	2850	160	18	405	46	75
300	10,360	30	14	2830	50	48	4530	204	2860	161	18	405	46	79
320	10,850	30	14	2880	51	52	4970	223	2880	161	18	405	46	84
340	11,340	30	15	2935	52	56	5405	242	2890	161	18	405	46	88
360	11,830	30	15	2980	53	60	5850	261	2910	161	18	405	46	93
380	12,325	30	15	3035	54	65	6290	280	2920	162	18	405	46	98
400	12,810	30	16	3090	55	69	6720	298	2940	162	18	405	46	102

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SPEED IS 180 KNOTS CAS AT SEA LEVEL DECREASING 11 KNOTS PER 10,000 FEET ALTITUDE.
4. IDLE DESCENT TO SEA LEVEL AT 124 KNOTS CAS.
5. BASIC AIRCRAFT WEIGHT IS 41,000 POUNDS.
6. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964 FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TEST FUEL DENSITY: 6.8 LB/GAL

Figure A-28. Fouled Deck Range – Two-Engine Gear and Flaps Down

ONE-ENGINE OPERATION

FOULED DECK RANGE (VFR)

MODEL: RA-3B – BASIC WING

ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	3580	5	3	465	9	2	115	8	3620	233	6	210	23	11
60	3870	5	3	465	9	7	405	28	3630	234	6	210	23	16
80	3940	10	4	750	20	3	190	15	3480	231	12	400	46	19
100	4205	10	4	755	20	8	450	34	3490	232	12	400	46	23
120	4270	15	7	1050	34	4	220	18	3390	226	17	570	68	27
140	4505	15	7	1050	34	8	455	38	3390	227	17	570	68	32
160	4595	20	10	1380	51	4	215	20	3330	224	21	705	89	35
180	4820	20	10	1390	52	8	430	39	3340	225	21	705	89	39
200	4900	25	15	1775	77	2	125	12	3310	222	26	825	111	42
220	5120	25	15	1800	78	6	320	31	3320	222	26	825	111	46
240	5325	25	15	1805	78	9	520	51	3340	222	26	825	111	50
260	5540	25	15	1825	80	13	715	69	3350	222	26	825	111	53
280	5750	25	15	1840	80	16	910	88	3350	222	26	825	111	57
300	5965	25	15	1845	80	20	1120	109	3360	222	26	825	111	61
320	6175	25	15	1855	81	24	1320	128	3370	223	26	825	111	64
340	6390	25	15	1875	82	27	1515	146	3380	223	26	825	111	68
360	6610	25	16	1890	83	30	1720	166	3380	223	26	825	111	72
380	6825	25	16	1900	83	34	1925	185	3390	223	26	825	111	75
400	7040	25	16	1915	84	38	2125	204	3400	224	26	825	111	79

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SCHEDULE IS 280 KNOTS CAS AT SEA LEVEL DECREASING 20 KNOTS PER 10,000 FEET.
4. DESCEND AT 220 KNOTS CAS USING 85% RPM.
5. BASIC AIRCRAFT WEIGHT IS 41,000 POUNDS.
6. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TEST

FUEL DENSITY: 6.8 LB/GAL

Figure A-29. Fouled Deck Range – One-Engine VFR

ONE-ENGINE OPERATION

FOULED DECK RANGE (IFR)

MODEL: RA-3B – BASIC WING

ENGINES: J57-P-10

			CLIMB			CRUISE					
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	TOTAL ETE
40	3850	S. L.	0	200	0	10	650	40	3820	237	10
60	4175	S. L.	0	200	0	15	975	60	3820	237	15
80	4500	S. L.	0	200	0	20	1300	80	3830	237	20
100	4805	5	2	470	9	22	1335	92	3650	234	24
120	5075	10	4	765	21	22	1310	99	3510	232	27
140	5335	15	7	1075	35	22	1260	105	3420	228	29
160	5590	15	7	1090	36	26	1500	124	3430	228	33
180	5845	20	11	1435	54	25	1410	127	3380	226	36
200	6070	20	11	1445	54	29	1625	146	3390	226	40
220	6305	25	15	1870	82	25	1430	138	3370	224	41
240	6515	25	15	1880	82	29	1635	158	3380	224	45
260	6735	25	16	1905	83	32	1830	177	3390	224	48
280	6955	25	16	1910	84	36	2045	197	3390	224	52
300	7175	25	16	1925	84	40	2250	216	3400	224	56
320	7395	25	16	1945	85	43	2450	235	3410	224	59
340	7615	25	16	1960	86	47	2655	254	3420	225	63
360	7835	25	16	1970	87	50	2865	274	3430	225	67
380	8055	25	17	1980	87	54	3075	293	3440	225	70
400	8275	25	17	1990	88	57	3285	313	3450	225	74

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT APPROACH FIX. NO WIND CONDITIONS.
3. CLIMB SCHEDULE IS 280 KNOTS CAS AT SEA LEVEL DECREASING 20 KNOTS PER 10,000 FEET ALTITUDE.
4. BASIC AIRCRAFT WEIGHT IS 41,000 POUNDS.
5. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TEST

FUEL DENSITY: 6.8 LB/GAL

Figure A-30. Fouled Deck Range – One-Engine IFR

ONE-ENGINE OPERATION

SEA LEVEL FOULED DECK RANGE

MODEL: RA-3B – BASIC WING

ENGINES: J57-P-10

DIST	FUEL REQ	FLOW LBS/HR	CAS	ETE
40	3850	3820	237	10
60	4175	3830	237	15
80	4500	3830	237	20
100	4825	3840	238	25
120	5150	3860	238	30
140	5475	3860	238	35
160	5800	3880	238	40
180	6125	3890	238	45
200	6460	3900	239	50
220	6795	3910	239	55
240	7125	3910	239	60
260	7460	3920	239	65
280	7790	3930	240	70
300	8120	3930	240	75
320	8460	3940	240	80
340	8790	3950	240	85
360	9130	3960	240	90
380	9460	3970	241	94
400	9805	3990	241	100

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL RESERVE FOR LANDING, NO WIND CONDITIONS.
3. BASIC AIRCRAFT WEIGHT IS 41,000 POUNDS.
4. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT INCREASE THE FUEL REQUIRED BY 0.6 PERCENT.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TEST

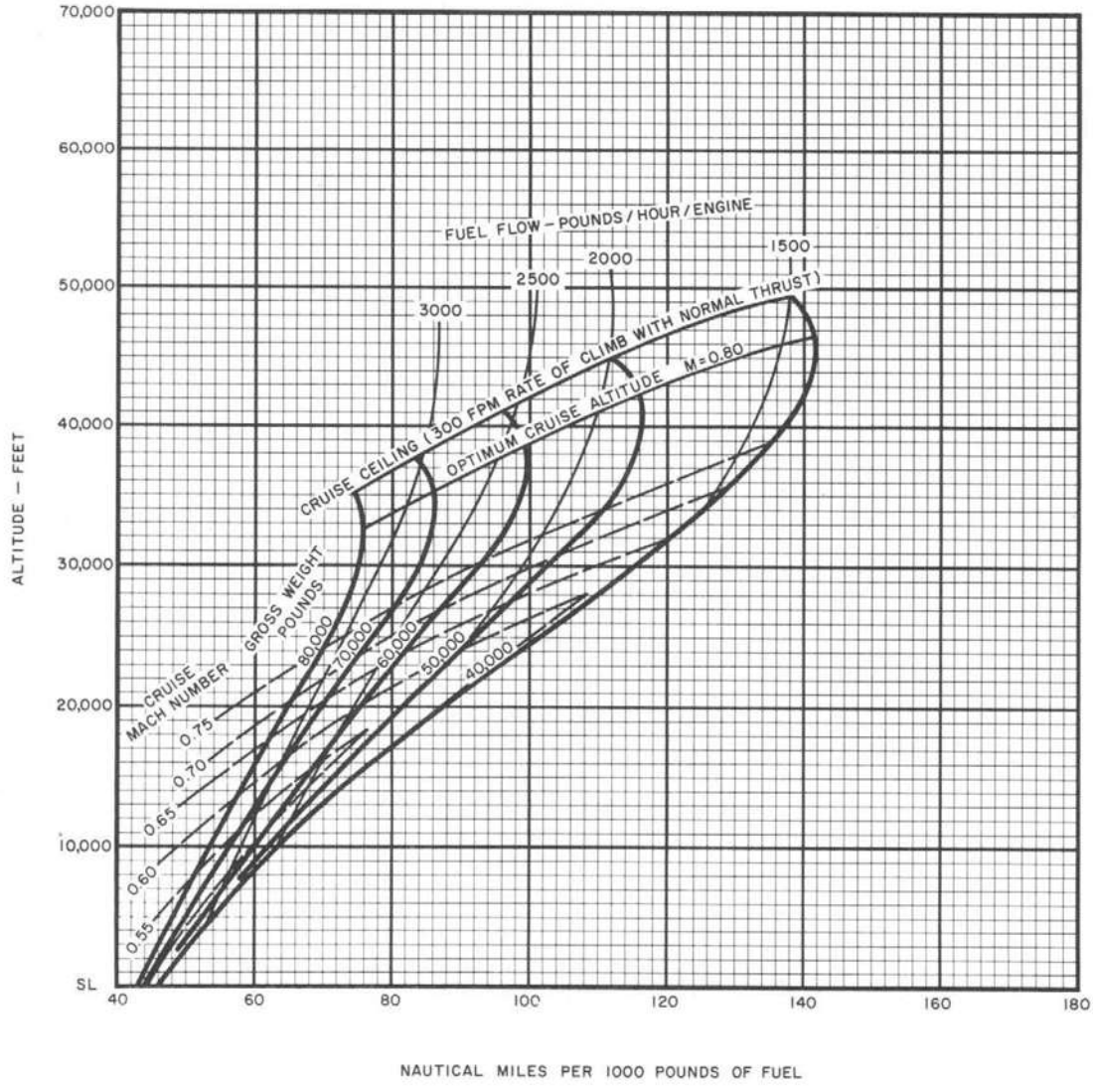
FUEL DENSITY: 6.8 LB/GAL

Figure A-31. Fouled Deck Range – One-Engine, Sea Level

TWO ENGINE OPERATION

MAXIMUM SPECIFIC RANGE VS ALTITUDE

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



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DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

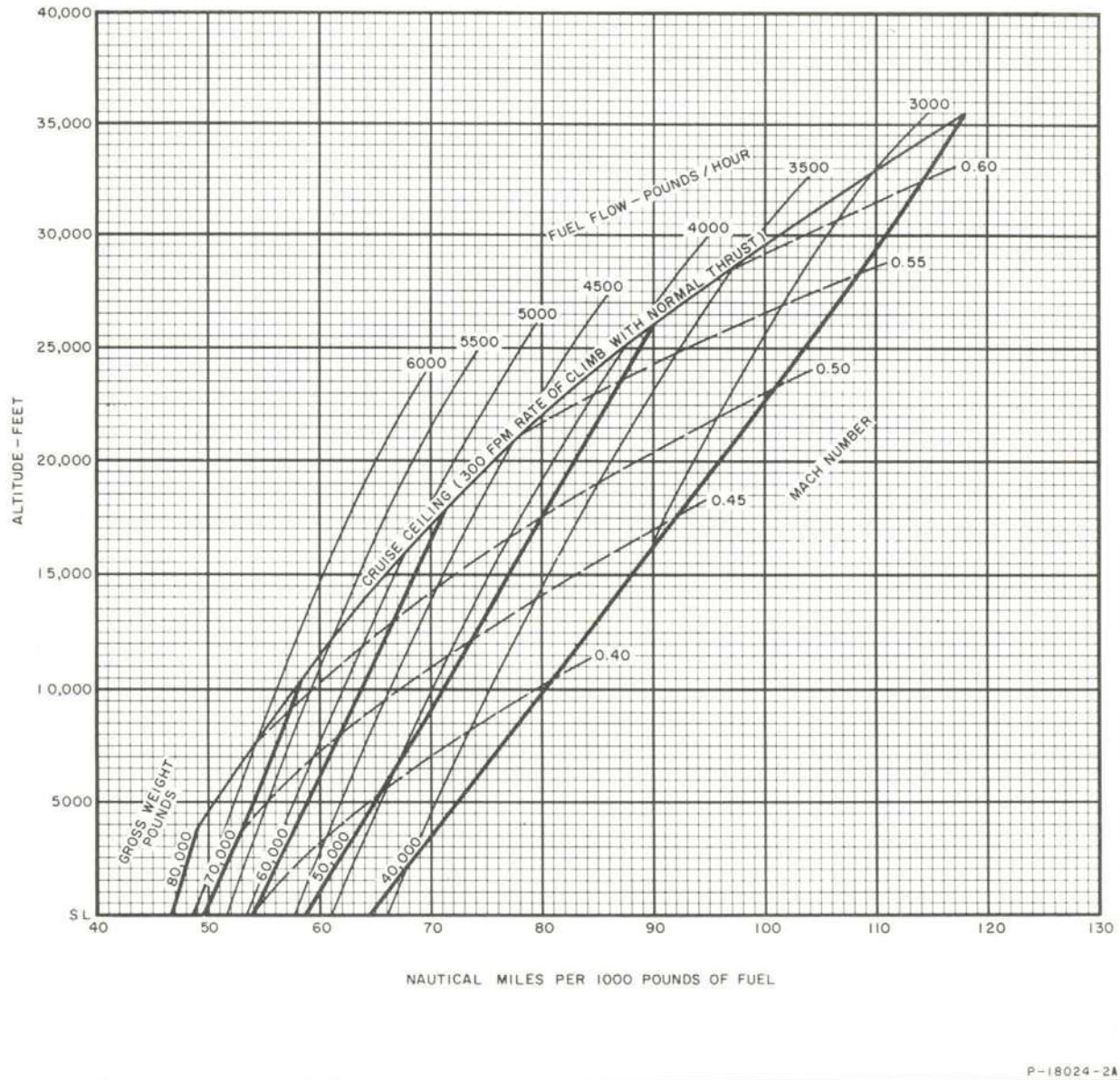
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-32. Maximum Specific Range vs Altitude (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM SPECIFIC RANGE VS ALTITUDE

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-32. Maximum Specific Range vs Altitude -- One-Engine Operation (Sheet 2)

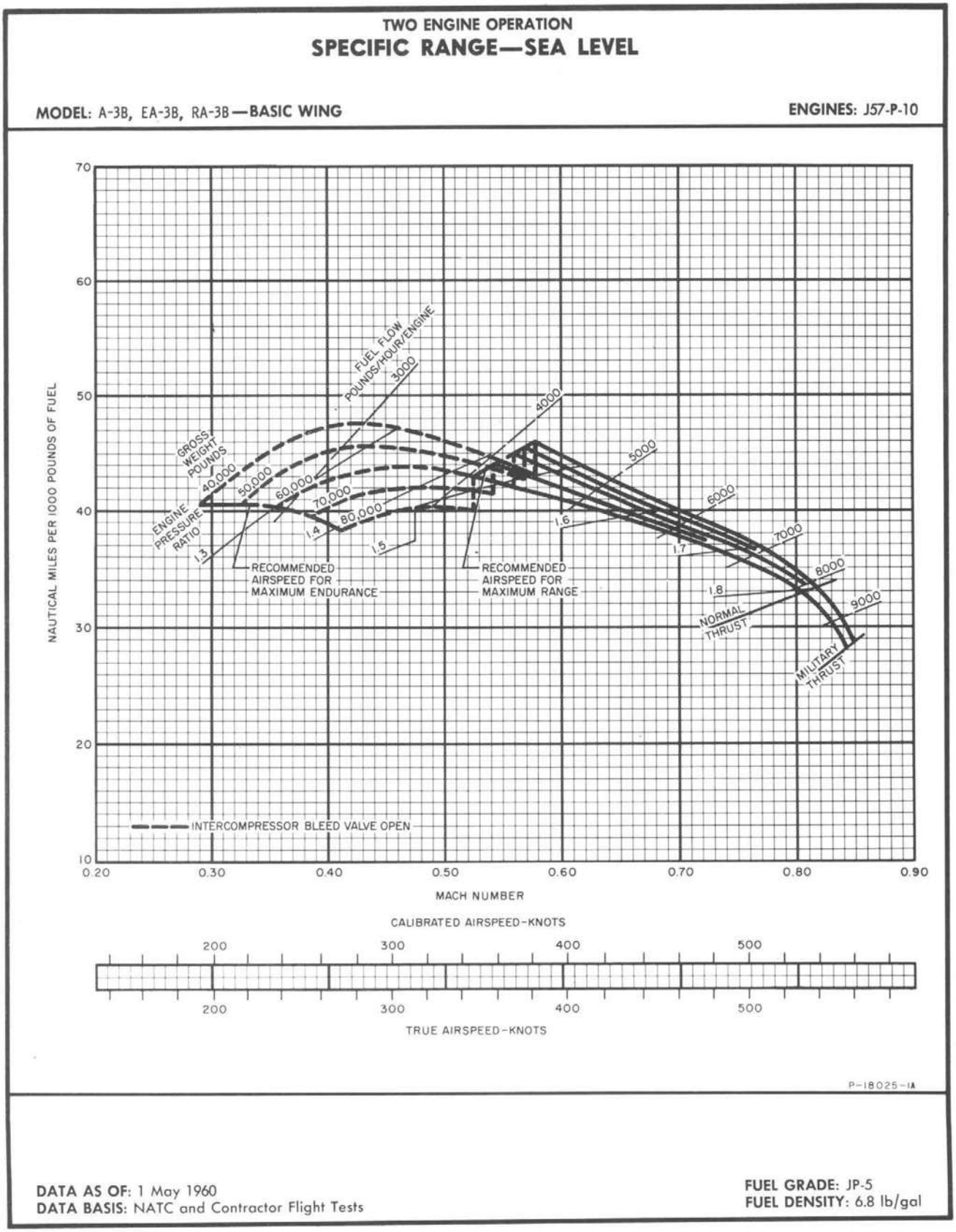


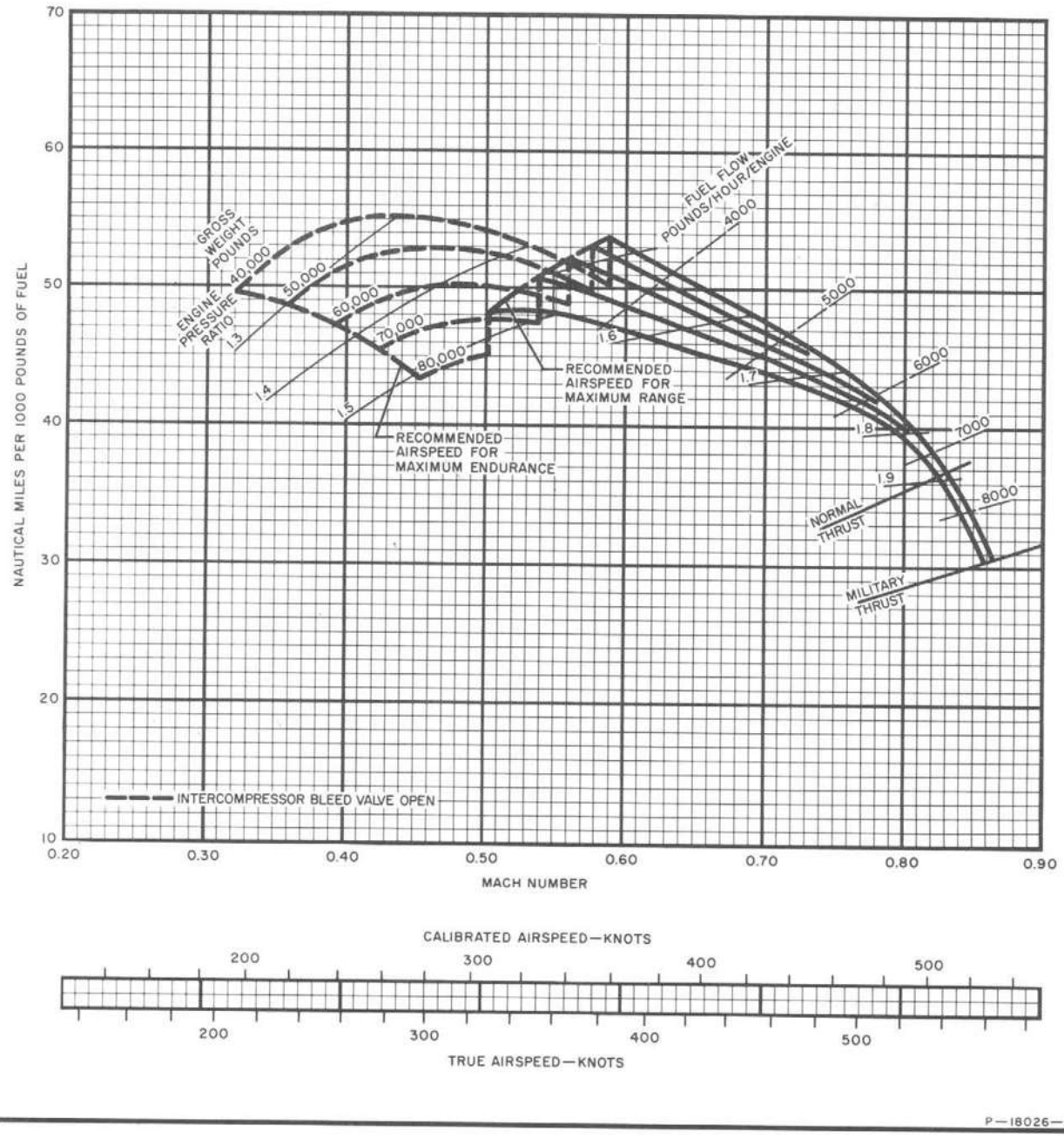
Figure A-33. Specific Range – Sea Level (Sheet 1)

TWO ENGINE OPERATION

SPECIFIC RANGE—5000 FEET

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING**

ENGINES: J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-33. Specific Range – 5000 Feet (Sheet 2)

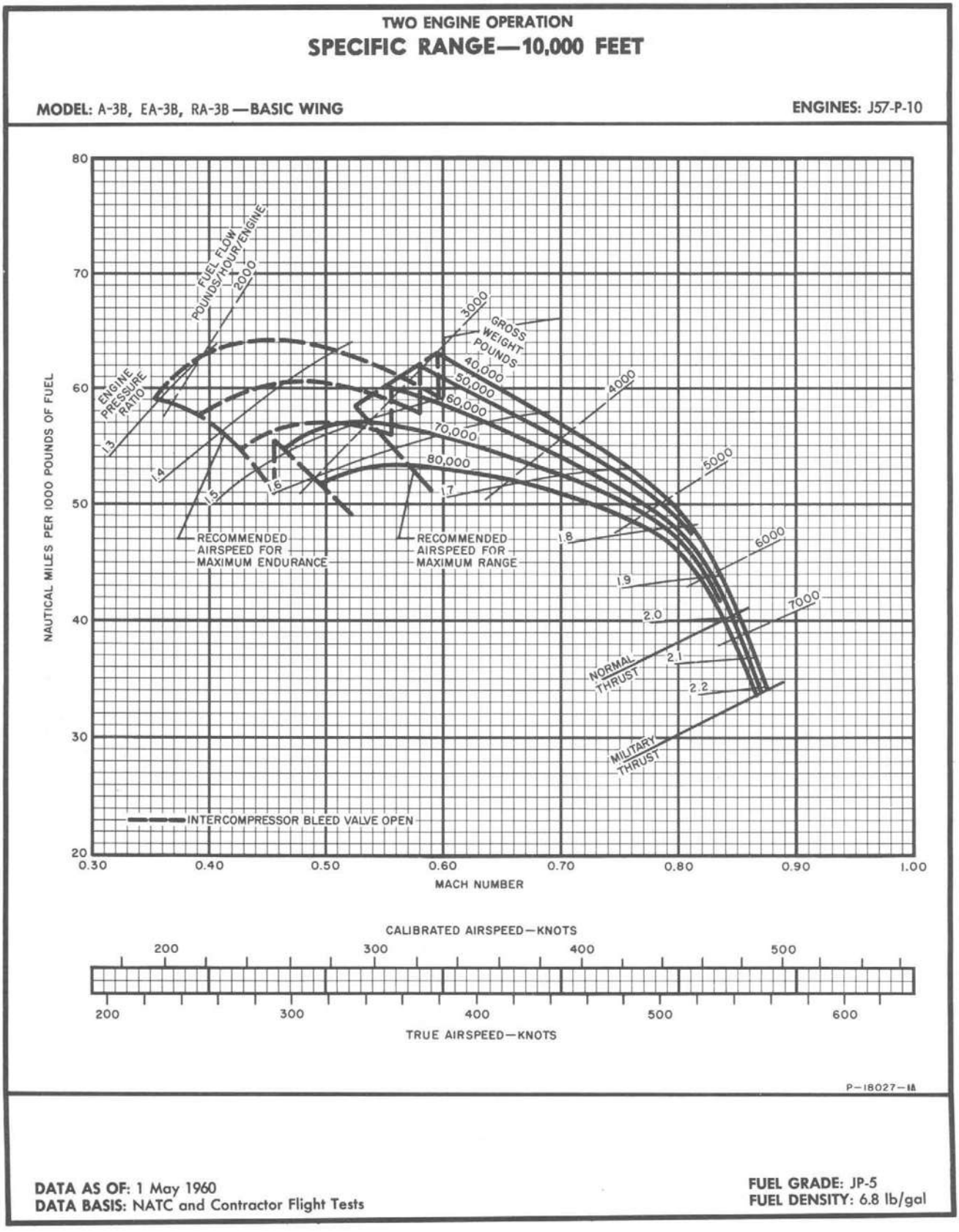
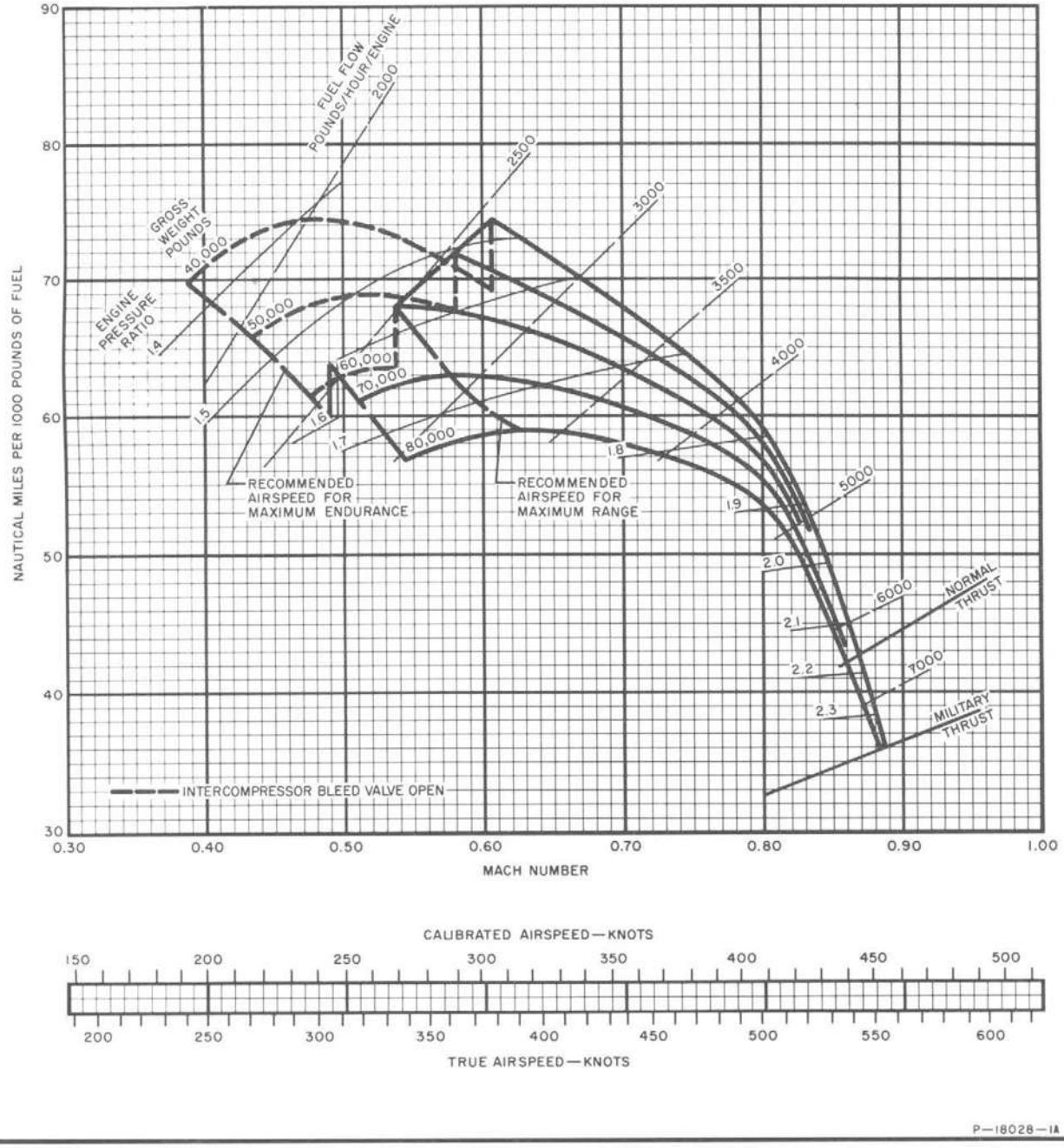


Figure A-33. Specific Range – 10, 000 Feet (Sheet 3)

TWO ENGINE OPERATION

SPECIFIC RANGE—15,000 FEET

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10



P—18028—1A

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-33. Specific Range – 15,000 Feet (Sheet 4)

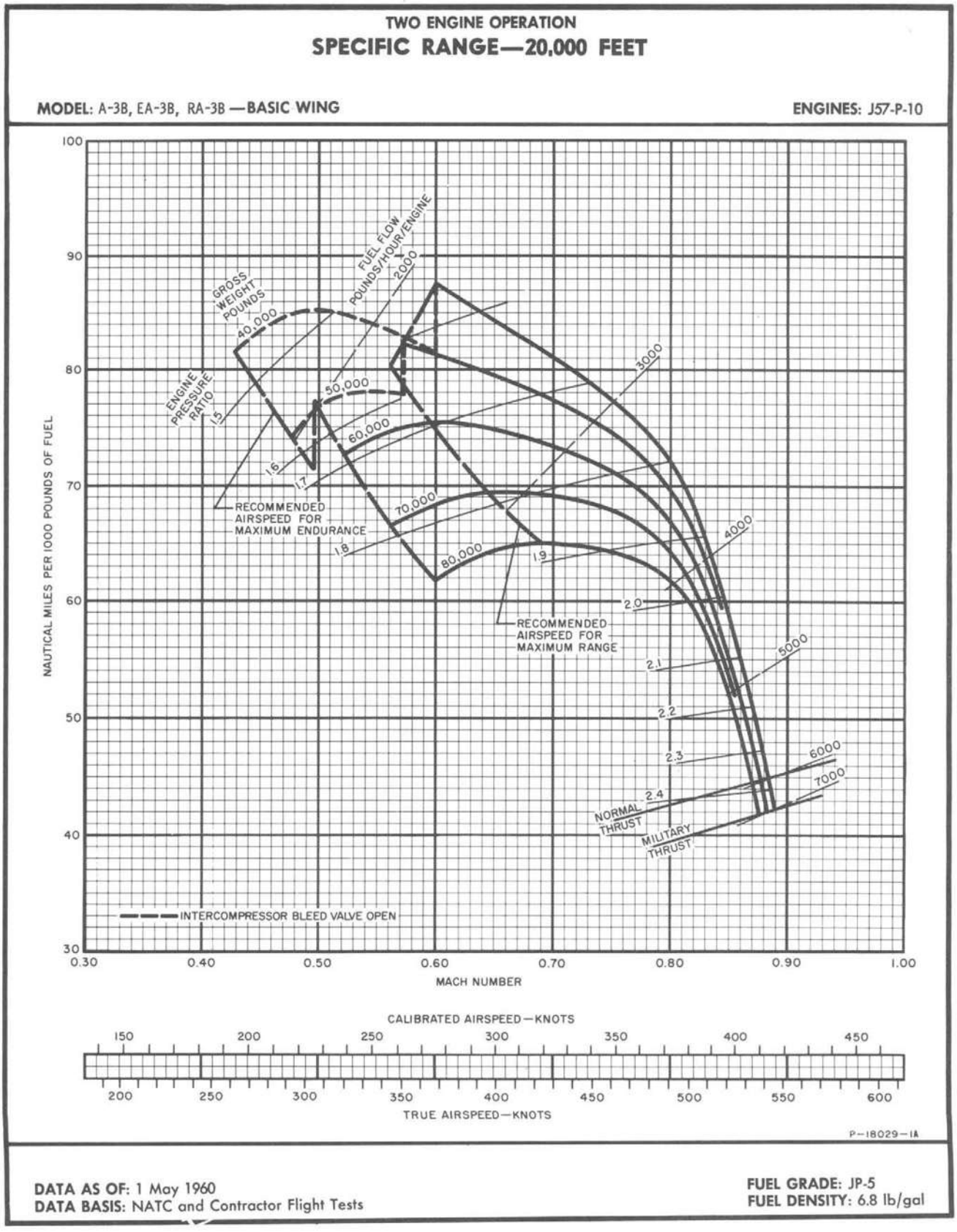


Figure A-33. Specific Range – 20, 000 Feet (Sheet 5)

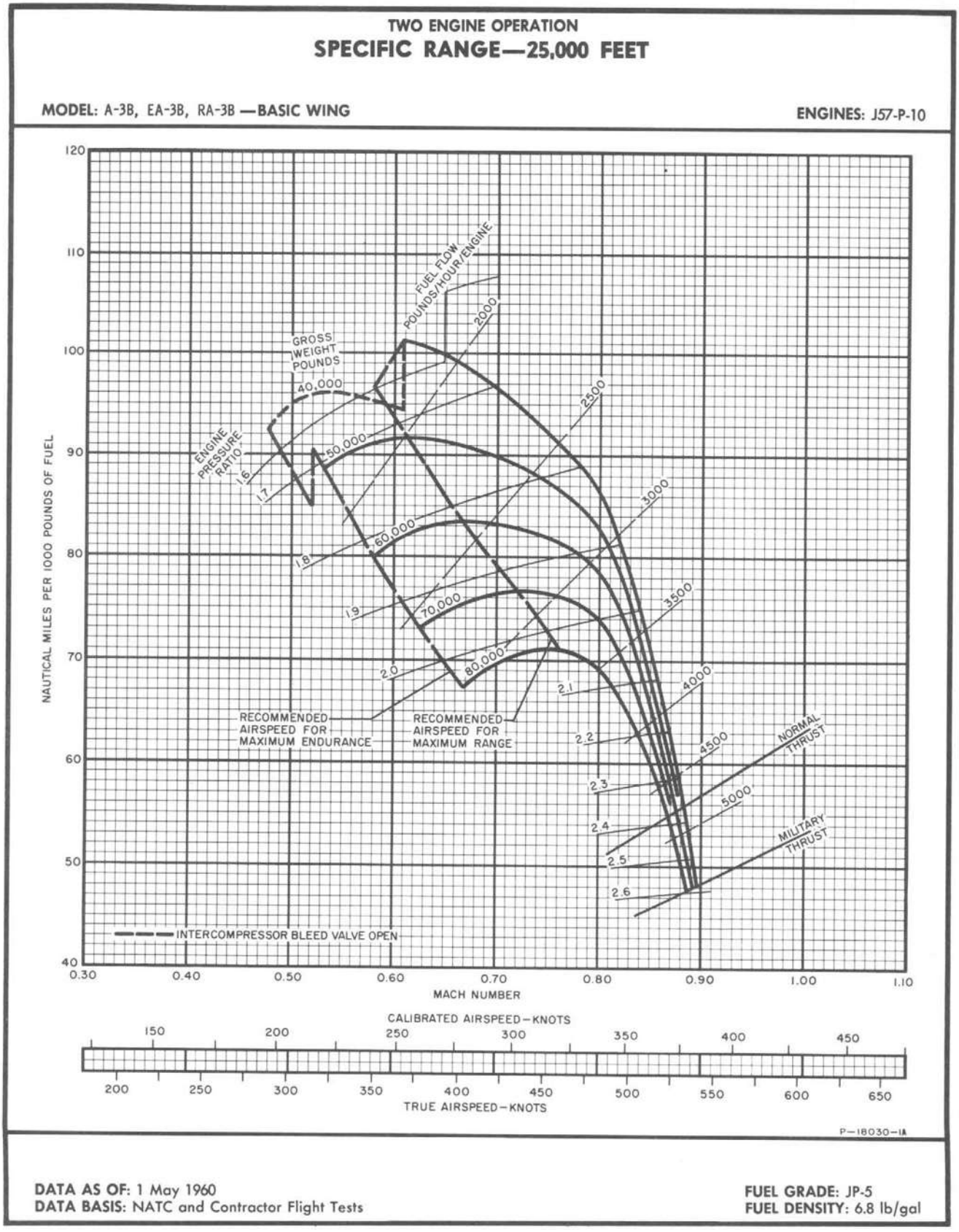


Figure A-33. Specific Range – 25,000 Feet (Sheet 6)

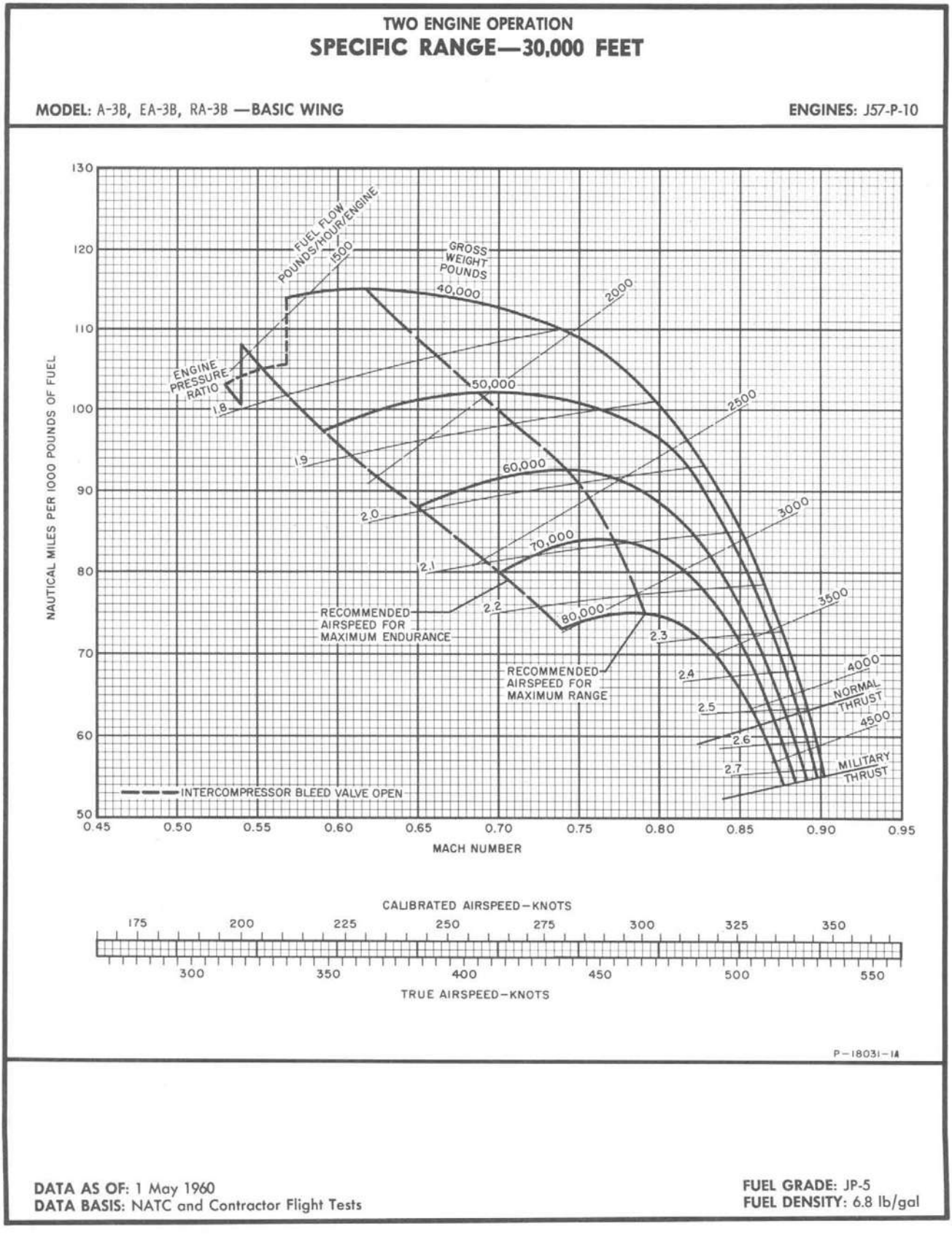


Figure A-33. Specific Range – 30,000 Feet (Sheet 7)

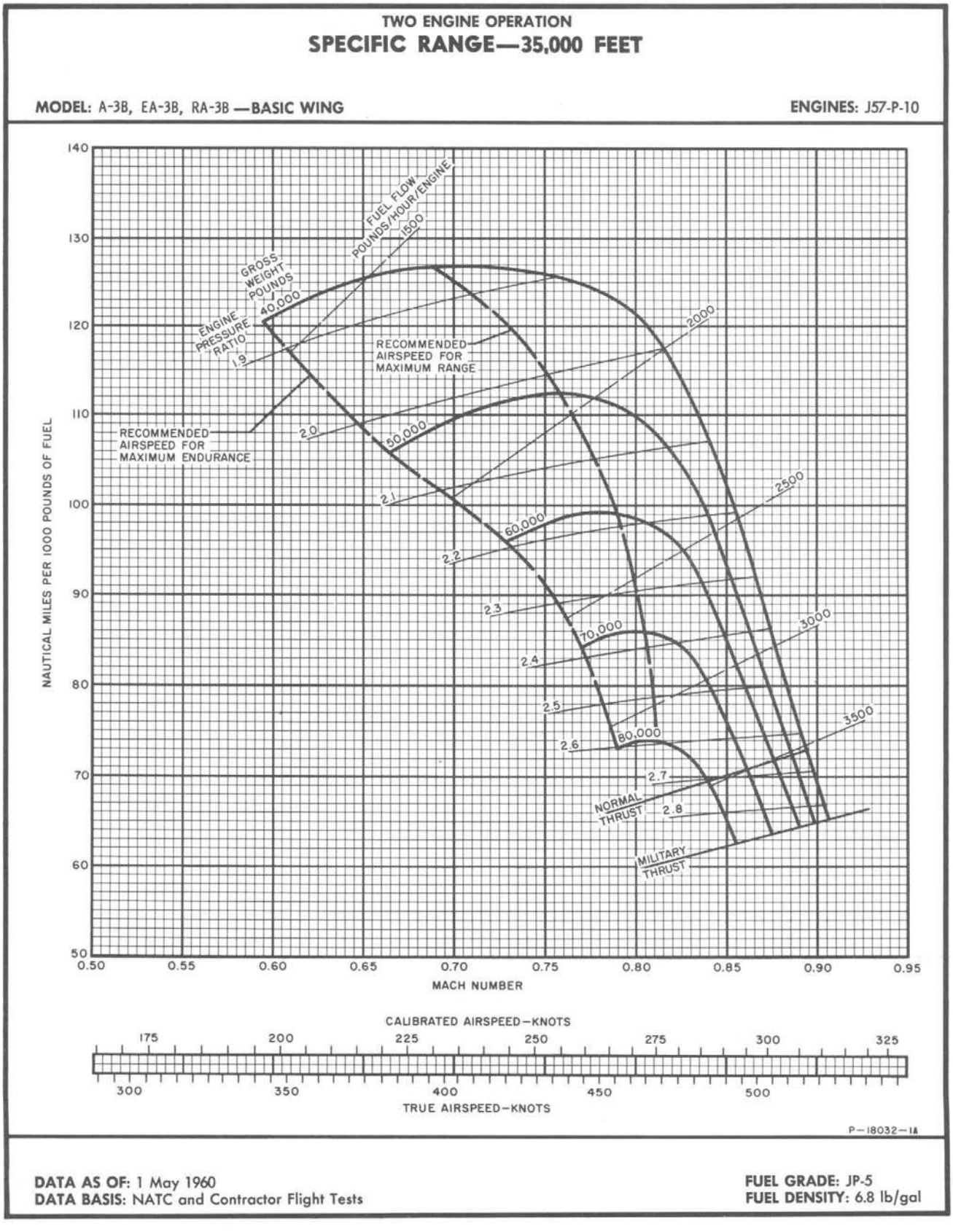


Figure A-33. Specific Range – 35,000 Feet (Sheet 8)

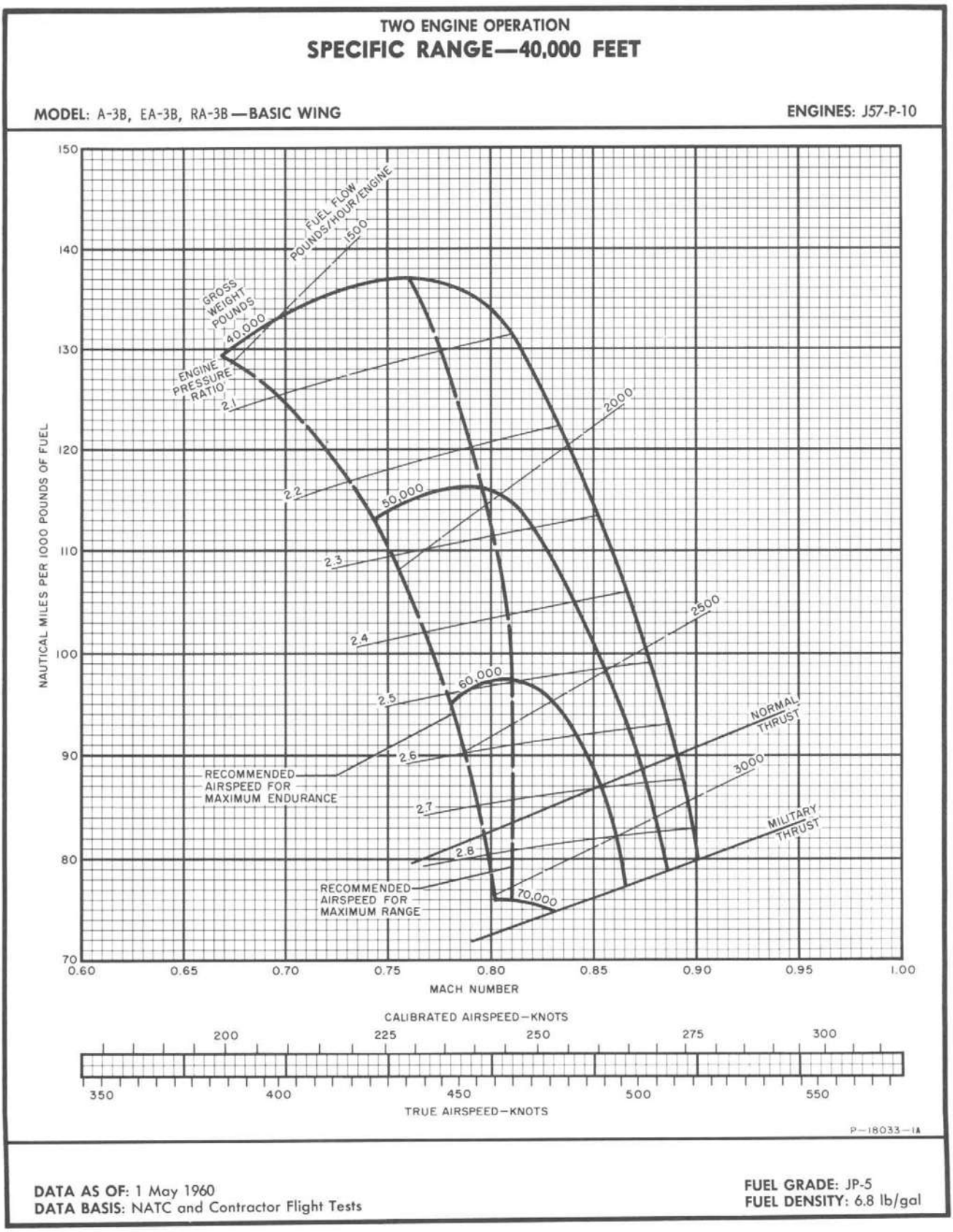


Figure A-33. Specific Range – 40, 000 Feet (Sheet 9)

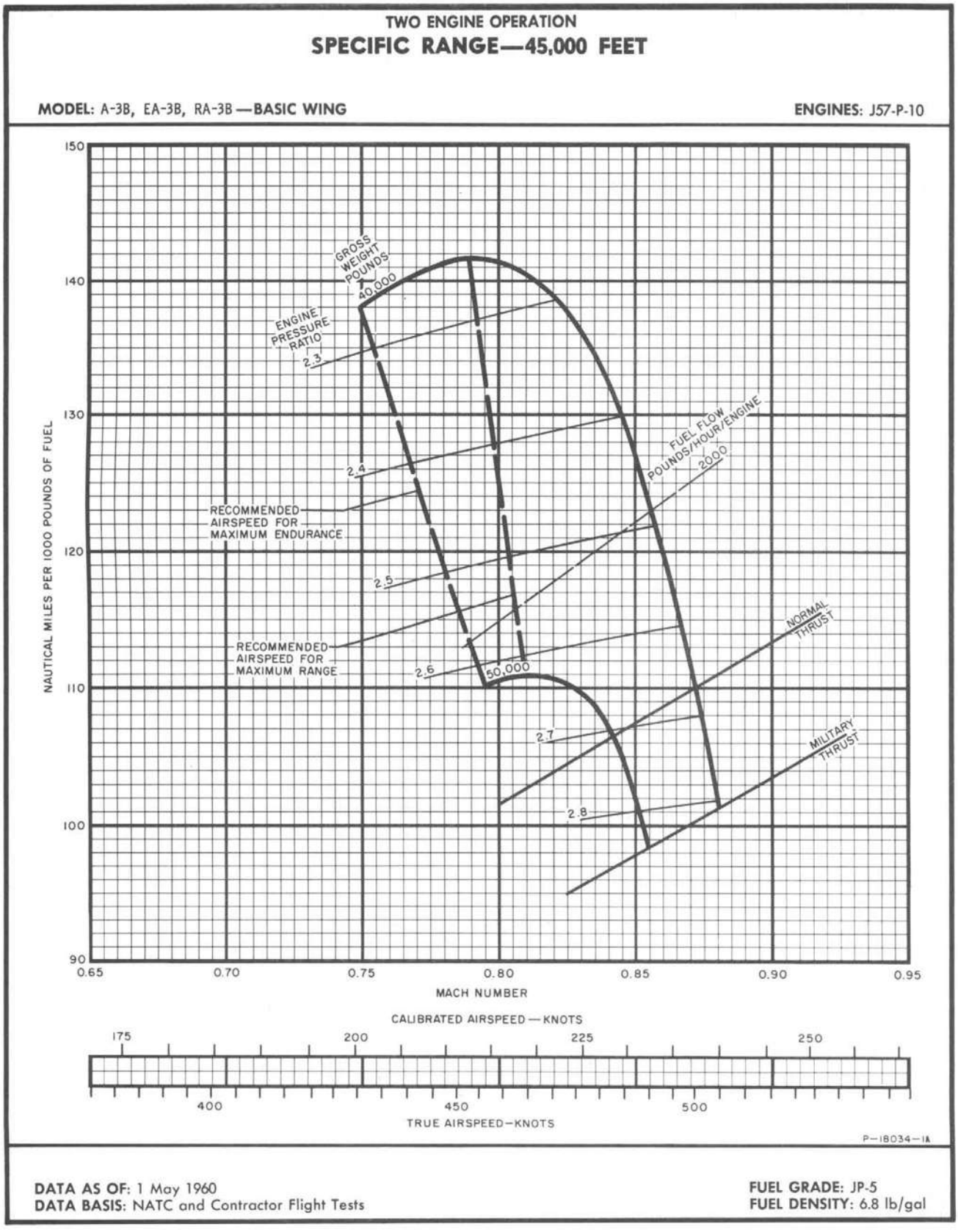
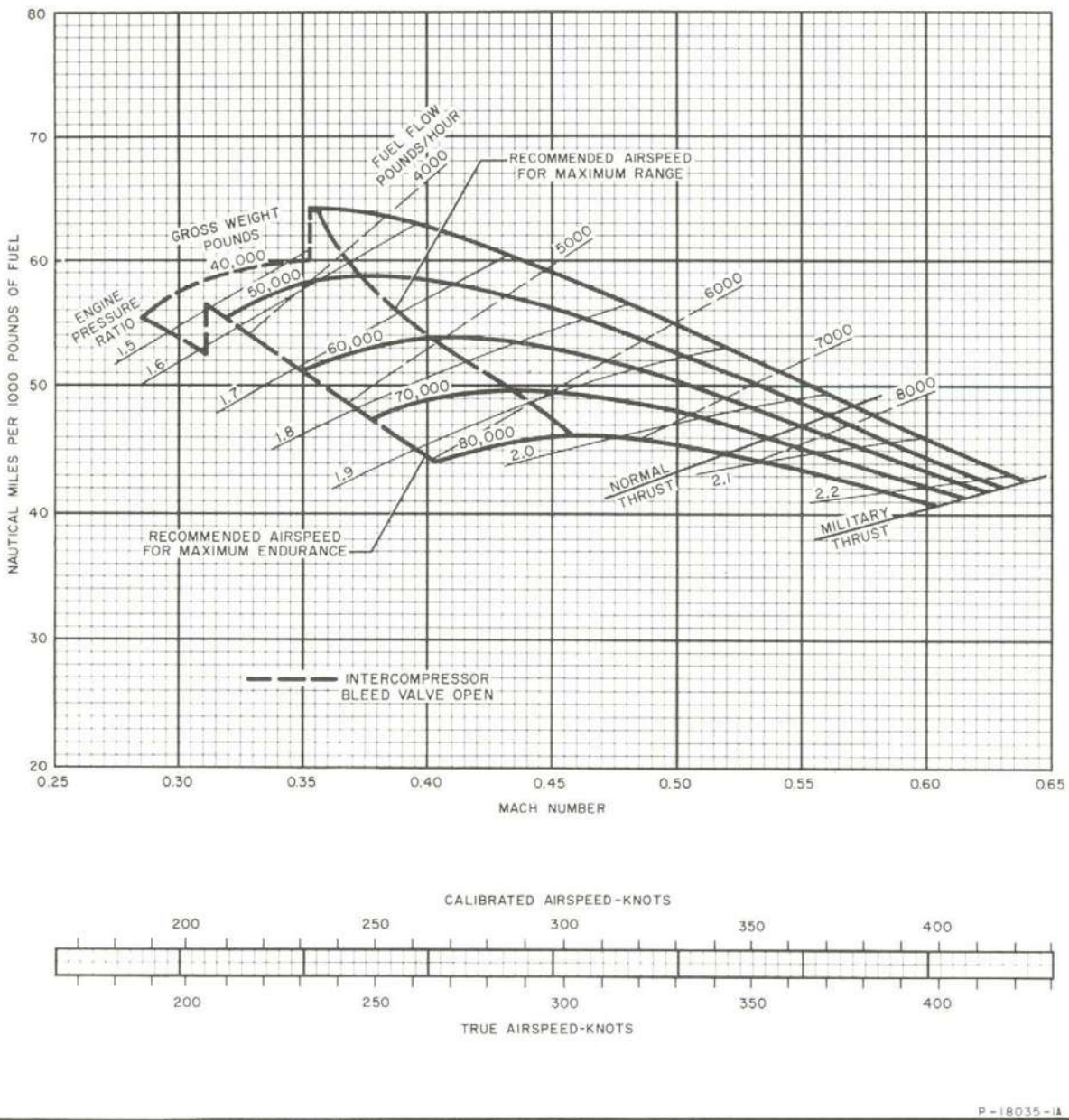


Figure A-33. Specific Range – 45, 000 Feet (Sheet 10)

ONE ENGINE OPERATION

SPECIFIC RANGE—SEA LEVEL

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

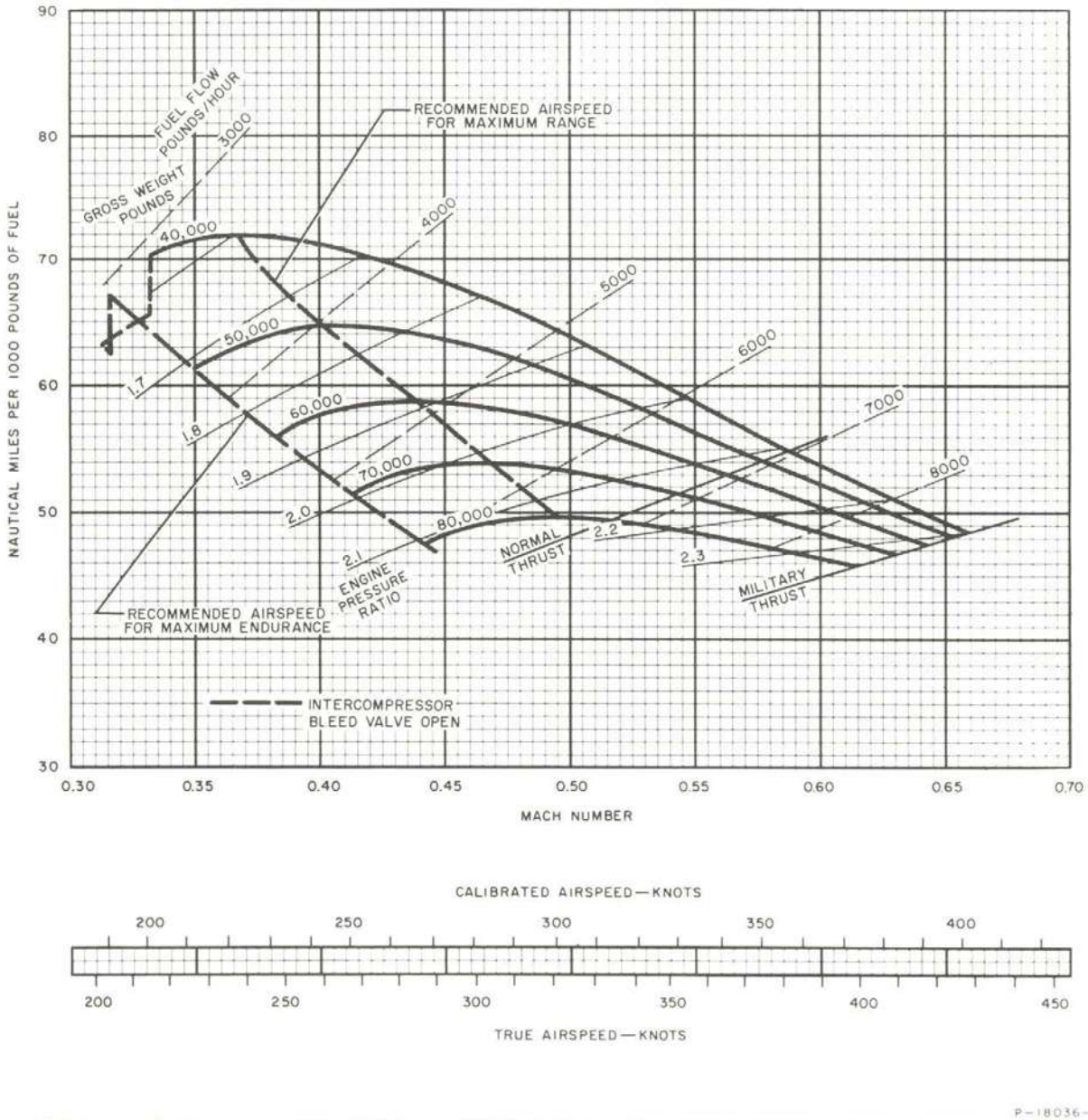
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-34. Specific Range, One-Engine – Sea Level (Sheet 1)

ONE ENGINE OPERATION

SPECIFIC RANGE—5000 FEET

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

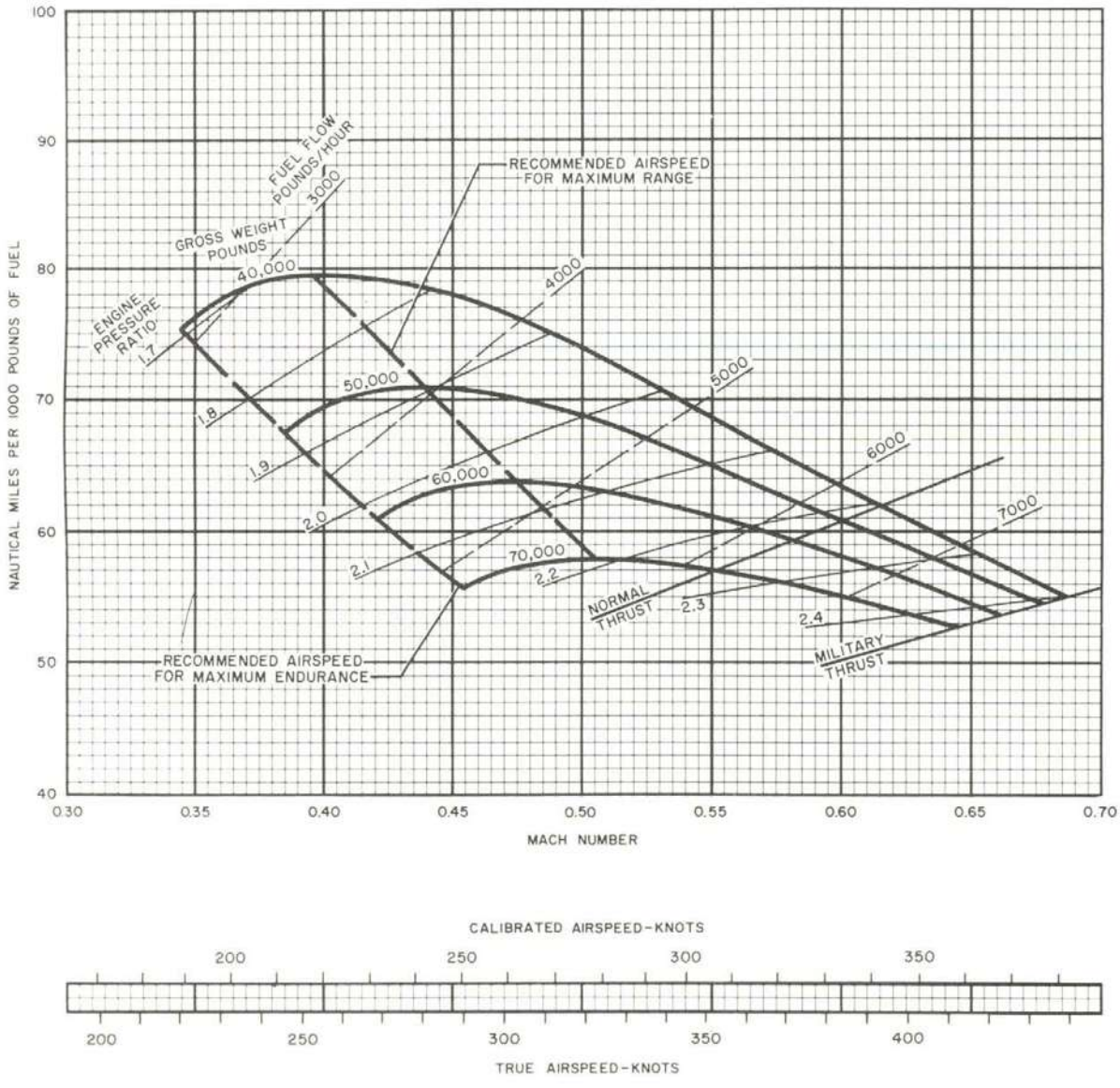
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-34. Specific Range, One-Engine – 5000 Feet (Sheet 2)

ONE ENGINE OPERATION

SPECIFIC RANGE—10,000 FEET

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

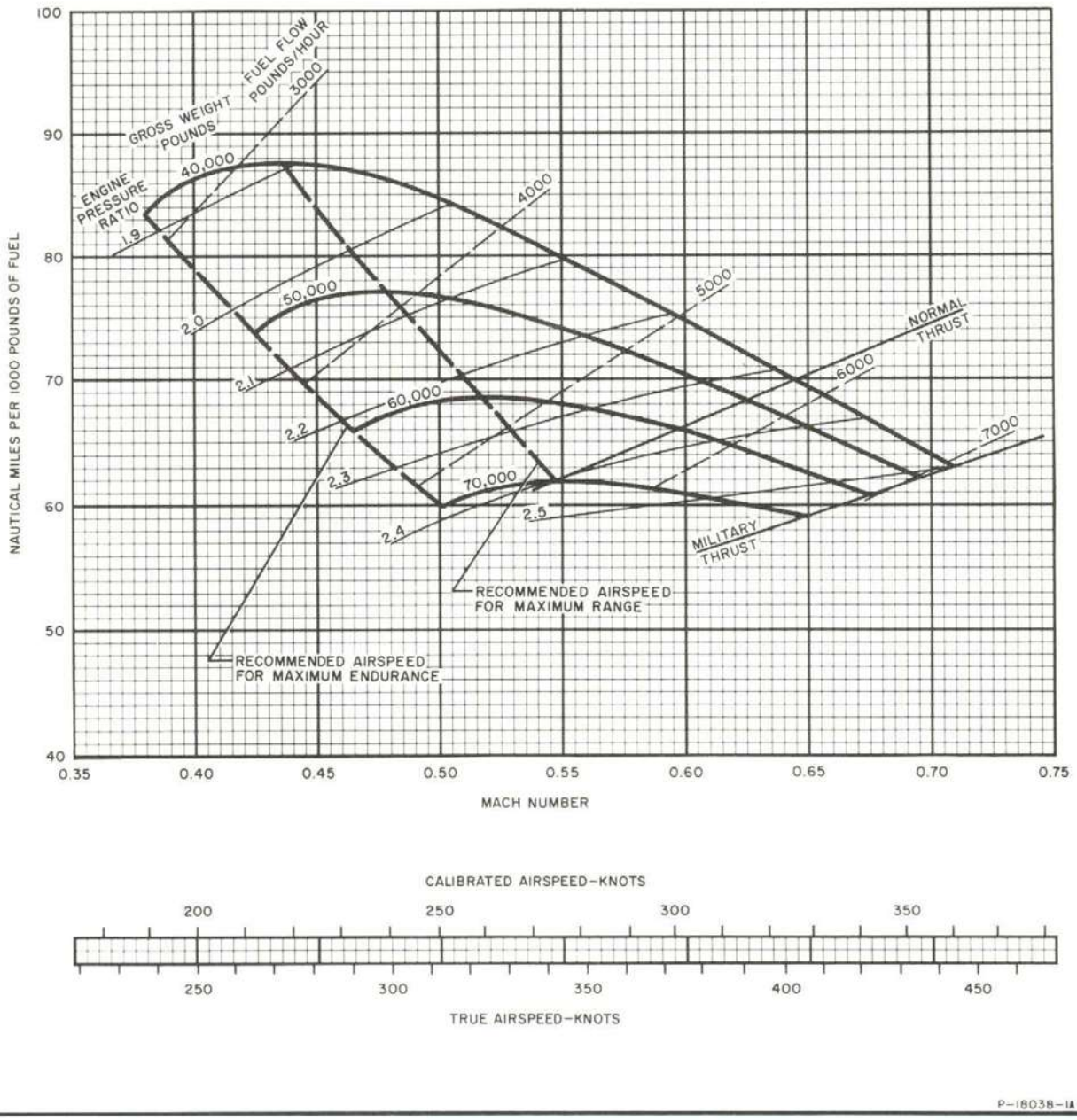
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-34. Specific Range, One-Engine – 10,000 Feet (Sheet 3)

ONE ENGINE OPERATION

SPECIFIC RANGE—15,000 FEET

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

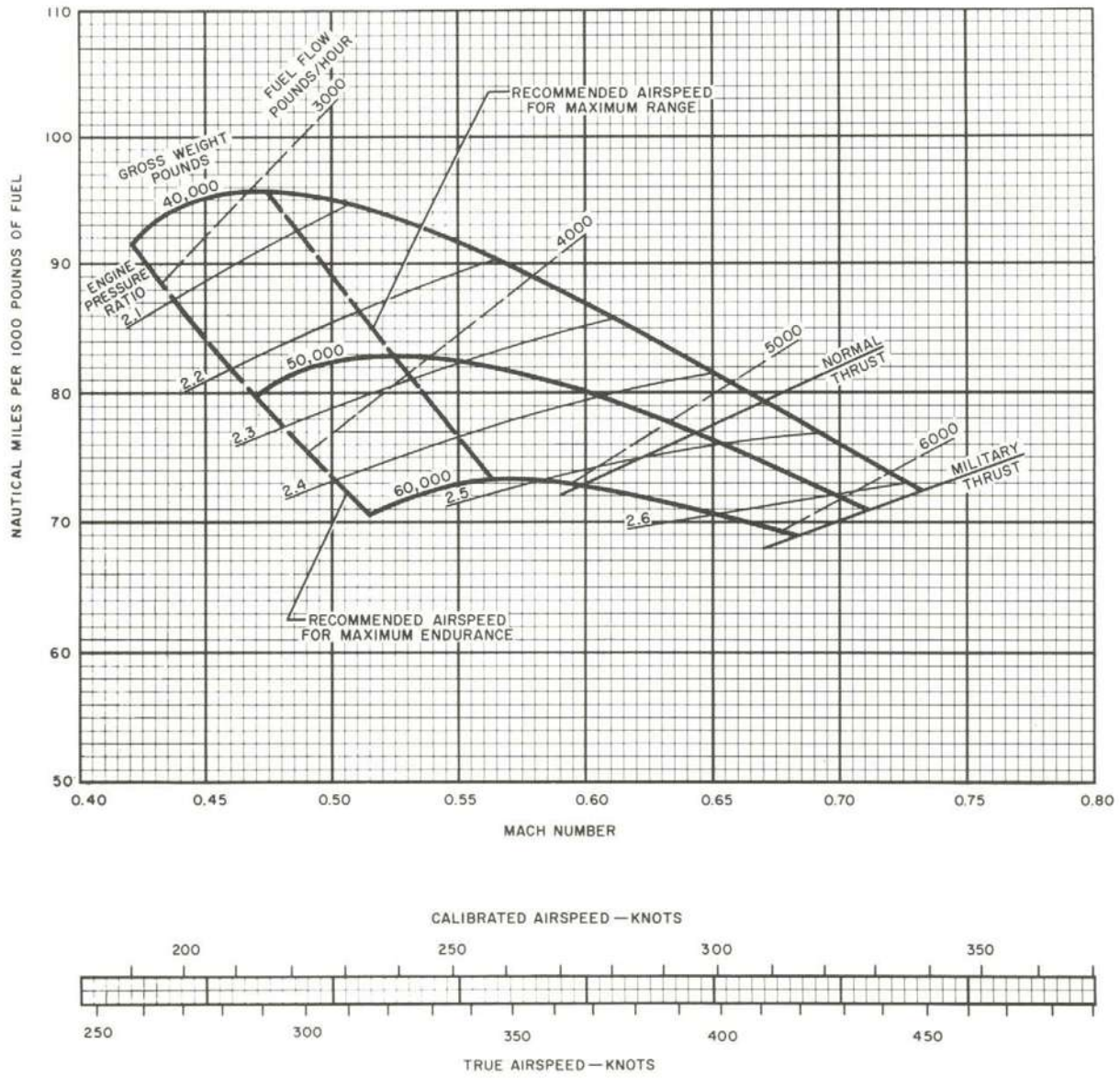
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-34. Specific Range, One-Engine – 15,000 Feet (Sheet 4)

ONE ENGINE OPERATION

SPECIFIC RANGE—20,000 FEET

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

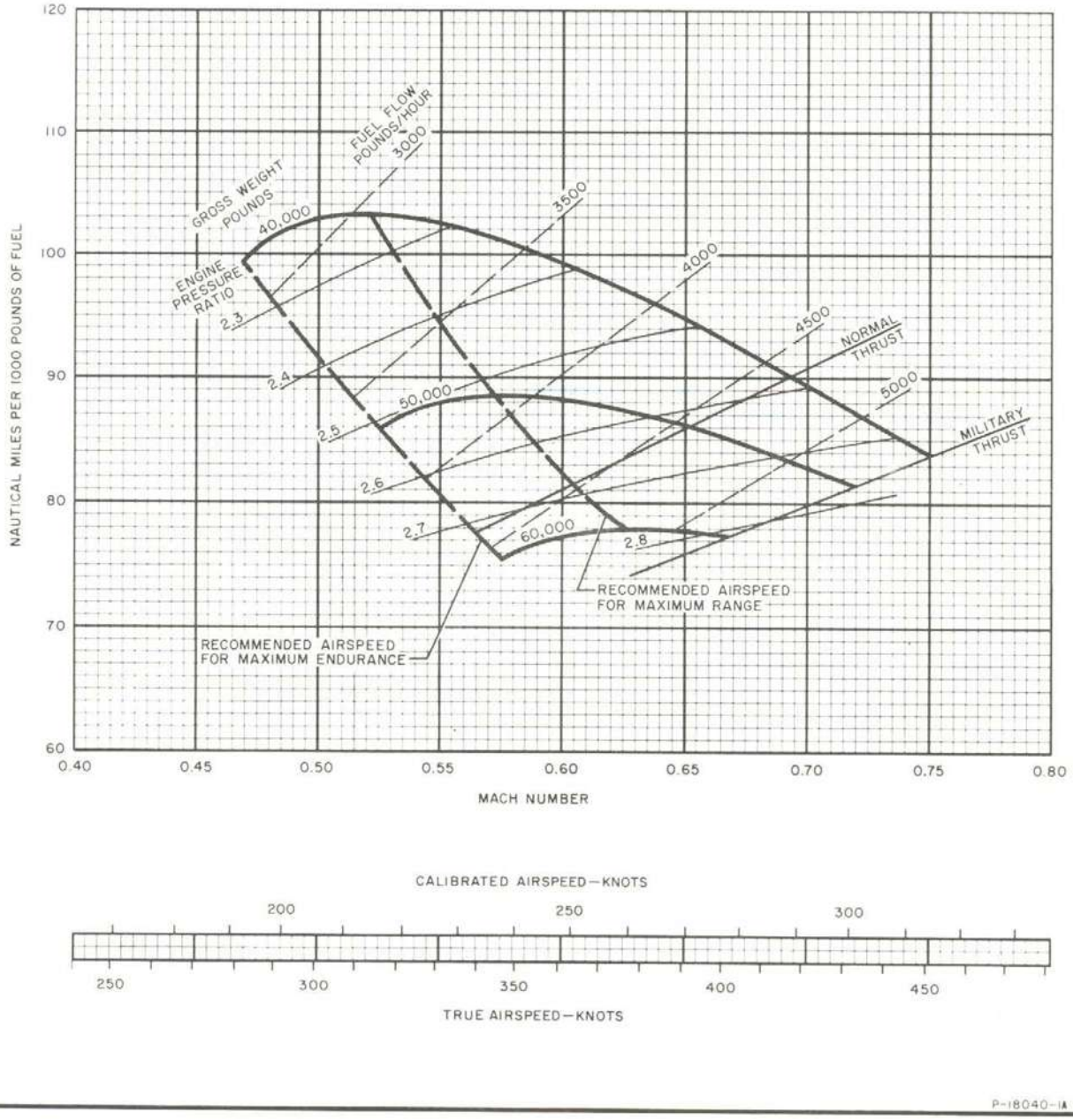
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-34. Specific Range, One-Engine – 20,000 Feet (Sheet 5)

ONE ENGINE OPERATION

SPECIFIC RANGE—25,000 FEET

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

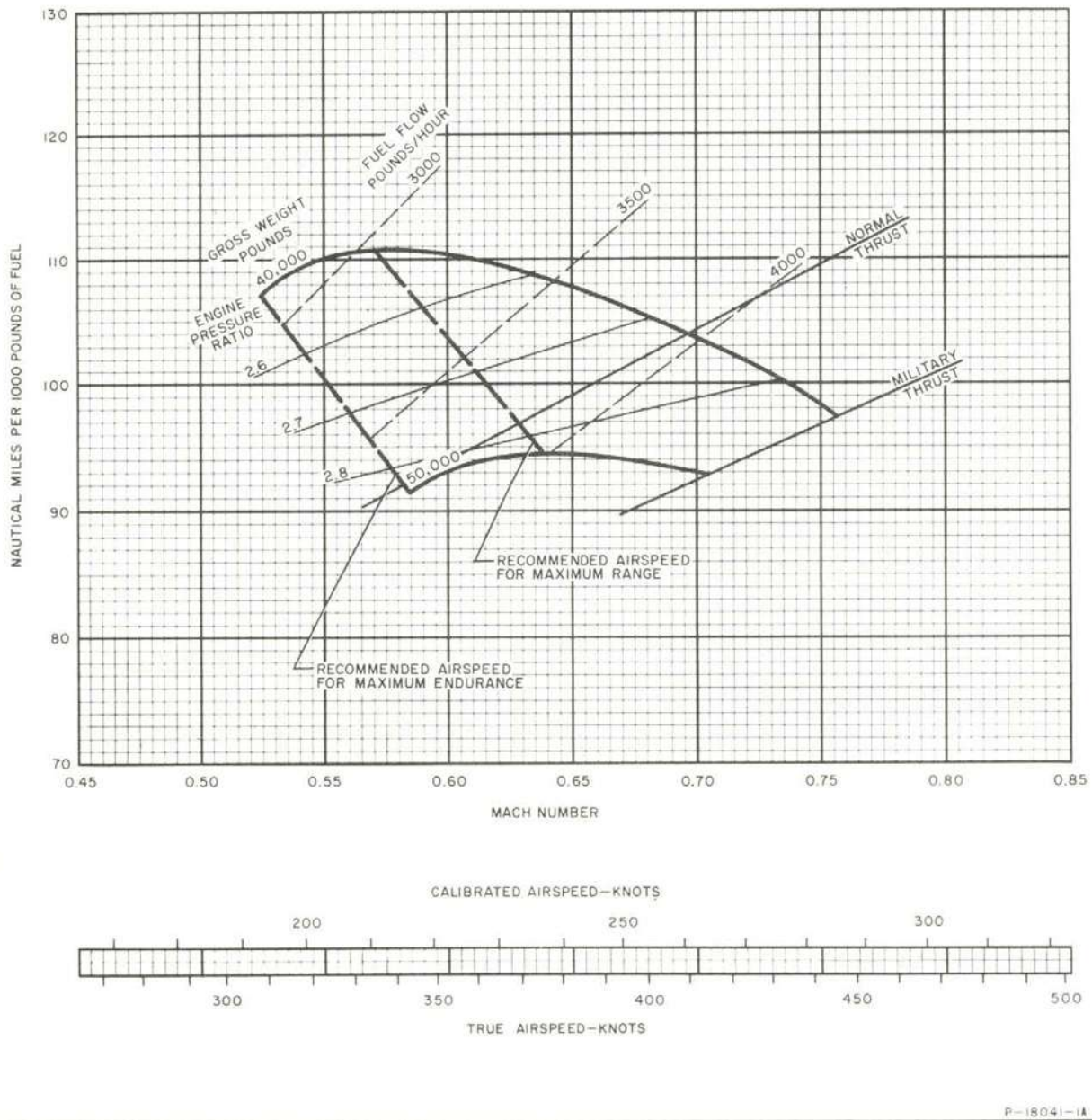
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-34. Specific Range, One-Engine – 25,000 Feet (Sheet 6)

ONE ENGINE OPERATION

SPECIFIC RANGE—30,000 FEET

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-34. Specific Range, One-Engine – 30,000 Feet (Sheet 7)

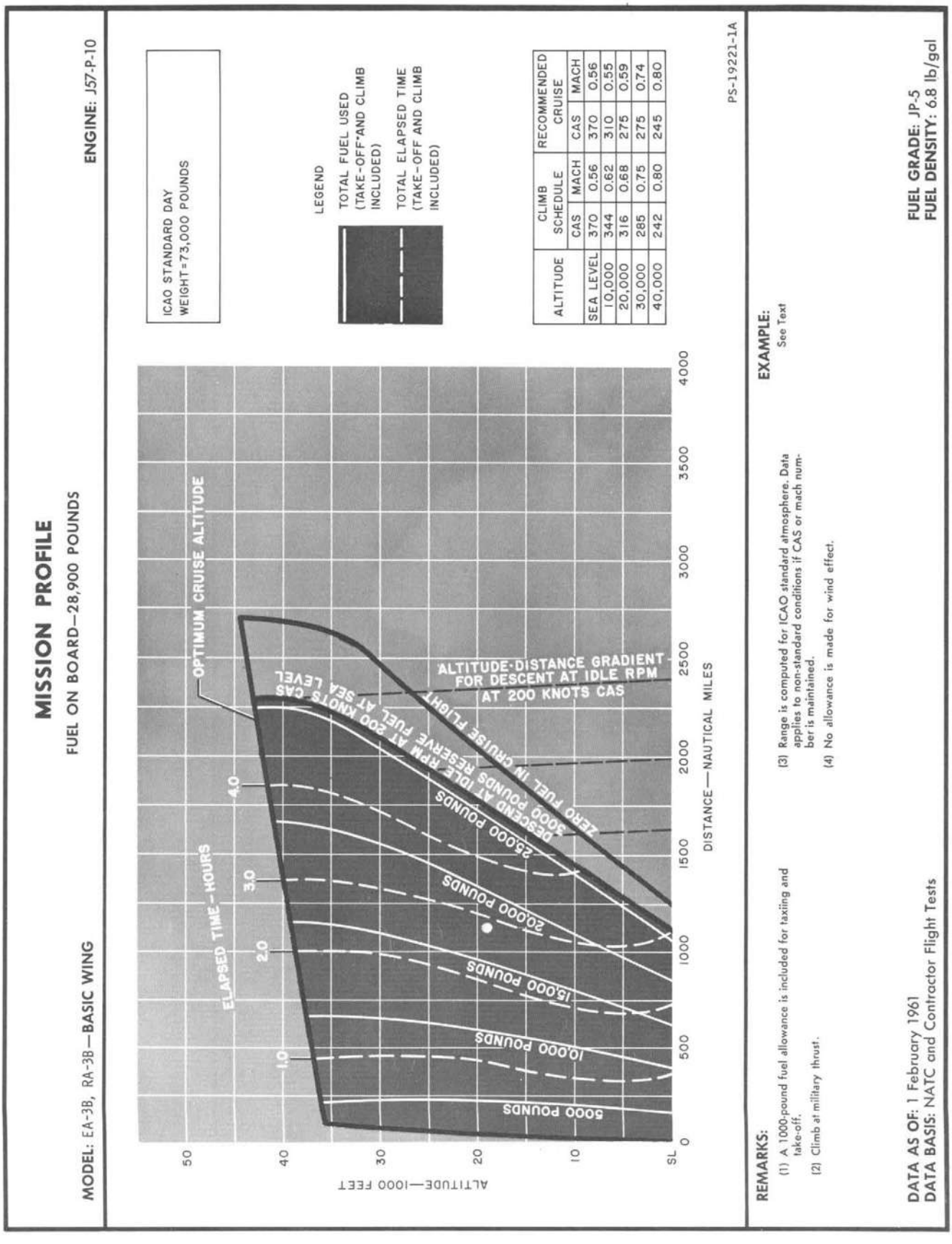
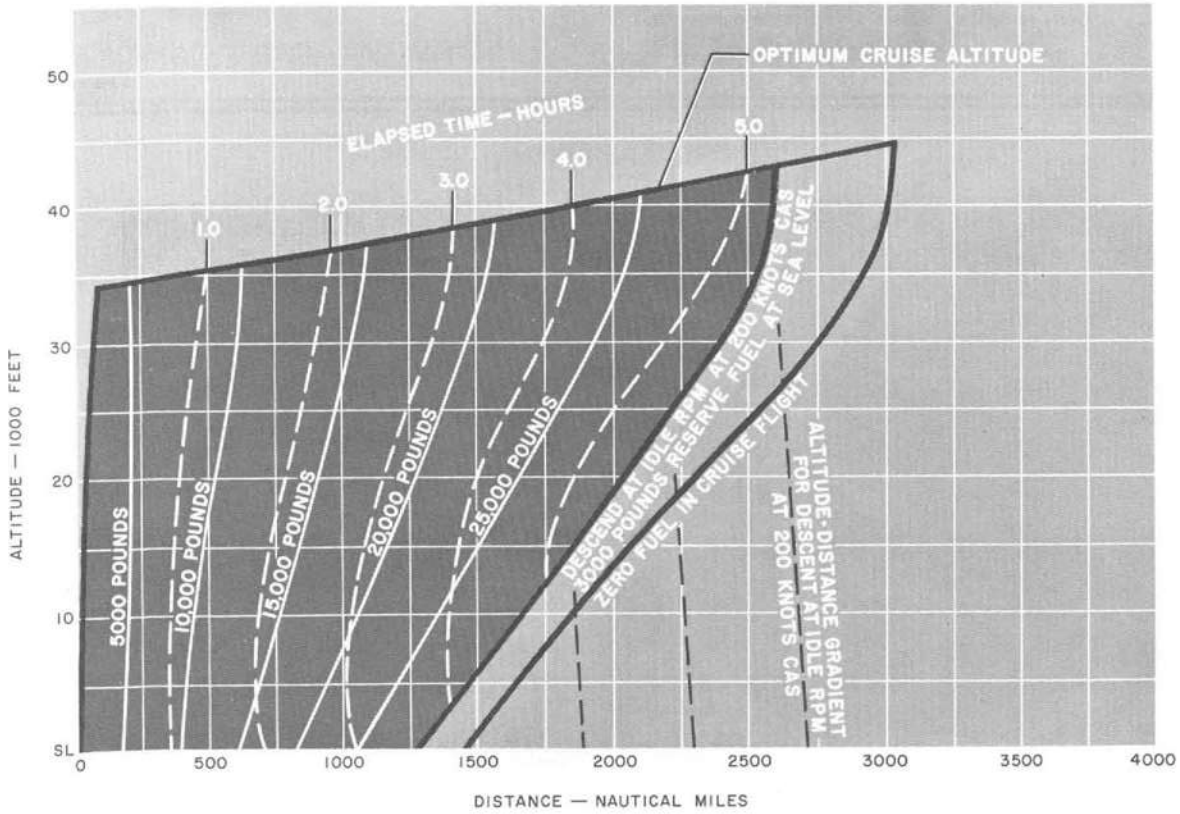


Figure A-35. Mission Profile – 73,000 Pounds (Sheet 1)

MISSION PROFILE

FUEL ON BOARD—33,130 POUNDS

MODEL: EA-3B, RA-3B—**BASIC WING** **ENGINE:** J57-P-10



ICAO STANDARD DAY
WEIGHT=77,230 POUNDS

LEGEND

TOTAL FUEL USED (TAKE-OFF AND CLIMB INCLUDED)

TOTAL ELAPSED TIME (TAKE-OFF AND CLIMB INCLUDED)

ALTITUDE	CLIMB SCHEDULE		RECOMMENDED CRUISE	
	CAS	MACH	CAS	MACH
SEA LEVEL	370	0.56	370	0.56
10,000	344	0.62	310	0.55
20,000	316	0.68	275	0.59
30,000	285	0.75	275	0.74
40,000	242	0.80	245	0.80

PS-19221-2A

REMARKS:

(1) A 1000-pound fuel allowance is included for taxiing and take-off.

(2) Climb at military thrust.

(3) Range is computed for ICAO standard atmosphere. Data applies to non-standard conditions if CAS or mach number is maintained.

(4) No allowance is made for wind effect.

EXAMPLE:
See Text

DATA AS OF: 1 February 1961
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

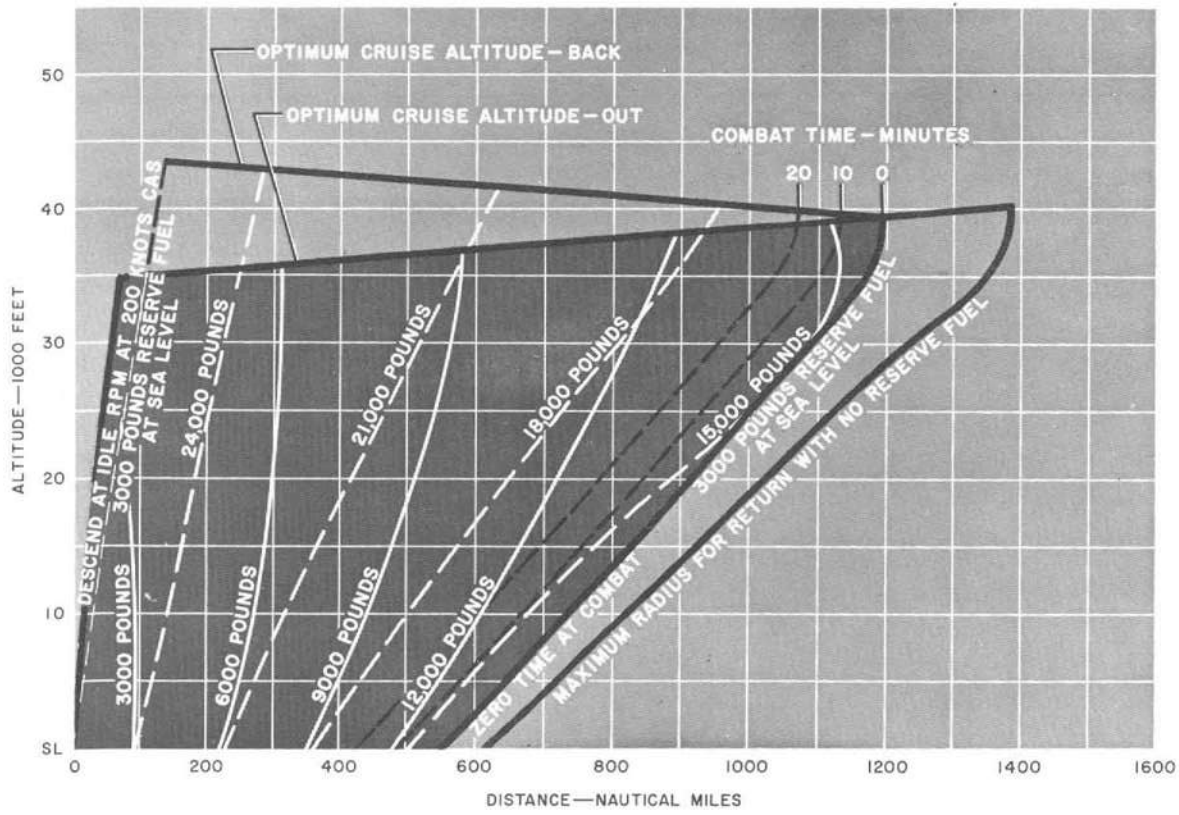
Figure A-35. Mission Profile — 77,230 Pounds (Sheet 2)

COMBAT RADIUS PROFILE

FUEL ON BOARD—28,900 POUNDS

MODEL: EA-3B, RA-3B—**BASIC WING**

ENGINE: J57-P-10



ICAO STANDARD DAY
WEIGHT=73,000 POUNDS

LEGEND

TOTAL FUEL USED WHEN OUTBOUND (TAKE-OFF AND CLIMB FUEL INCLUDED)

TOTAL FUEL USED WHEN INBOUND (OUTBOUND FUEL AND COMBAT FUEL INCLUDED)

TOTAL COMBAT TIME SPENT AT INITIAL ALTITUDE

ALTITUDE	CRUISE SCHEDULE		RECOMMENDED CRUISE	
	CAS	MACH	CAS	MACH
SEA LEVEL	370	0.56	370	0.56
10,000	344	0.62	310	0.55
20,000	316	0.68	275	0.59
30,000	285	0.75	275	0.74
40,000	242	0.80	245	0.80

PS-19222-1A

REMARKS:

(1) A 1000-pound fuel allowance is included for taxiing and take-off.

(2) Climb at military thrust.

(3) Range is computed for ICAO standard atmosphere. Data applies to non-standard conditions if cruise CAS or mach number is maintained.

(4) No allowance is made for wind effect.

(5) Combat time includes fuel used at initial altitude for a specified time at military thrust with no distance made good.

EXAMPLE:

See Text

DATA AS OF: 1 February 1961
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-36. Combat Radius Profile – 73,000 Pounds (Sheet 1)

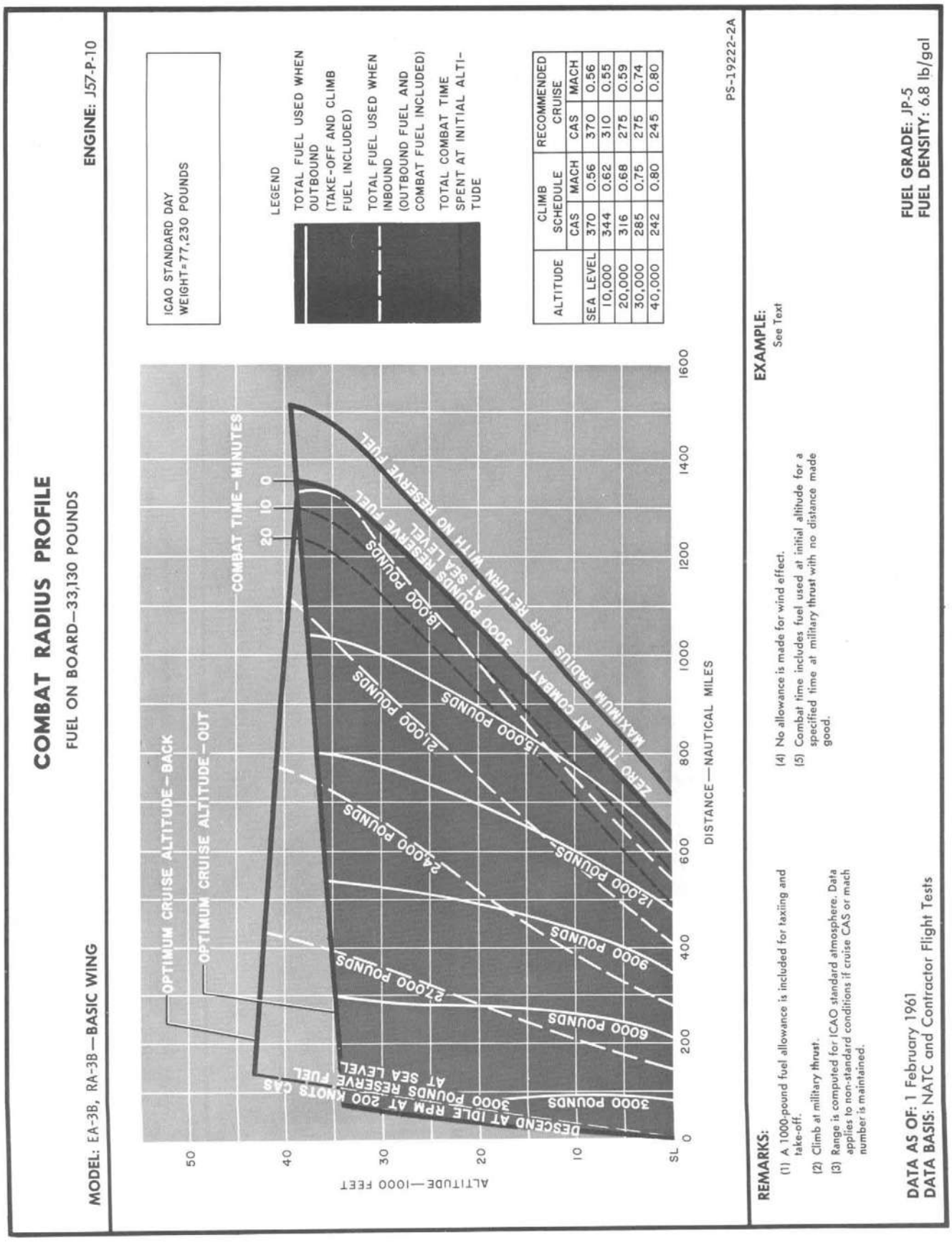


Figure A-36. Combat Radius Profile – 77, 230 Pounds (Sheet 2)

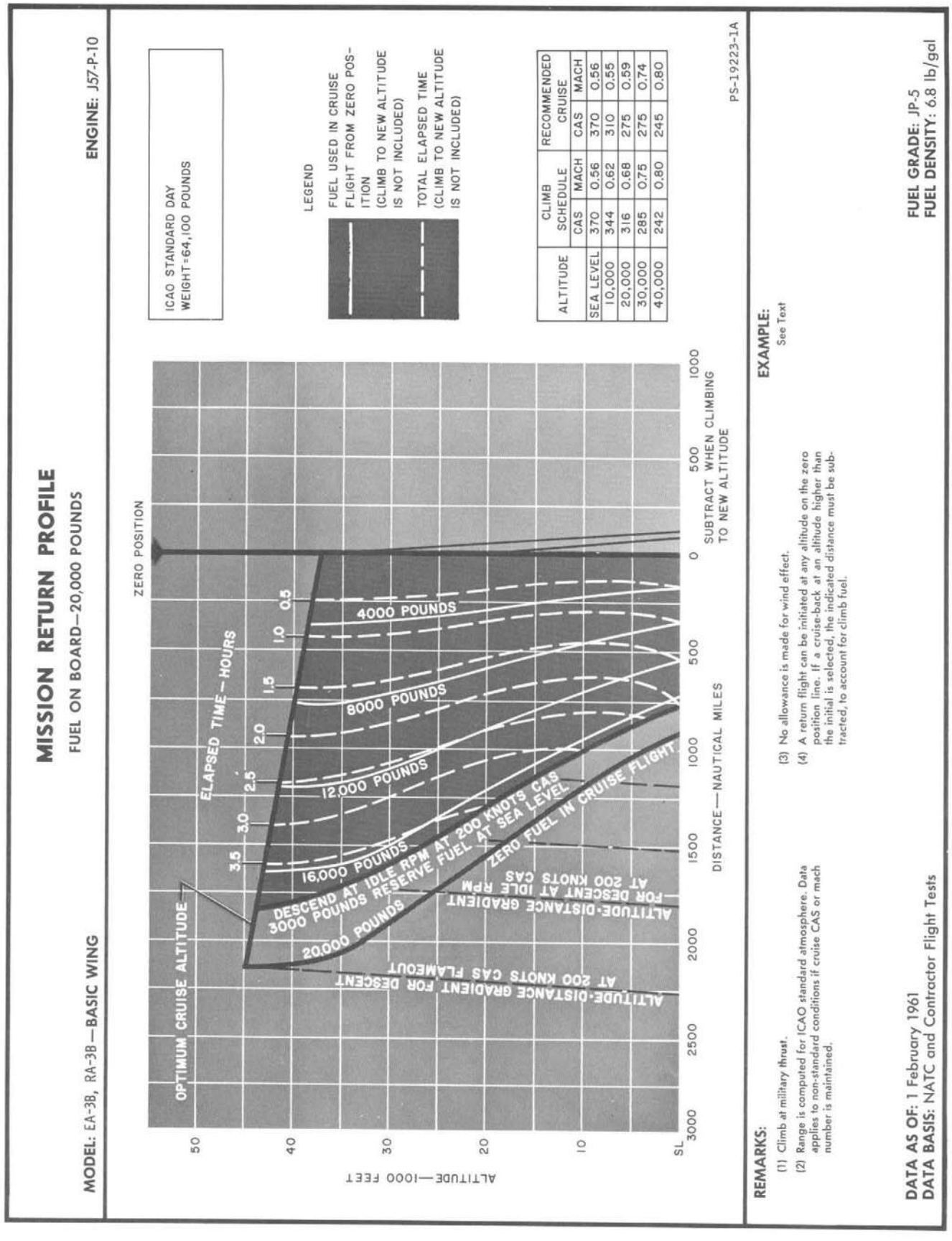


Figure A-37. Mission Return Profile

PART 5A

ENDURANCE

ENDURANCE CHARTS

When maximum endurance operation is required during flight, such as holding at altitude while awaiting clearance to land, the recommended airspeed to be maintained is approximately ten percent higher than that at which minimum fuel flow is obtained. The higher airspeed will result in generally better handling characteristics for the aircraft, particularly in mild or moderate turbulence, with only a slight increase in fuel consumption. The endurance data presented in this section are based on using the recommended airspeeds. These airspeeds should be maintained by occasional adjustment of the throttle(s) as fuel is consumed.

FOULED DECK ENDURANCE

The fouled deck endurance charts for two-engine operation (figure A-38, sheet 1) and one-engine operation (figure A-38, sheet 2) are provided to indicate the maximum available endurance at low values of fuel remaining for various altitudes. For each initial altitude, the endurance at optimum altitude and the optimum altitude are provided. Climb and loiter speed are indicated. A 3000-pound fuel allowance for landing is included.

MAXIMUM ENDURANCE PROFILE

The maximum endurance profile (figure A-40) presents the loiter time in hours for various quantities of fuel on board as a function of altitude. These data are presented for two conditions, namely:

(1) The aircraft initially at the selected loiter altitude (solid lines), and

(2) The aircraft initially at sea level and climb to a selected loiter altitude (dashed lines).

The calibrated airspeed for loiter does not vary with altitude and is indicated for each value of fuel on board. The climb schedule is noted in the lower right-hand corner of the chart. The climb and descent time is not included in the loiter time shown. The indicated fuel is the fuel available for climb and loiter, thus fuel for descent, landing and reserve must be subtracted from fuel on board to obtain the indicated fuel. The recommended descent speed is 200 knots, CAS.

To determine the time available for a given amount of fuel with the aircraft initially at the desired loiter altitude, enter chart at loiter altitude and proceed horizontally to right to amount of fuel available for loiter (solid line). Directly below, read loiter time available. The chart should be interpreted in same manner if aircraft is initially at sea level and it is desired to loiter at altitude other than sea level. In this instance, broken lines should be used as an indication of fuel available for climb and loiter.

To obtain the fuel required to loiter a given time, enter chart at desired loiter altitude and note initial time, also amount of fuel on board at start of loiter. Reenter chart at time when loiter ends (initial time less loiter time) and read final fuel on board. The difference between initial and final fuel on board is fuel required for loiter.

EXAMPLE. Determine fuel required to loiter at 25,000 feet for 2 hours with 15,000 pounds of fuel on board.

a. Initial time at 25,000 feet and 15,000 pounds . . . . . 4.2 hrs

b. Final time (4.2 hrs - 2 hrs) . . . . 2.2 hrs

c. Fuel on board at end of loiter (2.2 hours at 25,000 feet) . . . . . 7000 pounds

d. Fuel required to loiter (15,000 pounds - 7000 pounds) . . . . . 8000 pounds

e. Recommended loiter CAS . . . . . 225-210 knots

MAXIMUM SPECIFIC ENDURANCE VS ALTITUDE

Maximum specific endurance vs altitude charts present specific endurance (hours per 1000 pounds of fuel) as a function of momentary gross weight and altitude for two-engine operation (figure A-39, sheet 1) and one-engine operation (figure A-39, sheet 2). The recommended airspeed for maximum endurance is indicated on the charts. The broken lines included in the charts reflect increase in fuel consumption resulting from opening of intercompressor bleed valves. It will be noted that specific endurance increases as gross weight decreases due to consumption of fuel. To obtain accurate endurance values under certain conditions it may be necessary to reenter chart frequently with small increments to take full advantage

of endurance capabilities of the aircraft. To determine the specific endurance for any given altitude and gross weight, enter chart at that altitude and move to right to applicable momentary gross weight curve. Directly below, read the specific endurance (hours per 1000 pounds of fuel).

EXAMPLE. Given an altitude of 30,000 feet, a gross weight of 70,000 pounds, and 20,000 pounds of fuel available for loiter; find the maximum loiter time.

a. Specific endurance at initial gross weight . . . 0.22 hours/1000 pounds of fuel

b. Specific endurance at final gross weight (70,000 pounds - 20,000 pounds = 50,000 pounds). . 0.315 hours/1000 pounds of fuel

c. Specific endurance at average gross weight (70,000 pounds + 50,000 pounds) ÷ 2 = 60,000 pounds). . . 0.26 hours/1000 pounds of fuel

d. Maximum loiter time (0.26 hours/1000 pounds of fuel x 20,000 pounds). . . . . 5.2 hours

ENDURANCE FACTORS WITH GEAR AND FLAPS DOWN

Apply these endurance factors when attempting to loiter with gear down, flaps down and speedbrakes closed. Multiply the values in the fouled deck endurance charts by the appropriate factors.

	Sea Level Endurance	
	Endurance Factors	CAS KTS
RA-3B Basic Wing		
One Engine	0.70	120-130
Two Engine	0.75	120-130

TWO ENGINE OPERATION

FOULED DECK ENDURANCE

MODEL: A-3B, EA-3B, RA-3B – BASIC WING

ENGINES: J57-P-10

FUEL ON BOARD ~ POUNDS	IF YOU ARE AT SEA LEVEL					IF YOU ARE AT 20,000 FEET				
	ENDURANCE AT SEA LEVEL	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 20,000 FEET	OPTIMUM ALTITUDE	ENDURANCE OPTIMUM AT ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	38	30,000	46	0.56	206	54	30,000	57	0.56	207
5500	27	15,000	29	0.41	204	38	30,000	38	0.56	206
4500	15	5,000	15	0.34	204	21	20,000	21	0.45	205
4000	9	SEA LEVEL	9	0.30	201	13	20,000	13	0.45	204
3500	2	SEA LEVEL	2	0.30	200	4	20,000	4	0.45	204
	CLIMB CAS	370 KNOTS CAS				CLIMB CAS	316 KNOTS CAS			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			
	IF YOU ARE AT 25,000 FEET					IF YOU ARE AT 30,000 FEET				
	ENDURANCE AT 25,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 30,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	56	30,000	59	0.56	207	61	30,000	61	0.56	208
5500	39	30,000	41	0.56	207	43	30,000	43	0.56	206
4500	22	25,000	22	0.50	204	24	30,000	24	0.55	206
4000	13	25,000	13	0.50	204	15	30,000	15	0.55	205
3500	5	25,000	5	0.50	204	5	30,000	5	0.55	204
	CLIMB CAS	301 KNOTS CAS				CLIMB CAS	286 KNOTS CAS			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			
	IF YOU ARE AT 35,000 FEET					IF YOU ARE AT 40,000 FEET				
	ENDURANCE AT 35,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 40,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	61	30,000	62	0.56	208	59	30,000	62	0.56	207
5500	42	30,000	43	0.56	207	41	30,000	43	0.56	207
4500	24	30,000	24	0.55	206	23	30,000	24	0.55	206
4000	15	30,000	15	0.55	205	14	30,000	15	0.55	205
3500	5	35,000	5	0.62	206	5	35,000	5	0.62	206
	CLIMB CAS	NO CLIMB REQUIRED				CLIMB CAS	NO CLIMB REQUIRED			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED.
3. DESCEND AT IDLE THRUST.
4. BASIC AIRCRAFT WEIGHT IS 40,342 POUNDS.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL DENSITY: 6.8 LB/GAL

Figure A-38. Fouled Deck Endurance – Two-Engine Operation (Sheet 1)

ONE ENGINE OPERATION

FOULED DECK ENDURANCE

MODEL: A-3B, EA-3B, RA-3B – BASIC WING ENGINES: J57-P-10

FUEL ON BOARD ~ POUNDS	IF YOU ARE AT SEA LEVEL					IF YOU ARE AT 20,000 FEET				
	ENDURANCE AT SEA LEVEL	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 20,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
7000	65	SEA LEVEL	65	0.30	199	71	20,000	71	0.45	204
6500	57	SEA LEVEL	57	0.30	199	62	20,000	62	0.45	203
5500	38	SEA LEVEL	38	0.30	198	44	20,000	44	0.44	202
4500	22	SEA LEVEL	22	0.30	197	26	20,000	26	0.44	200
3500	5	SEA LEVEL	5	0.30	196	7	20,000	7	0.44	199
	CLIMB CAS	NO CLIMB REQUIRED				CLIMB CAS	NO CLIMB REQUIRED			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			
	IF YOU ARE AT 25,000 FEET					IF YOU ARE AT 30,000 FEET				
	ENDURANCE AT 25,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 30,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
7000	70	20,000	71	0.45	204	70	20,000	71	0.45	204
6500	62	20,000	62	0.45	203	61	20,000	62	0.45	203
5500	44	20,000	44	0.44	202	44	20,000	44	0.44	202
4500	25	20,000	26	0.44	200	25	20,000	26	0.44	200
3500	7	25,000	7	0.49	200	7	30,000	7	0.55	202
	CLIMB CAS	NO CLIMB REQUIRED				CLIMB CAS	NO CLIMB REQUIRED			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED.
3. DESCEND AT IDLE THRUST.
4. BASIC AIRCRAFT WEIGHT IS 40,342 POUNDS.

DATA AS OF: 1 MARCH 1964 FUEL GRADE: JP-5

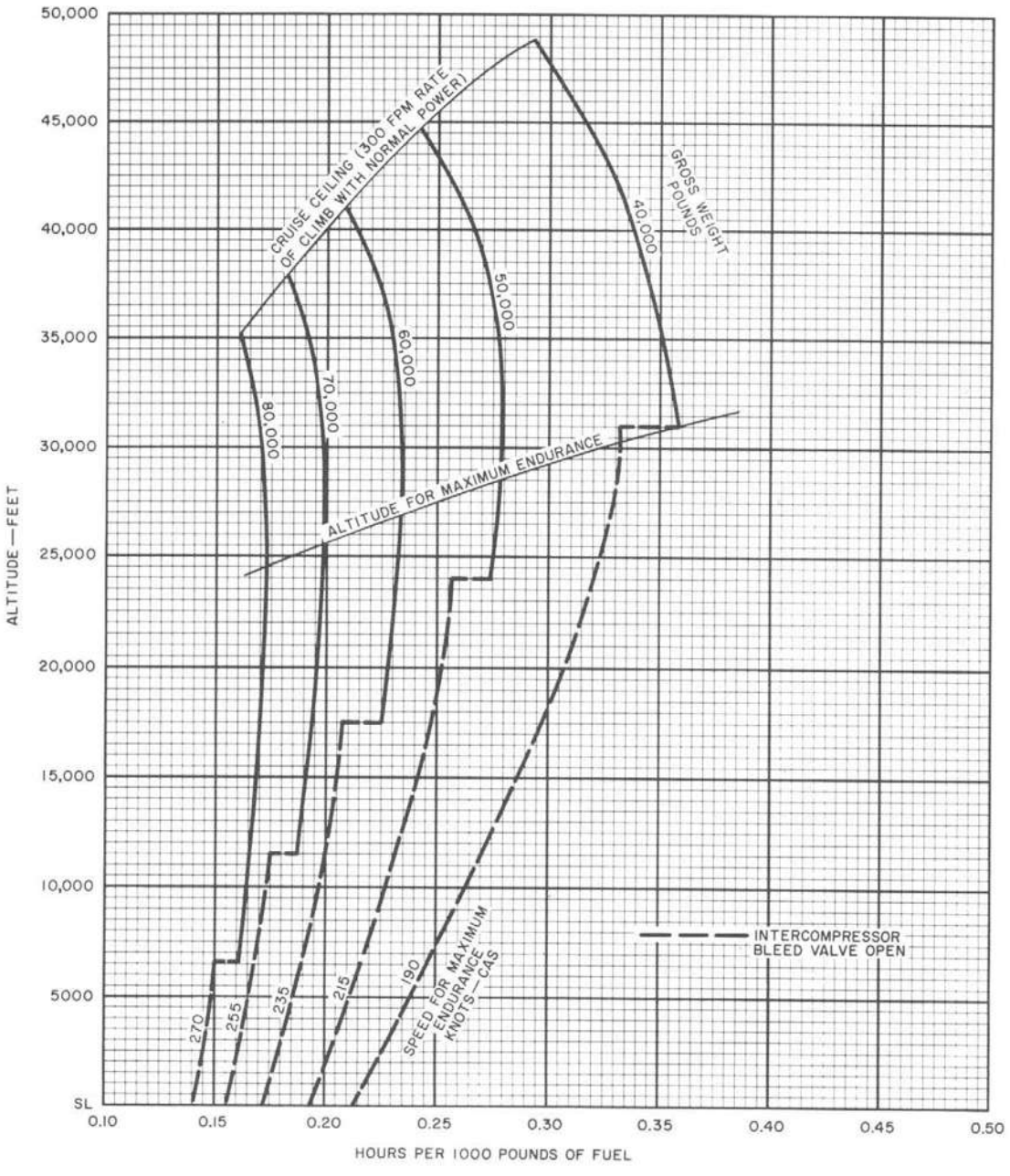
DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS FUEL DENSITY: 6.8 LB/GAL

Figure A-38. Fouled Deck Endurance – One-Engine Operation (Sheet 2)

TWO ENGINE OPERATION

MAXIMUM SPECIFIC ENDURANCE VS ALTITUDE

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

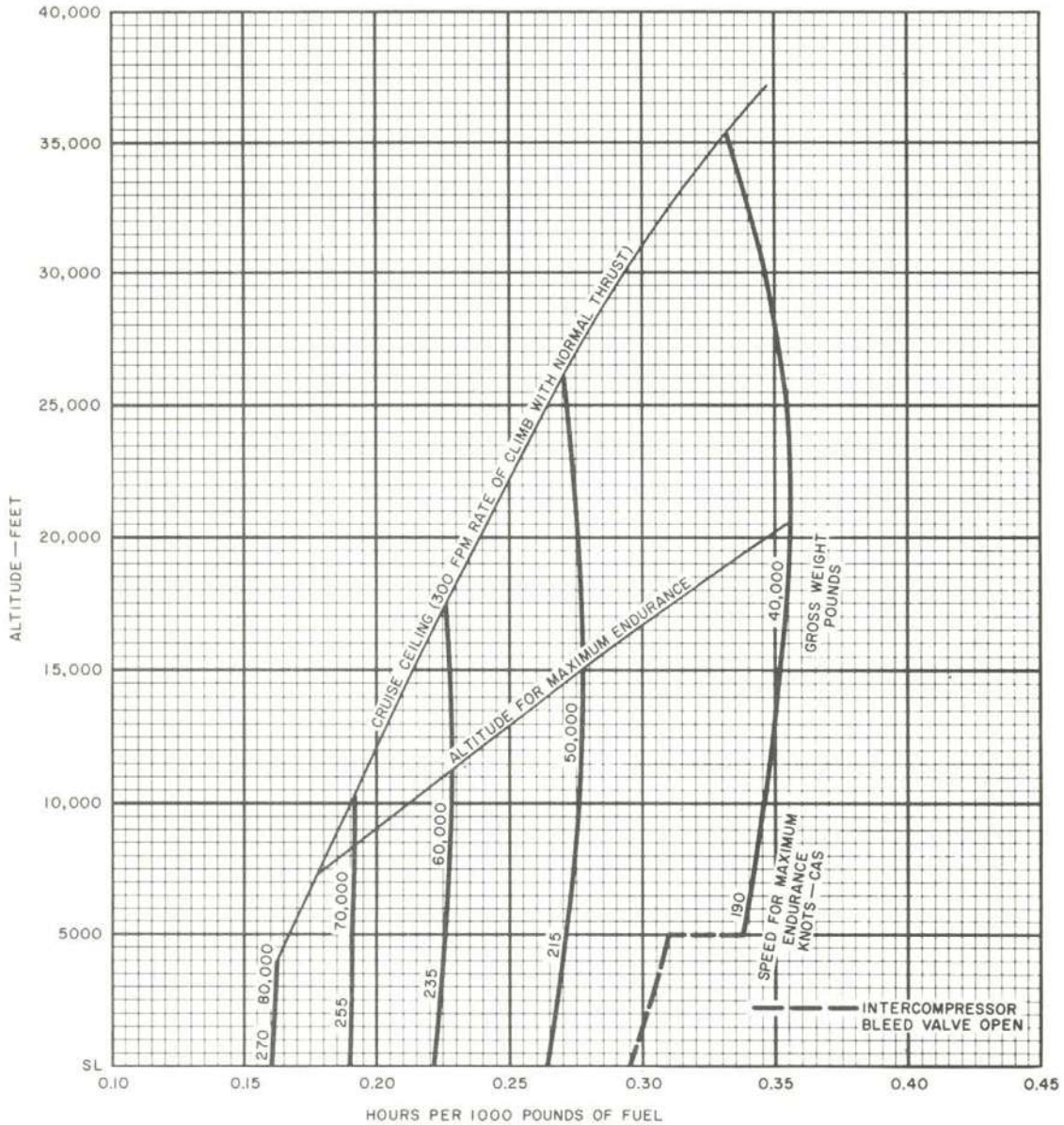
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-39. Maximum Specific Endurance vs Altitude – Two-Engine (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM SPECIFIC ENDURANCE VS ALTITUDE

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



P-18044-2A

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

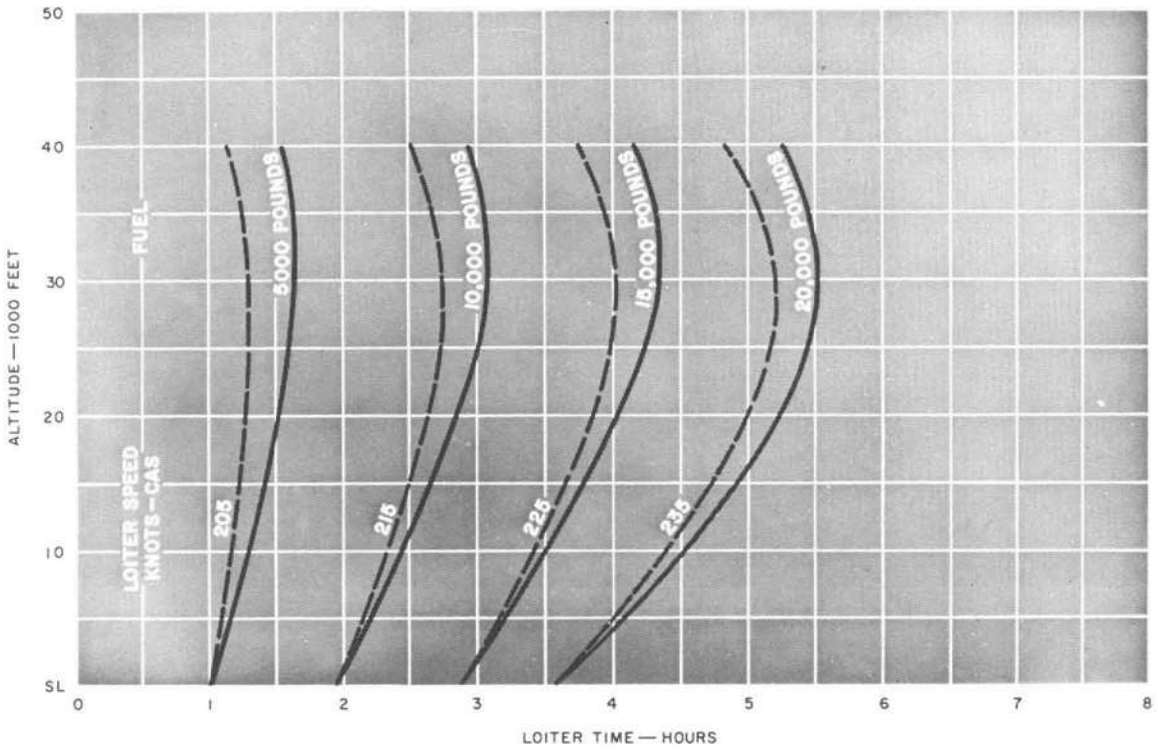
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-39. Maximum Specific Endurance vs Altitude – One-Engine (Sheet 2)

MAXIMUM ENDURANCE PROFILE

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING**

ENGINES: J57-P-10



LEGEND

MAXIMUM LOITER TIME AT INITIAL ALTITUDE BEFORE DESCENT TO SEA LEVEL (NO CLIMB ASSUMED)

MAXIMUM LOITER TIME AT SELECTED ALTITUDE AFTER CLIMB FROM SEA LEVEL AND BEFORE DESCENT TO SEA LEVEL (TIME TO CLIMB AND DESCEND NOT INCLUDED)

ALTITUDE	CLIMB SCHEDULE	
	CAS	MACH
SEA LEVEL	370	0.56
10,000	344	0.62
20,000	316	0.68
30,000	285	0.75
40,000	242	0.80

P-18043-1A

REMARKS:

(1) Climb at military thrust.

(2) Indicated fuel is fuel available for climb and loiter. Descent, landing and reserve fuel must be subtracted from total fuel on board to obtain indicated fuel.

(3) Climb and descent time not included.

EXAMPLE:

(1) Total fuel on board is 18,000 pounds. If an allowance of 3000 pounds for descent and landing is desired, the fuel available for climb and loiter is 15,000 pounds.

(2) For an initial altitude of 30,000 feet, loiter time is 4.4 hours at 30,000 feet.

(3) For an initial altitude of sea level, loiter time is 4.0 hours at 30,000 feet.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-40. Maximum Endurance Profile

PART 6A

DESCENT

DESCENT CHARTS

A maximum range descent should be made with idle power, flaps and gear retracted, and speedbrakes closed. The Maximum Range Descent chart, (figure A-41, sheet 1), shows descent performance which will be obtained in the above configuration when the recommended airspeeds (CAS) shown in the chart are maintained in the descent. These data may be used for determining rates of descent, elapsed time, distance and/or fuel consumed in descending from any altitude to sea level or from one altitude to another by taking the differences in the desired values at the initial and at the final altitudes.

EXAMPLE. A descent is made from 41,000 feet pressure altitude to 21,000 feet pressure altitude at 40,000 pounds gross weight. Using the data provided on the Maximum Range Descent chart, the descent range is found to be: 81 nautical miles - 27 nautical miles = 54 nautical miles. The elapsed time is:

19 minutes - 7 minutes = 12 minutes

The fuel consumed is:

440 pounds - 160 pounds = 280 pounds

Descent is made at 220 knots CAS.

Note

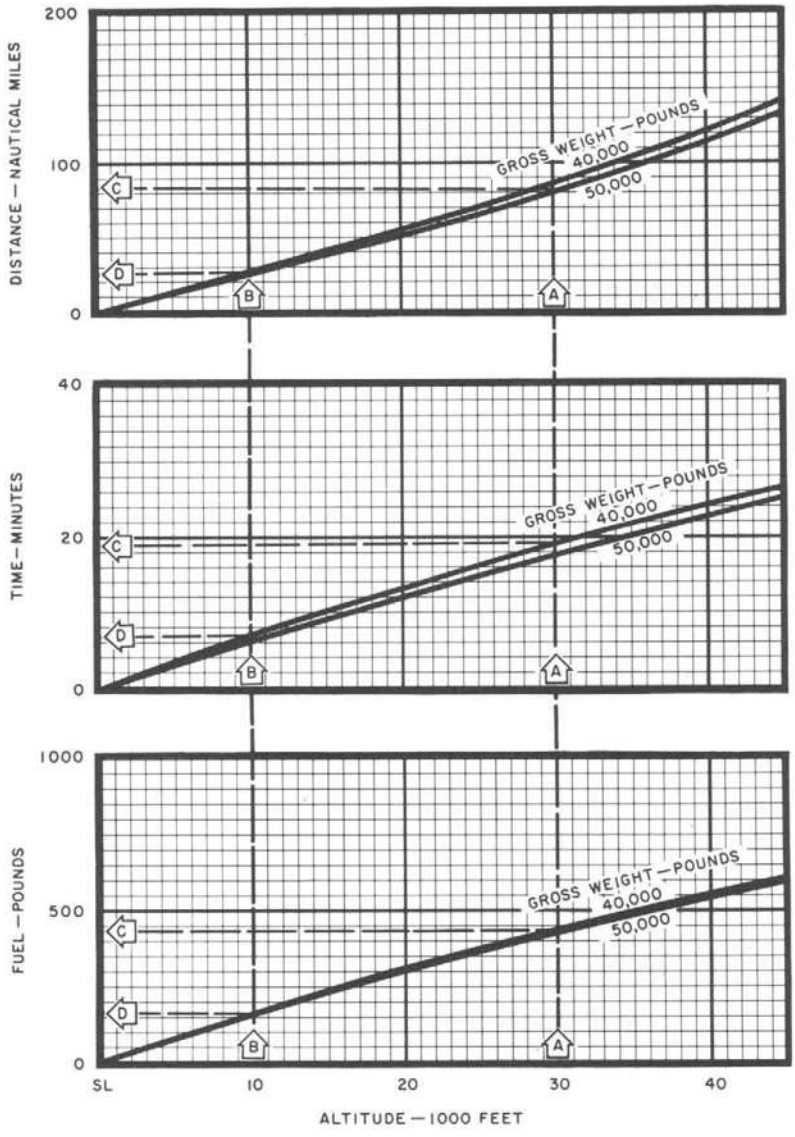
Distance, time, and fuel consumed in descent with one engine operating at idle power and the other engine completely shut down may be obtained similarily from figure A-41, sheet 2. Descent data with both engines inoperative are presented in Emergency Procedures, Section V.

TWO ENGINE OPERATION

MAXIMUM RANGE DESCENT

IDLE THRUST

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



REMARKS:

The descent speed is a constant 220 knots CAS.

EXAMPLE:

If the weight is 40,000 pounds and a maximum range descent is desired from 30,000 feet (A) to 10,000 feet (B).

Then:

(1) Distance in descent is 81 nautical miles (C) minus 27 nautical miles (D) = 54 nautical miles.

(2) Time in descent is 19 minutes (C) minus 7 minutes (D) = 12 minutes.

(3) Fuel used in descent is 440 pounds (C) minus 160 pounds (D) = 280 pounds.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

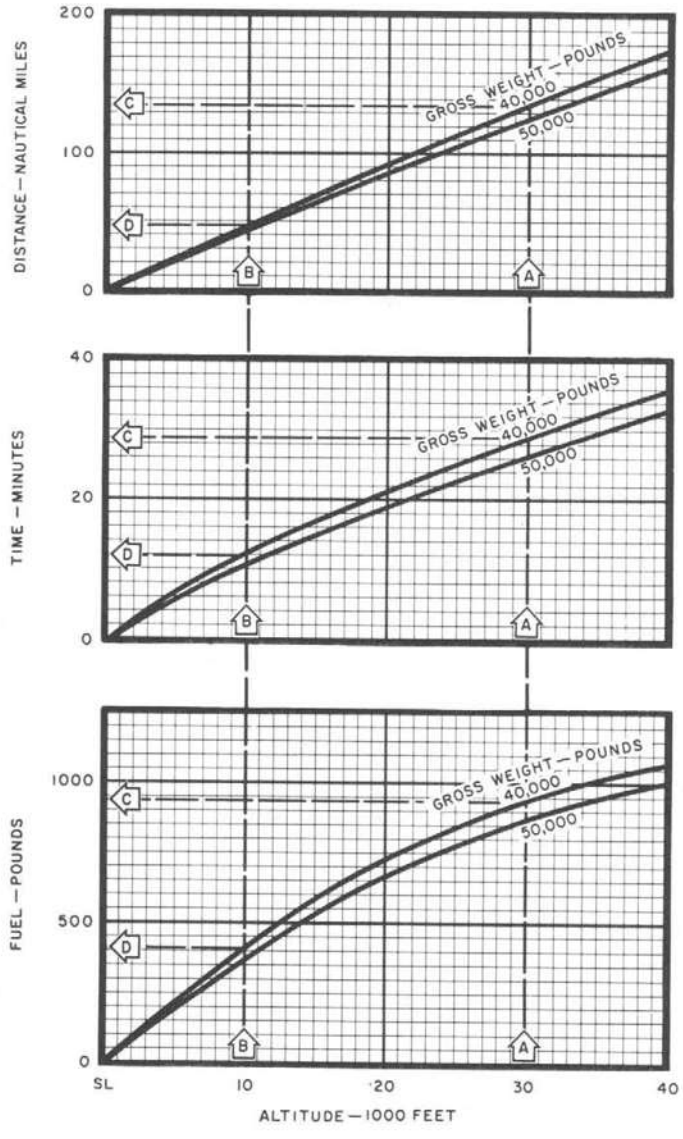
Figure A-41. Maximum Range Descent – Two-Engine (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM RANGE DESCENT

85% RPM

MODEL: A-3B, EA-3B, RA-3B —**BASIC WING** **ENGINES:** J57-P-10



REMARKS:

The descent speed is a constant 220 knots CAS.

EXAMPLE:

If the weight is 40,000 pounds and a maximum range descent is desired from 30,000 feet (A) to 10,000 feet (B)

Then:

(1) Distance in descent is 135 nautical miles (C) minus 47 nautical miles (D) = 88 nautical miles.

(2) Time to descend is 29 minutes (C) minus 12 minutes (D) = 17 minutes.

(3) Fuel used in descent is 940 pounds (C) minus 410 pounds (D) = 530 pounds.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-41. Maximum Range Descent (Sheet 2)

PART 7A

LANDING

INDICATED ANGLE-OF-ATTACK

The angle-of-attack indicator, when properly calibrated, will indicate the attitude of the aircraft to the relative airstream only, and will not relate the aircraft attitude or flight path with respect to the terrain. Figure A-42 represents the aircraft indicated airspeed as a function of the angle-of-attack indicator reading, providing the system is properly calibrated. It is recommended that this chart be used only for landing approach conditions.

The recommended angle-of-attack setting for landing approach, when the angle-of-attack system is properly calibrated, is 15 units. The indicated units should be checked against the airspeed indicator readings during the approach on each flight. If the 15 units does not indicate the airspeeds shown on figure A-42, disregard the angle-of-attack indicator and make the approach at the airspeed shown on figure A-43.

EXAMPLE. If approach gross weight is 47,000 pounds at indicator reading of 12 units angle-of-attack, then aircraft indicated airspeed should be 127 knots.

APPROACH CHARTS

RECOMMENDED APPROACH SPEEDS AND STALL SPEEDS

The recommended approach and stall speeds chart, (figure A-43) shows the approach and stall speeds in relation to gross weight. It also clearly indicates the increase in stalling speed as the angle-of-bank increases. The chart is plotted to show the stalling speeds with different power settings and with or without flaps.

EXAMPLE. At a gross weight of 50,000 pounds, in level flight, with power off, and with no flaps, the stalling speed is 123 knots. For bank angle of 20 degrees, follow the guideline to read stalling speed as 127 knots.

LANDING CHARTS

LANDING GROUND ROLL

Data for determining the landing ground roll on a hard surface runway, or on a wet icy runway are presented for varying conditions of gross weight, pressure altitude, and headwind in the Landing Ground Roll chart (figure A-44). Landing ground roll is shown with and without drag chute. Ground roll distances are the minimum landing distances obtained when maximum braking is used. Minimum distance requires that the throttles be reduced to idle power at the beginning of the flare and maximum braking maintained during the entire ground roll. The recommended approach speeds (CAS) indicated on the chart are 20 percent above the power-off stalling speed. Reduction in ground roll due to headwind may be estimated for headwinds up to 40 knots, as indicated on the lower portion of the chart. To clear a 50-foot obstacle, an additional 715 feet must be added to the total landing distance.

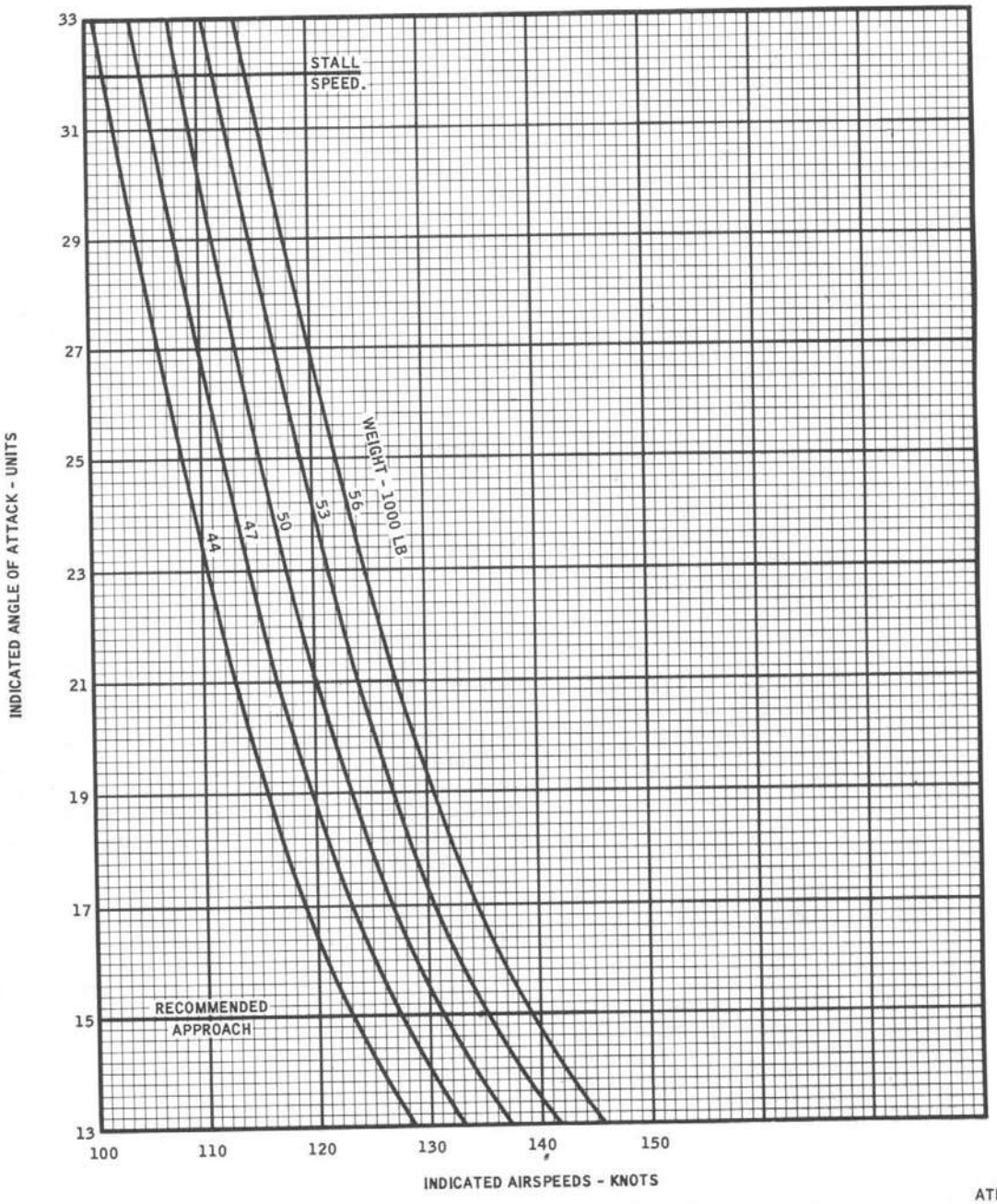
INDICATED ANGLE-OF-ATTACK vs AIRSPEED

POWER APPROACH CONFIGURATION

FULL FLAPS, SPEEDBRAKES OPEN

MODEL: A-3B, EA-3B, RA-3B — BASIC WING

ENGINES: J57-P-10



ATB-1-11 P-40521-1

REMARKS:

EXAMPLE:

DATA AS OF: 1 MARCH 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

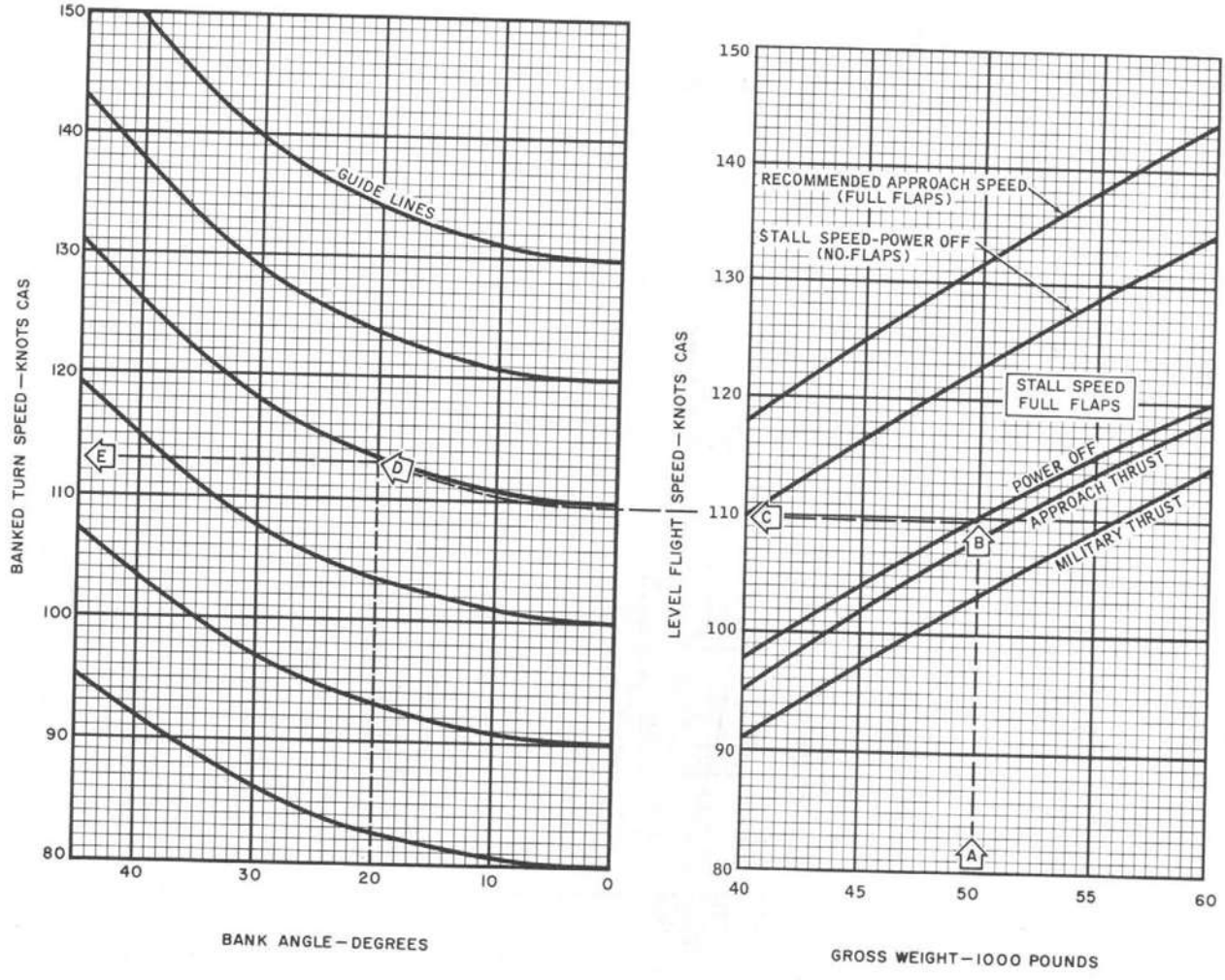
Figure A-42. Indicated Angle-of-Attack vs Airspeed

TWO ENGINE OPERATION

RECOMMENDED APPROACH SPEEDS AND STALL SPEEDS

MODEL: A-3B, EA-3B, RA-3B —BASIC WING

ENGINES: J57-P-10



ATB-I-II P-40522-I

EXAMPLE:

At a gross weight of 50,000 pounds (A), the power off stall speed, full flaps, (B) for level flight is 110 knots (C). For a banked turn of 20°, follow the guide line to the intersection of the 20° bank angle (D) and read a stall speed of 113 knots (E).

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

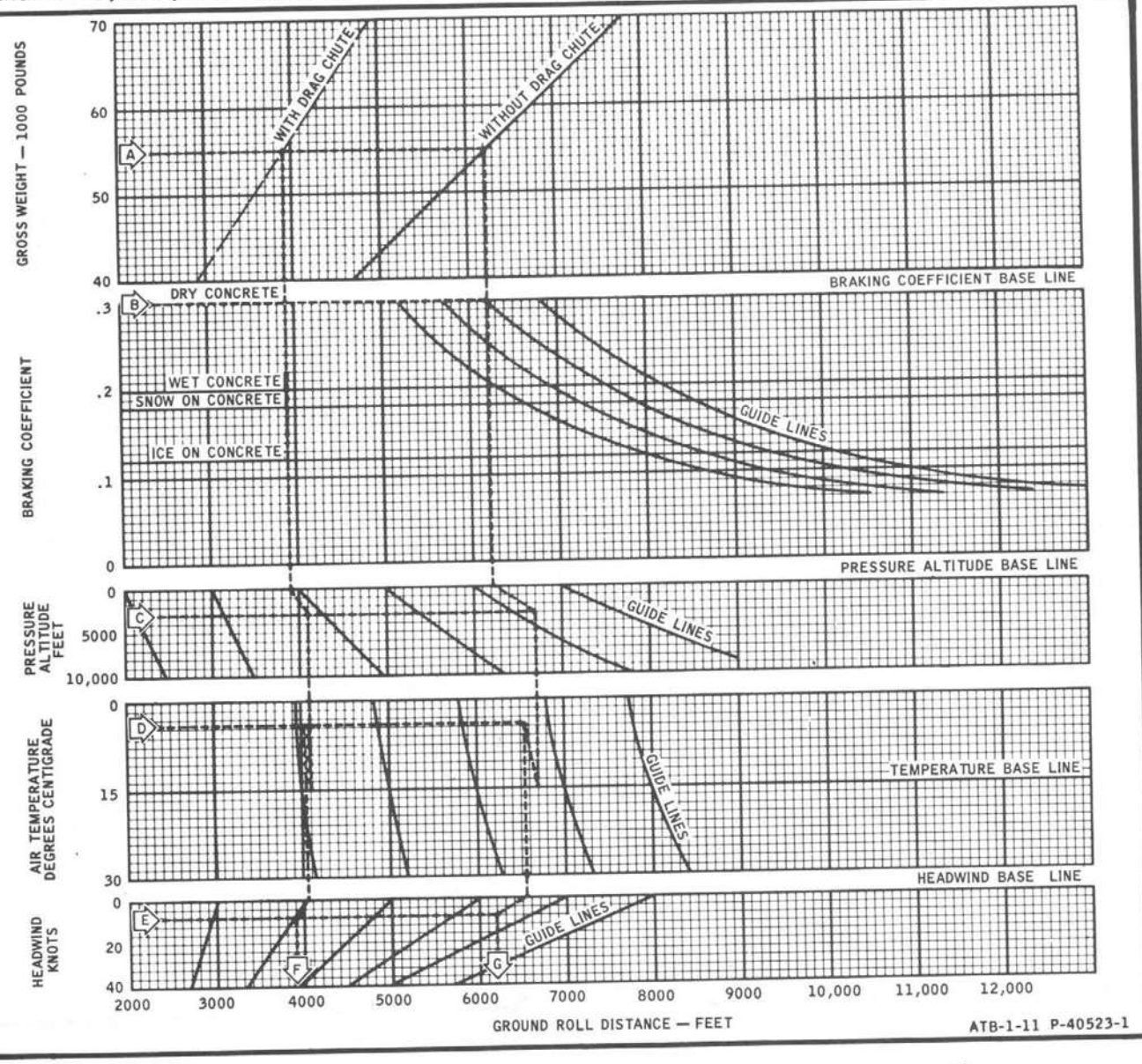
Figure A-43. Recommended Approach Speeds and Stall Speeds

LANDING GROUND ROLL

HYTROL BRAKING **IDLE THRUST** **FLAPS FULL DOWN**

MODEL: A-3B, EA-3B, RA-3B — BASIC WING

ENGINES: J57-P-10



REMARKS:

(1) Add 715 feet for distance to clear a 50 foot obstacle.

(2) Drag chute deployed at touchdown.

EXAMPLE:

Under the following conditions:

(a) Gross weight = 55,000 pounds (A).

(b) Braking coefficient (dry concrete) = 0.3 (B).

(c) Pressure altitude = 3000 feet (C).

(d) Air temperature = 4°C (D).

(e) Headwind = 8 knots (E).

(1) With drag chute deployed the landing ground roll is 3900 feet (F). The total distance to clear a 50 foot obstacle is 4615 feet.

(2) Without drag chute the landing ground roll is 6200 feet (G). The total distance to clear a 50 foot obstacle is 6915 feet.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-44. Landing Ground Roll

PART 8A

COMBAT PERFORMANCE

COMBAT ALLOWANCE

Figure A-45 presents the combat time available for various quantities of combat fuel as a function of altitude. These data are given for both military and normal thrust.

MAXIMUM CONTINUOUS POWER SUMMARY

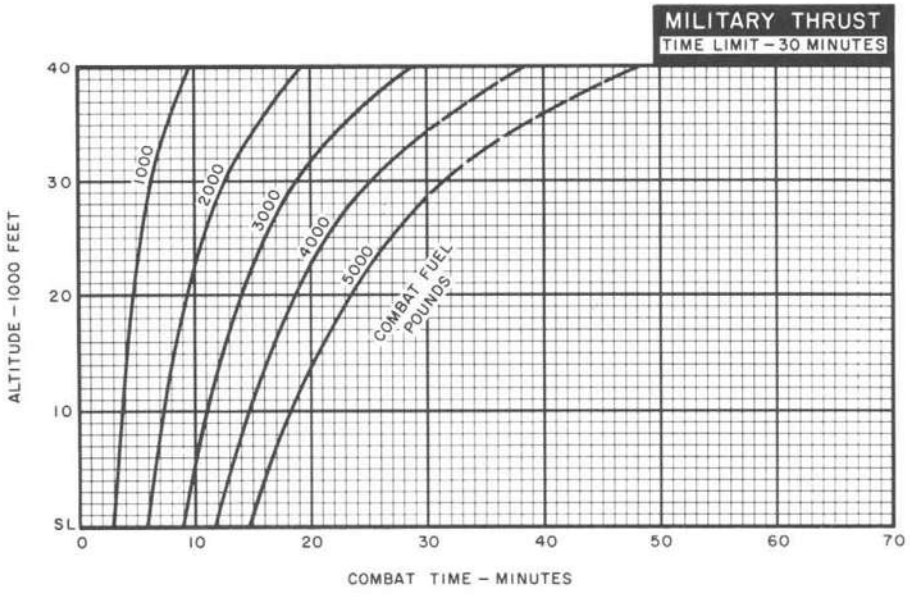
The charts shown in figure A-46 are a summary of operating data for both one-engine and two-engine operation at maximum continuous power (normal thrust) for several gross weights. The airspeeds (CAS and TAS) and corresponding fuel consumption figures in pounds per hour per engine are representative of maximum speed in level flight at various altitudes with throttle(s) set at normal power.

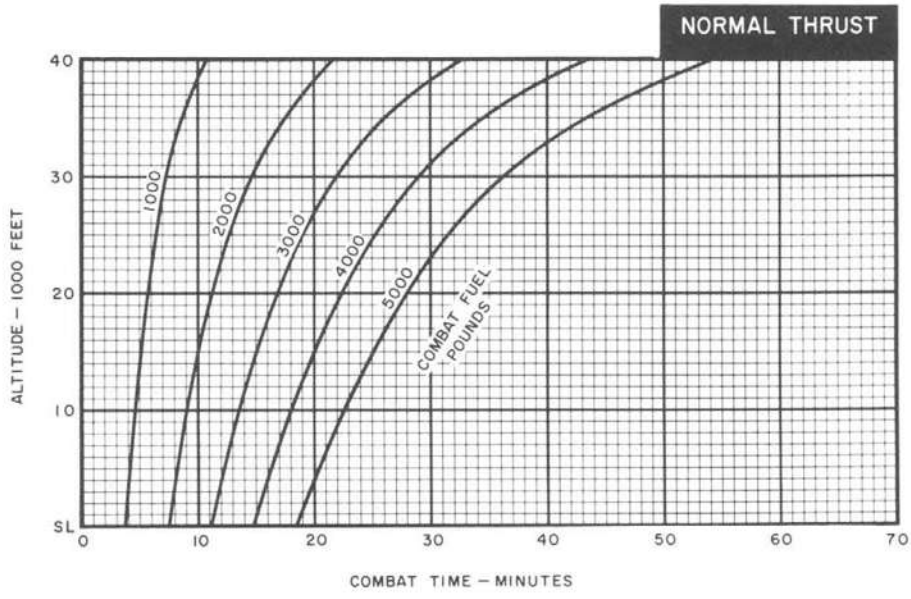
TWO ENGINE OPERATION

COMBAT ALLOWANCE CHART

STANDARD DAY

MODEL: A-3B, EA-3B, RA-3B—**BASIC WING** **ENGINES:** J57-P-10





P-17978-1A

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-45. Combat Allowance Chart

TWO ENGINE OPERATION

MAXIMUM CONTINUOUS POWER SUMMARY

MODEL: A-3B, EA-3B, RA-3B — **BASIC WING** **ENGINES:** J57-P-10

CLEAN CONFIGURATION WEIGHT: 80,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 70,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS / HOUR / ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR / ENGINE
8200	535	535	SEA LEVEL	535	535	8200
6600	535	470	10	475	540	6600
6050	535	440	15	440	535	6050
5650	530	405	20	405	530	5650
4850	520	370	25	370	525	4800
4150	510	330	30	335	515	4150
3400	485	285	35	295	495	3450

CLEAN CONFIGURATION WEIGHT: 60,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 50,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS / HOUR / ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR / ENGINE
8200	540	540	SEA LEVEL	540	540	8200
6600	540	475	10	475	540	6600
6050	535	440	15	440	540	6050
5650	530	405	20	410	535	5650
4750	525	370	25	375	530	4750
4150	520	340	30	340	520	4150
3400	505	300	35	305	510	3400
2750	490	260	40	265	500	2750
—	—	—	45	225	480	2050

P-17979-1A

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-46. Maximum Continuous Power Summary – Two-Engine (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM CONTINUOUS POWER SUMMARY

MODEL: A-3B, EA-3B, RA-3B — **BASIC WING** **ENGINES:** J57-P-10

CLEAN CONFIGURATION WEIGHT: 80,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 70,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS/HOUR / ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR / ENGINE
7650	345	345	SEA LEVEL	355	355	7650
6250	345	295	10	305	355	6250
——	——	——	15	275	340	5550

CLEAN CONFIGURATION WEIGHT: 60,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 50,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS/HOUR /ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR /ENGINE
7700	365	365	SEA LEVEL	370	370	7750
6300	370	325	10	335	385	6350
5650	375	300	15	315	390	5700
5000	380	275	20	295	395	5050
——	——	——	25	270	390	4350

P-17979-2A

REMARKS:

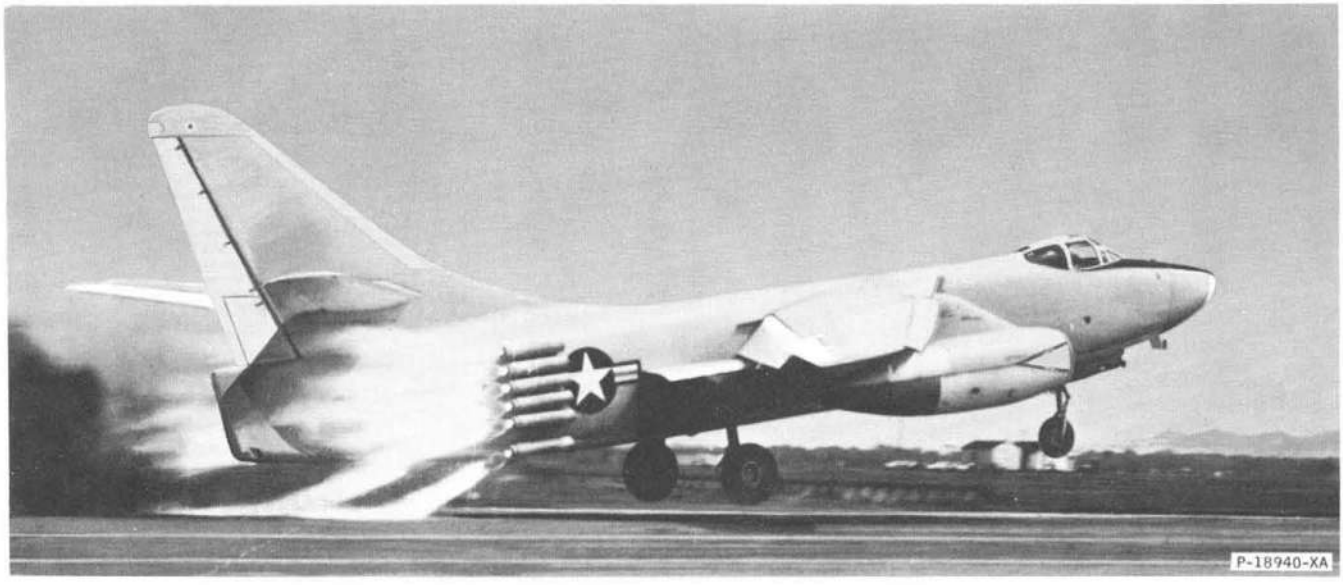
(1) Inoperative engine windmilling.

(2) Normal thrust on operating engine.

DATA AS OF: 1 May 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure A-46. Maximum Continuous Power Summary – One-Engine (Sheet 2)



PART B

RA-3B CAMBERED WING AIRCRAFT PERFORMANCE DATA CHARTS

PART 1B

AIRSPEED AND ALTITUDE CORRECTIONS

AIRSPEED AND ALTITUDE CORRECTION CHARTS

AIRSPEED CORRECTIONS

In order to obtain true airspeed, several corrections must be applied to the airspeed indicator reading. Instrument error, which varies for each airspeed indicator as a result of manufacturing tolerances, is noted on the instrument calibration card. This error is usually small and normally may be disregarded, in which case the instrument reading is the actual indicated airspeed (IAS).

The position error correction, determined for each location of the static pressure source, is added to indicated airspeed to obtain calibrated airspeed (CAS). (See figure B-1.) A Mach number correction for position error is included in figure B-2.

True airspeed (TAS) and Mach number are read directly from figure A-1, using known calibrated airspeed, outside air temperature, and true pressure altitude. To obtain equivalent airspeed (EAS), true airspeed is multiplied by $\sqrt{\sigma}$ corresponding to pressure altitude and ambient temperature.

True ambient temperature is obtained by applying a temperature correction increment, which includes installation and compressibility error, to the cockpit temperature indicator reading (which is always high). This temperature correction increment may be obtained from figure A-2, Temperature Correction for Compressibility. Using the corrected temperature, the value for $\sqrt{\sigma}$ may then be obtained from figure A-3. Similar data may be obtained from the ICAO Standard Altitude Table, figure A-4, when standard atmospheric conditions are desired.

EXAMPLE. Assume aircraft is at pressure altitude of 40,000 feet, with airspeed indicator reading of 325 knots and temperature indicator reading of +37°C. Assuming zero instrument error, correct ambient temperature and true airspeed are then found as follows:

Airspeed indicator reading . . . . . 325 knots

Correction for instrument error . . . . . 0 knots

Indicated airspeed . . . . . 325 knots

Correction for position error (figure B-1) . . . . . -10 knots

Calibrated airspeed . . . . . 315 knots

Temperature indicator reading . . . . . +37°C

Correction for instrument error 0

Indicated temperature . . . . . +37°C

Correction for compressibility (see figure A-2, sheet 2) . . . . . -37°C

Ambient temperature . . . . . 0°C

Then Mach No. = 1.035 and true airspeed = 598 knots under standard day conditions (figure A-1).

At 25,000 feet pressure altitude with an ambient temperature of 0° C, true airspeed = 648 knots (figure A-1).

ALTITUDE CORRECTIONS

Instrument error and position error corrections similar to those applied for airspeed indicator readings must be added to the indicated altimeter readings to obtain true pressure altitude. Figure B-1 provides the correction necessary to compensate for the installation.

EXAMPLE. Assume RA-3B cambered wing aircraft is at indicated pressure altitude of 40,000 feet with airspeed indicator reading of 325 knots. The true pressure altitude, assuming zero instrument error, is obtained by the following method:

Altimeter reading . . . . . 40,000 feet

Correction for instrument error (assumed) . . . . . 0 feet

Indicated airspeed . . . . . 325 knots

Altimeter correction for position error (figure B-1) . . . . . -1500 feet

True pressure altitude . . . . . 38,500 feet

Conversely, the indicated pressure altitude required to establish a selected true pressure altitude can be determined by subtracting algebraically the position error correction provided by figure B-1.

EXAMPLE:

Selected true pressure altitude . . . . . 40,000 feet

Instrument error (assumed) . . . . . 0 feet

Indicated airspeed . . . . . 310 knots

Altitude correction . . . . . -500 feet

Required indicated pressure altitude
[40,000 - (-500)] . . . . . 40,500 feet

MACH NUMBER CORRECTIONS

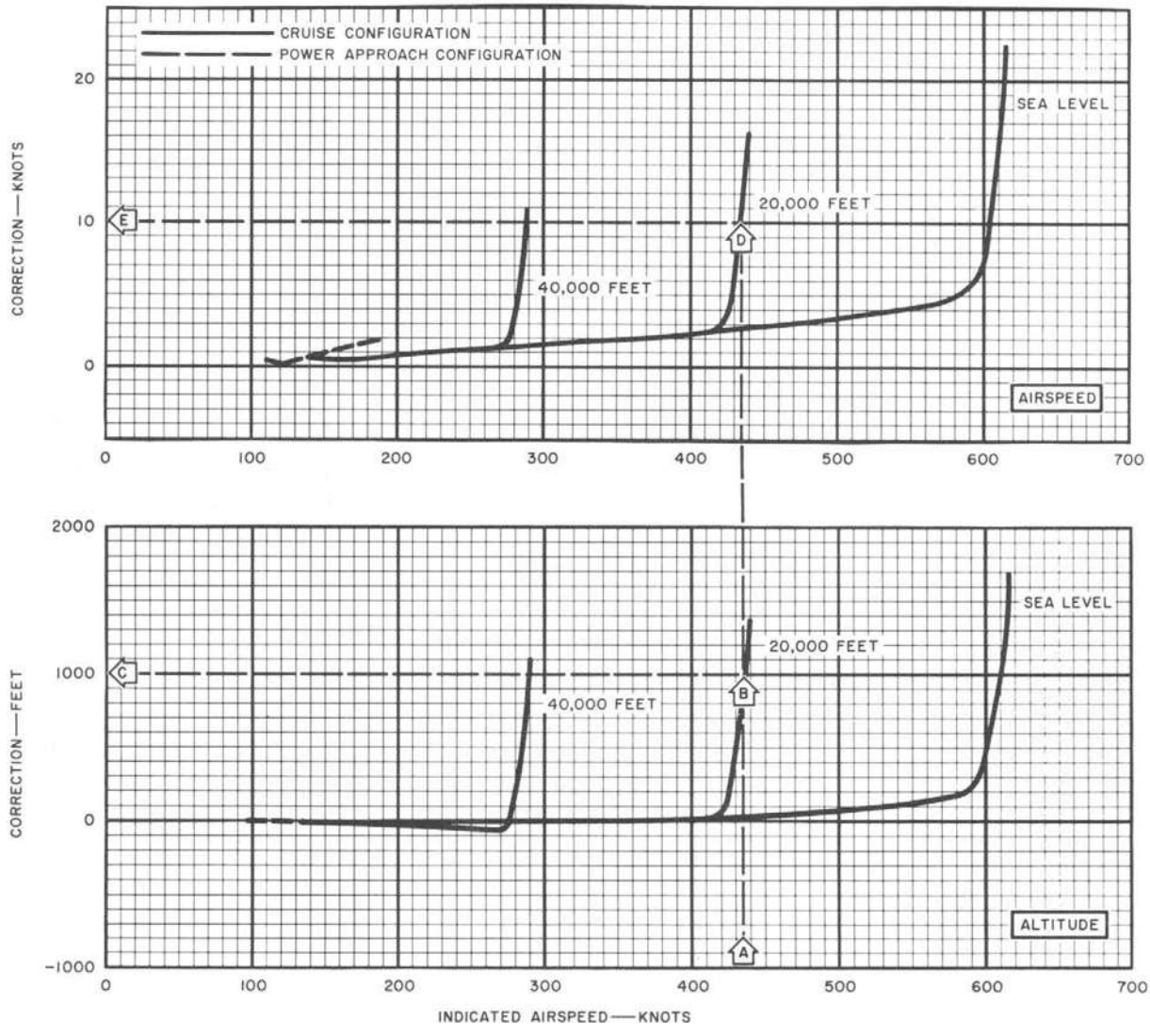
Instrument error and position error corrections must be applied to the indicated Mach number readings (IMN) to obtain a true Mach number reading (TMN). Figure B-2 incorporates the position error correction to make possible direct reading of true Mach number. For all flight in the permissible airspeed range, this correction is virtually zero.

AIRSPEED AND ALTITUDE CORRECTION FOR POSITION ERROR

CORRECTION TO BE ADDED ALGEBRAICALLY

PITOT STATIC SOURCE: CHANNEL AND BUMP AT STATION 76

MODEL: A-3B, EA-3B, RA-3B, TA-3B —**CAMBERED WING** **ENGINES:** J57-P-10



PS-19754-1A

EXAMPLE:

Assume an indicated airspeed of 435 knots and an indicated pressure altitude of 20,000 feet.

(1) Enter chart at 435 knots IAS (A). Sight vertically upward to the 20,000-foot curve; altitude (B), or airspeed (D)

(2) Sight horizontally to the left from (B) to read altitude correction = +1000 feet (C); or airspeed correction = +10 knots (E)

(3) True pressure altitude = (20,000 + 1000 = 21,000) feet.

(4) Calibrated airspeed = (435 + 10 = 445) knots.

DATA AS OF: 15 March 1959
DATA BASIS: Contractor Flight Tests

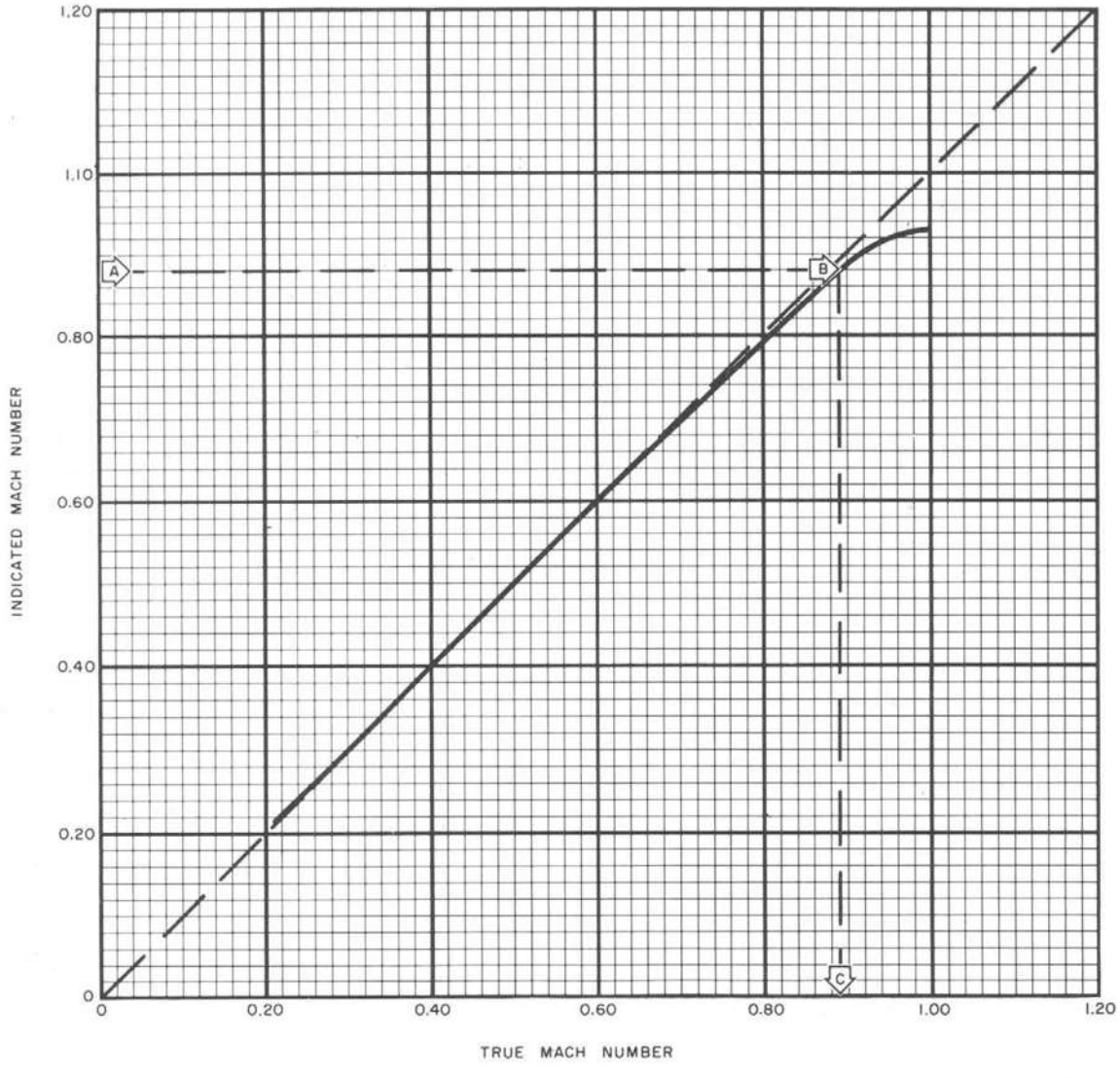
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-1. Airspeed and Altitude Correction for Position Error

MACH NUMBER CORRECTION FOR POSITION ERROR

PITOT STATIC SOURCE: CHANNEL AND BUMP AT STATION 76

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



EXAMPLE:

Assume an indicated mach number of 0.88.

(1) Enter chart at 0.88 IMN [A]. Sight horizontally to (unbroken) mach number curve [B].

(2) Sight vertically downward to true mach number scale and read TMN = 0.89 [C].

DATA AS OF: 15 March 1959
DATA BASIS: Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-2. Mach Number Correction for Position Error

PART 2B

TAKEOFF

TAKEOFF CHARTS

The takeoff charts present the ground roll distance to clear a 50-foot obstacle, both with and without JATO assist, and for a hard surface runway with a zero runway gradient. The charts encompass such variables as takeoff weight, liftoff speed, ambient runway air temperature, runway pressure altitude, and headwind. Full flaps and MILITARY thrust are recommended for all takeoffs.

RECOMMENDED LIFTOFF SPEED– WITHOUT JATO

Liftoff speeds are based on operational NATC recommended data and are shown on figure B-3.

EXAMPLE. Given a takeoff weight of 70, 000 pounds, a runway air temperature of 30°C, and a runway pressure altitude of 4000 feet:

1. Enter chart at 30°C (A). Sight vertically upward to 4000 feet pressure altitude line (B).

2. Sight horizontally to right from (B) to gross weight of 70, 000 pounds (C).

3. Proceed vertically downward from (C) and read recommended liftoff speed of 135 KIAS (D).

TAKEOFF DISTANCE – NO JATO

Takeoff distance and total distance to clear a 50-foot obstacle, without JATO assist, is shown on figure B-4. The takeoff distances are based on operational NATC flight test data.

Note that there is a region in the temperature and altitude correction boxes where takeoff is marginal. This region represents an area where rate of climb after takeoff may be between 300 and 400 feet per minute and climbout capability is marginal. Since temperature and altitude are not independent, the boundary lines in these boxes are shown for extreme altitude-temperature combinations. In order to determine accurately if the rate of climb is less than 800 fpm, when operating in this region, refer to B-5. A more detailed explanation of the marginal region is given in the following paragraphs under MAXIMUM RECOMMENDED TAKEOFF WEIGHT.

The method of obtaining the ground roll distance, total distance to clear a 50-foot obstacle, and a line speed check from the takeoff chart is described in the following examples.

EXAMPLE. Given a takeoff weight of 70, 000 pounds, a runway air temperature of 30°C, and a runway pressure altitude of 4000 feet. To determine takeoff ground roll distance and total distance to clear a 50-foot obstacle proceed as follows:

1. Enter figure B-4 at 135 KIAS (D) as determined from figure B-3, and continue horizontally to right to line representing takeoff weight of 70, 000 pounds (E).

2. Sight vertically downward to temperature baseline and follow parallel to guidelines to temperature of 30°C (F).

3. Continue vertically downward to pressure altitude baseline, then parallel to guidelines to pressure altitude of 4000 feet (G).

4. Proceed vertically downward to headwind baseline, then parallel to guidelines to headwind of 10 knots (H).

5. Proceed vertically downward and read ground roll distance of 6350 feet (J).

6. Note that in step 3, point (G) fell in region where takeoff is marginal. Therefore, check figure B-5 to see if rate of climb is less than 800 fpm. In making this check, note that for this temperature-altitude condition maximum takeoff weight at 800 fpm rate of climb is 71, 500 pounds. Therefore, at gross weight of 70,000 pounds, rate of climb is greater than 800 fpm and takeoff is not marginal in this case.

LINE SPEED CHECK

EXAMPLE: To determine a line speed check at the 2000-foot runway marker:

1. Enter takeoff distance chart (figure B-4) at ground roll distance of 2000 feet and proceed vertically upward to headwind of 10 knots, then parallel to guidelines to headwind baseline.

2. Continue vertically upward to pressure altitude of 4000 feet, then parallel to guidelines to altitude baseline.

3. Proceed vertically upward to temperature of 30°C, then parallel to guidelines to temperature baseline.

4. Proceed upward to takeoff weight of 70,000 pounds, then horizontally to left and read line speed of 85 KIAS.

MAXIMUM RECOMMENDED TAKEOFF WEIGHT – WITHOUT JATO

The maximum takeoff weight shown on figure B-5 is given as a function of rate-of-climb after takeoff. The data basis for this chart assumes that the landing gear is fully extended, the aircraft is climbing out with MILITARY thrust and without the assist of ground effect.

A rate-of-climb of 800 fpm, which corresponds approximately to an excess thrust to weight ratio of 0.05, is considered as a minimum acceptable climbout rate where obstacle clearance is required. Takeoff weight limitations and rate-of-climb less than 800 fpm are shown for conditions where the climbout is made over flat terrain or over the water. Note that in this region the additional horizontal distances to clear a 50-foot obstacle are 2000 to 3000 feet. If flat terrain condition exists at the end of the runway for a considerable distance, takeoffs may be extended into the marginal region. The required technique would be to lift the aircraft off the runway, accelerate and build up climbing speed while the gear is being retracted. After 10 to 15 seconds, the gear will be fully retracted and the reduced drag will permit a more reasonable climbout. Rates-of-climb of less than 400 fpm are considered insufficient for attempted takeoff.

EXAMPLE. Given a runway air temperature of 30°C, a pressure altitude of 4000 feet, and flat terrain at the end of the runway which would permit a minimum rate-of-climb after takeoff of 700 fpm.

1. Enter figure B-5 at temperature of 30°C (A) and sight vertically upward to pressure altitude of 4000 feet (B).

2. From 4000 foot pressure altitude line (B), continue horizontally to right to rate-of-climb baseline (C), represented by 800 fpm, then parallel to guidelines to point (D).

3. Point (D) is determined by entering at rate-of-climb and 700 fpm and proceeding vertically upward to intersection of imaginary line drawn in step 2.

4. From point (D) proceed horizontally to right and read maximum permitted takeoff weight of 74,800 pounds.

5. Note that for rate-of-climb of 800 fpm (C) with same configuration, maximum permitted takeoff weight is 71,500 pounds.

MINIMUM ONE-ENGINE CONTROL SPEED

Minimum one-engine control speeds are shown in figure B-6. The indicated minimum control speed is the speed that a straight course can be maintained with a bank angle of 5 degrees or less, utilizing rudder as necessary to overcome the yaw due to asymmetric thrust.

CAUTION

Avoid permitting aircraft to overrotate upon firing of JATO units in order to preclude scraping drag chute doors.

TAKEOFF DISTANCE MINIMUM GROUND ROLL – JATO UNITS

The optimum aircraft speed at firing are given, using 12 MK7 Mod. 1, 5KS – 4500 JATO units. The minimum ground roll distances shown in figure B-8, will be obtained by stabilizing the power on both engines with the throttles in takeoff position before releasing the wheelbrakes. Fire the JATO units 5 seconds before actual takeoff. The JATO-firing speed can be determined from the JATO firing speed chart, figure B-7. The ground roll distance can be determined from the Takeoff Distance Minimum Ground Roll chart, figure B-8.

TAKEOFF REFUSAL SPEEDS

Takeoff refusal speed, figure B-9, is that speed at which the pilot can cut the power and still stop the aircraft on a runway of a specified length.

EXAMPLE. Assume a takeoff is to be made from an airfield 7600 feet long (A) (dry concrete runway) at 70,000 pounds gross weight (B) under the following conditions: 6000 foot pressure altitude (C), 4°C air temperature (D) and 20 knot headwind (E). To determine the refusal speed enter the chart at (A) 7600 foot runway length, proceed horizontally to (B) 70,000 pounds gross weight, then vertically downward to pressure altitude baseline. Follow guideline to point where it intercepts 6000 foot pressure altitude line (C). Proceed vertically downward to temperature base line, then follow guideline up to intersection of 4°C air temperature line (D). Then downward again to headwind baseline, follow guideline to point where it intersects 20 knot headwind line (E). Proceed downward again to 113 knots refusal speed CAS (F). This is maximum speed that can be reached and still enable the pilot to stop the aircraft on a 7600 foot runway.

REFUSED TAKEOFF STOPPING DISTANCE – NO JATO

The refused takeoff stopping distance (figure B-10) is that distance required to stop an aircraft after it reaches a specified speed. The flight conditions to be taken into consideration are ground speed, gross weight, pressure altitude and air temperature. Two stopping distances can be obtained; one as the result of using a drag chute and the second distance without the use of the drag chute.

EXAMPLE. Assume a ground speed of 82 knots CAS (A) is reached, during takeoff, at a pressure altitude of 4000 feet (B) with an air temperature of 6°C (C), takeoff weight of 65, 000 pounds (D) and a headwind of 10 knots (E). Refer to figure B-10, and enter graph at refusal speed of 82 knots (A), follow guideline to 4000 foot pressure altitude (B), proceed horizontally to temperature baseline, follow guideline to point where it meets air temperature line of 6°C (C). Proceed horizontally once more to aircraft takeoff weight of 65, 000 pounds (D) without drag chute, follow graph line down to headwind baseline, then follow guideline to where it intersects 10 knots headwind line (E). Follow graph line down to stopping distance of 2500 feet (F). The stopping distance with drag chute deployed is 2000 feet (G).

JATO FIRING SPEED

This chart (figure B-7) enables the pilot to determine the exact moment for firing the JATO units. The pilot must have this knowledge to allow for complete burnout of the units by the time the aircraft reaches liftoff speed.

EXAMPLE. Assume a takeoff at 76,000 pounds gross weight (A), pressure altitude of 6000 feet (B) and air temperature of 6°C (C). Enter chart (figure B-7) at 76,000 pounds (A), proceed horizontally to intersection of guideline and drop downward to pressure altitude baseline. Follow guideline down to where it intersects 6000 foot pressure altitude line from (B). From this point continue down to temperature baseline, then follow guideline up to where it meets 6°C air temperature from (C). Proceed down to JATO firing speed at bottom of graph and read 63 knots CAS (D). This is speed to fire JATO units to assure complete burnout at liftoff.

JATO TAKEOFF DISTANCE

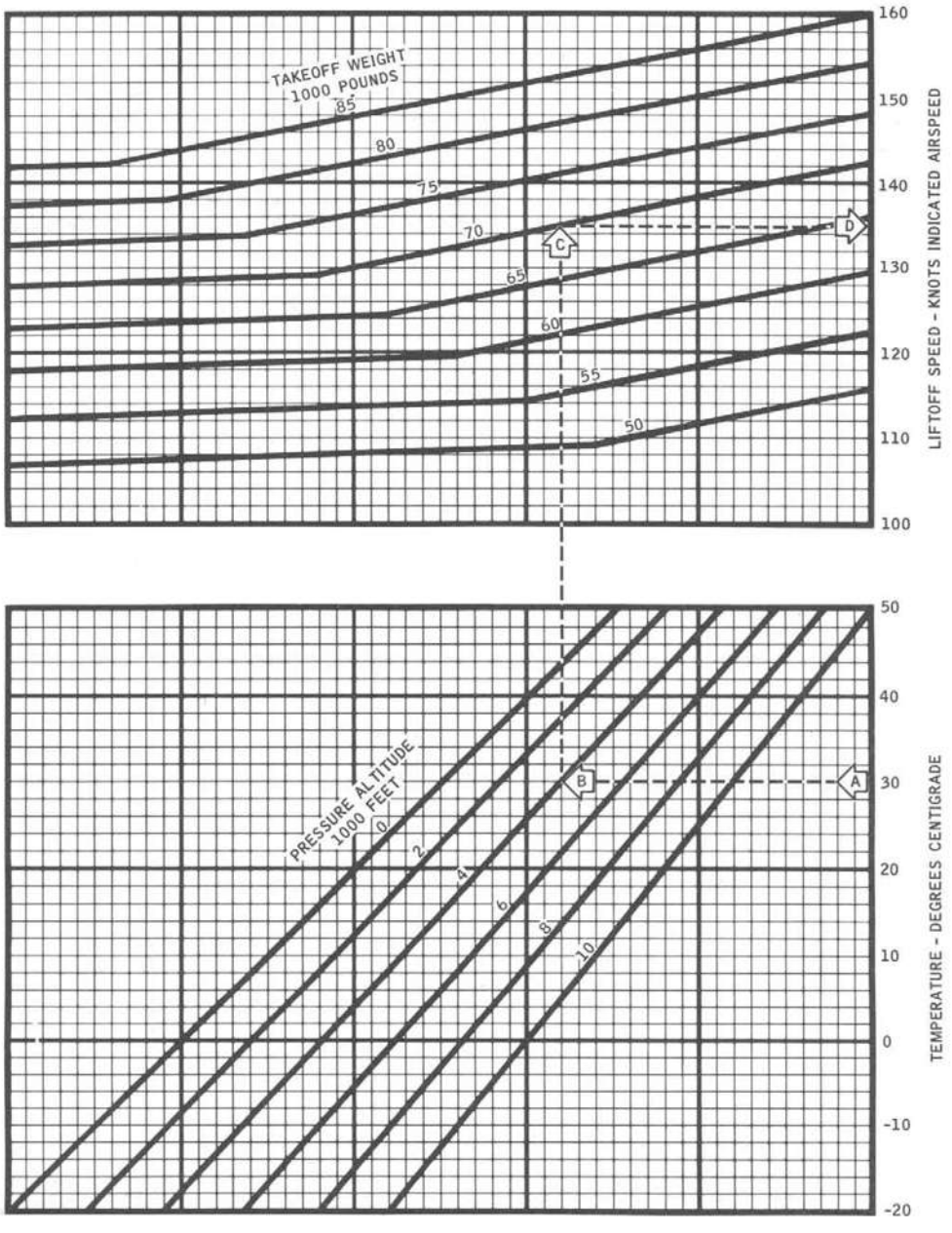
EXAMPLE. Assume takeoff is to be made at 76,000 pounds gross weight (A) at a pressure altitude of 6000 feet (B) and at an ambient temperature of 6°C (C). Enter chart (figure B-8) at 76,000 pounds (A), proceed horizontally on graph to point where it intersects guideline. Sight horizontally from this point to where line would fall on liftoff speed scale and read 135 knots CAS. Return to guideline and proceed downward to pressure altitude baseline, follow guideline to point where it intersects 6000 foot pressure altitude line from (B). Continue down to temperature baseline, follow the guideline up to where it intersects 6°C temperature line from (C). Move down graph to headwind from (D). Drop downward on graph to distance for takeoff and read 1330 feet (E).

TWO ENGINE OPERATION

RECOMMENDED LIFTOFF SPEED

FULL FLAPS MILITARY THRUST NO JATO

MODEL: A-3B, EA-3B, RA-3B, TA-3B—CAMBERED WING **ENGINES:** J57-P-10



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REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-3. Recommended Liftoff Speed

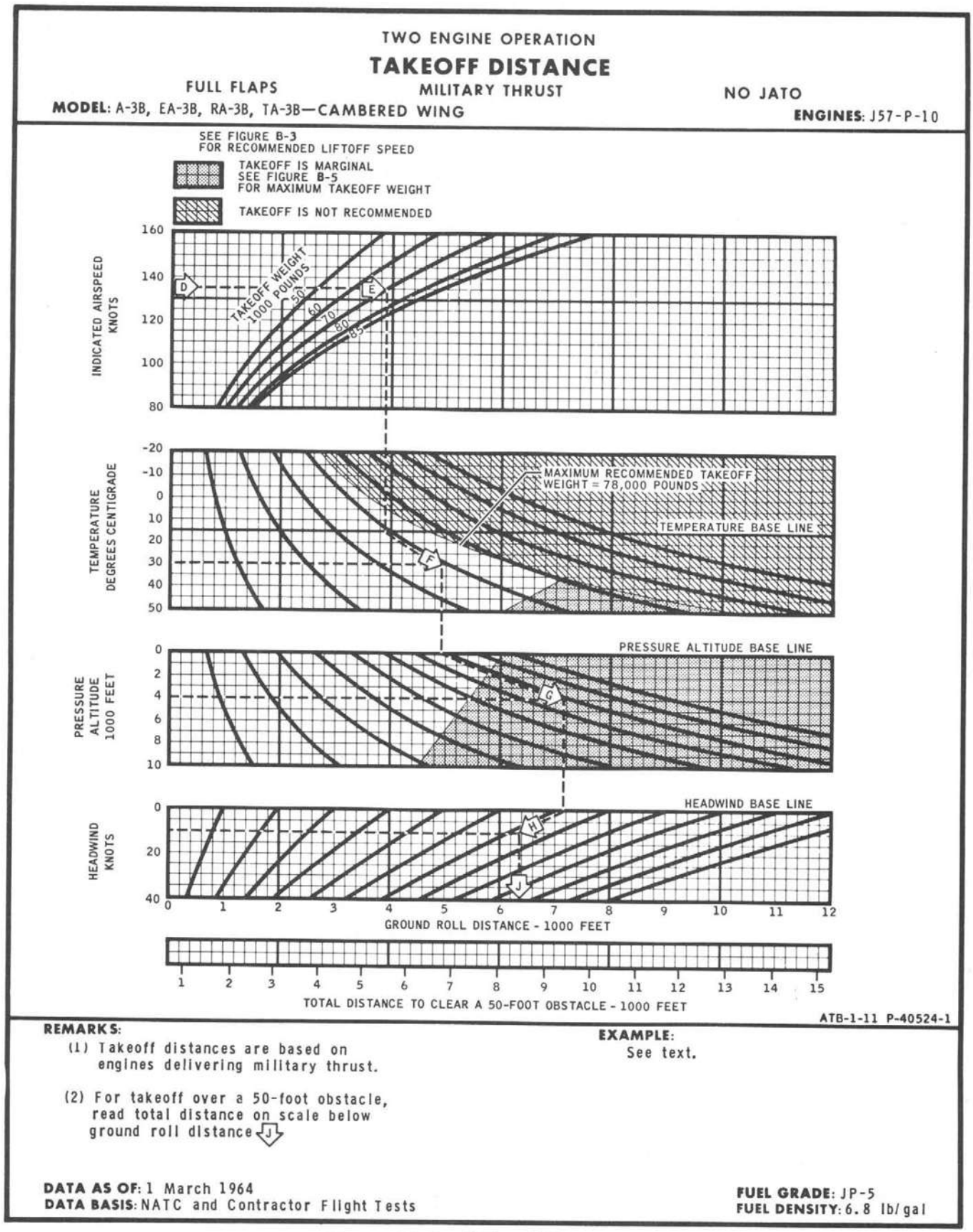


Figure B-4. Takeoff Distance

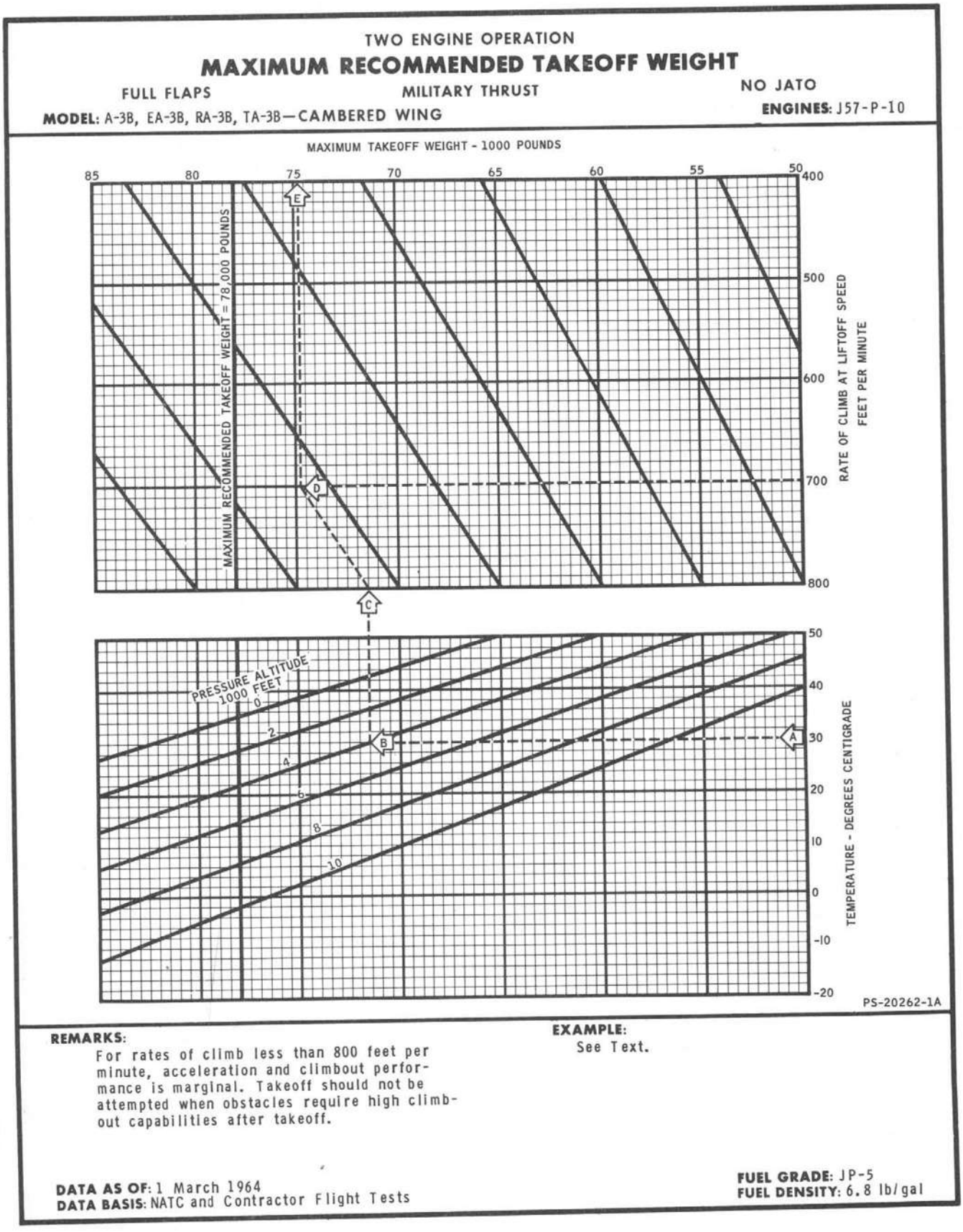
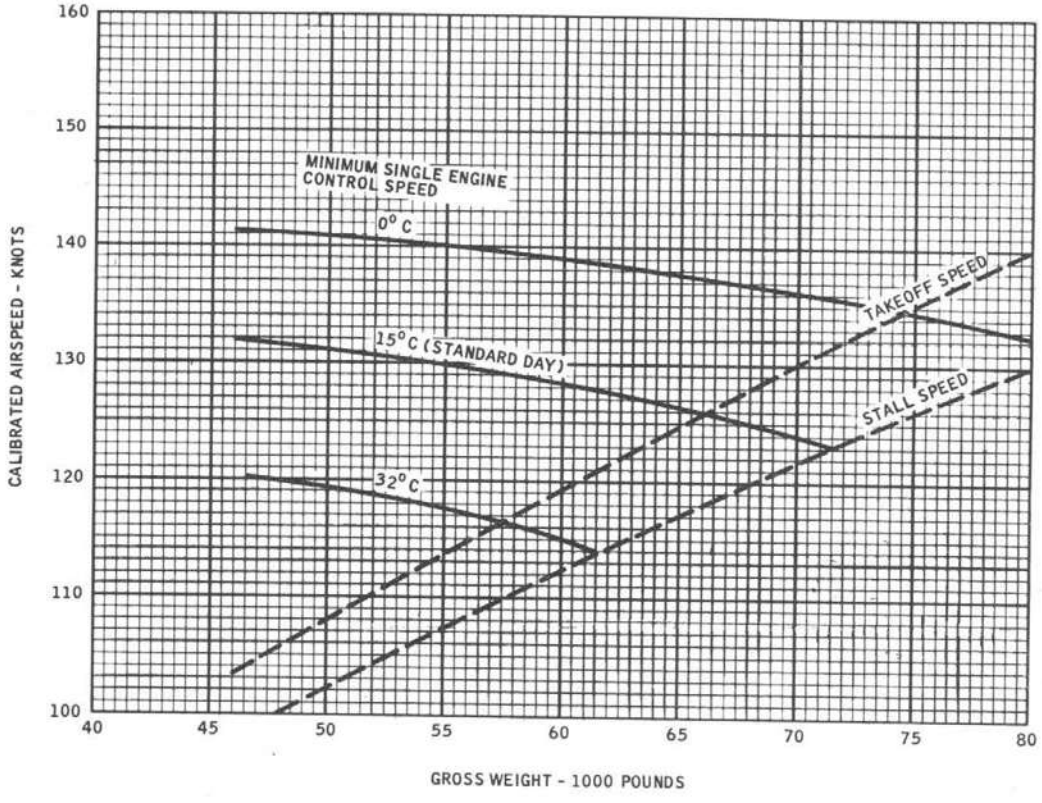


Figure B-5. Maximum Recommended Takeoff Weight

ONE ENGINE OPERATION
MINIMUM SINGLE ENGINE CONTROL SPEED
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B— **CAMBERED WING** **ENGINES:** J57-P-10



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REMARKS:

(1) Sea Level.

(2) Minimum single engine control speed based on holding constant heading with full rudder deflection and 5° bank angle.

(3) MILITARY THRUST •

0°C = 11,600 LBS
15°C = 10,500 LBS
32°C = 9,400 LBS

DATA AS OF: 1 July 1961
DATA BASIS: Estimated

• BASED ON P & W CURVES LESS DUCT LOSS

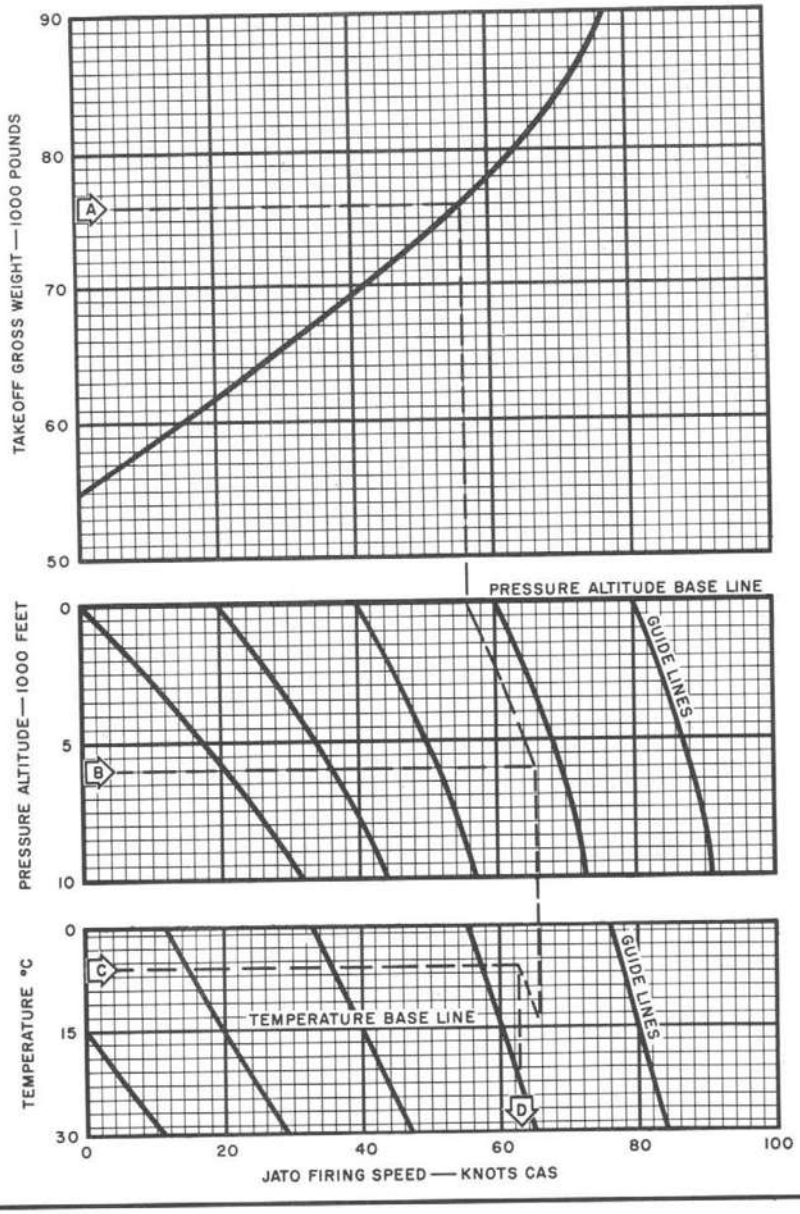
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/ gal

Figure B-6. Minimum Single-Engine Control Speed

JATO FIRING SPEED

FULL FLAPS **12 JATO UNITS**

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



REMARKS:

(1) JATO burning time is 5 seconds.

(2) JATO burn-out at liftoff.

EXAMPLE:

Under the following conditions:

(a) Takeoff weight = 76,000 pounds [A]

(b) Pressure altitude = 6000 feet [B]

(c) Air temperature = 6°C [C]

Then:

The JATO firing speed for burn-out at liftoff is 63 knots [D]

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

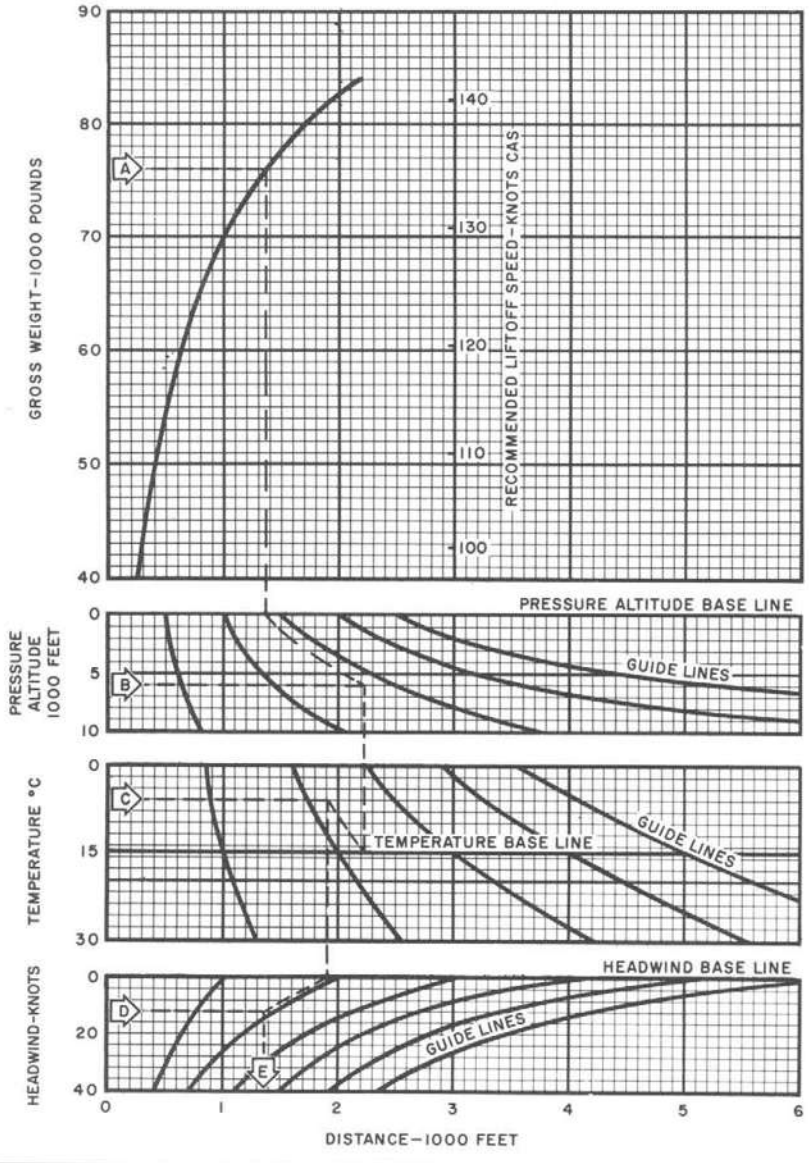
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-7. JATO Firing Speed

TAKEOFF DISTANCE MINIMUM GROUND ROLL

FULL FLAPS **12 JATO UNITS**

MODEL: A-3B, EA-3B, RA-3B, RA-3B—CAMBERED WING **ENGINES:** J57-P-10



REMARKS:

(1) JATO burns out at liftoff if fired as shown on JATO FIRING SPEED chart.

EXAMPLE:

Under the following conditions:

(a) Takeoff weight = 76,000 pounds [A]. Liftoff speed = 135 knots CAS.

(b) Pressure altitude = 6000 feet [B].

(c) Air temperature = 6°C [C].

(d) Headwind = 12 knots [D].

Then:

The takeoff ground roll with 12 JATO units is 1330 feet [E].

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

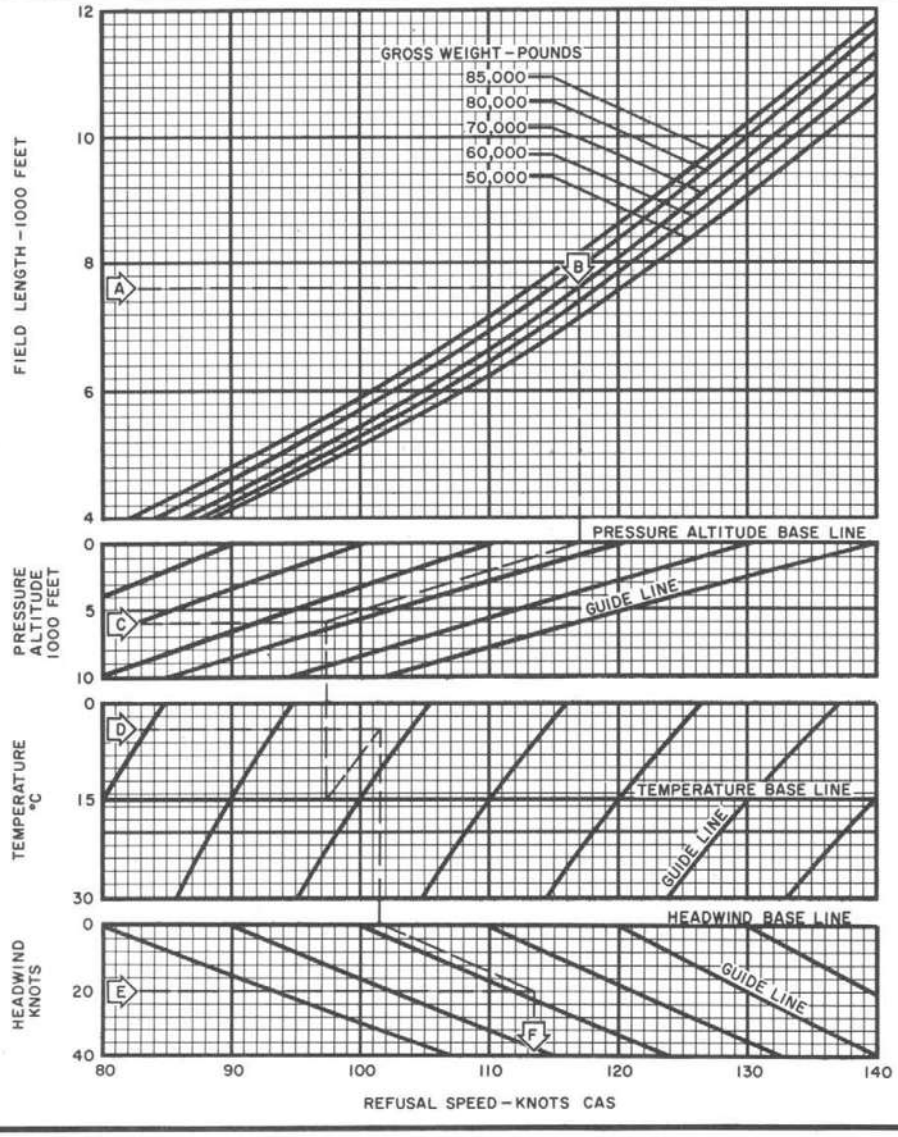
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-8. Takeoff Distance Minimum Ground Roll

TAKEOFF REFUSAL SPEEDS

FULL FLAPS **NO JATO**

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



REMARKS:

(1) Data includes distance covered in 5 seconds pilot reaction time.

(2) Maximum hytrol braking used for stopping.

EXAMPLE:

Under the following conditions

(a) Field length = 7600 feet (A).

(b) Takeoff weight = 70,000 pounds (B).

(c) Pressure altitude = 6000 feet (C).

(d) Air temperature = 4°C (D).

(e) Headwind = 20 knots (E).

Then:

The maximum refusal speed is 113 knots CAS (F)

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

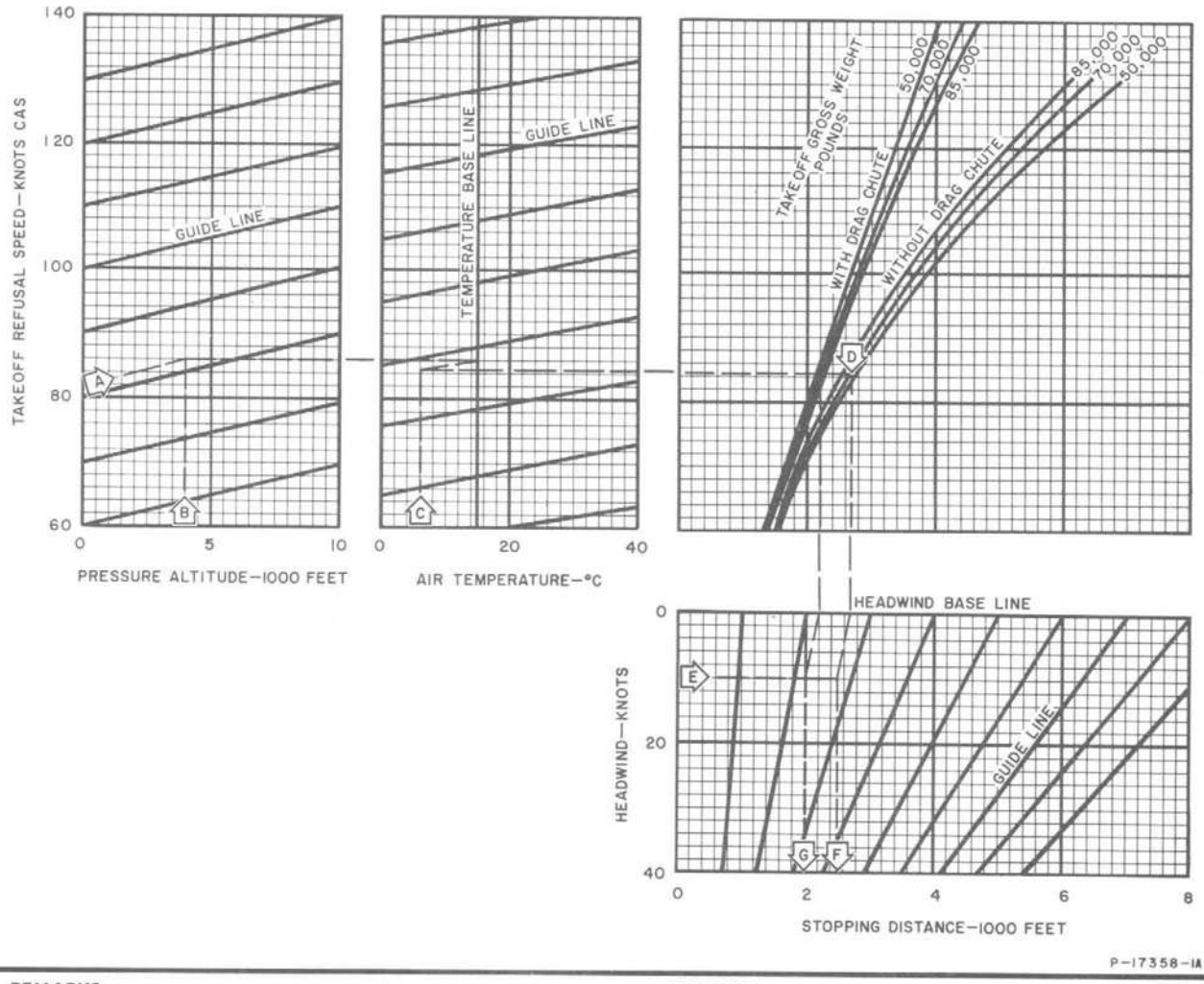
Figure B-9. Takeoff Refusal Speeds

TWO ENGINE OPERATION

REFUSED TAKEOFF STOPPING DISTANCE

FULL FLAPS NO JATO
IDLE THRUST HYTROL BRAKING

MODEL: A-3B, EA-3B, RA-3B, TA-3B— **CAMBERED WING** **ENGINES:** J57-P-10



REMARKS:

(1) Data includes 5 seconds pilot reaction time.
(2) Idle thrust and maximum hytrol braking after refusal.

EXAMPLE:

Under the following conditions:

(a) Speed = 82 knots CAS (A).
(b) Pressure altitude = 4000 feet (B).
(c) Air temperature = 6°C (C).
(d) Takeoff weight = 65,000 pounds (D).
(e) Headwind = 10 knots (E).

Then:

The stopping distance is 2500 feet (F). If the drag chute is deployed the stopping distance is 2000 feet (G).

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-10. Refusal Takeoff Stopping Distance

PART 3B

CLIMB

CLIMB CHARTS

CLIMB PERFORMANCE AFTER TAKEOFF

Figure B-11 shows the climb characteristics of the aircraft immediately after takeoff at sea level pressure altitude and a takeoff gross weight of 70, 000 pounds. These data show the effects of airspeed, flap position and landing gear extension on the maximum rate-of-climb with takeoff power. Rates-of-climb for each landing gear and flap configuration at airspeeds below the recommended airspeed are included.

Note

This chart shows maximum rates-of-climb available at zero acceleration (i. e., stabilized airspeed). Upon achieving a given climb airspeed, the pilot can obtain the corresponding rate-of-climb shown on the chart if he makes no attempt to increase the airspeed.

This chart shows graphically that landing gear should be raised immediately after takeoff; and – from airspeed, flap retraction time, and rate-of-climb relationships – that flap retraction should be initiated only after the aircraft has accelerated to an airspeed approximately 30 to 40 knots above the recommended takeoff airspeed.

Two additional curves are provided on the chart. The dashed line in center of grid can be used to estimate the loss of rate-of-climb should one engine fail immediately after takeoff. This curve shows the absolute necessity of increasing the forward speed of the aircraft as well as raising the landing gear and flaps before any attempt is made to gain altitude with one engine inoperative. The curve at the bottom of grid can be used to estimate effect on available rate-of-climb of deviations in ambient temperature from standard temperature of 15°C at sea level. Note that, except at low takeoff airspeeds with full flaps (i. e., minimum ground roll), the aircraft has excellent climbout performance on two engines, even with ambient temperatures considerably above standard.

EXAMPLE. A field takeoff (full flaps) is to be made at 70, 000 pounds gross weight with no wind, with sea level pressure altitude, and an ambient temperature of 5°C. Find rate-of-climb at 164 knots for normal climbout; and for climbout following engine failure after landing gear has been retracted.

1. Enter Climb Performance After Takeoff Chart, figure B-11, with 164 knots CAS (A); read vertically to intersection with solid line (full flaps and gear down). Opposite this point on left-hand scale (E), read approximately 2300 feet per minute available rate of climb for normal Standard Day operations. From temperature correction curve note that available rate-of-climb is increased by 400 feet per minute for each 10°C temperature decrease from Standard Day. The correction then is:

$$\frac{15 - 5}{10} \times 400 = 400 \text{ feet per minute.}$$

This results in:

2300 + 400 = 2700 feet per minute actual rate of climb. Assume landing gear is fully retracted at 175 knots CAS. From chart, rate-of-climb at this point is determined to be:

2820 + 425 = 3245 feet per minute.

2. Assume that with landing gear retracted and full flaps extended, one engine fails at 175 knots CAS. As shown on chart, loss in rate-of-climb due to failure of one engine at this airspeed is approximately 2400 feet per minute. If climb-out is continued, maximum available rate-of-climb of one engine then becomes:

3245 – 24 = 845 feet per minute.

CLIMB PERFORMANCE FOR WAVEOFF

Figure B-12, which uses the format of figure B-11, Climb Performance after Takeoff, shows climb-for-waveoff capability at a gross weight of 50, 000 pounds and with military thrust.

ALTITUDE CLIMB PERFORMANCE CHARTS

Clean configuration climb performance with respect to time, fuel, and distance from sea level to altitude may be determined from the data presented in three charts; (figure B-15) identified as Time to Climb, Climb Distance (figure B-14), and Fuel Consumed During Climb (figure B-13). Climbs may be made with military thrust to cruise ceiling (that altitude at which the rate-of-climb is 300 feet per minute with

normal thrust) at any operating gross weight up to 70,000 lbs without exceeding the engine operating time limit of 15 minutes. It is best to maintain the airspeed schedule shown in the table on each climb chart, although variations in climb airspeed up to ten knots above or below the scheduled airspeed will not materially affect climb performance, except at altitudes near the ceiling.

The Altitude Climb Performance charts may also be used to determine elapsed time, distance, and/or fuel used in climbing from one altitude to another in flight by taking the difference between the values at the initial and final altitudes, as illustrated on the chart.

EXAMPLE. Assume that climb is required from 10,000 feet pressure altitude to 40,000 feet pressure altitude, with momentary gross weight at 10,000 feet of 60,500 pounds. On time, fuel, and distance plots, read initial values at intersection of 60,500-pound gross weight line with 10,000 foot pressure altitude line. Next, determine final values at intersection of weight guideline with 40,000-foot pressure altitude line. From these data, the following computations are made:

(figure B-13)	Fuel consumed during climb (2040 - 450 = 1590) pounds
(figure B-14)	Climb distance =(76 - 11 = 65) N. miles
(figure B-15)	Climb time = (10.7 - 1.7 = 9.0) minutes

ONE-ENGINE RATE-OF-CLIMB

The one-engine rate-of-climb charts, figures B-16 and B-17, are presented for emergency use in the event of engine failure on takeoff or during the initial climbout immediately after liftoff. Minimum single engine control speeds, figure B-6, are shown on the graphs for the lower gross weights where control speeds are critical. Two engine liftoff speeds, figure B-3, are shown on the higher gross weight curves where liftoff speed is higher than minimum one-engine control speeds. The figures include data for gear down and gear up with the flaps positioned at full up, half, and fully extended. The figures indicate that the gear should be retracted immediately but the flaps should not be raised until sufficient airspeed is built up to produce a greater rate of climb with the flaps positioned at half or full up. Figure B-17 shows the effect of outside air temperature on rate-of-climb at sea level.

EXAMPLE. If the gross weight is 70,000 pounds, the outside air temperature is 15°C (59°F), and the indicated airspeed is 150 knots then the rate-of-climb in feet per minute is:

figure B-16 (Sheet 2)

	Gear Down	Gear Up
Full Flaps	75	345
Half Flaps	150	375
Flaps Up	-400	-135

figure B-17

If the outside air temperature is 10°C (50°F) higher, reduce the above tabulated rates-of-climb by 185 feet per minute.

EMERGENCY CLIMB CHARTS

The Emergency Climb Charts, figures B-18 through B-20, are presented for use in emergency operation only (one engine windmilling), since, in normal procedure, climbs are always made with both engines operating.

The use of military thrust during a climb to altitude is restricted to 15 minutes, due to engine operating limitations. If the climb time will exceed 15 minutes, use military thrust during the early stage of the climb and normal thrust during the last stage.

Follow airspeed schedule shown on chart as closely as possible. Climb time, fuel, and distance data for inflight climbs, with one engine operating on military thrust may be calculated by taking the difference between the time, fuel, and distance values at the initial and at the final altitudes.

EXAMPLE. Assume that a climb is made at 55,000 pounds gross weight on one engine with military thrust from 10,000 feet pressure altitude to 20,000 feet pressure altitude. As indicated on the Emergency Climb Chart:

Climb time = (13.5 - 5.5 = 8.0) minutes.

Climb distance = (66 - 26 = 40) nautical miles.

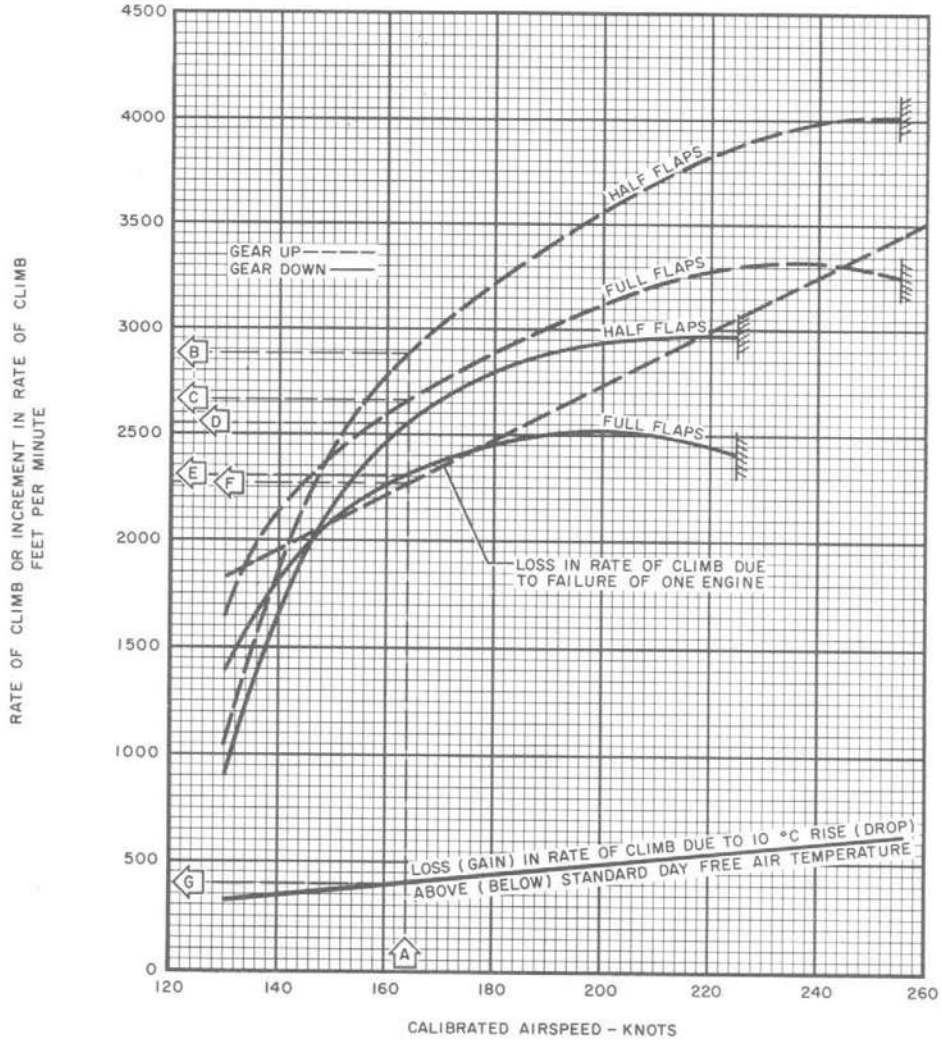
Fuel used during climb = (1550 - 725 = 825) pounds.

TWO ENGINE OPERATION

CLIMB PERFORMANCE AFTER TAKEOFF

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **WEIGHT:** 70,000 POUNDS **ENGINES:** J57-P-10



P-17359-1A

REMARKS:

(1) Sea level pressure altitude.

(2) Speed limited to 225 knots CAS with gear down and 255 knots CAS with flaps down.

EXAMPLE:

After takeoff at 70,000 pounds on standard day conditions, at 164 knots CAS (A) the rate of climb will be

Half flaps, gear up (B) = 2880 FPM

Full flaps, gear up (C) = 2660 FPM

Half flaps, gear down (D) = 2550 FPM

Full flaps, gear down (E) = 2300 FPM

In the event of an engine failure, the loss in rate of climb will be 2260 FPM (F). This must be subtracted from (B), (C), (D), or (E) as applicable, to show single engine rates of climb.

Temperature correction may be made by subtracting 400 FPM (G) for each 10°C rise in air temperature, or adding 400 FPM for each 10°C drop in air temperature.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

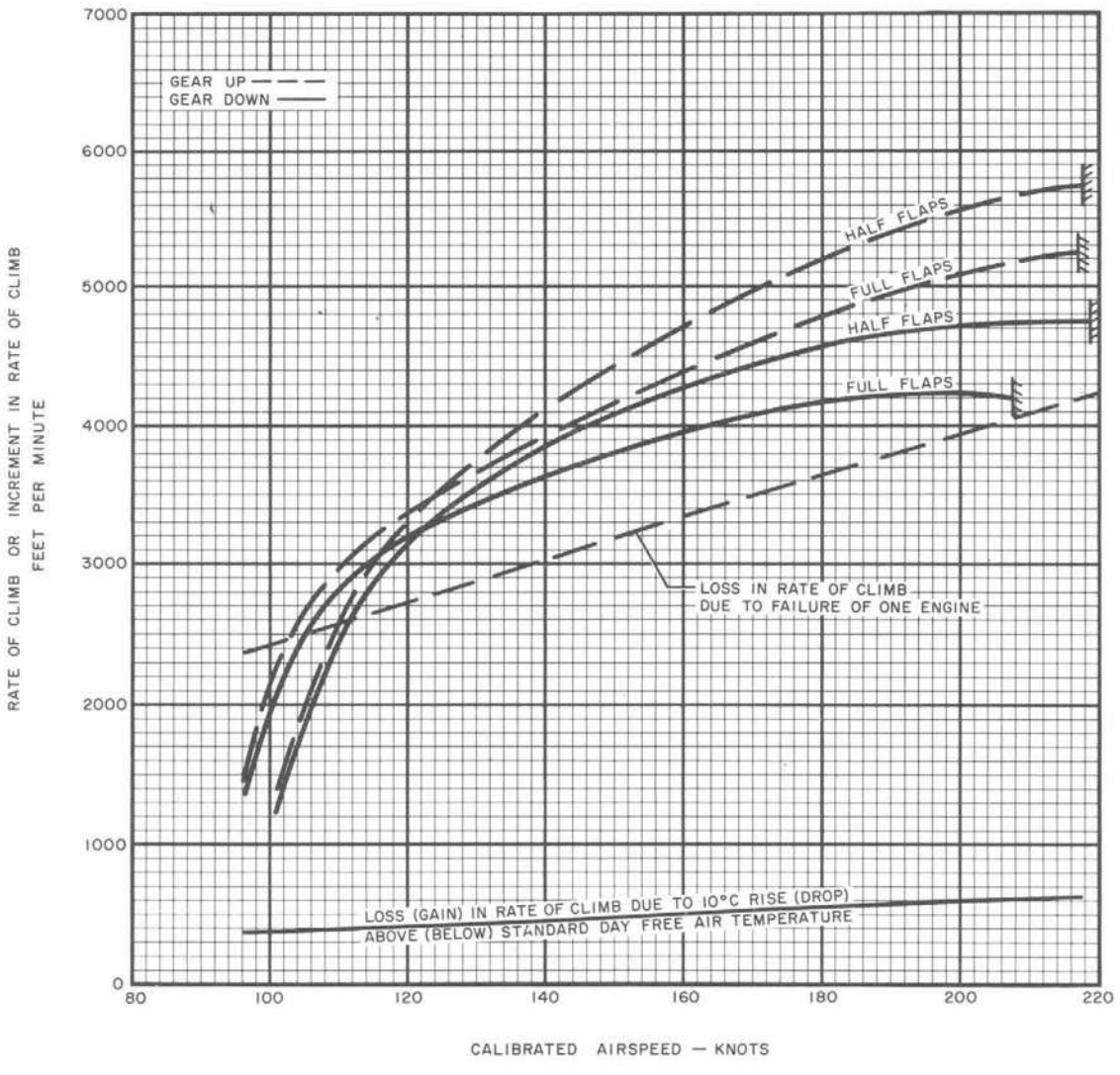
Figure B-11. Climb Performance after Takeoff

TWO ENGINE OPERATION

CLIMB PERFORMANCE FOR WAVEOFF

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **WEIGHT:** 50,000 POUNDS **ENGINE:** J57-P-10



REMARKS:

(1) Sea level.

(2) Speed brakes retracted.

DATA AS OF: 1 July 1961
DATA BASIS: NATC and Contractor Flight Test

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

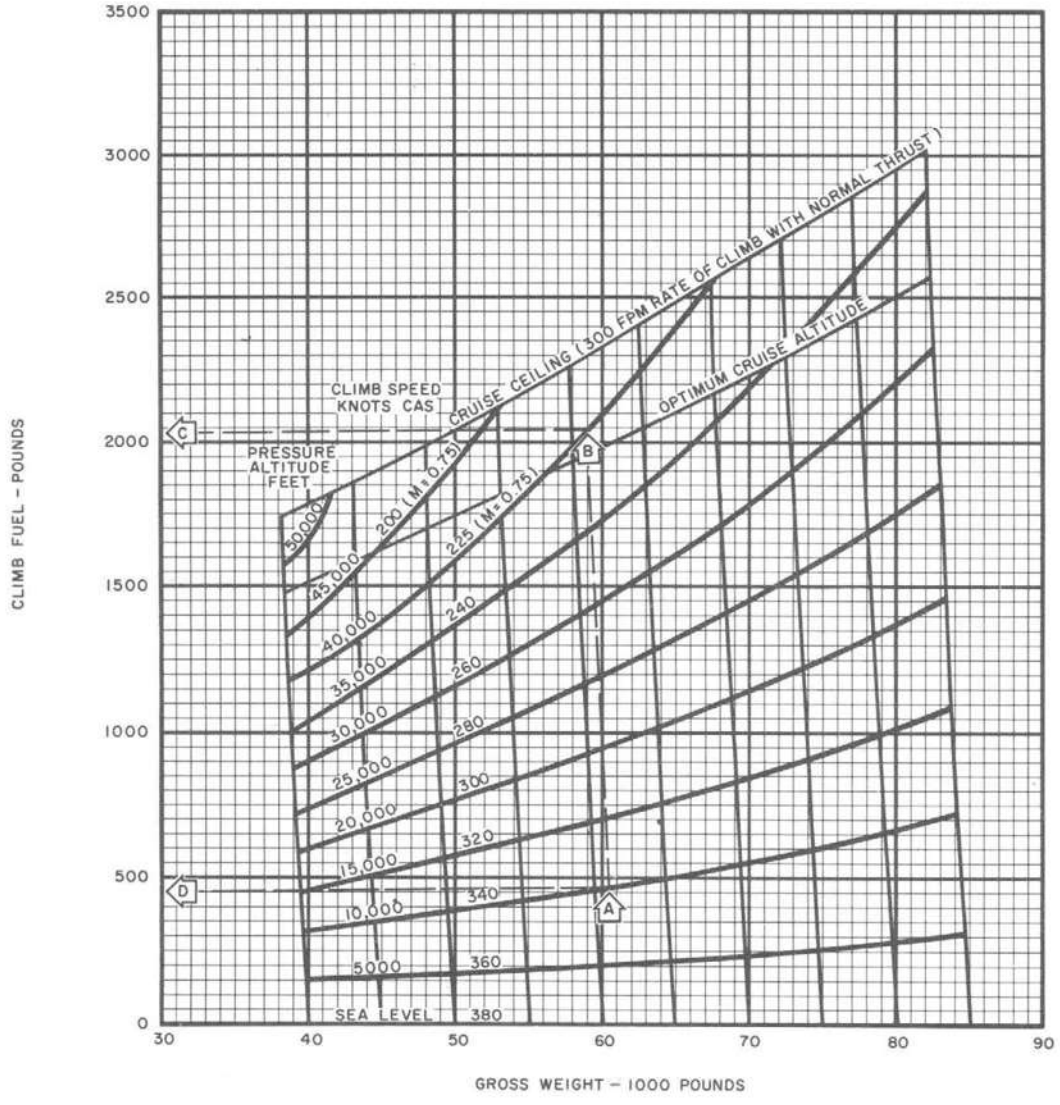
Figure B-12. Climb Performance for Waveoff

TWO ENGINE OPERATION

FUEL CONSUMED DURING CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



P-17393-IA

REMARKS:

(1) The effect on climb fuel of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to actual gross weight to enter chart.

(2) Add 600 pounds to climb fuel for takeoff and acceleration to climb speed.

EXAMPLE:

If the gross weight is 60,500 pounds at 10,000 feet (A) and climb is made to 40,000 feet (B), the fuel used during climb is 2040 pounds (C) minus 450 pounds (D) or 1590 pounds.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

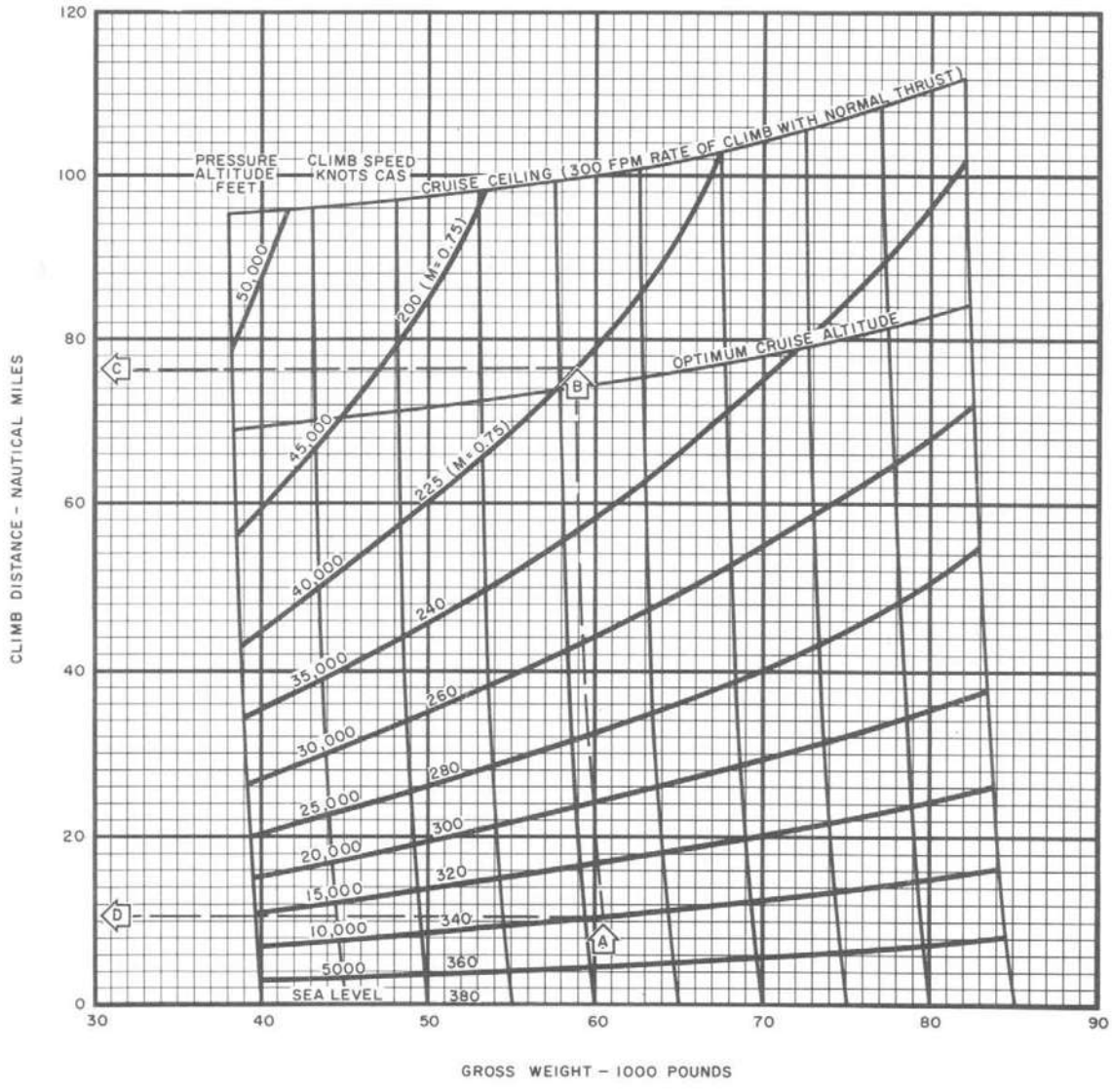
Figure B-13. Fuel Consumed During Climb

TWO ENGINE OPERATION

CLIMB DISTANCE

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B— **CAMBERED WING** **ENGINES:** J57-P-10



P-17392-1A

REMARKS:

(1) The effect on climb distance of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to actual gross weight to enter chart.

EXAMPLE:

If the gross weight is 60,500 pounds at 10,000 feet (A) and a climb is made to 40,000 feet (B), the climb distance is 76 nautical miles (C) minus 11 nautical miles (D) or 65 nautical miles.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

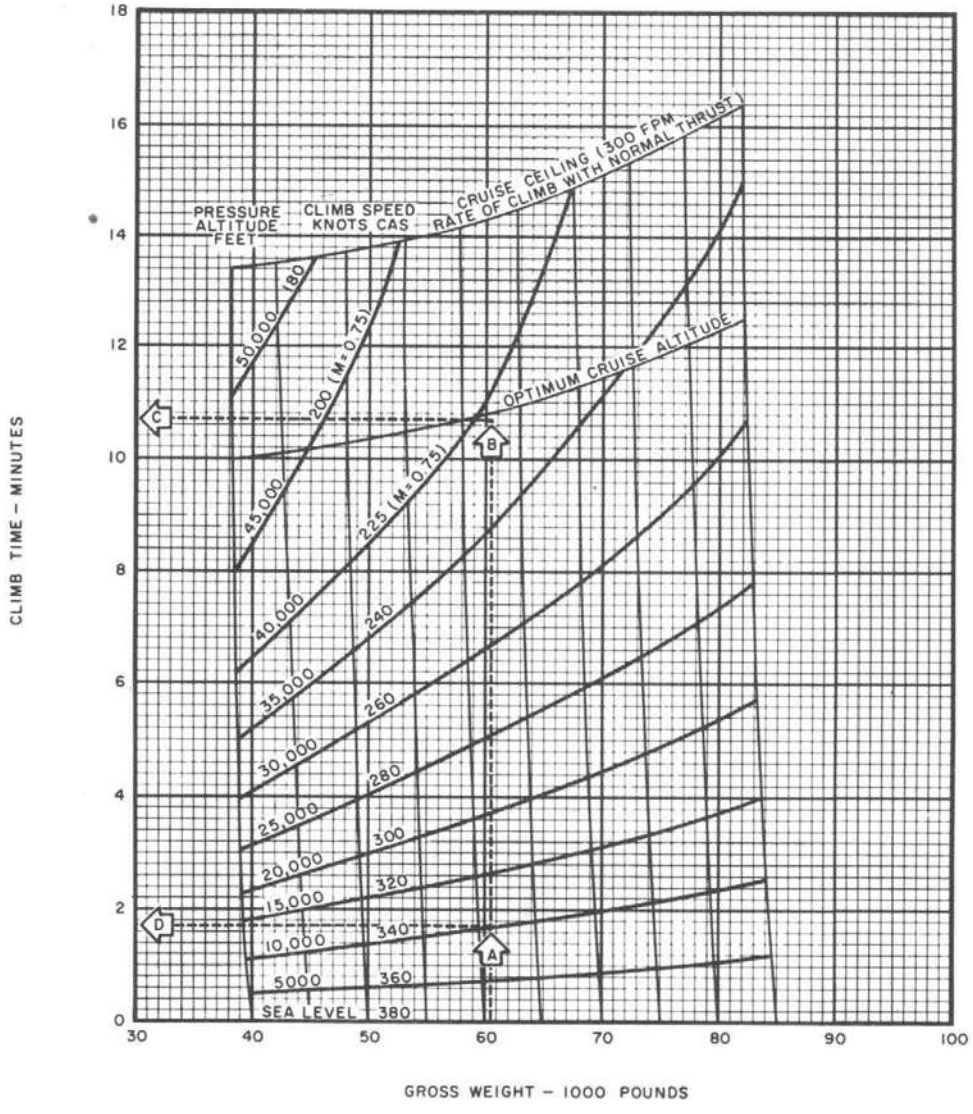
Figure B-14. Climb Distance

TWO ENGINE OPERATION

TIME TO CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B– **CAMBERED WING** **ENGINES:** J57-P-10



ATB-1-11 P-40526-1

REMARKS:

(1) The effect on climb time of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to actual gross weight to enter chart.

EXAMPLE:

If the gross weight is 60,500 pounds at 10,000 feet (A), and a climb is desired to 40,000 feet (B), the climb time is 10.7 minutes (C) minus 1.7 minutes (D) or 9.0 minutes.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-15. Time to Climb

ONE ENGINE

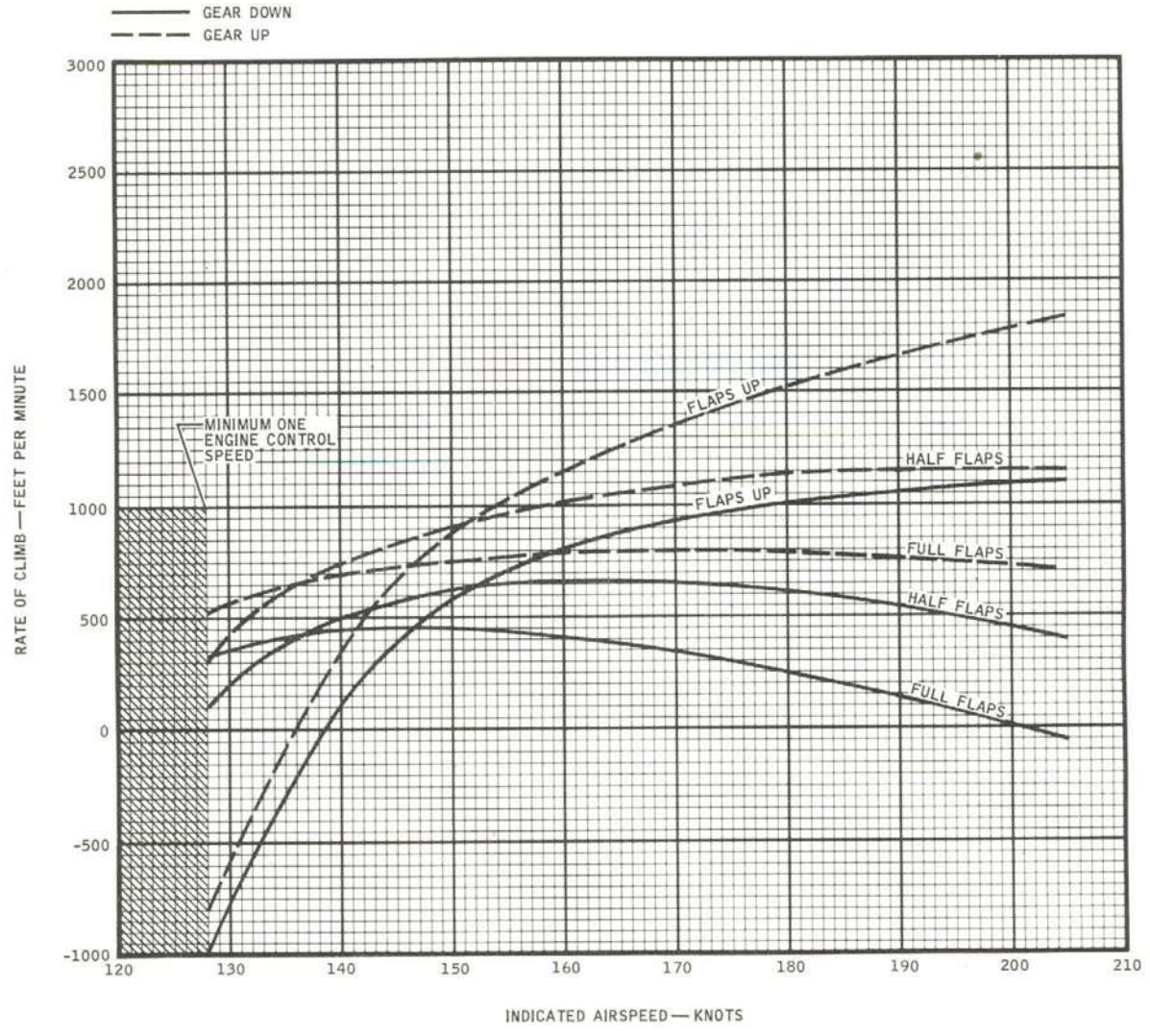
STANDARD DAY (15°C)
SEA LEVEL

RATE OF CLIMB

WEIGHT=60,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—CAMBERED WING

ENGINE: J57-P-10



P-28268-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-16. One-Engine Rate-of-Climb – 60,000 Pounds (Sheet 1)

ONE ENGINE

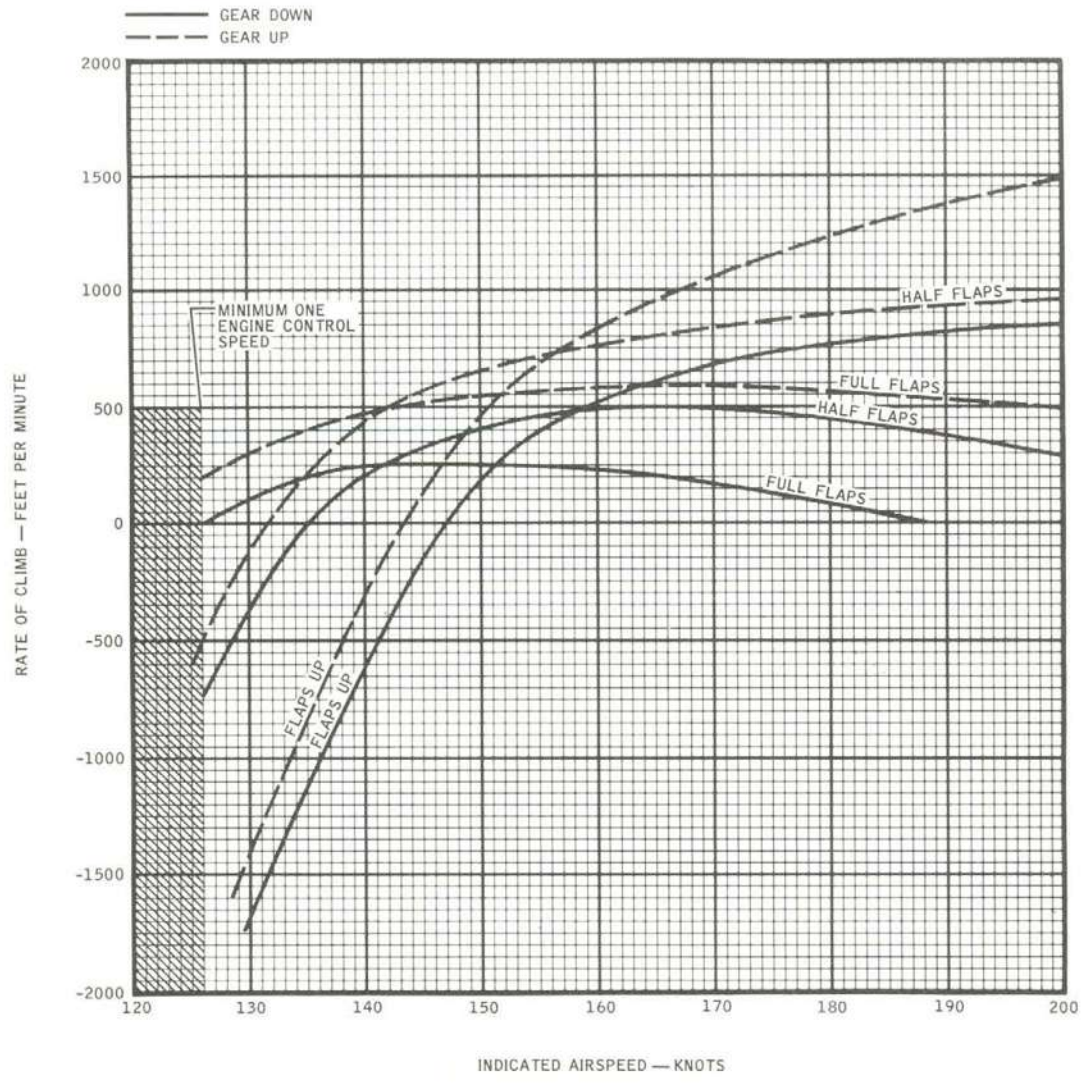
STANDARD DAY (15°C)
SEA LEVEL

RATE OF CLIMB

WEIGHT=65,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—CAMBERED WING

ENGINE: J57-P-10



P-28269-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-16. One-Engine Rate-of-Climb – 65,000 Pounds (Sheet 2)

ONE ENGINE

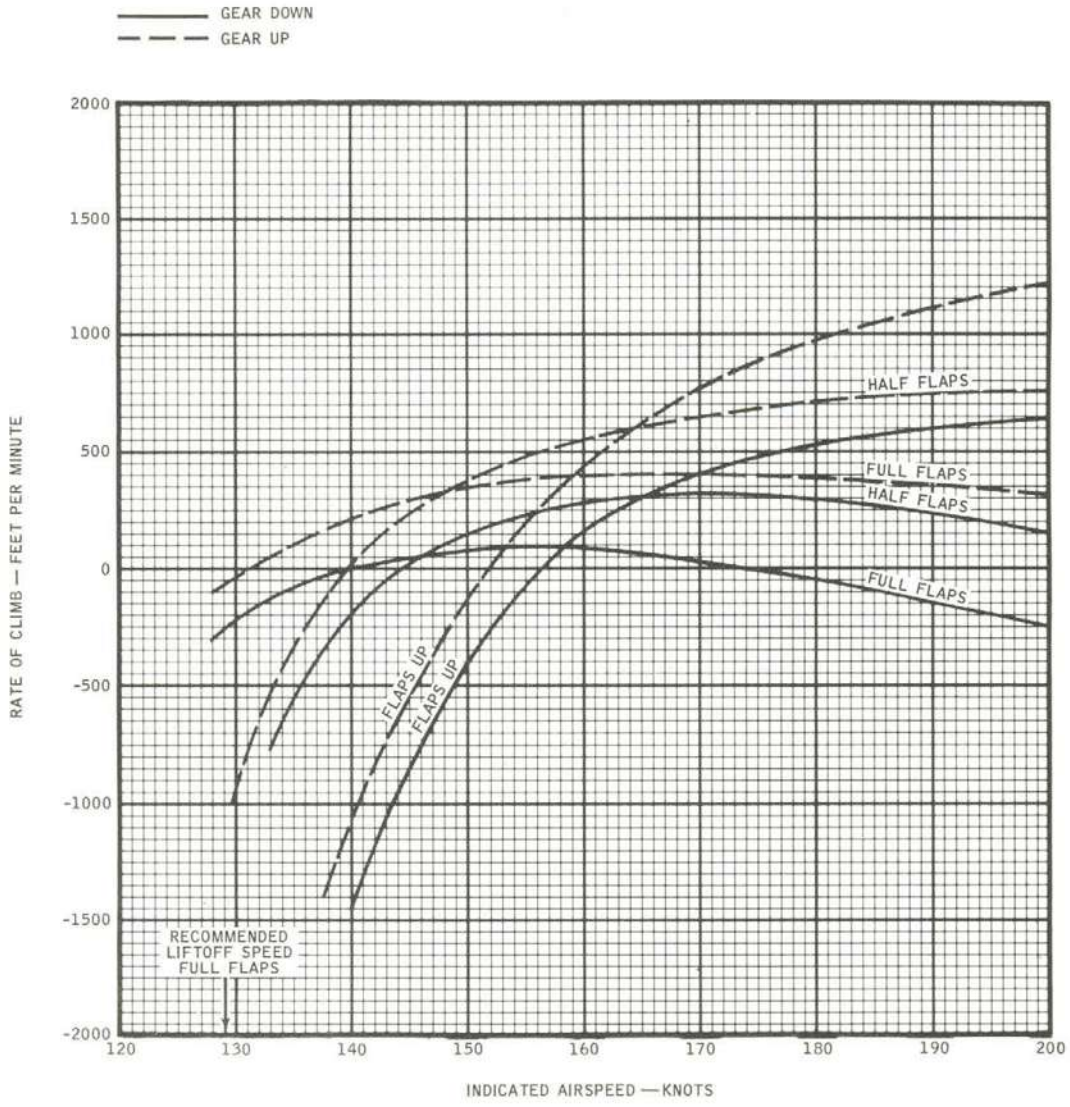
STANDARD DAY (15°C)
SEA LEVEL

RATE OF CLIMB

WEIGHT=70,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—CAMBERED WING

ENGINE: J57-P-10



P-28270-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-16. One-Engine Rate-of-Climb – 70,000 Pounds (Sheet 3)

ONE ENGINE

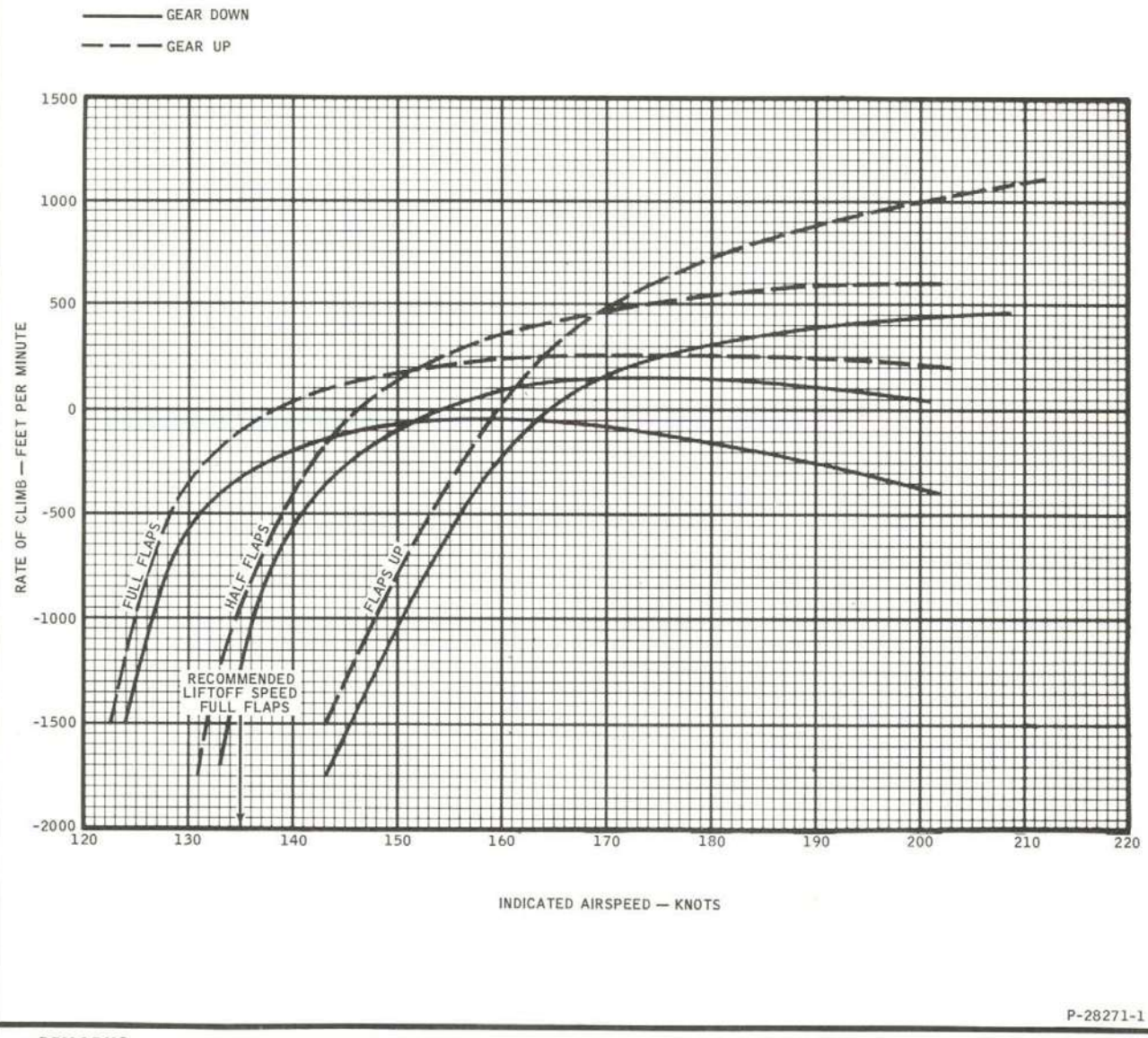
STANDARD DAY (15°C)
SEA LEVEL

RATE OF CLIMB

WEIGHT=75,000 LBS
MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—CAMBERED WING

ENGINE: J57-P-10



P-28271-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

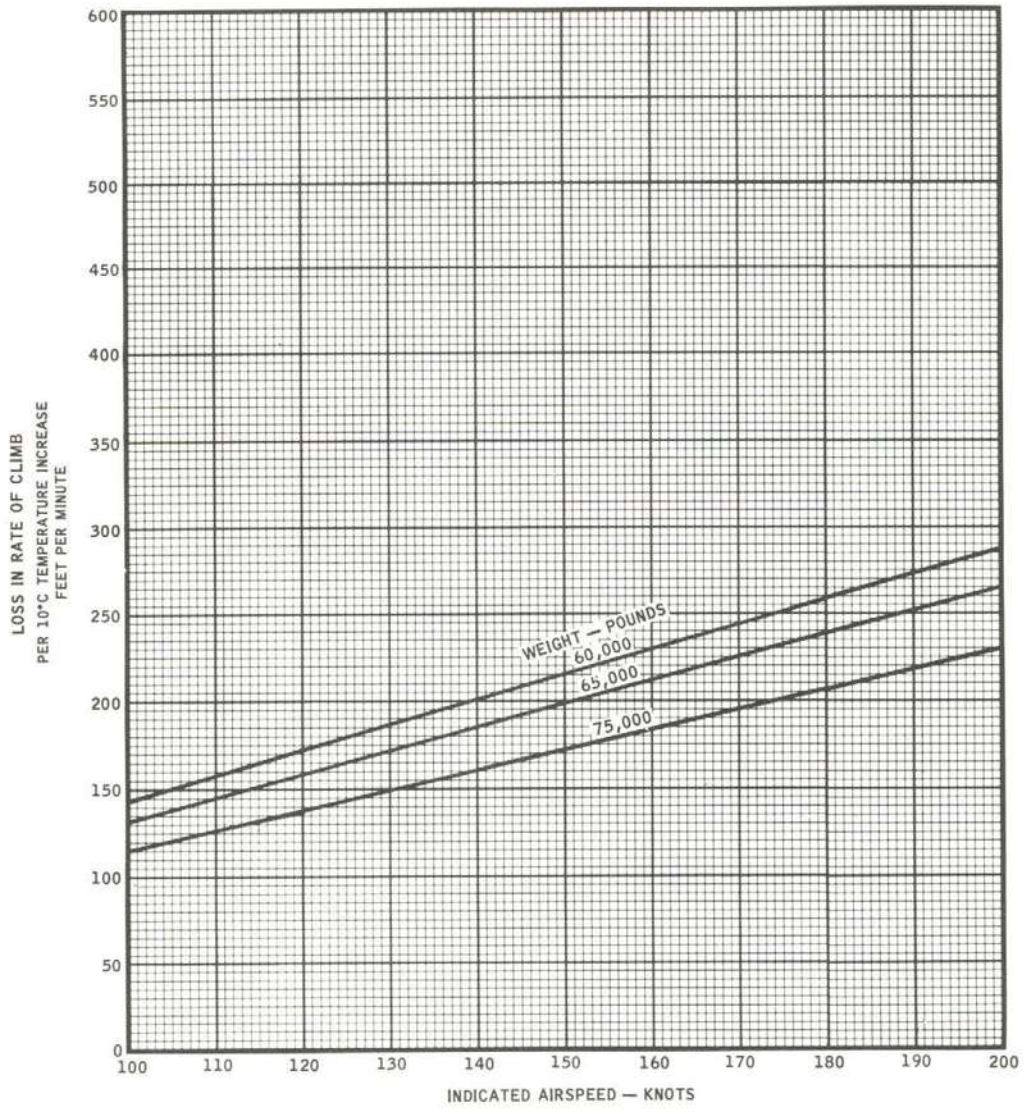
Figure B-16. One-Engine Rate-of-Climb – 75,000 Pounds (Sheet 4)

ONE ENGINE

TEMPERATURE EFFECT ON RATE OF CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B— CAMBERED WING **ENGINE:** J57-P-10



P-28272-1

REMARKS:

EXAMPLE:
See text.

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

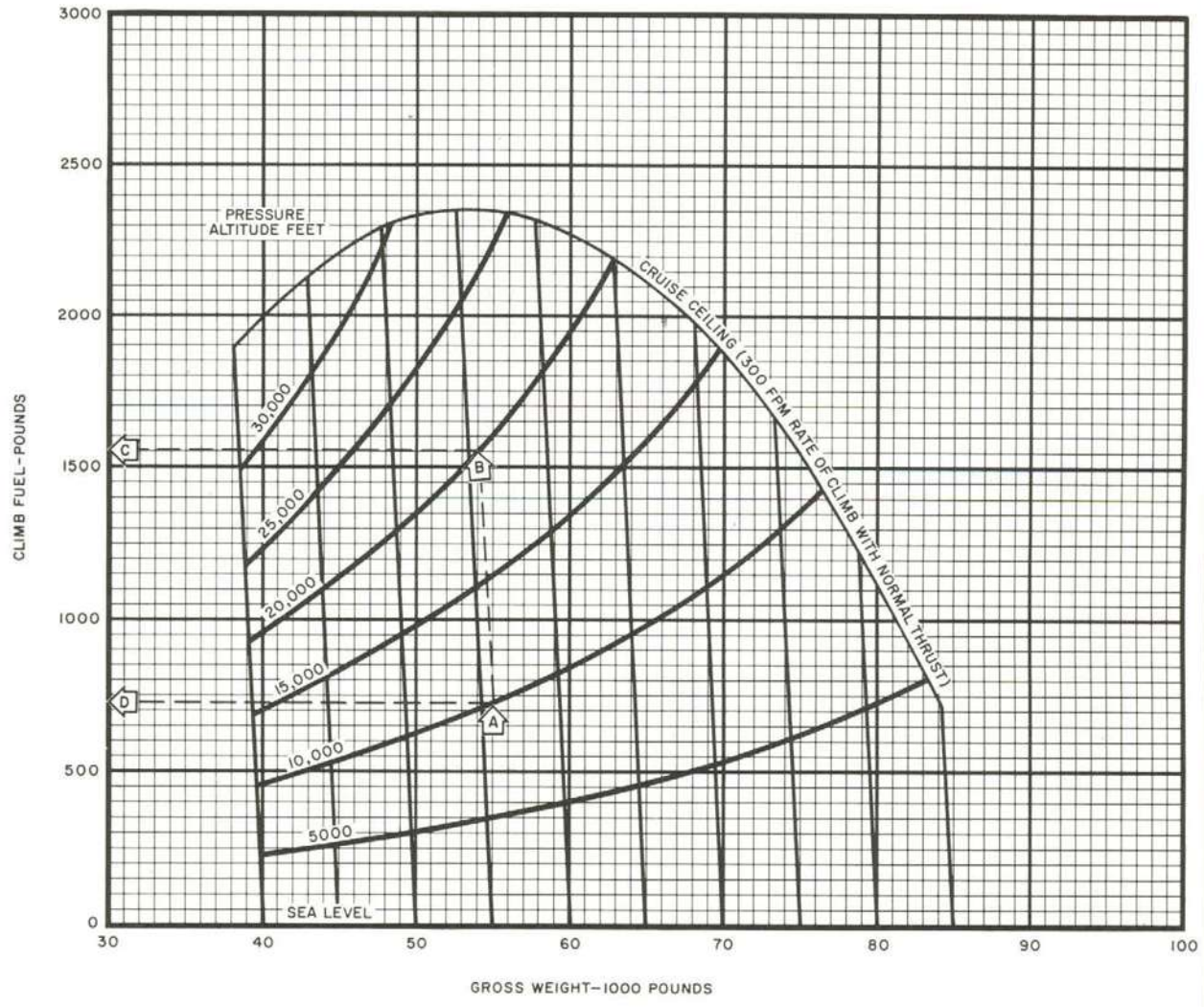
Figure B-17. Temperature Effect on One-Engine Rate-of-Climb

ONE ENGINE OPERATION

FUEL CONSUMED DURING CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B – **CAMBERED WING** **ENGINES:** J57-P-10



REMARKS:

(1) Inoperative engine windmilling.

(2) Climb speed is 270 knots CAS at sea level, decreasing 2 knots per 1000 feet increase in altitude.

(3) The effect on climb fuel of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to the actual gross weight to enter the chart.

EXAMPLE:

If the gross weight is 55,000 pounds at 10,000 feet (A) and a climb is made to 20,000 feet (B), the fuel consumed is 1550 pounds (C) minus 725 pounds (D) or 825 pounds.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

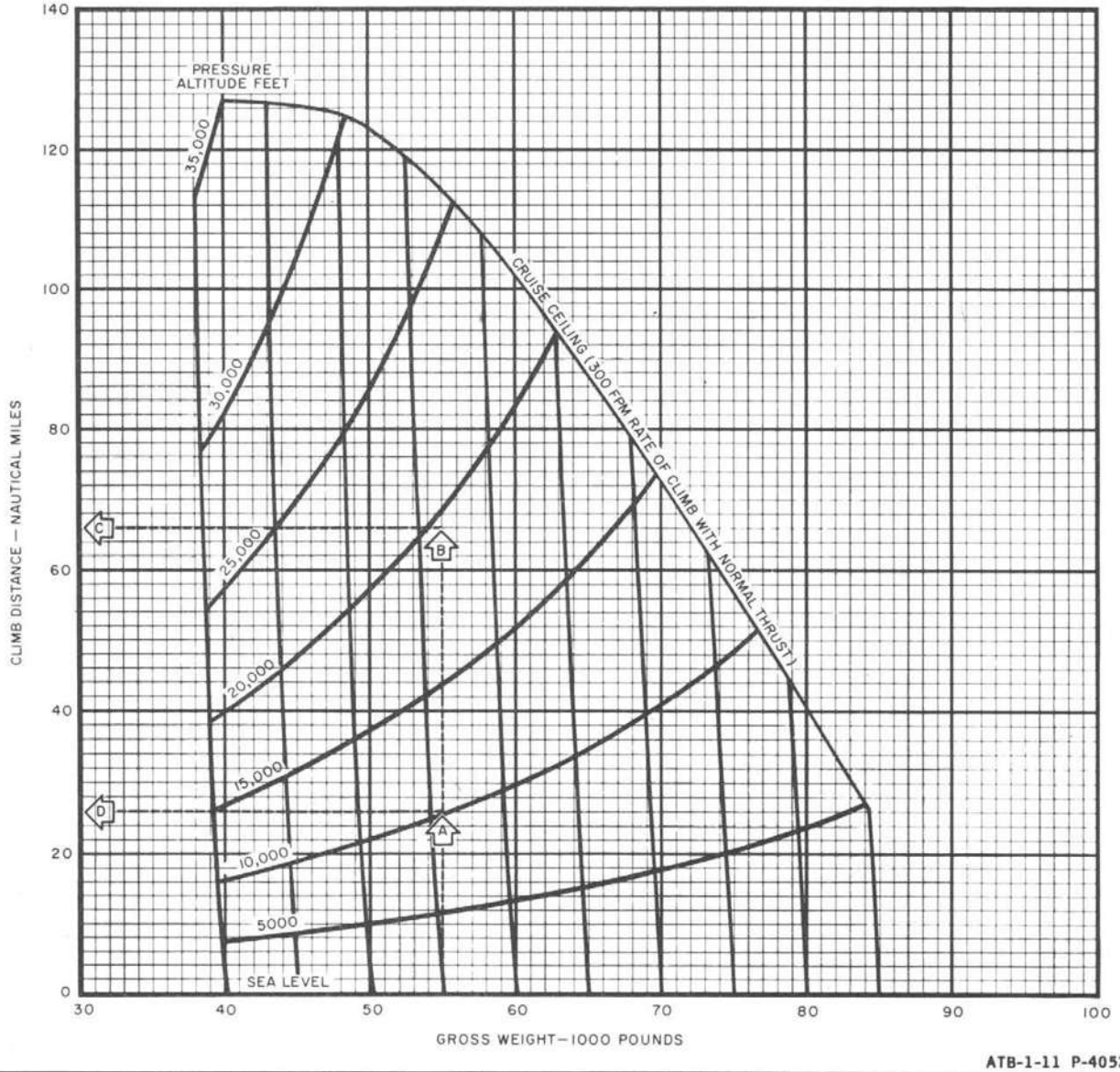
Figure B-18. Fuel Consumed During Climb

ONE ENGINE OPERATION

CLIMB DISTANCE

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B– **CAMBERED WING** **ENGINES:** J57-P-10



ATB-1-11 P-40527-1

REMARKS:

(1) Inoperative engine windmilling.

(2) Climb speed is 270 knots CAS at sea level, decreasing 2 knots per 1000 feet increase in altitude.

(3) The effect on climb distance of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to the actual gross weight to enter the chart.

EXAMPLE:

If the gross weight is 55,000 pounds at 10,000 feet (A) and a climb is made to 20,000 feet (B), the distance covered is 66 nautical miles (C) minus 26 nautical miles (D) or 40 nautical miles.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

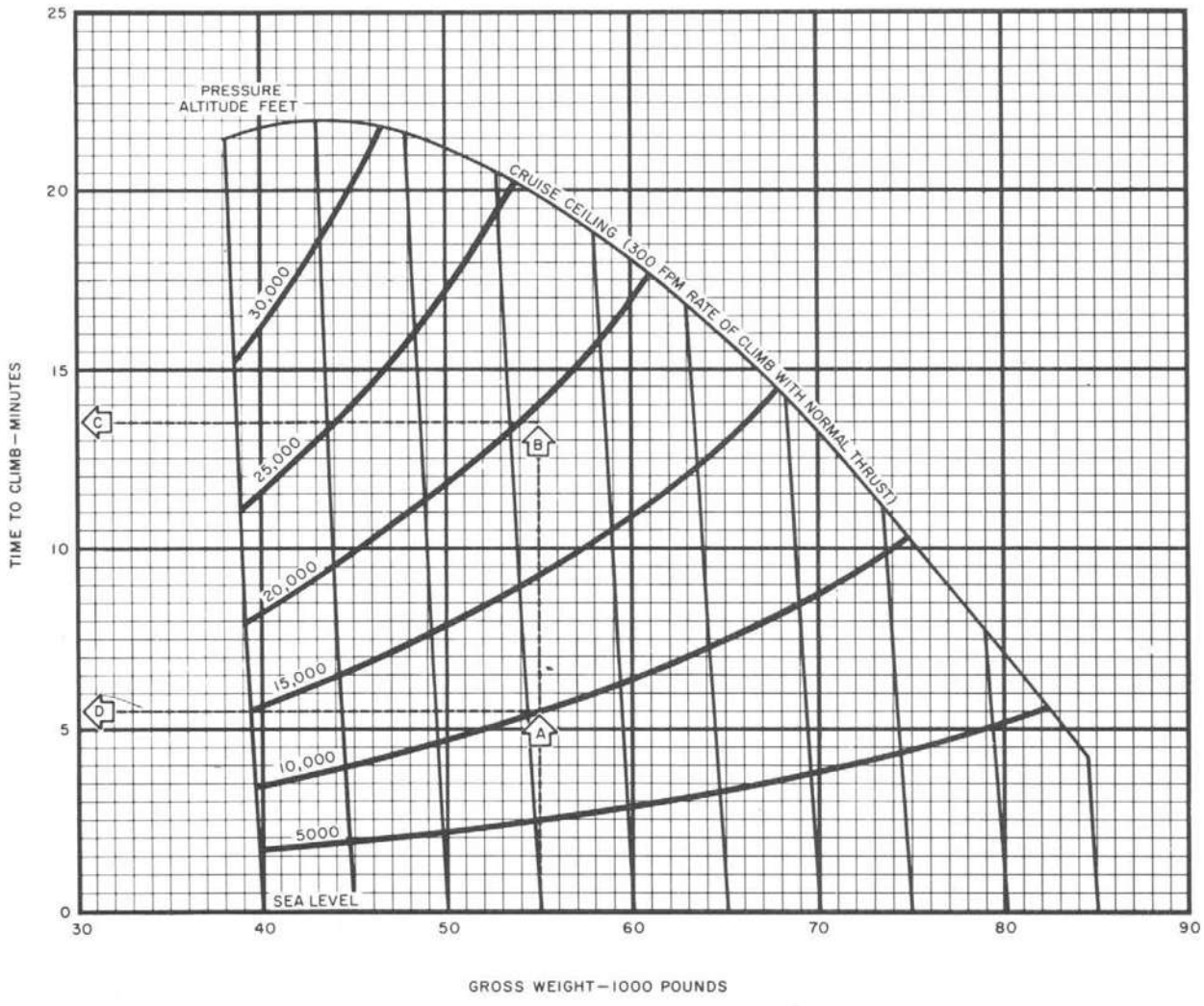
Figure B-19. Climb Distance

ONE ENGINE OPERATION

TIME TO CLIMB

MILITARY THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



ATB-1-11 P-40528-1

REMARKS:

(1) Inoperative engine windmilling.

(2) Climb speed is 270 knots CAS at sea level, decreasing 2 knots per 1000 feet increase in altitude.

(3) The effect on time to climb of non-standard temperatures can be accounted for as follows:

For each 10°C increase in temperature above standard, add 5000 pounds to the actual gross weight to enter chart.

EXAMPLE:

If the gross weight is 55,000 pounds at 10,000 feet (A) and a climb is made to 20,000 feet (B), the time to climb is 13.5 minutes (C) minus 5.5 minutes (D) or 8.0 minutes.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-20. Time to Climb

PART 4B

RANGE

RANGE CHARTS

Range data for RA-3B cambered wing aircraft are presented as follows:

1. Fouled Deck Range ("Bingo Cards"), figures B-21 through B-27)

2. Maximum Specific Range vs altitude (figure B-28)

3. Specific Range (figures B-29 and B-30).

These range data are presented for the aircraft in the clean configuration and are representative of the cruise performance which may be obtained during normal service operation. All data are given for an ICAO standard day.

At a given altitude and gross weight, the maximum range of the aircraft is obtained at the recommended airspeed for maximum range. This airspeed should be primarily established by Mach number (or CAS since Mach number and CAS are directly related at a given altitude). If desirable at altitudes of 40, 000 ft and below, penalties in the range of the aircraft may be tolerated by increasing the recommended cruise speed such that the range penalty is no greater than one percent. This increase in cruise speed will result in significant reductions in elapsed time.

Note

The characteristics of the J57 engine are such that engine rpm cannot be used for cruise control. However, as an aid in establishing proper cruise control, engine pressure ratio and engine fuel flow data are provided.

A description of three types of range presentation follows.

FOULED DECK RANGE ("BINGO CARDS")

The Fouled Deck Range Charts (figures B-21 through B-24 for two-engine operation and figures B-25, through B-27 for one-engine operation) are provided to indicate the available range, for low values of fuel remaining, at optimum cruise altitudes. Both VFR and IFR charts are included for one-engine and two-engine operation with the flaps and gear retracted. Also included, for two-engine operation, are VFR charts for gear down and gear and flaps down (full flaps). A one-engine sea level fouled deck range chart is also included.

Fuel allowances of 300 pounds for two-engine operation and 200 pounds for one-engine operation are included for raising the gear and flaps (where applicable), making a turn and accelerating to climb speed. A 3000-pound reserve fuel allowance is included at the point where descent is commenced for the VFR charts and at the approach fix for the IFR charts. The charts are based on a basic aircraft weight of 43,000 pounds with a percentage correction factor for additional fuel required at heavier basic weights. Climb, cruise, and let down speeds are provided together with the let down time, fuel required, and distances where applicable.

Figures are for a no-wind standard day. Add one percent for each 5 knots of head wind for rough calculations.

MAXIMUM SPECIFIC RANGE vs ALTITUDE

The maximum specific range characteristics are summarized for two-engine and one-engine operation in Figure B-28. These data present the specific range as a function of altitude and gross weight that is attainable at the recommended speed for maximum range. Cruise Mach numbers corresponding to the recommended airspeed for maximum specific range are superimposed on these plots together with the corresponding fuel flow. Cruise ceilings are indicated for both two-engine and one-engine operation. The optimum cruise altitude is provided for two-engine operation.

SPECIFIC RANGE

The specific range charts, Figure B-29, for two-engine operation and Figure B-30 for one-engine operation, present the nautical miles per pound of fuel, or specific range, as a function of Mach number for every 5000 ft of altitude from sea level to 45, 000 ft for two-engine operation and 30, 000 ft for one-engine operation. The recommended airspeed for maximum range is indicated on each of the charts. The Mach number corresponding to this speed should be used as the primary indication of proper cruise control. In

addition, lines of fuel flow and engine pressure ratio are superimposed to provide additional checks on proper cruise control. At low power settings, the intercompressor bleed valves on the J57 engine are scheduled to open. This results in an increase in the fuel consumption at these power settings which in turn reduces the nautical miles per pound of fuel. Therefore, at the lower altitudes the specific range curves are presented to include this effect. The scheduled opening of these valves will vary from engine to engine and, therefore, the data in Figure B-29 should be considered approximate. For flight planning purposes, however, it is recommended that these data be used to predict the cruise characteristics for these conditions. The specific range data are provided for speeds between the recommended speed for maximum endurance and maximum speed with maximum thrust. The specific range data obtained from these charts can be used for all ambient air temperatures as long as the specific range is determined for a given Mach number or CAS. The corresponding TAS, however, for nonstandard conditions will have to be obtained from figure B-1. Subscales on each chart show the relationship between Mach number and TAS for standard day conditions only. The relationship between Mach number and CAS is also provided and is independent of ambient conditions.

EXAMPLE. A request is received to escort another aircraft which is returning from a mission at 20,000 feet pressure altitude of 300 knots CAS. If initial gross weight is 60,000 pounds, including 10,000 pounds of available cruise fuel after allowances for descent and/or reserve, determine range available and fuel consumption with no wind.

1. Enter 20,000 foot specific range (nautical miles per 1000 pounds of fuel) chart for two engines operating (figure B-29) at 300 knots CAS. At 60,000 pounds initial cruising gross weight, specific range is 77.5 nautical miles per 1000 pounds of fuel. At final cruising gross weight,

$$60,000 - 10,000 = 50,000 \text{ pounds.}$$

The specific range is 82.4 nautical miles per 1000 pounds of fuel.

2. Specific range during cruise, based on average gross weight of 55,000 pounds, is 80 nautical miles per 1000 pounds of fuel. By multiplying this number by available cruise fuel in thousands of pounds, range is:

$$80 \times \frac{10,000}{1000} = 800 \text{ nautical miles.}$$

3. Initial fuel flow at 20,000 feet (at 60,000 pounds) is approximately 2600 pounds per hour per engine multiplied by two, or 5200 pounds per hour. During cruise, fuel flow will decrease due to decreasing gross weight, and at end of flight fuel flow will be approximately:

$$2 \times 2400 = 4800 \text{ pounds per hour}$$

4. True airspeed (also ground speed in this example) and Mach number are 400 knots and 0.65 respectively.

5. When large amounts of cruise fuel are considered, or when range is critical, greater accuracy may be obtained by computing range in steps using above procedure. Degree of accuracy will depend on number of incremental values of fuel weight used.

For purpose of determining whether operation on one engine would provide better maximum range performance, follow same procedure through specific range chart for one-engine operation, as follows:

1. Enter 20,000 foot specific range (nautical miles per 1000 pounds of fuel) chart for one-engine operation (figure B-30) at 300 knots CAS. At 60,000 pounds initial cruising gross weight, specific range is 73.8 nautical miles per 1000 pounds of fuel. At final cruising gross weight (50,000 pounds), specific range is 78.8 nautical miles per 1000 pounds of fuel.

2. Specific range during cruise, based on average gross weight of 55,000 pounds, is 76.4 nautical miles per 1000 pounds of fuel. By multiplying this number by available cruise fuel in thousands of pounds, range is:

$$76.4 \times \frac{10,000}{1000} = 764 \text{ nautical miles}$$

3. Comparison of one-engine specific range with that obtainable during two-engine operation reveals a disadvantage in proceeding with one engine shut down. For this reason, two-engine operation should be used for this particular flight.

TWO-ENGINE OPERATION
FOULED DECK RANGE (VFR)

MODEL: RA-3B – CAMBERED WING

ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	3790	10	1	645	8	1	145	6	3020	331	7	190	26	9
60	3970	15	2	810	12	1	160	8	2540	308	11	276	40	14
80	4120	20	3	980	17	1	140	7	2170	248	15	350	56	19
100	4225	25	4	985	17	2	150	10	1820	248	19	425	73	25
120	4370	30	5	1320	30	0	50	0	1700	241	23	495	90	28
140	4555	30	5	1325	31	3	230	20	1700	241	23	495	90	31
160	4645	35	6	1490	40	2	155	12	1680	245	26	560	108	34
180	4770	40	8	1690	51	0	80	3	1640	225	30	630	126	38
200	4930	40	8	1690	51	3	240	23	1640	225	30	630	126	41
220	5035	45	10	1950	71	0	85	3	1630	205	34	695	146	44
240	5185	45	10	1955	71	3	230	23	1630	205	34	695	146	47
260	5345	45	10	1960	71	6	385	43	1630	205	34	695	146	50
280	5505	45	10	1970	72	9	535	62	1640	205	34	695	146	53
300	5655	45	10	1970	72	11	685	82	1640	205	34	695	146	55
320	5810	45	11	1980	73	14	830	102	1640	205	34	695	146	59
340	5980	45	11	2000	73	17	980	121	1660	205	34	695	146	61
360	6135	45	11	2005	74	19	1130	140	1660	205	34	695	146	62
380	6295	45	11	2010	74	22	1285	160	1660	205	34	695	146	67
400	6445	45	11	2015	75	25	1430	179	1660	205	34	695	146	70

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SPEED IS 376 KNOTS CAS AT SEA LEVEL DECREASING 35 KNOTS PER 10,000 FEET ALTITUDE TO 36,000 FEET. CLIMB AT M = .75 ABOVE 36,000 FEET.
4. IDLE DESCENT TO SEA LEVEL AT 200 KNOTS CAS.
5. BASIC AIRCRAFT WEIGHT IS 43,000 POUNDS.
6. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT, INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964
DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

Figure B-21. Fouled Deck Range – Two-Engine VFR

TWO-ENGINE OPERATION
FOULED DECK RANGE (IFR)

MODEL: RA-3B – CAMBERED WING

ENGINES: J57-P-10

			CLIMB			CRUISE					
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	TOTAL ETE
40	4220	5	1	480	3	6	790	37	3550	359	7
60	4510	15	2	820	13	7	635	47	2540	308	9
80	4780	20	3	990	18	10	635	63	2150	280	13
100	4990	25	4	1160	24	13	830	76	1820	248	17
120	5195	30	5	1340	31	14	855	89	1700	242	19
140	5375	30	5	1340	32	17	1035	109	1710	242	22
160	5550	35	6	1520	41	17	1030	119	1690	242	23
180	5720	35	6	1525	41	20	1195	139	1690	242	26
200	5890	35	6	1535	41	23	1355	158	1690	242	29
220	6065	35	6	1540	42	26	1525	179	1700	242	32
240	6245	40	8	1740	54	26	1505	186	1650	225	34
260	6405	40	8	1745	54	29	1665	206	1650	225	37
280	6575	40	8	1755	54	31	1820	226	1660	225	39
300	6730	40	8	1760	54	34	1970	246	1660	225	42
320	6880	40	8	1765	54	37	2125	266	1660	225	45
340	6995	40	8	1770	55	40	2280	285	1660	225	48
360	7220	40	8	1780	55	42	2440	305	1670	225	50
380	7360	40	8	1785	56	45	2575	321	1680	226	53
400	7540	40	8	1795	56	48	2775	343	1680	226	56

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR CLEANUP, TURN, AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT APPROACH FIX. NO WIND CONDITIONS.
3. CLIMB SPEED IS 376 KNOTS CAS AT SEA LEVEL DECREASING 35 KNOTS PER 10,000 FEET ALTITUDE TO 36,000 FEET. CLIMB AT M = .75 ABOVE 36,000 FEET.
4. BASIC AIRCRAFT WEIGHT IS 43,000 POUNDS.
5. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT, INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964
DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

Figure B-22. Fouled Deck Range – Two-Engine IFR

FOULED DECK RANGE (VFR) GEAR DOWN

MODEL: RA-3B – CAMBERED WING

ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	4165	10	2	780	7	4	385	15	2500	200	2	165	18	8
60	4410	20	4	1270	18	1	140	4	2240	191	5	300	38	10
80	4660	25	6	1530	26	1	130	5	2175	187	6	360	49	13
100	4945	30	8	1820	36	1	125	4	2155	185	9	420	60	18
120	5260	30	8	1840	36	5	420	24	2160	185	9	420	60	22
140	5480	35	11	2180	51	3	300	17	2235	189	12	480	72	26
160	5775	35	11	2200	51	7	575	37	2245	189	12	480	72	30
180	6060	35	11	2220	52	10	840	56	2250	189	12	480	72	33
200	6355	35	11	2235	52	14	1120	76	2260	189	12	480	72	37
220	6660	35	11	2255	53	17	1405	95	2270	189	12	480	72	40
240	6930	35	11	2275	54	21	1655	114	2275	189	12	480	72	44
260	7245	35	11	2290	54	24	1955	134	2285	189	12	480	72	47
280	7530	35	12	2300	55	28	2230	153	2300	189	12	480	72	52
300	7825	35	12	2320	55	31	2505	173	2305	189	12	480	72	55
320	8115	35	12	2340	56	35	2775	192	2315	189	12	480	72	59
340	8420	35	12	2360	57	38	3060	211	2320	189	12	480	72	62
360	8125	35	12	2380	57	42	3345	231	2325	189	12	480	72	66
380	9040	35	12	2400	58	45	3640	250	2335	190	12	480	72	69
400	9355	35	12	2420	58	49	3935	270	2345	190	12	480	72	73

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SPEED IS 225 KNOTS CAS TO 5000 FEET DECREASING 12 KNOTS PER 10,000 FEET ABOVE 5000 FEET.
4. IDLE DESCENT TO SEA LEVEL AT 158 KNOTS CAS.
5. BASIC AIRCRAFT WEIGHT IS 43,000 POUNDS.
6. FOR EACH 1000-POUND INCREASE IN BASIC AIRCRAFT WEIGHT, INCREASE THE FUEL REQUIRED BY 1.1 PERCENT.

DATA AS OF: 1 MARCH 1964
DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

Figure B-23. Fouled Deck Range – Gear Down

TWO-ENGINE OPERATION
GEAR AND FLAPS DOWN
FOULED DECK RANGE (VFR)

MODEL: RA-3B – CAMBERED WING

ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	4495	15	4	1290	13	2	205	6	2845	159	9	230	21	15
60	5005	20	6	1660	20	3	345	11	2800	159	12	290	29	21
80	5420	25	9	2020	30	4	400	14	2810	158	15	350	36	28
100	5900	30	13	2580	44	3	320	12	2845	158	17	400	44	33
120	6375	30	13	2625	45	7	750	31	2865	158	17	400	44	37
140	6865	30	13	2665	46	12	1200	50	2880	159	17	400	44	42
160	7340	30	14	2710	47	16	1630	69	2895	159	17	400	44	47
180	7835	30	14	2770	48	20	2065	88	2915	160	17	400	44	51
200	8320	30	14	2810	49	25	2310	107	2935	160	17	400	44	56
220	8805	30	14	2840	50	29	2965	126	2940	161	17	400	44	60
240	9300	30	15	2900	52	33	3300	144	2960	161	17	400	44	65
260	9790	30	15	2940	53	37	3850	163	2975	161	17	400	44	69
280	10335	30	15	3010	53	42	4325	183	2990	162	17	400	44	74
300	10820	30	16	3060	55	46	4760	201	3010	162	17	400	44	79
320	11345	30	16	3120	56	51	5225	220	3025	163	17	400	44	84
340	11865	30	16	3190	57	55	5675	239	3045	163	17	400	44	88
360	12380	30	17	3250	59	59	6130	257	3060	164	17	400	44	93
380	12905	30	17	3300	60	63	6605	276	3075	165	17	400	44	97
400	13430	30	18	3380	62	67	7050	294	3095	166	17	400	44	102

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT AT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SPEED IS 180 KNOTS CAS AT SEA LEVEL DECREASING 12 KNOTS PER 10,000 FEET ALTITUDE.
4. IDLE DESCENT TO SEA LEVEL AT 122 KNOTS CAS.
5. BASIC AIRCRAFT WEIGHT IS 43,000 POUNDS.
6. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT, INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964
DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

Figure B-24. Fouled Deck Range – Gear and Flaps Down

ONE-ENGINE OPERATION

FOULED DECK RANGE (VFR)

MODEL: RA-3B – CAMBERED WING

ENGINES: J57-P-10

			CLIMB			CRUISE					DESCENT			
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	ETE	FUEL	DIST	TOTAL ETE
40	3595	5	2	470	8	1	125	6	3620	237	7	175	26	16
60	3895	5	2	475	8	6	420	26	3620	237	7	175	26	15
80	3925	10	4	740	19	2	185	11	3420	230	13	500	50	19
100	4195	10	4	745	19	7	450	31	3420	230	13	500	50	24
120	4225	15	7	1035	32	3	190	12	3290	225	19	670	76	29
140	4460	15	7	1040	33	7	420	31	3290	225	19	670	76	33
160	4525	20	10	1340	48	2	185	12	3190	220	24	810	100	36
180	4755	20	10	1355	48	6	400	32	3190	220	24	810	100	40
200	4835	25	14	1705	70	1	130	7	3160	219	28	930	123	43
220	5040	25	14	1720	71	5	320	26	3180	219	28	930	123	47
240	5245	25	14	1730	72	8	515	45	3190	219	28	930	123	50
260	5310	30	21	2180	105	1	130	7	3240	219	33	1035	148	55
280	5505	30	21	2200	106	4	305	26	3240	219	33	1035	148	58
300	5700	30	21	2210	107	8	490	45	3250	219	33	1035	148	62
320	5900	30	21	2230	108	11	670	64	3260	219	33	1035	148	65
340	6095	30	21	2240	109	14	855	84	3260	220	33	1035	148	68
360	6285	30	21	2250	110	18	1035	102	3270	220	33	1035	148	72
380	6490	30	22	2275	111	21	1215	121	3280	220	33	1035	148	76
400	6690	30	22	2290	112	24	1400	140	3300	221	33	1035	148	79

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN, AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED. NO WIND CONDITIONS.
3. CLIMB SPEED IS 270 KNOTS CAS AT SEA LEVEL DECREASING 20 KNOTS PER 10,000 FEET ALTITUDE.
4. DESCENT AT 220 KNOTS AT 85 PERCENT RPM.
5. BASIC AIRCRAFT WEIGHT IS 43,000 POUNDS.
6. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT, INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964
DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 LB/GAL

Figure B-25. Fouled Deck Range – One-Engine VFR

ONE-ENGINE OPERATION
FOULED DECK RANGE (IFR)

MODEL: RA-3B – CAMBERED WING

ENGINES: J57-P-10

			CLIMB			CRUISE					
DIST	FUEL REQ	ALT	ETE	FUEL	DIST	ETE	FUEL	DIST	FUEL FLOW LB/HR/ ENG	CAS	TOTAL ETE
40	3875	SL	0	200	0	10	675	40	3820	244	10
60	4195	SL	0	200	0	15	995	60	3830	244	15
80	4505	SL	0	200	0	20	1305	80	3840	244	20
100	4830	5	2	480	9	21	1350	90	3650	237	23
120	5125	5	2	480	9	26	1645	111	3660	238	28
140	5365	10	4	760	20	27	1605	119	3460	232	31
160	5635	15	7	1010	34	27	1505	127	3340	226	34
180	5860	15	7	1075	34	31	1785	145	3360	227	38
200	6105	20	10	1400	50	30	1705	148	3240	221	60
220	6325	20	10	1410	51	34	1315	169	3240	221	61
240	6560	25	14	1800	75	31	1760	166	3250	221	89
260	6760	25	14	1820	75	34	1940	184	3260	221	89
280	6955	30	21	2310	114	28	1645	166	3300	221	135
300	7170	30	21	2335	115	32	1835	186	3310	221	136
320	7370	30	21	2355	116	35	2015	204	3310	221	137
340	7580	30	21	2375	117	38	2205	223	3320	221	138
360	7785	30	21	2390	118	41	2395	242	3330	221	139
380	7995	30	21	2410	119	44	2575	261	3350	222	140
400	8200	30	22	2435	121	48	2765	280	3350	222	143

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT APPROACH FIX, NO WIND CONDITIONS.
3. CLIMB SPEED IS 270 KNOTS CAS AT SEA LEVEL DECREASING 20 KNOTS PER 10,000 FEET ALTITUDE.
4. BASIC AIRCRAFT WEIGHT IS 43,000 POUNDS.
5. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT, INCREASE THE FUEL REQUIRED BY 1 PERCENT.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

FUEL DENSITY: 6.8 LB/GAL

Figure B-26. Fouled Deck Range – One-Engine IFR

ONE-ENGINE OPERATION

SEA LEVEL FOULED DECK RANGE

MODEL: RA-3B – CAMBERED WING ENGINES: J57-P-10

DIST	FUEL REQ	FLOW LBS/HR	CAS	ETE
40	3845	3830	244	10
60	4175	3830	244	15
80	4480	3840	244	20
100	4810	3860	245	25
120	5125	3860	245	29
140	5460	3870	245	34
160	5770	3870	245	39
180	6095	3880	245	44
200	6420	3890	245	49
220	6730	3910	246	54
240	7070	3910	246	59
260	7385	3920	246	63
280	7735	3930	246	68
300	8060	3940	246	73
320	8370	3940	246	78
340	8690	3940	246	83
360	9045	3950	246	88
380	9370	3950	246	93
400	9720	3980	247	98

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN, AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL RESERVE FOR LANDING. NO WIND CONDITIONS.
3. BASIC AIRCRAFT WEIGHT IS 43,000 POUNDS.
4. FOR EACH 1000 POUNDS INCREASE IN BASIC AIRCRAFT WEIGHT, INCREASE THE FUEL REQUIRED BY 0.6 PERCENT.

DATA AS OF: 1 MARCH 1964 FUEL GRADE: JP-5

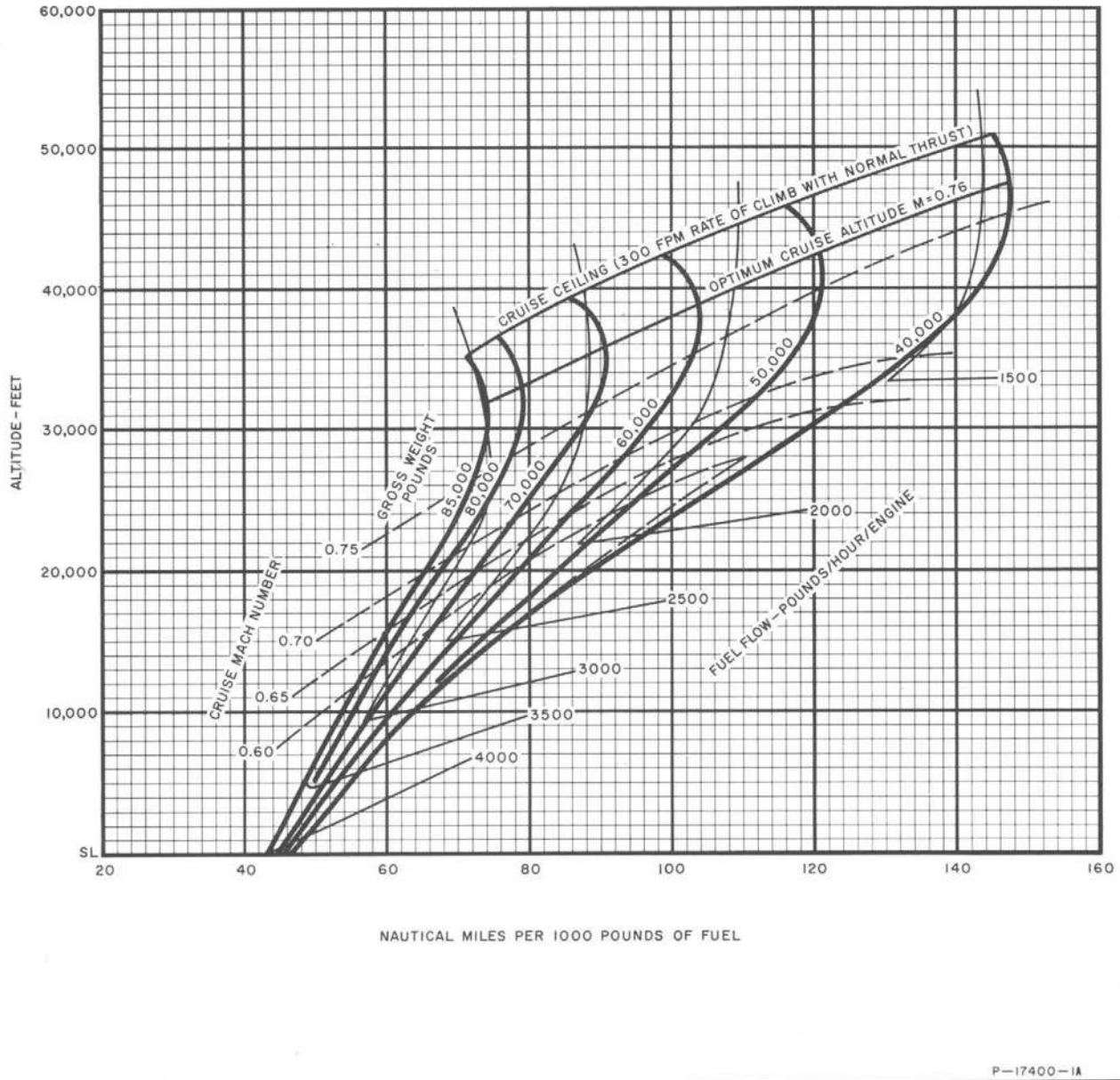
DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS FUEL DENSITY: 6.8 LB/GAL

Figure B-27. Fouled Deck Range – One-Engine, Sea Level

TWO ENGINE OPERATION

MAXIMUM SPECIFIC RANGE VS ALTITUDES

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

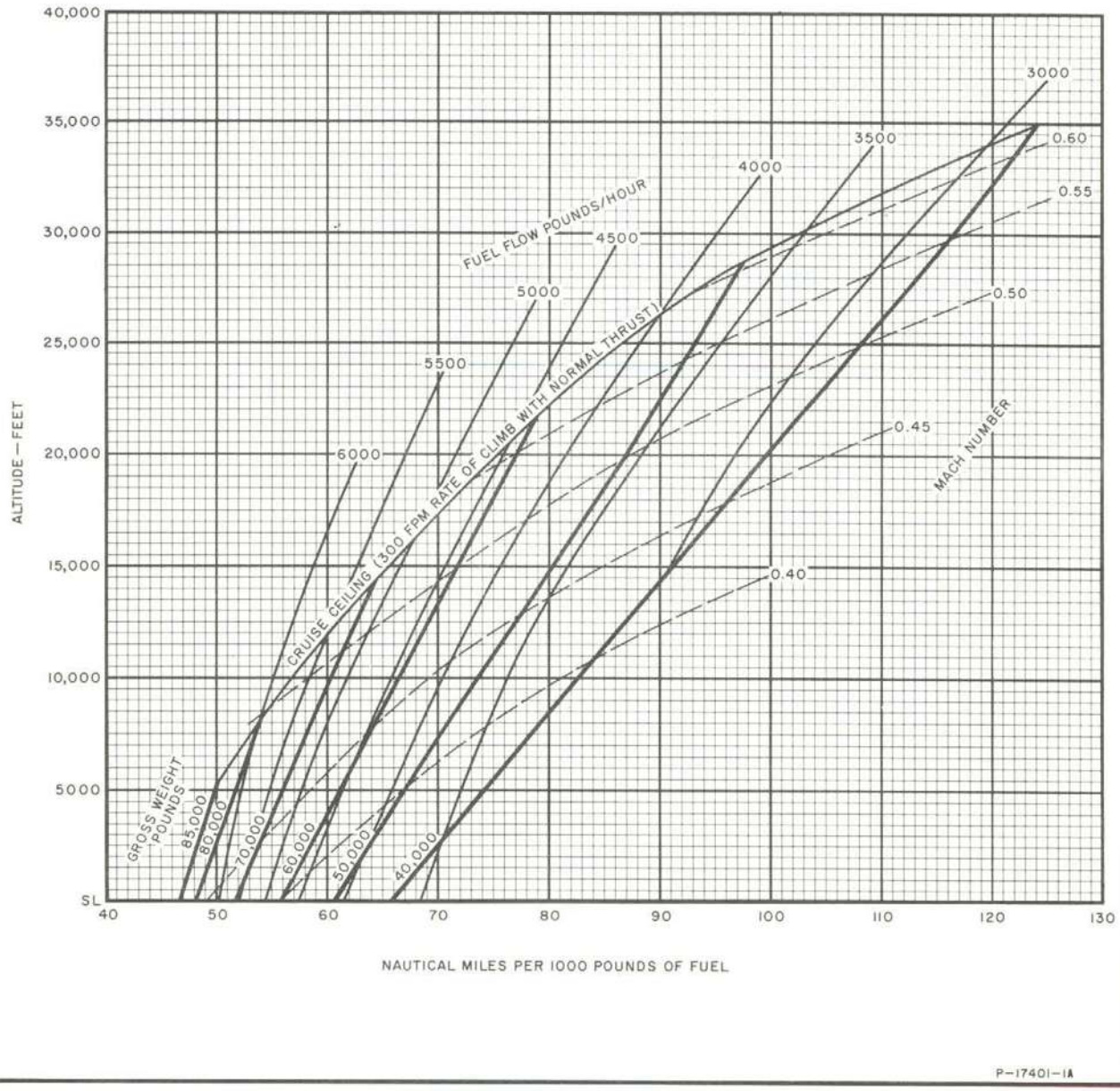
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-28. Maximum Specific Range vs Altitude – Two-Engine (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM SPECIFIC RANGE VS ALTITUDES

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-28. Maximum Specific Range vs Altitude – One-Engine (Sheet 2)

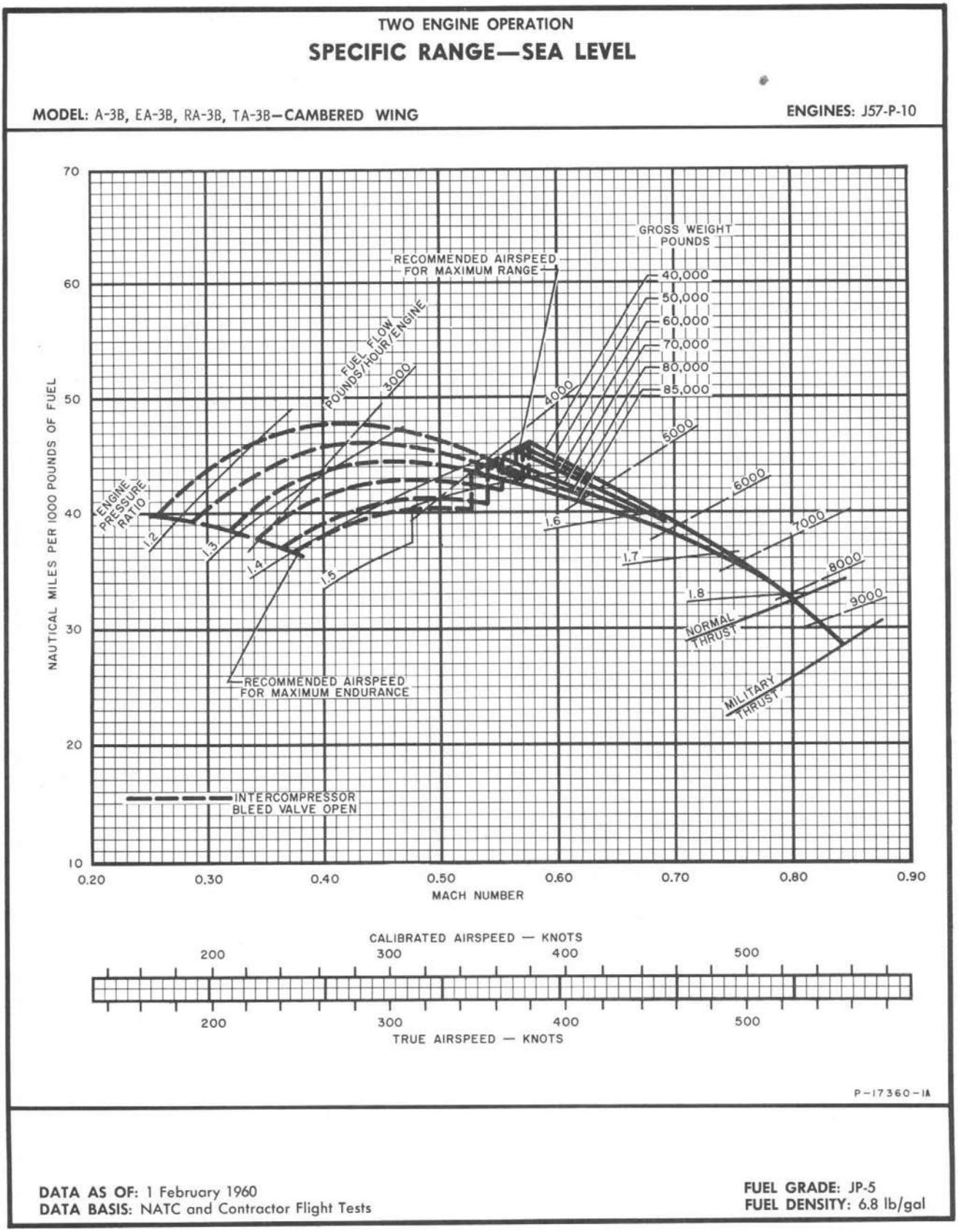
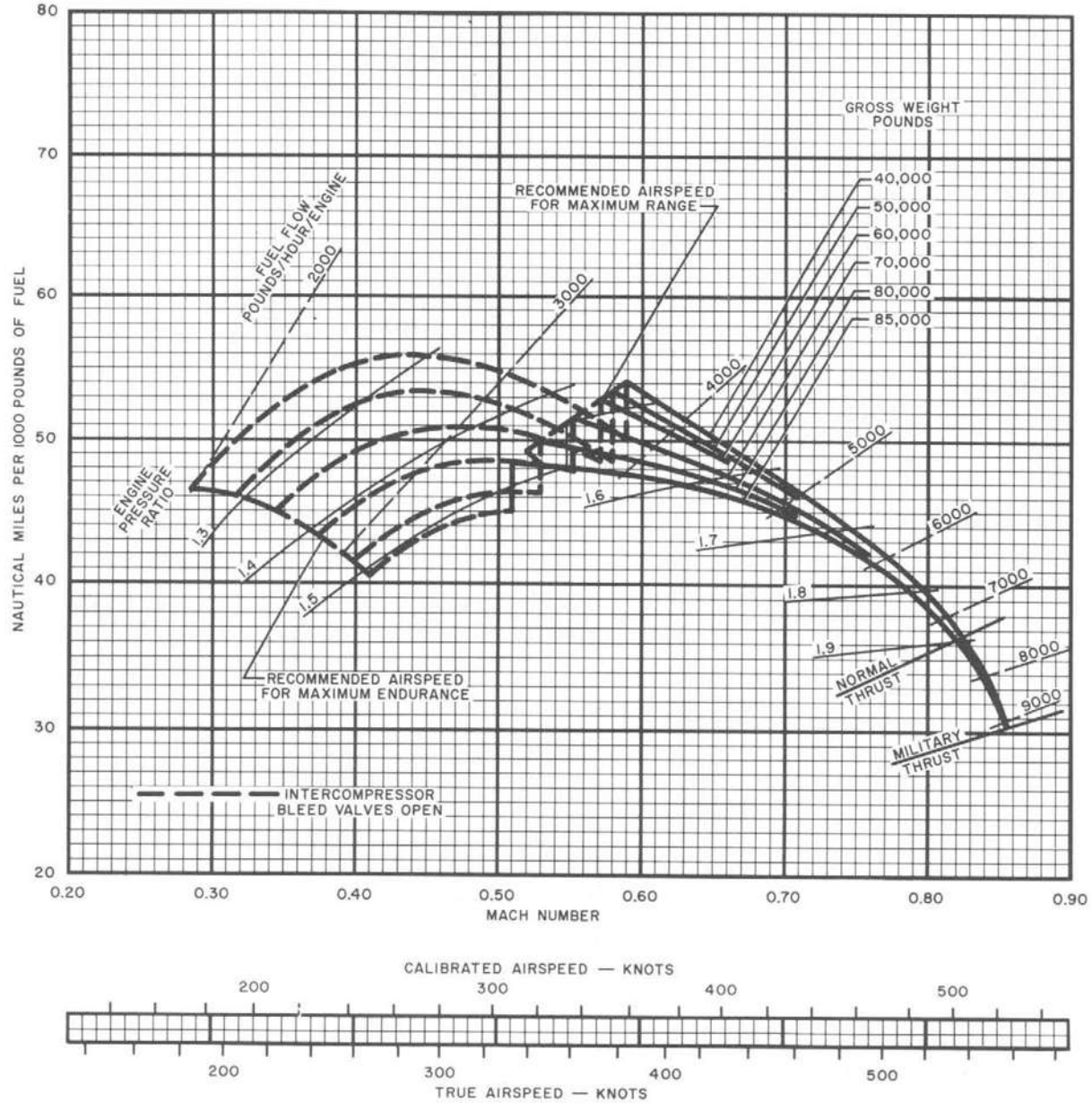


Figure B-29. Specific Range – Sea Level (Sheet 1)

TWO ENGINE OPERATION

SPECIFIC RANGE—5000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-29. Specific Range – 5000 Feet (Sheet 2)

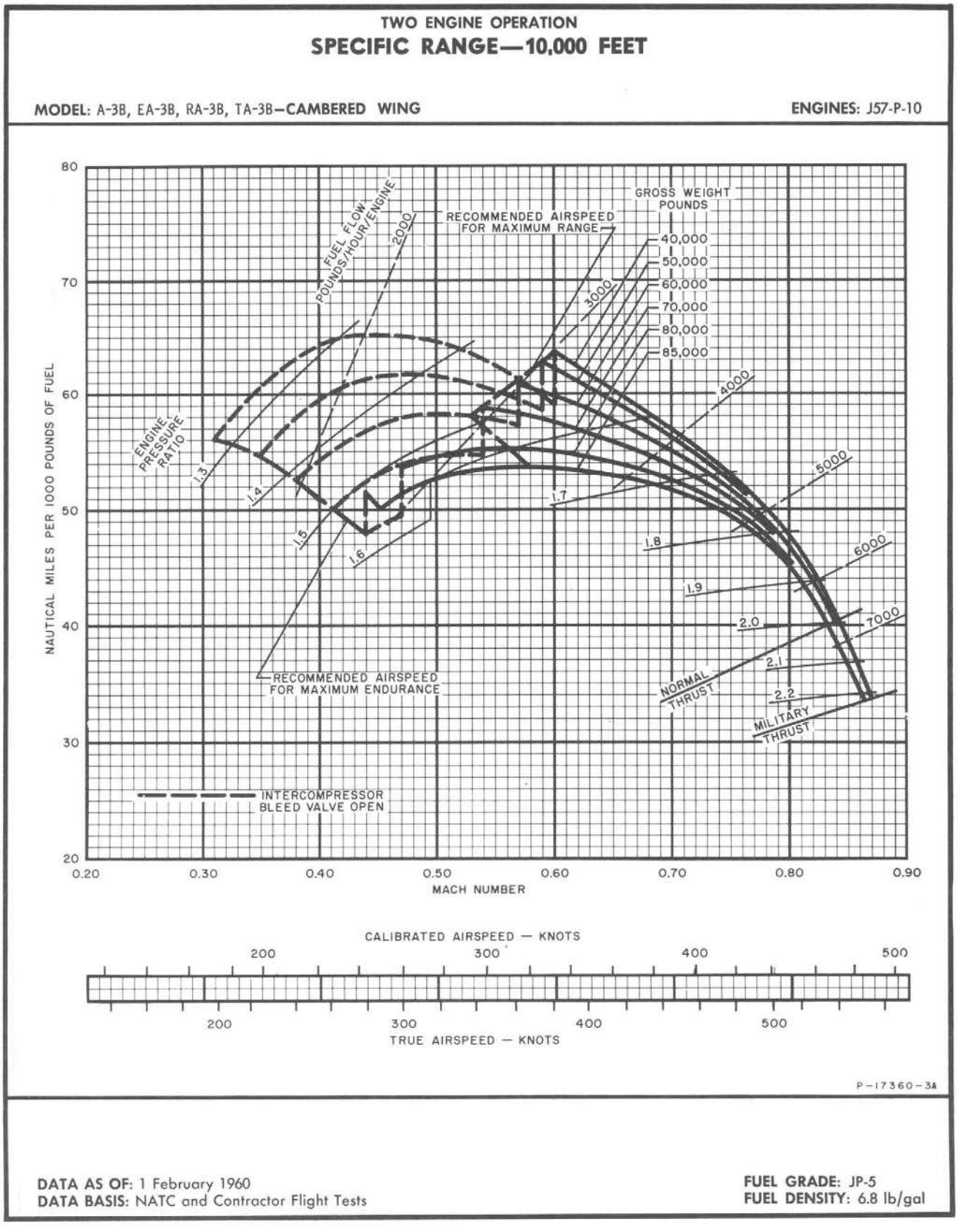


Figure B-29. Specific Range – 10, 000 Feet (Sheet 3)

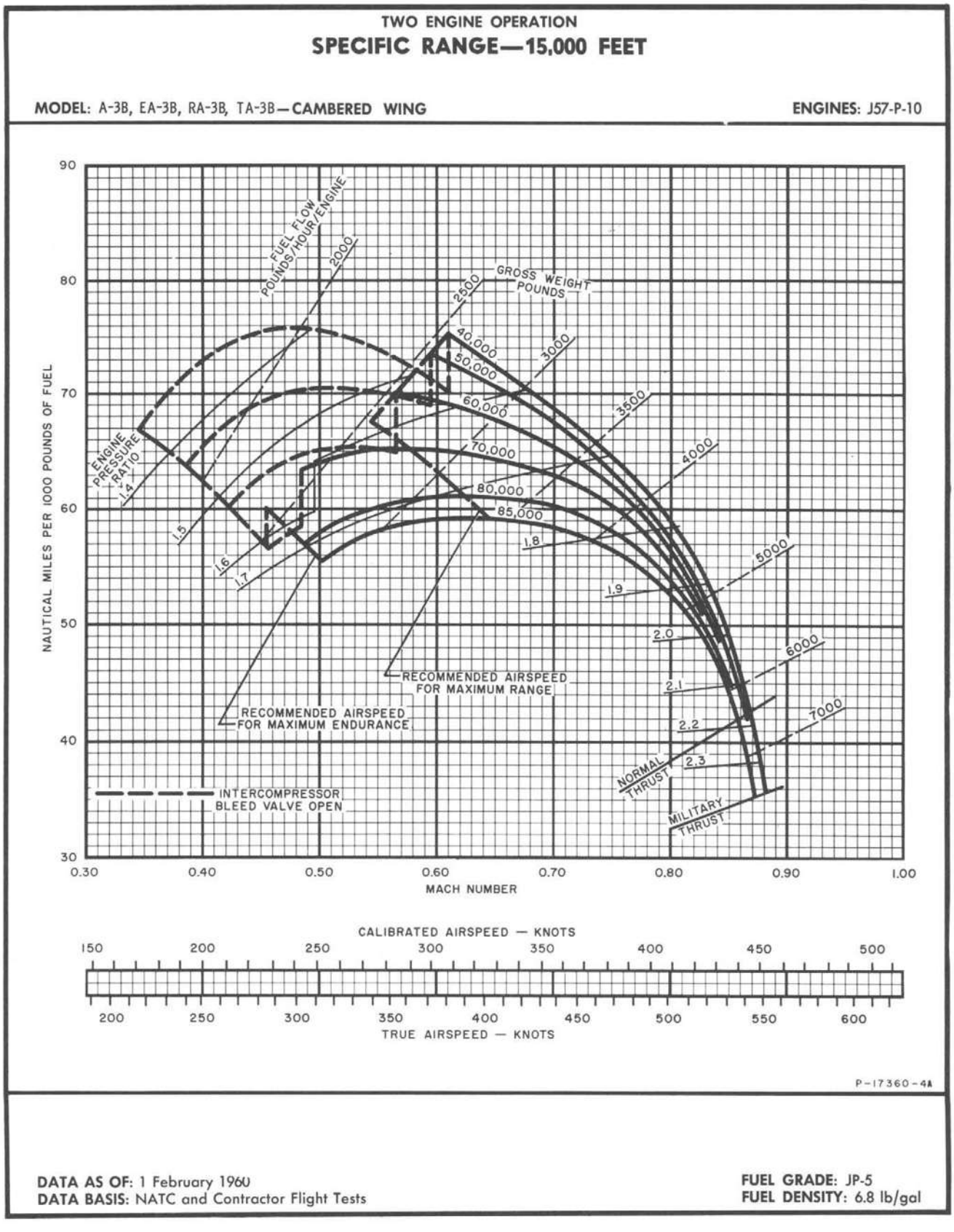


Figure B-29. Specific Range – 15,000 Feet (Sheet 4)

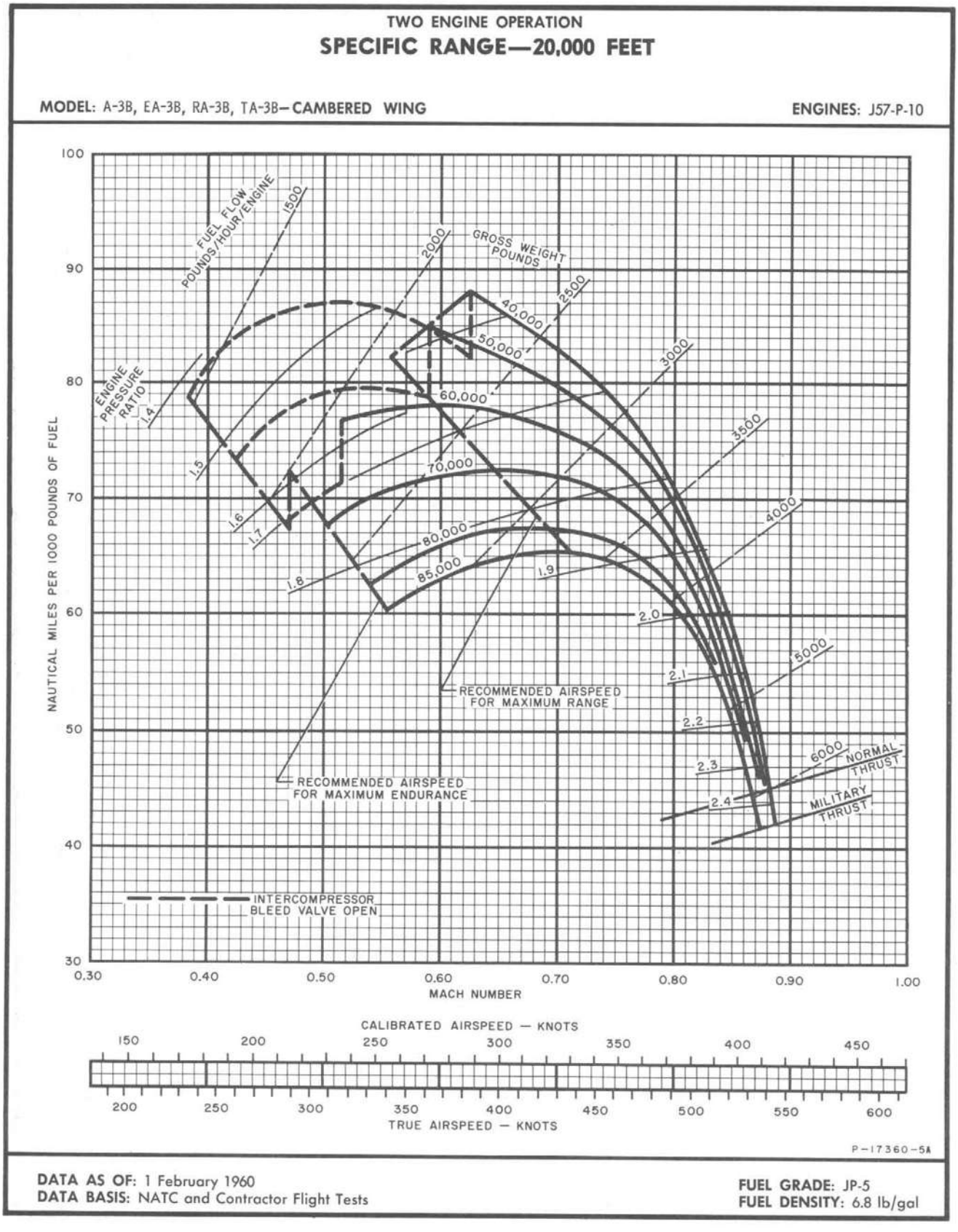
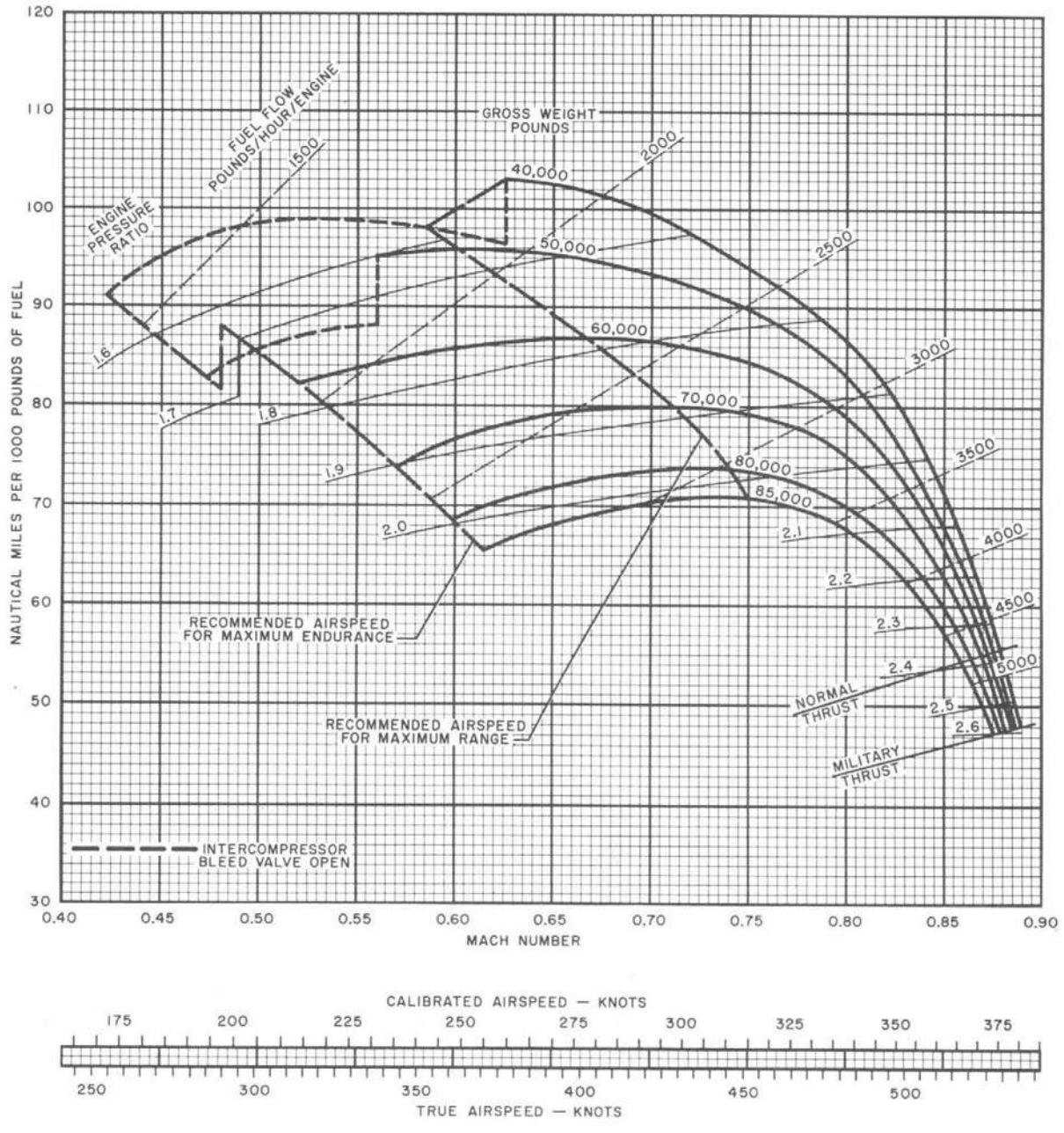


Figure B-29. Specific Range – 20,000 Feet (Sheet 5)

TWO ENGINE OPERATION

SPECIFIC RANGE—25,000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

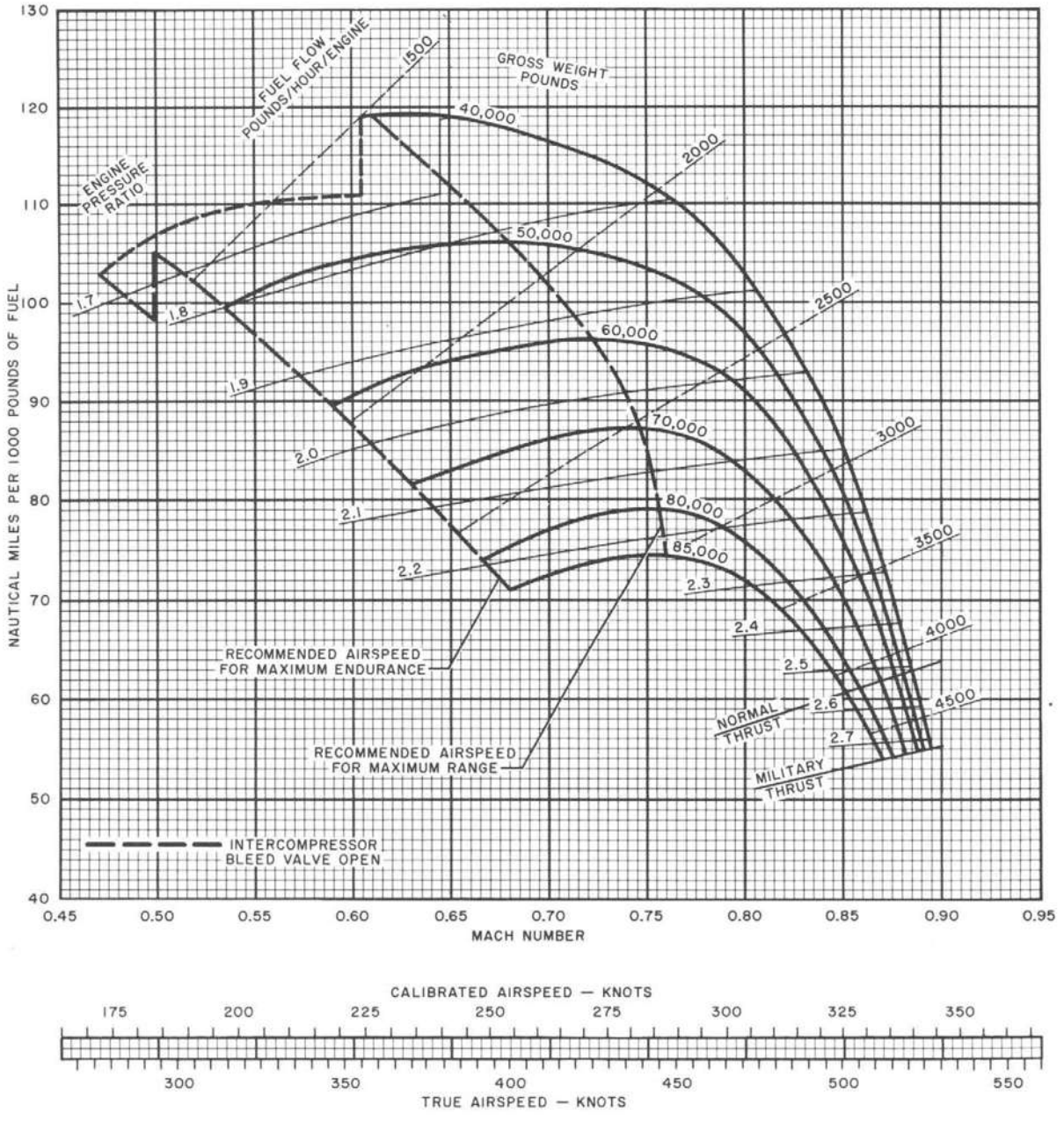
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-29. Specific Range – 25,000 Feet (Sheet 6)

TWO ENGINE OPERATION

SPECIFIC RANGE—30,000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-29. Specific Range – 30,000 Feet (Sheet 7)

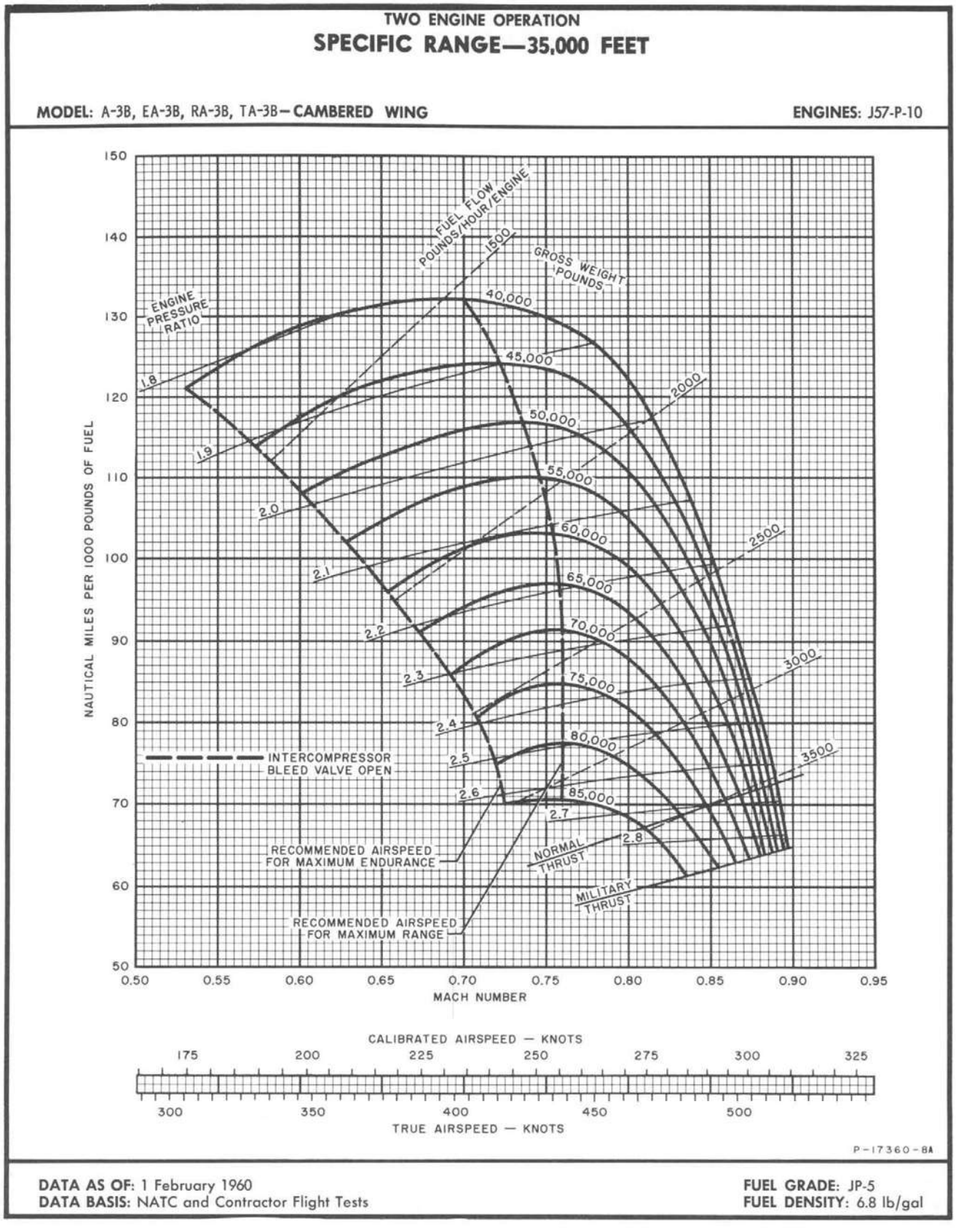


Figure B-29. Specific Range – 35,000 Feet (Sheet 8)

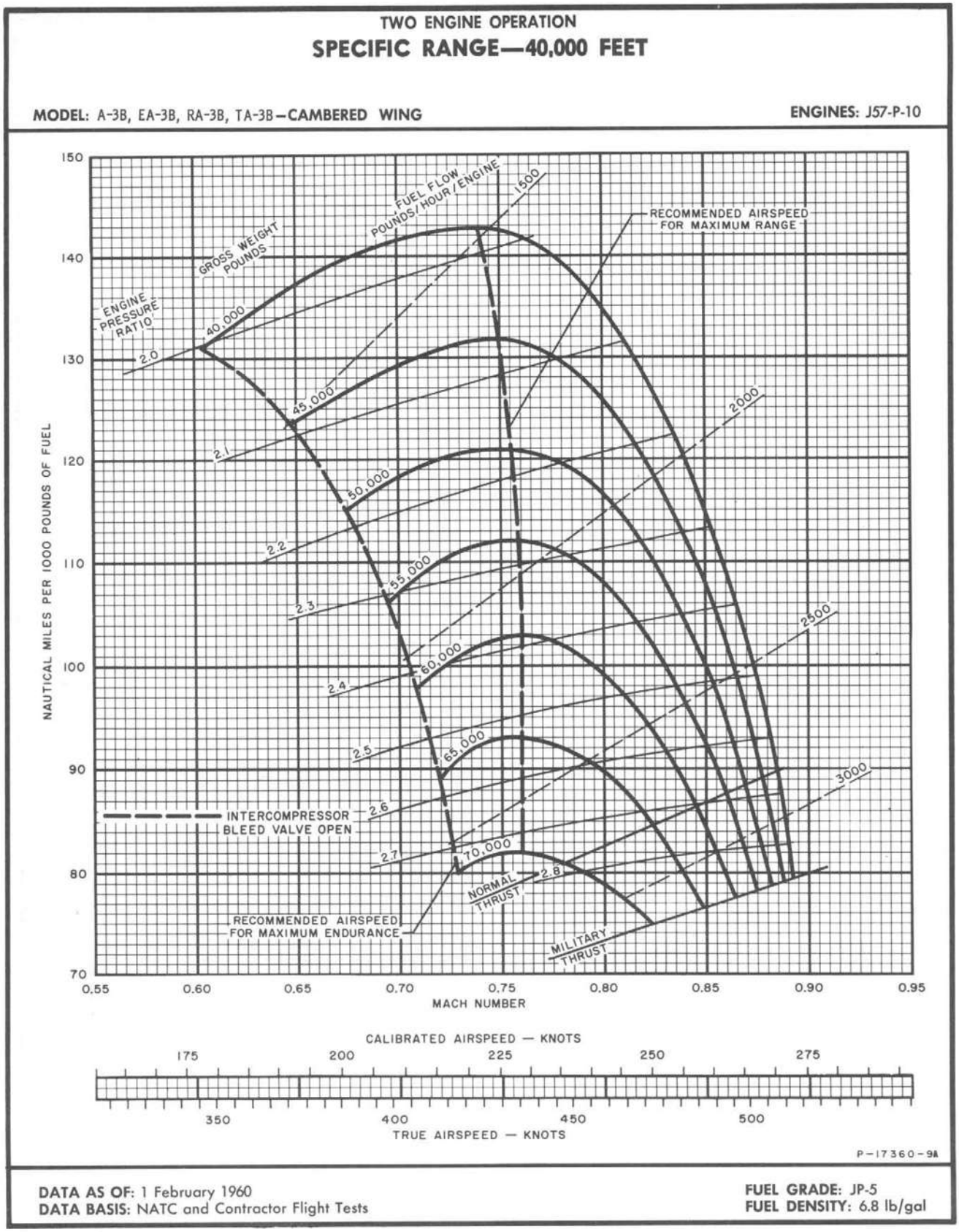


Figure B-29. Specific Range – 40,000 Feet (Sheet 9)

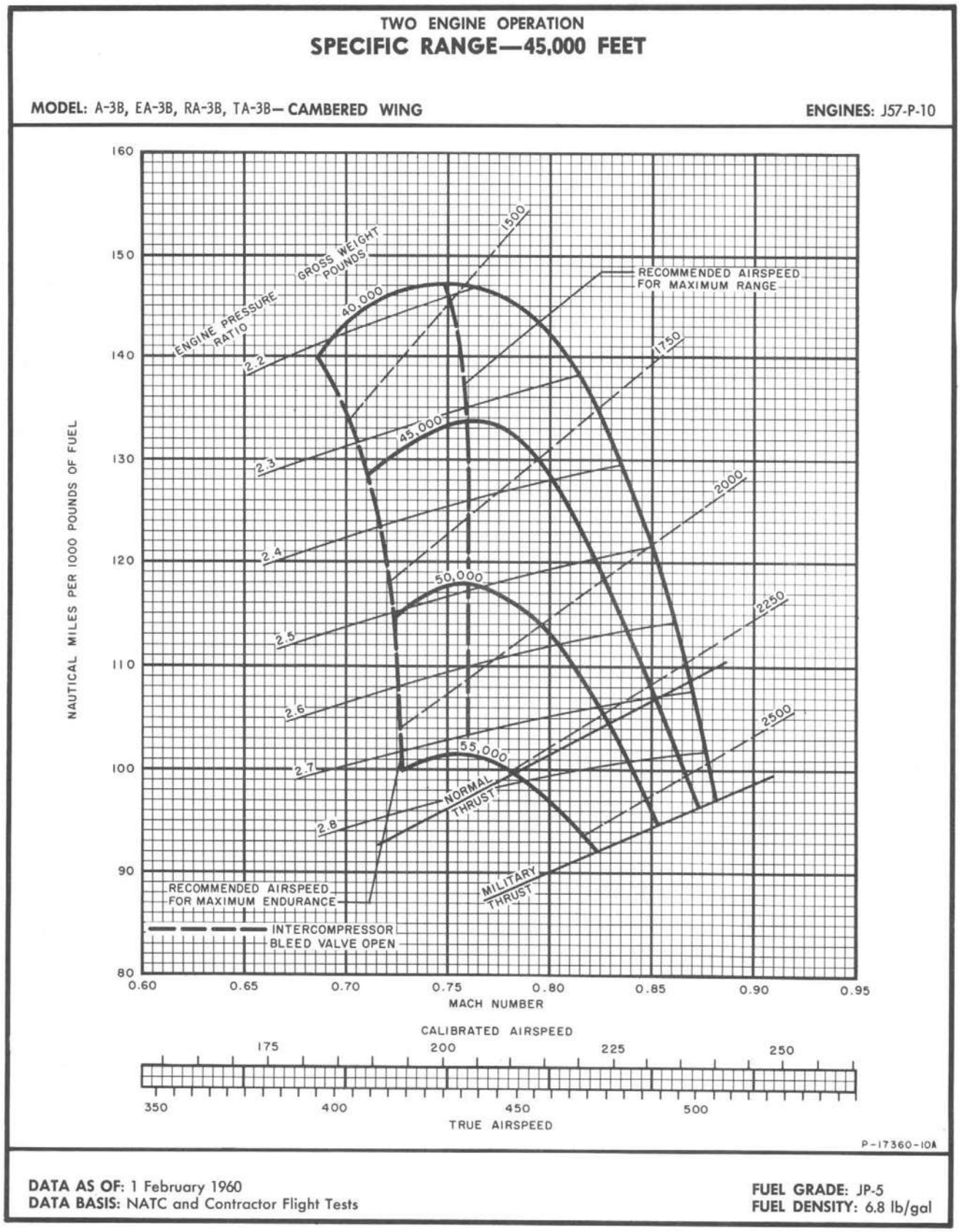
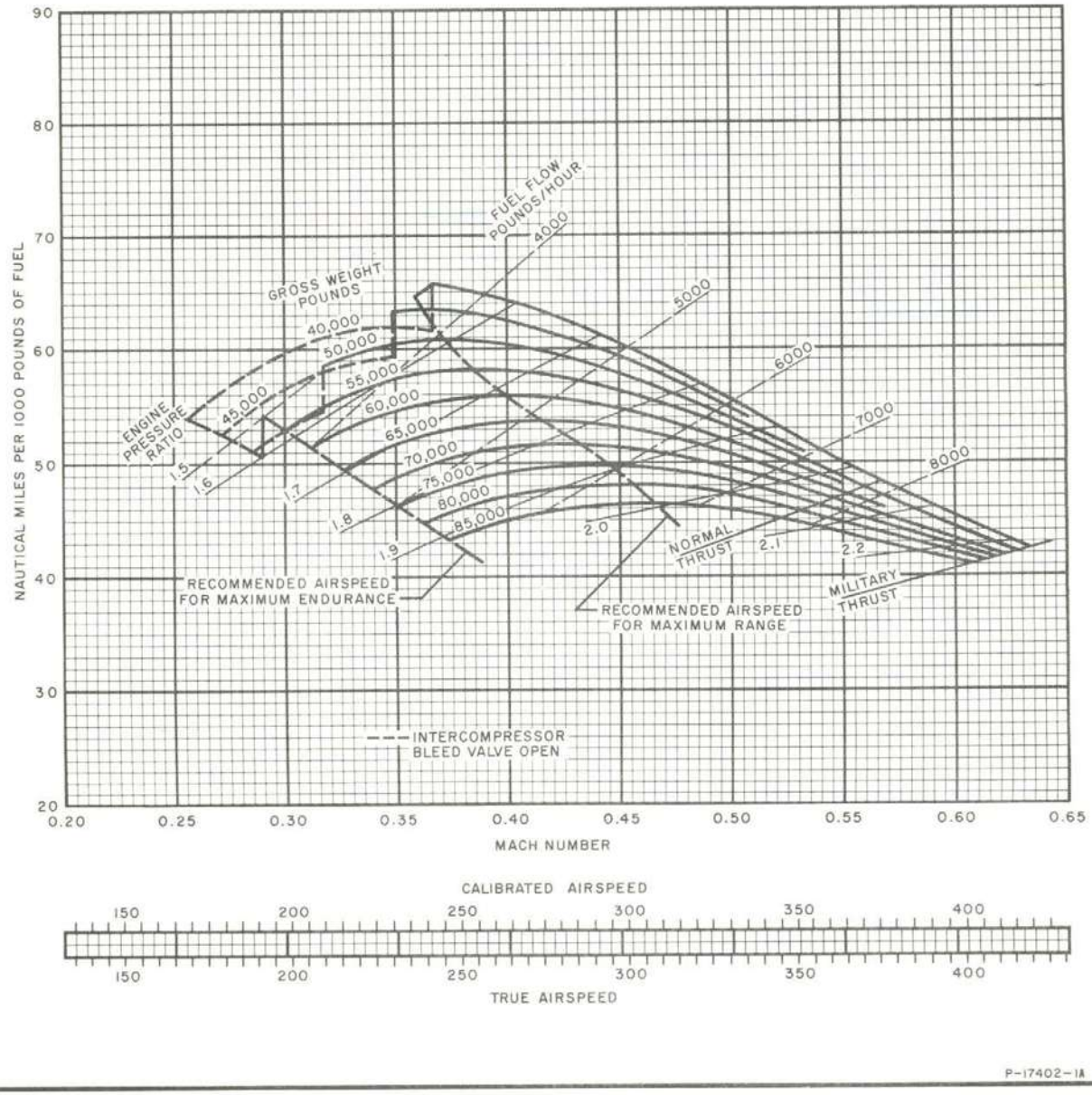


Figure B-29. Specific Range – 45, 000 Feet (Sheet 10)

ONE ENGINE OPERATION

SPECIFIC RANGE—SEA LEVEL

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

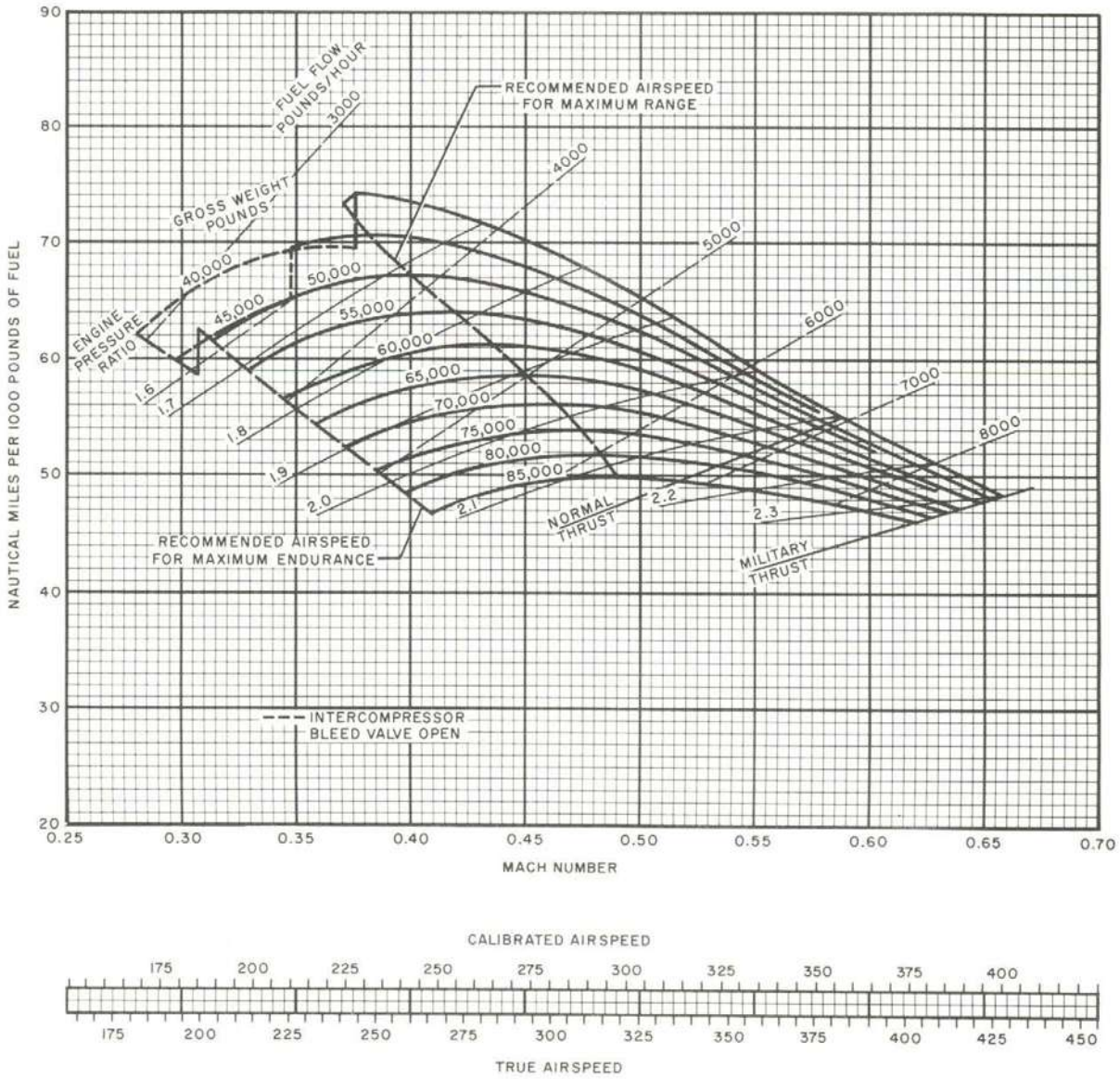
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-30. Specific Range – One-Engine – Sea Level (Sheet 1)

ONE ENGINE OPERATION

SPECIFIC RANGE—5000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



P-17403-1A

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

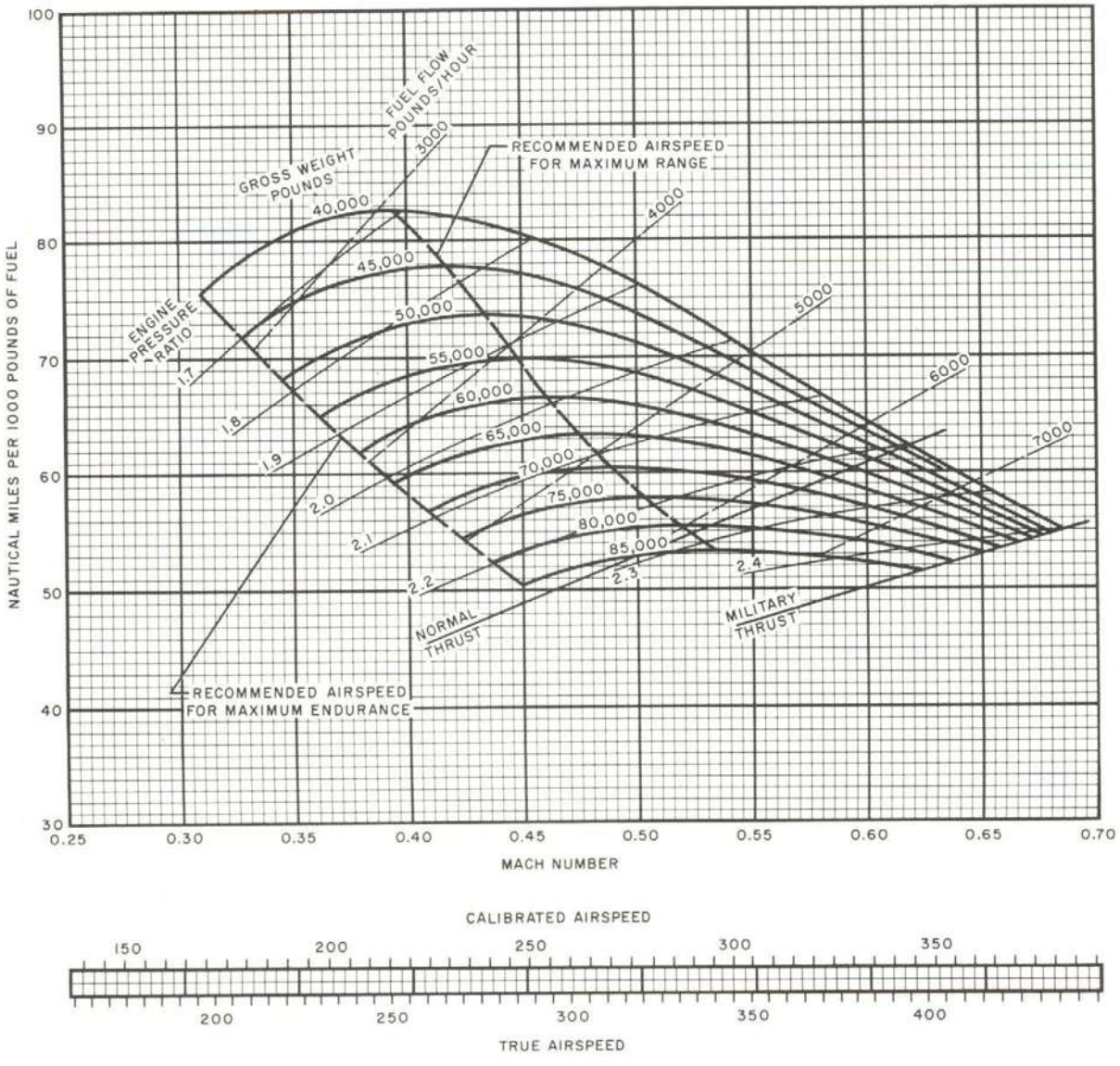
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-30. Specific Range – One-Engine-5000 Feet (Sheet 2)

ONE ENGINE OPERATION

SPECIFIC RANGE—10,000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

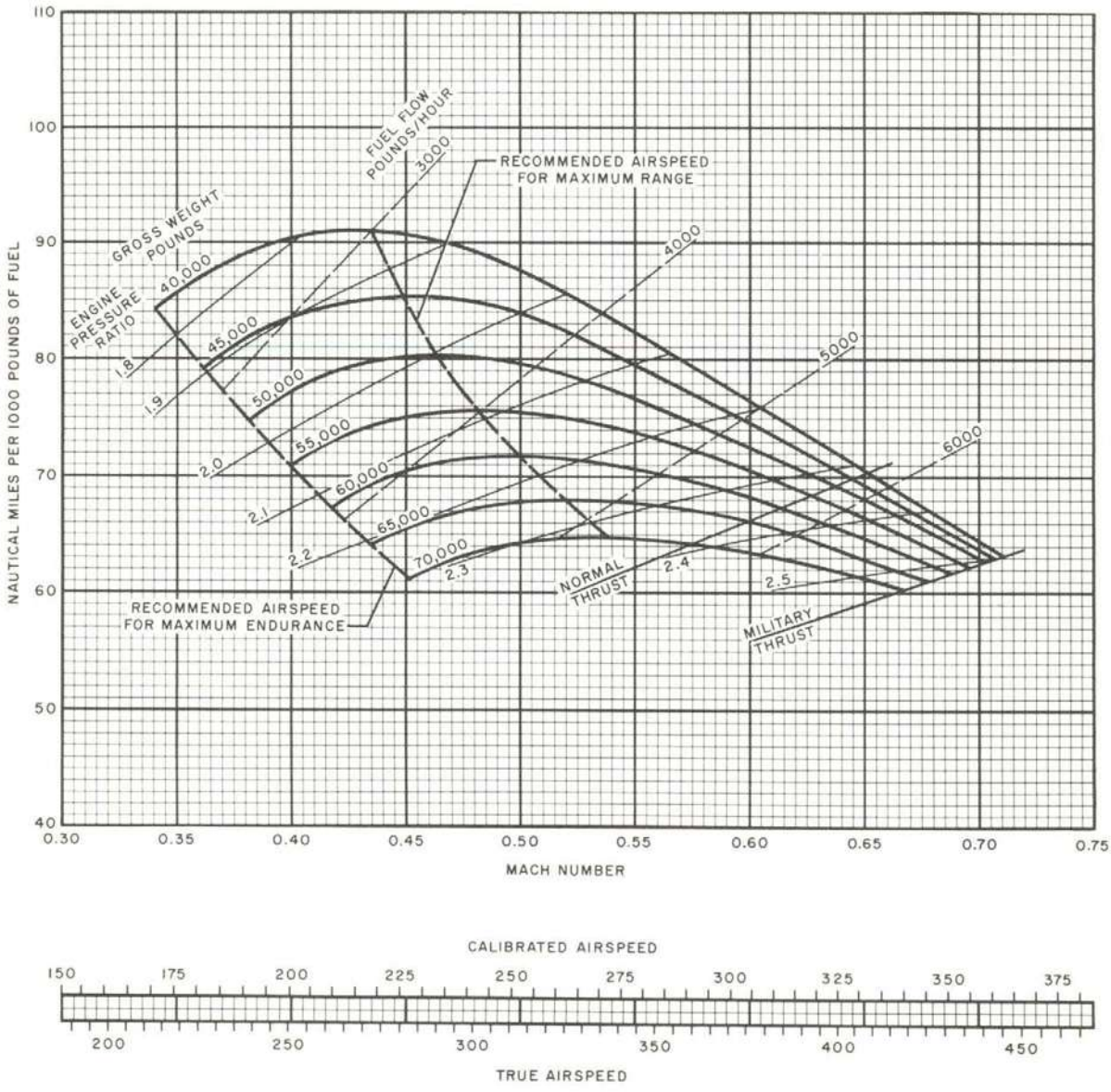
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-30. Specific Range – One-Engine-10, 000 Feet (Sheet 3)

ONE ENGINE OPERATION

SPECIFIC RANGE—15,000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

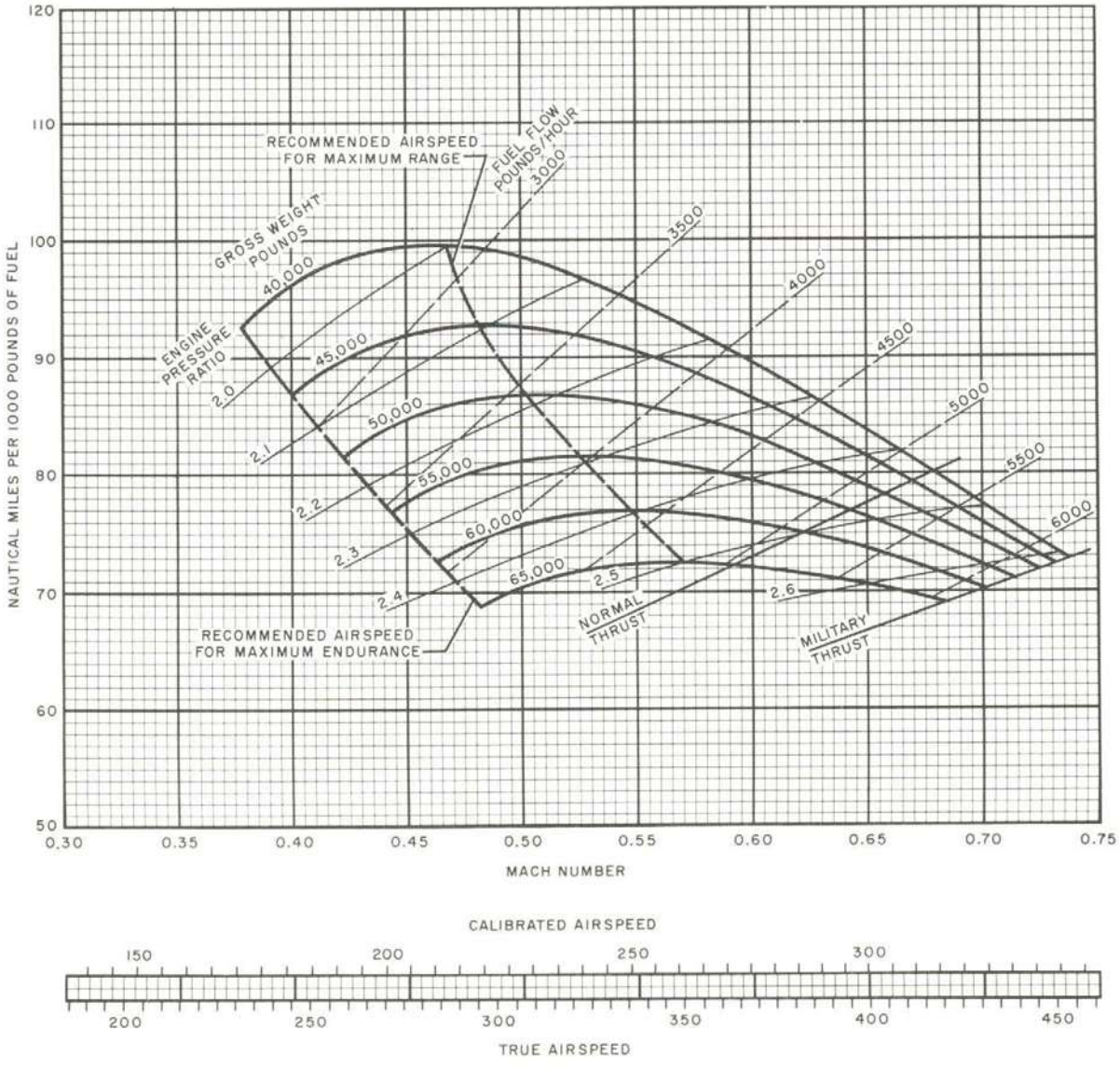
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-30. Specific Range – One-Engine–15, 000 Feet (Sheet 4)

ONE ENGINE OPERATION

SPECIFIC RANGE—20,000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

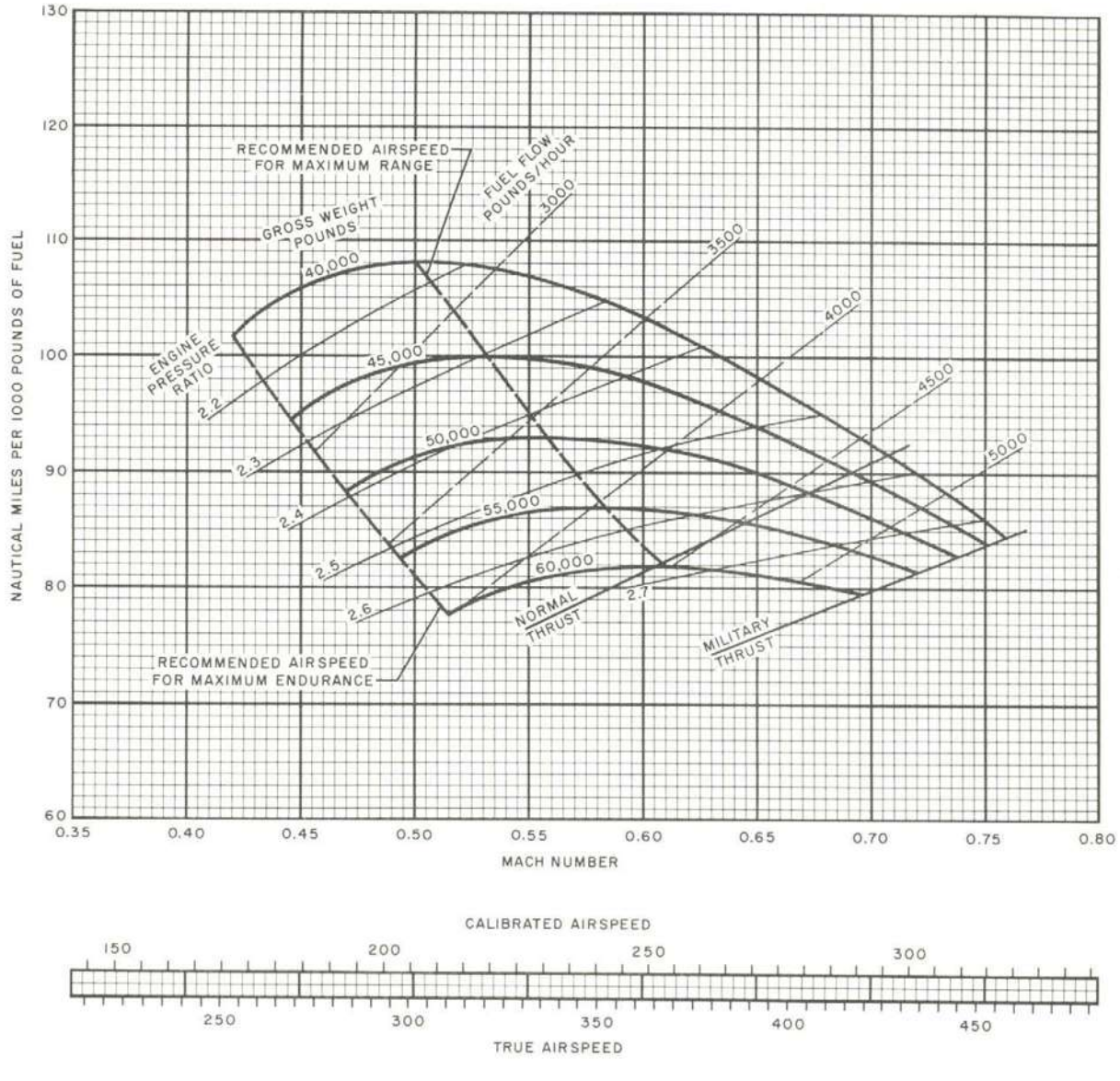
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-30. Specific Range – One-Engine-20, 000 Feet (Sheet 5)

ONE ENGINE OPERATION

SPECIFIC RANGE—25,000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

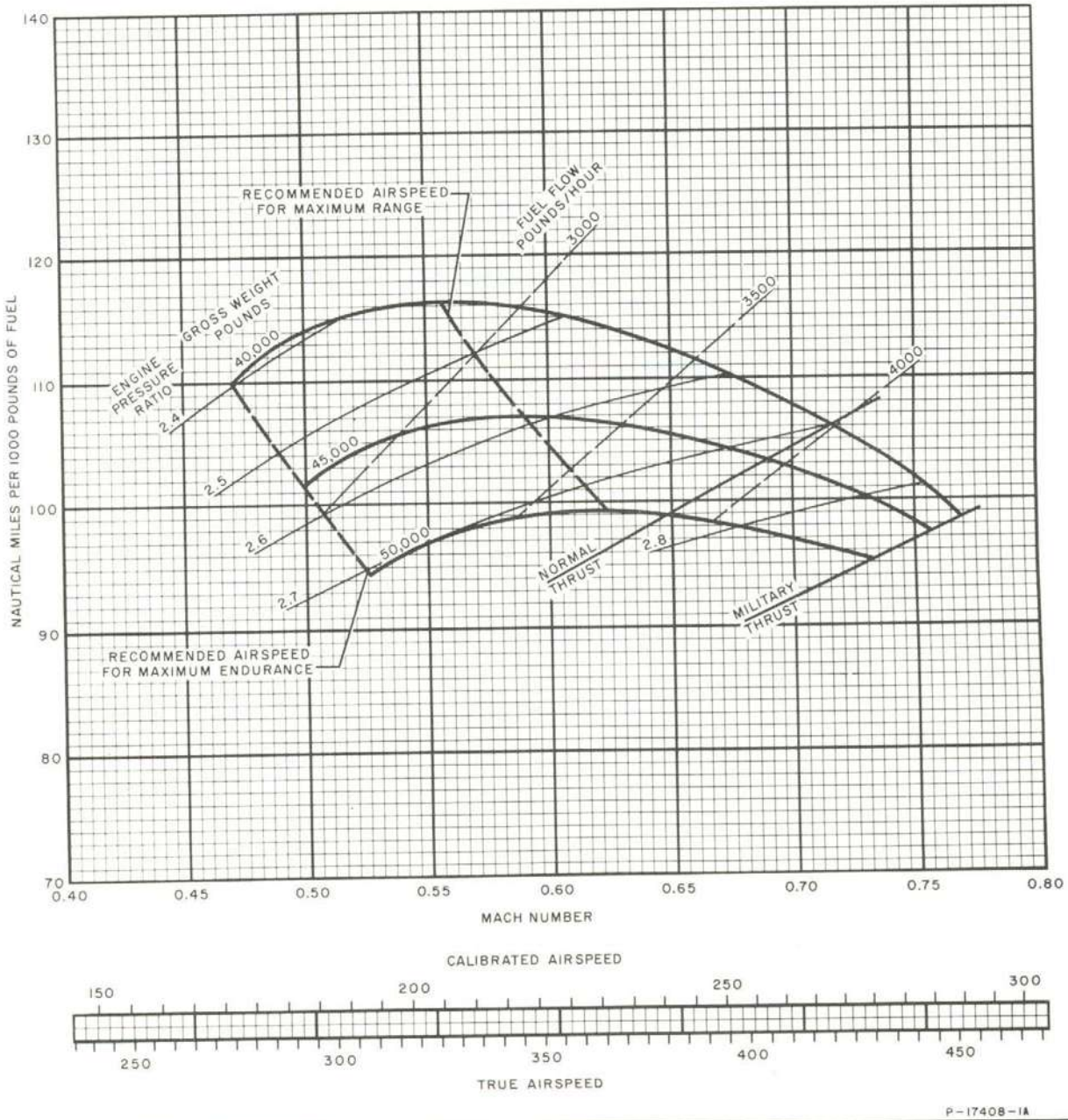
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-30. Specific Range – One-Engine-25, 000 Feet (Sheet 6)

ONE ENGINE OPERATION

SPECIFIC RANGE—30,000 FEET

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-30. Specific Range – One-Engine-30, 000 Feet (Sheet 7)

PART 5B

ENDURANCE

ENDURANCE CHARTS

When maximum endurance operation is required during flight, such as holding at altitude while awaiting clearance to land, the recommended airspeed to be maintained is approximately 10 percent higher than that at which minimum fuel flow is obtained. The higher airspeed will result in generally better handling characteristics for the aircraft, particularly in mild or moderate turbulence, with only a slight increase in fuel consumption. The endurance data presented in this section are based on using the recommended airspeeds. These airspeeds should be maintained by occasional adjustment of the throttle(s) as fuel is consumed.

FOULED DECK ENDURANCE

The fouled deck endurance charts for two-engine operation (figure B-31, sheet 1) and one-engine operation (figure B-31, sheet 2) are provided to indicate the maximum available endurance at low values of fuel remaining for various altitudes. For each initial altitude, the endurance at optimum altitude and the optimum altitude are provided. Climb and loiter speeds are indicated. A 3000-pound fuel allowance for landing is included.

MAXIMUM SPECIFIC ENDURANCE VS. ALTITUDE

Maximum specific endurance vs altitude charts present specific endurance (hours per 1000 pounds of fuel) as a function of momentary gross weight and altitude for two-engine operation (figure B-32, sheet 1) and one-engine operation (figure B-32, sheet 2). The recommended airspeeds for maximum endurance are indicated on the charts. The broken lines included in the charts reflect the increase in fuel consumption resulting from opening the intercompressor bleed valves. It will be noted that the specific endurance increases as the gross weight decreases due to the consumption of fuel. To obtain accurate endurance values under certain conditions it may be necessary to reenter the chart frequently with small increments to take full advantage of the endurance capabilities of the airplane. To determine the specific endurance for any given altitude and gross weight, enter chart at that altitude and move to right to applicable momentary gross weight curve, directly below read specific endurance (hours per 1000 pounds of fuel).

EXAMPLE. Given an altitude of 30,000 feet, a gross weight of 70,000 pounds and 20,000 pounds of fuel available for loiter; find maximum specific endurance.

1. Specific endurance at initial gross weight . . . . . 0.22 hours/1000 pounds of fuel

2. Specific endurance at final gross weight (70,000 - 20,000 pounds = 50,000 pounds). . . . . .0.315 hours/1000 pounds of fuel

3. Specific endurance at average gross weight (70,000 pounds + 50,000 pounds)÷2=60,000 pounds) . . . . . 0.26 hours/1000 pounds of fuel

4. Maximum loiter time (0.26 hours/1000 pounds of fuel X 20,000 pounds) . . . . . .5.2 hours

MAXIMUM ENDURANCE PROFILE

The maximum endurance profile (figure B-33) presents the loiter time in hours for various quantities of fuel on board as a function of altitude. These data are presented for two conditions, namely:

(1) The aircraft initially at the selected loiter altitude (solid lines), and

(2) The aircraft initially at sea level and climb to a selected loiter altitude (dash lines).

The calibrated airspeed for loiter does not vary with altitude and is indicated for each value of fuel on board. The climb schedule is noted in the lower right-hand corner of the chart. The climb and descent time is not included in the loiter time shown. The indicated fuel is the fuel available for climb and loiter, thus fuel for descent, landing and reserve must be subtracted from fuel on board to obtain the indicated fuel. The recommended descent speed is 200 knots, CAS.

To determine the time available for a given amount of fuel with the aircraft initially at the desired loiter altitude, enter chart at loiter altitude and proceed horizontally to right to amount of fuel available for loiter (solid line). Directly below, read loiter time available. Chart should be interpreted in same manner if aircraft is initially at sea level, except that broken lines should be used for amount of fuel available for climb and loiter.

To obtain fuel required to loiter given time, enter chart at desired loiter altitude and note initial time and amount of fuel on board at start of loiter. Reenter chart at time when loiter ends (initial time less loiter time) and read final fuel on board. The difference between initial and final fuel on board is fuel required for loiter.

EXAMPLE. Determine fuel required to loiter at 25,000 feet for 2 hours with 15,000 pounds of fuel on board.

1. Initial time at 25,000 feet and 15,000 pounds . . . . . .4.6 hours

2. Final time (4.6 - 2 hours) . . . . . 2.6 hours

3. Fuel on board at end of loiter (2.6 hours at 25,000 feet) . . . . . 9000 pounds

4. Fuel required to loiter (15,000 pounds - 9000 pounds) . . . . . 6000 pounds

5. Recommended loiter CAS. . . . .214 - 207 knots

ENDURANCE FACTORS WITH GEAR AND FLAPS DOWN

Apply these endurance factors when attempting to loiter with gear down, flaps down, and speedbrakes closed. Multiply the values in the fouled deck endurance charts by the appropriate factors.

	Sea Level Endurance	
	Endurance Factors	CAS KTS
RA-3B Cambered Wing		
One Engine	0.60	120 to 130
Two Engine	0.65	120 to 130

TWO-ENGINE OPERATION

FOULED DECK ENDURANCE

MODEL: A-3B, EA-3B, RA-3B, TA-3B – CAMBERED WING ENGINES: J57-P-10

FUEL ON BOARD ~ POUNDS	IF YOU ARE AT SEA LEVEL					IF YOU ARE AT 20,000 FEET				
	ENDURANCE AT SEA LEVEL	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 20,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	41	30,000	51	0.51	188	58	30,000	62	0.51	188
5500	28	20,000	31	0.41	184	41	30,000	42	0.51	188
4500	16	S.L.	16	0.27	182	23	20,000	23	0.41	186
4000	9	S.L.	9	0.27	181	14	20,000	14	0.40	185
3500	3	S.L.	3	0.27	181	5	20,000	5	0.40	185
	CLIMB CAS	376 KNOTS CAS				CLIMB CAS	305 KNOTS CAS			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			
	IF YOU ARE AT 25,000 FEET					IF YOU ARE AT 30,000 FEET				
	ENDURANCE AT 25,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 30,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	61	30,000	65	0.51	188	67	30,000	67	0.51	188
5500	43	30,000	45	0.51	188	47	30,000	47	0.51	188
4500	24	25,000	24	0.45	182	27	30,000	27	0.50	187
4000	15	25,000	15	0.45	182	15	30,000	15	0.50	186
3500	5	25,000	5	0.45	182	5	30,000	5	0.50	186
	CLIMB CAS	287 KNOTS CAS				CLIMB CAS	269 KNOTS CAS			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			
	IF YOU ARE AT 35,000 FEET					IF YOU ARE AT 40,000 FEET				
	ENDURANCE AT 35,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 40,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	66	30,000	67	0.51	188	64	30,000	68	0.51	188
5500	46	30,000	47	0.51	188	45	30,000	48	0.51	188
4500	26	30,000	27	0.50	187	26	30,000	27	0.50	187
4000	16	35,000	16	0.57	188	16	35,000	16	0.57	188
3500	6	35,000	6	0.57	188	6	35,000	6	0.57	188
	CLIMB CAS	252 KNOTS CAS				CLIMB CAS	NO CLIMB REQUIRED			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			

REMARKS:

1. FUEL REQUIRED INCLUDES 300 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED.
3. DESCEND AT IDLE THRUST.
4. BASIC AIRCRAFT WEIGHT IS 41,782 POUNDS.

DATA AS OF: 1 MARCH 1964 FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS FUEL DENSITY: 6.8 LB/GAL

Figure B-31. Fouled Deck Endurance – Two-Engine (Sheet 1)

ONE-ENGINE OPERATION

FOULED DECK ENDURANCE

MODEL: A-3B, EA-3B, RA-3B, TA-3B – CAMBERED WING

ENGINES: J57-P-10

FUEL ON BOARD ~ POUNDS	IF YOU ARE AT SEA LEVEL					IF YOU ARE AT 20,000 FEET				
	ENDURANCE AT SEA LEVEL	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 20,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	57	S. L.	57	0.28	182	68	20,000	68	0.41	185
5500	40	S. L.	40	0.27	181	49	20,000	49	0.40	184
4500	23	S. L.	23	0.27	180	28	20,000	28	0.40	183
4000	14	S. L.	14	0.27	180	18	20,000	18	0.40	182
3500	5	S. L.	5	0.27	179	7	20,000	7	0.40	181
	CLIMB CAS	NO CLIMB REQUIRED				CLIMB CAS	NO CLIMB REQUIRED			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			

FUEL ON BOARD ~ POUNDS	IF YOU ARE AT 25,000 FEET					IF YOU ARE AT 30,000 FEET				
	ENDURANCE AT 25,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE	ENDURANCE AT 30,000 FEET	OPTIMUM ALTITUDE	ENDURANCE AT OPTIMUM ALTITUDE	MACH AT OPTIMUM ALTITUDE	CAS AT OPTIMUM ALTITUDE
	MINUTES	FEET	MINUTES	MACH	KNOTS	MINUTES	FEET	MINUTES	MACH	KNOTS
6500	68	25,000	68	0.45	185	67	25,000	68	0.45	185
5500	49	25,000	49	0.45	184	48	25,000	49	0.45	184
4500	28	25,000	28	0.45	183	28	25,000	28	0.45	183
4000	18	25,000	18	0.45	182	18	25,000	18	0.45	182
3500	7	25,000	7	0.45	182	7	25,000	8	0.45	182
	CLIMB CAS	NO CLIMB REQUIRED				CLIMB CAS	NO CLIMB REQUIRED			
	LET-DOWN	30° DIVE – SPEED BRAKES OPEN				LET-DOWN	30° DIVE – SPEED BRAKES OPEN			
	START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000				START LET-DOWN WITH FUEL ON BOARD ~ POUNDS	3000			

REMARKS:

1. FUEL REQUIRED INCLUDES 200 POUNDS FOR CLEANUP, TURN AND ACCELERATION.
2. PROVIDES 3000 POUNDS FUEL AT POINT WHERE DESCENT IS COMMENCED.
3. DESCEND AT IDLE THRUST.
4. BASIC AIRCRAFT WEIGHT IS 41,782 POUNDS.

DATA AS OF: 1 MARCH 1964

FUEL GRADE: JP-5

DATA BASIS: NATC AND CONTRACTOR FLIGHT TESTS

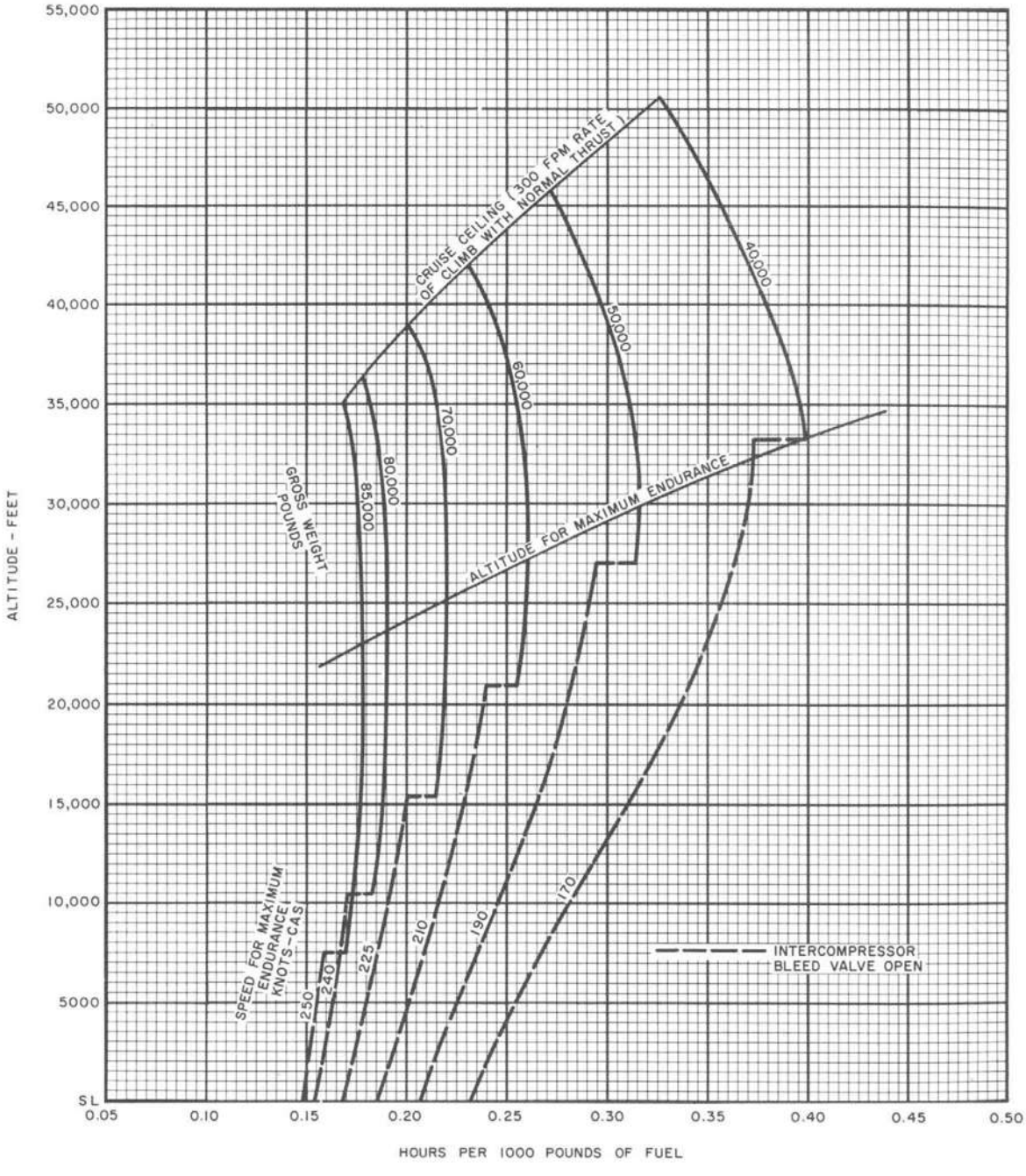
FUEL DENSITY: 6.8 LB/GAL

Figure B-31. Fouled Deck Endurance – One-Engine (Sheet 2)

TWO ENGINE OPERATION

MAXIMUM SPECIFIC ENDURANCE VS ALTITUDES

MODEL: A-3B, EA-3B, RA-3B, TA-3B—CAMBERED WING **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

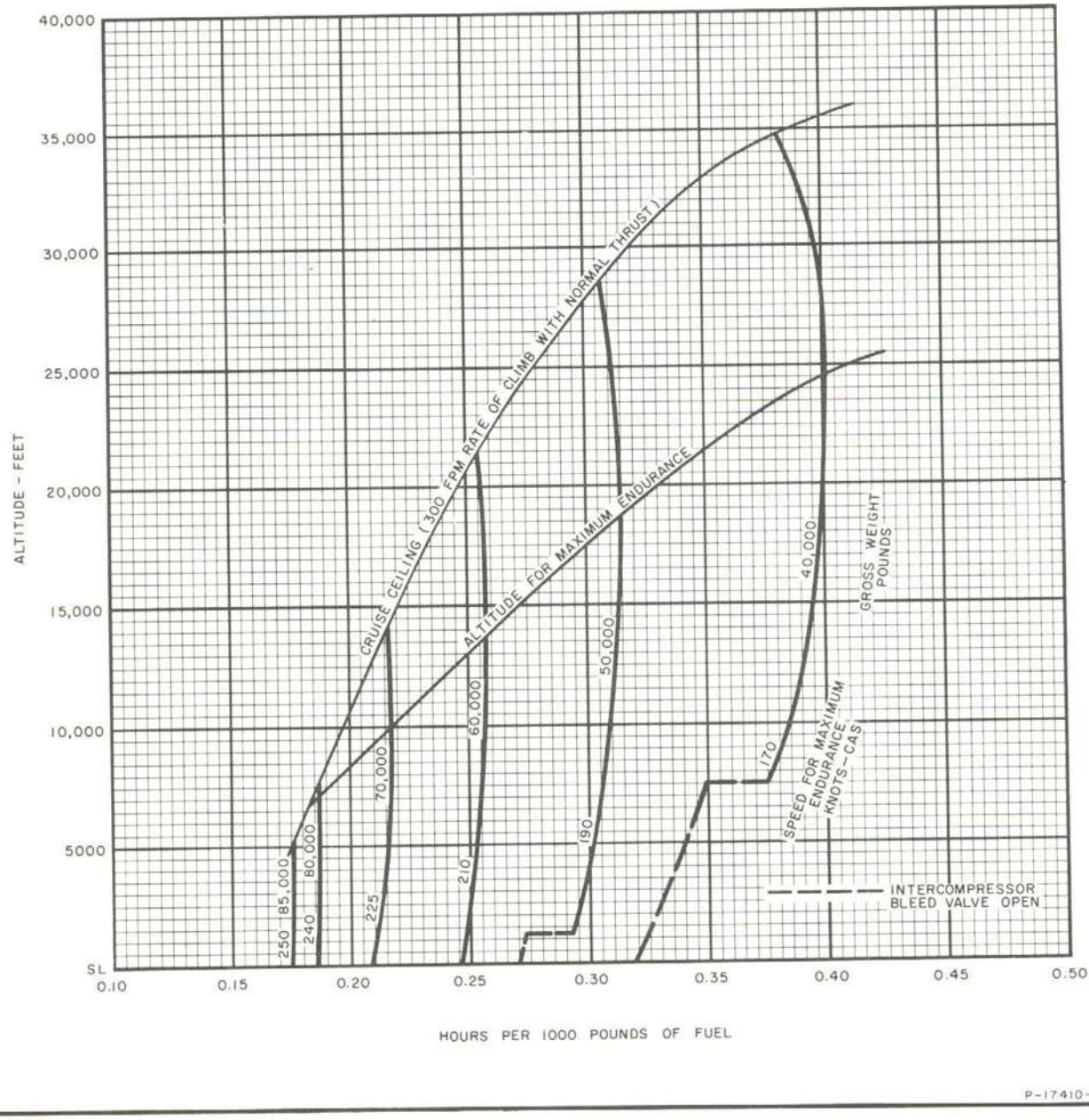
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-32. Maximum Specific Endurance vs Altitudes – Two-Engine (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM SPECIFIC ENDURANCE VS ALTITUDES

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-32. Maximum Specific Endurance vs Altitude – One-Engine (Sheet 2)

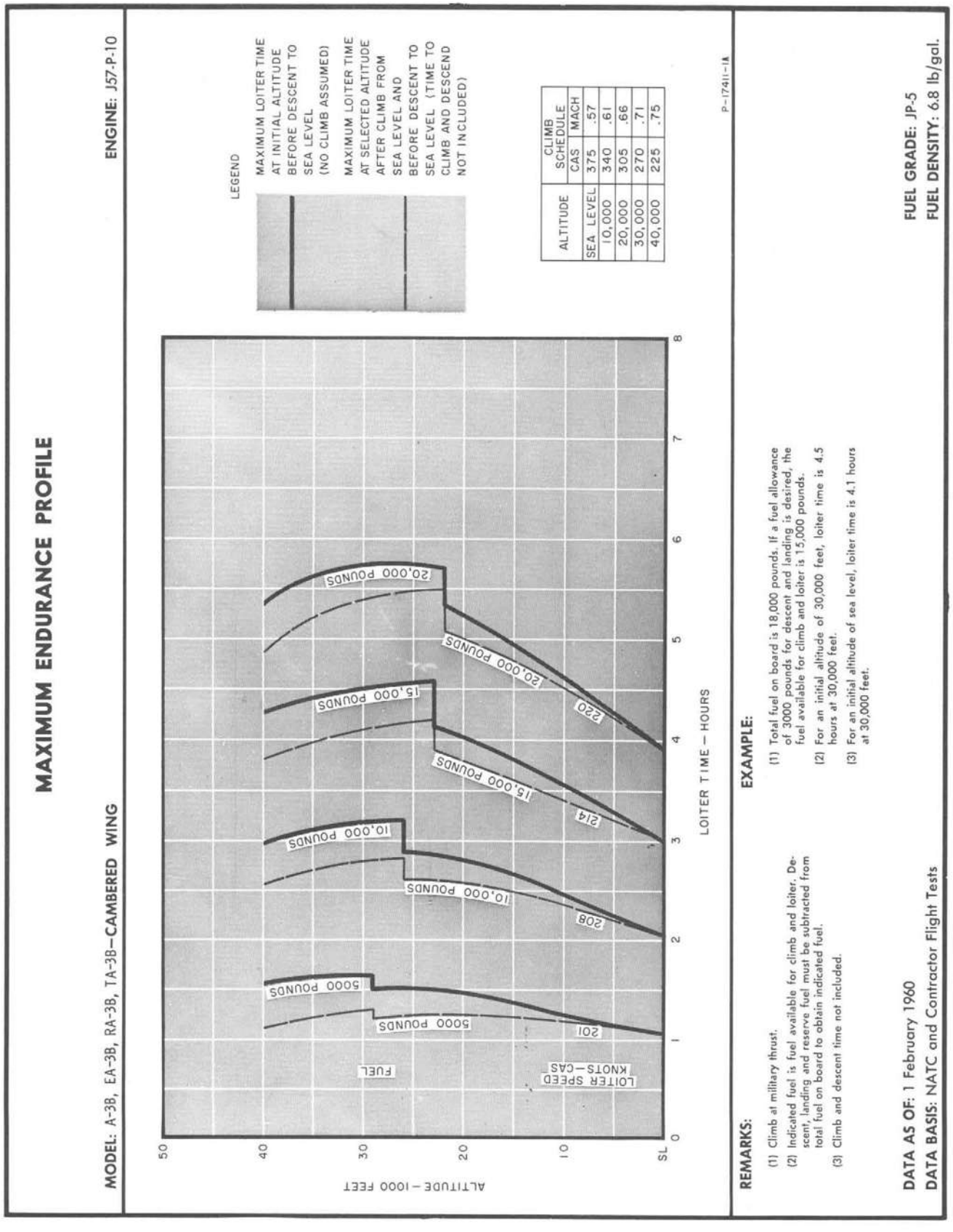


Figure B-33. Maximum Endurance Profile

PART 6B

DESCENT

DESCENT CHARTS

A maximum range descent should be made with idle power, flaps and gear retracted, and speedbrakes closed. The Maximum Range Descent chart, figure B-34, sheet 1, shows descent performance which will be obtained in the above configuration when the recommended airspeeds (CAS) shown in the chart are maintained in the descent. These data may be used for determining rates of descent, elapsed time, distance and/or fuel consumed in descending from any altitude to sea level, or from one altitude to another by taking the differences in the desired values at the initial and at the final altitudes.

EXAMPLE. A descent is made from 41,000 feet pressure altitude to 21,000 feet pressure altitude at 50,000 pounds gross weight. Using data provided on Maximum Range Descent chart, the descent range is found to be:

125 nautical miles - 55 nautical miles
= 70 nautical miles

The elapsed time is:

30 minutes - 16 minutes = 14 minutes

The fuel consumed is:

620 pounds - 360 pounds = 260 pounds

Descent is made at 200 knots CAS.

Note

Distance, elapsed time, and fuel consumed in descent with one engine operating at idle power and the other engine completely shut down may be obtained similarly from figure B-34, sheet 2.

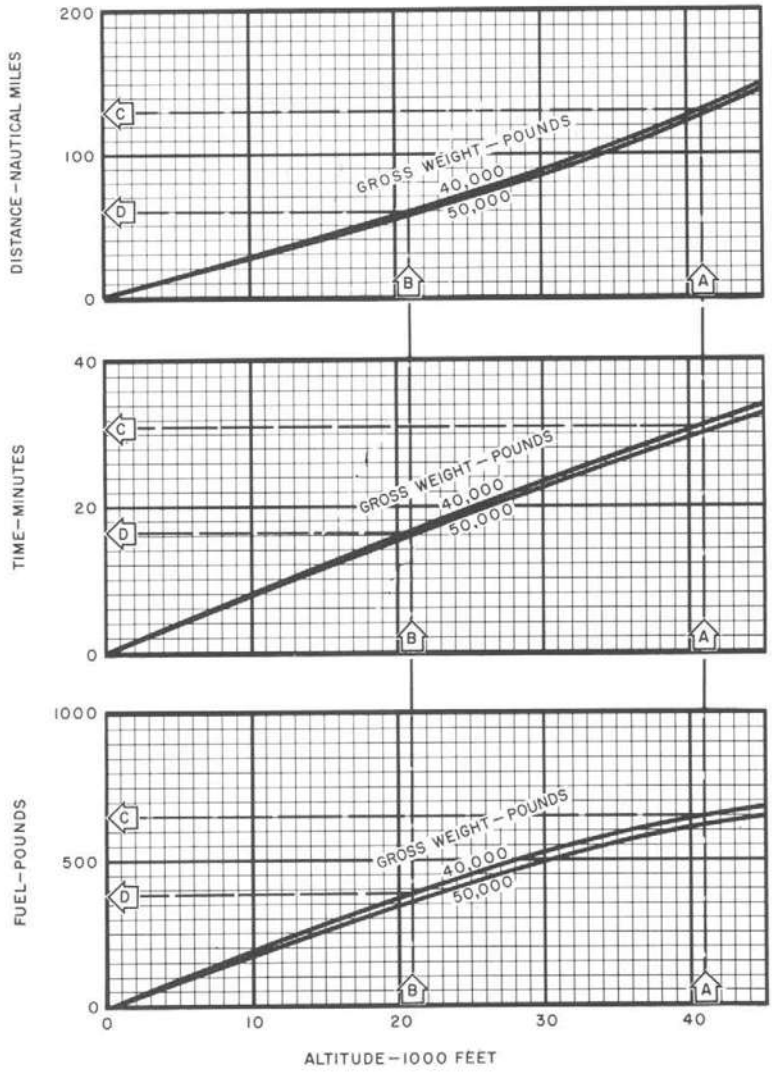
Descent data with both engines inoperative are presented in Emergency Procedures, Section V.

TWO ENGINE OPERATION

MAXIMUM RANGE DESCENT

IDLE THRUST

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



REMARKS:

The descent speed is a constant 200 knots CAS.

EXAMPLE:

If the weight is 40,000 pounds and a maximum range descent is desired from 41,000 feet (A) to 21,000 feet (B)

Then:

(1) Distance in descent is 130 nautical miles (C) minus 60 nautical miles (D) = 70 nautical miles.

(2) Time in descent is 31 minutes (C) minus 16 minutes (D) = 15 minutes.

(3) Fuel used in descent is 650 pounds (C) minus 380 pounds (D) = 270 pounds.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

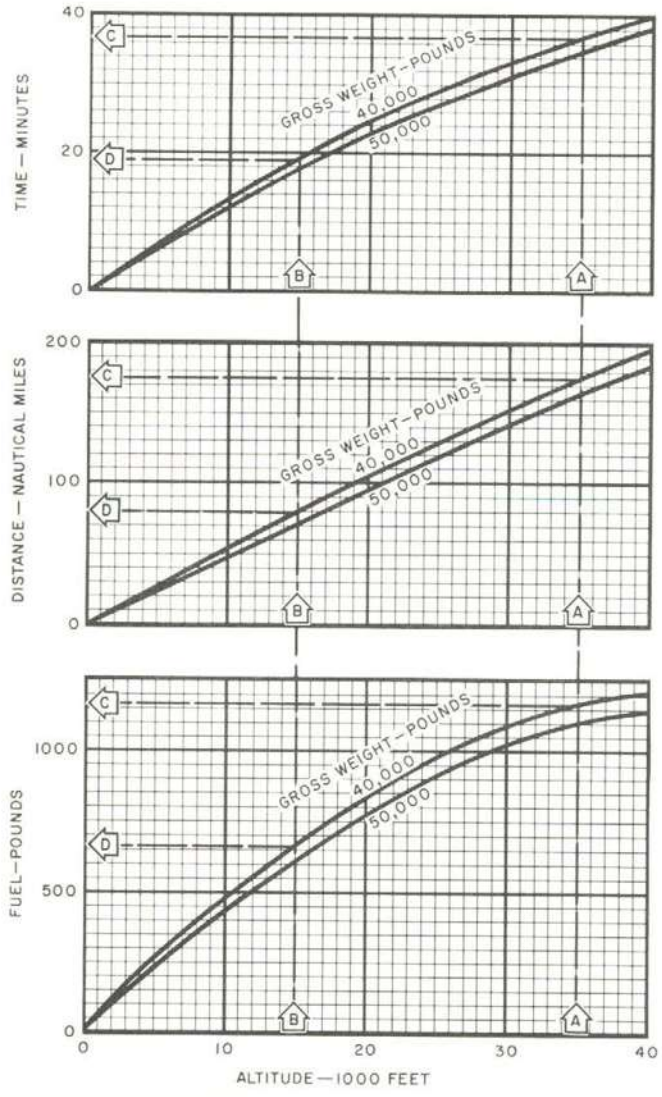
Figure B-34. Maximum Range Descent – Two-Engine (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM RANGE DESCENT

85% RPM

MODEL: A-3B, EA-3B, RA-3B, TA-3B - **CAMBERED WING** **ENGINES:** J57-P-10



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REMARKS:

The descent speed is a constant 220 knots CAS.

EXAMPLE:

If the weight is 40,000 pounds and a maximum range descent is desired from 35,000 feet (A) to 15,000 feet (B).

Then:

(1) Distance in descent is 175 nautical miles (C) minus 80 nautical miles (D) or 95 nautical miles.

(2) Time in descent is 37 minutes (C) minus 19 minutes (D) or 18 minutes.

(3) Fuel used in descent is 1170 pounds (C) minus 660 pounds (D) or 510 pounds.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-34. Maximum Range Descent – One-Engine (Sheet 2)

PART 7B

LANDING

INDICATED ANGLE-OF-ATTACK

The angle-of-attack indicator, when properly calibrated, will indicate the attitude of the aircraft to the relative airstream only, and will not relate the aircraft attitude or flight path with respect to the terrain. Figure B-35 represents the aircraft indicated airspeed as a function of the angle-of-attack indicator reading, providing the system is properly calibrated. It is recommended that this chart be used only for landing approach conditions.

The recommended angle-of-attack setting for landing approach, when the angle-of-attack system is properly calibrated is 15 units. The indicated units should be checked against the airspeed indicator readings during the approach on each flight. If the 15 units does not indicate the airspeeds shown on figure B-35 disregard the angle-of-attack indicator and make the approach at the airspeed shown on figure B-36.

EXAMPLE. If approach gross weight is 47,000 pounds at an indicator reading of 12 units angle-of-attack, then aircraft indicated airspeed should be 135 knots.

APPROACH CHARTS

RECOMMENDED APPROACH SPEEDS AND STALL SPEEDS

The recommended approach and stall speeds chart (figure B-36) shows the approach and stall speeds in relation to gross weight. It also clearly indicates the increase in stalling speed as the angle-of-bank increases. The chart is plotted to show the stalling speeds with different power settings and with or without flaps.

EXAMPLE. At a gross weight of 55,000 pounds, in level flight, with power off, and with no flaps, the stalling speed is 119 knots. For a bank angle of 25 degrees, follow the guideline to read the stalling speed as 125 knots.

LANDING CHARTS

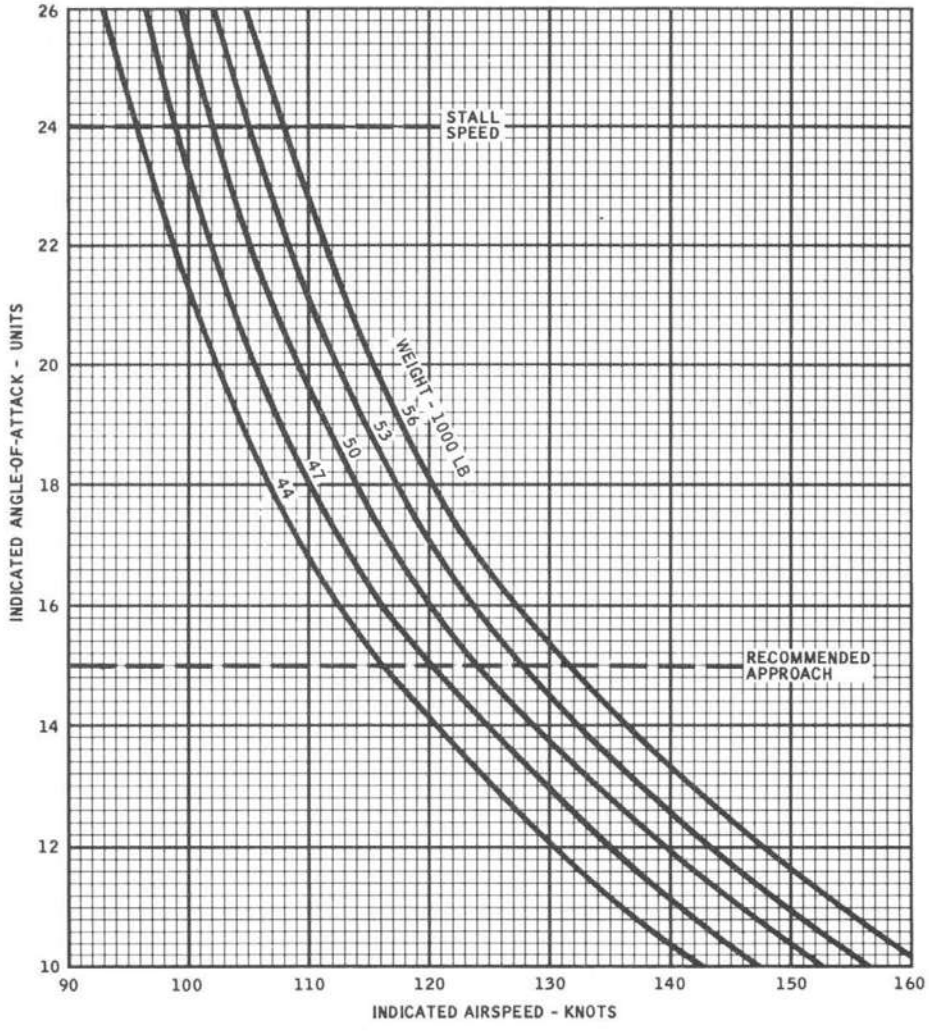
LANDING GROUND ROLL

Data for determining the landing ground roll on a hard surface runway, or on a wet icy runway are presented for varying conditions of gross weight, pressure altitude, and headwind in the Landing Ground Roll chart (figure B-37). Landing ground roll is shown with and without drag chute. Ground roll distances are the minimum landing distances obtained when maximum braking is used. Minimum distance requires that the throttles be reduced to idle power at the beginning of the flare and maximum braking maintained during the entire ground roll. The recommended approach speeds (CAS) indicated on the chart are 20 percent above the power-off stalling speed. Reduction in ground roll due to headwind may be estimated for headwinds up to 40 knots, as indicated on the lower portion of the chart. To clear a 50-foot obstacle, an additional 715 feet must be added to the total landing distance.

INDICATED ANGLE-OF-ATTACK vs AIRSPEED

POWER APPROACH CONFIGURATION
FULL FLAPS, SPEEDBRAKES OPEN

MODEL: A-3B, EA-3B, RA-3B, TA-3B CAMBERED WING **ENGINES:** J57-P10



ATB-1-11 P-40529-1

REMARKS:

EXAMPLE:

DATA AS OF: 1 March 1964
DATA BASIS: NATC and Contractor Flight Tests

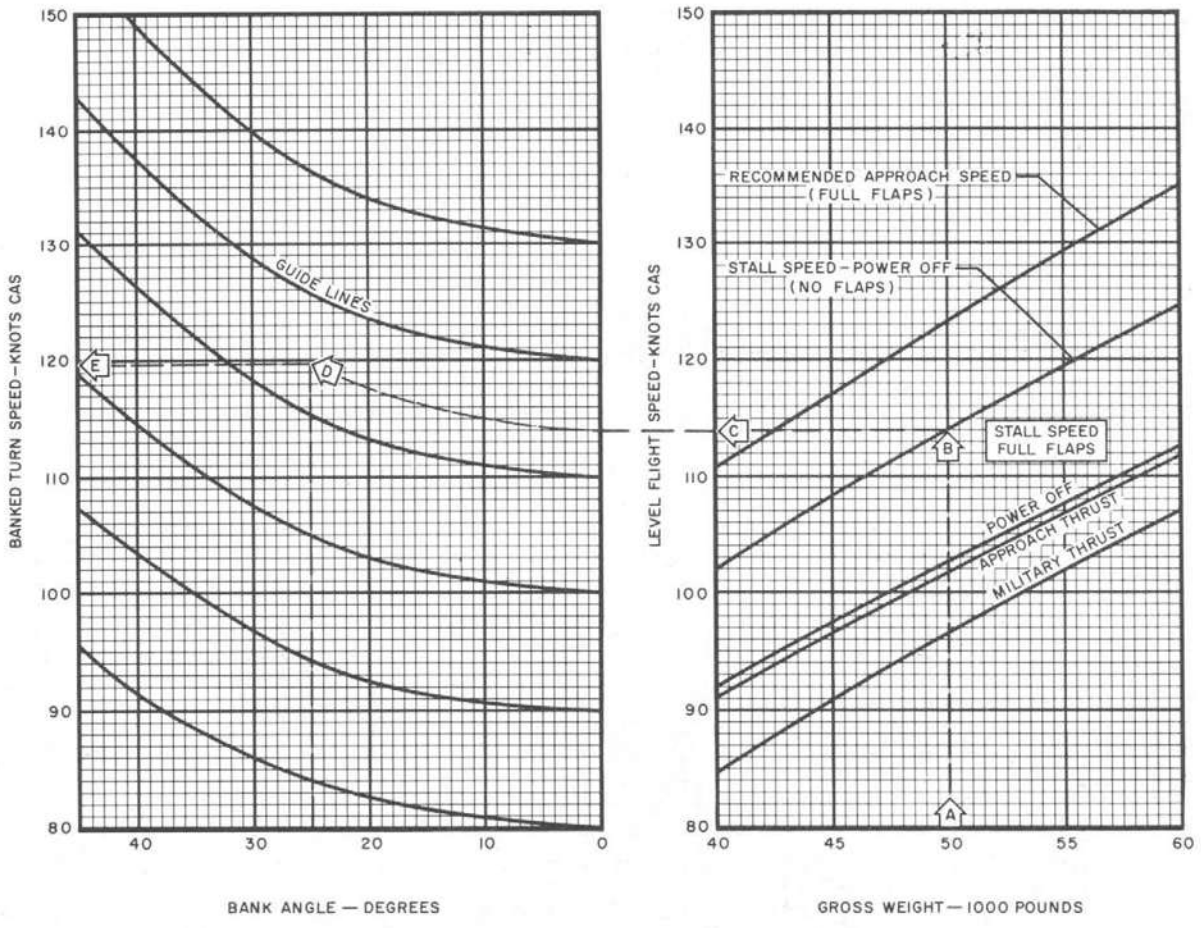
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-35. Indicated Angle-of-Attack vs Airspeed

TWO ENGINE OPERATION

RECOMMENDED APPROACH SPEEDS AND STALL SPEEDS

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10



PS-17362-18

EXAMPLE:

(1) At a gross weight of 50,000 pounds (A), the power off stall speed, no flaps, (B) for level flight is 114 knots (C). For a banked turn of 25°, follow the guide line to the intersection of the 25° bank angle (D) and read a stall speed of 120 knots (E).

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

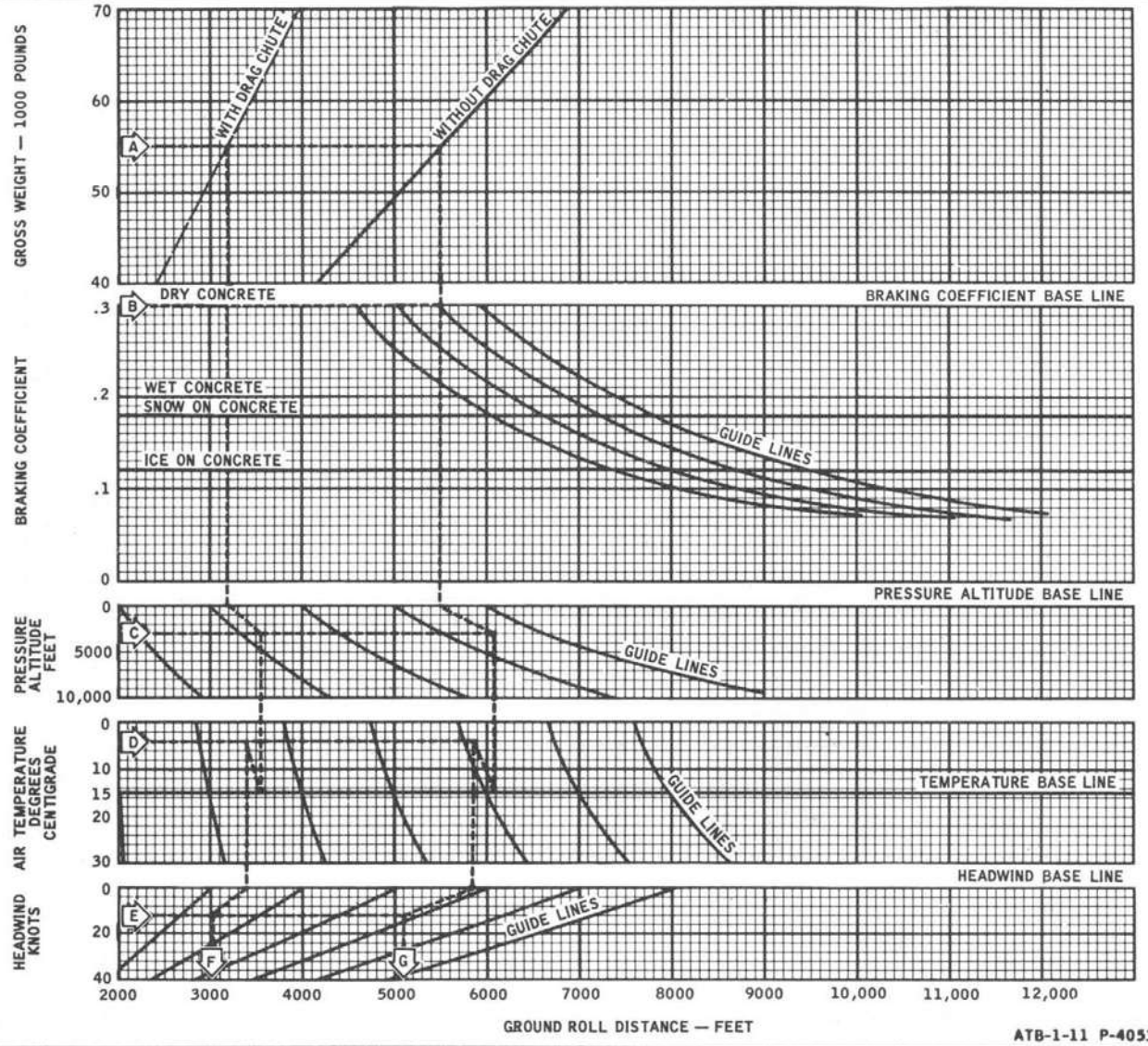
FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

B-36. Recommended Approach Speeds and Stall Speeds

LANDING GROUND ROLL

HYTROL BRAKING IDLE THRUST FLAPS FULL DOWN

MODEL: A-3B, EA-3B, RA-3B, TA-3B—CAMBERED WING **ENGINES: J57-P-10**



REMARKS:

(1) Add 715 feet for distance to clear a 50 foot obstacle.

(2) Drag chute released at touchdown.

EXAMPLE:

Under the following conditions:

(a) Gross weight = 55,000 pounds (A).

(b) Braking coefficient (dry concrete) = 0.3 (B)

(c) Pressure altitude = 3000 feet (C).

(d) Air temperature = 4°C (D).

(e) Headwind = 12 knots (E).

(1) With drag chute deployed the landing ground roll distance is 3020 feet (F). The total distance to clear a 50 foot obstacle is 3735 feet.

(2) Without drag chute the landing ground roll distance is 5100 feet (G). The total distance to clear a 50 foot obstacle is 5815 feet.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-37. Landing Ground Roll

PART 8B

COMBAT PERFORMANCE

COMBAT ALLOWANCE

Figure B-38, presents the combat time available for various quantities of combat fuel as a function of altitude. These data are given for both military and normal thrust.

MAXIMUM CONTINUOUS POWER SUMMARY

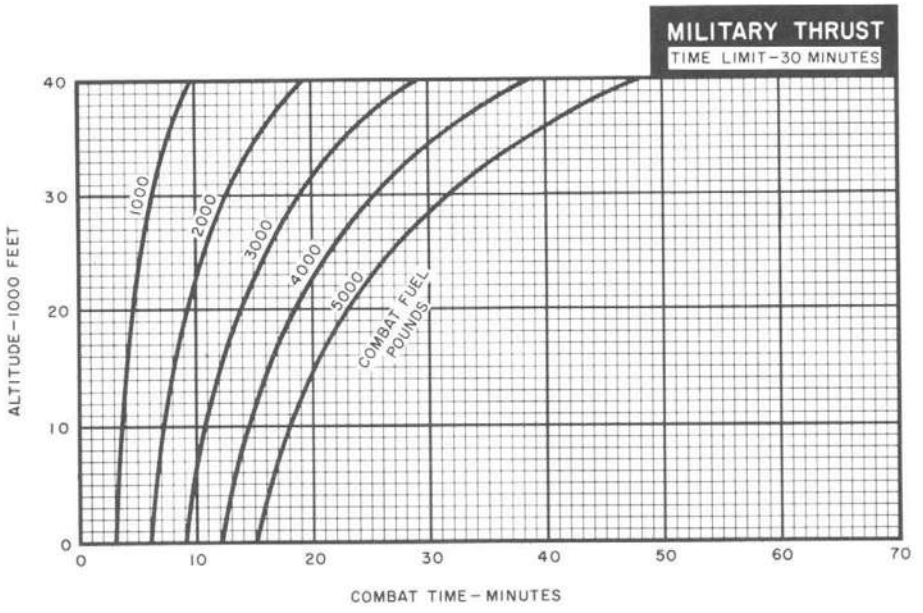
The charts shown in figure B-39, include a summary of operating data for both one-engine and two-engine operation at maximum continuous power (normal thrust) for several gross weights. The airspeeds (CAS and TAS) and corresponding fuel consumption figures in pounds per hour per engine are representative of maximum speed in level flight at various altitudes with throttle(s) set at normal power.

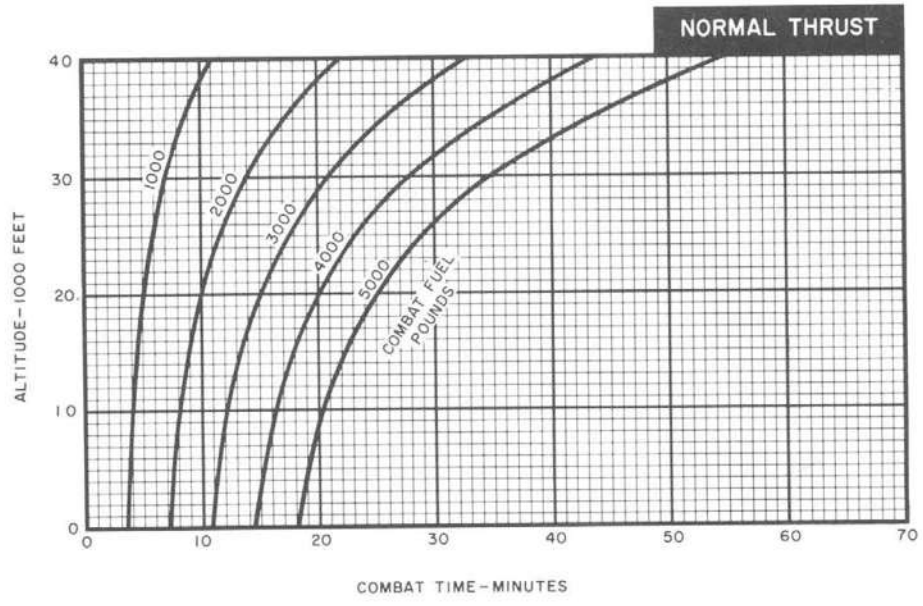
TWO ENGINE OPERATION

COMBAT ALLOWANCE CHART

STANDARD DAY

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10





P-17357-1A

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-38. Combat Allowance Chart

TWO ENGINE OPERATION

MAXIMUM CONTINUOUS POWER SUMMARY

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10

CLEAN CONFIGURATION WEIGHT: 80,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 70,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS / HOUR / ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR / ENGINE
8200	530	530	SEA LEVEL	530	530	8200
7350	535	500	5000	500	535	7350
6600	535	470	10,000	470	535	6600
6100	535	435	15,000	440	535	6100
5700	530	405	20,000	405	530	5700
4800	520	365	25,000	370	525	4800
4200	505	330	30,000	335	515	4150
3400	480	285	35,000	295	495	3400
—	—	—	40,000	235	445	2650

CLEAN CONFIGURATION WEIGHT: 60,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 50,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS / HOUR / ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR / ENGINE
8150	535	535	SEA LEVEL	530	530	8200
7350	535	505	5000	505	535	7350
6600	540	475	10,000	475	540	6600
6050	535	440	15,000	440	535	6050
5600	530	405	20,000	405	535	5600
4850	525	370	25,000	375	525	4800
4150	515	335	30,000	340	520	4150
3500	505	300	35,000	305	510	3450
2700	485	255	40,000	265	500	2750
—	—	—	45,000	225	475	2100

P-17380-1A

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-39. Maximum Continuous Power Summary – Two-Engine (Sheet 1)

ONE ENGINE OPERATION

MAXIMUM CONTINUOUS POWER SUMMARY

MODEL: A-3B, EA-3B, RA-3B, TA-3B—**CAMBERED WING** **ENGINES:** J57-P-10

CLEAN CONFIGURATION WEIGHT: 80,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 70,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS / HOUR / ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR / ENGINE
7600	350	350	SEA LEVEL	360	360	7650
6850	350	325	5000	340	365	6900
6150	340	295	10,000	320	365	6250
—	—	—	15,000	290	360	5600
—	—	—	20,000	250	335	4900

CLEAN CONFIGURATION WEIGHT: 60,000 POUNDS				CLEAN CONFIGURATION WEIGHT: 50,000 POUNDS		
APPROXIMATE			PRESSURE ALTITUDE FEET	APPROXIMATE		
POUNDS / HOUR / ENGINE	TAS KNOTS	CAS KNOTS		CAS KNOTS	TAS KNOTS	POUNDS / HOUR / ENGINE
7700	370	370	SEA LEVEL	375	375	7750
6950	375	350	5000	355	380	6950
6300	380	330	10,000	340	390	6350
5700	385	310	15,000	325	400	5700
5100	380	285	20,000	305	405	5150
4450	360	250	25,000	280	405	4600
—	—	—	30,000	245	385	3850

P-17381—1A

REMARKS:

(1) Inoperative engine windmilling.

(2) Normal thrust on operating engine.

DATA AS OF: 1 February 1960
DATA BASIS: NATC and Contractor Flight Tests

FUEL GRADE: JP-5
FUEL DENSITY: 6.8 lb/gal

Figure B-39. Maximum Continuous Power Summary – One-Engine (Sheet 2)

ALPHABETICAL INDEX

Primary subjects are listed flush with left-hand margin. Secondary subjects are indented under related primary subjects. The number following subjects indicates page on which text appears. Items underlined indicate tables and illustrations contained in the test, followed by page on which they appear. All charts and tables concerning aircraft and engine performance are listed alphabetically under Performance Data.

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Detail procedures, components and sub-systems are listed under the major system heading.

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15 FEBRUARY 1965

MAR 29 1965

NOTICE NOTICE NOTICE NOTICE

THIS IS NOT A CHANGE. ATTACHED INDEX PAGES 5, 6, 7 and 8 WERE INADVERTENTLY OMITTED FROM MANUAL DATED 15 OCTOBER 1964. PLEASE INSERT.

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