Wallace

TM 55-1510-204-10

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

OPERATORS' MANUAL

ARMY MODELS OV-1A, OV-1B and OV-1C AIRCRAFT

HEADQUARTERS, DEPARTMENT OF THE ARMY
SEPTEMBER 1963

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CHAPTER 1
INTRODUCTION

Section I. Scope

IMPORTANT

In order to obtain complete information and derive maximum benefits from this manual, it is necessary that this chapter be read carefully and thoroughly.

Note

In accordance with DOD Directive number 4505.6, dated July 6, 1962 the model designation of all Mohawk aircraft is changed as follows:

Old Designation	New Designation
AO-1A	OV-1A
AO-1B	OV-1B
AO-1C	OV-1C

This technical manual reflects the new model designations.

1-1. This manual, issued expressly for operators, is an official document for Army Models OV-1A Aircraft (Serial No. 59-2603 through 59-2620 and 60-3720 through 60-3744), OV-1B Aircraft (Serial No. 59-2621 through 59-2637 and 62-5859 through 62-5906), and OV-1C Aircraft (Serial No. 60-3745 through 60-3761, 61-2675 through 61-2728 and 62-5849 through 62-5858). The purpose of this manual is to supply you with the latest information and performance data derived from flight test programs and operational experience. The study and use of this manual will enable you to perform the assigned missions and duties with maximum efficiency and safety.

1-2. Your ability and experience are recognized. It is not the function of this manual to teach the pilot how to fly; basic flight principles and elementary instructions are not included. The contents of this manual will provide you with a general knowledge of Army Models OV-1A, OV-1B, and OV-1C aircraft, their flight characteristics, and specific normal and emergency operating procedures. Recommendations and comments pertaining to content of this manual should be submitted to the U.S. Army Transportation Materiel Command.

1-3. Reports necessary to comply with the Army Safety Program are prescribed in detail in AR 385-40.

1-4. The index lists, in alphabetical order, every important subject under the topic which may be of significance to the operator.

1-5. Appendix I consists of a list of references applicable and available to the operator. All references called out in the text are reflected in this appendix.

1-6. Appendix II references the Maintenance Allocation Chart.

1-7. Appendix III references the Basic Issue Item List.

1-8. Appendix IV is the Operator's Check List and is published separately from the Operator's Manual.

Section II. General

2-1. SCOPE. The contents of this manual are arranged under chapters and sections as indicated in the Table of Contents. A brief description of each chapter is provided in Section I of the applicable chapters.

2-2. Distribution and revision of pages contained in this Technical Manual is accomplished in accordance with AR310-1.

2-3. Notes, cautions, and warnings are included as adjuncts to the text and are used as defined below:

NOTE

An operating procedure or condition, which is essential to highlight.

CAUTION

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

WARNING

Operating procedures or practices which will result in personal injury or loss of life if not correctly followed.

2-4. Authorizations for issue of this Technical Manual will be made in accordance with AR310-1 and AR310-3.

2-5. The direct reporting of errors, omissions and recommendations for improving this equipment manual by the individual user, is authorized and encouraged. DA Form 2028 will be used for reporting these improvements. This form may be completed using pencil, pen or typewriter. DA Forms 2028 will be completed in triplicate and forwarded by the individual using the manual. The original and one copy will be forwarded direct to: Commanding General, U. S. Army Aviation and Surface Materiel Command, P. O. Box 209, Main Office, St. Louis, Mo. 63166. One information copy will be provided to the individual's immediate supervisor (e.g., officer, noncommissioned officer, supervisor, etc.).

2-6. GROUP CODING. With the exception of Chapters 12 and 14, paragraphs and text that do not apply to all OV-1 aircraft will be accompanied by a group coding symbol. Each symbol represents the model designation and serial numbers of the applicable aircraft. The Group Coding Chart (table 2-I) indicates what aircraft each symbol represents.

2-7. Since the OV-1 aircraft consist of three models (OV-1A, OV-1B, and OV-1C), the Group Coding Chart has been divided in three columns, each column representing a model designation. This allows for complete identification of the applicable aircraft when checking symbol representation. Each symbol in the chart represents the entire horizontal line adjacent to it. The cross-hatched areas indicate that the model in that column does not apply to the symbol representing that line.

2-8. To insure proper use of the group coding system, an example of use has been provided below.

Example: (See paragraph 2-10, Chapter 2, Section II, page 2-2.) The symbols [3], [4], [5] and [6] appear in the paragraph indicating that specific information does not apply to all OV-1 aircraft. To determine what aircraft do apply, refer to the Group Coding Chart (Chapter 1, Section II, table 2-I). From the chart determine that the SLAR system pertains only to OV-1B model aircraft having serial numbers 59-2621 thru 59-2637 ([3]) and 62-5859 thru 62-5906 ([4]). Also determine that the IR system pertains only to OV-1C model aircraft having serial numbers 60-3745 thru 60-3761 and 61-2675 thru 61-2728 ([5]), and 62-5849 thru 62-5858 ([6]).

GROUP CODING—TM 55-1510-204-10

Aircraft having different or additional systems and equipment are group coded to avoid the listing of model designations and serial numbers in the text. Information not applicable to all OV-1 aircraft will be accompanied by a group coding symbol. The groups with the aircraft they include are as follows:

CODE	MODEL		
	OV-1A SERIAL NUMBERS	OV-1B SERIAL NUMBERS	OV-1C SERIAL NUMBERS
1	59-2603 THRU 59-2620		
2	60-3720 THRU 60-3744		
3		59-2621 THRU 59-2637	
4		62-5859 THRU 62-5906	
5			60-3745 THRU 60-3761 61-2675 THRU 61-2728
6			62-5849 THRU 62-5858
7	60-3720 THRU 60-3744	59-2621 THRU 59-2637 62-5859 THRU 62-5906	60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
8	59-2603 THRU 59-2620 60-3720 THRU 60-3744	59-2627 THRU 59-2633	60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
9		59-2621 THRU 59-2626 59-2634 THRU 59-2637 62-5859 THRU 62-5906	
10	59-2603 THRU 59-2620 60-3720 THRU 60-3730	59-2621 THRU 59-2637	
11	60-3731 THRU 60-3744		
12	60-3720 THRU 60-3730		
13	60-3720 THRU 60-3726		
14	60-3727 THRU 60-3744		

GROUP CODING—TM 55-1510-204-10 (cont)

CODE	MODEL		
	OV-1A SERIAL NUMBERS	OV-1B SERIAL NUMBERS	OV-1C SERIAL NUMBERS
15		59-2627 THRU 59-2633	
16		59-2621 THRU 59-2626 59-2634 THRU 59-2637	
17			61-2720 THRU 61-2728
18			61-2675 THRU 61-2719
19		62-5859 THRU 62-5906	61-2675 THRU 61-2728 62-5849 THRU 62-5858
20	60-3731 THRU 60-3744	62-5859 THRU 62-5906	60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
21	59-2603 THRU 59-2620	59-2621 THRU 59-2637	
22	60-3720 THRU 60-3744	62-5859 THRU 62-5906	60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
23	59-2603 THRU 59-2620 60-3720 THRU 60-3744		
24			61-2720 THRU 61-2728 62-5849 THRU 62-5858
25	59-2603 THRU 59-2620 60-3720 THRU 60-3744	59-2621 THRU 59-2637	60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
26	59-2603 THRU 59-2620 60-3720 THRU 60-3726	59-2621 THRU 59-2637	
27	60-3727 THRU 60-3744		60-3745 THRU 60-3761 61-2675 THRU 61-2728
28		62-5859 THRU 62-5906	62-5849 THRU 62-5858

GROUP CODING—TM 55-1510-204-10 (cont)

CODE	MODEL		
	OV-1A SERIAL NUMBERS	OV-1B SERIAL NUMBERS	OV-1C SERIAL NUMBERS
29	60-3720 THRU 60-3726	59-2621 THRU 59-2637	60-3745 THRU 60-3761 61-2675 THRU 61-2701
30			61-2702 THRU 61-2728
31			60-3745 THRU 60-3761
32			61-2675 THRU 61-2728 62-5849 THRU 62-5858
33			61-2675 THRU 61-2728
34	59-2603 THRU 59-2620 60-3720 THRU 60-3744	59-2621 THRU 59-2637	60-3745 THRU 60-3761 61-2675 THRU 61-2681
35		62-5859 THRU 62-5906	61-2682 THRU 61-2728 62-5849 THRU 62-5858
36	60-3720 THRU 60-3744	59-2621 THRU 59-2637 62-5859 THRU 62-5906	
37		59-2621 THRU 59-2637 62-5859 THRU 62-5906	60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
38	59-2603 THRU 59-2620 60-3720 THRU 60-3744	59-2621 THRU 59-2637	60-3745 THRU 60-3761 61-2675 THRU 61-2710
39	60-3720 THRU 60-3744	59-2621 THRU 59-2637	60-3745 THRU 60-3761 61-2675 THRU 61-2710
40		62-5859 THRU 62-5906	61-2711 THRU 61-2728 62-5849 THRU 62-5858
41		62-5859 THRU 62-5906	60-3758 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
42		59-2621 THRU 59-2637 62-5859 THRU 62-5906	60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858
43	59-2603 THRU 59-2620 60-3720 THRU 60-3744		60-3745 THRU 60-3761 61-2675 THRU 61-2728 62-5849 THRU 62-5858

Figure 2-1. The Aircraft

CHAPTER 2
DESCRIPTION

Section I. Scope

1-1. The purpose of Chapter 2 is to provide the pilot with information that will familiarize him with the AO-1 (Mohawk) aircraft and all the systems, controls, and indicators which contribute to the physical act of flying the aircraft.

1-2. This chapter is not designed to provide instruction on the complete mechanical and electrical workings of the various systems. Therefore each is described only in enough detail to make comprehension of that system sufficiently complete to allow for its safe and efficient operation.

Section II. Systems and Controls

2-1. THE AIRCRAFT.

2-2. GENERAL.

2-3. The OV-1 (Mohawk) is a two-place, twin-engine turboprop aircraft (See figure 1-1). It is designed to operate from small, unimproved fields for purposes of tactical observation. Specifically, the aircraft is capable of performing visual observation missions, day and night photography, electronic surveillance, and is suitable for night and instrument operations. It can provide the field commander with timely target information, aerial fire direction, and post strike damage assessment for Army long- and medium-range weapons.

2-4. The aircraft is a tricycle-geared, mid-winged, tri-tail type with engine nacelles mounted on top of the wings. (For aircraft and cockpit general arrangement diagrams, see figures 2-2 and 2-3.) The aircraft incorporates provisions to mount drop tanks or resupply containers, which are hung as

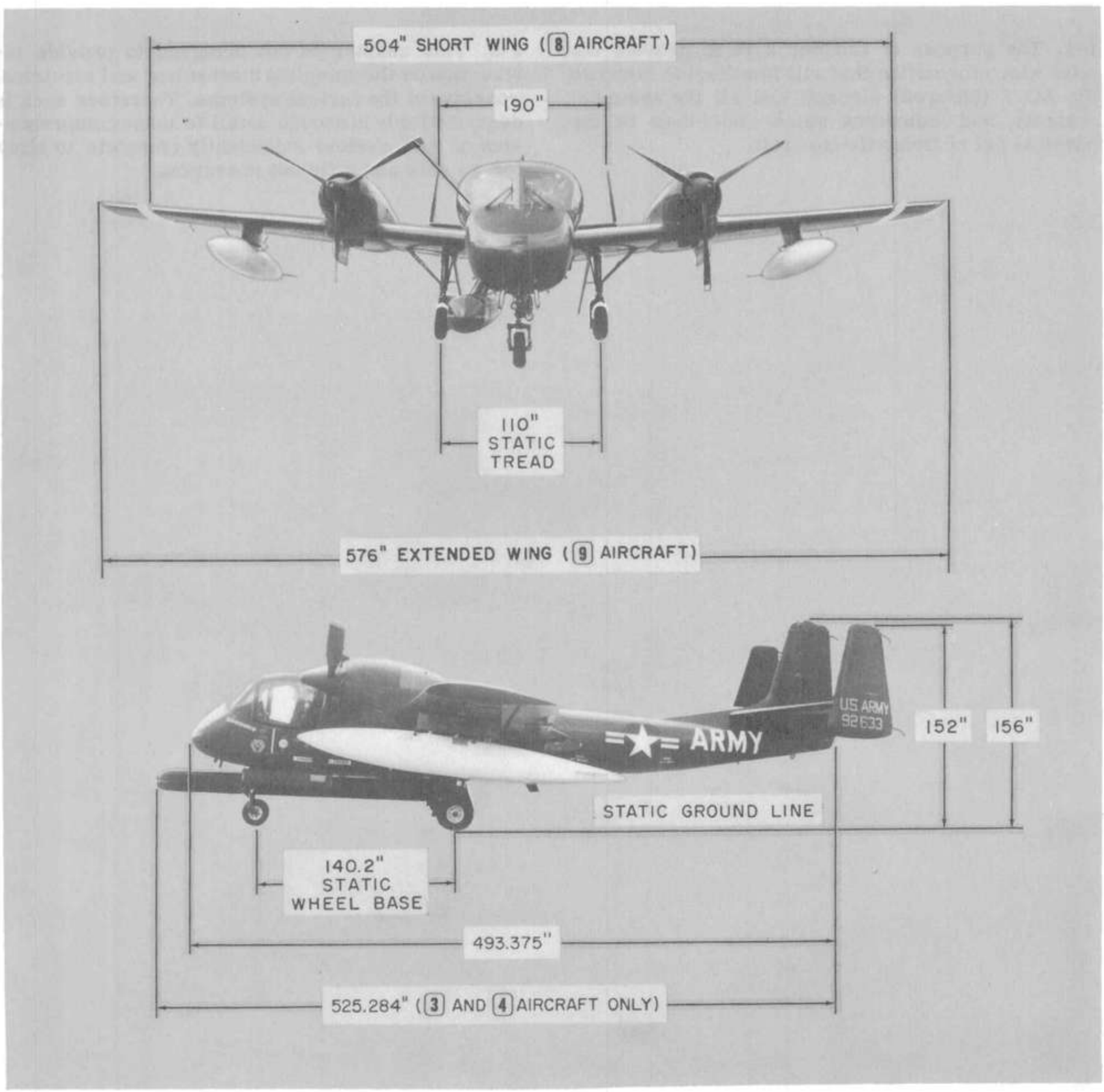


Figure 2-1. Overall Dimensions

external stores on the wing outer panels. A camera installation is located in the fuselage midsection. Primary control surfaces are standard and consist of manually operated ailerons, elevators, and rudders. A 3000 psig hydraulic system actuates the landing gear, speed brakes, flaps, slats, inboard ailerons, wheel brakes, and windshield wipers. The OV-1 aircraft incorporates the following electrically operated equipment: communication, navigation, radar, heating and ventilation, anti-icing, photographic, radar surveillance (SLAR) ([3] and [4] aircraft and infrared surveillance ([5] and [6] aircraft). [7] Aircraft also incorporate an automatic flight control system.

2-5. LEADING PARTICULARS.

2-6. The leading particulars of the aircraft are listed below (see figure 2-1). For main differences of the various Mohawk models, refer to table 2-1.

Wing Span .... 42 ft. on [8] aircraft.
48 ft. on [9] aircraft.

Overall Length .... 41 ft. 1.37 in.

Tail Height .... 12 ft. 8 in.

Powerplant.....(2)Lycoming T53-L-3 on [8] aircraft.
(2)Lycoming T53-L-7 on [9] aircraft.

Takeoff Power .... 1005 eshp each for T53-L-3 engines.
1150 eshp each for T53-L-7 engines.

2-7. OBSERVATION MISSION.

2-8. VISUAL OBSERVATION. The principal function of the OV-1 aircraft is observation. Maximum visibility is achieved by the use of large blister side windows, bubbled side hatches, and a low main supporting longeron. A transparent jettisonable hatch, which provides necessary clearance for ejection, also allows complete vision directly overhead.

2-9. PHOTOGRAPHIC. The OV-1 aircraft camera installation consists of a photographic control system which remotely operates a camera located in the fuselage midsection. This camera is capable of shooting vertical and 15° and 30° oblique photographs to either side. A flare pod can be installed at each fuselage and wing center panel intersection to accommodate night photography. (See Chapter 6, Section V for further details.)

2-10. RADAR OR INFRARED SURVEILLANCE. On [3] and [4] aircraft, surveillance equipment includes a radar (SLAR) reconnaissance system with a data link also installed on [3] aircraft. An infrared (IR) system is installed on [5] and [6] aircraft. (For further details see Chapter 5, Section II.)

2-11. ENGINE.

2-12. GENERAL. (See figure 2-4.)

2-13. The aircraft is powered by two Lycoming turboprop engines turning three bladed Hamilton Standard Hydromatic propellers. The powerplant installation on short wing ([8] aircraft) consists of two T53-L-3 engines, each capable of producing 1005 equivalent shaft horsepower (eshp). The powerplant on extended wing ([9] aircraft) consists of two T53-L-7 engines each capable of producing 1150 eshp. No distinction is made between the left and right installations. Some of the main characteristics and features of the engine and propeller are described below.

a. The engine features a single-stage, free-type power turbine, a combination axial-centrifugal compressor driven by a single-stage turbine, and an external annular vaporizing combustor.

b. At takeoff rated power the propeller shaft speed is approximately 1678 rpm. The gear ratio between the power turbine and the propeller drive is 12.40 to 1.

c. The propellers are capable of variable pitch, with full feathering and reverse pitch operation, and have synchronizing and synchrophasing features. (See Chapter 9, Section II.)

2-14. ENGINE FUEL CONTROL SYSTEM.

2-15. GENERAL. The engine fuel system comprises a combination high-pressure pump and fuel control unit, a main fuel manifold and a starting manifold with nozzles incorporating high-pressure filters, a fuel pressurizing and shutoff valve, and an automatic pressure-activated combustion chamber drain valve. The fuel control unit meters fuel flow in relation to the primary turbine (gas producer speed). Fuel flows thus established are maintained automatically in accordance with changes in altitude and changes in compressor inlet temperature. An emergency fuel metering system is provided as an integral part of the control. The control is composed of three units: the fuel meter, the computer, and the topping governor. The fuel meter, pumps, meters, and delivers fuel to the solenoid-operated starter manifold. The computer determines the rate at which the fuel meter delivers fuel to the engine, as a function of primary turbine speed, altitude, compressor inlet temperature, and manual throttle (power lever) selection. The topping governor overrides the primary turbine governor of the computer to control metered fuel flow at prescribed power turbine speeds.

2-16. FUEL CONTROL SWITCHES. The fuel control switches (see figure 2-9) are located on the engine control panel. Each switch has two positions: AUTO and EMER. When the switch is in AUTO position, operation is as described in a. below. In the EMER position, operation is as described in b. below.

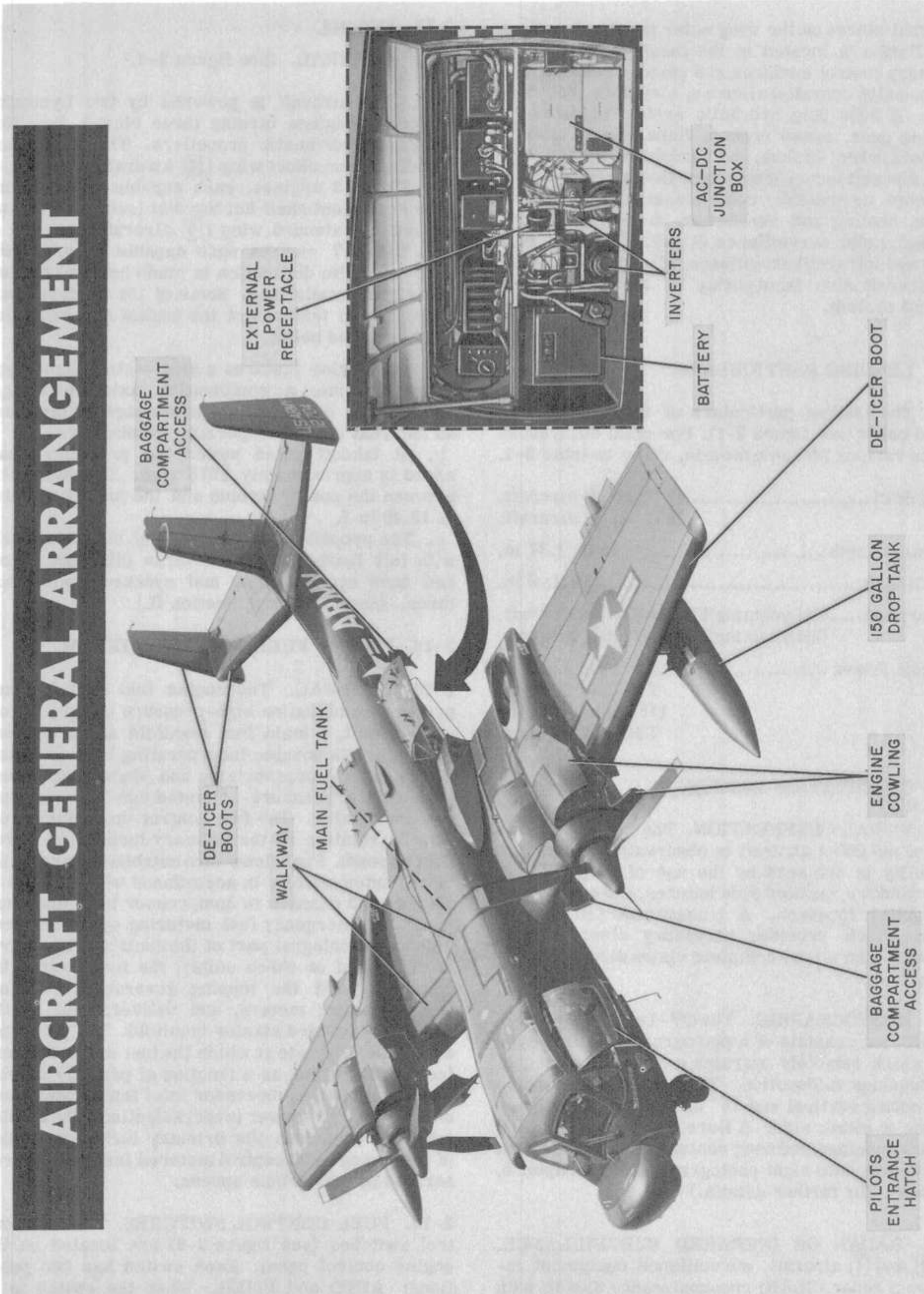


Figure 2-2. General Arrangement Diagram (Sheet 1 of 2)

Figure 2-2. General Arrangement Diagram (Sheet 2 of 2)

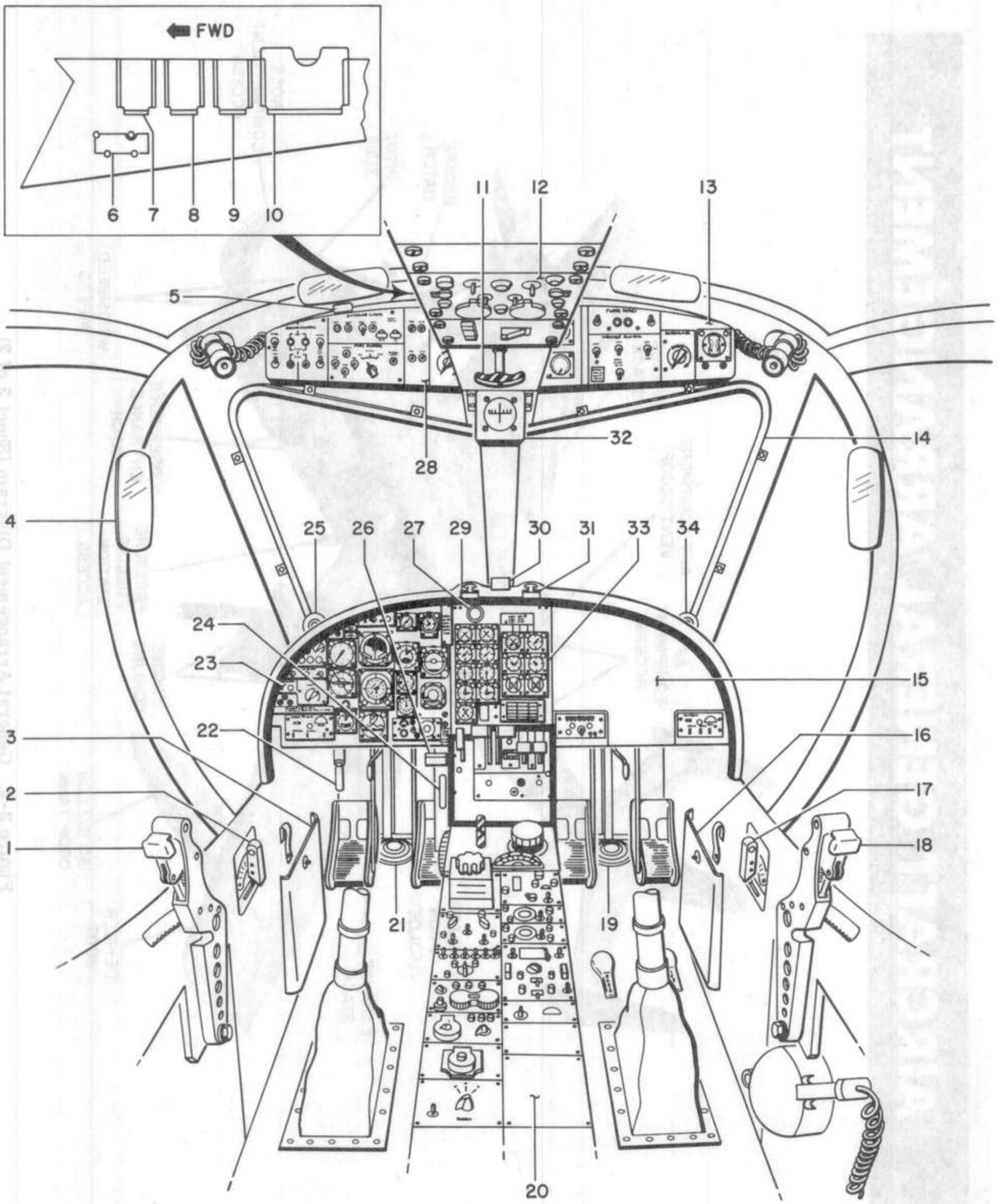


Figure 2-3. Cockpit General Arrangement, Typical (Sheet 1 of 2)

KEY TO FIGURE 2-3:

1. Pilot's entrance hatch handle
2. Pilot's air diffuser handle
3. Pilot's map case
4. Mirror (4)
5. Airspeed correction card
6. ICS function chart
7. Course indicator correction card
8. Standby compass correction chart
9. RMI compass correction card
10. HF frequency chart
11. Emergency hatch jettison handle
12. Center overhead console
13. Right overhead console
14. Windshield defog nozzle
15. Observer's console
16. Observer's map case
17. Observer's air diffuser handle
18. Observer's entrance hatch handle
19. Observer's air diffuser
20. Center lower console
21. Pilot's air diffuser
22. Foot pedal adjust handle
23. Pilot's instrument panel
24. Auxiliary vent handle
25. Pilot's face air outlet
26. Parking brake handle
27. Windshield wiper control
28. Left overhead console
29. No. 1 fire emergency control handle
30. Radio call numbers
31. No. 2 fire emergency control handle
32. Standby compass
33. Center instrument panel
34. Observer's face air outlet
35. Observer's circuit breaker panel ([3] thru [6] aircraft)
36. Center circuit breaker panel
37. Observer's oxygen hose (secured)
38. Observer's sunshade
39. Pilot's sunshade
40. Emergency hatch pneumatic actuator fill valve
41. Center sloping console
42. Pilot's oxygen hose (secured)
43. Pilot's circuit breaker panel [7] aircraft
44. Pilot's relief tube
45. MK-J5 Martin-Baker ejection seat (2)
46. Observer's relief tube

NOTE

On [10] aircraft, without MWO 55-1510-204-34/10 incorporated, the AUTO position is called PRIMARY and the EMER position is called MANUAL (see figure 2-11). All other aircraft are as described above.

a. Automatic Operation. In normal operation with the fuel control switch in AUTO position, fuel is fed into both engines by two low-pressure centrifugal boost pumps located fore and aft in the main tank. The fuel is then passed in turn through a low-pressure filter, through the dual-element high-pressure pumps, to the fuel control unit where it is properly metered. The metered fuel then travels through the manifold to the filtering fuel nozzles and then to the annular combustion chamber.

b. Emergency Operation. When the fuel control switch is in the EMER position, there is no automatic acceleration or deceleration control, nor are there any temperature or density compensations. Therefore, the power levers must be operated carefully to avoid overtemperature (overspeeding) or the loss of engine fire resulting from too rapid a power lever operation. RAPID POWER LEVER MOTIONS MUST BE AVOIDED WHETHER OPERATING IN THE FORWARD THRUST RANGE, REVERSE THRUST RANGE, OR CHANGING FROM ONE RANGE TO THE OTHER. On aircraft with T 53-L-3 engines only reverse thrust for landing is possible with emergency fuel control; however, care and slow power lever motion should be observed particularly when accelerating from low engine rpm conditions. Engine damage can be prevented by diligent observation of the exhaust gas temperature indicator.

2-17. EMERGENCY FUEL CONTROL INDICATOR LIGHTS. The emergency fuel control indicator lights are located on the caution light panel (12, figure 2-7). They are amber colored lights that glow whenever the engine fuel control switches are in the EMER position.

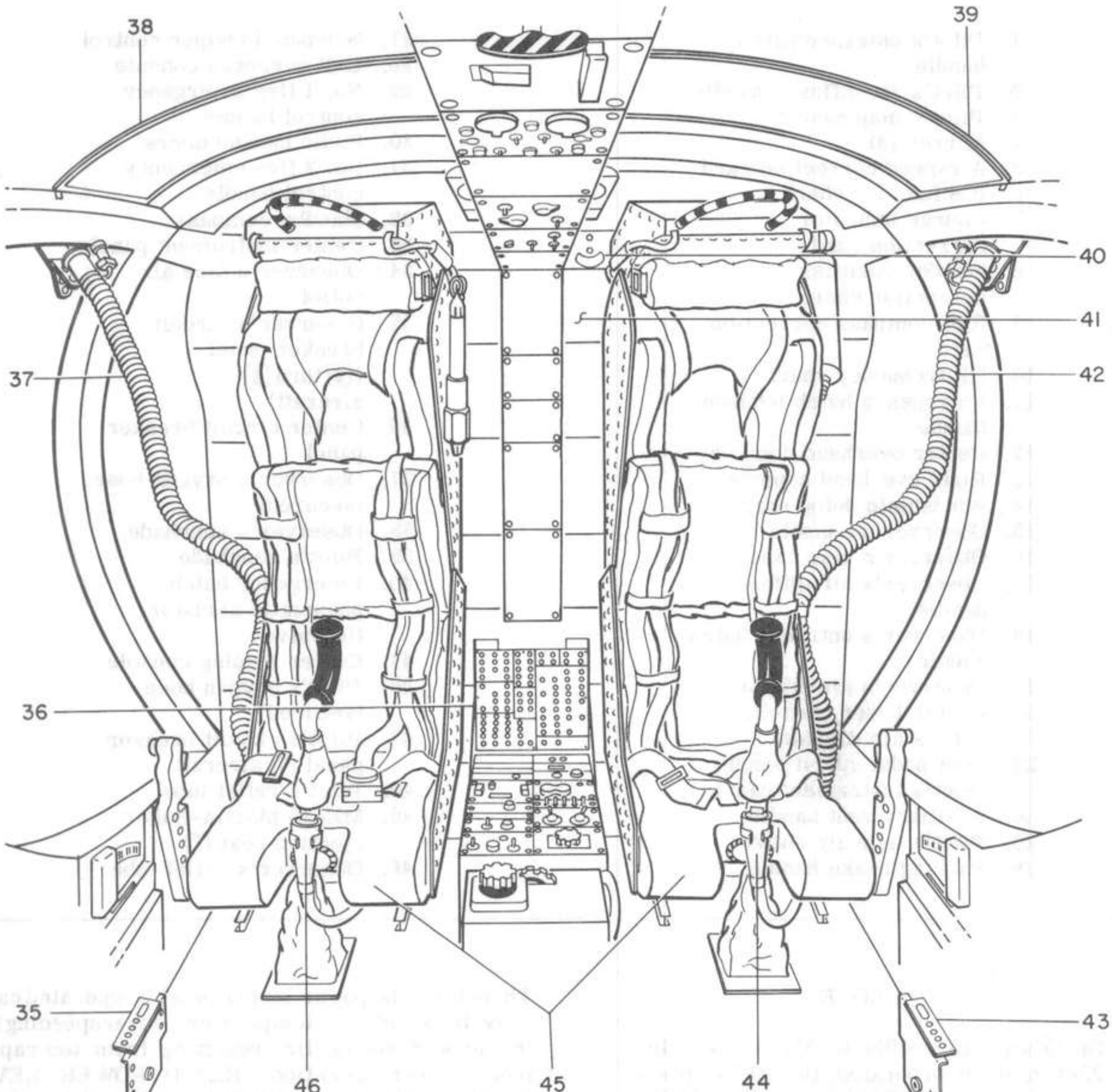


Figure 2-3. Cockpit General Arrangement, Typical (Sheet 2 of 2)

NOTE

On [10] aircraft, without MWO 55-1510-204-34/10 incorporated, these caution lights are called fuel manual. All other aircraft are as described above.

2-18. POWER LEVERS. The power levers (9, figure 2-8) are located on the upper left side of the control pedestal. The levers are operable individually and have five basic positions: TAKE OFF, MILPOWER, FLIGHT IDLE, GROUND IDLE, and FULL REVERSE. A detent at FLIGHT IDLE minimizes the possibility of inadvertent use of GROUND IDLE while in flight, as this would make an acceleration to takeoff power too lengthy when in the approach configuration. To prevent reversing the propeller by accident, either on the ground or in the air, a cam has been placed within the quadrant between GROUND IDLE and FULL REVERSE. The power lever must be raised radially 1-1/2 inches along the cam to reverse thrust. A thumb operated switch (10, figure 2-8) on the left power lever controls the speed brakes. Apparent power back-

TABLE 2-I. MAIN DIFFERENCES TABLE

ITEM	OV-1A [1] AIRCRAFT	OV-1A [2] AIRCRAFT	OV-1B [3] AIRCRAFT	OV-1C [5] AIRCRAFT	OV-1B [4] AIRCRAFT	OV-1C [6] AIRCRAFT
Normal Observation Takeoff Gross Weight** (with 1930 lbs internal fuel)	12,061 lbs	12,345 lbs	13, 318 lbs	12,676 lbs		
Weight Empty**	9,390 lbs	9,673 lbs	10,650 lbs	10,004 lbs		
Wing	Short	Short	Short[g] Extended[h]	Short	Extended	Short
Flight Controls	Pilot and observer	Pilot and observer	Pilot only	Pilot only	†Pilot only	†Pilot only
Slats	Installed	Installed	Installed[g] None[h]	Fixed[i] Installed[j]	None	None
Speed Brakes	Installed	Installed	Installed	Installed	None	Installed
Martin Baker Ejection Seat	MK-J5A	MK-J5A	MK-J5A	MK-J5A	MK-J5B	MK-J5A
Circuit Breaker Panel Locations	Center	Center and Left	Center and Left and Right	Center and Left and Right	Center and Left and Right	Center and Left and Right
Console Locations	Center Overhead, Center Lower, Left and Right Overhead, and Observer	Center Overhead, Center Lower, Left and Right Overhead, Observer, and Center Sloping	Center Overhead, Center Lower, Left and Right Overhead, Observer, and Center Sloping	Center Overhead, Center Lower, Left and Right Overhead, Observer, and Center Sloping	Center Overhead, Center Lower, Left and Right Overhead, Observer, and Center Sloping	Center Overhead, Center Lower, Left and Right Overhead, Observer, and Center Sloping
Nosewheel Steering	*	Installed[a] (*)[b]	*	Installed	Installed	Installed
Communications	ICS - AN/AIC-12 UHF command - AN/ARC-55B FM liaison - AN/ARC-44	ICS - AN/AIC-12 UHF command - AN/ARC-55B[c] or VHF command - AN/ARC-73[d] FM liaison - AN/ARC-44	ICS - AN/AIC-12 UHF command - AN/ARC-55B[c] or VHF command - AN/ARC-73[d] FM liaison - AN/ARC-44	ICS - AN/AIC-12 UHF command - AN/ARC-55B[c] or VHF command - AN/ARC-73[d] FM liaison - AN/ARC-44	ICS - AN/AIC-12 UHF command - AN/ARC-55B[c] or VHF command - AN/ARC-73[d] FM liaison - AN/ARC-44	ICS - AN/AIC-12 UHF command - AN/ARC-55B[c] or VHF command - AN/ARC-73[d] FM liaison - AN/ARC-44

TABLE 2-1. MAIN DIFFERENCES TABLE (cont)

ITEM	OV-1A [1] AIRCRAFT	OV-1A [2] AIRCRAFT	OV-1B [3] AIRCRAFT	OV-1C [5] AIRCRAFT	OV-1B [4] AIRCRAFT	OV-1C [6] AIRCRAFT
Communications (cont)		Emer VHF - T-366A/ARC	Emer VHF - T-366A/ARC	Emer VHF - T-366A/ARC	Emer VHF - T-366A/ARC	Emer VHF - T-366A/ARC
Navigation	VOR - AN/ARN - 30A Mkr bcn - AN/ARN-68 ADF - AN/ARN-59(V) Gyrocompass - MA-1 (Lear) Flt sys - AN/ASN-33	VOR - AN/ARN-30A [e] or AN/ARN-30D[f] (one[d] or two[c]) Mkr bcn - R-1041/ARN ADF - AN/ARN-59(V) (one[c] or two[d]) Gyrocompass - MA-1 (Lear) Flt sys - AN/ASN-33 Glide slope rcvr - AN/ARA-54	VOR - AN/ARN-30A (one[d] or two[c]) Mkr bcn - R-1041/ARN ADF - AN/ARN-59(V) (one[c] or two[d]) Gyrocompass - MA-1 (Lear) Flt sys - AN/ASN-33 Glide slope rcvr - AN/ARA-54 Radar navigation (doppler sys) - AN/APN-129(V)1	VOR - AN/ARN-30D (one[d] or two[c]) Mkr bcn - R-1041/ARN ADF - AN/ARN-59(V) (one[c] or two[d]) Gyrocompass - MA-1 (Lear) Flt sys - AN/ASN-33 Glide slope rcvr - AN/ARA-54	VOR - AN/ARN-30E (one[d] or two[c]) Mkr bcn - R-1041/ARN ADF - AN/ARN-59(V) (one[c] or two[d]) Gyrocompass - MA-1 (Lear) Flt sys - AN/ASN-33 Glide slope rcvr - AN/ARA-54 Radar navigation (doppler sys) - AN/APN-129(V)1	VOR - AN/ARN-30E (one[d] or two[c]) Mkr bcn - R-1041/ARN ADF - AN/ARN-59(V) (one[c] or two[d]) Gyrocompass - MA-1 (Lear) Flt sys - AN/ASN-33 Glide slope rcvr - AN/ARA-54
Radar	IFF - AN/APX-44	IFF - AN/APX-44 Gnd tck bcn - AN/DPN-62 Radar altm - AN/APN-22	IFF - AN/APX-44 Gnd tck bcn - AN/DPN-62 Radar altm - AN/APN-22	IFF - AN/APX-44 Gnd tck bcn - AN/DPN-62 Radar altm - AN/APN-22	IFF - AN/APX-44 Gnd tck bcn - AN/DPN-62 Radar altm - AN/APN-22	IFF - AN/APX-44 Gnd tck bcn - AN/DPN-62 Radar altm - AN/APN-22
Autopilot	None	AFCS - AN/ASW-12(V)	AFCS - AN/ASW-12(V)	AFCS - AN/ASW-12(V)	AFCS - AN/ASW-12(V)	AFCS - AN/ASW-12(V)
Surveillance	None	None	SLAR sys - AN/APS-94	IR sys - AN/AAS-14	††SLAR sys - AN/APS-94	††IR sys - AN/AAS-14

TABLE 2-1. MAIN DIFFERENCES TABLE (cont)

ITEM	OV-1A [1] AIRCRAFT	OV-1A [2] AIRCRAFT	OV-1B [3] AIRCRAFT	OV-1C [5] AIRCRAFT	OV-1B [4] AIRCRAFT	OV-1C [6] AIRCRAFT
Surveillance (cont)			Data link - AN/AKT-16 Recorder processor - viewer - RO-166/UP	Data link - AN/ART-41	††Recorder processor - viewer - RO-166/UP	††Data link - AN/ART-41

*Installed when MWO 55-1510-204-34/4 has been incorporated.
**Weight includes catalytic filter installation (70 lbs) and nosewheel steering installation (30 lbs).

[a] On [11] aircraft.

[b] On [12] aircraft.

[c] On aircraft based stateside.

[d] On aircraft based in Europe (USAREUR).

[e] On [13] aircraft.

[f] On [14] aircraft.

[g] On [15] aircraft.

[h] On [16] aircraft.

[i] On [17] aircraft.

[j] On [18] aircraft.

†If surveillance equipment has been installed, otherwise observer has flight controls.
††To be installed at a future date.

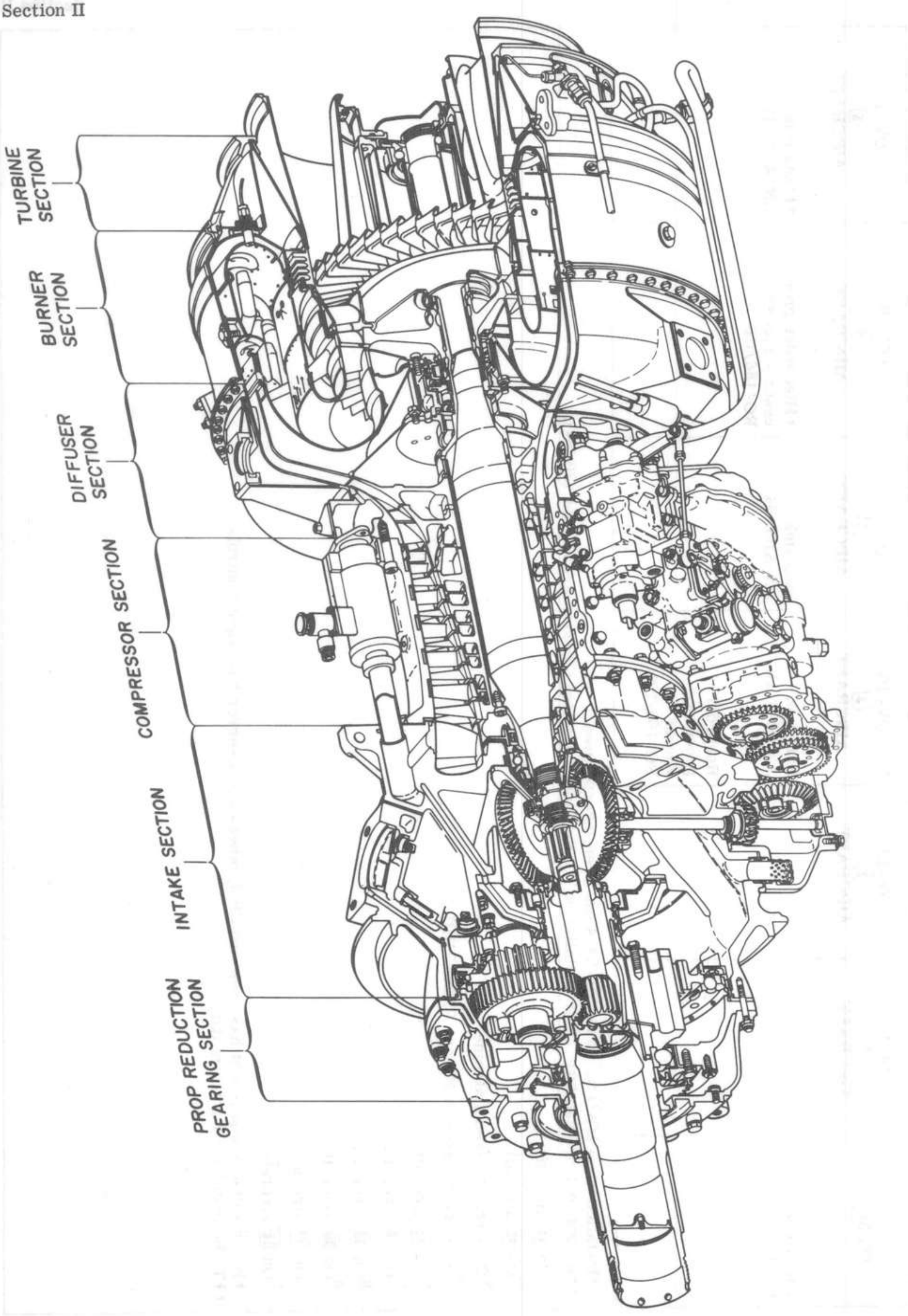
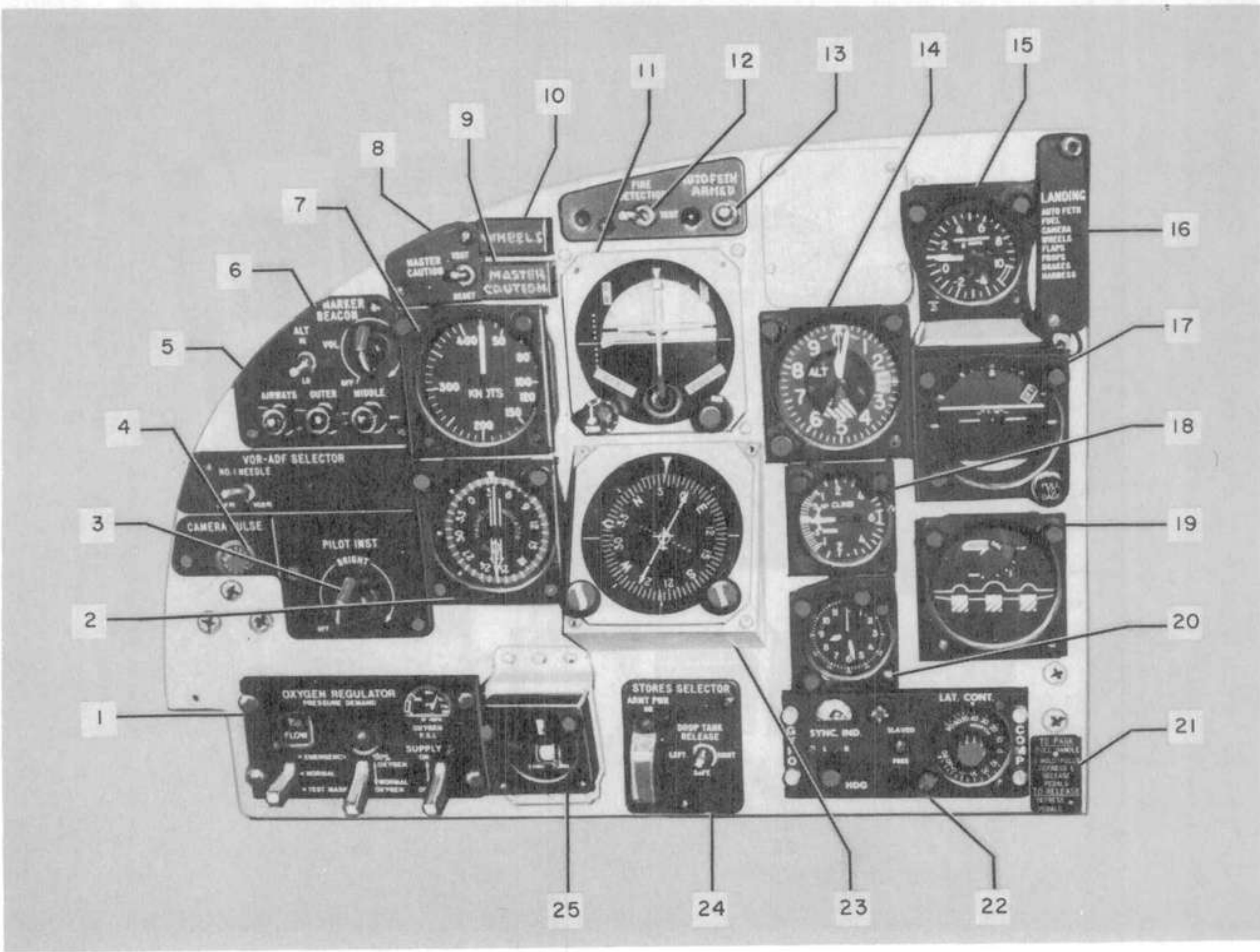
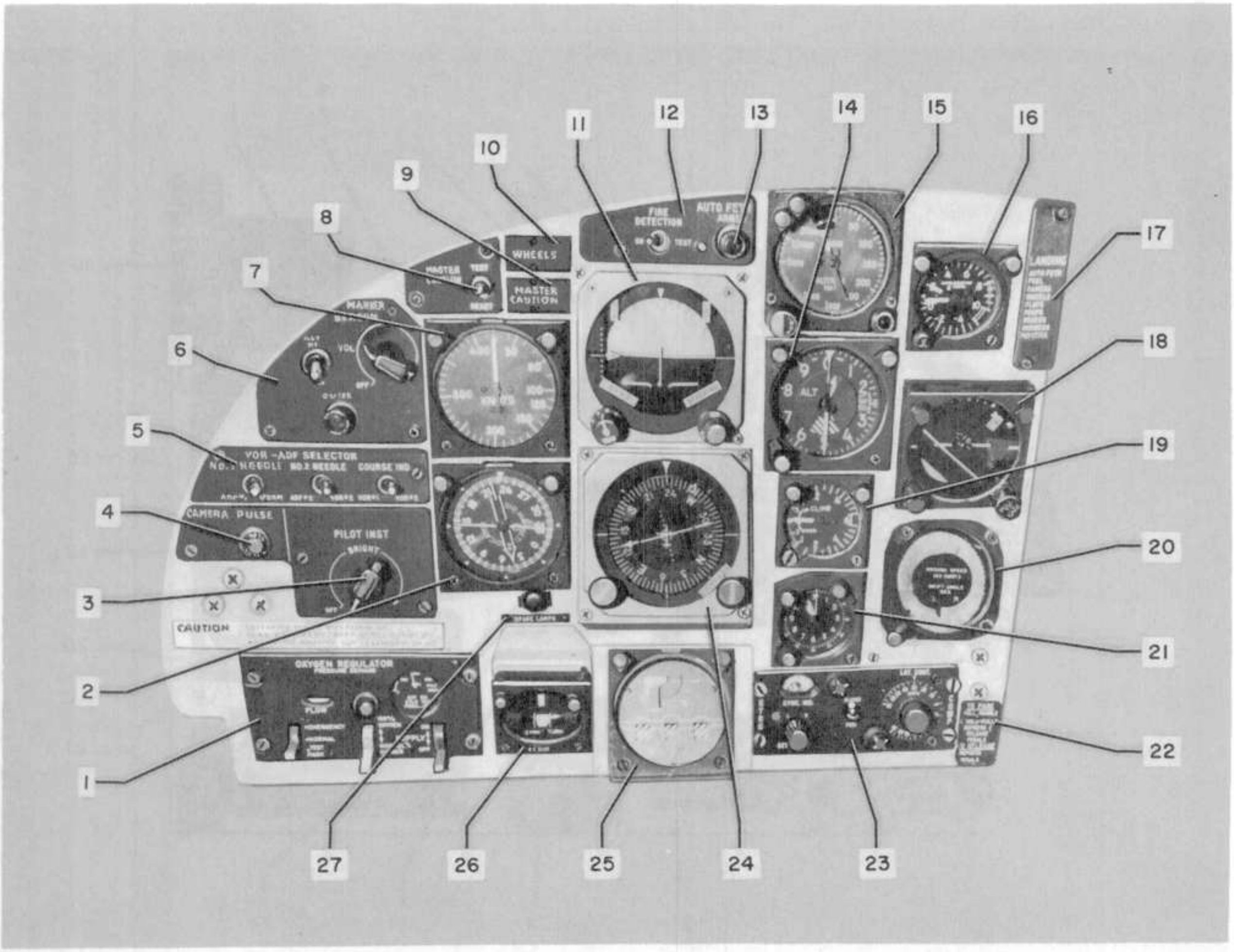


Figure 2-4. T53-L-3 or T53-L-7 Engine



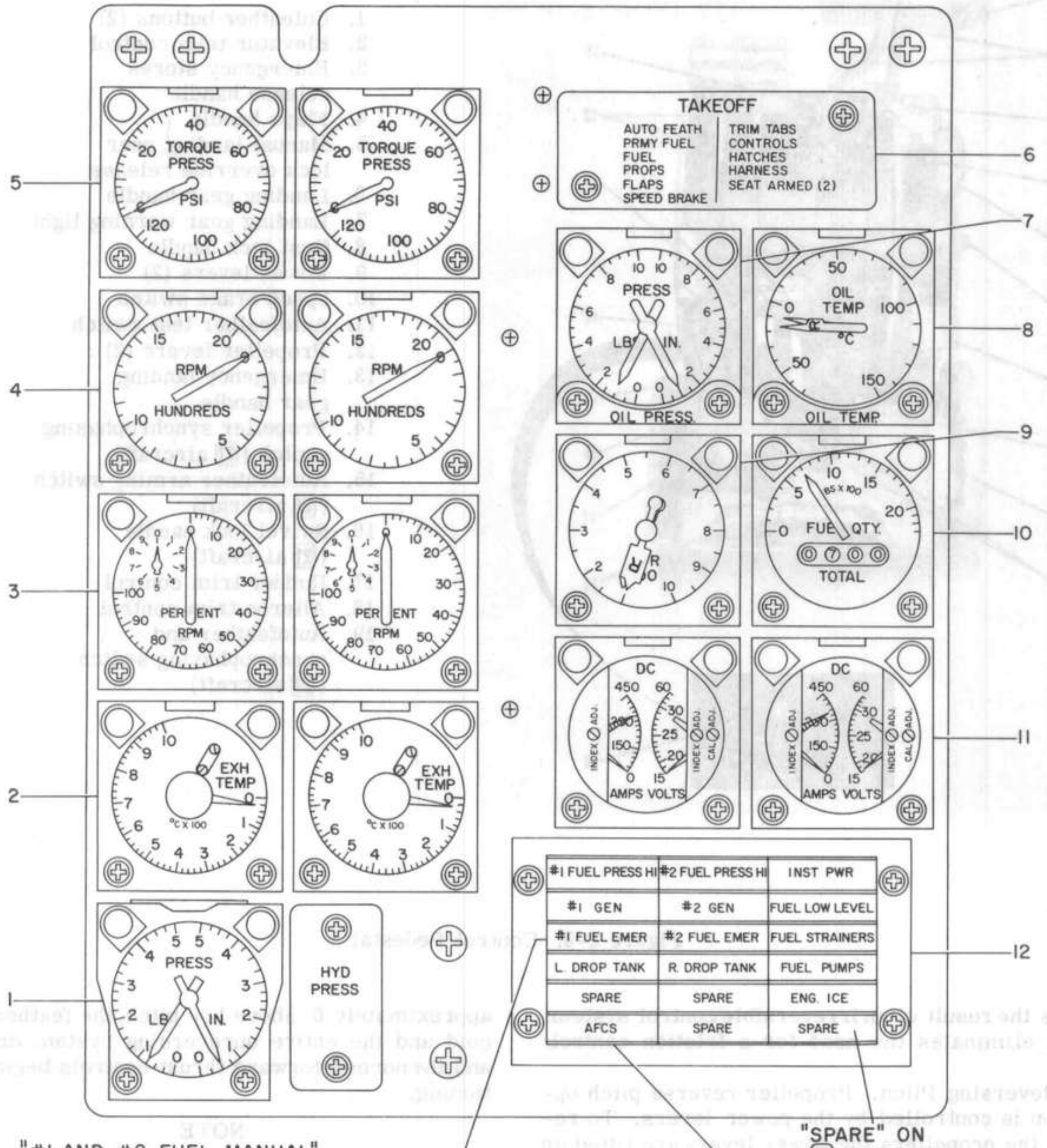
1. MD-2 oxygen regulator
2. Radio magnetic indicator (RMI)
3. Pilot's instrument brightness rheostat
4. CAMERA PULSE light
5. VOR-ADF selector panel
6. Marker beacon panel (ARN-68)
7. Airspeed indicator
8. Master caution test switch
9. MASTER CAUTION light
10. WHEELS warning light
11. Approach horizon indicator (ASN-33)
12. Fire detection test switch
13. Autofeather arming light (with MWO 55-1510-204-34/8 incorporated)
14. Altimeter
15. Accelerometer
16. Landing checklist
17. Vertical gyro indicator (VGI)
18. Rate of climb indicator
19. Wheels and flaps indicator
20. Mechanical clock
21. Parking checklist
22. Gyrocompass control panel (MA-1)
23. Course indicator (ASN-33)
24. Stores selector panel
25. Turn and slip indicator

Figure 2-5. Pilot's Instrument Panel (1 Aircraft)



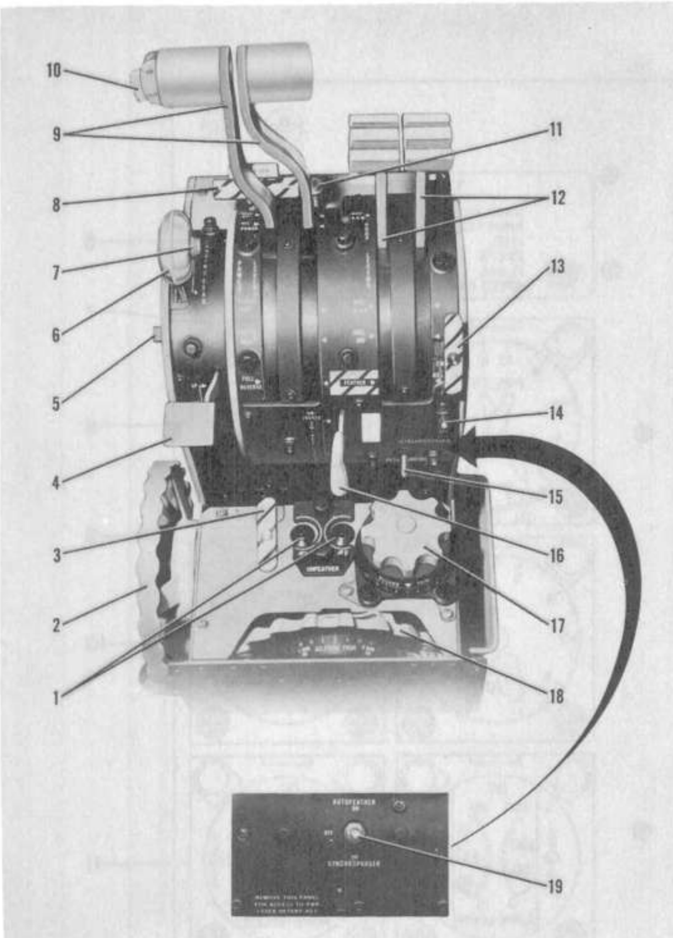
1. MD-2 oxygen regulator
2. Radio magnetic indicator (RMI)
3. Pilot's instrument brightness rheostat
4. CAMERA PULSE light
5. VOR-ADF selector panel
6. Marker beacon panel (typical)
7. Airspeed indicator
8. Master caution test switch
9. MASTER CAUTION light
10. WHEELS warning light
11. Approach horizon indicator (ASN-33)
12. Fire detection test switch
13. Autofeather armed light
14. Altimeter
15. Height indicator (APN-22)
16. Accelerometer
17. Landing checklist
18. Vertical gyro indicator (VGI)
19. Rate of climb indicator
20. Drift angle-ground-speed indicator (APN-129) (9 aircraft)
21. Mechanical clock
22. Parking checklist
23. Gyrocompass control panel (MA-1)
24. Course indicator (ASN-33)
25. Wheels and flaps indicator
26. Turn and slip indicator
27. Spare lamp

Figure 2-6. Pilot's Instrument Panel (7 Aircraft)



1. Hydraulic pressure indicator
2. Exhaust gas temperature indicators (2)
3. Engine tachometers (2)
4. Propeller tachometers (2)
5. Torquemeters (2)
6. Takeoff checklist
7. Oil pressure indicator
8. Oil temperature indicator
9. Fuel flowrate indicator
10. Fuel quantity indicator
11. Voltammeters (2)
12. Caution light panel

Figure 2-7. Center Instrument Panel



1. Unfeather buttons (2)
2. Elevator trim control
3. Emergency stores release handle
4. Flaps handle
5. Manual landing gear lock override release
6. Landing gear handle
7. Landing gear warning light
8. Gust lock handle
9. Power levers (2)
10. Speed brake switch
11. Autofeather test switch
12. Propeller levers (2)
13. Emergency landing gear handle
14. Propeller synchrophasing switch (21 aircraft)
15. Autofeather arming switch (21 aircraft)
16. Swivel lock handle (21 aircraft)
17. Rudder trim control
18. Aileron trim control
19. Autofeather and synchrophasing switch (22 aircraft)

Figure 2-8. Control Pedestal

lash is the result of an irreversible control system, which eliminates the need for a friction control.

a. Reversing Pitch. Propeller reverse pitch operation is controlled by the power levers. To reverse the propellers the power levers are lifted up and aft to the FULL REVERSE position. This action mechanically actuates the reversing valve and governor pilot valve and electrically energizes the auxiliary pump, moving the propeller blades to the reverse pitch position. Operation of the No. 1 and 2 blade switches and the pressure cutout switch terminate the action of the auxiliary pump when the blades reach the reverse setting. All reverse operations should be accomplished with the propeller levers in the MAX RPM position.

b. Unreversing Pitch. To unreverse the propeller, the power lever is moved forward and down, out of the REVERSE power range. This motion energizes the feather solenoid which causes the blades to increase pitch. When the blades reach approximately 6° above low pitch, the feather solenoid and the entire unreversing system drop out and the normal forward thrust controls begin functioning.

NOTE

The propeller should be completely unreversed during the downward movement of the power levers. The propeller will not unreverse with the engine not operating. Unreversing without the engine running is accomplished by the procedures for feathering.

2-19. IGNITION SYSTEM.

2-20. GENERAL. The ignition system is used only for engine starting, ground or air, and not for sustaining combustion as in reciprocating engines. It consists of an ignition unit, spark splitter coil, two spark igniters, and ignition leads.

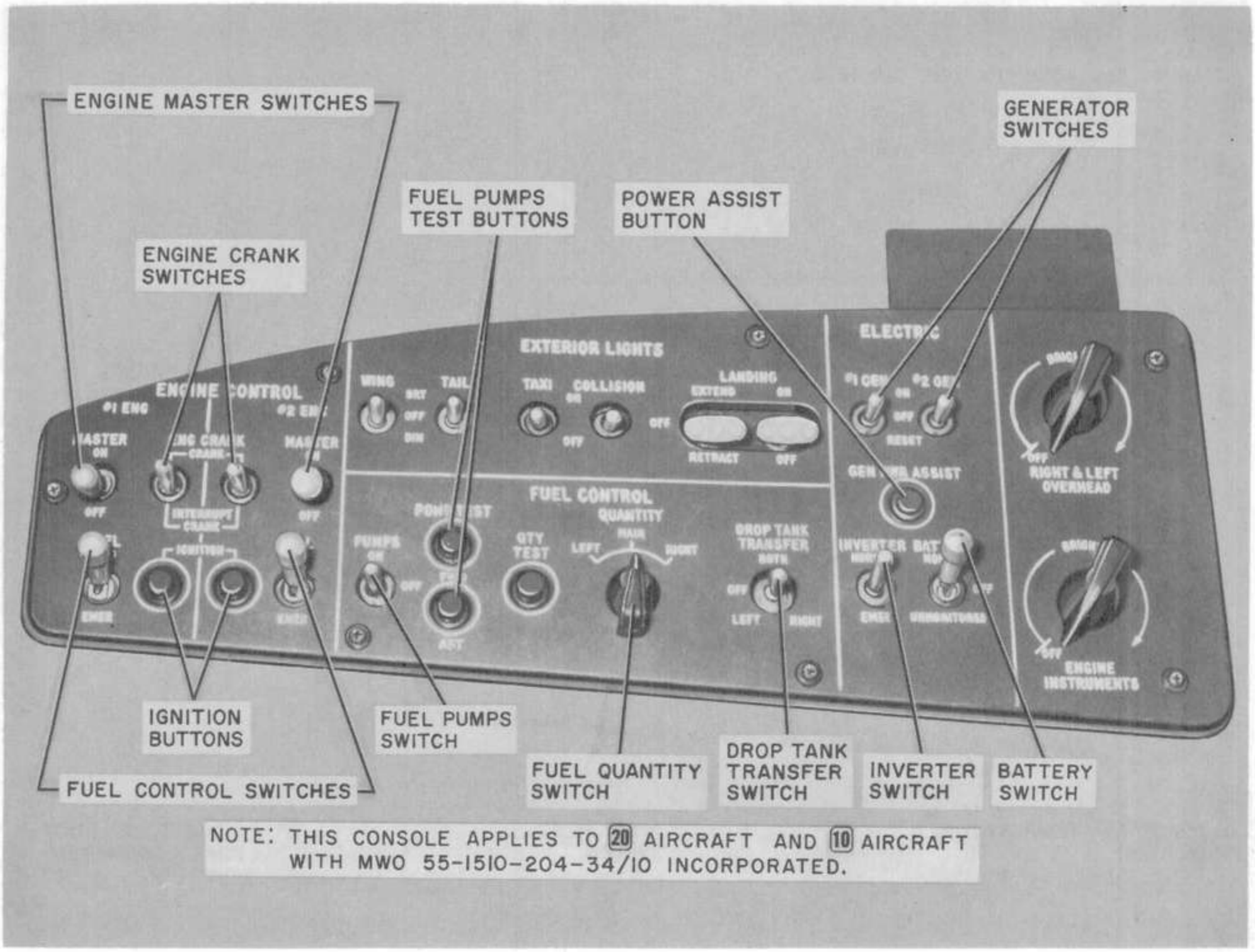


Figure 2-9. Left Overhead Console

2-21. On [20] aircraft, and [10] aircraft with MWO 55-1510-204-34/10 incorporated ignition is supplied to the combustion chamber whenever the ignition switch (see figure 2-9) is depressed during the starting cycle. Ignition is interrupted when the ignition button is released.

2-22. On [10] aircraft, without MWO 55-1510-204-34/10 incorporated, ignition is automatically supplied to the combustion chamber whenever the engine start switch (see figure 2-11) is placed in the START position with the fuel pumps switch in ON. Ignition is interrupted when the fuel pumps switch is placed in OFF, or when the starting cycle is completed.

2-23. STARTING FUEL SYSTEM.

2-24. On [20] aircraft, and [10] aircraft with MWO 55-1510-204-34/10 incorporated, starting fuel is initiated by depressing the ignition button (see figure 2-9). This causes the solenoid-actuated fuel valve to open and supply starting fuel to the engine through five igniter nozzles in the combustion chamber. The starting fuel is cut off when the ignition button is released.

2-25. On [10] aircraft, without MWO 55-1510-204-34/10 incorporated, starting fuel is initiated by positioning the engine start switch (see figure 2-11) in the START position with the fuel pumps switch in ON. Starting fuel is cut off when the fuel pumps switch is placed in OFF.

2-26. ENGINE STARTING SYSTEM.

2-27. GENERAL. The starting system consists of the starter-generator located on the lower pad of the engine accessory drive gearbox, the engine control switches, and the fuel pumps switch. The battery is used to power the starter-generator during all engine starting procedures including air starts. When the engine has been brought up to speed and stabilizes, the driving action will reverse itself and the engine will drive the starter.

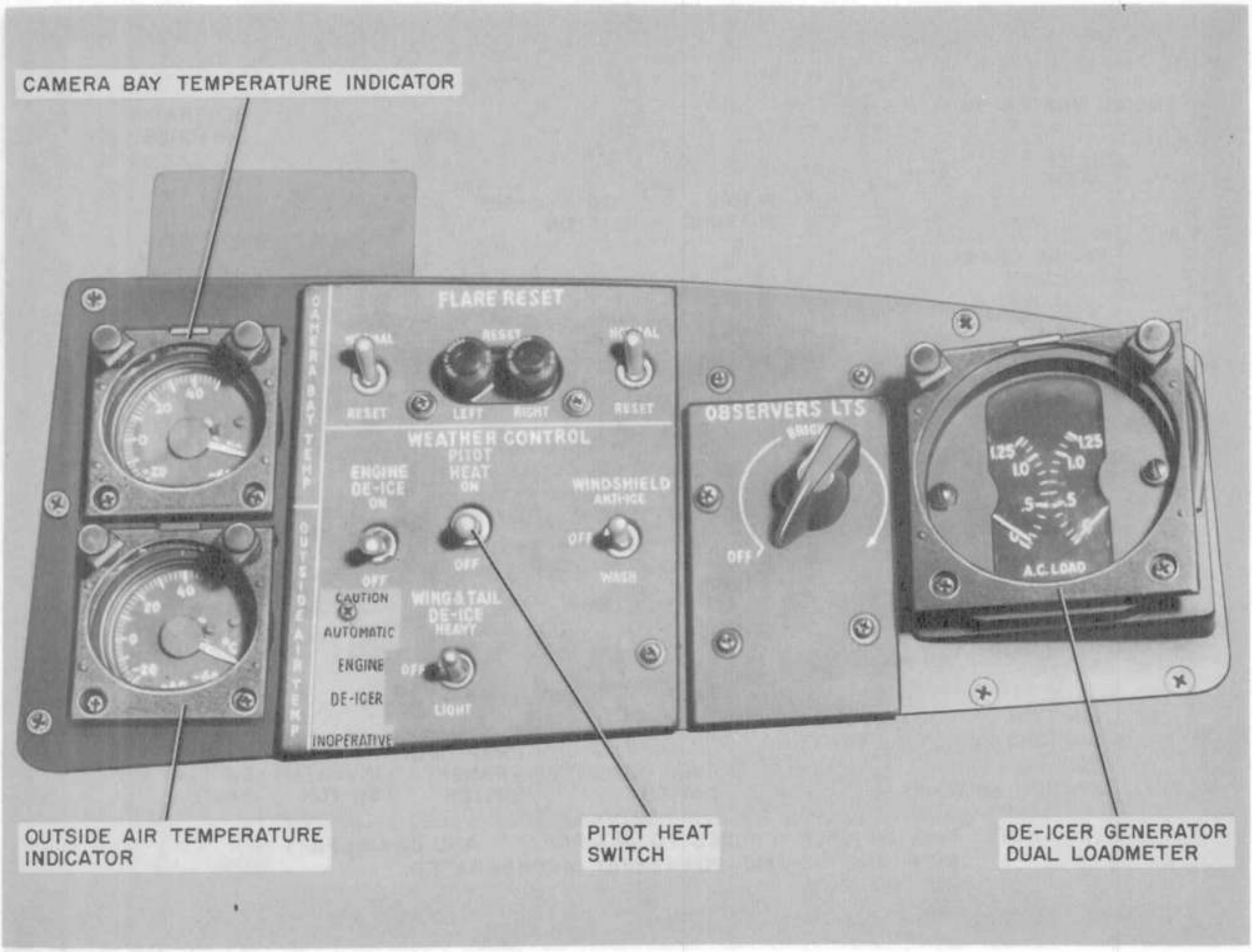


Figure 2-10. Right Overhead Console

In this mode the starter-generator will operate as a generator.

2-28. ENGINE START CONTROLS.

a. On [20] aircraft, and [10] aircraft with MWO 55-1510-204-34/10 incorporated, the engines are started with the following controls located on the left overhead console (figure 2-9):

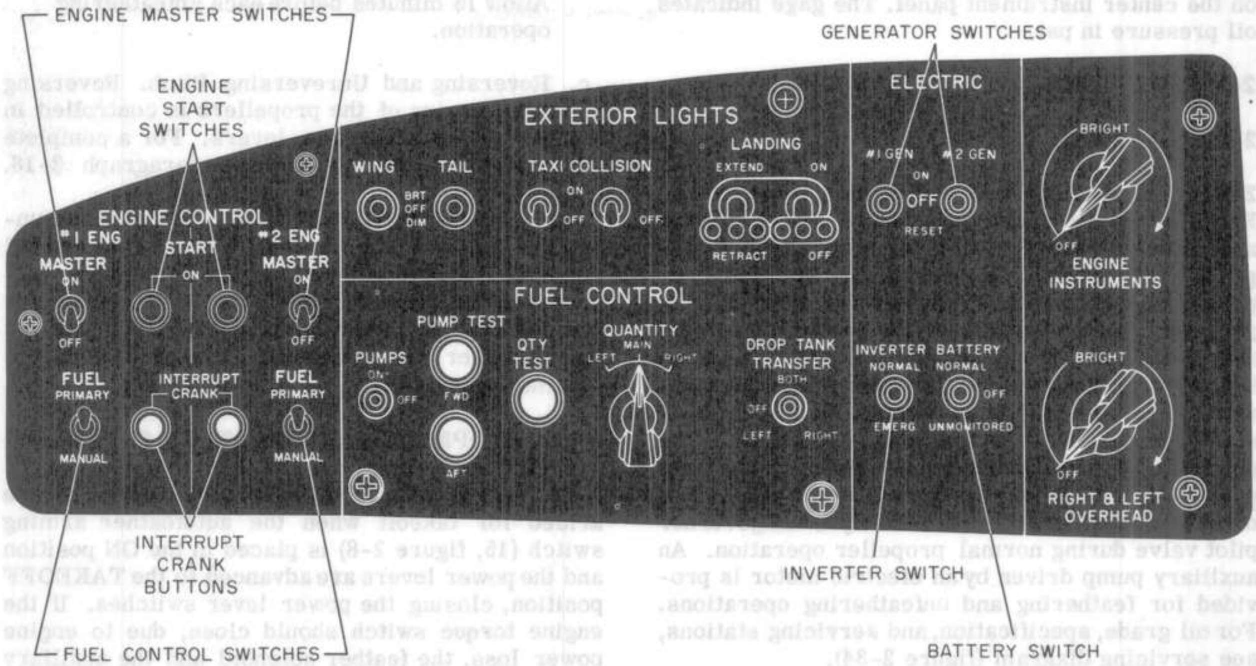
(1) Engine Master Switches. The engine master switches, located on the engine control panel, are two-position ON-OFF switches. In the ON position, each switch supplies power to the engine crank switch and deenergizes the fuel shutoff relay, opening the fuel shutoff valve, and the hydraulic shutoff valve. The switches are pull-to-unlock switches that require a definite pressure to place in the OFF position. This provides a safety factor to prevent accidental cutting off of the switch during engine operation.

(2) Engine Crank Switches. The engine crank switches, located on the engine control panel, have three positions: CRANK, off and INTERRUPT CRANK. The switches are spring-loaded to the center (off) position. Placing the switch momentarily in the CRANK position will supply power to the starter. When the second engine crank switch is set to crank, the generator associated with the first engine is automatically disconnected from the bus. Placing the switch in the INTERRUPT CRANK position will interrupt the cranking cycle.

(3) Ignition Buttons. The ignition buttons, located on the engine control panel, are pushbutton type switches. When depressed, the ignition switches provide power for ignition and actuate the engine fuel primer valve.

(4) Power Assist Button. The generator power assist switch is located on the electric master panel. This button, when depressed, permits power from the generator of the first engine (running) to assist the battery to crank the starter of the second engine. It is used when battery power is insufficient for starting the second engine.

b. On [10] aircraft without MWO 55-1510-204-34/10 incorporated, the engines are started with the fol-



NOTE:
THIS CONSOLE APPLIES TO (10) AIRCRAFT WITHOUT MWO 55-1510-204-34/10 INCORPORATED.

Figure 2-11. Left Overhead Console

lowing controls located on the left overhead console (figure 2-11):

(1) Engine Master Switches. The engine master switches are identical to the engine master switches described in paragraph 2-28a. (1) above.

(2) Engine Start Switches. The engine start switches, located on the engine control panel, are two-position OFF-START switches. Placing the switch momentarily in the START position energizes a self-holding relay which supplies power to the starter, ignition, and fuel solenoid circuits.

(3) Interrupt Crank Buttons. The interrupt crank buttons, located on the engine control panel, are pushbutton switches. Depressing these buttons interrupts the engine cranking cycle.

2-29. ENGINE INSTRUMENTS.

2-30. TORQUEMETERS. The two torquemeters (5, figure 2-7), located on the center instrument panel, are the primary instruments for indication of propeller shaft power. The indicators are graduated in psi and are actuated by a hydraulic pressure indicating system measuring the pressure produced by a bell gear annular type piston arrangement located in the inlet housing of the engine.

2-31. PROPELLER TACHOMETERS. The propeller tachometers (4, figure 2-7), located on the center instrument panel, measure propeller shaft speed in hundreds of rpm.

2-32. ENGINE TACHOMETERS. The engine tachometers (3, figure 2-7) are located on the lower part of the center instrument panel. They are powered by tachometer generators and indicate the engine rpm in percentage of maximum engine rpm.

2-33. EXHAUST GAS TEMPERATURE INDICATORS. The exhaust gas temperature (egt) indicators (2, figure 2-7) are located on the lower section of the center instrument panel. The exhaust gas temperature is measured in °C. The indicators are actuated by three thermocouples in the exhaust diffuser of each engine.

2-34. OIL TEMPERATURE INDICATOR. The oil temperature indicator (8, figure 2-7) is a dual gage located on the center instrument panel. The oil temperature is measured by means of an oil temperature bulb located on the line entering the engine. It provides direct reading of the temperature in °C.

2-35. OIL PRESSURE INDICATOR. The oil pressure indicator (7, figure 2-7) is a dual gage located on the center instrument panel. The gage indicates oil pressure in psi.

2-36. PROPELLER.

2-37. GENERAL.

2-38. The engines are fitted with three-bladed Hamilton Standard Hydromatic Propellers. These are constant-speed, full-feathering, reversible-pitch propellers with synchronizing and synchrophasing features. The oil supply for operating the propeller is independent of the engine oil system and is contained in the integral oil control assembly. A propeller governor for each propeller automatically adjusts the blade pitch to maintain a constant speed under varying flight conditions. The power for all pitch changes is supplied by the main pump which is driven by propeller rotation. The main pump delivers oil continuously to the governor pilot valve during normal propeller operation. An auxiliary pump driven by an electric motor is provided for feathering and unfeathering operations. For oil grade, specification, and servicing stations, see servicing diagram (figure 2-34).

2-39. PROPELLER LEVERS. The propeller control levers (12, figure 2-8) located on the right side of the control pedestal, are used to regulate the propeller speeds. The propeller lever positions are as follows: MAX RPM to MIN RPM, FUEL OFF, and FEATHER. With the propeller lever in the full forward position, a maximum of 1663 to 1693 rpm can be obtained. Moving the levers aft reduces the rpm within governor limits. Movement of the levers past the detent shuts off the fuel flow to the engines. When the levers are brought to the end of travel, the propellers are feathered, and fuel shutoff is maintained.

a. Feathering. Feathering of a propeller is accomplished by placing the propeller lever in the FEATHER position. This mechanically positions the feather valve and simultaneously closes the feather switch (in the pedestal), energizing the feather solenoid and the auxiliary pump. The auxiliary pump drives the blades to the full feather position after gear-driven pump output has ceased.

b. Unfeathering. To unfeather a propeller (torque pressure at 30 psi), the propeller lever is placed at MIN RPM, and the unfeather button is depressed, energizing the auxiliary motor and the unfeather solenoid. The unfeather button must be depressed until an increase in RPM is noted. The unfeather solenoid will be deenergized by the No. 1 blade switch to prevent inadvertent propeller reversal.

NOTE

Since the auxiliary pump will continue to operate as long as the unfeather button is manually held engaged, do not depress the button for more than 10 seconds at a time. Allow 15 minutes before each unfeathering operation.

c. Reversing and Unreversing Pitch. Reversing and unreversing of the propellers is controlled in the cockpit by the power levers. For a complete description of the system, see paragraph 2-18.

2-40. UNFEATHER BUTTONS. The #1 and #2 unfeather buttons (1, figure 2-8) located on the control pedestal are used to unfeather the propellers. Depressing the unfeather button with the propeller lever between MIN RPM and MAX RPM energizes the unfeather relay, which in turn energizes the auxiliary pump motor and the unfeather solenoid.

2-41. PROPELLER AUTOFEATHER SYSTEM.

2-42. GENERAL. The autofeather circuits are armed for takeoff when the autofeather arming switch (15, figure 2-8) is placed in the ON position and the power levers are advanced to the TAKEOFF position, closing the power lever switches. If the engine torque switch should close, due to engine power loss, the feather solenoid and the auxiliary pump will be energized, and the propeller will completely feather. The autofeathering circuits for both engines are interlocked so that actuation of either circuit automatically disarms the remaining autofeathering circuit.

WARNING

Due to slow acceleration characteristics inherent in turbine engines, a sudden power lever advance to the TAKEOFF position before the torque pressure can increase beyond the pressure setting of the engine torque switch will actuate the autofeather system and feather one propeller. One power lever therefore must never be retarded below a torque pressure of 10 psi when the autofeather system is armed. Refer to figure 2-12 for curve of torque pressure vs. acceleration time.

NOTE

The autofeather arming switch and the propeller synchrophasing switch are combined on one switch on [22] aircraft (See 19, figure 2-8).

2-43. AUTOFEATHER ARMING SWITCH. This switch (15, figure 2-8) is an ON-OFF toggle switch that arms the autofeather circuits in the ON position. It is located on the rear of the control pedestal.

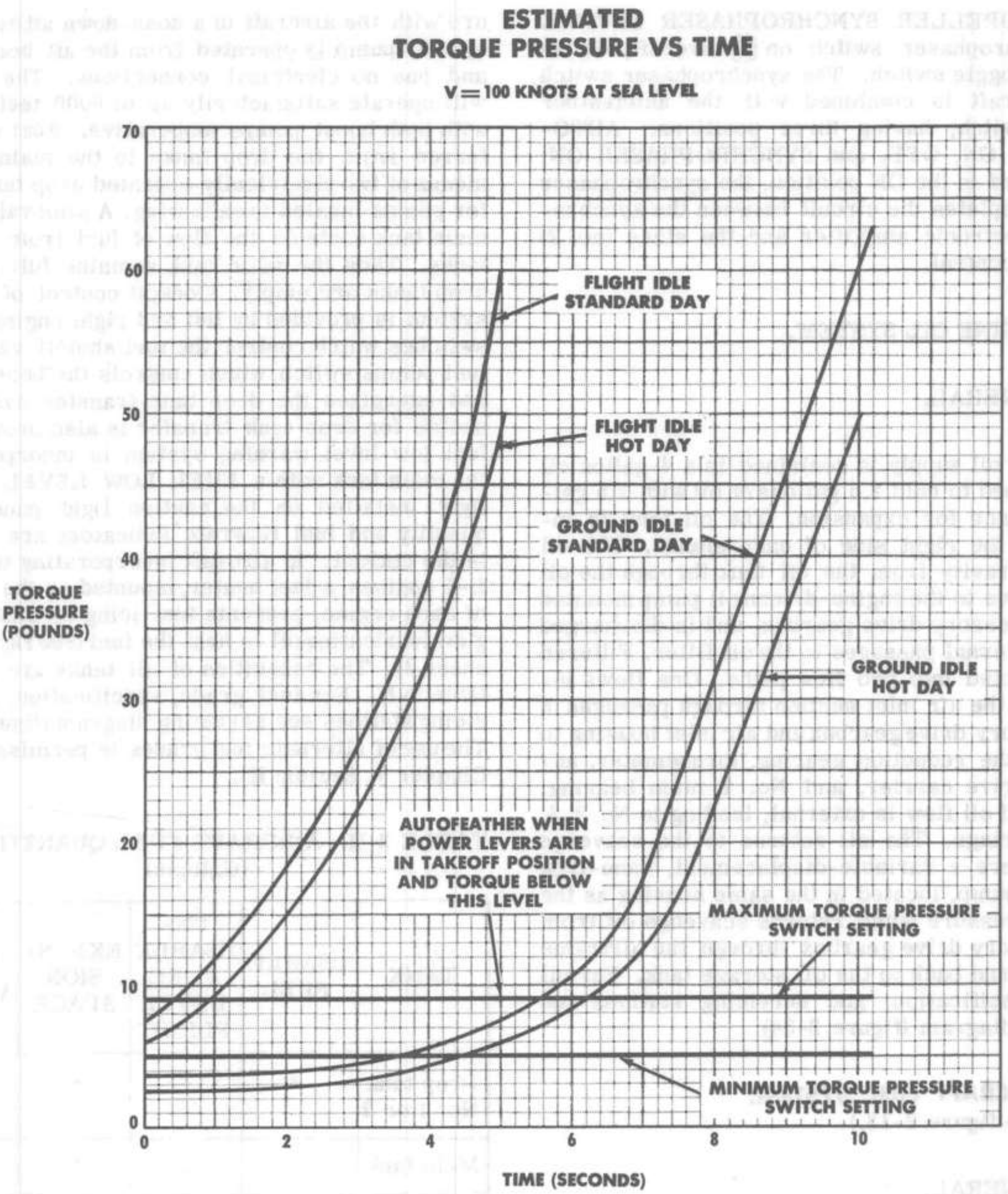


Figure 2-12. Engine Acceleration Characteristics Curve

2-44. AUTOFEATHER TEST SWITCH. The autofeather test switch (see figure 2-21) is located near the forward section of the control pedestal. The autofeather test switch, when used in conjunction with the power levers, enables the autofeather circuitry to be tested.

2-45. AUTOFEATHER ARMED LIGHT (7 AIRCRAFT, AND 21 AIRCRAFT WITH MWO 55-1510-204-34/8 INCORPORATED). The autofeather armed light (13, figure 2-6), when illuminated, indicates that the autofeather system is energized. The light is green and will glow when the autofeather arming switch is in the ON position. The light is a press-to-test type and can be dimmed by turning it clockwise.

2-46. PROPELLER SYNCHROPHASER SYSTEM.

2-47. GENERAL. Synchrophasing is the process by which the propellers are maintained at identical speeds with the angular relationship of the two sets of blades arranged to transmit the least amount of vibration and noise to the airframe. The proper propeller phase relationships are automatically established by the synchrophasing circuits. See Chapter 9, Section II for synchrophaser system operation.

2-48. PROPELLER SYNCHROPHASER SWITCH. The synchrophaser switch on 21 aircraft, is an ON-OFF toggle switch. The synchrophaser switch on 22 aircraft is combined with the autofeather arming switch, having three positions: AUTO-FEATHER ON, OFF, and SYNCHROPHASER ON. When placed in the ON position, the synchrophaser switch completes the circuit between the synchrophaser electronic amplifier and the slave (no. 2) propeller control.

2-49. ENGINE OIL SYSTEM.

2-50. GENERAL.

2-51. The oil supply is contained in a 4-gallon oil tank designed to hold 2.5 gallons of oil with 1.5 gallons of space for expansion. The oil tank is installed to the right side of each engine. The oil flows by gravity from the oil tank through the oil shutoff valve to the engine-driven oil pump mounted on the accessory drive gearbox, and is discharged through internal passages to the oil filter. Filtered oil is directed into two flow paths. One flows internally to the air inlet section through passages in the accessory drive gearbox and air inlet housing to lubricate the reduction gearing, torquemeter, accessory drive carrier, and No. 1 main bearing. The second oil flow is external, leading to No. 2, 3, and 4 bearings. The oil returns to the scavenge cavity where a variable-displacement, vane-type scavenge pump, located in the same housing as the main oil pressure pump, returns scavenge oil from the accessory drive gearbox through the airframe oil cooler and back to the oil storage tank. For oil grade, specification, and servicing stations see servicing diagram (figure 2-34).

2-52. AIRCRAFT FUEL SYSTEM.
(See figure 2-13.)

2-53. GENERAL.

2-54. Fuel is contained in one 296-gallon self-sealing tank located in the fuselage over the wing and (if installed) in two external 150-gallon drop tanks (see figure 2-2) attached to the pylons on the wing. All tanks may be fueled through 3-inch gravity filler units, one at each tank, or by single-point pressure fueling (see Chapter 9). Two tank-mounted centrifugal boost pumps are located forward and aft in the main tank. The forward boost pump feeds a negative-g can in which the aft boost pump is mounted. The engines are fed from the aft boost pump. With the failure of the aft boost pump, the forward pump will supply sufficient fuel through the aft boost pump bypass for proper engine operation when the aircraft is in a nosedown attitude with low fuel quantity. An ejector pump will supply the negative-g can in case of forward boost pump failure with the aircraft in a nose-down attitude. The ejector pump is operated from the aft boost pump and has no electrical connections. The aircraft will operate satisfactorily up to 6000 feet altitude with both boost pumps inoperative. Fuel is transferred from the drop tanks to the main tank by means of two electrically operated drop tank transfer pumps located in each wing. A pilot valve in the main tank controls the flow of fuel from the drop tanks. Thus the main tank remains full until the drop tanks are empty. Cockpit control of the fuel system is provided by left and right engine master switches which control the fuel shutoff valves, the fuel pumps switch, which controls the boost pumps, and energizes the drop tank transfer system. A switch for drop tank transfer is also provided. A fuel low-level warning system is incorporated in the main tank with a FUEL LOW LEVEL warning light installed on the caution light panel. Fuel quantity and fuel flowrate indicators are installed in the cockpit. In aircraft incorporating the T 53-L-7 engines, a fuel heater, mounted on the left side of each engine, prevents fuel icing by utilizing engine lubricating oil to heat the fuel (See figure 2-13, sheet 2). The capacities of all tanks are shown in table 2-II. For fuel grade, specification, and servicing stations see servicing diagram (figure 2-34). The use of alternate fuel grades is permissible (see Chapter 7, Section II).

TABLE 2-II. AIRCRAFT FUEL QUANTITY DATA
(Gallons)

TANK	USABLE FUEL	UN-USABLE FUEL LEVEL FLIGHT	EXPANSION SPACE	TOTAL VOLUME
Drop tank No. 1 or 2	*	*	*	150
Main tank	*	2	*	296

*Information to be supplied when available.

2-55. FUEL SYSTEM CONTROLS.

2-56. FUEL CONTROL SWITCHES. The fuel control switches, located on the engine control panel (see figure 2-9 or 2-11), are two-position toggle switches. With the switch in the AUTO position, fuel is metered by the main fuel control metering system. If the fuel control unit fails, the fuel control switch may be set to the EMER position; the changeover valve will then shift and allow fuel to bypass the main fuel control metering system and flow directly to the engine.

2-57. FUEL PUMPS SWITCH. The fuel pumps switch is a two-position ON-OFF toggle switch

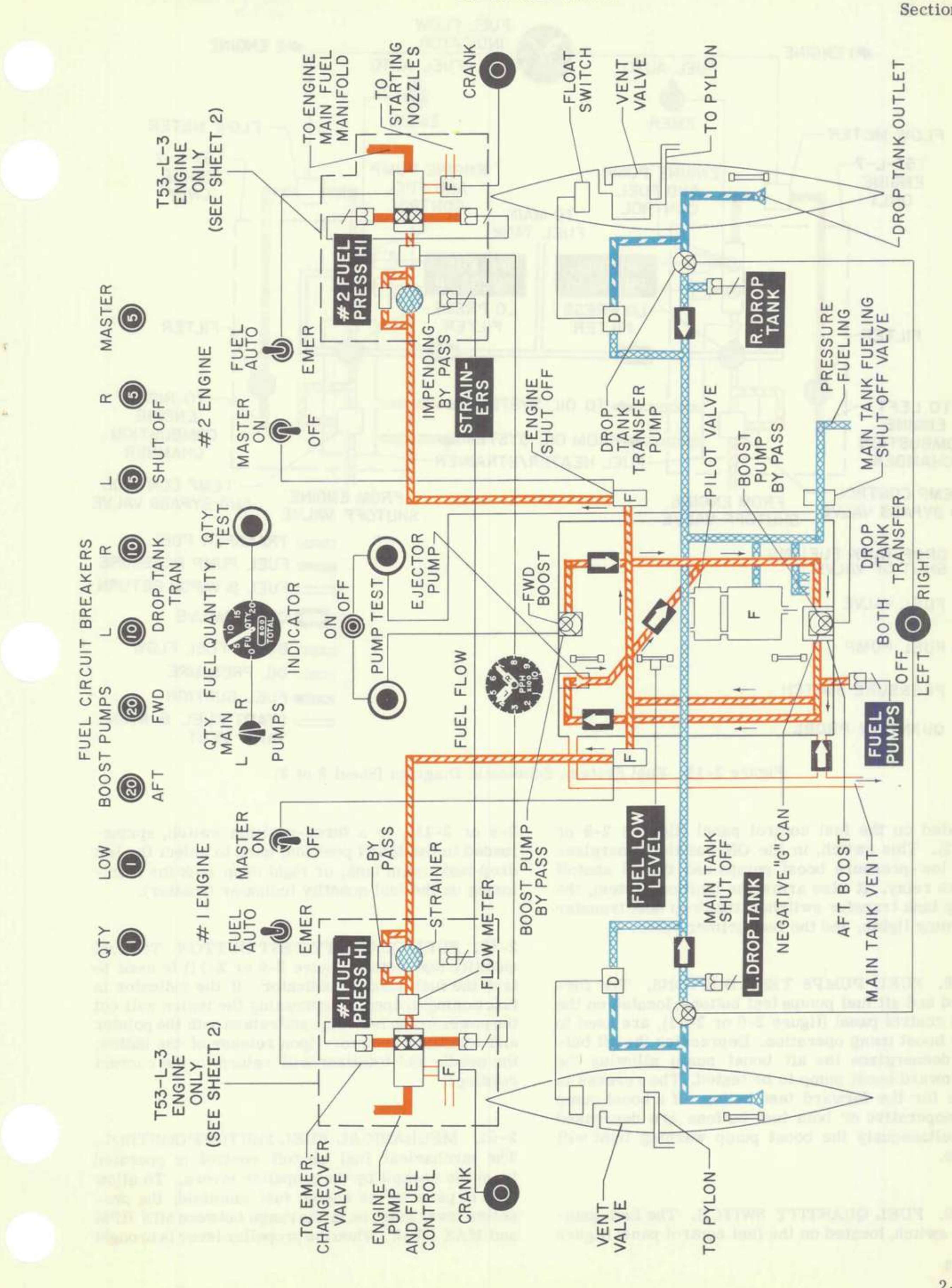


Figure 2-13. Fuel System, Schematic Diagram (Sheet 1 of 2)

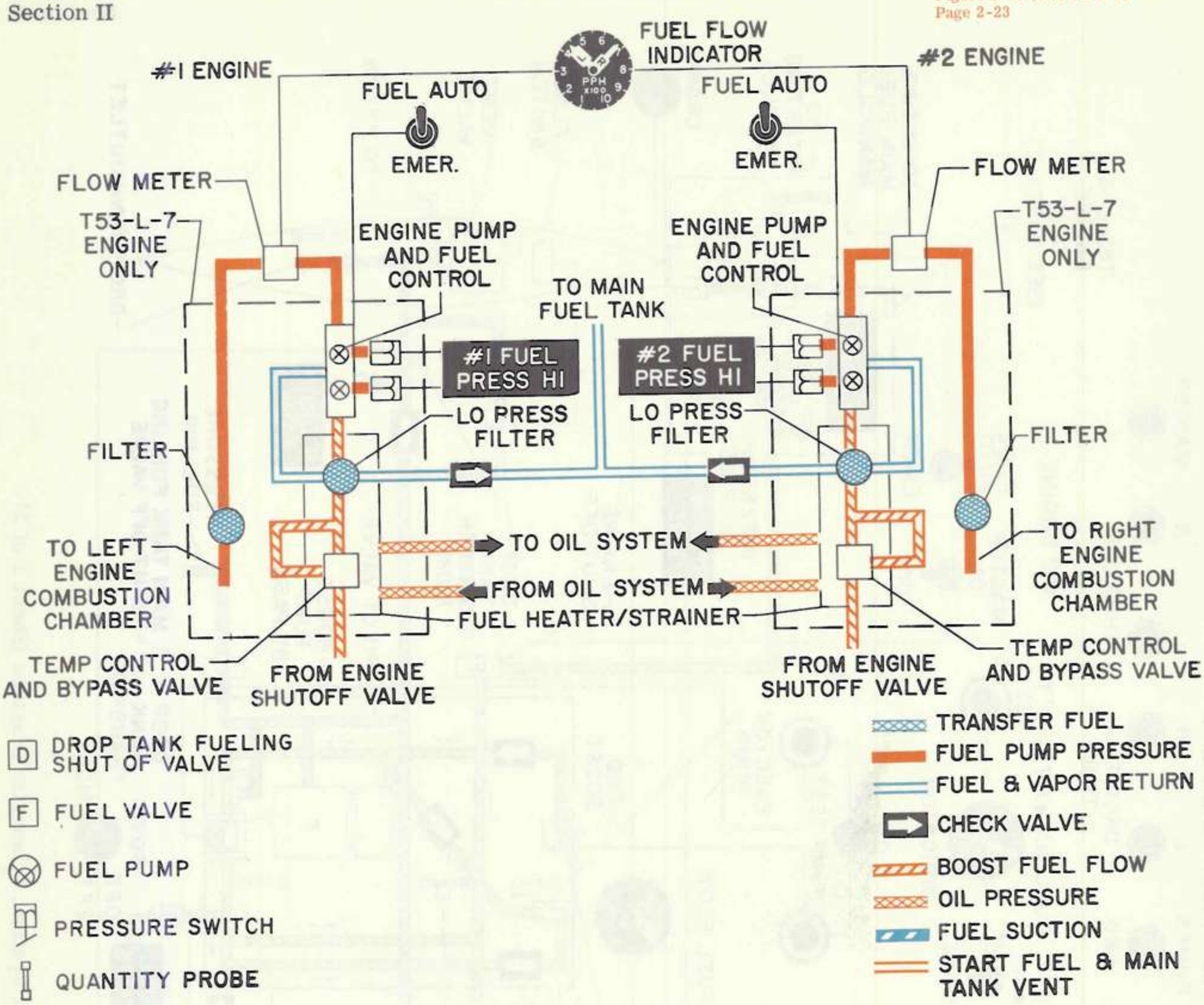


Figure 2-13. Fuel System, Schematic Diagram (Sheet 2 of 2)

located on the fuel control panel (figures 2-9 or 2-11). This switch, in the ON position, energizes the low-pressure boost pumps and the oil shutoff valve relay. It also arms the ignition system, the drop tank transfer switches, the drop tank transfer warning lights, and the fuel primer valve.

2-58. FUEL PUMPS TEST BUTTONS. The forward and aft fuel pumps test buttons, located on the fuel control panel (figure 2-9 or 2-11), are used to test boost pump operation. Depressing the aft button deenergizes the aft boost pump allowing the downward boost pump to be tested. The reverse is true for the forward test button. If a boost pump is inoperative or both test buttons are depressed simultaneously the boost pump warning light will glow.

2-59. FUEL QUANTITY SWITCH. The fuel quantity switch, located on the fuel control panel (figure 2-9 or 2-11), is a three-position switch, spring-loaded to the MAIN position, used to select the left drop tank, main tank, or right drop tank for monitoring on the fuel quantity indicator (pointer).

2-60. FUEL QUANTITY TEST BUTTON. The fuel quantity test button (figure 2-9 or 2-11) is used to test the fuel quantity indicator. If the indicator is functioning properly, depressing the button will cut the power to the indicator and return both the pointer and totalizer to zero. Upon release of the button, the needle and totalizer will return to the correct reading.

2-61. MECHANICAL FUEL SHUTOFF CONTROL. The mechanical fuel shutoff control is operated from the cockpit by the propeller levers. To allow fuel to pass to the engine fuel manifold, the propeller lever must be in the range between MIN RPM and MAX RPM. When the propeller lever is brought back to the FUEL OFF or FEATHER position, the engine fuel control shutoff valve is closed, cutting off the supply of fuel to the engine. The engine fuel control shutoff valve is located on the outlet side of the fuel control unit.

2-62. DROP TANK TRANSFER SWITCH. The drop tank transfer switch, located on the fuel control panel (figure 2-9 or 2-11), is a four-position toggle switch used to transfer fuel from the left and/or right drop tank to the main tank. (The fuel pumps switch must be ON, thus arming the drop tank transfer pumps and the drop tank transfer warning lights.) When the drop tank transfer switch is set to LEFT, RIGHT, or BOTH, the corresponding transfer pump(s) are energized and fuel flows from the selected drop tank(s) to the main tank at a rate of 8 gpm (controlled by the pilot and shutoff valves used for pressure fueling). A pressure switch in each transfer line operates its respective warning light. Crossflow from one tank to another is prevented by a check valve in each line.

2-63. FUEL SYSTEM INDICATORS.

2-64. FUEL QUANTITY INDICATOR. The fuel quantity indicator (10, figure 2-7) is located on the center instrument panel. The total weight of fuel in all tanks is indicated in pounds by a four-digit totalizer below the instrument pointer. The pointer indicates the weight of fuel in an individual tank, with selection of the particular tank being made by the fuel quantity switch on the fuel control panel (figure 2-14). The tolerance of the indicator is $\pm 2\%$ of full scale (4300 pounds totalizer and 2200 pounds pointer) $\pm 4\%$ of indication. For this reason, the pointer is to be used when on main tank fuel (no drop tanks or empty drop tanks).

2-65. FUEL FLOWRATE INDICATOR. The fuel flowrate indicator (9, figure 2-7) is a dual gage located on the center instrument panel. Flowmeters, located at the entrance to the engine fuel control, measure the fuel flow. The flow is registered on the indicator in hundreds of pounds per hour for each engine.

2-66. FUEL LOW-LEVEL WARNING LIGHT. A FUEL LOW LEVEL warning light located on the caution light panel (12, figure 2-7) will glow automatically whenever the fuel in the main tank drops below 290 pounds.

2-67. FUEL LOW-PRESSURE WARNING LIGHTS. The two fuel low-pressure warning lights are amber lights located on the caution light panel (12, figure 2-7). Illumination of the FUEL STRAINERS light indicates that one or both of the fuel strainers is being bypassed due to a blocked strainer element. The FUEL PUMPS light indicates failure of both boost pumps when illuminated.

2-68. FUEL HIGH-PRESSURE WARNING LIGHTS. The #1 and #2 FUEL PRESS HI warning lights are amber lights located on the caution light panel (12, figure 2-7). These lights indicate that one element of the dual element engine-driven fuel pump has failed.

2-69. DROP TANK WARNING LIGHTS. The L. and R. DROP TANK warning lights are amber lights located on the caution light panel (12, figure 2-7). These lights indicate zero fuel pressure from the drop tanks when the fuel transfer switch is in the ON position.

2-70. ELECTRICAL POWER SUPPLY SYSTEMS.

2-71. GENERAL.

2-72. The electrical systems are composed of a 28-volt direct-current system (figure 2-14), a 24-volt direct-current storage battery system and a three-phase, 400-cps, 115-volt alternating-current system (figure 2-15). An external power receptacle (see figure 2-2) is installed on the left side of the aft equipment compartment. This receptacle is accessible through a spring-loaded access plate on the aft equipment compartment door. The three systems are conventional, using standard aircraft equipment, and all use the aircraft frame as a common ground.

2-73. DIRECT-CURRENT SYSTEM.

2-74. GENERAL. The primary source of dc power for this aircraft is the engine-driven starter-generator. A starter-generator is mounted on and driven by each of the two engines. The starter-generators also function as electrically driven starters. When the engines are up to speed, however, the starter motor then acts as an electrical generator, providing dc power at 27.7 volts. This dc power is applied to all of the distribution buses (primary, secondary, monitored, and armament bus groups). If the generators should fail in flight (indicated by the #1 and #2 GEN warning lights and the left and right voltammeters), the secondary and monitored buses are disconnected and power is applied to the primary bus. When the landing gear handle is placed in the DOWN position, however, power is again applied to the secondary bus. Power can also be applied to the secondary bus by placing the battery switch to the UNMONITORED position. When external power is applied to the aircraft, all buses except the armament bus are en-

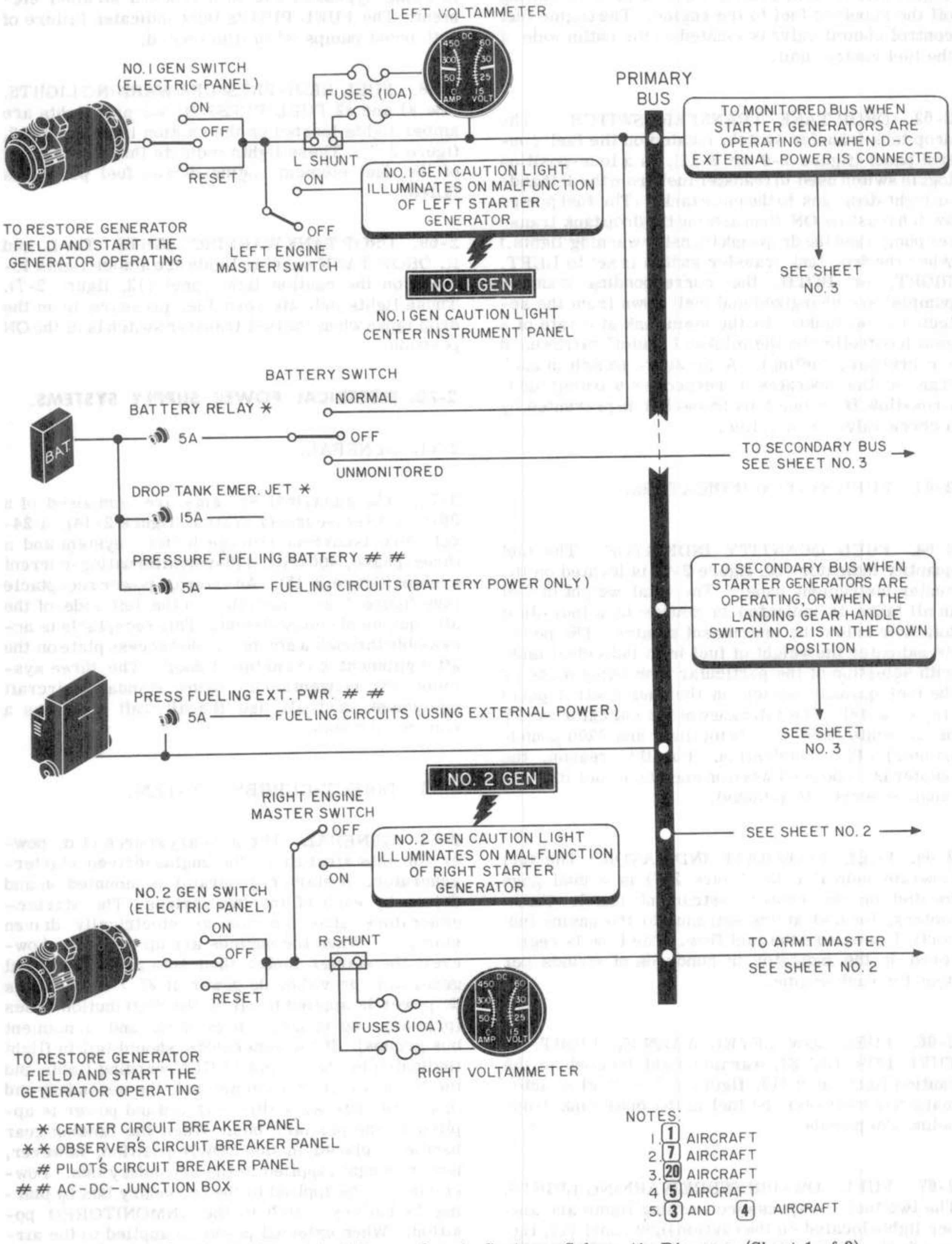


Figure 2-14. Dc Electrical Power Supply System, Schematic Diagram (Sheet 1 of 3)

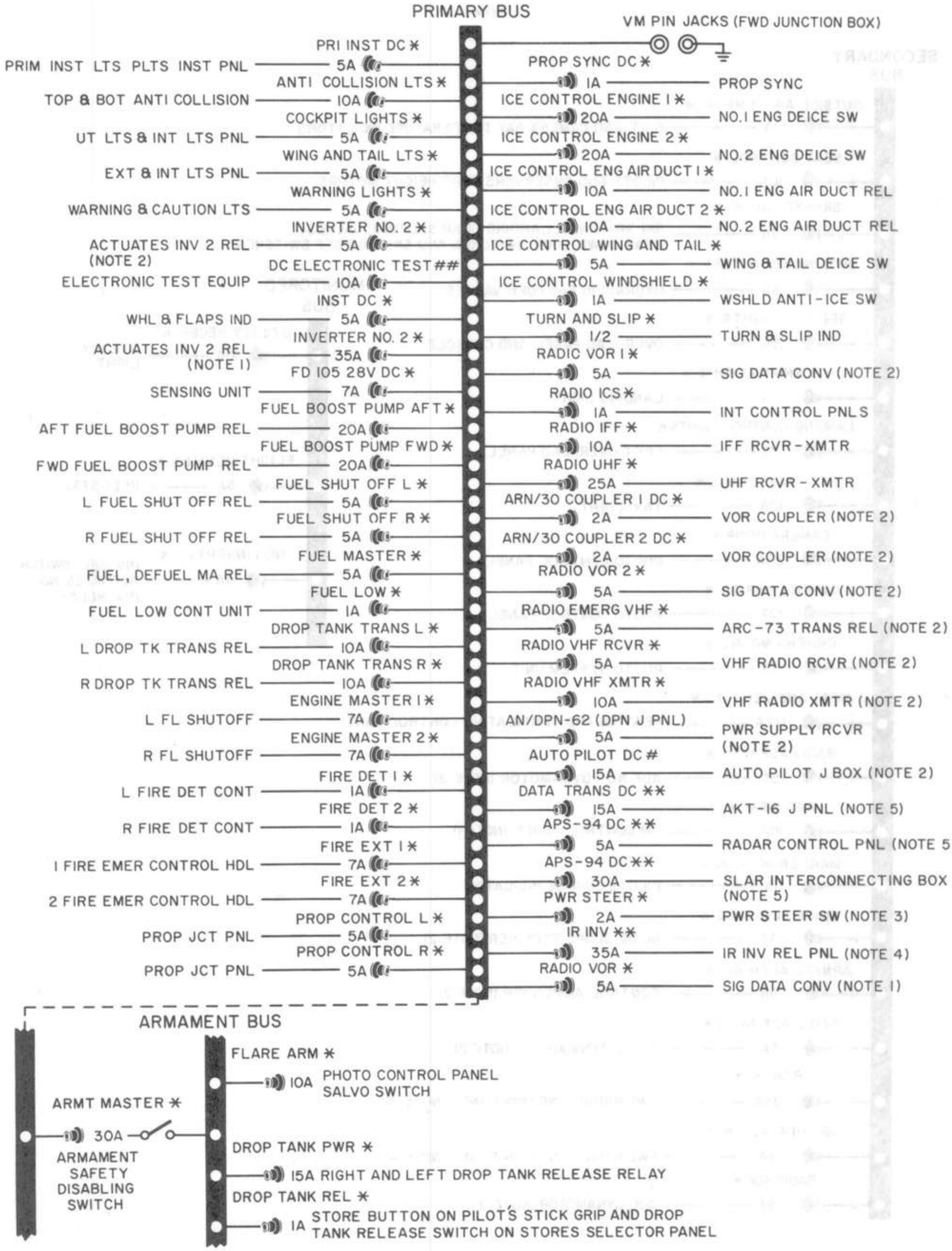


Figure 2-14. Dc Electrical Power Supply System, Schematic Diagram (Sheet 2 of 3)

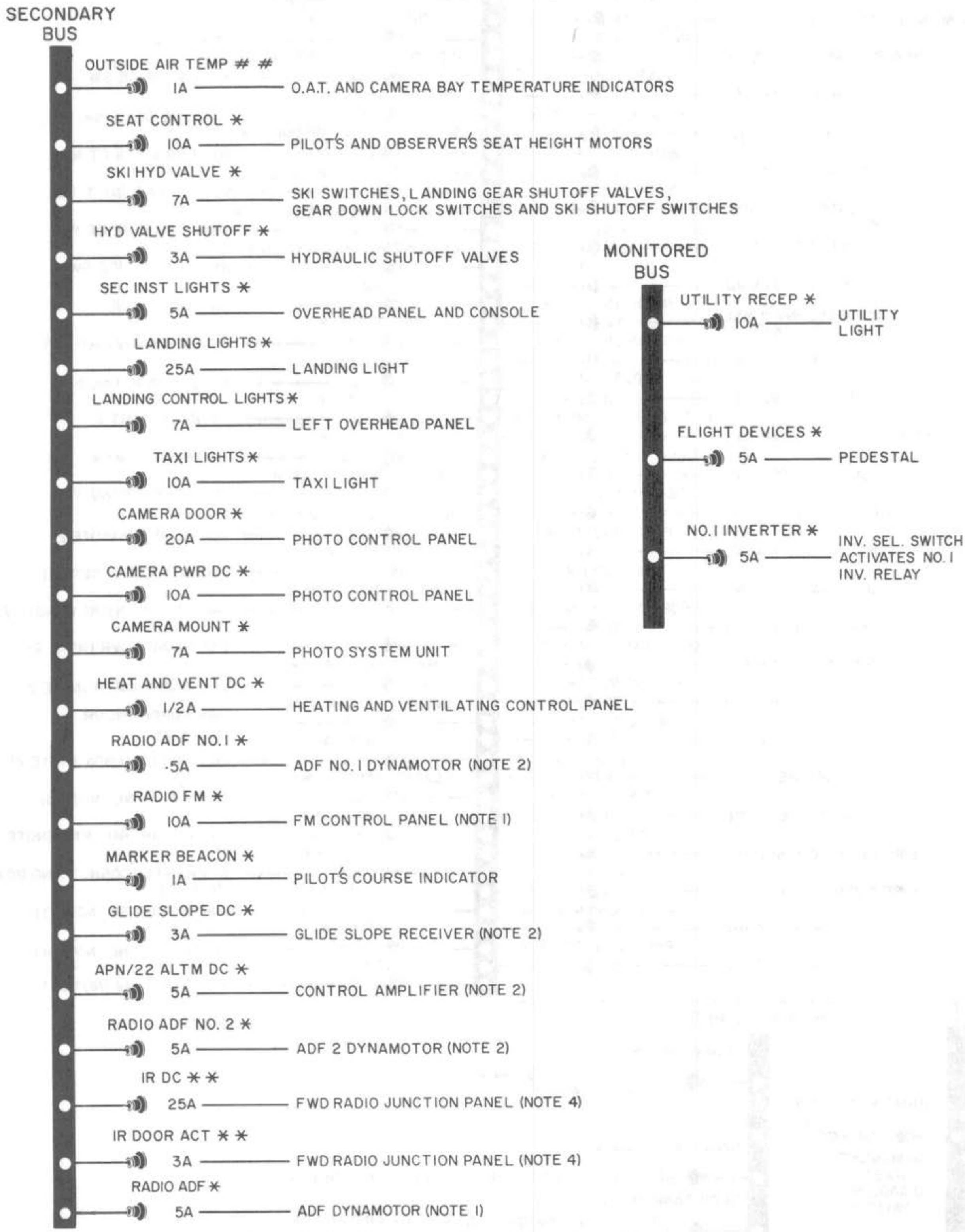
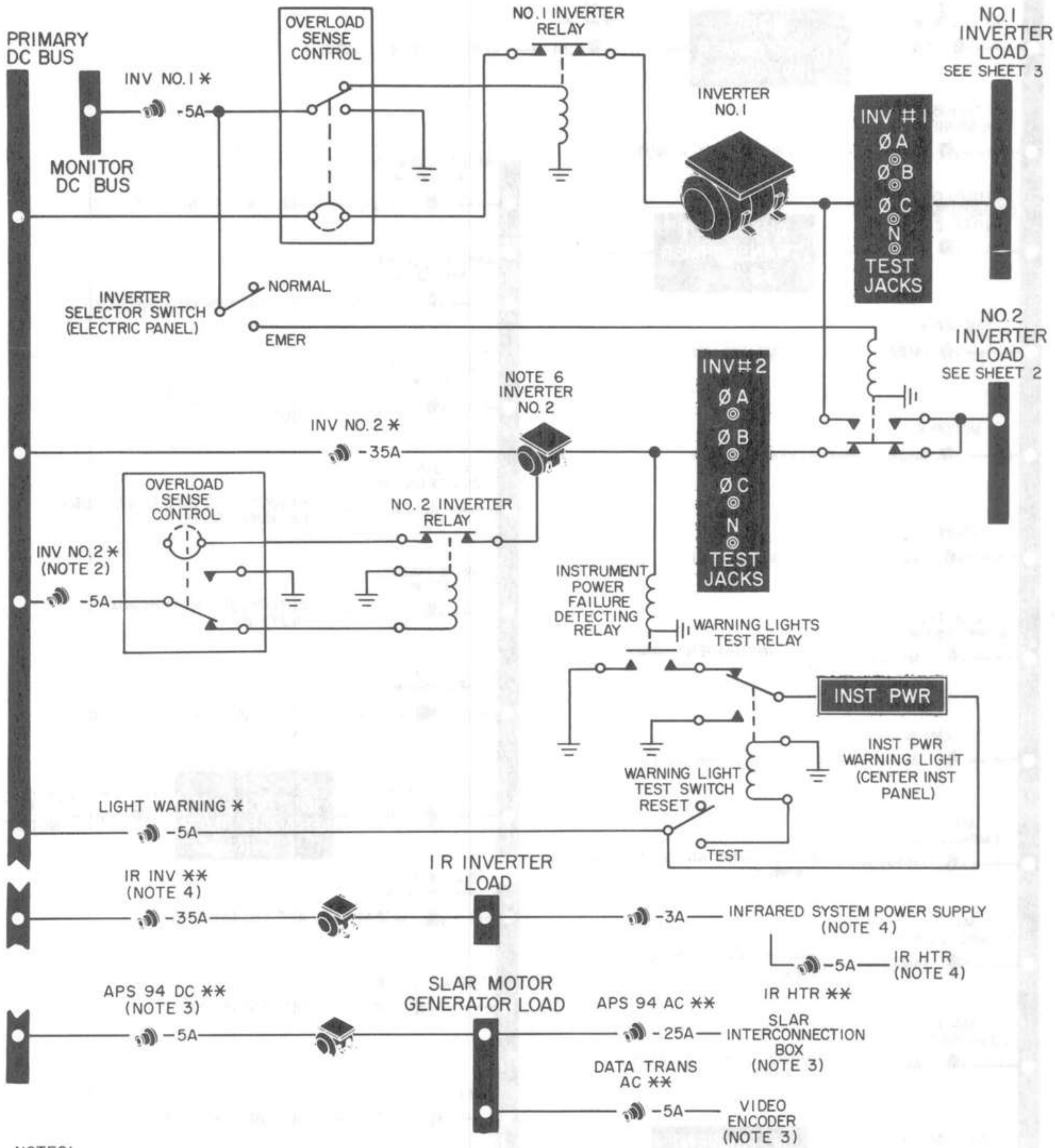


Figure 2-14. Dc Electrical Power Supply System, Schematic Diagram (Sheet 3 of 3)



NOTES:

1. 21 AIRCRAFT
2. 7 AIRCRAFT
3. 3 AND 4 AIRCRAFT
4. 5 AIRCRAFT
5. ALL RELAYS ARE SHOWN IN THEIR NORMAL OPERATING POSITION WITH POWER APPLIED.
6. 1 AIRCRAFT
7. 22 AIRCRAFT

* CENTER CIRCUIT BREAKER PANEL
** OBSERVER'S CIRCUIT BREAKER PANEL
# PILOT'S CIRCUIT BREAKER PANEL
# # AFT JUNCTION BOX

Figure 2-15. Ac Electrical Power Supply System, Schematic Diagram (Sheet 1 of 3)

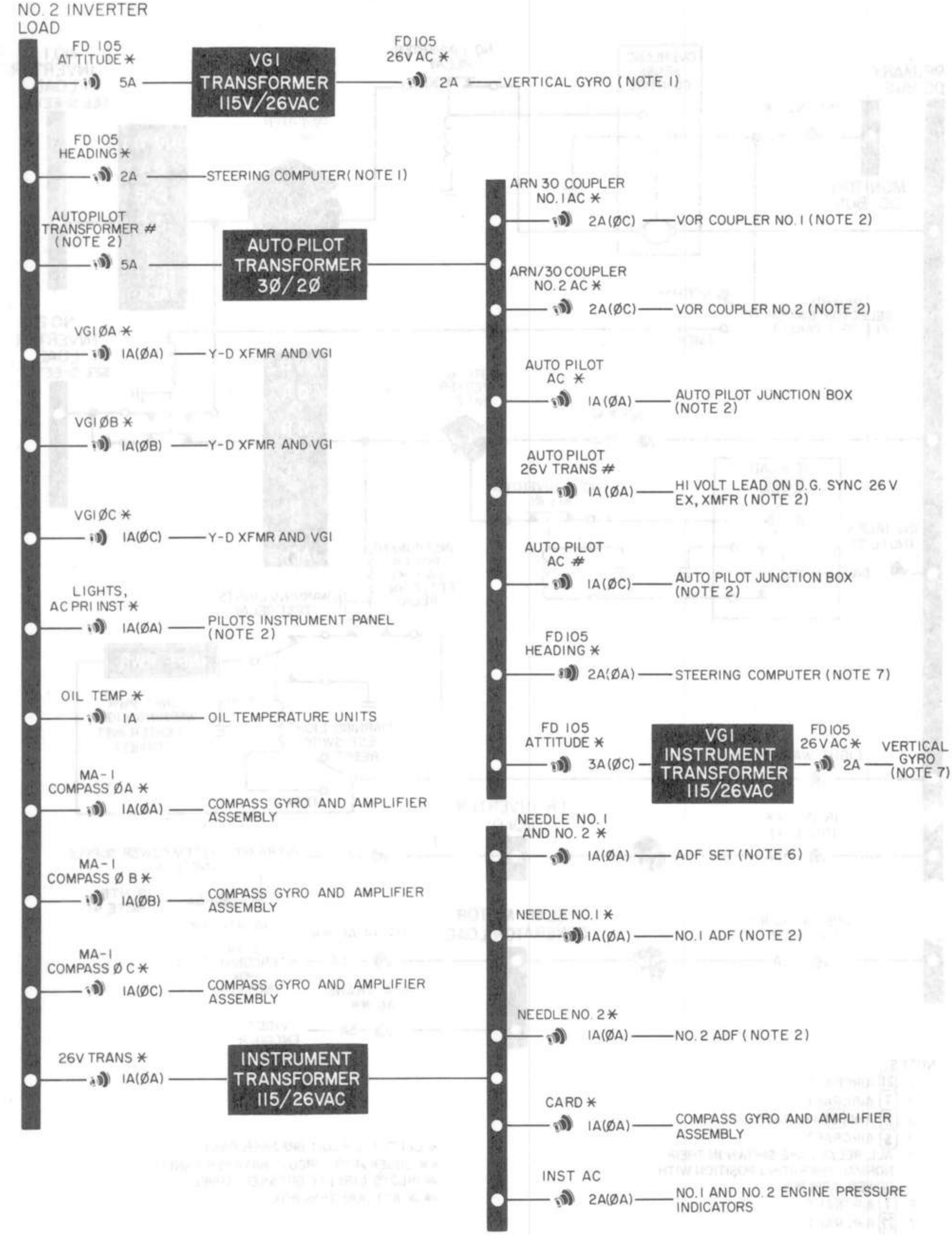


Figure 2-15. Ac Electrical Power Supply System, Schematic Diagram (Sheet 2 of 3)

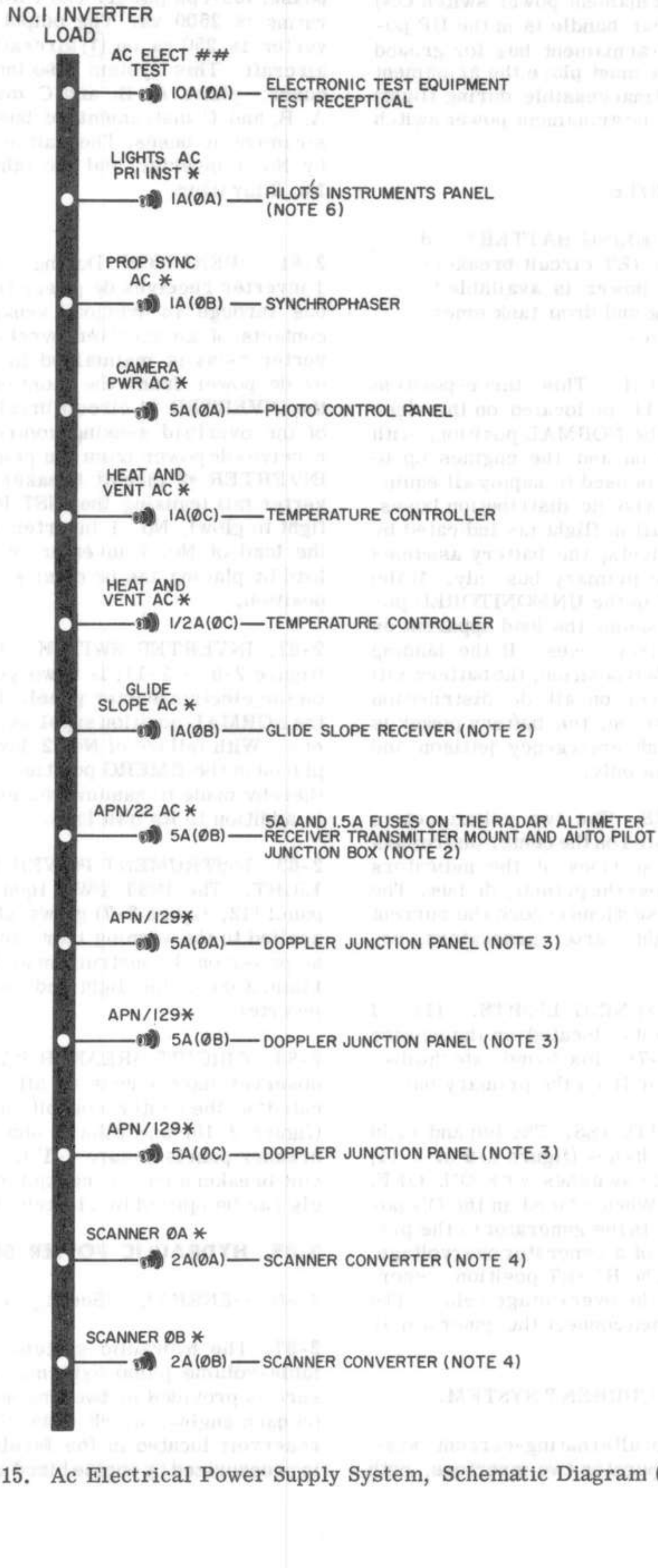


Figure 2-15. Ac Electrical Power Supply System, Schematic Diagram (Sheet 3 of 3)

ergized. The armament bus is energized from the primary bus (with the armament power switch ON) only when the landing gear handle is in the UP position. To energize the armament bus for ground testing, the ground crew must place the armament safety disabling switch (inaccessible during flight) to the ON position (with the armament power switch ON).

NOTE

With the PRESS FUELING BATTERY and DROP TANK EMER JET circuit breakers depressed, battery power is available to the pressure fueling and drop tank emergency jettison circuits.

2-75. BATTERY SWITCH. This three-position switch (figure 2-9 or 2-11) is located on the electric master panel. In the NORMAL position, with the generator switches on and the engines up to speed, generator power is used to supply all equipment through the respective dc distribution buses. Should the generators fail in flight (as indicated by the generator warning lights, the battery assumes the load apparent on the primary bus only. If the battery switch is placed in the UNMONITORED position the battery will assume the load apparent on the primary and secondary buses. If the landing gear handle is in the DOWN position, the battery will assume the load apparent on all dc distribution buses. In the OFF position, the battery power is applied to the drop tank emergency jettison and pressure fueling circuits only.

2-76. VOLTAMMETERS. The two voltammeters (11, figure 2-7) are located on the center instrument panel. The voltmeter sections of the indicators measure the voltage across the primary dc bus. The left and right ammeter sections record the current drain on the left and right starter-generators, respectively.

2-77. GENERATOR WARNING LIGHTS. The #1 and #2 GEN warning lights, located on the caution light panel (12, figure 2-7), glow to indicate the disconnection of a generator from the primary bus.

2-78. GENERATOR SWITCHES. The left and right (#1 and #2) generator switches (figure 2-9 or 2-11) are three-position toggle switches with ON, OFF, and RESET positions. When placed in the ON position, the switch connects the generator to the primary bus. In the event of a generator overvoltage, the switch is placed in the RESET position, energizing the reset coil of the overvoltage relay. The overvoltage relay will then connect the generator to the primary bus.

2-79. ALTERNATING-CURRENT SYSTEM.

2-80. GENERAL. The alternating-current system (figure 2-15) incorporates two inverters, both of which operate continuously to supply three-phase, 400-cps power. No. 1 inverter has an output rating of 2500 va. The output rating of No. 2 inverter is 250 va on [1] aircraft, and 750 va on [7] aircraft. This system also includes three sets of buses: phase A, B, and C main ac buses; phase A, B, and C instrument ac buses; and 26-volt instrument ac buses. The main ac buses are powered by No. 1 inverter, and the others are powered by No. 2 inverter.

2-81. OPERATION. During normal operation, No. 1 inverter receives dc power from the primary dc bus through an overload sensing control and the contacts of an inverter overload relay. The inverter relay is maintained in the energized state by dc power from the monitored dc bus through the INVERTER #1 circuit breaker and the contacts of the overload sensing control. No. 2 inverter receives dc power from the primary dc bus through INVERTER #2 circuit breaker. Should No. 2 inverter fail (causing the INST PWR failure warning light to glow), No. 1 inverter is made to assume the load of No. 2 inverter in addition to its own load by placing the inverter switch in the EMERG position.

2-82. INVERTER SWITCH. The inverter switch (figure 2-9 or 2-11) is a two-position toggle switch on the electric master panel. Placing the switch in the NORMAL position supplies power to both inverters. With failure of No. 2 inverter, the switch is placed in the EMERG position and No. 1 inverter is thereby made to assume the load of No. 2 inverter in addition to its own load.

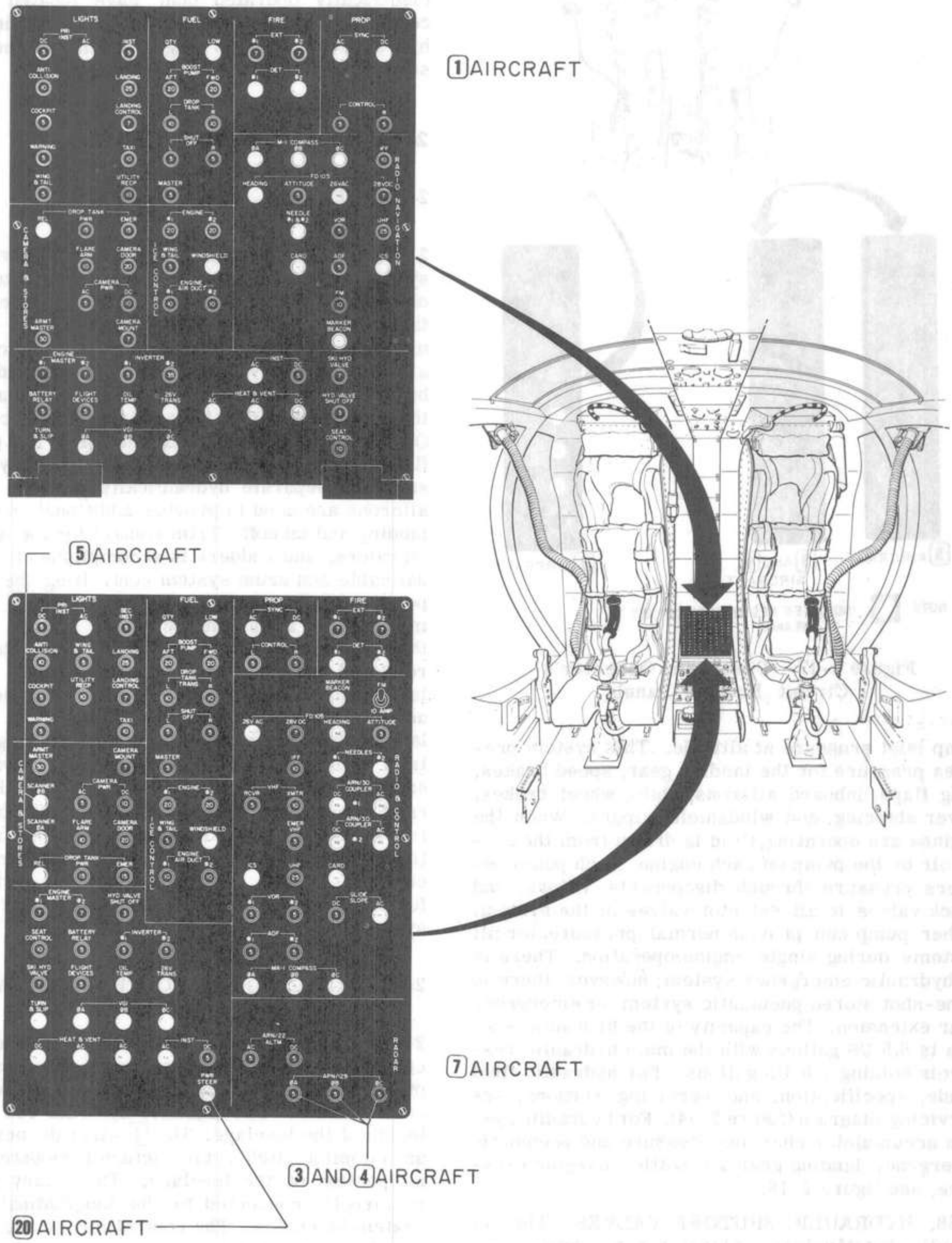
2-83. INSTRUMENT POWER FAILURE WARNING LIGHT. The INST PWR light on the caution light panel (12, figure 2-7) glows whenever dc power is applied to the warning light circuits and there is no ac power on the instrument ac buses. In flight, illumination of the light indicates failure of No. 2 inverter.

2-84. CIRCUIT BREAKER PANELS. The pilot and observer have access to all circuit breakers located on the center cockpit circuit breaker panel (figure 2-16) and pilot's and observer's circuit breaker panels (figure 2-17). All red button circuit breakers on the cockpit circuit breaker panels can be opened by electrical overload only.

2-85. HYDRAULIC POWER SUPPLY SYSTEMS.

2-86. GENERAL. (See figure 2-19.)

2-87. The hydraulic system is a 3000-psig variable-volume pump system. The hydraulic pressure is provided by two-engine-driven pumps, one on each engine, which draw fluid from a common reservoir located in the fuselage. The reservoir is pressurized by engine bleed air to maintain proper



NOTE: ◎ - INDICATES RED BUTTON CIRCUIT BREAKER

Figure 2-16. Center Cockpit Circuit Breaker Panels

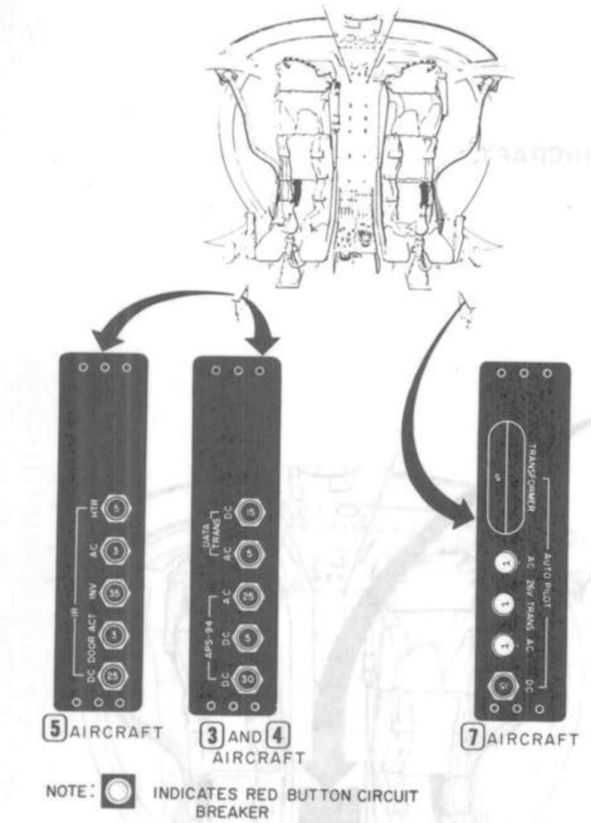


Figure 2-17. Pilot's and Observer's Circuit Breaker Panels

pump inlet pressure at altitude. This system provides pressure for the landing gear, speed brakes, wing flaps, inboard ailerons, slats, wheel brakes, power steering, and windshield wipers. When the engines are operating, fluid is drawn from the reservoir by the pump on each engine. Each pump delivers pressure through disconnects, filters, and check valves to all selector valves in the system. Either pump can provide normal pressure for all systems during single-engine operation. There is no hydraulic emergency system; however, there is a one-shot stored pneumatic system for emergency gear extension. The capacity of the hydraulic system is 6.5 US gallons with the main hydraulic reservoir holding 2.6 US gallons. For hydraulic fluid grade, specification, and servicing stations, see servicing diagram (figure 2-34). For hydraulic system accumulator charging pressure and pneumatic emergency landing gear air bottle charging pressure, see figure 2-18.

2-88. HYDRAULIC SHUTOFF VALVES. The hydraulic shutoff valves are located in the suction lines of the hydraulic pumps. These valves are closed and opened by the engine master switch (see figure 2-9 or 2-11). In aircraft where ECP-GR-AO-108 has been incorporated, the shutoff valves are closed only by activating the emergency fire handle. This prevents valve operation during normal engine shutdown.

2-89. HYDRAULIC PRESSURE INDICATOR. The hydraulic pressure indicator (1, figure 2-7) is an electrically operated dual gage located on the center instrument panel. This gage indicates hydraulic pressure in psig. Normal system pressure is 3000 psig.

2-90. FLIGHT CONTROL SYSTEM.

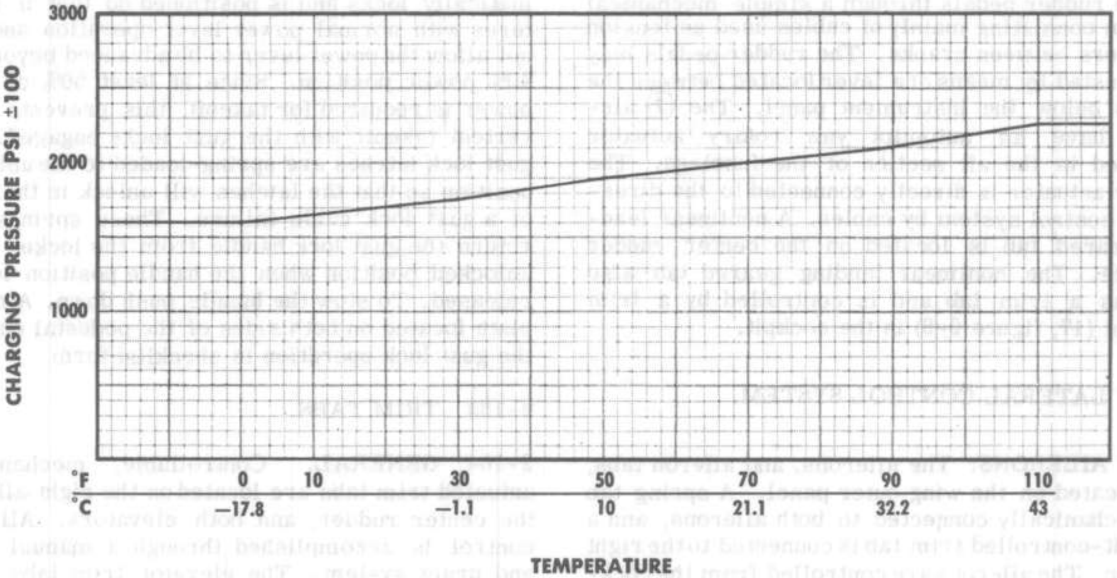
2-91. GENERAL. (See figure 2-20.)

2-92. The flight control system is a conventional system with primary control surfaces consisting of rudders, elevators, and ailerons. These surfaces are controlled from the cockpit through mechanical linkages using control sticks for ailerons and elevators, and adjustable rudder and brake pedals for the rudders. On all [23] aircraft, the pilot and observer have primary flight controls. On [3] thru [5] aircraft, only the pilot has primary flight controls. In addition to the primary control surfaces, separate hydraulically powered inboard ailerons are used to provide additional control for landing and takeoff. Trim control for the ailerons, elevators, and rudders is accomplished by a manual cable and drum system controlling the neutral position of the geared trim tabs. The [7] aircraft incorporate an automatic flight control system that can control flight attitudes along the pitch, roll, and yaw axes. Automatic attitude control is accomplished through rotary electromechanical actuators connected to the longitudinal (pitch), lateral (roll), directional (yaw), and longitudinal trim systems. Each rotary actuator (with the exception of longitudinal trim) has a calibration card specifically designed for the individual control systems. The calibration cards set the travel limits of the longitudinal, lateral, and directional control systems. See Chapter 5 for further information regarding the automatic flight control system.

2-93. LONGITUDINAL CONTROL SYSTEM.

2-94. The longitudinal control system consists of conventional elevators operated mechanically by a push rod and crank linkage connected to the cockpit control stick. Two parallel systems run the full length of the fuselage. The [7] aircraft incorporate an autopilot pitch rotary actuator mounted in the aft section of the fuselage. The rotary actuator is directly connected to the longitudinal control system by cables. The control forces are reduced for the pilot by the use of aerodynamic balance and a trim tab on the elevator. Both elevators have trim tabs controlled by a trim control (2, figure 2-8) in the cockpit. The [7] aircraft longitudinal trim system has a directly connected rotary actuator and cable system mounted in the aft section of the fuselage.

HYDRAULIC SYSTEM ACCUMULATOR CHARGING PRESSURE



PNEUMATIC EMERGENCY LANDING GEAR AIR BOTTLE CHARGING PRESSURE

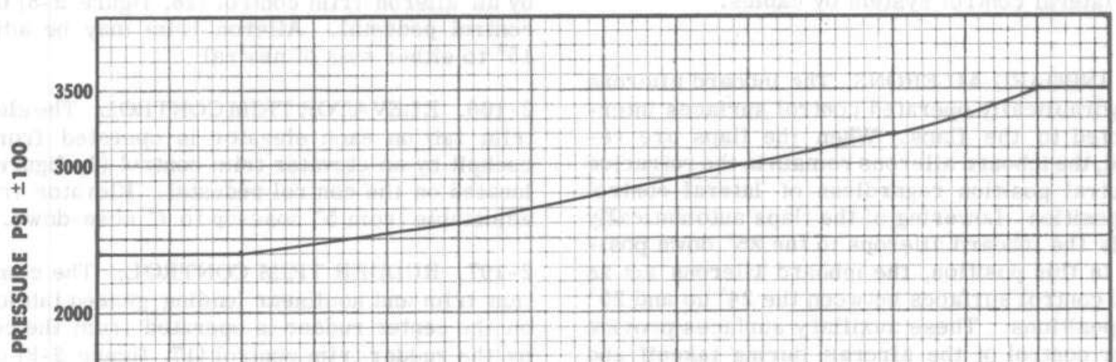


Figure 2-18. Hydraulic System Charging Curves

2-95. DIRECTIONAL CONTROL SYSTEM.

2-96. The directional control system consists of three rudder surfaces located on the vertical tail fins. The rudders are controlled from the cockpit by the rudder pedals through a simple mechanical system consisting mainly of cables used as tension members between cranks. The rudder pedals may be adjusted by means of a lever located between the pedals below the instrument panel. The [7] aircraft have an autopilot yaw rotary actuator mounted in the aft section of the fuselage. The rotary actuator is directly connected to the directional control system by cables. A nonlinear leading geared tab is located on the center rudder surface. The nonlinear landing geared tab also acts as a trim tab and is controlled by a trim control (17, figure 2-8) in the cockpit.

2-97. LATERAL CONTROL SYSTEM.

2-98. AILERONS. The ailerons, and aileron tabs, are located on the wing outer panel. A spring tab is mechanically connected to both ailerons, and a cockpit-controlled trim tab is connected to the right aileron. The ailerons are controlled from the cockpit by the control stick, through a series of push rods connected to the spring tabs. Rapid full lateral stick displacement will bottom the spring tab. The [7] aircraft incorporate an autopilot roll rotary actuator located in the midsection of the fuselage. The rotary actuator is directly connected to the lateral control system by cables.

2-99. INBOARD AILERONS. The inboard ailerons are hydraulically operated control surfaces interconnected to the flaps. When the flaps are retracted, the inboard ailerons remain in the retracted or neutral position regardless of lateral control stick position. Lowering of the flaps automatically extends the inboard ailerons to the 25° down position. In this position, the inboard ailerons act as lateral control surfaces between the 24° up and 25° down positions. These auxiliary surfaces provide greater control of the aircraft during takeoff and landing and for single-engine operation with flaps extended.

2-100. GUST LOCK CONTROL SYSTEM.

2-101. GENERAL. The gust lock control system consists of a manual cockpit control handle and a cable and pulley control system connected to the gust lock mechanisms near each control surface. The gust lock locks the surface controls in their neutral positions after the aircraft has been parked. All controls should be neutralized before the gust lock is engaged; however, if the lock is engaged when the controls are not in the neutral positions, they will automatically be locked in position when the controls are deflected to neutral.

2-102. GUST LOCK CONTROL HANDLE. The gust lock handle (figure 2-21) is a T-handle located on the cockpit control pedestal. The gust lock is positioned by pulling the handle up and aft to engage the locks. In the locked position, the handle automatically locks and is positioned so that it interferes with normal power lever operation and will not allow the power lever to be advanced beyond the 40% power position. Since at least 50% of rated power is required for takeoff, this prevents inadvertent takeoff with the gust locks engaged. The gust lock latches are spring-loaded to the unlocked position so that the latches will unlock in the event of a gust lock cable failure. These springs also return the gust lock handle from the locked to the unlocked position when the handle position lock is released. To stow the handle, push down. A nameplate located on both sides of the pedestal outlines the gust lock operation in checklist form.

2-103. TRIM TABS.

2-104. GENERAL. Controllable, mechanically actuated trim tabs are located on the right aileron, the center rudder, and both elevators. All trim control is accomplished through a manual cable and drum system. The elevator trim tabs on [7] aircraft can also be controlled by the autopilot system.

2-105. AILERON TRIM CONTROL. The aileron trim tab, located on the right aileron, is operated by an aileron trim control (18, figure 2-8) on the control pedestal. Aileron trim may be adjusted 15° to either side of neutral.

2-106. ELEVATOR TRIM CONTROL. The elevator trim tab on each elevator is operated from the cockpit by an elevator trim control (2, figure 2-8) located on the control pedestal. Elevator trim is adjustable from 5° nose-up to 7° nose-down.

2-107. RUDDER TRIM CONTROL. The combination trim and nonlinear leading geared tab located on the center rudder is operated from the cockpit by the rudder trim control (17, figure 2-8) on the control pedestal. Internal stops in the pedestal determine the maximum amount of trim tab travel available, which varies somewhat with rudder position. With neutral rudder, 22° right or left trim is available.

2-108. WING FLAPS.

2-109. GENERAL.

2-110. The wing flaps are operated from the hydraulic system. The flaps are controlled from the cockpit by the flaps handle (4, figure 2-8) and may be placed in any one of three detented positions: UP, 15° DOWN, and 45° DOWN. The flaps are supported and guided in motion by parallelogram

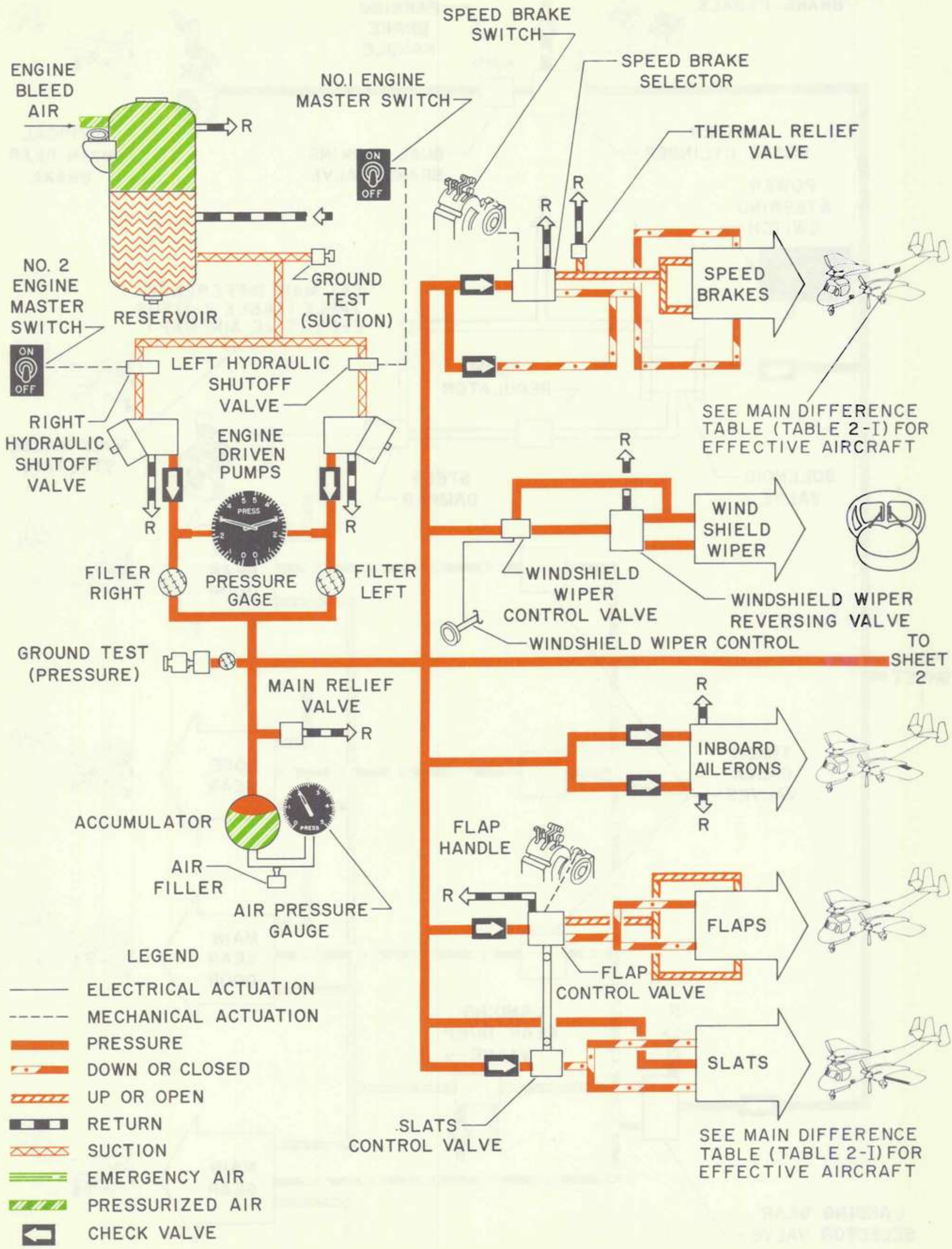


Figure 2-19. Hydraulic System, Schematic Diagram (Sheet 1 of 2)

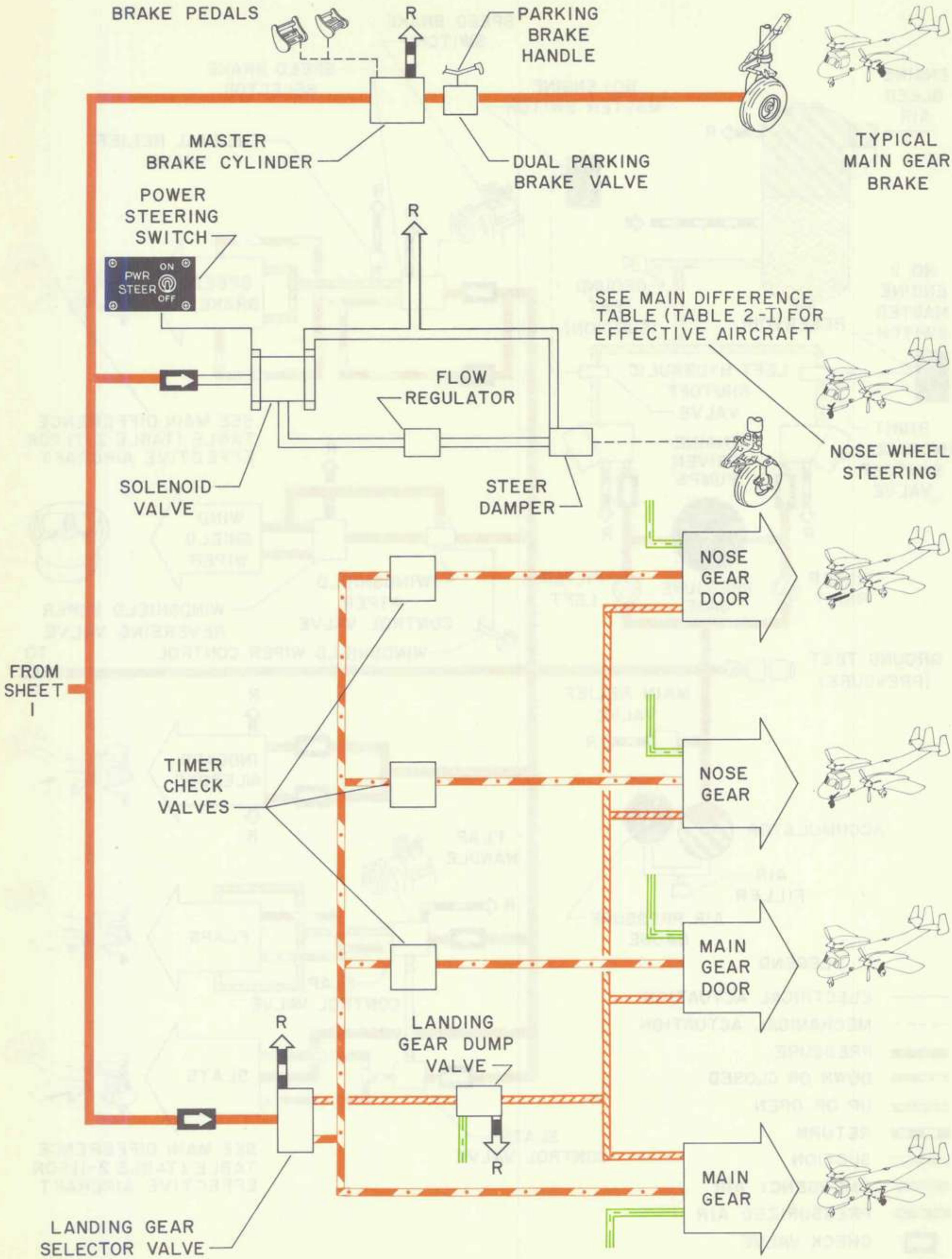


Figure 2-19. Hydraulic System, Schematic Diagram (Sheet 2 of 2)

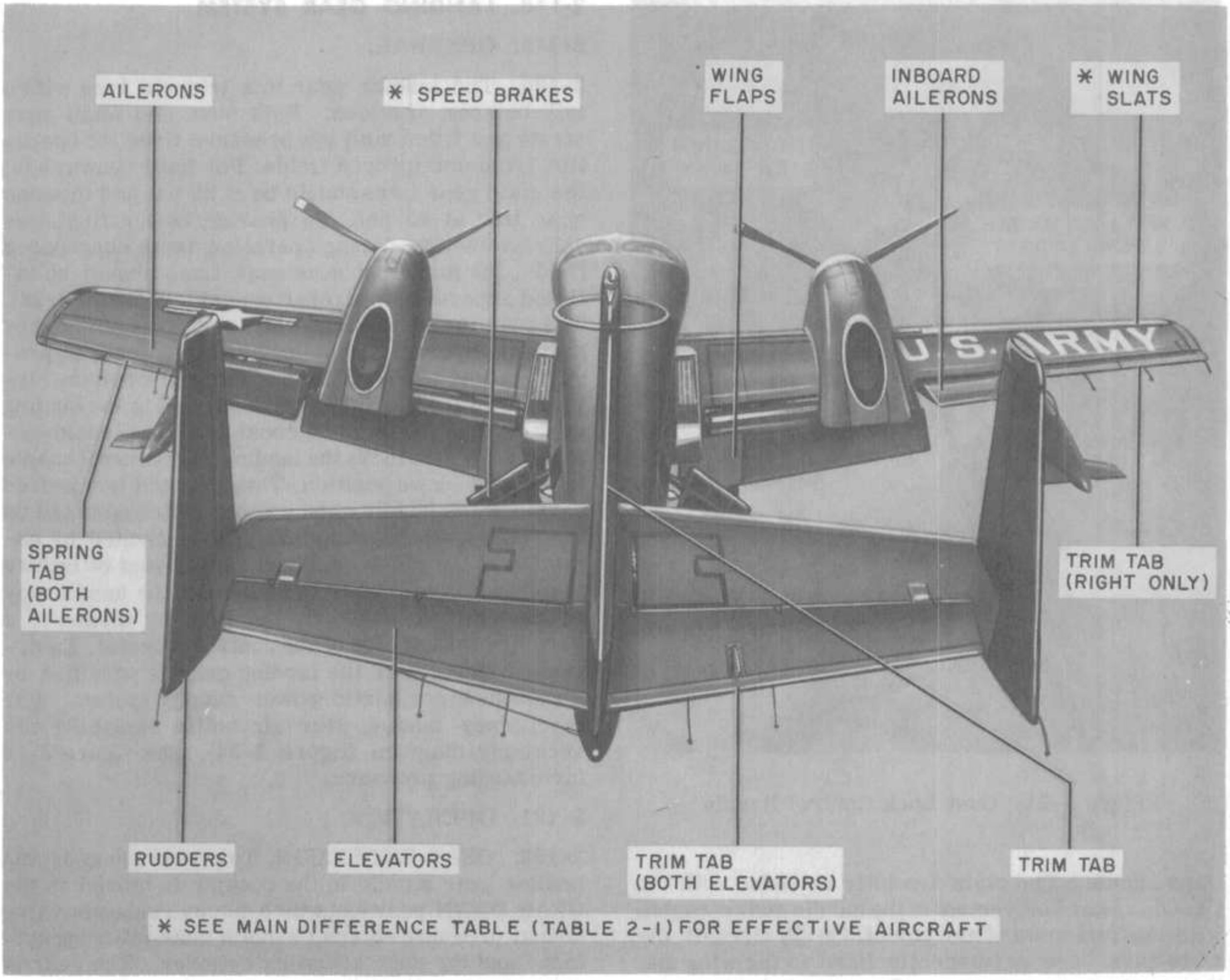


Figure 2-20. Flight Control Surfaces

linkages near each end. Each flap is actuated both up and down by an hydraulic cylinder located in the wing stub forward of the inboard end. The hydraulic cylinder drives a bellcrank and push rod linkage that actuates the forward linkage of the four bar linkage. A push rod and idler linkage between the left and right flap-drive bellcranks interconnects the flaps to insure synchronization. The inboard aileron is connected to the flaps by a jack shaft and link arrangement at the outboard end of the flap. The flaps actuating mechanism and actuator are designed to allow the flaps to "blow-up" or partially retract from the extended position, at speeds in excess of 110 knots. This is accomplished by providing only enough actuator power to maintain flap extension at this airspeed. Above this speed the hydraulic pressure relief allows the airload to overpower the actuator, forcing the flaps up, until a new balance of flap hinge movement and actuator power is reached. The wing slats are interconnected to the wing flaps and the inboard ailerons, and are controlled from the cockpit by the wing flaps handle. In the event of the loss of hydraulic system pressure, the wing flaps are inoperative since there is no emergency wing flaps lowering system.

2-111. FLAPS HANDLE. The flaps handle (4, figure 2-8) is located on the control pedestal in the cockpit. The handle may be placed in any one of three detented positions: UP, 15° DOWN, or 45° DOWN. In addition to flaps extension, the flaps handle also controls the extension and retraction of the wing slats and inboard ailerons.

2-112. FLAPS POSITION INDICATOR. The flaps portion of the wheels and flaps position indicator (19, figure 2-5 or 25, figure 2-6) on the pilot's instrument panel shows the position of the flaps.

2-113. WING SLATS. The wing slats are located on the outboard leading edge of each wing. Extension and retraction of the slats is controlled by the

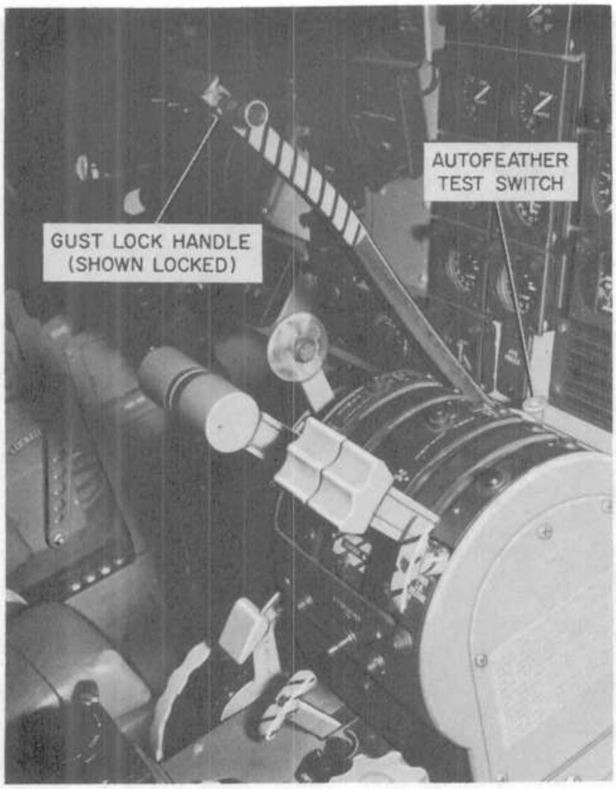


Figure 2-21. Gust Lock Control Handle

flaps handle. The slats are fully extended with the first downward movement of the handle and retracted with the final upward movement. On [24] aircraft, the slats have been permanently fixed to the wing and their actuators removed. On extended wing aircraft ([9]), the slats have not been installed.

2-114. SPEED BRAKES.

2-115. GENERAL. (See figure 2-20.)

2-116. The speed brakes, located on the fuselage midway between the wing and stabilizer, are drag-increasing devices used for reducing speed in a dive or any other flight attitude where reduction of speed is desired. They are also used in maintaining constant-speed glide path control. They are powered by the normal hydraulic system and are controlled by a switch located on the left power lever. No speed brakes have been installed on [4] craft.

2-117. SPEED BRAKE SWITCH. The speed brake switch (10, figure 2-8) is a thumb-operated switch located on the left power lever in the cockpit. The switch has two positions: a maintained OUT position to extend the brakes; and a maintained IN position for retraction of the brakes. There is no speed brake switch on [4] aircraft.

2-118. LANDING GEAR SYSTEM.

2-119. GENERAL.

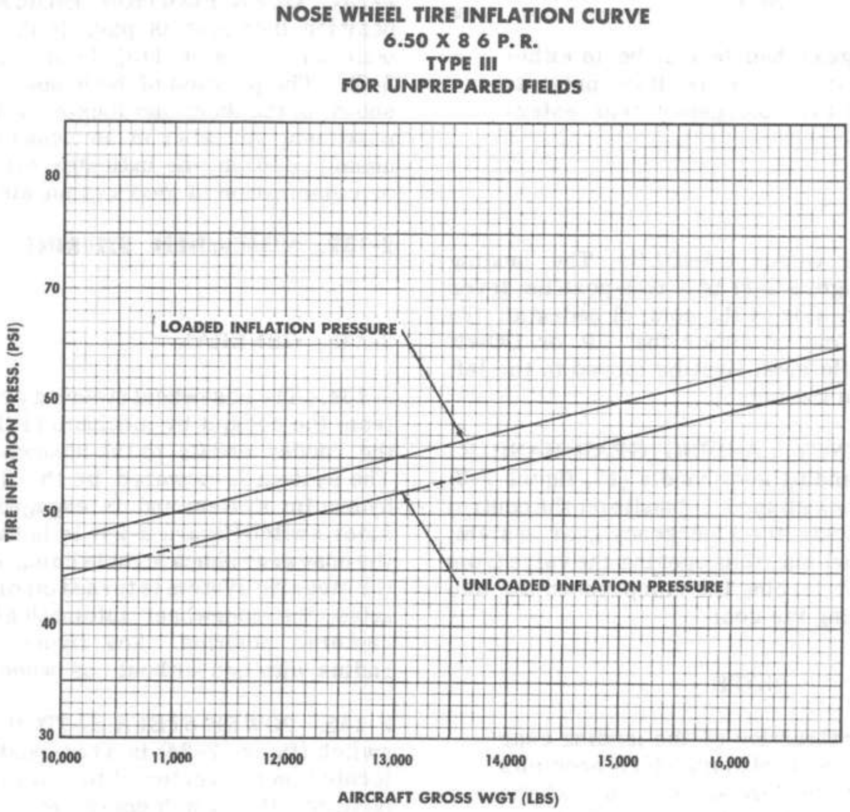
2-120. The landing gear is a tricycle type with a tail bumper provided. Both nose and main gear struts are fitted with low pressure tires for operation from unimproved fields. For hard runway use, the main gear tires should be at 90 psi and the nose gear tire at 65 psi. To provide better floatation characteristics during operation from unprepared fields, the main and nose gear tires should be inflated according to aircraft weight (see figure 2-22). The gear is extended and retracted hydraulically by the main hydraulic system. A safety lock, to prevent inadvertent retraction of the gear when the aircraft is on the ground, is incorporated in the landing gear control system and consists of a solenoid-actuated pin which locks the landing gear control handle in the gear-down position. This solenoid is powered to unlock the handle when a limit switch mounted on the right main gear shrink rod is activated by extension of the inner cylinder. In the event of failure of the switch to actuate the solenoid, the handle may be manually unlocked by the pilot by means of a switch on the left side of the control pedestal. Emergency extension of the landing gear is provided by a one-shot pneumatic power supply system. For emergency landing gear air bottle servicing see servicing diagram (figure 2-34). See figure 2-18 for charging pressure.

2-121. OPERATION.

2-122. GEAR EXTENSION. To extend the gear, the landing gear handle in the cockpit is moved to the GEAR DOWN position, which moves a selector valve so that pressure enters the main gear actuating cylinder and the door actuating cylinder. The gear is restrained in the UP position by the up-lock hook. The door cylinder extends and the door opens. As the door approaches the full open position, a cable actuated by the door crank pulls the up-lock hook to the "unlocked" position and permits the gear to extend. When the gear reaches the full down position, the down-lock engages and locks the gear in the extended position.

2-123. GEAR RETRACTION. To retract the gear, the gear handle is placed in the UP position. This actuates the selector valve so that pressure enters the retracting side of the gear actuating cylinder and the extending side of the door cylinder. Pressure is trapped in the door cylinder return line by means of a timer checkvalve. As the gear retracts, the down-lock latch is unlocked and the timer valve is actuated, allowing the door to close. The door always permits the up-lock hook to reach the locked position before the door enters the gear retraction path.

2-124. EMERGENCY GEAR EXTENSION. The emergency landing gear extension system is a 3000 psig pneumatic system utilizing dry compressed air or nitrogen. The system provides for lowering the gear only one time. Emergency gear extension is controlled by the emergency landing gear handle.



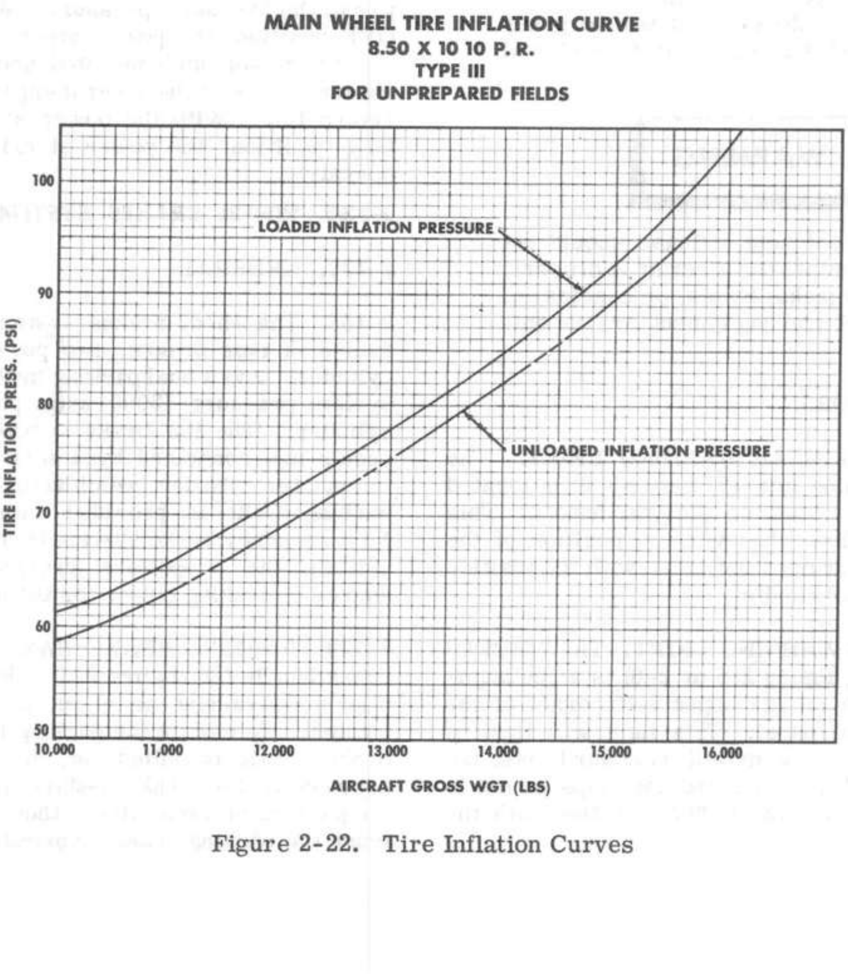


Figure 2-22. Tire Inflation Curves

NOTE

The landing gear handle can be in either the DOWN or the UP position prior to utilization of the emergency gear extension system.

2-125. CONTROLS.

2-126. LANDING GEAR HANDLE. The landing gear handle (6, figure 2-8) is a two-position lever located on the left side of the control pedestal. To move the handle out of either the UP or DOWN position, the handle must first be moved to the left to release it from the detent.

2-127. EMERGENCY LANDING GEAR HANDLE. The emergency landing gear handle (13, figure 2-8) is a yellow and black striped T-handle on the control pedestal. To actuate the emergency gear system, the handle is pulled out, thus opening the valve from the air bottle and forcing the compressed air into the lines, extending the gear.

NOTE

Inadvertent retraction of the landing gear is prevented by a solenoid which prohibits movement of the landing gear unless the aircraft is airborne. A release (5, figure 2-8) is provided for manual override of this solenoid in the event of an emergency or for ground testing without electrical power.

WARNING

The manual solenoid release should not be operated unless the aircraft is properly supported on jacks, hoists, or cradles and all personnel and equipment are in safe positions.

2-128. INDICATORS.

2-129. LANDING GEAR WARNING LIGHT. The landing gear warning light (7, figure 2-8) is located in the translucent knob on the gear handle. This red light will glow whenever the position of the nose and main gear does not agree with the position of the landing gear handle.

2-130. WHEELS WARNING LIGHT. The WHEELS warning light (10, figure 2-5 or 2-6) is a rectangular warning light on the upper left corner of the pilot's instrument panel. This light will flash if the power levers are moved rearward past the MIL POWER detent setting and the flaps handle is in either the 15° or 45° DOWN position with the landing gear up.

2-131. GEAR POSITION INDICATOR. The gear position indicator is part of the wheels and flaps position indicator (19, figure 2-5 or 25, figure 2-6). The position of both nose and main gear is shown in the down and locked or the up and locked positions, and also in any unsafe position. In an unsafe position, the indicator will show which gear or combination of gears is unsafe.

2-132. NOSEWHEEL STEERING

2-133. GENERAL.

2-134. The nosewheel steering system is controlled from the cockpit by mechanical linkage connecting the rudder pedals to the nosewheel steer damper. The system is powered by the 3000 psig aircraft hydraulic system and is engaged when the power steer switch (figure 2-24) is in the ON position and the nose gear shock strut is compressed. Whenever the steering system is turned off or rendered inoperative, the nosewheel automatically returns to the centered position. See figure 2-23 for turning radius with and without nosewheel steering.

2-135. POWER STEER SWITCH. The power steer switch (figure 2-24) is a two-position toggle switch located on the center of the glareshield. In the ON position, the switch energizes a solenoid-operated shutoff valve connecting one port of the steer damper to the hydraulic pressure. When placed in the OFF position, the power steer switch will deenergize the solenoid-operated shutoff valve, opening both ports of the steer damper to the hydraulic return line. With the power steer switch in the OFF position, the power steering system is inoperative.

2-136. WHEEL BRAKES SYSTEM.

2-137. GENERAL.

2-138. The wheel brakes system consists of two dual-disk type brakes, two power boost master-cylinders, and a dual parking brake valve. Normal system pressure (3000 psig) powers the master cylinder. The toe brake sections of the rudder pedals are connected by a series of push rods to the master cylinder, which actuates the brakes. A parking brake is provided with cockpit control. No emergency brake system is incorporated. Reversing the propellers provides an additional source of braking power for the aircraft.

2-139. PARKING BRAKE HANDLE. The parking brake handle (26, figure 2-3) is located beneath the pilot's instrument panel on the left side of the cockpit. To engage the parking brake, the parking brake handle is pulled out, the brake pedals are depressed, the brake pedals are released, and the parking brake handle is then released. To release the parking brake, depress the brake pedals.

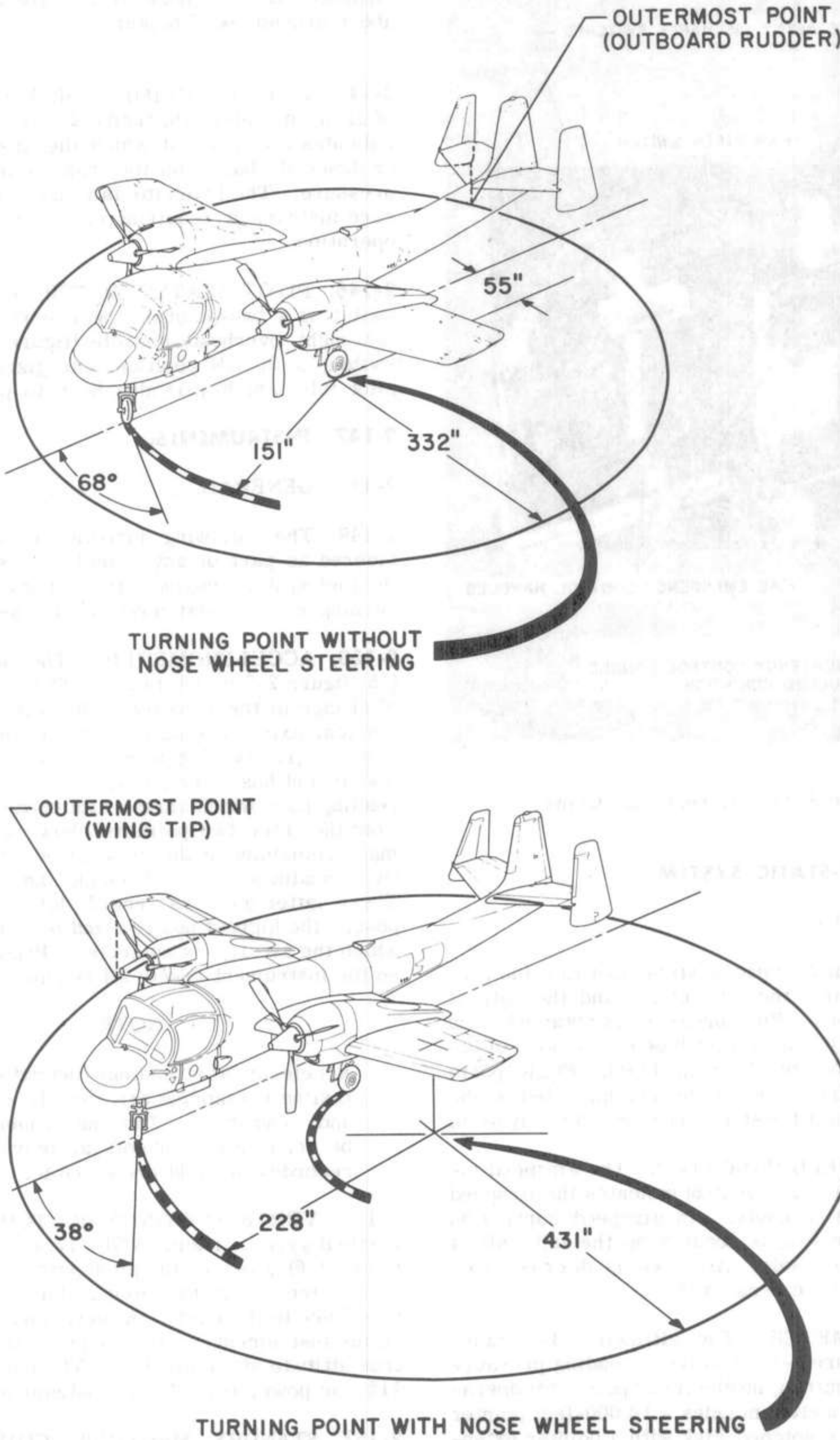


Figure 2-23. Turning Radius

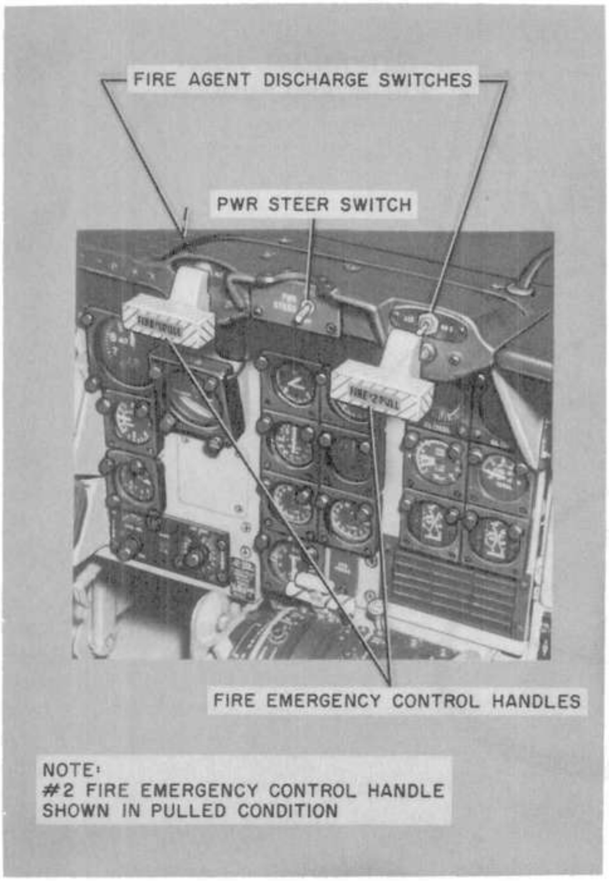


Figure 2-24. Glareshield, Center

2-140. PITOT-STATIC SYSTEM.

2-141. GENERAL.

2-142. The pitot-static system operates the airspeed indicators, the altimeters, and the rate of climb indicators. Pitot pressure is obtained from the electrically heated pitot tube on the nose of the aircraft in front of the windshield. Static ports located on either side of the fuselage, below the cockpit, transmit the static pressure to the system.

2-143. AIRSPEED INDICATOR. The airspeed indicator (7, figure 2-5 or 2-6) indicates the airspeed of the aircraft in knots. An airspeed correction card (7, figure 2-3) is located on the left side of the overhead console. Airspeed is derived from the pitot and static pressures.

2-144. ALTIMETER. The altimeter (14, figure 2-5 or 14, figure 2-6) is a direct-reading pressure instrument requiring no electrical power for operation. The altimeter includes a 10,000-feet pointer incorporating a notched disk with a pointer extension and a warning indicator consisting of a striped section which appears through the notched disk at altitudes below 16,000 feet. On [7] aircraft, a radar altimeter is incorporated for altitude indication above ground (see Chapter 5).

2-145. RATE OF CLIMB INDICATOR. The rate of climb indicator (18, figure 2-5 or 19, figure 2-6) indicates the speed at which the aircraft ascends or descends based on the changes in atmospheric pressure. The indicator is a direct-reading pressure instrument requiring no electrical power for operation.

2-146. PITOT HEATER SWITCH. The pitot heater switch is a two-position toggle-switch located on the right overhead console (figure 2-11). This switch, in the ON position, energizes a coil in the pitot tube which provides heat to prevent icing.

2-147. INSTRUMENTS.

2-148. GENERAL.

2-149. The following instruments are not considered as part of any complete system, such as the fuel system, engine, etc. For information concerning navigational instruments, see Chapter 5.

2-150. ACCELEROMETER. The accelerometer (15, figure 2-5 or 16, figure 2-6) indicates the rate of change in the velocity of the aircraft along its vertical axis. The dial is graduated in terms of units of gravity with a range of -5 to +10 g. The instrument has three pointers: one is a continuous reading hand which varies with changing acceleration; the other two pointers show maximum readings, remaining at the greatest positive and negative readings reached during any maneuvers. These latter pointers record, for reference purposes, the highest positive and negative g-loads to which the aircraft is subjected. Pressing the knob on the instrument resets all readings to 1 g.

NOTE

Accelerometer readings indicated during taxiing and landing are usually erroneous and read high. The instrument should be reset after takeoff as only readings recorded in flight are reliable.

2-151. VERTICAL GYRO INDICATOR. The 3-inch vertical gyro indicator (VGI) (17, figure 2-5 or 18, figure 2-6) provides the pilot with a visual indication of the aircraft's pitch and roll attitude with reference to the earth. A mechanical caging knob on the instrument is used to place the gyro in the true attitude of the aircraft. The unit operates on 115-vac power from the ac instrument bus.

2-152. STANDBY MAGNETIC COMPASS. The standby magnetic compass (32, figure 2-3) is located on the front of the overhead console. It is used in the event of failure of the master direction indicator or as an instrument cross-check. Readings should be taken only during steady flight since errors may be introduced by turning or acceleration. A compass correction card (7, figure 2-3) indicating deviation is located on the left side of the overhead console.

2-153. TURN AND SLIP INDICATOR. The dc-powered turn and slip indicator (25, figure 2-5 or 26, figure 2-6) consists of a turn indicator (needle) and slip indicator (ball). The turn needle is driven by a gyroscope through mechanical linkage. The slip indicator is an inclinometer, with a ball enclosed in a glass tube.

2-154. OUTSIDE AIR TEMPERATURE INDICATOR. The outside air temperature (O. A. T.) indicator, located on the right overhead console (figure 2-10), registers the outside air temperature in °C.

2-155. CAMERA BAY TEMPERATURE INDICATOR. The camera bay temperature indicator, located on the right overhead console (figure 2-10), registers the camera bay temperature in °C.

2-156. MECHANICAL CLOCK. The mechanical clock (20, figure 2-5 or 21, figure 2-6) is equipped with a sweep second hand and totalizer that indicate elapsed time. The sweep hand and totalizer are controlled by a knob in the upper right corner of the instrument. Successive depressing of the knob starts, stops, and returns the hands to zero. The totalizer indicates 1 minute for each sweep of the second hand.

2-157. MASTER CAUTION LIGHT AND TEST SWITCH. The master caution test switch and MASTER CAUTION light (8 and 9, figure 2-5 or 2-6) are located on the pilot's instrument panel. Whenever a specific caution light is lit on the caution light panel (12, figure 2-7), the MASTER CAUTION light glows to call this to the pilot's attention. The caution light test switch is used to check the caution light circuitry; when actuated, the switch energizes all of the caution lights including the MASTER CAUTION light.

2-158. EMERGENCY EQUIPMENT.

2-159. FIRST AID KIT.

2-160. A first aid kit is located on the rear of the overhead console within reach of either occupant. (See Chapter 4, Section V, figure 5-4.)

2-161. HAND FIRE EXTINGUISHER.

2-162. The fire extinguisher is located on the left side of the pilot's ejection seat (see Chapter 4, Section V, figure 5-4) within reach in the event of fire. It is filled with 1 quart of chlorobromomethane under pressure.

2-163. SIGNAL LIGHT.

2-164. The signal light is a hand-operated light mounted on a bracket on the lower right side of the cockpit (see Chapter 4, Section V, figure 5-4). The light is attached to a 10-foot cord and is used primarily for air-to-ground and air-to-air communications. Red, green, amber, and dimming filters are provided. The light is powered by 28 vdc through the UTILITY RECP circuit breaker located on the center cockpit circuit breaker panel (figure 2-16).

2-165. ESCAPE HATCH JETTISONING SYSTEM.

2-166. GENERAL. The escape hatch is the section making up the cockpit roof directly over the occupants' heads. The system consists of a cam mechanism, a pneumatic actuator, and a lanyard-operated firing pin. The pneumatic actuator is a self-contained system including cylinder and air bottle. A single cockpit control handle (28, figure 2-3) is the only means of actuating the system. Jettisoning of the hatch occurs in two successive operations. The actuator first drives the cam mechanism which disengages the hatch from the fuselage structure, and then proceeds to fling the hatch up and away from the aircraft. See figure 2-34 for filler location.

2-167. ESCAPE HATCH JETTISON HANDLE. The escape hatch jettison handle (11, figure 2-3), located on the forward section of the overhead console, is a yellow and black striped T-handle that actuates the hatch jettisoning system. The handle must be rotated 90° clockwise and pulled to jettison the hatch.

2-168. FIRE DETECTION SYSTEM.

2-169. GENERAL. The fire detection system provides a warning to the pilot if a fire occurs in either engine. Each engine's system is a continuous-type automatic-resetting detection system consisting of a control unit, three sensing elements in the engine area, one sensing element in the nacelle area, warning lights, and connectors. A test switch is used to check the operation of both systems simultaneously. The system is powered by 28 vdc from the primary bus and is protected by circuit breakers. The sensing elements are wired in series with the warning lights and in the normal condition present an open circuit. A wire assembly connects the elements with the test relay, the control unit, and the power source. When excessive temperatures exist in the areas in which the sensing elements are located, the electrical resistance of the ceramic material in which the element wires are encased decreases rapidly and current passes between the two wires, completing the circuit and causing the warning light to glow.

2-170. FIRE DETECTION TEST SWITCH. The fire detection test switch (12, figure 2-5 or 2-6) is a momentary toggle switch with OFF and TEST positions. In the TEST position, the fire detection circuit is completed and the fire warning lights will go on.

2-171. FIRE WARNING LIGHTS. On (10) aircraft, the warning lights are located in the two fire emergency control handles (figure 2-24) on the cockpit glareshield. The handles, labelled FIRE #1 PULL and FIRE #2 PULL, light when a fire exists in the respective engine.

2-172. FIRE EXTINGUISHING SYSTEM.

2-173. GENERAL. The fire extinguishing system consists of two bottles containing an extinguishing agent ($CBrF_3$) and the necessary lines running to each engine. Only one fire extinguisher container is installed, with plumbing provisions included for field installation of the second container. The system is cockpit-controlled and provides a main and alternate source for extinguishing. Normally the No. 1 bottle provides the extinguishing agent for the No. 1 engine and the No. 2 bottle for the No. 2 engine. However, the alternate system allows each bottle to be selected for the opposite engine in the event of depletion of the other bottle. Discharge of the agent takes place through the line ends in the nacelle, eliminating the need for nozzles. For fire extinguisher agent grade, specification, and servicing station see servicing diagram (figure 2-34). See figure 2-25 for fire extinguisher bottles charging curve.

2-174. ENGINE FLUID SHUTOFF SWITCHES. The engine fluid shutoff switches operate in conjunction with the fire emergency control handles (figure 2-3) and are located, together with the handles, on the center of the cockpit glareshield. The electrical circuitry for the engine fluid shutoff associated with the fire emergency control handle is provided with 28 volt dc power from the aircraft primary bus. In the event of generator failure, this bus is energized by the aircraft battery if the battery switch is either in the NORMAL or UNMONITORED position. By pulling out the fire emergency control handles, the switches close the oil shutoff valve, the hydraulic shutoff valve, and the main fuel tank shutoff valve.

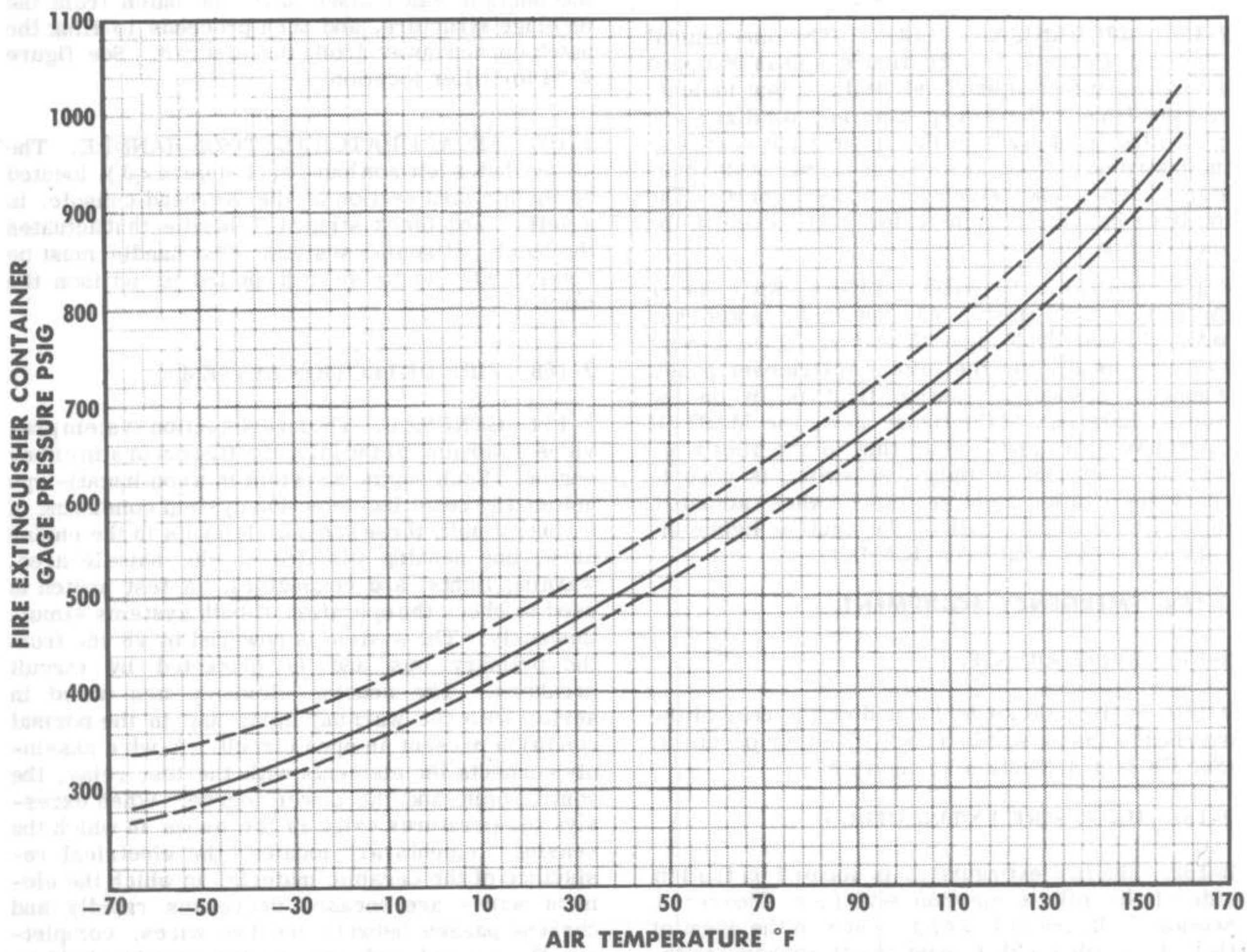


Figure 2-25. Fire Extinguisher Container Charging Curve

2-175. FIRE AGENT DISCHARGE SWITCHES. Fire agent discharge switches are three-position toggle switches located under the fire emergency control handles (figure 2-24). Placing the switch for the No. 1 engine in the No. 1 position forces the extinguishing agent from the No. 1 bottle into the No. 1 nacelle. In the ALT position, the agent in the No. 2 bottle is directed to the No. 1 engine. The switch for the No. 2 engine operates in a similar manner.

2-176. MK-J5 MARTIN-BAKER EJECTION SEAT. (See figure 2-26.)

2-177. GENERAL.

2-178. Each of the two MK-J5 Martin-Baker ejection seats consists of an ejection gun, main beam assembly, seat bucket assembly (35), drogue parachutes container (27), drogue gun (32), time release mechanism (9), personnel parachute, and survival kit assembly (see figure 2-29). On [25] aircraft, MK-J5A ejection seats are installed. On [4] aircraft, MK-J5B ejection seats are installed. The differences between the two seats are in the time delay setting of the time release mechanism and drogue gun. See Chapter 4, Section V, paragraphs 5-16c and 5-16f for these time settings. The seat is designed to provide safe escape at speeds from 100 knots on the ground (straight and level) and throughout the complete capability of the aircraft, and after ejection to deploy the parachute automatically and separate the occupant from the seat. Ejection at ground level during takeoff or landing, at airspeeds of 100 knots and over, is both safe and practicable because of the ejection velocity of the long-stroke ejection gun and the rapid extraction and deployment of the personnel parachute. For high-altitude ejection, a barostatic control attached to the seat delays opening of the parachute and separation of the occupant from the seat until the occupant has descended through the cold, rarefied atmosphere to an altitude of 15,000 to 10,000 feet above sea level. In high-speed ejections, further safety is afforded through a g-controller which delays opening of the parachute until g forces are reduced to within safe limits.

2-179. COMPONENTS.

2-180. EJECTION GUN. The ejection gun is attached to the bulkhead behind the seats in two places. The gun provides the power for ejection of the seat and occupant from the aircraft with the channel numbers mounted on opposite sides of the cylinder serving as guides to the seat. Three explosive charges (one primary and two auxiliary) are used for ejection of this seat. The primary is placed in the top of the tube, under the firing mechanism. When the face blind or the secondary firing handle is pulled, the primary cartridge is fired forcing the seat upward. With further movement of the seat, successive ports are opened allowing the flame to fire the auxiliary charges.

2-181. SEAT ASSEMBLY. The seat assembly consists of two vertical side beams bridged by three horizontal crossmembers supporting the seat pan drogues container, drogue gun, and time delay mechanism. The middle crossmember is the top support of the seat raising jack, the lower end of which is attached to a beam at the rear of the seat bucket. The inertia reel mechanism is mounted above the top support of the seat raising jack and is capable of supporting the seated occupant in his harness and preventing him from being thrown forward in the event of a crash landing. The vertical beams support the drogue gun and the time release mechanism. The purpose of the drogue gun is to extract two drogue parachutes. The drogue parachutes container is bolted to the upper portion of each vertical beam and houses the face blind and two drogue parachutes. The sides of the drogue parachute container extend upward to form overhead hatch breakers, permitting "through the hatch" ejections. Four guide tracks bolted to the lower portion of the seat main beams (two per beam) guide the seat bucket assembly in height adjustment. The seat bucket assembly supports the occupant and is the only part of the seat that moves with height adjustment. A toggle switch (2, figure 2-26) on the right side of the seat bucket, controls the height adjustment. Additional items fitted to the seat are a secondary firing handle, manual override handle, inertia reel manual control, and two release locks for the leg restraint cords. The dual leg restraint mechanism is designed to pull and hold the occupant's legs against the seat bucket during ejection by means of the leg restraint cords attached to the two quick-release leg garters which are attached securely just below the knees. Slack is provided for leg movement during normal flight. When the seat is ejected, the initial movement of the seat takes up the slack in the cords pulling the occupant's legs tight against the seat. Further movement of the seat tightens the cords, shearing the rivets on the roller brackets separating the cords from the aircraft. The leg restraint cords are released from their locks when the time release mechanism fires.

2-182. PERSONNEL PARACHUTE AND HARNESS ASSEMBLY. (See figure 2-27.)

a. The personnel parachute and harness assembly consists of a 24-foot parachute (8), back pad (17), a wedge pack (9), and a quick-fit harness (2). An MA-2 torso suit may be substituted for the quick-fit harness (for comparison, see figure 2-28). The parachute is contained in a horseshoe-shaped pack designed to provide the proper ejection posture by means of the harness and the inertia reel. The parachute rests on a central support bracket and is secured by two restraint straps (16, figure 2-26) running from the adjustment buckle on a wedge pack (9, figure 2-27), which fits above the parachute pack (8), through rectangular rings on straps attached to each side of the drogue container. The restraint straps (16, figure 2-26) then pass down over the parachute pack (8, figure 2-27), between the parachute and the support bracket, and through the loops of the support bracket. The parachute restraint straps are then secured by the lug end of the harness lock. The parachute remains attached to the seat, and need be removed only for servicing. During the ejection sequence, the parachute is automatically extracted by the drogue parachutes through connecting lines.

b. A plate (16) is sewn to the back pad (17) and the back pad is secured to the seat by four screws, washers, and nuts. The upper part of the back pad is tucked under the elastic straps (14) sewn to the personnel parachute.

c. The occupant is secured in the seat by means of the principal attachment points as described below.

d. The shoulder portion of the personnel parachute risers (7) carries a strap with a two-piece roller yoke at the center. The roller yoke (5) is retained by a loop strap (6) which is in turn secured by the harness loop strap lock and the snubber of the inertia reel.

e. The two personnel parachute risers (7) originate from within the parachute pack (8) and are attached to the two buckles (4) located just below the shoulders on the quick-fit harness (2). These buckles are attached to straps which pass over the occupant's shoulders. The straps provide the occupant with greater security within the harness when properly adjusted and tightened.

f. Two additional straps are attached to two buckles (3) located just below the center adjustment strap on the quick-fit harness and are known as the survival kit vertical restraint straps. These additional straps also serve as shoulder restraint lines and are connected to the lap belt (15, figure 2-26) of the survival kit assembly (see figure 2-29).

2-183. SURVIVAL KIT ASSEMBLY. (See figure 2-29.) The survival kit assembly consists of a lap belt, seat pan, and a survival kit container. The lap belt is used to hold the occupant securely in the seat and is a quick-disconnect, adjustable type belt. Two straps with lugs attached, known as sticker straps, are stitched to the lap belt and are retained by clips riveted to the inside of each seat bucket side panel. Their purpose is to insure clean separation from the seat and prevent collision between the seat and occupant during the ejection sequence. Another strap, fastened to a clip, is stitched to the front of the lap belt and is known as the survival kit retention strap. This strap attaches the lap belt to the left survival kit vertical restraint strap of the quick-fit harness. This strap may also be used if the occupant should feel uncomfortable with the lap belt and survival kit while descending in his parachute. If so, the occupant may attach the survival kit retention strap to the left survival kit vertical restraint strap fitting of the quick-fit harness, release the lap belt, and let the survival kit hang at this side. The seat pan consists of a metal plate supporting a layer of energy absorption material, and an Ensolite comfort pad covered with a plastic material. The seat pan provides support for the occupant while in flight or during ejection. The survival kit container is securely attached to the seat pan and lap belt, and is stowed under the seat pan in the seat bucket.

2-184. INERTIA REEL. The inertia reel mechanism located behind the center support brackets consists of a spring-loaded strap retraction reel, a loop strap snubber, a loop strap, and a harness lock. The strap which is rolled around the retraction reel, runs through the snubber to the split roller yoke on the parachute riser straps and from there back to the harness lock. The inertia reel is controlled by a three-position handle on the left side of the seat bucket. In the forward locked

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KEY TO FIGURE 2-26:

1. Manual override lever
2. Seat height adjustment switch
3. Time release mechanism trip rod
4. Time release mechanism
5. Link line
6. Face blind locking mechanism
7. Face blind handle
8. Inertia reel manual control lever
9. Leg restraint cord lock-release lever
10. Secondary firing handle
11. Secondary firing handle safety guard
12. Snubber finger rings
13. Leg restraint cords
14. Leg restraint quick-release garters
15. Lap belt
16. Personnel parachute restraint straps
17. Rocket jet fitting
18. Wedge pack
19. Drogue parachutes container
20. Personnel parachute withdrawal line
21. Static line slide disconnect
22. Drogue parachute withdrawal line
23. Tommy bar
24. Drogue gun
25. Personnel parachute riser
26. Seat bucket
27. Back pad
28. Seat cushion

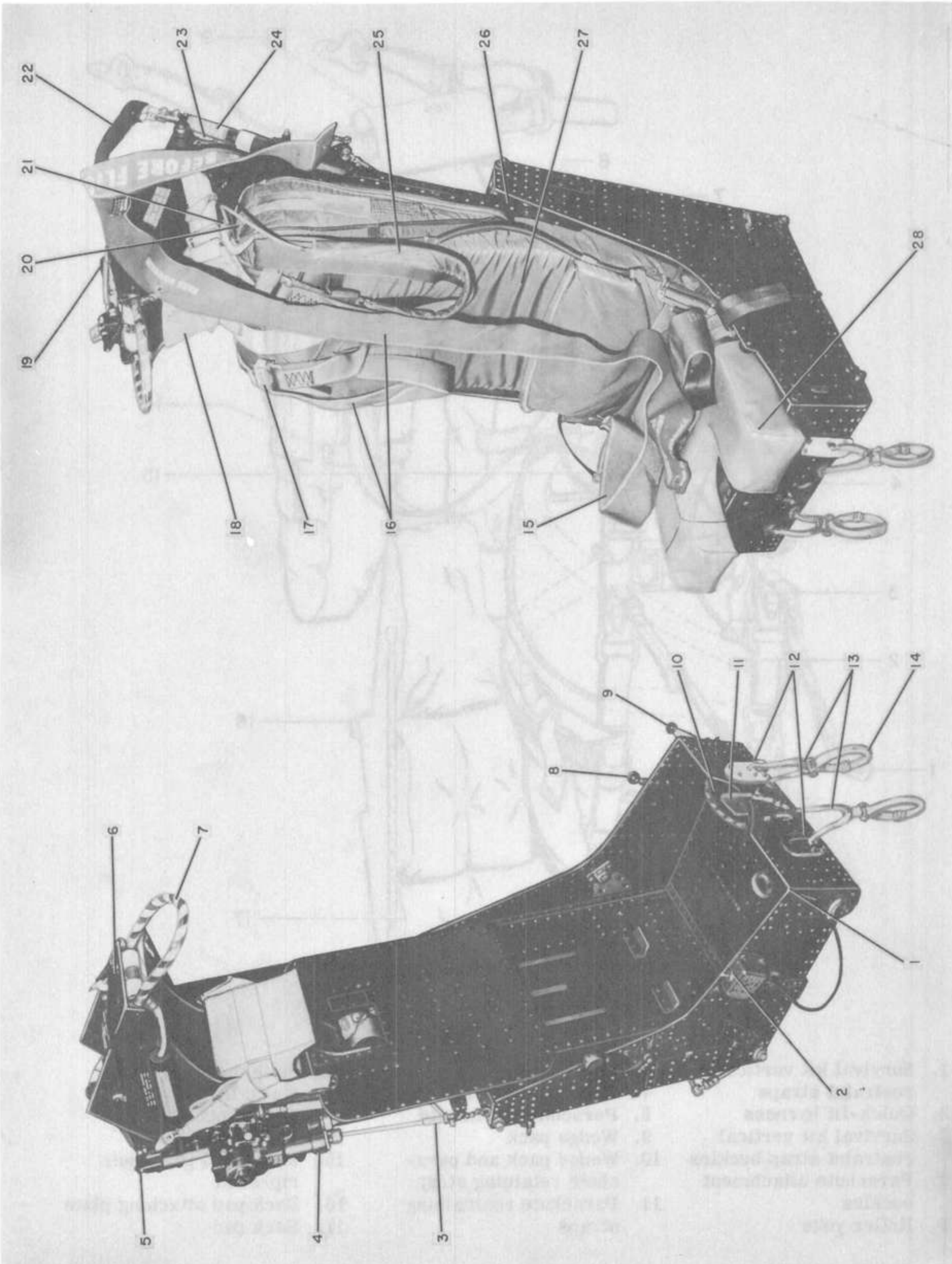
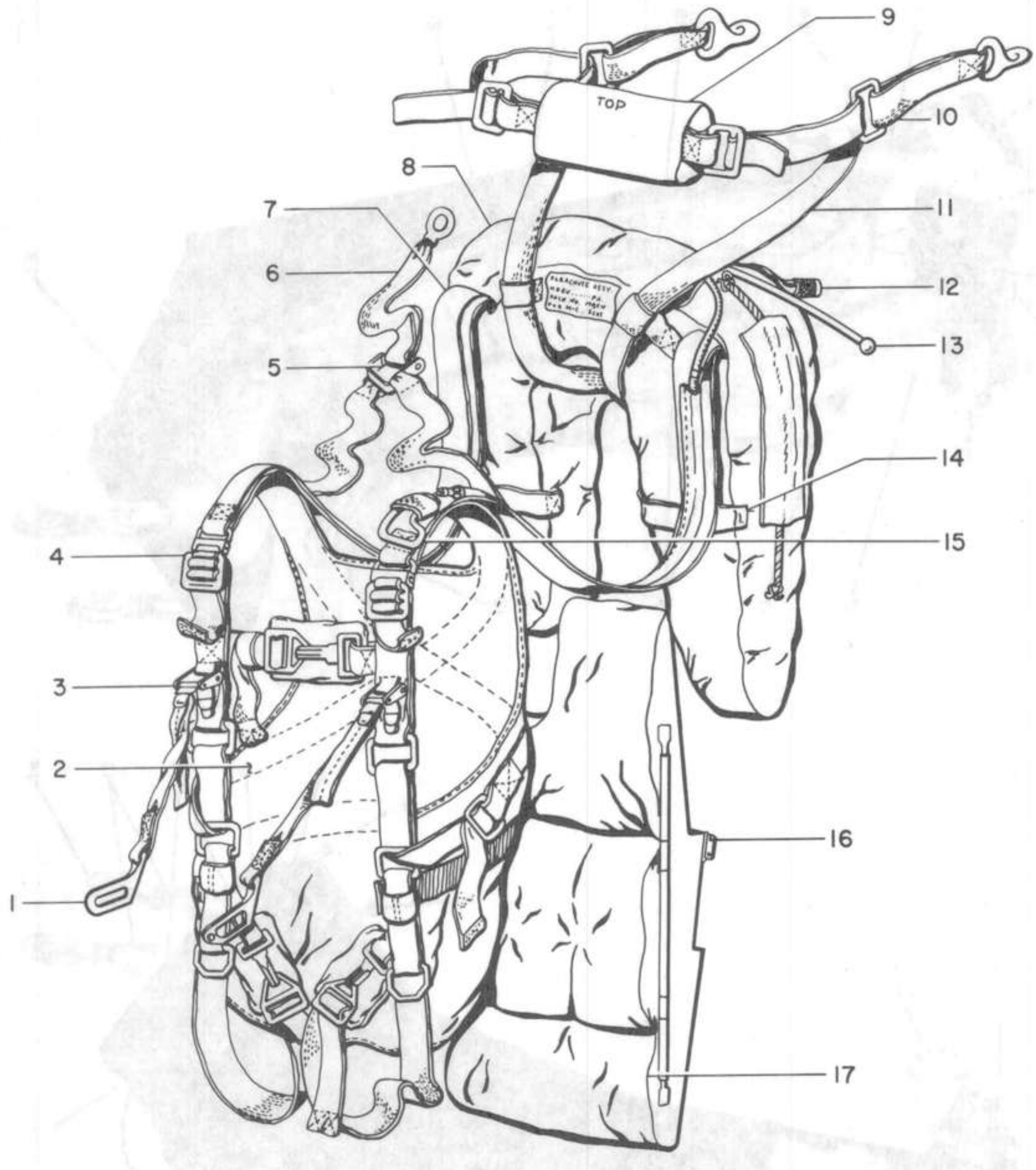


Figure 2-26. MK-J5 Martin-Baker Ejection Seat



1. Survival kit vertical restraint straps
2. Quick-fit harness
3. Survival kit vertical restraint strap buckles
4. Parachute attachment buckles
5. Roller yoke
6. Loop strap
7. Parachute risers
8. Personnel parachute
9. Wedge pack
10. Wedge pack and parachute retaining strap
11. Parachute restraining straps
12. Slide disconnect line
13. Static line slide disconnect cable
14. Elastic straps
15. Personnel parachute rip-cord
16. Back pad attaching plate
17. Back pad

Figure 2-27. Personnel Parachute and Harness Assembly

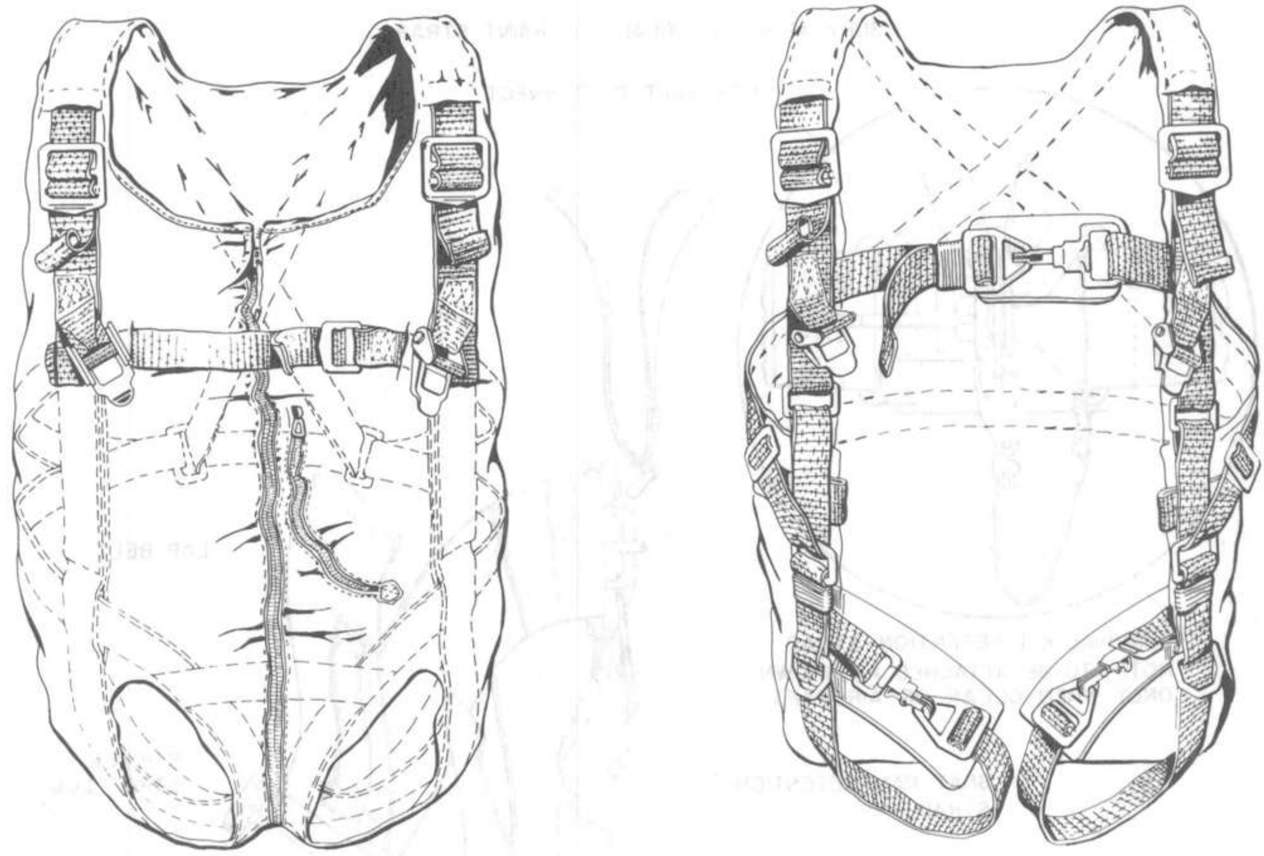


Figure 2-28. Quick-fit Harness and MA-2 Torso Harness

position, forward movement is prevented by the snubber and any slack is taken up by the reel, keeping the harness loop strap taut. When the handle is cycled through the aft position, the snubber unlocks and goes into the auto-lock position. In the auto-lock position, the loop strap may be extended, allowing the occupant to move forward, and will lock when subjected to approximately 5 to 7 g.

2-185. TIME RELEASE MECHANISM. The time release mechanism, located on the right side of the main beam, automatically delays the extraction of the main parachute until the seat has been retarded and stabilized by the drogue parachutes. For altitudes below 15,000 to 10,000 feet and g-loads not more than +3 to 4 1/2 g acting upward and parallel to the seat vertical main beams, the time delay does not exceed 1.40 to 1.75 seconds (MK-J5A) or 1.65 to 1.85 seconds (MK-J5B). When the mechanism is actuated, it releases the drogue parachute from the scissor shackle, unlocks the harness and leg restraint lines, and releases the face blind and leg restraint. In ejections at higher speeds and greater g-loads, the g-controller engages the escapement wheel of the time release mechanism until the loads have been sufficiently reduced to allow safe separation and deployment of the main parachute. Upon ejection above 15, 000 to 10,000 feet, a barostatic control engages the escapement wheel of the time release mechanism, preventing its operation until the seat and occupant have fallen to an altitude of 15,000 to 10,000 feet.

2-186. OPERATION. (See figure 2-30.)

NOTE

There is no interlock between the face blind or the secondary firing handle and the overhead hatch. When the face blind or the secondary firing handle is pulled, the seat will be ejected regardless of hatch position. The hatch may be jettisoned by pneumatic (emergency) operation.

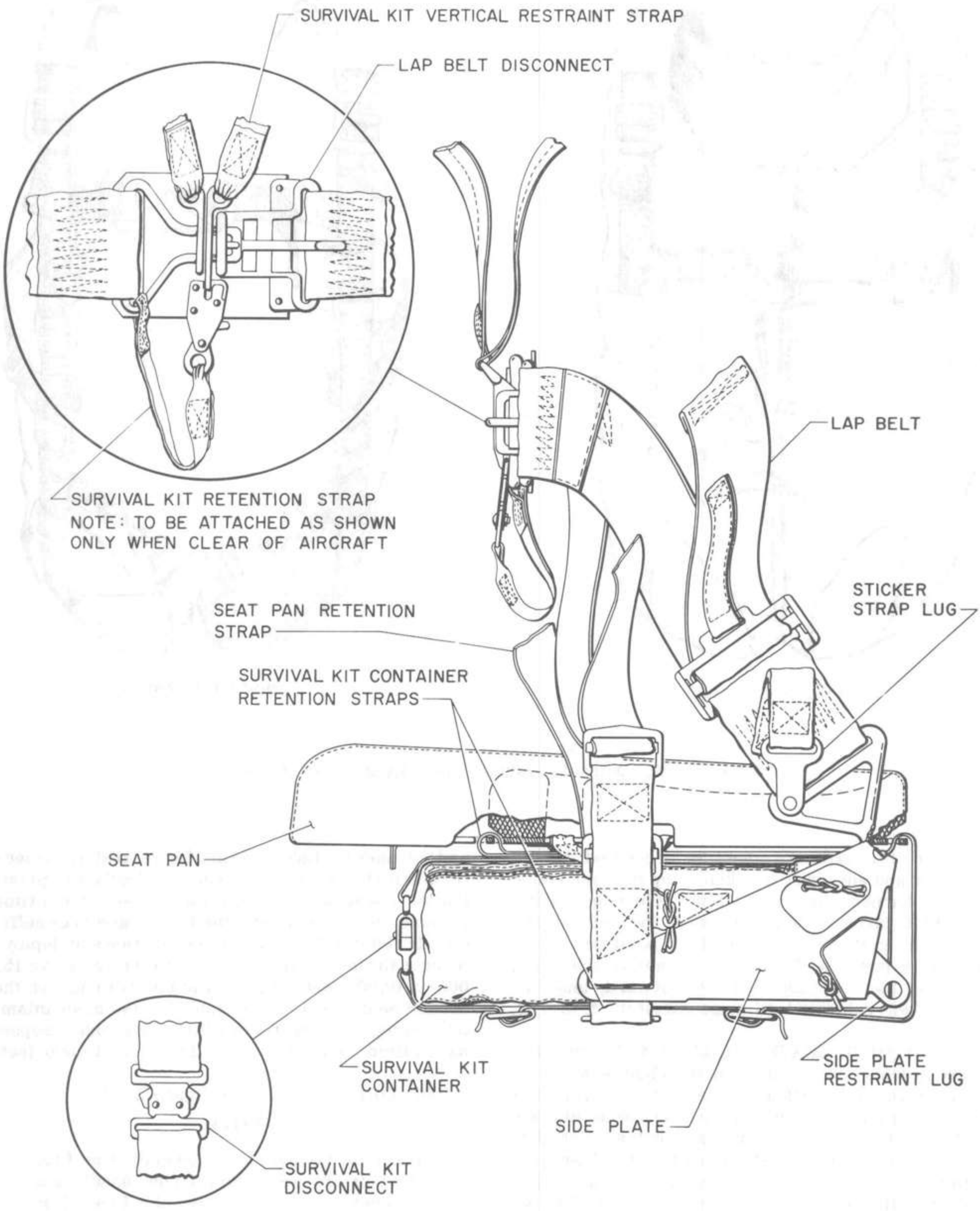


Figure 2-29. Survival Kit Assembly

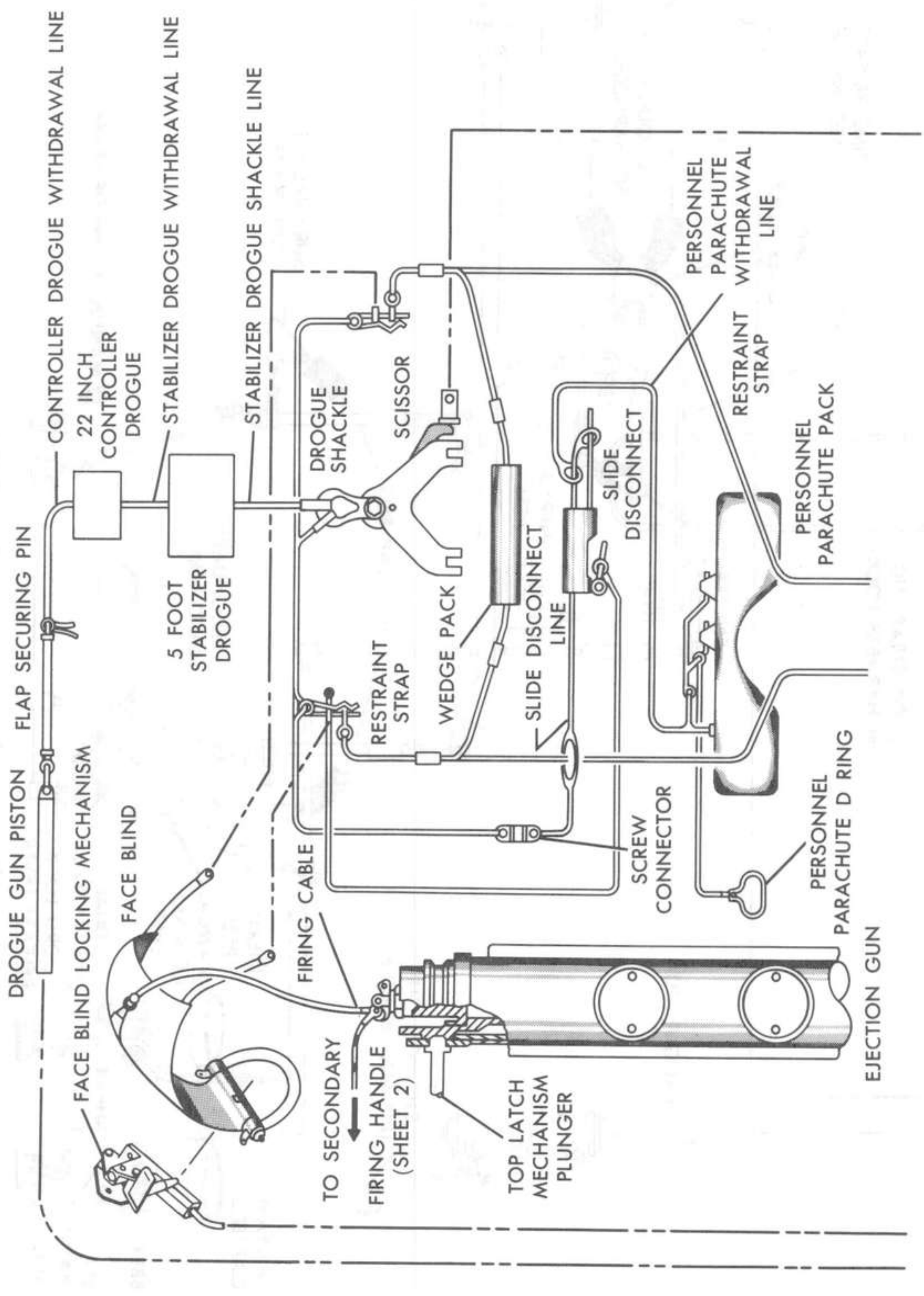


Figure 2-30. Martin-Baker Ejection Seat Schematic (Sheet 1 of 2)

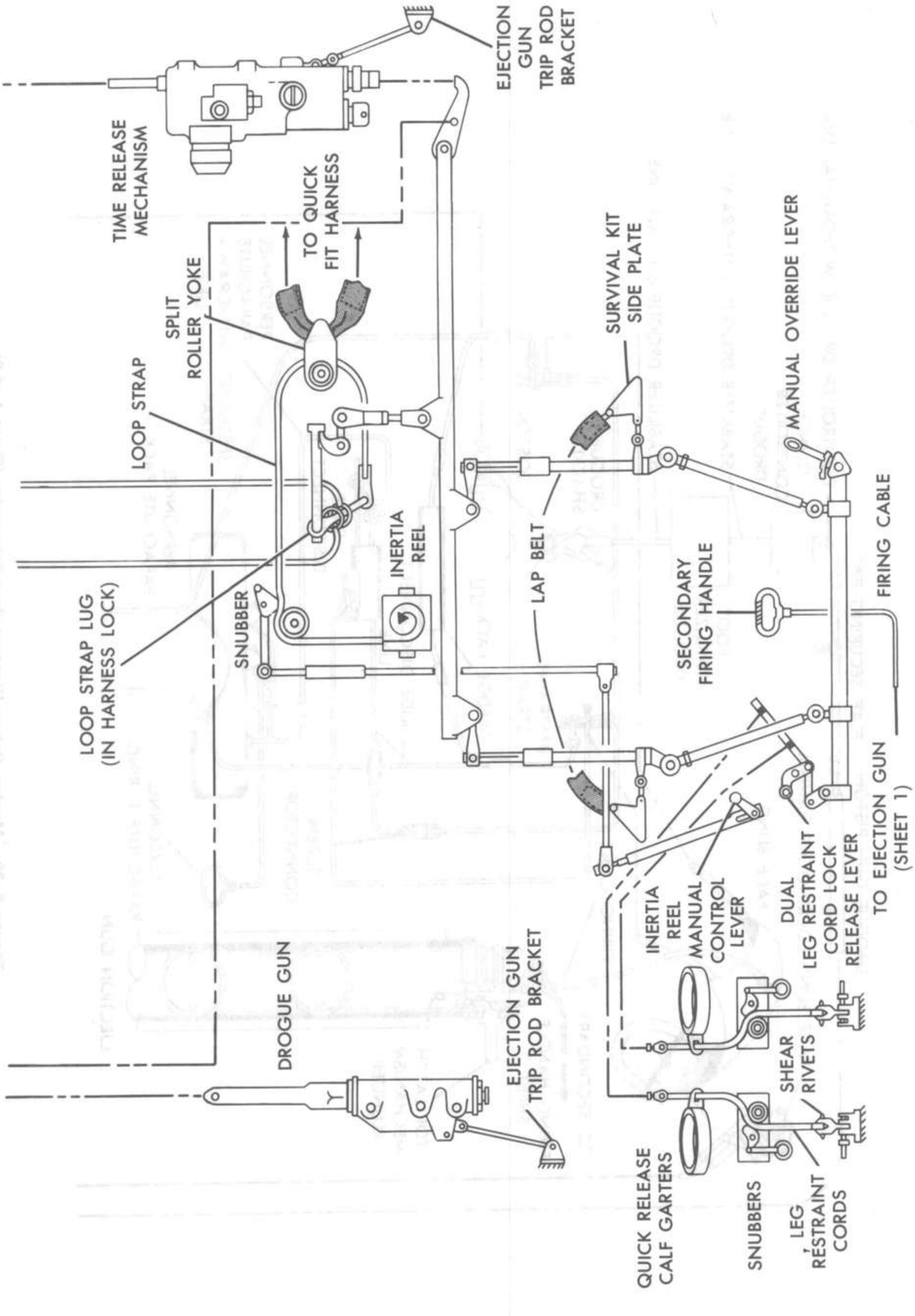


Figure 2-30. Martin-Baker Ejection Seat Schematic (Sheet 2 of 2)

2-187. NORMAL CONTROLS.

2-188. SEAT HEIGHT ADJUSTMENT SWITCH. The seat height adjustment switch (2, figure 2-26), located on the right side of the seat, is a three-position momentary toggle switch. The switch is spring-loaded to the neutral position. By moving the switch forward the seat bucket is lowered. In the aft position, the seat is raised.

CAUTION

The seat height adjustment jack must not be operated for more than 1/2 minute in every 5-minute period, to prevent overheating and subsequent damage to the electric motor.

2-189. INERTIA REEL MANUAL CONTROL LEVER. The inertia reel manual control lever (8, figure 2-26) is a three-position lever located on the left side of the seat bucket. The lever is normally in the auto-lock (aft) position. In this position, the shoulder harness may extend. In the forward position, the harness straps are locked and may not be extended. When cycled to full aft position, the lever releases the locked harness and returns to the auto-lock position.

2-190. LEG RESTRAINT CORD LOCK RELEASE LEVER. The leg restraint cord lock release lever (9, figure 2-26) is a two-position lever located on the left side of the seat bucket. Placing the lever in the forward position releases the upper end of the leg restraint cords.

2-191. LEG RESTRAINT CORD SNUBBER FINGER RINGS. The leg restraint cord snubber finger rings (12, figure 2-26) are located at the forward lower edge of the seat bucket. When pulled, these rings allow the occupant to pull the leg restraint cord forward through the snubber box in order to provide sufficient slack for comfortable leg movement in the cockpit.

2-192. EMERGENCY CONTROLS.

2-193. FACE BLIND FIRING HANDLE. The face blind firing handle (7, figure 2-26) is located on the front of the seat above the occupant's head. The handle is connected to the ejection gun sear through the face blind and cable. It must be retained by the face blind locking mechanism (6) at all times except during flight. It is the responsibility of the occupant to lock or unlock the face blind.

2-194. SECONDARY FIRING HANDLE. The secondary firing handle (10, figure 2-26), located on the front of the seat bucket between the occupant's legs, is used for ejection in event of the face blind handle being inaccessible due to abnormal flight conditions or any other reason. A safety guard is mounted in front of the secondary firing handle to prevent it from being extracted inadvertently. Rotating the guard to the right and down unlocks the firing handle. The guard should be up (locked) at all times except during flight. It is the responsibility of the occupant to lock or unlock the secondary firing handle.

2-195. MANUAL OVERRIDE LEVER. The two-position manual override lever (1, figure 2-26) is located on the right side of the seat bucket. By lifting the finger ring and moving the lever to the aft position, insuring that the lever engages the spring lock, the personnel parachute, survival kit assembly, and leg lines will be released from the seat. This will also lock the face blind and secondary firing handle. The manual override lever is to be used for manual separation from the seat and for removal of equipment when servicing the seat.

2-196. EMERGENCY OXYGEN SYSTEM.

2-197. The automatically activated oxygen system (figure 2-31) provides an emergency source of oxygen for approximately ten minutes. The emergency oxygen bottle is attached to the aft right side of the bucket seat. During ejection, a lever attached to the bucket strikes a pin, to activate the oxygen bottle automatically. A manual actuator (green apple), located on the upper right side of the seat bucket, is provided for manual activation of the bottle in the event the main oxygen system fails at high altitudes. For oxygen grade, specification, and servicing stations, see servicing diagram (figure 2-34).

2-198. ENTRANCE HATCHES, BOARDING AND ACCESS LADDERS. (See figures 2-32 and 2-33.)

2-199. The pilot and observer each have their own entrance hatch and boarding ladder. The hatches contain bubbled windows and are opened from the outside by two external hatch handles. From the cockpit the hatches are opened with the internal

Figure 2-31. Emergency Oxygen System

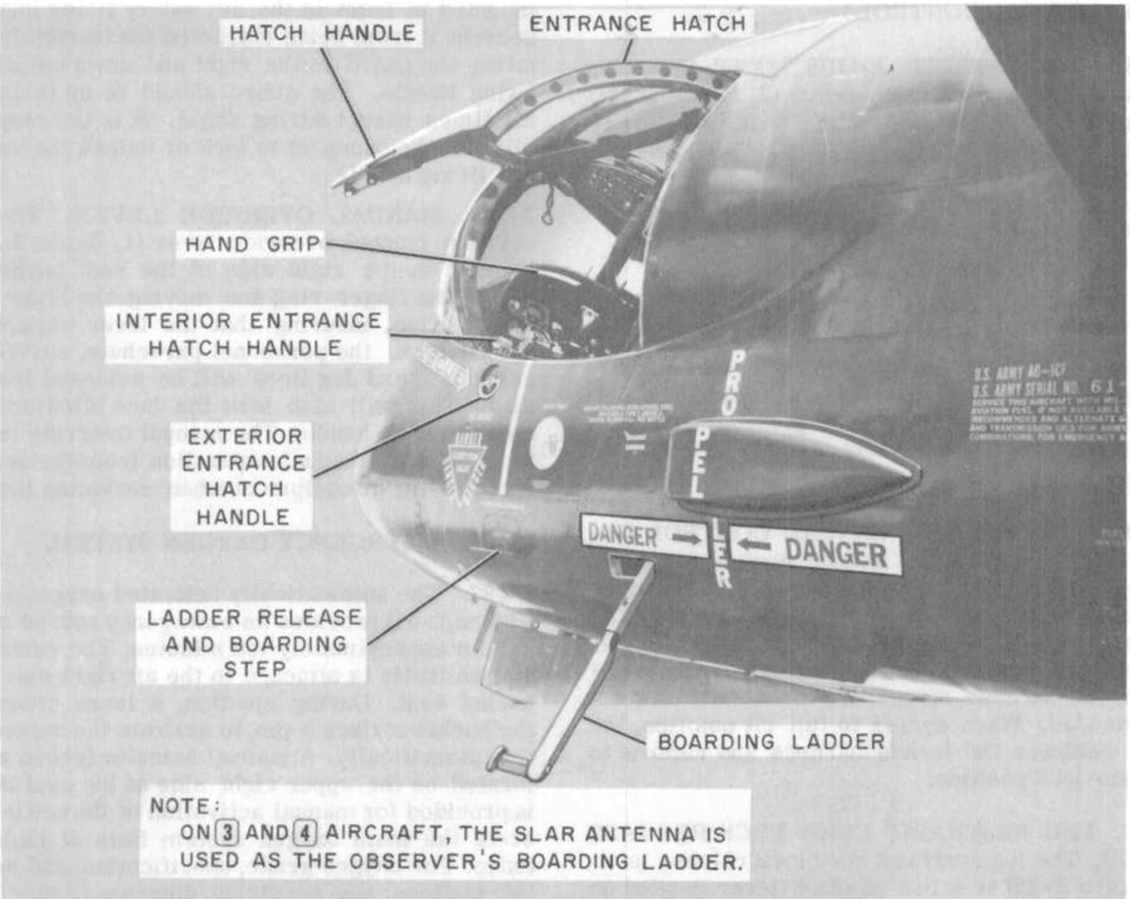


Figure 2-32. Entrance Hatch and Boarding Ladder

hatch handles (1 and 18, figure 2-3). When open, the hatches are supported by a spring bungee assembly. Hand grips on the glareshield are used to aid the pilot and observer in entering the cockpit. Wing access is available with a ladder (figure 2-33).

2-200. PERSONNEL FURNISHINGS.

2-201. Personnel furnishings include relief tubes (46 and 44, figure 2-3), map cases (3 and 16), and sunshades (38 and 39). The sunshades can be moved forward and aft as desired. On [3] and [4] aircraft, the observer's relief tube is secured to the cockpit floor.

2-202. AUXILIARY EQUIPMENT.

2-203. The following auxiliary equipment is described in Chapter 6:

Photographic Equipment
External Stores System
Heating and Ventilation System
Deicing Systems
Windshield Wiper System
Windshield Washing and Anti-Icing System
Oxygen System
Lighting Equipment

Figure 2-33. Wing Access

Figure 2-34. Servicing Diagram (Sheet 1 of 2)

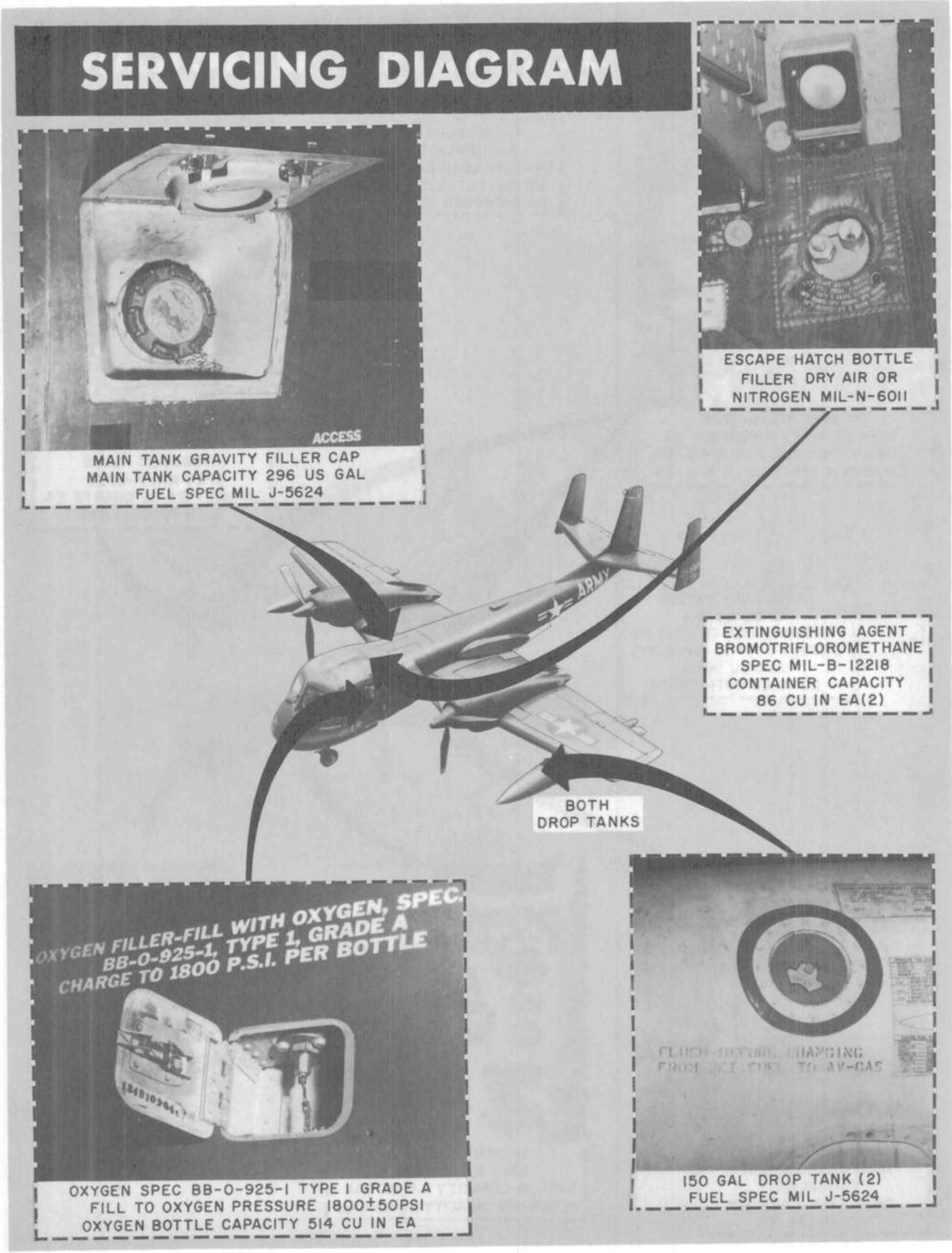


Figure 2-34. Servicing Diagram (Sheet 2 of 2)

CHAPTER 3
NORMAL PROCEDURES

Section I. Scope

1-1. This chapter deals with the many procedures which are required to insure safe and efficient operation of the aircraft. Steps are included in checklist form covering the flight from the time it is planned until it is completed and the aircraft is left properly parked and secure.

1-2. The flight envisioned in this chapter is of a nontactical nature and is considered to be accomplished under normal conditions. The checklists include all steps necessary to insure safe flight under all conditions (night, instrument, etc).

1-3. The unique "feel" characteristics and the reaction of the aircraft during specific phases of operation are also included in this chapter, along with the technique to be employed in accomplishing such operations as taxiing, takeoff, climb, etc.

Section II. Checks

2-1. CHECKLISTS.

2-2. The checklists used by the pilot and/or observer include the amplified normal and emergency procedures and the normal and emergency procedures in condensed form. The amplified normal and emergency procedures are contained in Chapters 3 and 4, respectively, and include all explanatory material, notes, cautions, and warnings. The condensed versions of the normal and emergency procedures are issued as a separate publication (see Appendix IV). The amplified and condensed procedures follow the same check numbers although the condensed procedures omit all explanatory text with the exception of an occasional note, caution, or warning.

2-3. The takeoff and landing checklist placards (figures 2-9 and 2-10) are mounted on the pilot's and center instrument panels, respectively. These placards provide a visible procedure to be followed when taking off or landing the aircraft.

2-4. When assigned tactical or administrative missions require intermediate stops, it is unnecessary and wasteful of time to perform all the checks required for normal operation. Under these conditions, only a portion of the normally required checks are necessary to assure safe operation. Accordingly, in the checks and procedures that follow, an asterisk (*) has been placed before each check that must be performed during thru-flight operations; performance of the remaining checks (those not preceded by asterisks) is not mandatory but may be performed at the discretion of the flight crew.

2-5. PREPARATION FOR FLIGHT.

2-6. Prior to flight, the pilot should insure that all information in this manual, that is applicable to the proposed mission is complied with.

2-7. FLIGHT RESTRICTIONS. See Chapter 7 for flight restrictions and limitations that apply to this aircraft.

2-8. FLIGHT PLANNING. The required fuel, airspeed, altitude, power settings, etc. for the proposed mission must be determined from the operating data contained in Chapter 14.

2-9. TAKEOFF AND LANDING DATA CARDS. In any operation, when takeoff and landing performance may become critical, takeoff and landing data cards will be completed. (See figures 2-1 and 2-2.)

2-10. WEIGHT AND BALANCE. Obtain the takeoff and anticipated landing gross weights of the aircraft from the Form "F" in Chapter 12, Section V. Be sure that the gross weight limitations have not been exceeded. Chart "C", the Basic Weight and Balance Record, should be kept up-to-date,

AO-1	
TAKEOFF DATA CARD	
CONDITIONS	
Max Gross Weight	lb
Field Length	ft
Density Altitude	ft
Effective Wind	Zero kn
TAKEOFF	
Takeoff Ground Roll (no obstacle)	ft
Takeoff Over 50ft Obstacle	ft
Obstacle Clearance Speed	kn IAS
LANDING IMMEDIATELY AFTER TAKEOFF	
Approach Speed at 50ft	kn IAS
Landing Distance Over 50ft	ft

Figure 2-1. Takeoff Data Card, Typical

AO-1	
LANDING DATA CARD	
CONDITIONS	
Field Length	ft
Gross Weight	lb
Density Altitude	ft
Effective Wind	Zero kn
LANDING	
Landing Distance Over 50ft	ft
Approach Speed at 50ft	kn IAS

Figure 2-2. Landing Data Card, Typical

and the Weight and Balance Clearance Form "F" (tactical) should be completed for each type of loading.

2-11. ENTRANCE TO AIRCRAFT. (See figure 2-3.)

2-12. To enter the aircraft proceed as follows:

a. Push in LADDER RELEASE to release boarding ladder.

NOTE

On [3] and [4] aircraft, the observer uses the SLAR antenna instead of a boarding ladder.

b. Lift the external entrance hatch handle and turn aft to unlock the hatch.
c. Push the forward portion of the hatch handle and pull handle out.
d. Place entrance hatch in OPEN and locked position.
e. Place foot on rung of ladder and grasp handgrip on glareshield.
f. Place other foot on boarding step and lift foot from ladder or antenna into cockpit.

CAUTION

The boarding ladder cannot be stowed from the cockpit. Be sure ladder is stowed by the ground crew before flight.

2-13. PREFLIGHT CHECK.

2-14. BEFORE EXTERIOR CHECK.

a. DA Form 2391 - Check aircraft status.
b. Battery Switch - OFF.
c. Gust Lock Handle - Disengaged.

2-15. EXTERIOR CHECK. Perform exterior check as outlined below (see figure 2-4):

Figure 2-3. Entrance to Aircraft

NOTE

Preflight checks for the photo system (required for photographic surveillance missions) are covered in Chapter 6, Section V.

a. Left Forward Fuselage.
(1) Fuselage skin - General condition, wrinkles or cracks, defective rivets, evidence of fuel, oil, or hydraulic leaks.
(2) Static port - Clean and clear.
(3) Nose compartment access - Closed and secure.
(4) Access panels - Closed and secure.
(5) Pitot head - Free of obstructions and covers removed.
(6) Ram air scoop - Clear and unobstructed and protective covers removed (see figure 2-5).
(7) Antennas - General condition and security.
b. Nose Landing Gear and Well.
(1) Nose gear strut - Proper extension and cleanliness.
(2) Nose gear tire - Cracks, wear, and proper inflation. Slippage marks aligned.
(3) Nosewheel shimmy damper or nosewheel steering cylinder - Condition and evidence of leaks.
(4) Nosegear safety lock - Removed (see figure 2-5).
(5) Nosewheel doors and fairings - Condition and security.
(6) Taxi light - Condition, and electrical connections secure.
(7) Hydraulic actuator - Leaks and security.
(8) Nose gear well - Leaks and cleanliness.
c. Right Forward Fuselage.
*(1) Windshield washer filler cap - On and secure.
(2) Access panels - Closed and secure.
(3) Static port - Clean and clear.
(4) Hydraulic reservoir sight gage - Above REFILL LEVEL.
(5) Hydraulic system access panel - Emergency pressure gage 3000 psi (±200 psi) and accumulator gage 2000 psi (±200 psi). Filler cap secure and access panel closed and secure.
*(6) Pressure refueling station - Leakage and cap locked, switches off, access door closed.
d. Right Main Landing Gear and Well.
(1) Strut - Proper extension and cleanliness.
(2) Tire - Wear, cracks, and proper inflation. Slippage marks aligned.
(3) Brake - Hydraulic leaks, condition of disks and thickness of brake pucks.
(4) Safety lock - Remove (see figure 2-5).
(5) Hydraulic actuator and uplock linkages - Leaks and security.
(6) Doors and fairings - Condition and security.
e. Right Engine and Nacelle.
*(1) Cowling fasteners and latches - Secure.
(2) Cowling - Evidence of fuel or hydraulic leaks.
*(3) Intake ducts - Covers removed and ducts free of foreign objects.

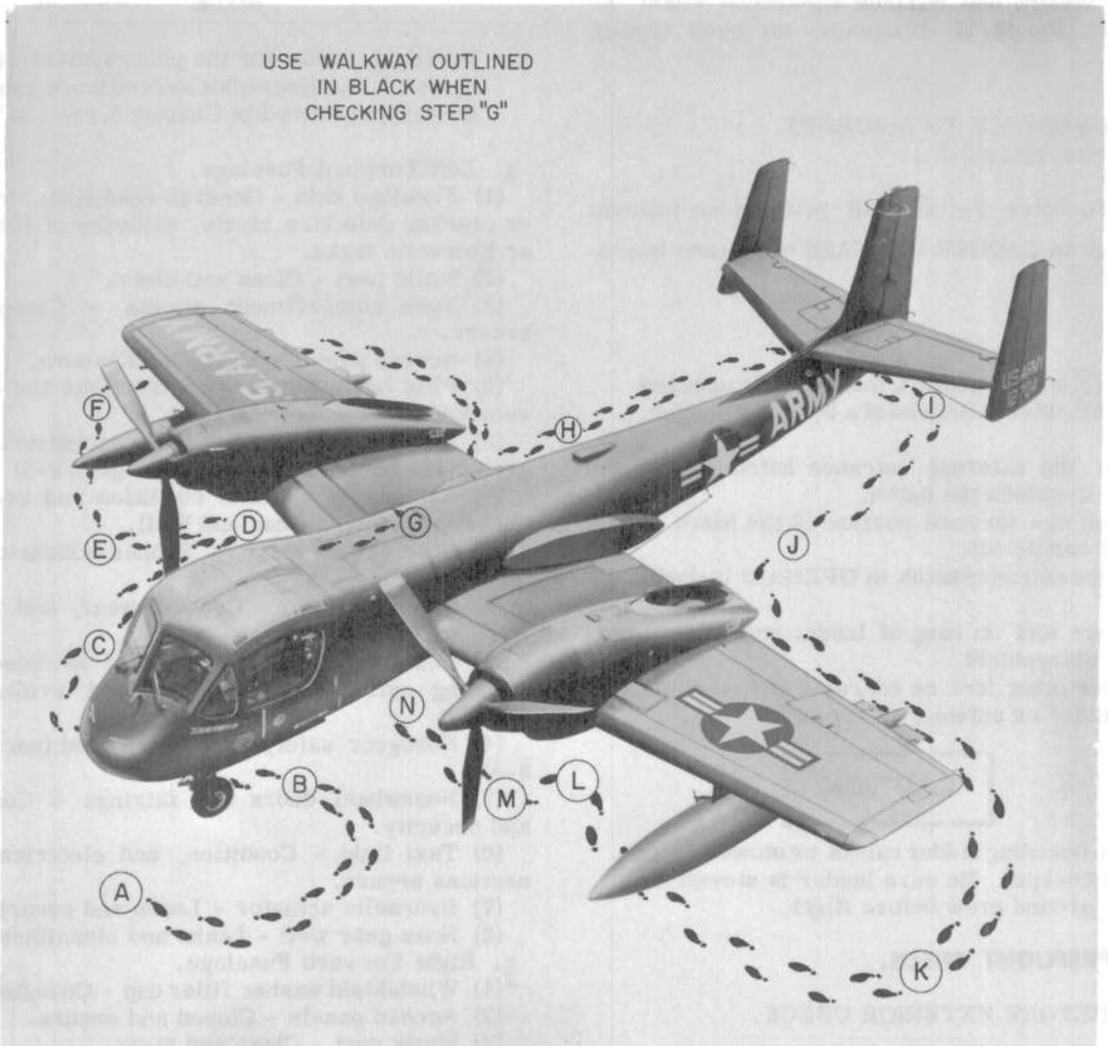


Figure 2-4. Exterior Check

(4) Propeller - Blades for condition and spinner dome for leakage and security.

f. Right Wing.

(1) Access panels - Closed and secure.

(2) Slats and deicer boots - General condition and excessive play.

*(3) Drop tank (when installed) - Fuel quantity, cap secure, pylon mount connections secure, and ground safety pin removed (see figure 2-5).

(4) Wing position light - Condition and cleanliness.

(5) Aileron - Condition, freedom of movement, and trim tab for excessive play.

(6) Tailpipe - Cracks, buckling, excessive oil leakage and turbines for condition. Protective covers removed (see figure 2-5).

(7) Inboard aileron and wing flap - Condition and security.

CAUTION

If flare pod is installed, insure that it is empty, unless the flight is a night photography mission.

g. Top Fuselage.

*(1) Fuel quantity - Check.

(2) Fitting cables (two) of Martin-Baker ejection seat - Attached to ejection gun sear; thick cable on bottom, thin cable on top.

(3) Escape hatch - Condition and security.

(4) Wing and fuselage - Condition.

h. Aft Fuselage, Right Side.

(1) Fuselage skin - General condition, wrinkles or cracks, defective rivets, evidence of oil or hydraulic leaks.

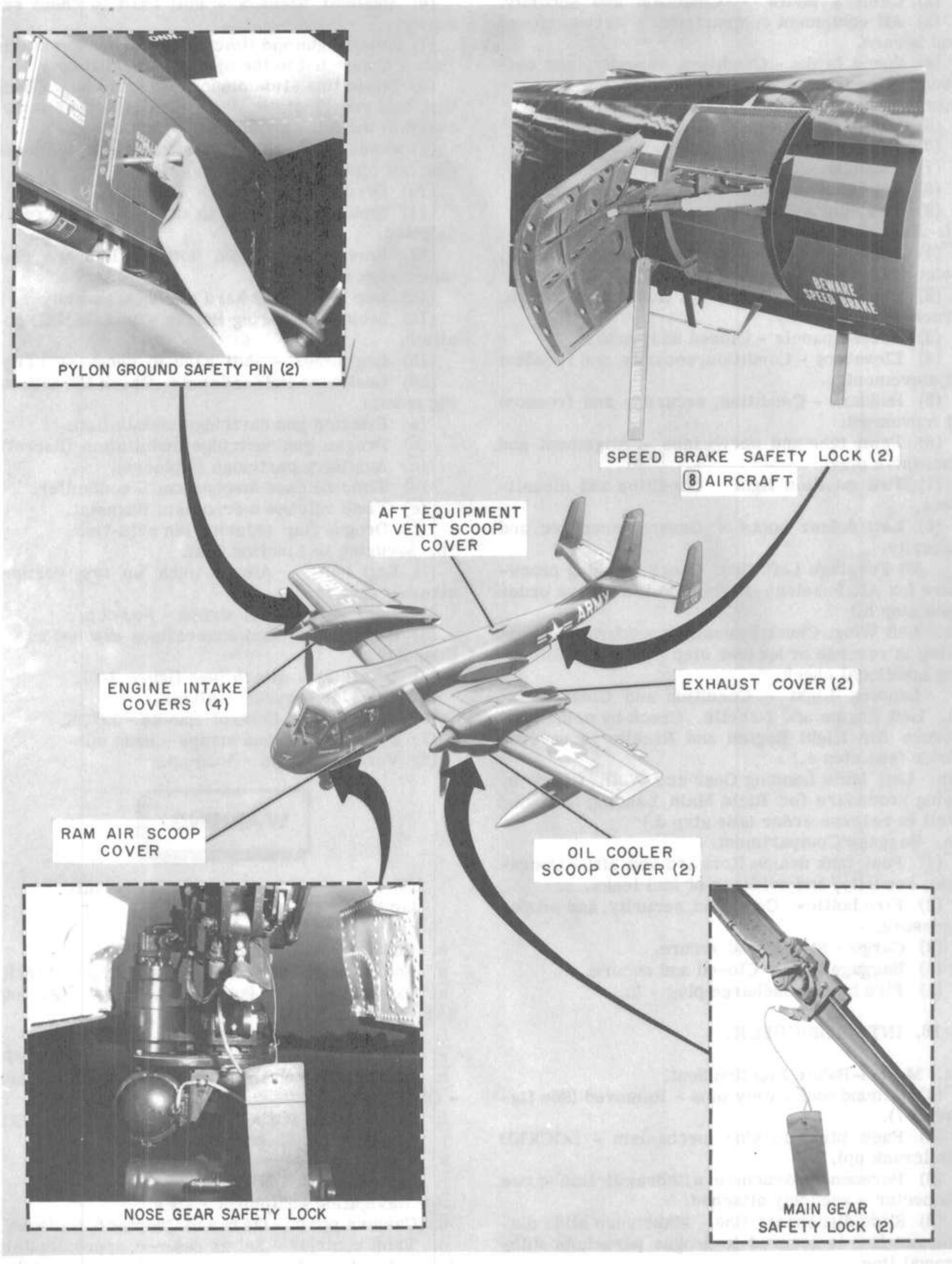


Figure 2-5. Ground Safety Locks and Protective Covers

(2) Camera doors - Condition and security.
(3) Aft equipment compartment - Access closed and secure.
(4) Speed brake - Condition, security, and evidence of hydraulic leaks. Ground safety lock removed (see figure 2-5).
(5) Wing Ladder - Locked-in.
(6) Vent scoop - Unobstructed.
(7) Antennas - Condition and security.
(8) Anticollision light - General condition.
(9) Tail skid - General condition.

i. Empennage.
(1) Skin - General condition, wrinkles or cracks, defective rivets.
(2) Right deicer boots - General condition, cracks, and security.
(3) Access panels - Closed and secure.
(4) Elevators - Condition, security, and freedom of movement.
(5) Rudders - Condition, security, and freedom of movement.
(6) Trim tabs and servo tabs - Alignment and excessive play.
(7) Tail position light - Condition and cleanliness.
(8) Left deicer boots - General condition and security.

j. Aft Fuselage Left Side. Check by using procedure for Aft Fuselage, Right Side in reverse order (see step h.)

k. Left Wing. Check by using procedure for Right Wing in reverse order (see step f.) plus the following additional check:

Landing Light - Condition and Cleanliness.

l. Left Engine and Nacelle. Check by using procedure for Right Engine and Nacelle in reverse order (see step e.)

m. Left Main Landing Gear and Well. Check by using procedure for Right Main Landing Gear and Well in reverse order (see step d.)

n. Baggage Compartment.
(1) Fuel tank drains (forward and aft) - Operation, security, and evidence of fuel leaks.
(2) Fire bottles - Condition, security, and proper pressure.
(3) Cargo - Stowed and secure.
(4) Baggage door - Closed and secure.
(5) Fire bottle discharge plug - In.

2-16. INTERIOR CHECK.

*a. Martin-Baker Ejection Seat.
(1) Ground lock safety pins - Removed (See figure 2-7).
(2) Face blind locking mechanism - LOCKED (bellcrank up).
(3) Personnel parachute withdrawal line screw connector - securely attached.
(4) Slide disconnect line - Make sure slide disconnect line is secured to drogue parachute withdrawal line.
(5) Parachute attachment - Pull hard to check security.
(6) Shoulder harness - Pull hard to check security.
(7) Drogue gun and time release mechanism trip rods - Connected to the ejection gun fittings.
(8) Static line slide disconnect ball end - Check that ball end of static line slide disconnect is secured to the left side of drogue container.
(9) Controller drogue withdrawal line - Passes over all other lines at top of seat.
(10) Drogue gun lanyard - Fastened.
(11) Knurled nut (next to drogue gun barrel) - Safetied.
(12) Emergency oxygen bottle - Lanyard fastened; check pressure.
(13) Lap belt - Pull hard to check security.
(14) Secondary Firing Handle - In LOCKED position.
(15) Leg Lines - Pull hard to check security.
(16) Lockwire and lead seals - Check the following points:
(a) Ejection gun cartridge installation.
(b) Drogue gun cartridge installation (barrel).
(c) Auxiliary cartridge (2 places).
(d) Time release mechanism G controller.
(e) Time release mechanism Barostat.
(f) Drogue flap securing pin safe-tie.

*b. Securing to Ejection Seat.
(1) Lap belt - Attach (pick up two vertical straps); snug up.
(2) Forward vertical straps - Snug up.
(3) Oxygen and communications disconnects - Connect.
(4) Leg lines - Attach (see figure 2-6).
(5) Shoulder harness - Attach.
(6) Inertia Reel Control Handle - LOCK.
(7) Shoulder harness straps - Snug up.
(8) Vertical straps - Snug up.

WARNING

Do not connect survival gear lanyard to lap belt.

c. Rudder pedals - Adjust.
d. Escape Hatch Jettison Handle - IN and LOCK.
e. Stores Selector Panel Switches - OFF and SAFE (7 aircraft).
f. AN/APX-44 (IFF) - OFF.
g. Interior Lights Control Panel Switches - OFF.
h. Heating and Ventilation Control Panel Switches - OFF.
i. Escape hatch jettison air pressure - CHECKED.
j. AN/APN-129 (Doppler) - OFF.
k. Circuit breakers - In.
l. Communication equipment - OFF.
m. Navigation equipment - OFF.
n. Camera power - OFF; see Chapter 6, Section V.
o. Trim controls - Set as desired; approximately 2° up elevators, 5° right aileron, 5° right rudder.
*p. Emergency Stores Release Handle - In.
*q. Emergency Landing Gear Handle - In.

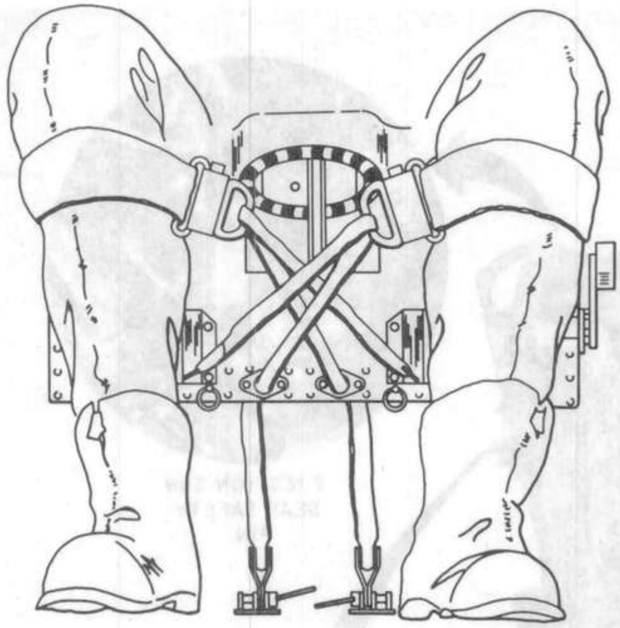


Figure 2-6. Leg Restraint Cord Routing

r. Autofeather Arming Switch - OFF (21 aircraft).
s. Synchrophaser Switch - OFF (21 aircraft).
t. Synchrophaser-Autofeather Switch - OFF (22 aircraft).
u. Flaps Handle - UP.
*v. Landing Gear Handle - DOWN.
*w. Power Levers - GROUND IDLE.
*x. Speed Brake Switch - IN.
*y. Propeller Levers - MIN RPM.
*z. Gust Lock Handle - Disengaged.
aa. Windshield Wiper Control - OFF.
ab. Fire Emergency Control Handle - In.
ac. Power Steer Switch - OFF.
*ad. Engine Instruments - Static readings.
*ae. Flight Instruments - Check altimeter set to field elevation.
af. MA-1 Compass - SLAVE and set local latitude.
*ag. Stores Selector Panel Switches - OFF and SAFE (1 aircraft).
ah. Oxygen Regulator Supply Switch - OFF; check pressure (1800 ±50 psi).
ai. Pilot's Instrument Brightness Rheostat - OFF.
aj. AN/ARN-68 or R-1041/ARN (Marker Beacon - OFF.
ak. AN/APN-22 (Radar Altimeter) - OFF.
*al. Engine Master Switches - ON.
*am. Fuel Control Switches - PRIMARY or AUTO.
*an. Fuel Pump Switch - ON.
*ao. Exterior Lights Control Panel Switches - OFF.
*ap. Generator Switches - ON.
aq. Inverter Switch - NORMAL.
*ar. Battery Switch - OFF.
as. Engine Instrument Brightness Rheostat - OFF.
at. Right and Left Overhead Brightness Rheostat - OFF.
au. Flare Reset Switches - NORMAL.
av. Engine De-Ice Switch - OFF.
aw. Pitot Heat Switch - OFF.
ax. Windshield Switch - OFF.
ay. Wing and Tail De-Ice Switch - OFF.
az. Observer's Brightness Rheostat - OFF.
ba. Observer's Oxygen Regulator Supply Switch - OFF; check pressure (1800 ±50 psi).

2-17. BEFORE STARTING ENGINES.

NOTE

For continuous operation, MIL-J-5624 Grade JP-4 fuel is used. If this fuel is not available, use the alternate fuel with lowest available octane. The alternate fuels include MIL-J-5624 Grade JP-5, MIL-G-5572 aviation gasolines, Grades 90/96, 115/145, and any leaded automobile gasoline. (See Chapter 7, Section II, paragraph 2-8 for alternate fuel grade operating limits.)

CAUTION

Do not use fuels containing tricresyl phosphate (TCP).

*a. Side hatches - In a locked position.
*b. Fire guard - Posted.
*c. Propeller - Personnel and ground equipment cleared.
*d. Exhaust blast area - Personnel and ground equipment cleared (see figure 2-8).

2-18. STARTING ENGINES.

2-19. GENERAL. Engine starting is accomplished with battery power only. Do not use external ground power. The use of external ground power would cause excessive torque resulting in permanent shaft distortion which leads to fatigue failure of the starter-generator shaft. External power may be used for charging a low battery only. When the battery is insufficient for engine starting, have the external ground power connected to the aircraft and place the Battery Switch in NORMAL. Charge the battery for 5 minutes at 28 volts. At the completion of charging, have the external ground power disconnected from the aircraft. The following precautions must be observed:

a. During starting, if the egt reaches 610°C, abort the start and clear the engine. If the egt momentarily exceeds 622°C for a total of three times, all first stage turbine blades must be inspected for cracks. If the egt exceeds 760°C at any time, the first stage blades must be inspected before further

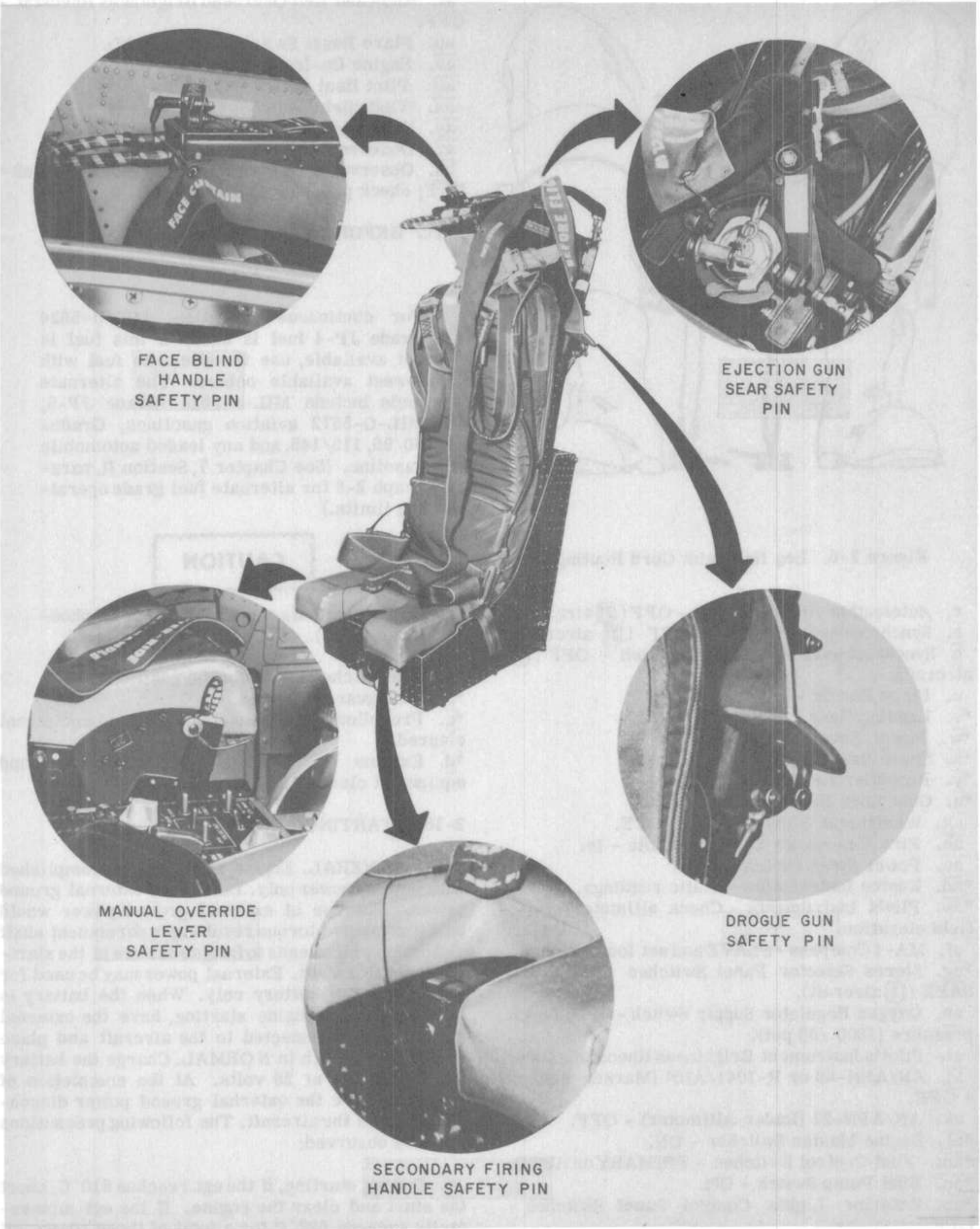
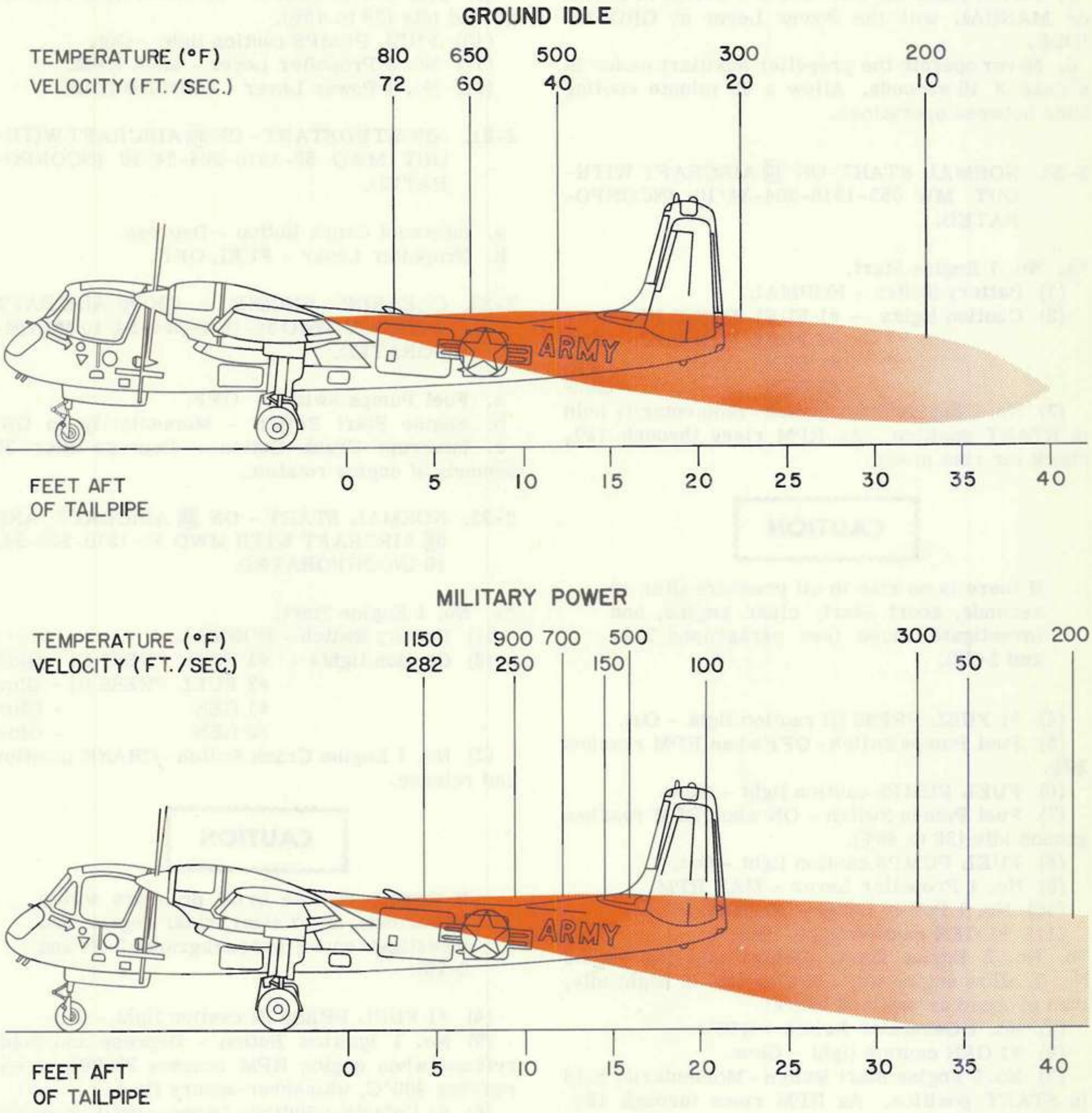


Figure 2-7. Ejection Seat Ground Lock Safety Pins



NOTE

THE BLAST AREA DOES NOT INCLUDE PROPELLER WAKE WHICH IS HIGHER IN VELOCITY BUT LOWERS THE EXHAUST GAS TEMPERATURE.

Figure 2-8. Blast Danger Area

use. All overtemperature conditions above 622°C must be recorded on DA Form 2391-2.

b. Do not exceed starter engagement limitation of 30 seconds on, 2 minutes off for three starts; and 30 seconds on, 5 minutes off for all additional starts.

c. Do not place the Fuel Control Switch in EMER or MANUAL with the Power Lever at GROUND IDLE.

d. Never operate the propeller auxiliary motor in excess of 10 seconds. Allow a 15 minute cooling time between operations.

2-20. NORMAL START-ON [10] AIRCRAFT WITHOUT MW 055-1510-204-34/10 INCORPORATED.

*a. No. 1 Engine Start.
(1) Battery Switch - NORMAL.
(2) Caution lights - #1 FUEL PRESS HI - Glow
#2 FUEL PRESS HI - Glow
#1 GEN - Glow
#2 GEN - Glow
(3) No. 1 Engine Start Switch - Momentarily hold in START position. As RPM rises through 12%, check for rise in egt.

CAUTION

If there is no rise in oil pressure after 10 seconds, abort start, clear engine, and investigate cause (see paragraphs 2-21 and 2-22).

(4) #1 FUEL PRESS HI caution light - Out.
(5) Fuel Pumps Switch - OFF when RPM reaches 20%.
(6) FUEL PUMPS caution light - Glow.
(7) Fuel Pumps Switch - ON when RPM reaches ground idle (38 to 46%).
(8) FUEL PUMPS caution light - Out.
(9) No. 1 Propeller Lever - MAX RPM.
(10) No. 1 Power Lever - FLIGHT IDLE.
(11) #1 GEN caution light - Out.

*b. No. 2 Engine Start. Before starting engine No. 2, allow engine No. 1 to stabilize at flight idle, then proceed as outlined below:
(1) No. 1 Generator Switch - OFF.
(2) #1 GEN caution light - Glow.
(3) No. 2 Engine Start Switch - Momentarily hold in START position. As RPM rises through 12%, check for rise in egt.

CAUTION

If there is no rise in oil pressure within
10 10 seconds, abort start, clear engine, and investigate cause (see paragraphs 2-21 and 2-22).

(4) #2 FUEL PRESS HI caution light - Out.
(5) No. 1 Generator Switch - ON after 5 seconds.
(6) #1 GEN caution light - Out.
(7) Fuel Pumps Switch - OFF when RPM reaches 20%.
(8) FUEL PUMPS caution light - Glow.
(9) Fuel Pumps Switch - ON when RPM reaches ground idle (38 to 46%).
(10) FUEL PUMPS caution light - Out.
(11) No. 2 Propeller Lever - MAX RPM.
(12) No. 1 Power Lever - GROUND IDLE.

2-21. ABORTED START - ON [10] AIRCRAFT WITHOUT MWO 55-1510-204-34/10 INCORPORATED.

a. Interrupt Crank Button - Depress.
b. Propeller Lever - FUEL OFF.

2-22. CLEARING ENGINE - ON [10] AIRCRAFT WITHOUT MWO 55-1510-204-34/10 INCORPORATED.

a. Fuel Pumps Switch - OFF.
b. Engine Start Switch - Momentarily to ON.
c. Interrupt Crank Button - Depress after 30 seconds of engine rotation.

2-23. NORMAL START - ON [20] AIRCRAFT, AND [10] AIRCRAFT WITH MWO 55-1510-204-34/10 INCORPORATED.

*a. No. 1 Engine Start.
(1) Battery Switch - NORMAL.
(2) Caution lights - #1 FUEL PRESS HI - Glow
#2 FUEL PRESS HI - Glow
#1 GEN - Glow
#2 GEN - Glow
(3) No. 1 Engine Crank Switch - CRANK position and release.

CAUTION

If there is no rise in oil pressure within 10 seconds, abort start, clear engine, and investigate cause (see paragraphs 2-24 and 2-25).

(4) #1 FUEL PRESS HI caution light - Out.
(5) No. 1 Ignition Button - Depress and hold; release when engine RPM reaches 23-28% or egt reaches 400°C, whichever occurs first.
(6) #1 Unfeather Button - Depress until propeller unfeathers.
(7) No. 1 Propeller Lever - MAX RPM.
(8) No. 1 Power Lever - FLIGHT IDLE.
(9) #1 GEN caution light - Out.

b. No. 2 Engine Start. When starting engine No. 2 the Engine Crank Switch automatically disconnects engine No. 1 generator from the bus. Power for starting engine No. 2 is provided by the aircraft battery. Before starting engine No. 2, allow engine

No. 1 to stabilize at flight idle, then follow the procedures outlined below.

(1) No. 2 Engine Crank Switch - CRANK and release.

CAUTION

If the No. 1 Engine Crank Switch is inadvertently positioned to CRANK, an overvoltage condition will be caused. The overvoltage relay will energize and starting current will be drawn by the No. 1 engine generator, causing the aircraft voltage to drop. This condition can be recognized by loss of communications and dimming of lights. To correct this condition, set the No. 1 Engine Crank Switch to INTERRUPT CRANK and reset the No. 1 engine generator.

CAUTION

If there is no rise in oil pressure within 10 seconds, abort the start, clear engine, and investigate cause (see paragraphs 2-24 and 2-25).

(2) #2 FUEL PRESS HI caution light - Out.

(3) No. 2 Ignition Button - Depress and hold, release when engine RPM reaches 23-28% or egt reaches 400°C, whichever occurs first.

(4) #2 Unfeather Button - Depress until propeller unfeathers.

(5) No. 2 Propeller Lever - MAX RPM.

(6) No. 1 Power Lever - GROUND IDLE.

NOTE

If the start is unsuccessful due to low battery voltage, abort the No. 2 engine start, clear engine, repeat steps (1) and (2) above, and then proceed as outlined below:

(7) Generator Power Assist Button - Depress and release.

(8) No. 2 Ignition Button - Depress and hold, release when engine RPM reaches 23-28% or egt reaches 400°C, whichever occurs first.

(9) #2 Unfeather Button - Depress until propeller unfeathers.

(10) No. 2 Propeller Lever - MAX RPM.

(11) No. 1 Power Lever - GROUND IDLE.

2-24. ABORTED START - ON [20] AIRCRAFT, AND [10] AIRCRAFT WITH MWO 55-1510-204-34/10 INCORPORATED.

a. Propeller Lever - FUEL OFF.

b. Ignition Button - Release.

c. Engine Crank Switch - INTERRUPT CRANK 10 seconds after Ignition Button is released.

2-25. CLEARING ENGINE - ON [20] AIRCRAFT, AND [10] AIRCRAFT WITH MWO 55-1510-204-34/10 INCORPORATED.

a. Engine Crank Switch. CRANK until engine rotates to maximum cranking speed.

b. Engine Crank Switch - INTERRUPT CRANK after 20 seconds.

2-26. ENGINE GROUND OPERATION.

a. Engine tachometers - 38 to 46% RPM.

b. Exhaust gas temperature - 300 to 589°C.

c. Oil pressure - 20 to 40 psi (10 psi min).

d. Oil temperature - 90°C (max).

e. Torquemeters - 3 to 15 psi.

f. Propeller tachometers - 400 to 600 RPM.

2-27. BEFORE TAXIING.

*a. Communication and navigation equipment - On as desired.

b. Speed Brakes Switch - OUT and IN.

c. Flaps Handle - Extend to 45° position, check slats extension.

d. Inboard ailerons - Check operation by moving control stick left and right; retract flaps.

e. Flight controls - Check for freedom of movement.

*f. Chocks - Removed.

*g. Power Levers - GROUND IDLE.

2-28. TAXIING. The basic aircraft has considerable residual thrust at ground idle. To maintain slow taxi speeds and avoid extensive brake usage, residual thrust can be reduced by feathering one propeller. It may even be desirable to feather both propellers when taxiing downwind with a strong wind velocity. When taxiing in a crosswind, add power to the upwind side for better control. All taxiing on unprepared fields should be made with flaps down, thus providing lift to keep the main gear from sinking.

*a. Power Steer Switch - As required.

*b. Power Levers - GROUND IDLE.

*c. Brakes - Release and check individually.

*d. Gyros:

(1) RMI - Check for slaving and synchronization.

(2) Steering pointer - Check for proper deflection.

(3) Turn and slip indicator - Check for proper operation.

CAUTION

During backup or turn around operations, care should be taken to keep the propeller in reverse as long as necessary, but not continually in and out of reverse. Continual reversing of the propeller during taxiing tends to overheat the auxiliary motor which has a limited cycle of usage.

2-29. ENGINE RUNUP.

NOTE

When running up in a crosswind, face aircraft into wind.

*a. Master Caution Test Switches - EMER.
*b. Fire Detection Test Switches - AUTO.
c. Power Levers - FLIGHT IDLE.
d. Generators - Check for 27.5 to 28 volts.
*e. Fuel pumps check:
(1) Aft Pump Test Button - Depress.
(2) FUEL PUMPS caution light - Remains out.
(3) Aft Pump Test Button - Release.
(4) FUEL PUMPS caution light - Remains out.
(5) Forward Pump Test Button - Depress.
(6) FUEL PUMPS caution light - Remains out.
(7) Both Pump Test Buttons - Depress.
(8) FUEL PUMPS caution light - Glows.
(9) Both Pump Test Buttons - Release.
(10) FUEL PUMPS caution light - Goes out.
*f. Fuel quantity check (drop tanks installed).
(1) Fuel Quantity Switch - MAIN; note pounds of fuel.
**(2) Fuel Quantity Switch - LEFT; note pounds of fuel.
*(3) Fuel Quantity Switch - RIGHT; note pounds of fuel.
*g. Fuel transfer check (drop tanks installed).
(1) Drop Tank Transfer Switch - LEFT.
(2) L DROP TANK caution light - Goes out.
(3) Drop Tank Transfer Switch - RIGHT.
(4) R DROP TANK caution light - Goes out.
(5) L DROP TANK caution light - Glows.
(6) Drop Tanks Transfer Switch - BOTH, until the drop tanks are empty, then OFF.
(7) L and R DROP TANK caution lights - Out.
*h. Reverse thrust check:
(1) Power Levers - Raise together from GROUND IDLE and move aft to REVERSE.
(2) Engine tachometers - 60% RPM.
(3) Power Levers - GROUND IDLE.
*i. Propeller check:
(1) Power Levers - Advance to 1400 rpm.
(2) Propeller Levers - MIN RPM.
(3) Propeller tachometers 1175 ±25 rpm.
(4) Propeller Levers - MAX RPM.
*j. Power check:
(1) Power Levers - 80% engine RPM.
(2) Power Lever - TAKEOFF (one engine at a time).
(3) Engine tachometer - 94 to 97% RPM (T53-L-3); 94 to 99% RPM (T53-L-7).
(4) Torquemeter - 73 psi max (T53-L-3); 100 psi max (T53-L-7).
(5) Propeller tachometer - 1693 ±15 rpm.
(6) Exhaust gas temperature indicator - 611°C max (T53-L-3); 638°C max (T53-L-7).
(7) Oil pressure indicator - 70 ±10 psi.
*k. Autofeather check:
(1) Power Levers - 20 psi torque.
(2) Autofeather Switch - ON.
(3) Autofeather Test Switch - Press and hold; propellers should not feather.
(4) With Autofeather Test Switch depressed, retard No. 2 Power Lever to GROUND IDLE. No. 2 propeller should feather at 5 to 9 psi torque.
(5) With Autofeather Test Switch still depressed, retard No. 1 Power Lever to GROUND IDLE. No. 1 propeller should not feather.
(6) Autofeather Test Switch - RELEASE.
(7) #2 Unfeather Button - Depress until No. 2 propeller passes through 400 RPM.
(8) Autofeather Arming Switch - Recycle; ON to OFF to ON.
(9) Power Levers - 20 psi torque.
(10) Autofeather Test Switch - Press and hold; propellers should not feather.
(11) With Autofeather Test Switch depressed, retard No. 1 Power Lever to GROUND IDLE. No. 1 propeller should feather at 5 to 9 psi torque.
(12) With Autofeather Test Switch still depressed, retard No. 2 Power Lever to GROUND IDLE. No. 2 propeller should not feather.
(13) Autofeather Test Switch - RELEASE.
(14) #1 Unfeather Button - Depress until No. 1 propeller passes through 400 RPM.
(15) Autofeather Arming Switch - Recycle; ON to OFF to ON.

2-30. BEFORE TAKEOFF. (See figure 2-9.)

a. Autofeather Switch - ON.
b. Flaps Handle - Set to 15°.

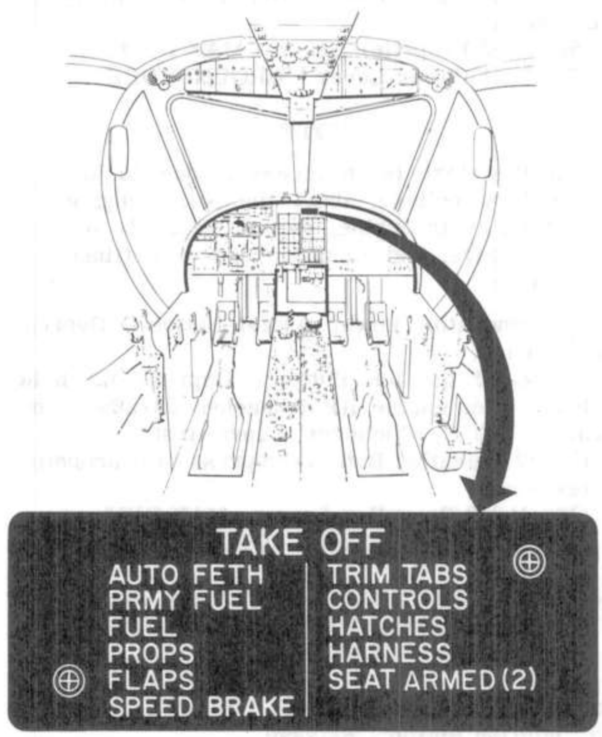


Figure 2-9. Takeoff Check List

c. Speed Brakes Switch - IN.
d. Trim controls - Recheck for takeoff.
e. Flight controls - Freedom of movement.
f. Hatches - Closed.
g. Inertia Reel Control Handle - LOCKED.
h. Face blind locking mechanism - Unlocked.
i. Anti-Collision Light Switch - ON when cleared for the active runway.

2-31. FLIGHT CHECKS.

2-32. TAKEOFF.

2-33. NORMAL TAKEOFF. Proceed as follows for normal takeoff.

a. Align the aircraft with the runway so that the nosewheel will be centered when the brakes are released.
b. Advance power levers symmetrically to approximately 80% RPM and stabilize.
c. Release brakes and advance power levers to TAKEOFF. (Do not exceed 73 psi torque for T53-L-3; 100 psi torque for T53-L-7.)
d. Maintain directional control through the use of nosewheel steering and rudders.

NOTE

During takeoff on prepared surfaces, the aircraft may be driven down the runway during the initial portion of the run, regardless of engine matching, without difficulty. Utilize nosewheel steering until the proper speed occurs for nosewheel lift off.

WARNING

For takeoff on cold days, it is necessary to place the power levers aft of the TAKEOFF position to avoid exceeding maximum allowable torque. Failure of either engine will not result in automatic feathering of that propeller (with autofeather circuit armed) since the power lever must be in the TAKEOFF position to complete the autofeather circuit.

e. At the airspeeds specified in the appropriate Takeoff Charts (see Chapter 14, Section II, paragraph 2-9), apply back pressure to the stick to ease the aircraft off the runway.
f. Obtain single-engine airspeed as soon as possible. (See Chapter 14, Section II, paragraph 2-28, for minimum safe single-engine airspeeds. See Chapter 8, Section III for flight characteristics for this configuration.)

NOTE

The foregoing is based on a configuration as referenced in the Takeoff Charts in Chapter 14, Section II, paragraph 2-9.

2-34. UNPREPARED SURFACE TAKEOFF. During a takeoff from any soft or unprepared surface, follow the normal takeoff procedure. Use sufficient aft control stick during the ground roll to keep the nosewheel unloaded as much as possible. Do not attempt to push the nosewheel down or it will sink into the soft soil and create a bow wave, throwing debris into the propeller. The takeoff run should be made with power steering only. Any alternate steering method will only lengthen the takeoff roll.

2-35. MINIMUM RUN TAKEOFF. Follow normal takeoff procedures and pull stick back as soon as the aircraft will fly. Lower the nose to pick up airspeed and establish normal climb angle.

2-36. OBSTACLE CLEARANCE TAKEOFF. Follow normal takeoff procedures and pull stick back as soon as the aircraft will fly. Climb at an angle sufficient to clear obstacle. If aircraft enters buffet after lift-off, lower nose slightly and continue climb to clear obstacle. To avoid excessive loss in airspeed while clearing obstacle, lower the nose of the aircraft.

2-37. CROSSWIND TAKEOFF. Crosswind takeoffs are not critical due to the inherent stability of the tricycle landing gear. Nosewheel steering or differential use of the throttles may be used to facilitate directional control. In strong crosswinds, it is recommended that the lift-off speed be increased to allow for a greater margin of safety. Counteract drift when the aircraft becomes airborne by lowering the upwind wing or crabbing into the wind.

2-38. HIGH GROSS WEIGHT TAKEOFF AT HIGH ALTITUDES. When high gross weight takeoffs are accomplished at high altitudes and at normal takeoff speeds, the aircraft may begin decelerating after lift-off. To prevent this, lower the nose of the aircraft to pick up airspeed and retract landing gear to increase acceleration.

2-39. NIGHT TAKEOFF. Check interior and exterior lighting for proper operation. In all other respects, use normal takeoff procedure.

*2-40. AFTER TAKEOFF.

a. Landing Gear Handle - Place in the UP position.
b. Wheels and flaps indicator - Check for gear-up indication.
c. Flaps Handle - Retract at 100 knots IAS and safe altitude.
d. Trim Controls - Retrim.
e. Power Levers - Reduce to 60 psi torque pressure.
f. Autofeather Arming Switch - OFF.
g. Synchrophaser Switch - ON.
h. Initial climb - 140 knots IAS.

*2-41. CLIMB. Accelerate to 140 knots IAS for basic climb speed. During climb, the correct airspeed must be flown, maintaining a steady rate of climb for the given airspeed and retrimming as necessary to obtain the best climb performance. Monitor the exhaust gas temperature indicator to avoid engine overtemperature. See appropriate Climb Charts (see Chapter 14, Section II, paragraph 2-14), for specific speeds vs. weights and configurations.

2-42. CRUISE CHECKS (NORMAL). Refer to the Range and Endurance Charts in Chapter 14, Section II, paragraphs 2-17 and 2-20 respectively, for recommended airspeed, engine torque, and propeller rpm.

2-43. FLIGHT CHARACTERISTICS. See Chapter 8, Sections II and III, for aircraft flight characteristics.

2-44. DESCENT. See Chapter 14, Section II, paragraph 2-24, for a standard descent chart. Select heater settings approximately 1 minute prior to rapid descent.

CAUTION

Rapid descents will cause severe windshield fogging, therefore, when a rapid descent is anticipated, set the Heating and Ventilation Control Panel for maximum heat, and defog, before descending.

NOTE

Errors up to 200 pounds in the fuel quantity reading will occur during rapid decelerations.

2-45. BEFORE LANDING.
(See figures 2-10 and 2-11.)

a. Camera controls - Off.
b. Shoulder harness - Locked.
c. Speed Brakes Switch - As desired.

2-46. LANDING.

2-47. GENERAL. See Chapter 14, Section II, paragraph 2-26, for landing distances for various weights and configurations. Observe the comments and instructions in the following paragraphs for various types of landings.

2-48. NORMAL LANDING. For normal landings, place the Power Steer Switch in the ON position, maintain a nose-high attitude, and touch down on the main gear. Hold the nose gear off the runway, easing it down as speed decreases. Power steering will become energized as soon as the nosewheel strut is compressed. If any rudder pedal deflection is present due to crosswind conditions or asymmetric power conditions, the aircraft will swerve slightly. This swerve is minor in nature and can be corrected before the aircraft moves laterally to any appreciable degree. If runway length permits, normal braking can be applied; otherwise, the propellers should be reversed to stop the aircraft. During reverse thrust landing, reverse air flow will tend to cause rapid fluttering of the rudders. This condition should be resisted to prevent these oscillations from being imposed on the nosewheel through the rudder pedals, thus causing lateral movement of the aircraft. Rapid fluttering of the rudders can be readily corrected by nosewheel steering which does not cause any violent motions. Maintain stick and rudder pedal control during reverse thrust landings. Follow the normal landing procedure given below:

*a. Landing Gear Handle - Down below 153 knots IAS. (Check handle is in DOWN detent.)
*b. Wheels and flaps indicator - Check for gear down indication.
*c. Flaps Handle - Down 15° above 100 knots IAS.
*d. Synchrophaser Switch - OFF.
*e. Autofeather Switch - ON.
*f. Power Levers - 80% RPM (approximate)
*g. Propeller Levers - MAX RPM.
*h. Propeller tachometer - 1693 RPM.
*i. Flaps Handle - Down 45° if desired.
*j. Power Steer Switch - ON if desired.

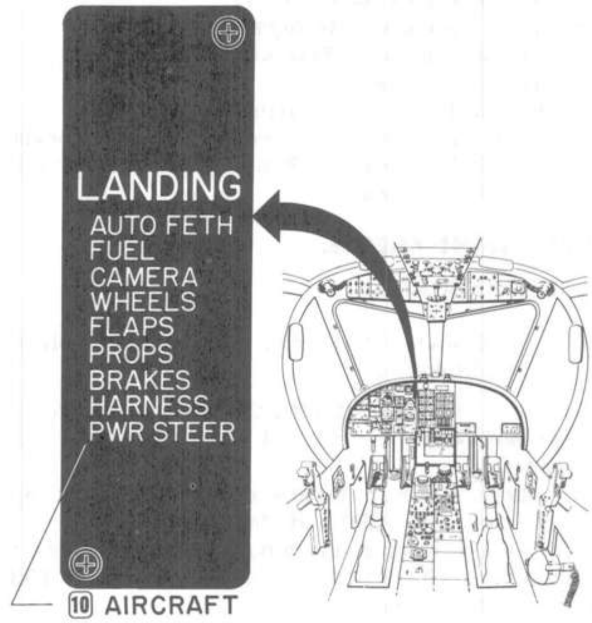


Figure 2-10. Landing Checklist

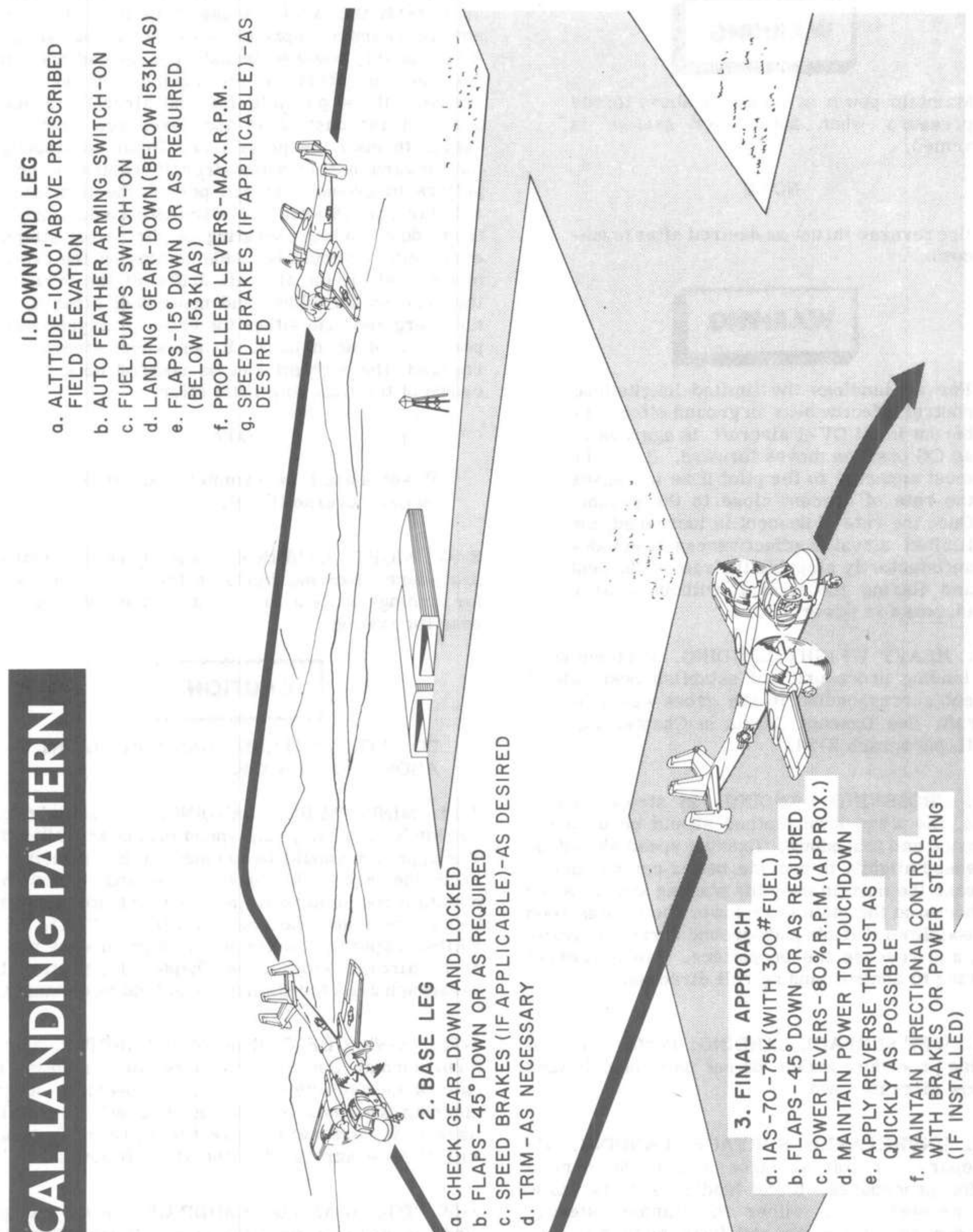


Figure 2-11. Typical Landing Pattern

WARNING

Maintain power at 10 psi or above torque pressure when autofeather system is armed.

NOTE

Use reverse thrust as desired after touchdown.

WARNING

For all landings the limited longitudinal control effectiveness in ground effect, inherent in all OV-1 aircraft, is aggravated as CG position moves forward. It will be most apparent to the pilot if he increases the rate of descent close to the ground. Once the rate of descent is increased, the limited elevator effectiveness precludes satisfactorily stopping the rate of descent and flaring the aircraft without a large increase in power.

2-49. HEAVY WEIGHT LANDING. Perform normal landing procedure and establish best rate of descent corresponding to the gross weight of the aircraft. See Descent Charts in Chapter 14, Section II, paragraph 2-24.

2-50. CROSSWIND LANDING. In strong crosswinds, the wing-down method should be used for approach and touchdown. Landing speed should be increased slightly to provide better control and to increase the margin over the stalling speed. After touchdown on the main gear, lower the nose as soon as possible so that adequate ground control is available, and reverse the propellers. Use nosewheel steering to control landing roll direction.

2-51. WET SURFACE LANDING. Perform normal landing procedure except do not use wheel brakes to slow aircraft down.

2-52. UNPREPARED SURFACE LANDING. On unprepared or soft surfaces, follow the normal landing procedures. If the landing is to be made over an obstruction, either the standard steady-rate descent or the dip and flare method can be used with adequate results. After touchdown, use only the amount of reverse thrust necessary to stop in the required distance. Excessive use of reverse thrust will cause severe erosion of the propellers due to the dust and debris thrown forward in reverse pitch. Normally, the aircraft will land in a shorter distance than is used in takeoff; as a result the excessive use of reverse thrust is not necessary on unprepared fields or road strips. By using full reverse thrust upon touchdown, and reducing the RPM as the landing roll-out progresses, it is possible for the aircraft to stay ahead of the dust cloud and never pull dust and debris through the propellers. Prior to stopping the forward motion of the aircraft, return the propellers to ground idle and permit the aircraft to roll far enough ahead to eliminate contamination from dust. When operating on dirt road strips, every effort should be made to stay on the crown of the road. If the aircraft drifts off the crown of the road on the slope, and nosewheel steering is not energized, use either the brake or asymmetric power to bring it back. If nosewheel steering is engaged, the aircraft can be steered back to the crown of the road with little effort.

NOTE

Power should be symmetrical when selecting reverse thrust.

2-53. NIGHT LANDINGS. Use normal landing procedure. Landing lights in the wings are used for landings while a taxi light on the nose gear is used for taxiing.

CAUTION

DO NOT EXTEND LANDING LIGHT ABOVE 180 KNOTS.

2-54. MINIMUM RUN LANDING. For a minimum run landing, full flaps and speed brakes are utilized. The approach should be planned so that touchdown is at the end of the runway. On final approach, maintain recommended final approach speed. Upon touchdown, place the power levers in FULL REVERSE, apply the brakes, and reduce reverse power as aircraft stops. See Chapter 14, Section II, paragraph 2-26, for minimum run landing distances.

2-55. OBSTACLE CLEARANCE LANDING. Perform normal landing procedure and establish a rate of descent needed to clear obstacle. After clearing the obstacle, nose the aircraft down until flareout is necessary. A greater degree of flareout will be necessary to slow the aircraft down.

2-56. TOUCH AND GO LANDINGS. Touch and go landings can only be made when authorized or directed by the major command concerned. This type of landing introduces a significant element of danger because of the many rapid actions which must be executed while rolling on the runway at high speed, or while flying in immediate proximity to the ground.

CAUTION

On the runway, care should be taken while making power changes to reduce directional control difficulties.

*a. Flaps Handle - 15° down until 100 knots IAS is attained, then UP.
*b. Speed Brakes Switch - IN.
*c. Power Levers - Advance smoothly to TAKEOFF and execute normal takeoff.
*d. After takeoff - Execute after takeoff and climb check (see paragraphs 2-40 and 2-41).

NOTE

Keep landing gear extended to facilitate brake cooling.

e. Before landing - Execute before landing check (see paragraph 2-45).

*2-57. GO-AROUND OR WAVEOFF.

a. Power Levers - Maximum rated power.
b. Speed Brakes Switch - IN.
c. Landing Gear Handle - Up.
d. Wheels and flaps indicator - Check landing gear position.
e. Flaps Handle - 15° until 100 knots IAS is attained, then UP.
f. Power Levers - As desired.
g. Trim controls - As necessary.

*2-58. AFTER LANDING.

a. Flaps Handle - Up.
b. Speed Brakes Switch - IN.
c. Auto-feather Switch - OFF.
d. Anti-Collision Light Switch - OFF.
e. Face blind locking mechanism - Locked after turning off active runway.
f. Secondary Firing Handle - In LOCKED position.

*2-59. ENGINE SHUTDOWN.

a. Parking Brake Handle - Set.
b. Communication equipment - OFF
c. Navigation equipment - OFF.
d. Power Levers - GROUND IDLE.
e. Propeller Levers - FUEL OFF (one at a time).
f. Propeller Levers - FEATHER one at a time, when engine tachometers indicate 10% RPM.
g. Propeller Levers - FUEL OFF.

NOTE

Returning the propeller levers to FUEL OFF insures the termination of auxiliary motor operation.

h. Engine Master Switches - OFF (with engine tachometers at 0% RPM).
i. Fuel Pumps Switch - OFF.
j. Battery Switch - OFF.
k. Face blind locking mechanism - Recheck locked.
l. Secondary Firing Handle - Recheck LOCKED.

2-60. BEFORE LEAVING THE AIRCRAFT.

a. Wheels - Chocked.
b. Parking Brake Handle - RELEASE.
c. Oxygen Regulators - OFF.
d. Gust Lock Handle - Engaged.
e. All Switches - OFF.
f. Ground safety pins - Inserted (see figure 2-5).
*g. DA Form 2391 - Complete.

CHAPTER 4
EMERGENCY PROCEDURES

Section I. Scope

1-1. Chapter 4 has been prepared to familiarize the operator with the action to be taken in the event of an emergency in flight or on the ground. This includes all emergencies which can reasonably be expected to be encountered, with the exception of those connected with the auxiliary equipment (see Chapter 6).

1-2. This chapter has been layed out in step-by-step procedural form to eliminate unnecessary delays when dealing with an emergency. Although time is an important factor in an emergency situation, it must be remembered that judgement, and the accuracy of the action taken, is of equal importance.

Section II. Engine

2-1. ENGINE FAILURE.

2-2. GENERAL. The majority of engine failures are caused by a malfunction in the fuel system or incorrect technique in fuel management. The engine and fuel system instruments and warning lights will provide indications of fuel system failure prior to and during flameout. If engine failure is due to a malfunction in the systems or fuel mismanagement, an air start can usually be accomplished. If the failure is due to an obvious material or mechanical failure, and air start should not be attempted. This aircraft has excellent single-engine flight characteristics; therefore, failure of one engine should not cause undue alarm.

NOTE

Engine compressor surge can be recognized by an intermittent engine roughness. This surge can occur with full forward throttles above 16,000 feet altitude. To eliminate the surge, reduce the engine speed slightly (about 1%).

WARNING

If at any time unusual or suspicious engine noises are heard (such as loud humming, knocking, pounding, or noises of metal-to-metal contact), the engine must be shut down immediately. In flight, an engine suspected of this type of malfunction is to be shut down when there is assurance that single-engine flight can be maintained and an emergency landing can be safely executed. Follow emergency procedures outlined in paragraph 2-9 for landing with one engine inoperative. After landing, if visual inspection does not reveal the cause of the noises, the engine must be inspected by third echelon maintenance personnel. The engine must not be operated again until the cause of the unusual noises is determined and remedial action is accomplished.

2-3. FLIGHT CHARACTERISTICS UNDER PARTIAL POWER CONDITIONS. Malfunction of an engine may result in a complete loss of power (flameout) or a partial power loss. In the event one engine fails, satisfactory flight characteristics permit continuing to a recognized airfield and making a single-engine landing. Landing characteristics are normal except for the asymmetric power being applied. Violent maneuvers and steep-banked turns should be avoided with one engine inoperative. See Chapter 14 for minimum safe single-engine airspeeds.

WARNING

Abrupt lightening of rudder pedal forces for rudder pedal deflections greater than 1/2 full displacement is encountered in all flaps-down flight conditions and in flaps-up flight conditions at airspeeds less than 170 knots. This force lightening is indicative of the reduced directional stability which occurs at large sideslip angles. Maneuvers requiring greater than 1/2 full rudder pedal deflection can be accomplished safely at airspeeds less than 170 knots IAS but should be avoided during normal operation of the aircraft.

2-4. ENGINE FAILURE DURING TAKEOFF. If failure of an engine occurs and sufficient runway remains for a normal stop, the takeoff should be aborted and the aircraft should be brought to a halt by normal braking. If failure occurs when the aircraft is airborne, maintain directional control with rudders and ailerons, jettison external stores (if required), and proceed as follows:

a. If propeller autofeathers:

(1) Power Levers - MIL POWER.
(2) Landing Gear Handle - UP.
(3) Flaps Handle - 0° flaps above 100 knots IAS, 15° flaps below 100 knots IAS.
(4) Speed Brakes Switch - IN.
(5) Power Lever (operating engine) - As required to maintain at least 120 knots.
(6) Engine Master Switch (inoperative engine) - OFF.
(7) Generator switch (inoperative engine) - OFF.
(8) Propeller Lever (inoperative engine) - FUEL OFF.
(9) Trim controls - Retrim for single-engine flight.
(10) Airspeed - As required.

b. If propeller is manually feathered:

(1) Propeller Levers - MAX RPM.
(2) Power Levers - MIL POWER.
(3) Propeller Lever (inoperative engine) - FEATHER.
(4) Landing Gear Handle - UP.
(5) Flaps Handle - 0° flaps above 100 knots IAS; 15° flaps below 100 knots IAS.
(6) Speed Brakes Switch - IN.
(7) Power Lever (operating engine) as required to maintain at least 120 knots.
(8) Engine Master Switch (inoperative engine) - OFF.
(9) Generator Switch (inoperative engine) - OFF.
(10) Propeller Lever (inoperative engine) - FUEL OFF.

(11) Trim controls - Retrim for single-engine flight.
(12) Airspeed - as required.

NOTE

A normal traffic pattern is used when attempting a single-engine landing.

CAUTION

The aircraft will not maintain straight and level flight with full flaps and gear down, when one engine is inoperative.

WARNING

In the event of an engine failure during heavy weight takeoffs, all external stores should be jettisoned immediately and landing gear retracted as soon as possible in order to attain single engine climb performance. Flap retraction must be delayed until the flaps-up single engine minimum control speed is attained.

2-5. ENGINE FAILURE DURING FLIGHT. Engine failure in flight should not cause alarm as the situation is not critical immediately. Retard the propeller lever to FEATHER, and proceed with air starting the engine (see paragraph 2-7). If the engine fails to start, the normal single-engine procedures will apply.

2-6. ENGINE FAILURE DURING FLIGHT, AUTOPILOT ENGAGED. In the event of engine failure during flight in the cruise or approach configuration, disengage the autopilot as soon as possible and proceed with engine failure during flight procedures (see paragraph 2-5). To insure safe single operation, with partial or full flaps down, the autopilot must not be engaged. When normal single engine cruise flight has been established the autopilot can then be re-engaged. The autopilot will stabilize the aircraft adequately under single engine cruise conditions as long as the aircraft is maintained in reasonably good trim. If a substantial speed change develops, or if the aircraft is allowed to otherwise go out of lateral and directional trim, the autopilot will not maintain control and the aircraft will bank and turn into the bad engine. Follow either of the procedures below to maintain autopilot control:

a. Retrim the aircraft; the autopilot will continue to function.

OR

b. Override the autopilot until the aircraft has been retrimmed.

NOTE

As trim is added, the overriding force will be relieved. The servoeffort indicators on the flight controller are useful in determining when adequate trim has been reached.

CAUTION

In order to prevent abrupt, undesirable recovery after releasing the controls, do not overpower longitudinal control unless the Vertical Engage Switch is disengaged.

WARNING

When operating under single engine cruise conditions, with autopilot engaged, airspeed must be kept above 130 knots. Excessive maneuvering should be avoided and caution exercised in the use of the turn knob to keep bank angles below 20 degrees to avoid encountering pre-stall buffet or running out of autopilot control. Closely monitor the servoeffort indicators, particularly when changing speed or power settings, to insure trim being maintained. Sustained out of trim flight conditions will result in overload and possible failure of roll and yaw stabilization systems.

WARNING

Disengage the autopilot for single engine flight below 130 knots IAS. The limited authority of the autopilot as single engine minimum control speeds are approached results in decreasing lateral control. Should the autopilot then be disengaged and an out-of-trim condition exist, an unusual attitude can occur. An unusual attitude can be avoided if the pilot trims the autopilot servoeffort indicators to neutral prior to disengagement. Should available trim control be insufficient to do this, the pilot must be ready to apply immediate corrective control upon autopilot disengagement.

2-7. ENGINE RESTART DURING FLIGHT.

a. The following steps apply to 10 AIRCRAFT without MWO 55-1510-204-34/10 incorporated:
(1) Power Lever - FLIGHT IDLE.
(2) Propeller Lever - MIN RPM.
(3) Fuel Control Switch - PRIMARY.

NOTE

If fuel control troubles are suspected, set Fuel Control Switch to MANUAL.

WARNING

When operating in the manual fuel control mode, extreme care should be taken not to make any rapid power lever motions. This is true whether operating in the forward thrust range or changing from one range to the other. On aircraft with T53-L-3 engines, reverse thrust for landing is possible in the manual fuel control mode; however, power lever motions should be made carefully and slowly, particularly when accelerating from low engine RPM conditions. Rapid movement of the power levers may result in a flameout. Diligent observation of the egt gage will preclude engine damage.

(4) Engine Master Switch - ON.
(5) Generator Switch (operating engine) - OFF.
(6) Battery Switch - NORMAL.
(7) Fuel Pumps Switch - ON.
(8) Engine Start Switch - Momentarily START.
(9) Generator Switch (operating engine) - ON at 20% RPM.
(10) Power Lever - Advance to 30 psi torque pressure after engine RPM has stabilized at FLIGHT IDLE.
(11) Unfeather Button - Depress below 150 knots TAS to unfeather propeller.
(12) Power Lever and Propeller Lever - Synchronize to operating engine.
(13) If the engine fails to function, descend to an altitude below 10,000 feet and repeat restart procedures. If engine still fails to function, secure engine as during normal shutdown and continue on remaining engine.

b. The following steps apply to [20] aircraft, and [10] aircraft with MWO 55-1510-204-34/10 incorporated.

(1) Power Lever - FLIGHT IDLE.
(2) Propeller Lever - MIN RPM.
(3) Fuel Control Switch - AUTO.

NOTE

If fuel control troubles are suspected, set Fuel Control Switch to EMER.

WARNING

When operating in the emergency fuel control mode, extreme care should be taken not to make any rapid power lever motions. This is true whether operating in the forward thrust range or changing from one range to the other. On aircraft with T53-L-3 engines, reverse thrust for landing is possible in the emergency fuel control mode; however, power lever motions should be made carefully and slowly, particularly when accelerating from low engine RPM conditions. Rapid movement of the power levers may result in flameout. Diligent observation of the egt gage will preclude engine damage.

(4) Engine Master Switch - ON.
(5) Generator Switches - ON.
(6) Battery Switch - NORMAL.
(7) Fuel Pumps Switch - ON.
(8) Engine Crank Switch - Momentarily CRANK.
(9) Ignition Button - Press and hold. Release when RPM reaches 23-28%, or egt reaches 400°C.
(10) Power Lever - Advance to 30 psi torque pressure after engine RPM has stabilized at FLIGHT IDLE.
(11) Unfeather Button - Depress below 150 knots TAS to unfeather propeller.
(12) Power Lever and Propeller Lever - Synchronize to operating engine.
(13) If engine fails to function, descend to an altitude below 10,000 feet and repeat restart procedures, if engine still fails to function, secure engine as during normal shutdown and continue on remaining engine.

2-8. MAXIMUM GLIDE. This information and the maximum glide chart will be supplied when available.

2-9. LANDING WITH ONE ENGINE INOPERATIVE. If it becomes necessary to execute a single-engine landing, the following procedures will apply:

a. Inoperative engine - Shut down.
b. Autopilot - Disengaged.

WARNING

Do not engage autopilot during approach or landing maneuvers.

c. Landing pattern - Establish.
d. Landing checks - Complete.
e. Landing Gear Handle - DOWN when landing is assured.
f. Airspeed - Maintain single-engine control speed.
g. Power Lever (operating engine) - Reduce power; retrim.
h. Flaps Handle - Lower flaps as desired when committed to land.

2-10. LANDING WITH BOTH ENGINES INOPERATIVE. If it becomes necessary to land with both engines inoperative, proceed as follows:

a. Perform radio distress procedures.
b. Airspeed - Maintain 110 to 120 knots IAS.
c. Both Propeller Levers - FEATHER.
d. Landing Gear Handle - DOWN when field is made, maintain 90 to 110 knots airspeed.
e. Flaps Handle - Down.
f. Shoulder harness - Locked.
g. Both Engine Master Switches - OFF.
h. Fuel Pumps Switch - OFF.
i. Battery Switch - OFF.
j. Escape Hatch Jettison Handle - TURN 90° and PULL.
k. Execute flareout in time to halt rapid rate of descent and fly aircraft onto ground at minimum but controllable airspeed.
l. After aircraft comes to rest:
(1) Manual Override Lever - RELEASE.
(2) Leg garter quick-release fittings - Release.
(3) Rocket jet fittings - Release.
(4) Abandon aircraft.

WARNING

Take care not to pull the ejection curtain handle.

2-11. GO-AROUND WITH ONE ENGINE INOPERATIVE.

a. If single engine control speed has not been maintained, perform the following steps:
(1) Landing Gear Handle - UP.
(2) Power Lever (operating engine) - Advance cautiously to MIL POWER while increasing airspeed (descent is necessary) at such a rate that single engine control speed (Chapter 14, Section II, paragraph 2-28) is attained before Military Power is reached.
(3) Flaps Handle - UP above 100 knots for [23] and [5] aircraft and above 110 knots for [3] and [4] aircraft.
(4) Trim aircraft as necessary.
b. Landing Gear Handle - Up.
c. Flaps Handle - Up when safe single-engine airspeed is attained.
d. Trim aircraft as necessary.

2-12. TAKEOFF WITH ONE ENGINE INOPERATIVE. To take off with one engine inoperative, perform the following steps:

a. Follow the normal takeoff procedures.
b. Obtain safe single-engine airspeed as soon as possible (see Chapter 14, Section II, paragraph 2-28).

2-13. PRACTICE MANEUVERS WITH ONE ENGINE INOPERATIVE. Perform practice maneuvers for one engine simulated inoperative as follows:

a. Power Lever (simulated inoperative engine) - Retard to FLIGHT IDLE.

CAUTION

Power levers must not be placed in GROUND IDLE during practice maneuvers with one engine inoperative. There is a possibility of obtaining propeller full reverse when GROUND IDLE.

b. Both Propeller Levers - MAX RPM.
c. Power Lever (operating engine) - MIL POWER.
d. Propeller Lever (inoperative engine) - MIN RPM.
e. Traffic pattern - Single-engine landing.
f. Power Lever (operating engine) - FLIGHT IDLE.
g. Propeller Lever (operating engine) - Retard to MIN RPM.

2-14. PROPELLER FAILURE.

2-15. If the propeller fails, feather it and bring the aircraft in. Follow the procedure for landing with one engine operative (see paragraph 2-9).

NOTE

Once the propeller is feathered, the propeller lever can be moved forward to clear the emergency gear release handle with no effect on the engine or propeller.

Section III. Fire

3-1. FIRES.

3-2. GENERAL. The paragraphs in this section outline the procedures to be followed in the event of various fire conditions that may be encountered.

3-3. ENGINE FIRE DURING FLIGHT.

a. Fire Emergency Control Handle - GLOWS.
b. Power Lever - FLIGHT IDLE; attempt visual identification of fire.
c. If Fire Emergency Control Handle goes out: Power Lever - Advance slowly and avoid overheating conditions.
d. If Fire Emergency Control Handle remains on - Secure engine as during normal shutdown.
e. If Fire Emergency Control Handle remains ON, or if visual evidence of fire has been established, proceed as follows:
(1) Battery Switch - NORMAL or UNMONITORED if generator failure is indicated by the warning lights.
(2) Fire Emergency Control Handle - Pull and position Fire Agent Discharge Switch to discharge fire extinguishing agent into affected engine.
(3) If one extinguisher does not perform its function, discharge second extinguisher by placing switch in ALT position.
(4) If positive evidence of fire is still present, eject.

3-4. ENGINE FIRE ON GROUND.

a. Fire Emergency Control Handle - Glows.
b. Power Lever - GROUND IDLE.
c. Propeller Lever - FUEL OFF.
d. Fuel Pumps Switch - OFF.
e. Engine Master Switch - ON.
f. ENGINE - Start (or Crank) Switch-On (or CRANK) until fire is extinguished.
g. If fire continues:
(1) Battery Switch - NORMAL or UNMONITORED if generator failure is indicated by warning lights.
(2) Interrupt Crank Button - Depress (or Engine Crank Switch - INTERRUPT CRANK).
(3) Fire Emergency Control Handle - Pull to shutoff fluids to the engine.
(4) Fire Agent Discharge Switch - Discharge one or both bottles to the affected engine.
(5) If fire persists, turn off Battery and Engine Master Switches and eject.

3-5. ELECTRICAL FIRE.

a. Individual electrical systems - Deenergize to determine location of fire.
b. Defective system - OFF.
c. Remaining systems - ON.
d. If unable to determine location of fire:
(1) Generator Switches - OFF.
(2) Battery Switch - OFF.
(3) Proceed to nearest airfield and land.

3-6. FUSELAGE FIRE.

a. Attempt to identify cause of fire.
b. If electrical, isolate affected system and deenergize system.
c. If cause of fire cannot be identified or if fire cannot be isolated - Eject.

3-7. WING FIRE.

a. Fire Emergency Control Handle (applicable wing) - Pull.
b. Attempt to blow fire out by diving the aircraft.
c. If fire persists - Eject.

3-8. SMOKE AND FUME ELIMINATION. The following procedure applies to all OV-1 aircraft which have not been modified by ECP GR-AO-85 or MWO 55-1510-204-34/18.

a. Oxygen Flow Control Switch - 100% oxygen.
b. Heating equipment - OFF.
c. Heating and Ventilation Flow Switch - VENT.
d. Face and foot air outlets - Open.
e. Abort mission if necessary.

NOTE

Incident must be reported to TMC, SMOSM-EOV-1.

f. In the event only one engine is source of smoke, the source of heat from that engine must be blocked off. In this case the following flight restrictions will apply:
(1) No flights into known or forecast icing conditions.
(2) Avoid rapid descents, especially from altitudes where OAT is below freezing.
g. If both engines are smokers, the bleed shut-off solenoid valve must be deactivated.

Section IV. Aircraft Systems

4-1. FUEL SYSTEM EMERGENCIES.

4-2. ENGINE DRIVEN FUEL PUMP FAILURE.

a. FUEL PRESS HI caution light - Glow.

NOTE

A FUEL PRESS HI caution light will glow if one or both elements of an engine driven fuel pump fails.

b. Monitor engine instruments and return to base. Land as quickly as possible.

4-3. FUEL BOOST PUMP FAILURE.

a. FUEL PUMPS caution light - Glow.

NOTE

The FUEL PUMPS caution light will glow upon failure of both fuel boost pumps. With both pumps inoperative, the aircraft can still maintain altitudes up to 6000 feet; however continued flight under this condition is not recommended.

b. Return to base and land as quickly as possible.

4-4. ELECTRICAL POWER SYSTEM EMERGENCIES.

4-5. GENERATOR FAILURE.

NOTE

Following the failure of a DC generator, the amperage load on the operating generator must be checked to determine that the full load rating of 400 amps is not exceeded. If required, the pilot must manually monitor the connected loads so as to limit the generator output to its 400 amp rating.

a. GEN caution light - GLOW.

b. Generator Switch (inoperative) - RESET; then ON.

c. Generator Switch (inoperative) (if RESET fails)- OFF.

d. If both generators fail:

(1) Battery Switch - UNMONITORED.

(2) All unnecessary electrical equipment - OFF.

4-6. INVERTER FAILURE.

a. INST PWR caution light - Glow.

b. #1 and #2 INVERTER circuit breakers - Check that they are depressed.

c. Inverter Switch (if circuit breakers are depressed) - EMER.

NOTE

If the INST PWR caution light goes out when the inverter switch is set to EMER, the No. 1 inverter is carrying the entire ac load; if the caution light remains on, No. 1 inverter has failed and only that equipment operated by No. 2 inverter will operate.

d. If ac power is still not available - Return to base and land using visual flight rules.

4-7. HYDRAULIC POWER SUPPLY SYSTEM EMERGENCIES.

4-8. LANDING GEAR EMERGENCY EXTENSION.

a. Airspeed - Below 153 knots IAS.

b. Landing Gear Handle - Down.

c. Emergency Landing Gear Release Handle - Pull.

d. Yaw aircraft to aid in locking main gear if necessary.

e. Pull aircraft up sharply to aid in locking nose gear if necessary.

NOTE

If nose gear fails to extend, a satisfactory landing may be accomplished by using maximum reverse thrust at touchdown without applying brakes. After stopping maintain reverse thrust and apply brakes to keep the aircraft in a tail-low position until weight can be added to the tail.

4-9. HYDRAULIC FAILURE - FLAPS DOWN. If a hydraulic failure occurs during flaps DOWN and inboard aileron operation, the aircraft will tend to nose-up, and a peculiar lateral stick condition results from both inboard ailerons blowing up to an approximate 15° UP position. Lateral control is still maintained by means of the outboard ailerons even though the inboard ailerons are inoperative. Laterally, an 8 to 10 pound force is required to hold the control stick in neutral; and unless restrained, the stick will move toward a new zero force position at about 60% stick throw to left or right. To move the stick to hard over from this position requires about 7 pounds effort, or to return the stick to center requires a breakout force of about 14 pounds. The unusual lateral stick forces are caused by force feedback from the spring bungees, now linked in, as a result of the "blow-up" of the inboard ailerons. By raising the Flaps Handle to UP, the flaps and inboard ailerons will retract (but not necessarily lock-up), and thereby deactivate the bungees. When loss of hydraulic pressure with the flaps extended is encountered, proceed as follows:

NOTE

Loss of hydraulic pressure with the flaps extended is immediately evident due to an unstable lateral stick force gradient with a control force neutral existing on either side of the stick center position.

CAUTION

Flaps must not be extended if a malfunction of the hydraulic system is suspected.

a. Initiate missed approach and increase airspeed to above 90 knots.

b. Control stick-Neutral, maintain wings as near level as possible.

c. Flaps Handle - UP, allow flaps to blow-up (8 to 15 seconds).

d. Perform standard no-flap approach and landing.

Section V. Miscellaneous

5-1. DITCHING.

5-2. The ditching capabilities of this aircraft are such that in any emergency condition over water, where airspeed can be maintained, bailout may not be advantageous. When ditching, the airspeed must be maintained at 110 to 120 knots IAS. Flareout must be executed in time to halt the rapid sink rate, and contact with the water must be made in a nose-high attitude while still maintaining airspeed. Refer to the ditching charts, tables 5-I and 5-II, for complete ditching instructions.

TABLE 5-I. DITCHING CHART - PILOT

DUTIES BEFORE IMPACT	POSITION	DUTIES AFTER IMPACT	EQUIPMENT	EXIT
1. Inform observer of decision to ditch. 2. Instruct observer to perform radio distress procedure. 3. Make sure IFF transponder is set to Emergency mode. 4. Fasten safety belt and shoulder harness. Lock inertia reel. 5. Jettison external stores. NOTE Do not jettison empty drop tanks, as they will aid in keeping the aircraft afloat. 6. Landing Gear Handle UP. Flaps Handle 45° DOWN. 7. Feather both propellers approximately 10 seconds before impact. 8. Instruct observer to jettison escape hatch. 9. Turn OFF Fuel Pumps, Engine Master, and Battery Switches. 10. Brace for Impact.	1. Feet against rudder pedals or otherwise braced. 2. Knees flexed.	1. See that observer is uninjured and is able to abandon aircraft. 2. Lift finger ring on manual override lever and rotate to aft position. Insure that lever engages spring lock. 3. Release leg garter quick-release fittings. 4. Release parachute riser rocket jet fitting. 5. Exit through escape hatch. 6. Release and inflate pararaft. 7. Proceed away from aircraft and rendezvous with observer. Tie rafts together.	One PK-2 survival kit.	Escape hatch.

TABLE 5-II. DITCHING CHART - OBSERVER

DUTIES BEFORE IMPACT	POSITION	DUTIES AFTER IMPACT	EQUIPMENT	EXIT
1. Perform radio distress procedure at pilot's command.	1. Feet against rudder pedals or otherwise braced.	1. See that pilot is uninjured and is able to abandon aircraft.	One PK-2 survival kit.	Escape hatch
2. Fasten safety belt and shoulder harness. Lock inertia reel.	2. Knees flexed.	2. Left finger ring on manual override lever and rotate to aft position. Insure that lever engages spring lock.		
3. Jettison escape hatch at pilot's command.		3. Release leg garter quick-release fittings.		
4. Brace for impact.		4. Release parachute riser rocket jet fitting.		
		5. Exit through escape hatch.		
		6. Release and inflate pararaft.		
		7. Proceed away from aircraft and rendezvous with the pilot. Tie rafts together.		

5-3. EMERGENCY DESCENT.

5-4. Perform the following steps for emergency descent.

a. Heating and Ventilation Control Panel - set for maximum heat and defog.
b. Speed Brakes Switch - OUT.
c. Place aircraft in a nose-down attitude and descend as rapidly as possible.

WARNING

Do not exceed airspeed limitations (see Chapter 7, Section II, paragraph 2-13).

5-5. EMERGENCY LANDINGS.

5-6. LANDING WITH ONE OR MORE GEAR RETRACTED. Whenever any of the gear cannot be extended by the normal hydraulic system, the emergency system must be used to lower the remaining gear. If a main gear cannot be extended, a gear-up landing must be attempted and the following procedures performed prior to landing:

a. Before contact:
(1) Emergency Hatch Jettison Handle - TURN 90° and PULL.
(2) Emergency Stores Release Handle - PULL.
(3) Power Levers - GROUND IDLE.
(4) Engine Master Switches - OFF.
b. Landing:
(1) Make landing as slow as possible.
(2) Abandon aircraft as soon as forward motion stops.

5-7. LANDING WITH FLAT TIRE. When a landing in this condition is necessary, it should be made in the normal manner with the gear extended.

a. Nose gear tire flat:
(1) Hold nosewheel off ground as long as possible.
(2) Maintain directional control with brakes.
b. Main gear tire flat:
(1) Touch down softly using normal short field landing technique.
(2) Power Levers - FULL REVERSE immediately after touchdown.
(3) Maintain directional control using brake on remaining good tire.

5-8. EMERGENCY ENTRANCE. (See figure 5-1.)

5-9. If fire should break out and fire fighting equipment is not available, omit step d. except for d.(9) and d.(10) which will eliminate engine fire.

NOTE

A hand fire extinguisher is located on the left side of the pilot's seat (see figure 5-4) but is limited to its effective use against larger fires. Apply extinguishing agent to interior area fires through any of the access panels and doors indicated in figure 5-1 (sheet 1 of 2)

a. Approaching Aircraft. Approach the aircraft from either side to gain access to the entrance hatches. If landing gear is extended and propellers are rotating, use extreme caution. If landing gear has collapsed or is retracted, keep clear of engine intake and exhaust.

b. Cockpit Access.

(1) Lift EXIT RELEASE lock ring and turn to UNLOCK.

(2) Open entrance hatch with release lever. Lift entrance hatch to full open position.

(3) Jettison escape hatch by rotating emergency hatch jettison handle 90° clockwise and pulling.

CAUTION

Make certain all personnel are clear of escape hatch area and trajectory patch.

(4) If the aircraft comes to rest in an inverted position and the entrance hatch cannot be opened, cut glass around edge of hatch. As a last resort, smash the glass with a heavy object using care to minimize the amount of glass falling on the pilot and observer.

c. Ejection Seat Safety.

(1) Lift red tab of face blind locking mechanism.

(2) Lift secondary firing handle safety guard.

(3) Insert safety pin in ejection gun sear. If safety pin is not available, a metal pin the diameter of a ten-penny nail can be used.

(4) Remove drogue gun trip rod safety pin and insert in drogue gun safety pin hole.

d. Cockpit Deactivation (Time Permitting).

(1) Power Levers - GROUND IDLE.

(2) Propeller Levers - FUEL OFF.

(3) Engine Master Switches - OFF.

(4) Fuel Pumps Switch - OFF.

(5) Battery and Generator Switches - OFF.

(6) Armament Power Switch - OFF.

(7) Both Oxygen Supply Switches - OFF.

(8) Flare Salvo Switch and Camera Poers Switch - OFF.

(9) Fire Emergency Control Handles - Pull.

(10) If engine fire exists:

(a) Battery Switch - ON.

(b) Fire Agent Dischart Switches - Set to affected engine or engines.

(c) Battery Switch - OFF.

(11) Gain access to battery through PUNCH IN panel and disconnect battery.

e. Remove Pilot and/or Observer. If there appears to be little chance of fire, it is advisable to leave the injured in their seats until qualified medical personnel arrive. To remove the pilot and/or observer, perform the following steps:

NOTE

If the harness quick disconnect fittings and the lap belt cannot be unlocked, or if survival kit restraint straps cannot be removed, the pilot and observer can be removed with parachute and survival kit attached.

(1) Unlock harness quick disconnect fittings by squeezing release bar tabs and moving release bar upward.

(2) Unlock lap belt and remove survival kit vertical restraint straps.

NOTE

Leg garters can be released from the leg restraint cords at the quick disconnect by squeezing serrated lock release tabs to release tabs to free lock ring.

(3) Tilt pilot or observer forward from waist and turn shoulders toward entrance hatch. Grasp pilot or observer under armpits, lift and pull through entrance hatch or escape hatch.

5-10. FLIGHT CONTROL EMERGENCIES.

5-11. FLAPS AND SLATS EMERGENCY OPERATION. No provisions are made for emergency extension of the slats and flaps. In the event of failure of either of these, normal landing procedures are followed except that landing is accomplished at a higher speed.

5-12. INBOARD AILERONS EMERGENCY OPERATION. No provisions are made for emergency operation of the powered inboard ailerons. Anticipate reduced roll rate in landing configuration. If one inboard aileron jams, even full up, the aircraft is controllable with the other powered aileron plus normal aileron with no emergency action.

5-13. BAILOUT.

5-14. Escape from the aircraft in flight is made with the ejection seat and it is an established procedure that the observer eject first. Ejection at low altitudes is facilitated by pulling the nose of the aircraft above the horizon. This maneuver affects the trajectory of the ejection seat providing a greater increase in altitude than if ejection is performed in a level flight attitude. This gain in altitude will increase the time available for separation from the

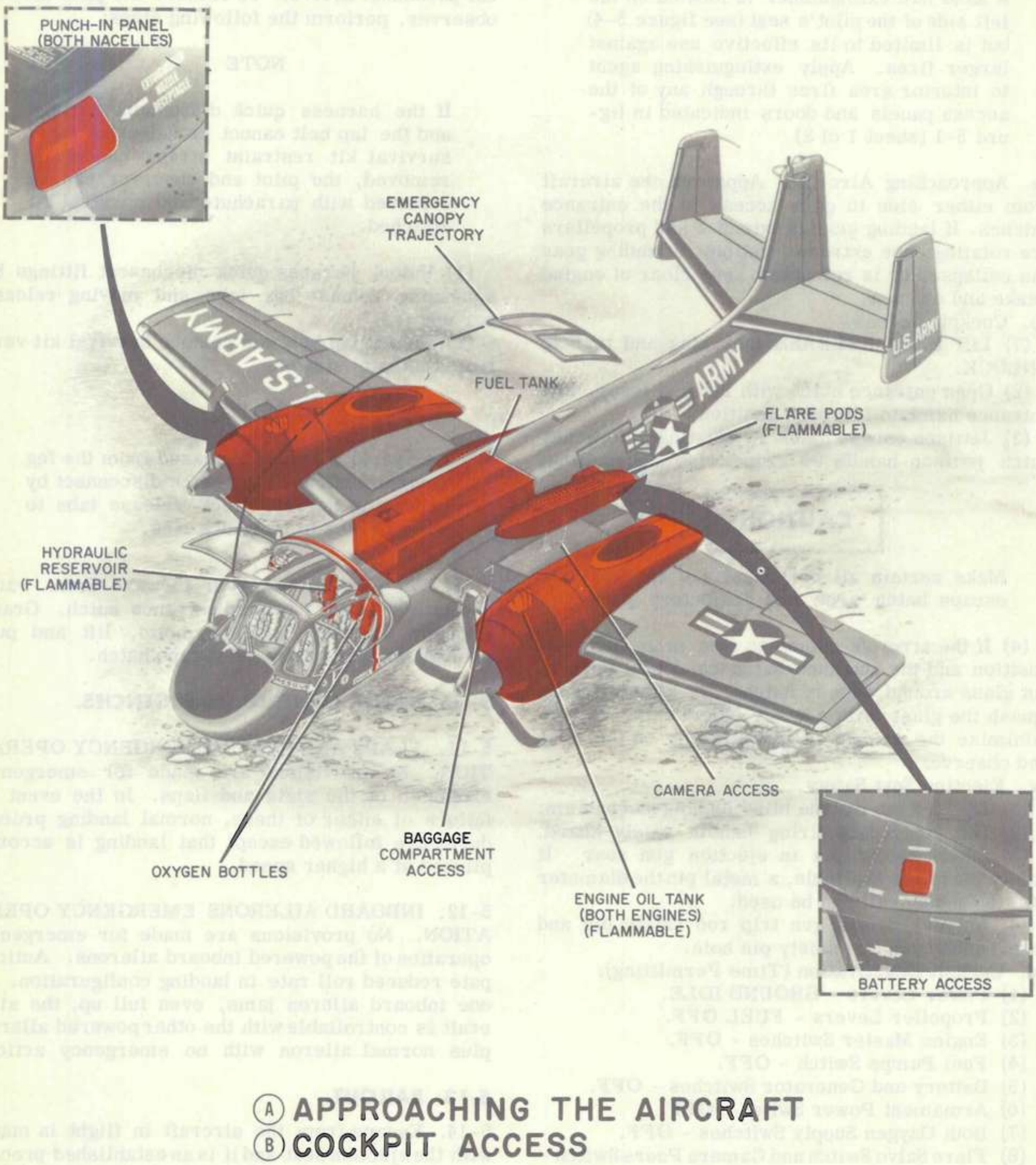
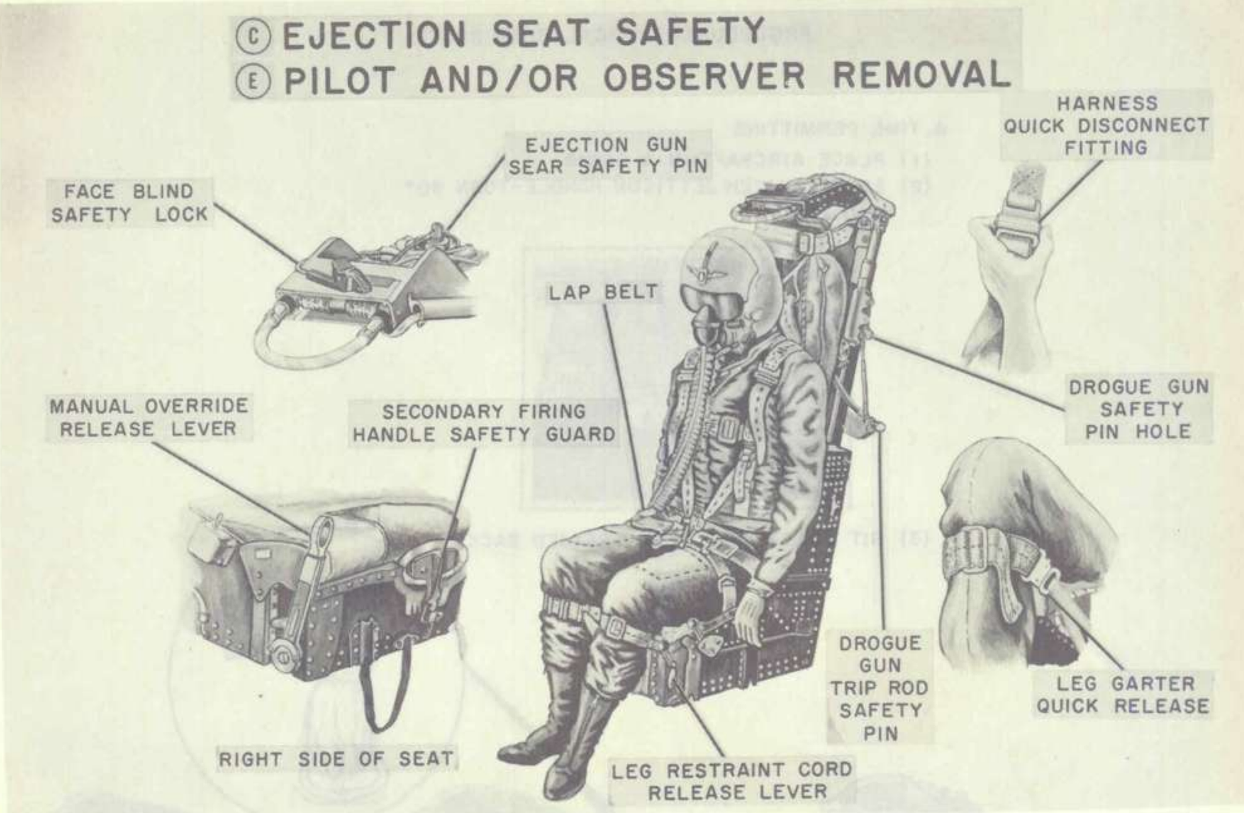


Figure 5-1. Emergency Entrance (Sheet 1 of 2)



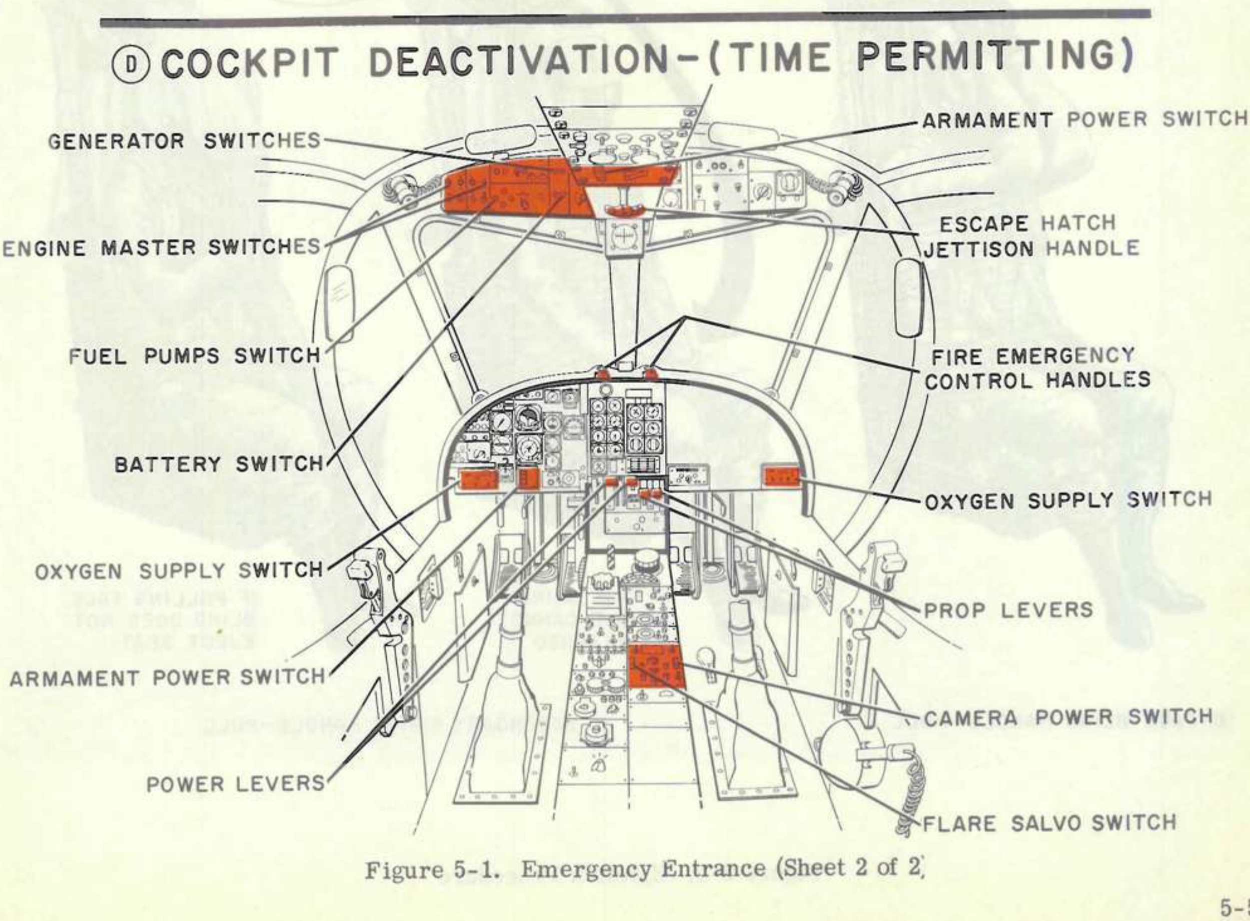


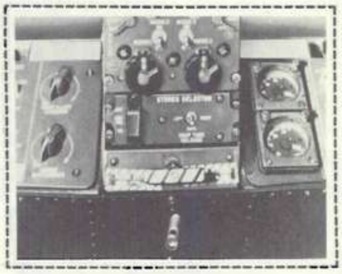
Figure 5-1. Emergency Entrance (Sheet 2 of 2)

PROCEDURE—TYPICAL BOTH SEATS

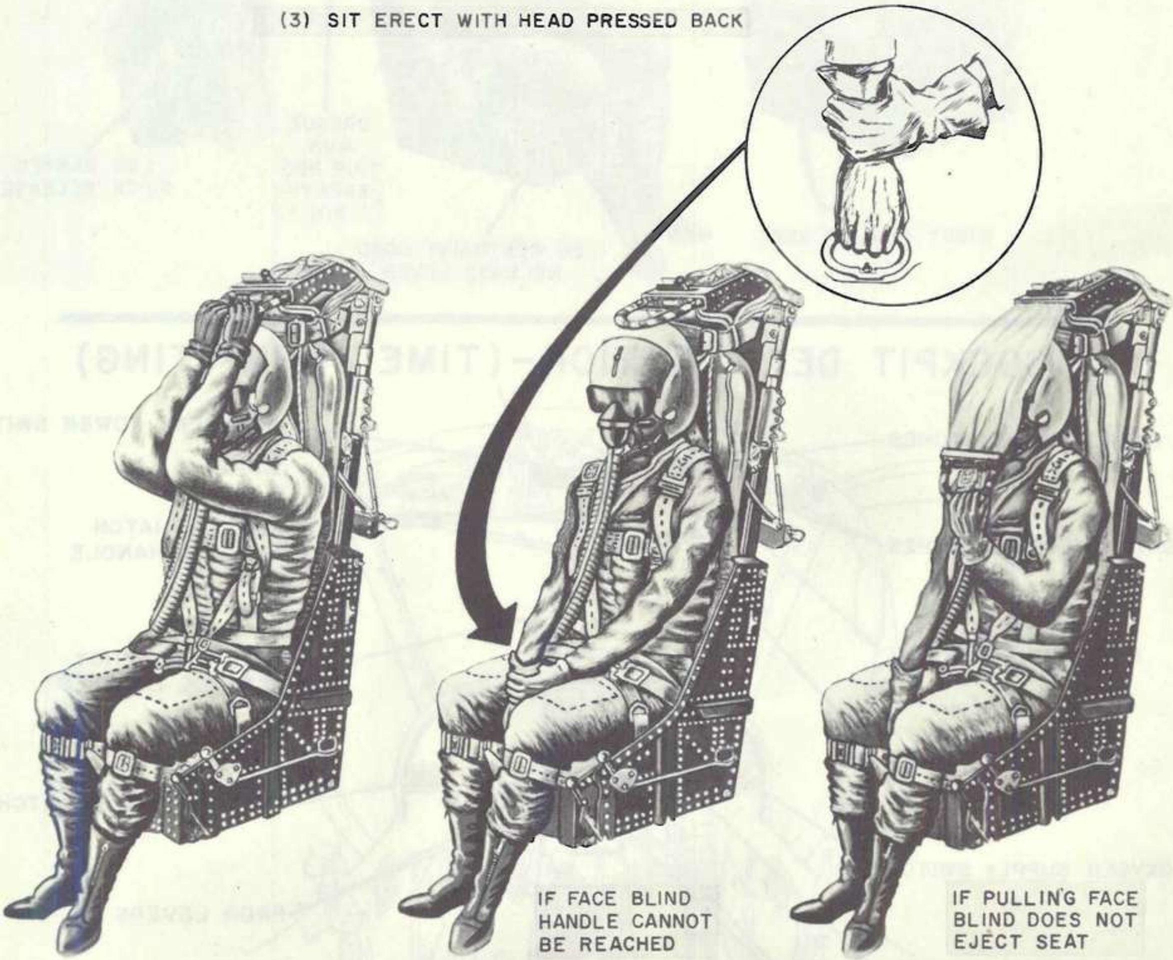
A. TIME PERMITTING:

(1) PLACE AIRCRAFT IN A CLIMB

(2) ESCAPE HATCH JETTISON HANDLE—TURN 90° AND PULL.



(3) SIT ERECT WITH HEAD PRESSED BACK



B. FACE BLIND HANDLE—PULL

C. SECONDARY FIRING HANDLE—PULL

Figure 5-2. Ejection Procedure

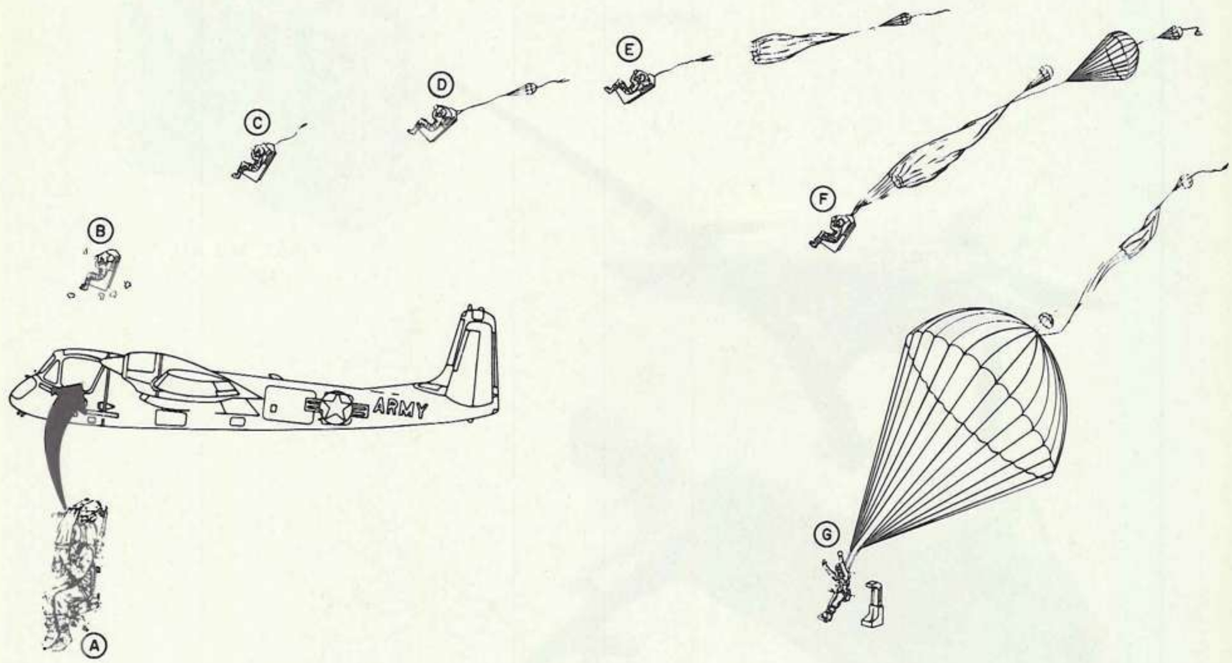


Figure 5-3. Ejection Sequence

seat and deployment of the parachute. Ejection should not be delayed when the aircraft is in a descending attitude and cannot be leveled out. When circumstances permit, slow the aircraft down prior to ejection to reduce the forces exerted on the body. The manual override lever must never be actuated before ejection. Actuating the manual override lever before ejection will cause the occupant to separate from the seat immediately after ejection. and severe shock loads will be imposed on the body.

5-15. EJECTION PROCEDURE. (See figure 5-2.)

a. Time permitting, perform the following:
(1) Place aircraft in a climb.
(2) Escape Hatch Jettison Handle - TURN 90° clockwise and pull down (if time permits).
(3) Sit erect with head pressed back and grasp Face Blind Handle with both hands (palms down).
b. Face Blind Handle - Pull out and down so that face blind covers face.

NOTE

While the face blind is being pulled, it is extremely important that the pilot make a conscious effort to hold his head back against the wedge pack (pad). The natural consequence of pulling the arms down is for the head to move forward, thus placing the spine in a curved position at the time of ejection gun firing. This must be avoided if possible.

c. If seat fails to eject:
(1) Sit erect with head pressed back.
(2) Secondary Firing Handle - Grasp handle with one hand and grasp wrist with the other. Pull handle up after insuring handle is armed.

NOTE

When the secondary firing handle is pulled, the pilot must make a conscious effort to hold his head against the wedge pack (pad). The natural tendency to place the spine in a curved position when pulling the secondary firing handle must be avoided whenever possible.

5-16. EJECTION SEQUENCE. (See figure 5-3.) The following is the ejection sequence for a normal seat-occupant ejection and automatic separation:

a. The occupant grasps the face blind handle (palms down), presses head back, and pulls handle out and down to fire the primary cartridge in the ejection gun.

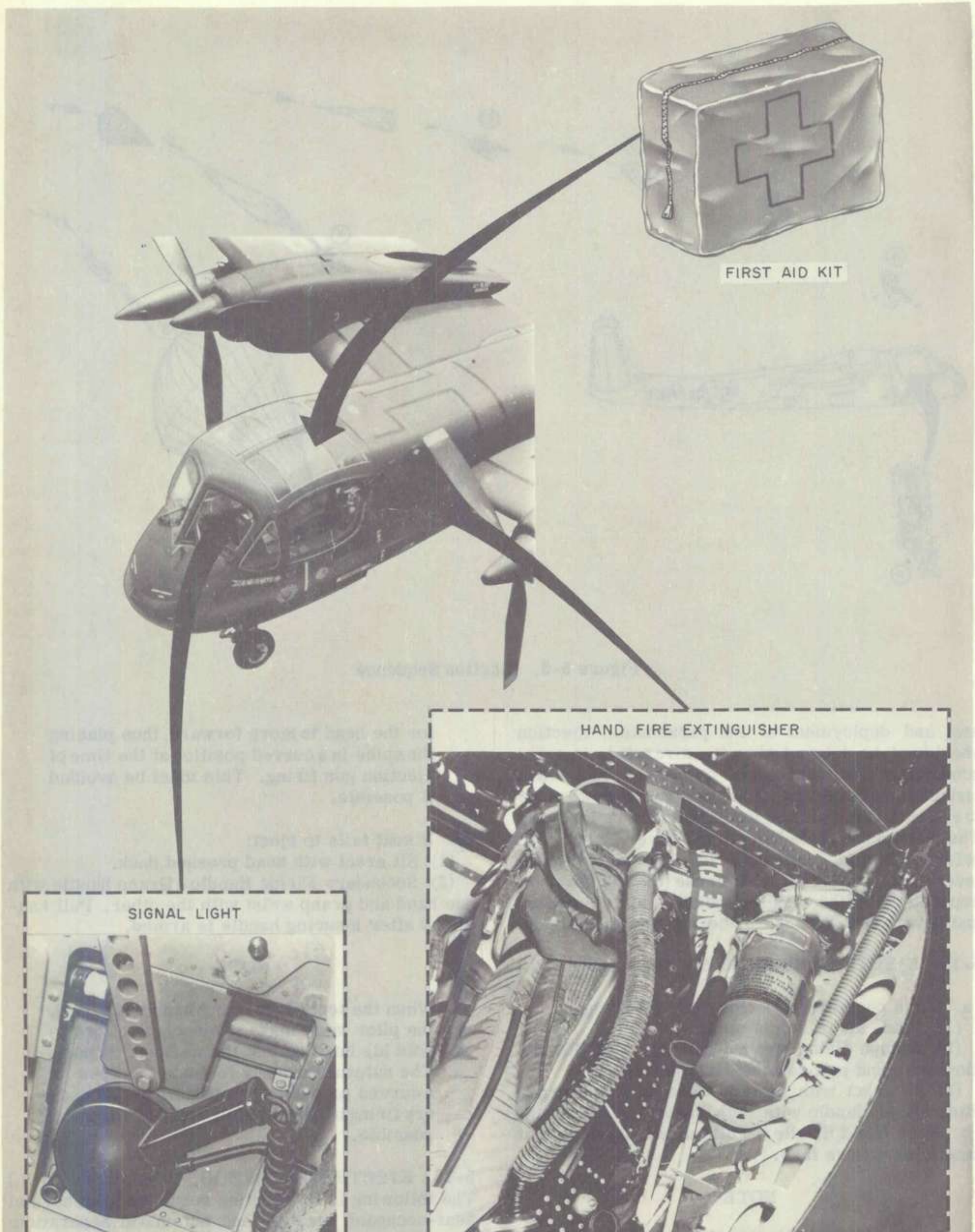


Figure 5-4. Emergency Equipment

b. As the seat and occupant start to rise, the following occurs:

(1) The primary cartridge ignites the two secondary cartridges, providing the necessary thrust to clear the aircraft.

(2) The drogue gun sear is extracted from the drogue gun, and the time release mechanism sear is extracted from the time release mechanism.

(3) The leg restraint cords tighten, pulling the occupant's legs against the seat bucket. As the seat and occupant continue to rise, rivets in the leg restraint cord roller brackets shear, freeing the lower end of the cord from the cockpit floor. The occupant's legs are still held securely against the seat by the upper cord locks and the snubbers.

(4) The emergency oxygen system is activated whether needed or not.

c. The seat is now clear of the aircraft. The drogue gun fires 0.5 second (MK-J5A) or 1.0 second (MK-J5B) after the sear is withdrawn from the drogue gun. The firing of the drogue gun propels a piston from the gun.

d. The 22-inch controller drogue is withdrawn from the drogue parachute container by the piston which was fired from the drogue gun.

e. The controller drogue, by means of a connecting line, extracts the 5-foot stabilizer drogue from the drogue parachute container. The drogues decelerate and stabilize the seat and occupant for separation.

f. The time release mechanism fires 1.40 to 1.75 seconds (MK-J5A) or 1.65 to 1.85 seconds (MK-J5B) after the seat has been withdrawn and performs the following functions through mechanical linkages. simultaneously:

NOTE

For high-altitude ejection, a barostat prevents operation of the time release mechanism until the seat and occupant have fallen through the rarefied, cold air to an altitude of 15,000 to 10,000 feet.

(1) Releases the points of attachment holding the occupant's torso suit and survival kit to the seat.

(2) Releases the upper lock fittings of the leg restraint cores, freeing the occupant's legs from the seat.

(3) Allows the scissor (holding the drogue chutes to the seat) to open, allowing the drogue chutes to pull the personnel parachute from its pack.

(4) Disconnects the face blind attachment from the drogue container. This ensures absolute separation if the occupant's hands are "frozen" to the face blind handle.

g. The opening shock of the personnel parachute overcomes the spring tension of the sticker clips and allows a clean, seat-occupant separation. The occupant then descends in a 24-foot personnel parachute.

NOTE

If the occupant should feel uncomfortable with the lap belt and survival kit while descending in his parachute, he may attach the survival kit retention strap to the survival kit vertical restraint strap fitting, release the lap belt, and let it hang at his side.

5-17. MANUAL SEPARATION FROM SEAT. If the time release malfunctions and occupant does not automatically separate from the seat, the following procedure must be followed:

a. Manual Override Lever - Lift finger ring and rotate to aft position, insure that lever engages spring lock.

b. Roll forward and push violently against the seat (to overcome spring tension of the sticker clips).

c. Personnel Parachute - Deploy by pulling rip cord D-ring located on left parachute riser (below 10,000 feet if possible).

NOTE

Should survival kit and lap belt be uncomfortable during descent, attach the survival kit retention strap to the survival kit vertical restraint strap fitting, and release lap belt.

b. As the seat and occupant start to rise, the following occurs:

(1) The primary cartridge ignites the two secondary cartridges, providing the necessary thrust to clear the aircraft.

(2) The drogue gun sear is extracted from the drogue gun, and the time release mechanism sear is extracted from the time release mechanism.

(3) The leg restraint cords tighten, pulling the occupant's legs against the seat bucket. As the seat and occupant continue to rise, stress in the leg restraint cord causes brackets shear, freeing the lower end of the cord from the cockpit floor. The occupant's legs are still held securely against the seat by the upper cord locks and the snubbers.

(4) The emergency oxygen system is activated whether needed or not.

c. The seat is now clear of the aircraft. The drogue gun fires 0.5 second (MK-16A) or 1.0 second (MK-15D) after the seat is withdrawn from the drogue gun. The firing of the drogue gun propels a piston from the gun.

d. The 22-inch controller drogue is withdrawn from the drogue parachute container by the piston which was fired from the drogue gun.

e. The controller drogue, by means of a connecting line, extracts the 5-foot stabilizer drogue from the drogue parachute container. The drogues decelerate and stabilize the seat and occupant for separation.

f. The time release mechanism fires 1.40 to 1.75 seconds (MK-15D) or 1.50 to 1.85 seconds (MK-16A) after the seat has been withdrawn and performs the following functions through mechanical linkage simultaneously:

NOTE

For high-altitude ejection, a barostat prevents operation of the time release mechanism until the seat and occupant have fallen through the rarefied, cold air to an altitude of 14,000 to 16,000 feet.

(1) Releases the points of attachment holding the occupant's torso and seat survival kit to the seat.

(2) Releases the upper lock fittings of the leg restraint cords, freeing the occupant's legs from the seat.

(3) Allows the scissor (holding the drogue shackle to the seat) to open, allowing the drogue chutes to pull the personnel parachute from its pack.

(4) Disconnects the face blind attachment from the drogue container. This ensures shackle separation if the occupant's hands are "frozen" to the face blind handle.

g. The opening shock of the personnel parachute overcomes the spring tension of the sticker clips and allows a clean, seat-occupant separation. The occupant then descends in a 24-foot personnel parachute.

NOTE

If the occupant should feel uncomfortable with the lap belt and survival kit while descending in his parachute, he may attach the survival kit retention strap to the survival kit vertical restraint strap fitting, release the lap belt, and let it hang at his side.

4-15. MANUAL SEPARATION FROM SEAT. If the time release malfunctions and occupant does not automatically separate from the seat, the following procedure must be followed:

a. Manual Override Lever - Lift finger ring and rotate to aft position. Insure that lever engages spring lock.

b. Roll forward and push violently against the seat (to overcome spring tension of the sticker clips).

c. Personnel Parachute - Deploy by pulling rip cord D-ring located on left parachute riser (below 10,000 feet if possible).

NOTE

Should survival kit and lap belt be uncomfortable during descent, attach the survival kit retention strap to the survival kit vertical restraint strap fitting and release lap belt.

CHAPTER 5
AVIONICS

Section I. Scope

1-1. The function of this chapter is to acquaint the pilot and observer with the avionics equipment installed in the various models of the aircraft. This equipment includes all the electronic communication, navigation, and surveillance systems, and their associated controls and indicators.

1-2. The information given includes the basic steps of procedure necessary to start, operate, and stop the equipment, and any applicable emergency operating instructions. No attempt has been made to discuss the electronic theory of operation of the equipment.

Section II. Communication and Associated Electronic Equipment

2-1. TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT.

2-2. See table 2-I for a complete listing of communication and associated electronic equipment installed on the OV-1 aircraft.

TABLE 2-I. TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT

TYPE	DESIGNATION	USE	OPERATOR	RANGE	LOCATION OF CONTROLS
COMMUNICATION EQUIPMENT					
ICS	AN/AIC-12	Intercommunication	Pilot Observer	Within the aircraft	Control panel at each crew station
[a]UHF Command Set	AN/ARC-55B	Two-way voice communication stateside	Pilot Observer	Line of sight	Center lower console
[b, c]VHF Command Set	AN/ARC-73	Two-way voice communication in Europe (USAREUR). Replaces AN/ARC-55B	Pilot Observer	Line of sight	Center lower console
[b]Emergency Transmitter Set	T-366A/ARC	Alternative VHF transmission	Pilot Observer	Line of sight	Center lower console
FM Liaison Set	AN/ARC-44	Two-way FM-HF radio-telephone communication	Pilot Observer	Line of sight	Center lower console
NAVIGATION EQUIPMENT					
VOR Set	[d]AN/ARN-30A [e]AN/ARN-30D [f]AN/ARN-30E	VOR, VAR, runway localizer, and voice signal reception for T-366A/ARC. [b]Two installed for operation stateside	Pilot Observer		Center lower console
ADF Set	AN/ARN-59(V)	Homing and position fixing. Aircraft bearing. [b]Two installed for operation in Europe (USAREUR)	Pilot		Center lower console
Marker Beacon Set	[g]AN/ARN-68 [h]R-1041/ARN	Reception of location marker beacon signals from instrument approach station	Pilot		Pilot's instrument panel
RMI	ID-250A/ARN	Combined indication of magnetic heading and radio compass bearing information	Pilot		Pilot's instrument panel

a-h, See Notes at end of table.

TABLE 2-I. TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT (cont)

TYPE	DESIGNATION	USE	OPERATOR	RANGE	LOCATION OF CONTROLS
Flight System	AN/ASN-33	Visual indication of heading, course, glideslope, bearing, and localizer information received from navigation equipment	Pilot		Pilot's instrument panel
MA-1 System	MA-1 (Lear)	Heading information to the RMI and flight system	Pilot		Pilot's instrument panel
[b]Glide Slope Receiver Set	AN/ARA-54	Vertical guidance information to flight system and autopilot	Pilot		Center lower console
[i]Doppler System	AN/APN-129(V)	Compute groundspeed and drift angle	Pilot	Aircraft to ground	Sloping console and pilot's instrument panel
RADAR EQUIPMENT					
IFF	AN/APX-44	Identification and emergency transmission	Pilot		Center overhead console
[b]Ground Track Beacon	AN/DPN-62(V)	Aircraft tracking from ground station	Triggered from ground station	Line of sight	None [l] Center lower Console[m]
[b]Radar Altimeter	AN/APN-22	Terrain clearance of aircraft	Pilot	Aircraft to ground	Pilot's instrument panel
AUTOPILOT					
[b]Autopilot	AN/ASW-12(V)	Automatic altitude, attitude, heading, and steering control. Automatic ILS	Pilot		Center lower console
SURVEILLANCE EQUIPMENT					
[j]SLAR System	AN/APS-94	Record mapping information	Observer	(Classified)	Observer's console
[k]Data Link	AN/AKT-16	Encodes and transmits mapping information from SLAR system	Observer		Sloping console

b, c, j, k, l. See Notes at end of table.

TABLE 2-I. TABLE OF COMMUNICATION AND ASSOCIATED ELECTRONIC EQUIPMENT (cont)

TYPE	DESIGNATION	USE	OPERATOR	RANGE	LOCATION OF CONTROLS
[j]Recorder Processor-Viewer	RO-166/UP	Records on a single strip of film the map information from SLAR system. Optional replacement for radar mapping recorder of SLAR system			
[n]IR System*	AN/AAS-14	Records mapping information	Observer	(Classified)	Observer's console
Data Link	AN/ART-41	Encodes and transmits mapping information from IR system	Observer	(Classified)	Observer's console

NOTES:

[a]Installed on [7] aircraft based stateside. Always installed on [1] aircraft.

[b]On [7] aircraft.

[c]Installed only on aircraft based in Europe (USAREUR) (replacing AN/ARC-55B).

[d]On [26] aircraft.

[e]On [27] aircraft.

[f]On [28] aircraft.

[g]On [1] aircraft.

[h]On [7] aircraft.

[i]On [3] and [4] aircraft.

[j]On [3] aircraft, but to be installed on [4] aircraft.

[k]On [3] aircraft.

[l]On [29] aircraft.

[m]On [30] aircraft.

[n]On [31] aircraft, but to be installed on [32] aircraft.

2-3. COMMUNICATION EQUIPMENT.

2-4. ICS - AN/AIC-12.

2-5. GENERAL. The ICS provides communication between the pilot and observer, reception from individual radio receivers, transmission over individual radio transmitters, and simultaneous monitoring of all navigation radio receivers in the aircraft. Controls for the ICS are located on the INT control panel (figure 2-1) and pilot's stickgrip (figure 3-2). The observer is provided with foot-switches (figure 2-3) to facilitate transmission. The pilot and observer each have a headset and microphone in their protective flying helmet (APH-5). On [33] aircraft, the observer has a control stick which includes a RADIO-ICS button as shown on the pilot's stick grip (figure 2-2). Primary dc power energizes the ICS set when the ICS circuit breaker (Chapter 2, Section II, figure 2-15) is depressed.

2-6. INT PANEL. The INT control panel has six receiver switches, a volume control, and a transmitter selector switch. When both crewmembers have the transmitter selector switch in the INT position, interphone operation is provided. See figure 2-4 for ICS switch settings necessary for reception and transmission with particular communication and navigation sets.

2-7. PILOT'S RADIO-ICS BUTTON. The pilot's RADIO-ICS Button (figure 2-2) is a three-position switch providing the pilot with a means of selecting interphone (ICS position) or radio (RADIO position) transmission. In the ICS position, the interphone relay in the pilot's INT control panel is energized and allows interphone operation from the pilot's mike. In the RADIO position, the transmitter control circuit is energized and keys the transmitter selected by the Transmitter Selector Switch on the pilot's INT panel. Both switch positions will energize the microphone amplifier in the INT control panel.

2-8. OBSERVER'S RADIO AND ICS FOOT-SWITCHES. The observer's RADIO and ICS Foot-Switches (figure 2-3) are two-position switches providing the observer with the same means of controlling the ICS as the pilot. The observer's INT control panel is energized in the same manner as the pilot's INT control panel.

2-9. OPERATION OF ICS.

a. Check that the ICS circuit breaker is depressed.

b. Pilot and observer - set Receivers INT Switch on INT control panel to ON (up) position.

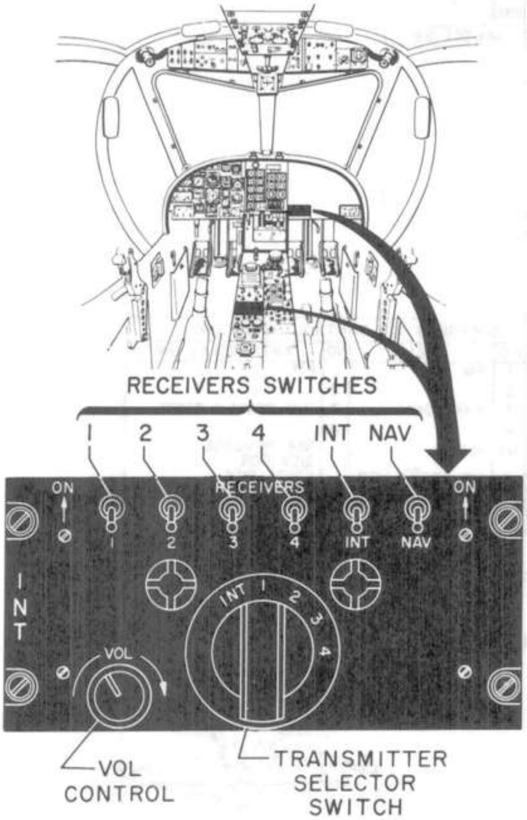


Figure 2-1. INT Control Panel

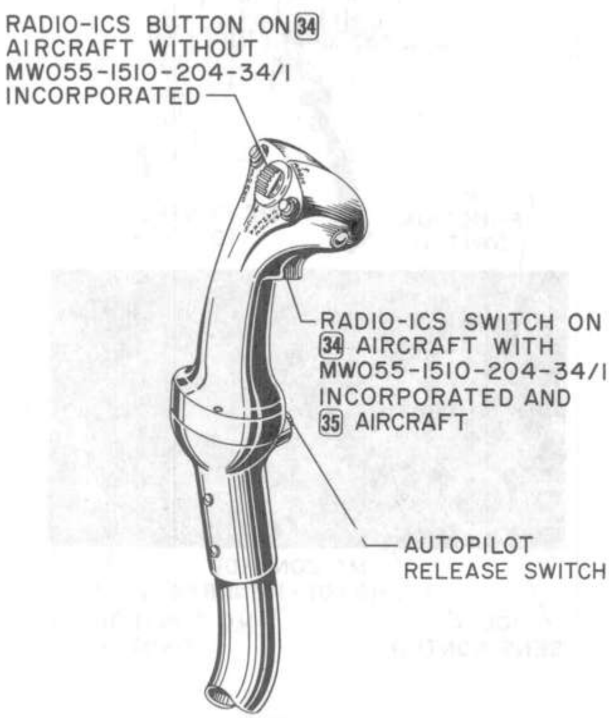


Figure 2-2. Pilot's Control Stick Grip

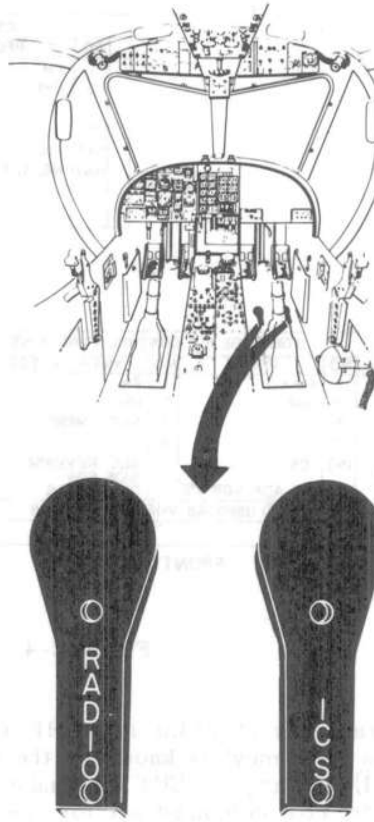


Figure 2-3. Observer's Foot Switches

c. Pilot - to speak to observer, set RADIO-ICS Button to ICS and talk into mike.

NOTE

Sidetone should be audible.

d. Observer - to speak to pilot, depress ICS Foot-Switch and talk into mike.

NOTE

Sidetone should be audible.

e. Pilot and observer - adjust Volume Control for desired audio level.

2-10. UHF COMMAND SET - AN/ARC-55B.

2-11. GENERAL. The UHF command set provides two-way amplitude-modulated radiotelephone communication between aircraft in flight, or between aircraft and ground or ship radio. The UHF set is capable of transmitting and receiving on any one of 1750 frequency channels, spaced at 100-kc intervals, in the band of 225.0 to 399.9 mc. One pre-

ICS CONTROL FUNCTIONS			
NO.	RECVR	NO.	XMTR SELECT SW
1	FM	1	FM
2	UHF	2	UHF
3		3	
4		4	
INT	ICS		
NAV	MB, ADF, VOR		

[1] AIRCRAFT

STATESIDE ICS CONTROL FUNCTIONS			
NO	RECVR	NO	XMTR SELECT SW
1	FM	1	FM
2	UHF	2	UHF
3		3	VHF EMERG
4		4	
INT	ICS		SEE REVERSE SIDE FOR OVER SEAS
NAV	MB ADF VOR#1#2		
VOR#1 USED AS VHF EMER RECVR			

FRONT FACE

OVERSEAS ICS CONTROL FUNCTIONS			
NO	RECVR	NO	XMTR SELET SW
1	FM	1	FM
2		2	
3	VHF COMM	3	VHF COMM & EMER
4		4	
INT	ICS		SEE REVERSE SIDE FOR STATE SIDE
NAV	MB ADF#1#2 VOR		
VOR#1 USED AS VHF EMER RECVR			

REAR FACE

[7] AIRCRAFT

Figure 2-4. ICS Function Cards

determined frequency of 243.0 mc (UHF emergency distress frequency) is known as the guard channel. On [7] aircraft, the UHF command set is replaced by the VHF command set for operation in Europe. Controls for the UHF command set are located on the UHF control panel (figure 2-5). Power is applied to the UHF command set through the UHF circuit breaker (Chapter 2, Section II, figure 2-16). Audio for UHF transmission and audio obtained from UHF reception are controlled and distributed by the ICS.

2-12. UHF CONTROL PANEL. The UHF control panel (figure 2-5) permits remote control of the receiver-transmitter operation. The controls permit selection of operational mode, volume control, and frequency channel selection (channeling).

2-13. OPERATION OF UHF COMMAND SET.

NOTE

Always monitor the channel before transmitting and when using emergency channels, transmit only as long as is absolutely necessary, then establish communications on another channel.

a. Check that the UHF circuit breaker is depressed.

b. Set Function Switch to T/R and allow a warm-up interval of at least 2 minutes or, if possible, 15 minutes.

c. For reception of UHF, set Receivers 2 Switch on INT control panel to ON.

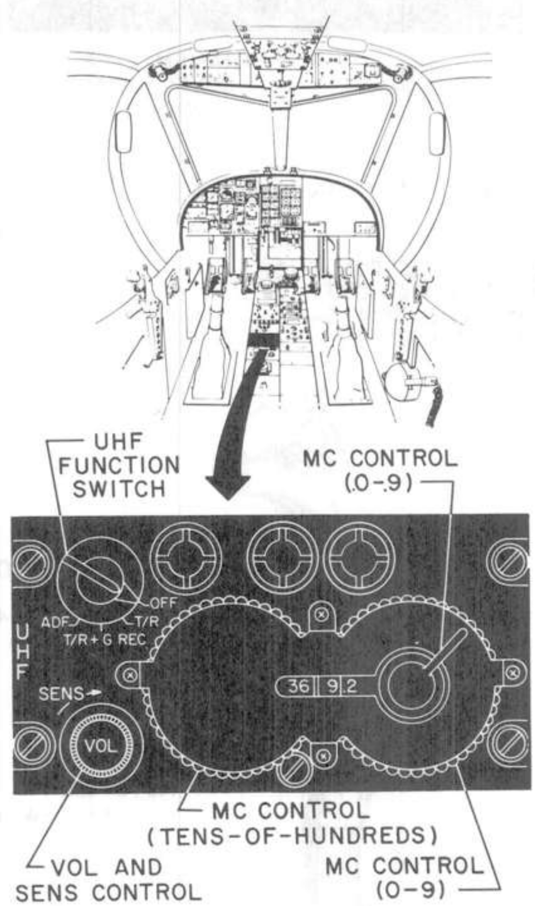


Figure 2-5. UHF Control Panel

d. For UHF transmission, set Receivers 2 Switch to ON, set Transmitter Selector Switch to "2", and depress pilot's RADIO-ICS button to RADIO or depress observer's RADIO Foot-Switch.

e. To select an operating frequency, set Manual Frequency Controls on UHF control panel as desired.

f. To provide a constant monitoring facility, set Function Switch on UHF control panel to T/R+G REC and operate equipment as described in steps c. through e. above. (Any communication received on the guard frequency will be heard in the headset.)

g. To transmit on the guard frequency, set Function Switch to T/R or T/R+G REC. Then proceed as in step d. above.

h. To turn off the UHF command set, place the Function Switch to OFF.

2-14. FM LIAISON SET - AN/ARC-44.

2-15. GENERAL. The FM set is a liaison line-of-sight receiver-transmitter operating in the frequency range of 24.0 to 51.9 mc, providing two-way communication to ground stations or other aircraft. Power is applied to the FM liaison set through the FM circuit breaker (Chapter 2, Section II, figure 2-16). Controls for the FM liaison set are located on the FM control panel (figure 2-6). Audio for FM transmission and audio obtained from FM reception are controlled and distributed by the ICS. A squelch control switch is incorporated on [30] aircraft (see paragraph 2-17).

2-16. FM CONTROL PANEL. The FM control panel (figure 2-6) contains the FM receiver-transmitter Frequency Selectors, Power Switch, and receiver Volume Control. All controls are located on the front panel. The FM control panel provides a choice of remote or local operation, but remote operation is not used in this installation.

2-17. FM SQUELCH CONTROL (AO-1C SERIAL NO. 61-2702 THRU 61-2728). The FM squelch control switch (see figure 2-7) is used to deenergize the FM squelch circuit to allow weak signals to be received. It is normally left in the ON position. On all other aircraft, the squelch circuit is always energized to filter out undesirable noise.

2-18. OPERATION OF FM LIAISON SET.

a. Check that the FM circuit breaker is depressed.

b. Set the Power ON-OFF Switch on the FM control panel to ON and allow a warmup interval of at least 1 minute.

c. For Fm reception, proceed as follows:

(1) On the INT control panel, set Receivers 1 Switch to ON.

(2) On FM control panel, rotate the Frequency Selectors to the desired frequency as indicated in FREQ window.

(3) Rotate the Volume Control on FM control panel approximately one-half turn clockwise.

(4) On [30] aircraft, set FM Squelch Control Switch as required.

CAUTION

Do not set REM-LOCAL Switch to REM, as the receiver-transmitter unit will not operate properly with the associated equipment.

d. For FM transmission, proceed as follows:

(1) Select operating frequency (c. (2) above) and set Transmitter Selector Switch on INT control panel to "1".

(2) Depress the pilot's RADIO-ICS Button to RADIO, or depress the observer's RADIO Foot-Switch.

e. To turn off the FM liaison set, place the Power ON-OFF Switch to OFF.

2-19. VHF COMMAND SET - AN/ARC-73.

2-20. GENERAL. The VHF command set is a VHF communications set with a frequency range of 116.0 to 149.95 mc. Reception frequency extends to 151.95 mc. The VHF command set replaces the UHF command set (AN/ARC-55B) when the aircraft is operating in Europe. Radio Transmitter T-366A/ARC is used as an emergency transmitter should the AN/ARC-73 malfunction in flight. Power for the VHF command set is applied through the VHF RCVR and VHF XMTR circuit breakers (Chapter 2, Section II, figure 2-16). Controls for the VHF command set are located on the VHF COMM receiver and transmitter control panels (figure 2-8). Audio for VHF transmission and audio obtained from VHF reception are controlled and distributed by the ICS.

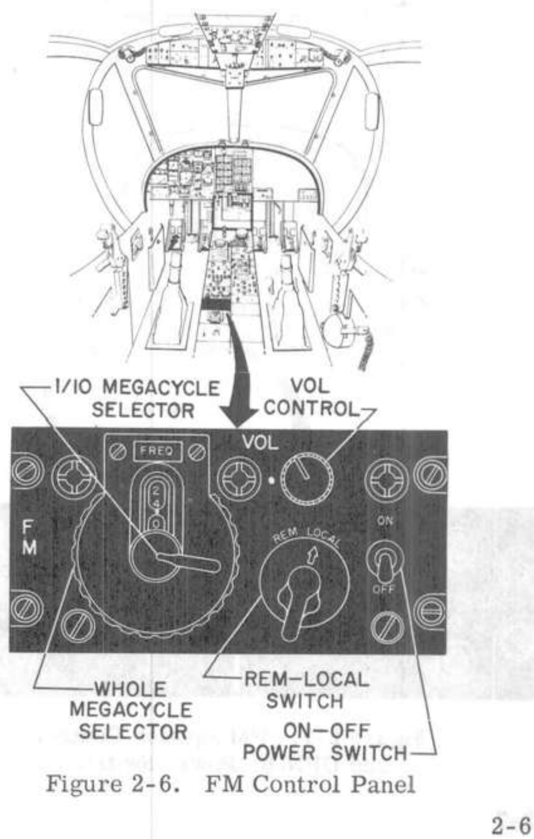


Figure 2-6. FM Control Panel

On [28] aircraft only, the transmitter and receiver are controlled from one control panel (lower panel in figure 2-8).

2-21. VHF COMM RECEIVER CONTROL PANEL. The VHF COMM receiver control panel (forward control panel) (figure 2-8) controls system power and adjusts squelch and volume levels. Receiver frequency is selected and indicated on the receiver control panel. The SCS-DCS/DCD Switch serves no function on this aircraft.

2-22. VHF COMM TRANSMITTER CONTROL PANEL. The VHF COMM transmitter control panel (aft control panel) (figure 2-8) controls the frequency selection for the transmitter. All other controls on the panel are not used.

2-23. OPERATION OF VHF COMMAND SET.

NOTE

The ON-OFF Switch on the EMER XMTR control panel can be in the ON or OFF position as long as the Frequency Selector Switch is in the ARC-73 position.

a. Check that the VHF RCVR, VHF XMTR, and EMER VHF circuit breakers are depressed.

b. Set Power Switch on Receiver control panel to ON.

c. Allow the set to warm up for 15 minutes.

d. Set Squelch Control on the receiver control panel fully clockwise.

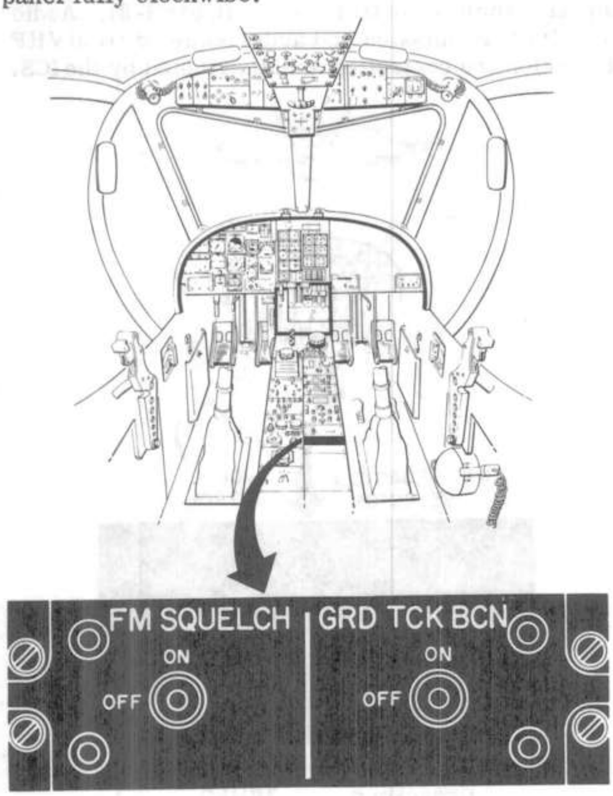


Figure 2-7. FM Squelch Control and DPN-62 Power Switch

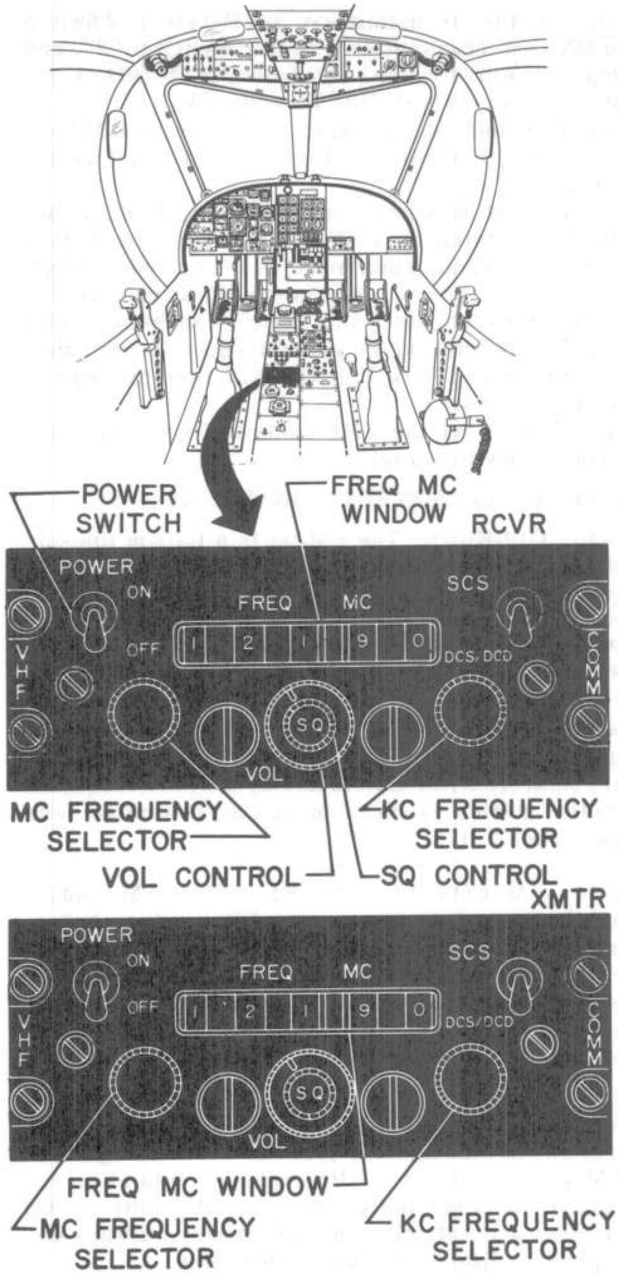


Figure 2-8. VHF COMM Control Panels

e. Set Receivers 3 Switch on INT control panel to ON and set Transmitter Selector Switch to "3".

f. Set up desired frequency on transmitter and receiver control panels.

g. Adjust Squelch Control so that it just opens the receiver to received signals.

NOTE

The SCS-DCS/DCD Switches on both control panels are not electrically connected, but the system functions in the Single-Channel-Simplex (SCS) mode.

h. Pilot - depress RADIO-ICS Button to RADIO to transmit. Observer - depress RADIO Foot-Switch to transmit.

NOTE

When the transmitter is keyed, reception is not possible.

i. To turn off VHF command set, place the Power Switch on the receiver control panel to OFF and set the Squelch Control fully counterclockwise.

2-24. EMERGENCY TRANSMITTER SET - T-366 A/ARC.

2-25. GENERAL. The emergency transmitter set is a VHF transmitter used with an associated receiver AN/ARN-30 (VOR #1) to provide a complete two-way communications system. The transmitter permits VHF transmission on five crystal-controlled channels in the frequency range of 116.0 to 132.0 mc. When the aircraft is operating in Europe (USAREUR), the transmitter is used as an emergency substitute transmitter for the AN/ARC-73. Power is applied to the emergency transmitter set through the EMER VHF circuit breaker (Chapter 2, Section II, figure 2-16). Controls for the emergency transmitter set are located on the EMER XMTR control panel (figure 2-9).

2-26. EMER XMTR CONTROL PANEL. The EMER XMTR control panel (figure 2-9) controls system power and selects one of five frequencies to be used for emergency transmission.

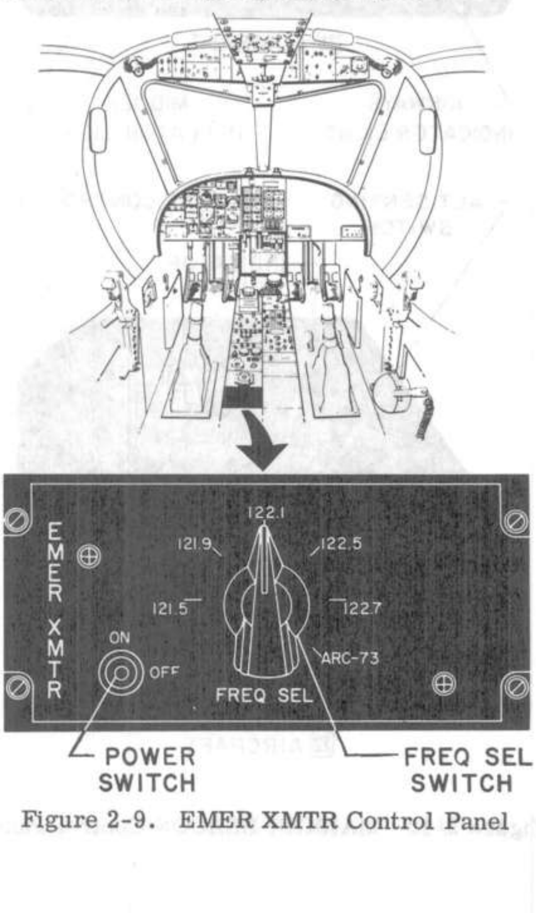


Figure 2-9. EMER XMTR Control Panel

2-27. OPERATION OF EMERGENCY TRANSMITTER SET.

a. Check that the EMER VHF and VOR #1 circuit breakers are depressed.

b. Deenergize the following navigational receivers:

(1) VOR #2 (if installed).
(2) Marker beacon set.
(3) ADF #1 and ADF #2 (if installed).

NOTE

Since all navigational signals are monitored through the Receivers NAV Switch, the above step must be accomplished to avoid interference from signals received by the navigational receivers.

c. Set Receivers NAV Switch on INT control panel to ON and set Transmitter Selector Switch to "3".

d. Set Power ON-OFF Switch on EMER XMTR panel to ON.

e. Set VOL-OFF Switch on aft VHF NAV control panel in midposition and allow at least 90 seconds for warmup.

f. Set Frequency Selector Switch in EMER XMTR control panel to desired frequency.

NOTE

With the Power Switch ON, and the Frequency Selector Switch in the ARC-73 position, the VHF set can be energized.

NOTE

Steps g. and h. below pertain to the ARN-30A receiver only, since tuning is accomplished automatically with the ARN-30D and ARN-30E receivers.

g. On aft VHF NAV control panel, depress PRESS TO WHISTLE Switch and rotate crank to the selected transmitter frequency.

NOTE

Rock the tuning crank for complete resonance. When receiver is in resonance with selected transmitter frequency, a 1000-cps signal will be heard.

h. Release PRESS TO WHISTLE Switch without disturbing the tuning crank.

i. Pilot - depress RADIO-ICS Button to RADIO to transmit. Observer - depress RADIO Foot-Switch to transmit.

NOTE

Release RADIO-ICS Button and RADIO Foot-Switch to receive.

j. To turn off emergency transmitter set, place the Power ON-OFF Switch to OFF and turn Volume Control on aft VHF NAV control panel to OFF.

2-28. NAVIGATIONAL EQUIPMENT

2-29. MARKER BEACON SET - AN/ARN-68 OR R-1041/ARN.

2-30. GENERAL. The marker beacon set is an airborne radio navigational aid. It receives signals transmitted by a 75-mc ground beacon transmitter and produces audible and visual indications of the signal for the pilot. Three indicator lights (on the AN/ARN-68) are used to provide visual indications, and the audio tone output is heard through the ICS. The R-1041/ARN incorporates only one indicator light. Power for the marker beacon set is applied through the MARKER BEACON circuit breaker (Chapter 2, Section II, figure 2-16). Controls for the marker beacon set are located on the MARKER BEACON control panel (figure 2-10).

2-31. MARKER BEACON CONTROL PANEL. The MARKER BEACON control panel (figure 2-10) has a VOL-OFF Control, Altitude Sensing Switch, and three indicator lights (AN/ARN-68) or one indicator light (R-1041/ARN).

2-32. OPERATION OF MARKER BEACON SET.

NOTE

The following operating procedure is based on the AN/ARN-68. The same procedures apply to the R-1041/ARN, except that only one light is incorporated on the MARKER BEACON control panel. This light serves the same function as the three indicator lights used with the AN/ARN-68. In this case, however, discrimination of marker types must be made by means of the distinctive codes alone (light, blinking and audio tone) rather than by illumination of different indicator lights.

a. Check that the MARKER BEACON circuit breaker is depressed.

b. Rotate the VOL-OFF Control on the MARKER BEACON control panel clockwise.

c. Set the Receivers NAV Switch on the INT control panel to ON (up).

NOTE

The length of time during which visual and audible indications are obtained while approaching, passing over, and leaving a marker beacon station depends on the altitude and speed of the aircraft, the type of beacon transmitter, and the sensitivity of the receiver, as described below.

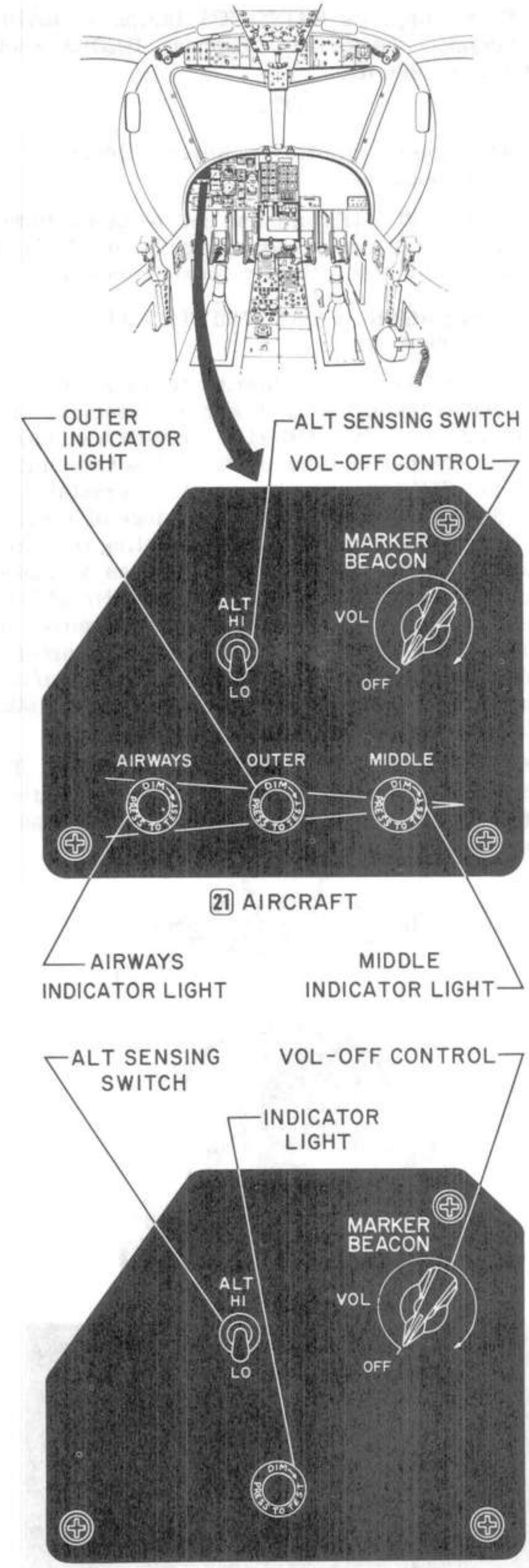


Figure 2-10. MARKER BEACON Control Panel

d. Airways Fan-Type Marker. When the aircraft enters the field of an airways marker beacon, the AIRWAYS indicator light (white) will flash and an interrupted 3000-cycle audible tone will be heard in the headset. As the aircraft approaches the marker beacon station, proceed as follows:

(1) Adjust the VOL-OFF Control on the MARKER BEACON control panel to a comfortable audio level.

(2) Observe the flashing AIRWAYS indicator light (white) and determine the code by which the lamp is keyed. This code may also be determined by listening to the audio signal.

(3) Determine the location of the aircraft in relation to the radio range station.

(4) As the audio signal increases in strength, set the Altitude Sensing Switch on the MARKER BEACON control panel to LO. Readjust the VOL-OFF Control as necessary.

NOTE

This insures a sharp audio indication for accurate determination of the position of the radio range station.

e. Airways Z-Type Marker. As the aircraft enters the field of a Z-type marker beacon, the AIRWAYS indicator light will glow steadily and a constant 3000-cycle tone will be heard in the headset. As the aircraft approaches the marker beacon station, proceed as follows:

(1) Adjust VOL-OFF Control on the MARKER BEACON control panel to obtain a comfortable audio level.

NOTE

As the aircraft approaches the radio range station, the audio signal increases in volume and attains its maximum volume when the aircraft is directly over the station.

(2) Readjust the VOL-OFF Control to maintain a comfortable audio level.

(3) As the audio signal increases in strength, place the Altitude Sensing Switch on the MARKER BEACON control panel to LO. Readjust VOL-OFF Control as necessary.

NOTE

This insures a sharp audio indication for accurate determination of the position of the radio range station.

f. ILS Outer Fan-Type Marker. As the aircraft enters the field of an outer fan-type marker, the OUTER indicator light (blue) glows and a 400-cycle tone is heard in the headset. The light and audio signal are keyed simultaneously at a rate of two dashes per second. As the aircraft approaches the marker beacon station, perform the operating procedure in e. above.

g. ILS Middle Fan-Type Marker. As the aircraft enters the field of the middle fan-type marker of an ILS system, the MIDDLE indicator light (amber) glows and a 1300-cycle tone will be heard in the headset. The light and audio tone are keyed simultaneously with alternate dots and dashes. As the aircraft approaches the marker beacon station, perform the operating procedures in e. above.

h. To turn off the marker beacon set, set Altitude Sensing Switch to HI and VOL-OFF Control to OFF. Set Receivers NAV Switch on INT control panel to the off (down) position.

2-33. RMI - ID-250A/ARN.

2-34. The radio magnetic indicator (RMI) (figure 2-11) consists of a rotating compass card, a lubber line, and No. 1 and No. 2 needles. The com-

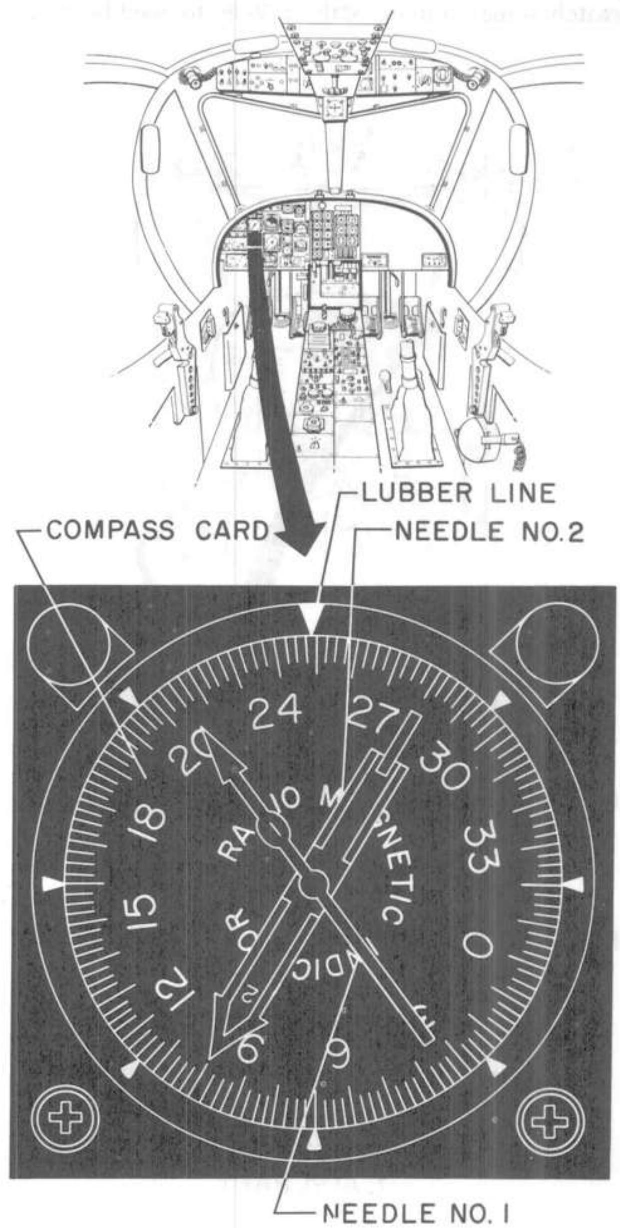


Figure 2-11. RMI

pass card shows the magnetic heading of the aircraft under the lubber line. No. 1 and No. 2 needles indicate magnetic bearing of selected stations. On [1] aircraft, either VOR or ADF can be selected to feed bearing information to needles No. 1 and No. 2 (both needles are electrically tied). On [5] aircraft, VOR #1 or ADF #1 can be selected to feed bearing information to No. 1 needle, and VOR #2 or ADF #2 can be selected to feed bearing information to No. 2 needle.

2-35. VOR-ADF SELECTOR PANEL.

2-36. On [1] aircraft, the VOR-ADF SELECTOR panel (figure 2-12) incorporates one switch. This switch selects either ADF or VOR to feed bearing information to the RMI needles. On [7] aircraft, the VOR-ADF SELECTOR panel (figure 2-12) incorporates three switches. These switches select any combination of ADF and VOR sets (as installed in the aircraft) to feed bearing information to the RMI needles and selects VOR #1 or #2 to feed bearing information to the course indicator (flight system).

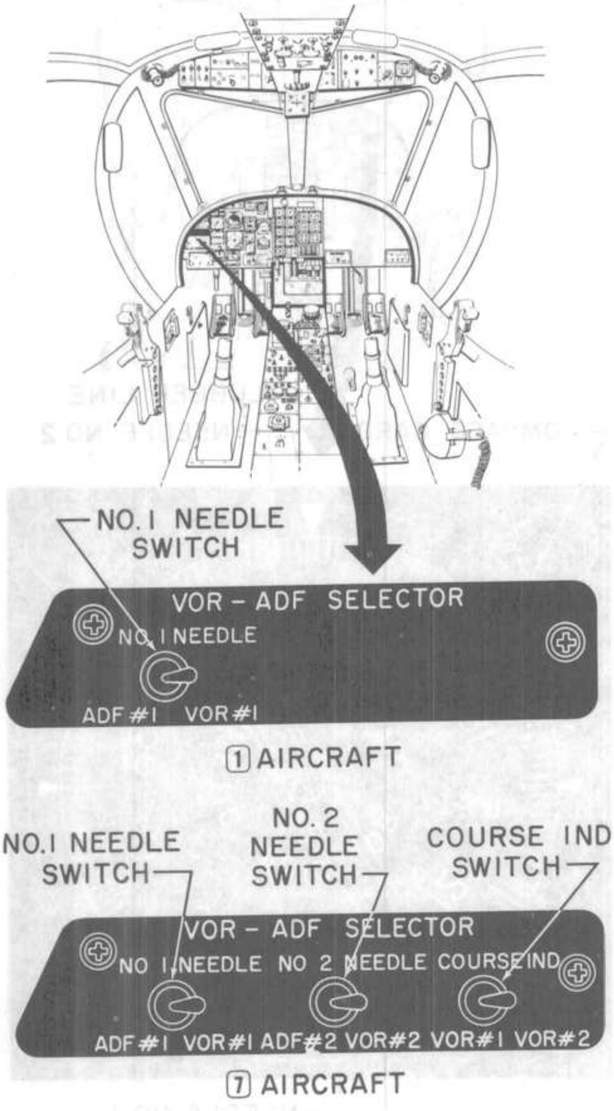


Figure 2-12. VOR-ADF Selector Panel

2-37. ADF SET - AN/ARN-59(V).

2-38. GENERAL. The ADF set is an airborne radiocompass (ADF) system which receives continuous-wave and modulated continuous-wave signals from ground stations to provide both a visual and an audio indication of the aircraft's bearing in relation to the ground station. The frequency range is 190 kc to 1750 kc. The ADF set can also be used for aircraft homing and position fixing. Bearing indications of received signals are displayed visually on the RMI (figure 2-11), and audio indications are monitored through the ICS. On [7] aircraft operating in Europe (USAREUR), two ADF sets are used; the second set replaces the second VOR set (AN/ARN-30A, AN/ARN-30D, or AN/ARN-30E). The VOR-ADF SELECTOR panel (figure 2-12) is used to select the particular ADF set (or VOR set) from which bearing information is supplied to the RMI needles. Power is applied to the ADF set(s) through the ADF circuit breaker(s) Chapter 2, Section II, figure 2-16). Controls for the ADF set(s) are on the ADF REC control panel(s) (figure 2-13).

2-39. ADF REC CONTROL PANEL. The ADF REC control panel (figure 2-13) provides for selection of three frequency bands by means of an MC Band Switch. Each of the three tuning bands is covered by 29 turns of the tuning crank. The loop antenna, sense antenna, or both can be used for receiver operation by setting the Function Switch as desired. Positioning of the loop antenna is controlled by the Loop Switch. On [7] aircraft stateside, the ADF REC control panel for ADF #2 replaces the VHF NAV control panel for VOR #2 and a blank panel.

2-40. OPERATION OF ADF SET.

a. Check that the CARD, NEEDLES, ADF, and ICS circuit breakers are depressed.

b. Rotate the VOL-OFF Control on the ADF REC control panel clockwise.

c. To check for tuning station identification and bearing, proceed as follows:

(1) Set Receivers NAV Switch on INT control panel to ON (up).

(2) Set Function Switch on ADF REC control panel to COMP.

(3) Set MC Band Switch to desired frequency band.

(4) Using the tuning crank, slowly tune to desired frequency with maximum meter reading.

(5) Monitor audio with headset and rotate VOL-OFF Control on ADF REC control panel for desired audio level.

(6) Check station identification to be sure that the desired station is received. If the signal is too weak for easy identification when the Function Switch is at COMP, set function switch to ANT. (This increases the signal-to-noise ratio and permits a more accurate station identification.)

(7) Return Function Switch to COMP.

(8) On VOR-ADF SELECTOR panel, set No. 1 Needle Switch to ADF #1. If ADF #2 is installed, set No. 2 Needle Switch to ADF #2.

(9) Monitor the RMI for bearing of the received station. The relative bearing of the received station is read as the angle between the lubber line and the respective needle.

NOTE

On [1] aircraft, needles 1 and 2 are electrically tied to travel together.

d. To ascertain that the relative bearing obtained on the indicator is accurate, move Loop Switch on ADF REC control panel to the right; the ADF needles on the RMI should rotate clockwise. After the needles have traveled 10° to 20°, release Loop Switch. If operation is normal and a reliable signal is being received, the needles should immediately return to the original reading. Repeat procedure by moving Loop Switch to the left. The needles should rotate counterclockwise.

e. To check station bearing using loop operation with bfo, proceed as follows:

NOTE

The bfo permits identifying cw transmissions that are frequently used in the 200- to 1700-kc band in areas outside the United States. The bfo is also used as an aid in the determination of aural nulls, with the Function Switch in the Loop position.

(1) Set the BFO Switch on ADF REC control panel to ON.

(2) Set Receivers NAV Switch on INT control panel to ON (up) and monitor audio with headset.

(3) Set Function Switch on ADF REC control panel to LOOP.

(4) Tune receiver for a beat signal at the lower frequency end of the zero beat.

(5) Operate the Loop Switch and rotate the loop until zero beat tone drops to a minimum. Read relative bearing of the station on the RMI.

NOTE

The tuning meter is used as the tuning aid when the Function Switch is set to COMP.

f. To turn off the ADF set, rotate VOL-OFF Control on ADF REC control panel fully counterclockwise and set Receivers NAV Switch on INT control panel to the off (down) position.

2-41. MA-1 SYSTEM - MA-1 (Lear).

2-42. GENERAL. The MA-1 system provides a directional-gyro-stabilized azimuth-heading reference with electrical error-signal outputs for servo control of the cards on the RMI and course indicator. This system may be operated as either a slaved or a free gyrocompass. In slaved gyrocompass operation, the gyro is erected to magnetic north field. In free gyrocompass operation, the gyro is again erected to magnetic north; however, reference signals from the earth's magnetic field are not used to maintain the erection. In this case, the gyro must periodically be erected to magnetic north by use of the Set Heading Switch. Power is supplied to the MA-1 system through the MA-1 COMPASS circuit breakers (Chapter 2, Section II, figure 2-16). Controls for the MA-1 system are located on the GYRO COMP control panel (figure 2-14).

2-43. GYRO COMP CONTROL PANEL. The GYRO COMP control panel (figure 2-14) provides for remote operation of the MA-1 system. No provision is made for turning the system on or off; power is applied directly through the MA-1 COMPASS circuit breakers.

2-44. OPERATION OF MA-1 SYSTEM.

a. Check that the MA-1 COMPASS, INST AC, INST DC, and 26 V TRANS circuit breakers are depressed.

b. Perform starting procedure for the flight system (see paragraph 2-54a.).

c. Allow a warmup period of at least 1 minute.

d. For "slaved" operation of the MA-1 system, proceed as follows:

(1) Set SLAVED-FREE Switch on GYRO COMP control panel to SLAVED.

(2) Check position of the pointer of the SYNC IND Meter; if off-center, turn Set Heading Switch as follows:

Pointer Direction	Turn Set Heading Switch To:
"L"	"R"
"R"	"L"

(3) Monitor SYNC IND Meter while the Set Heading Switch is out of its center position and turn the switch to its center position to stop the fast slaving when the meter pointer is centered.

(4) Repeat steps (2) and (3) until pointer of the SYNC IND Meter is centered or very close to centered.

NOTE

Small deviations of the pointer from center will be corrected automatically by normal slaving.

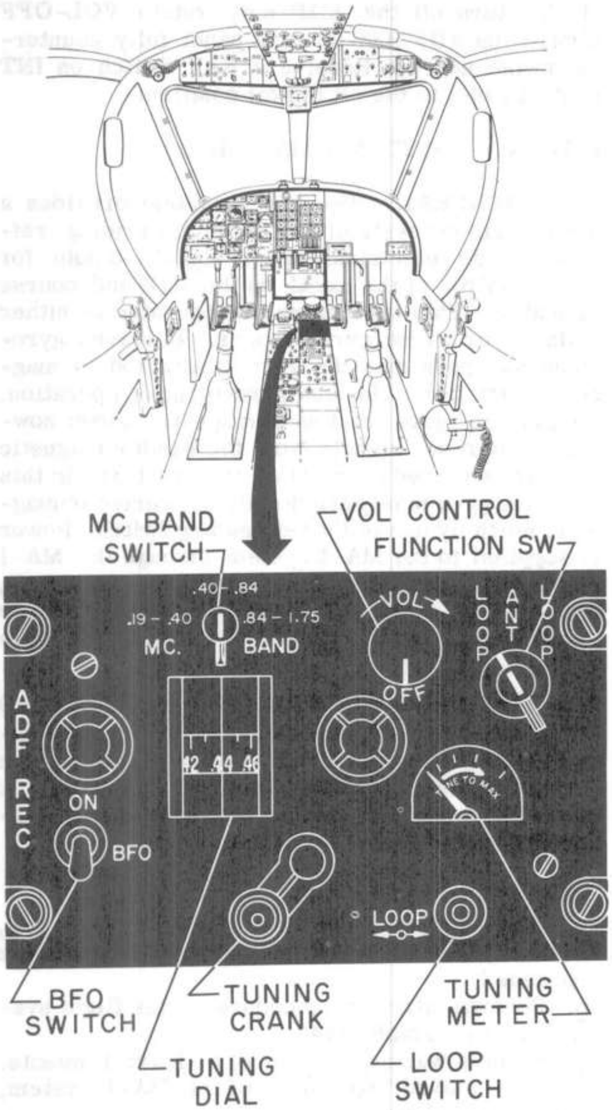


Figure 2-13. ADF REC Control Panel

NOTE

The RMI compass card and course indicator azimuth ring will show approximately the same displacement indicated by the standby compass.

(5) No further procedures are required for straight flight.

NOTE

A series of turns may leave SYNC IND Meter at or near end-scale position. If it is desired to reduce the time required for the synchronization, repeat steps (2) and (3) as required for each turn.

e. For "free" operation of the MA-1 system, proceed as follows:

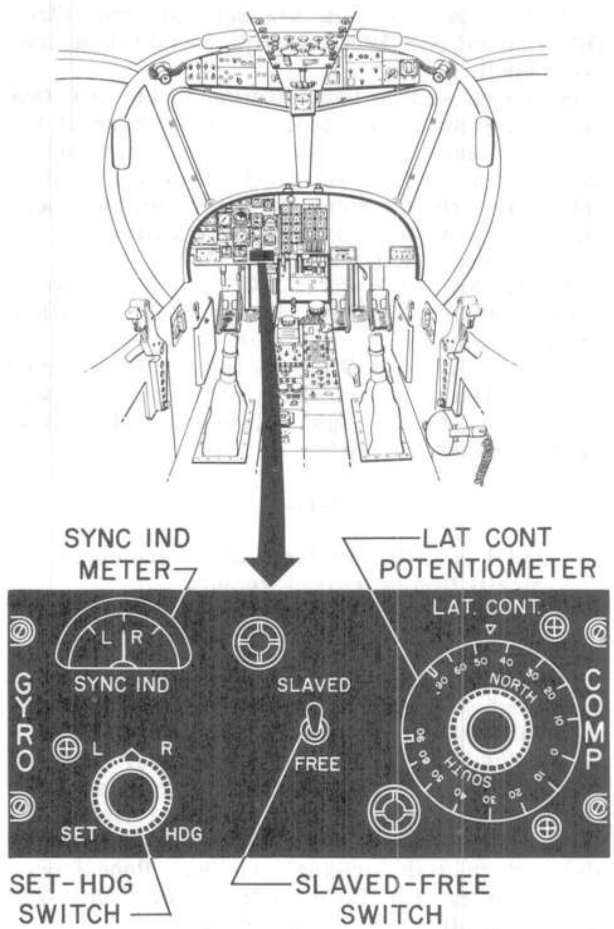


Figure 2-14. Gyro COMP Control Panel

(1) Set Latitude Control Dial on GYRO COMP control panel to the NORTH or SOUTH setting that represents the hemisphere and latitude of the present position of the aircraft.

NOTE

Operation as a free-gyro system requires the initial establishment of a known heading. This may be determined by the use of the RMI in combination with the course indicator. Runway direction may also be used. In flight, the heading may also be determined from the magnetically slaved course if the change in method of operation is made before direction of the earth's magnetic field causes slaved operation to become erratic.

(2) Set SLAVED-FREE Switch to FREE

(3) Check headings indicated on the compass card of the RMI, which is driven by the MA-1 system, and compare headings with known reference.

(4) Refer to the Note following step (1) above. Correct the difference in the two headings by correcting the MA-1 reference heading as follows:

Heading Indicators	Turn Set Heading Switch To:
Left of true heading	"R"
Right of true heading	"L"

(5) Monitor the RMI and course indicator while the Set Heading Switch is out of its center position, and turn the switch to its center position to stop the fast operation when the indicators show correct heading.

(6) Repeat steps (3) through (5) until the required true heading is indicated.

(7) Monitor change in latitude.

(8) For each 5° change in latitude position of the aircraft, readjust the Latitude Control Dial setting to the corresponding new setting.

(9) Repeat steps (7) and (8) throughout flight.

NOTE

After a change in heading (turns), the course indicator and RMI will reflect the heading change. Operation will be normal on the new heading.

NOTE

If abnormal or erratic indications are obtained during magnetically-slaved operation, set SLAVED-FREE Switch to FREE.

f. The MA-1 system is not normally deenergized.

WARNING

Do not pull the INST DC circuit breaker since this will deenergize the wheels and flaps indicator, landing gear handle solenoid, nutcracker switch, and the MA-1 system. This will not affect in-flight and landing operation. However, after landing, place a sign on the landing gear handle to read as follows: "WARNING, DO NOT TOUCH LANDING GEAR HANDLE." (The landing gear handle solenoid and nutcracker switch provide a safety device which prevents retraction of the landing gear when the aircraft is grounded.)

2-45. VOR SET - AN/ARN-30A, AN/ARN-30D OR AN/ARN-30E.

2-46. The VOR set is an airborne navigation-communication radio receiving set with a frequency range of 108.00 to 135 mc (ARN-30A) or 108.00 to 126.90 mc (ARN-30D and ARN-30E). The principal function of the VOR set is to receive and interpret vhf omnidirectional radio range (VOR) and localizer signals. In addition, the VOR set can be used with the emergency transmitter set (T-366A/ARC) to complete a vhf transmitter-receiver communication system. Two VOR sets (VOR #1 and VOR #2) are used for operation stateside. For operation in Europe (USAREUR), only VOR #1 is installed. Only one VOR set is installed on [1] aircraft at all times. Visual indications of the VOR and localizer signals are displayed on the RMI (figure 2-11) and the course indicator (figure 2-17). Audio indications are monitored through the ICS. The VOR-ADF SELECTOR panel (figure 2-12) selects the particular VOR set (or ADF set) from which information is supplied to the RMI needles and the course indicator. Power is applied to the VOR set(s) through the VOR circuit breaker(s) (Chapter 2, Section II, figure 2-16). Controls for the VOR set(s) are on the VHF NAV control panel(s) (figure 2-15 or 2-16).

NOTE

On [28] aircraft, the Glide Slope Receiver is controlled through the VOR #1 control panel.

2-47. VHF NAV CONTROL PANEL (ARN-30A). The VHF NAV control panel (figure 2-15) is an edge-lighted plastic console control unit. Electrical controls and switches on the panel provide for remote operation of the VOR set (remove power control, tuning, volume adjustment, and selection of receiver function). When two VOR sets are used, the forward VHF NAV control panel operates VOR #2.

2-48. VHF NAV CONTROL PANEL (ARN-30D). The VHF NAV control panel (figure 2-16) controls power for the VOR set by a combined on-off and volume control. Three other switches are used to select the desired frequency and to select automatically the type of signal (VOR or localizer). The switches control the grounding and interconnection sequence of ten wires used to form five-wire, open seeking, binary, reentrant switching circuits. These circuits slave the receiver tuning circuits to the setting of the channel selector switch on the VHF NAV control panel. When set to frequencies between 118.00 and 126.90 mc, the switches cause the tuner assembly to activate an audio-equalizing circuit which reduces the high level modulation signals to the level obtained from navigation band audio signals. A Squelch Control is used to set the squelch threshold level. When two VOR sets are used, the forward VHF NAV control panel operates VOR #2.

2-49. OPERATION OF VOR SET.

NOTE

The instructions given below apply equally to either type of VOR set that may be installed (ARN-30A, ARN-30D or ARN-30E), unless otherwise noted. The instructions refer basically to only one VOR set and associated equipment; when two VOR sets are installed, follow the same procedures for operation of either set, unless otherwise noted.

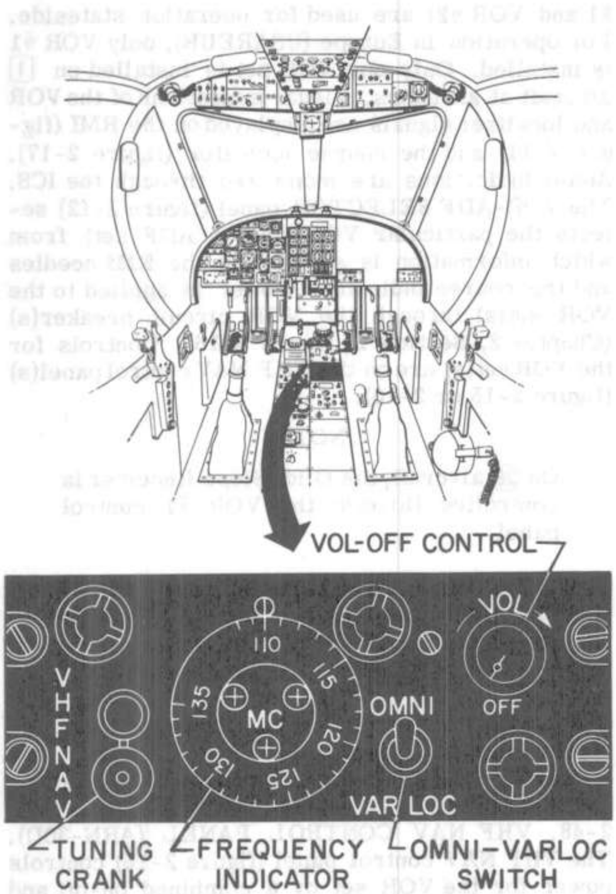


Figure 2-15. VHF NAV Control Panel (ARN-30A)

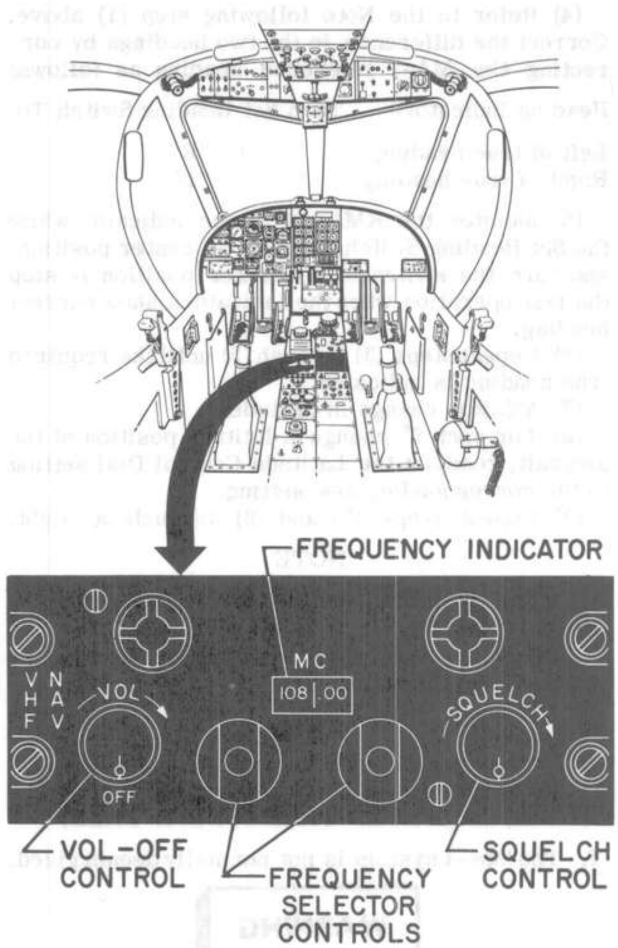


Figure 2-16. VHF NAV Control Panel (ARN-30D and ARN-30E)

a. Check that the ICS, MA-1 COMPASS, VOR, and NEEDLES circuit breakers are depressed.

b. At the VOR-ADF SELECTOR panel, make the following settings:

(1) No. 1 Needle Switch to VOR #1 (if VOR #1 is used to supply bearing information to No. 1 needle of the RMI).

(2) No. 2 Needle Switch to VOR #2 (if VOR #2 is used to supply bearing information to No. 2 Needle of the RMI).

c. At the VHF NAV control panel, turn the VOL-OFF Control clockwise.

d. Allow the equipment to warm up for 90 seconds.

e. On VHF NAV control panel, set the Frequency Indicator to desired VOR frequency.

NOTE

VOR frequencies are even-tenth mc frequencies between 108.2 mc and 112.0 mc.

f. Set Receivers NAV Switch on INT control panel to ON (up) position. Monitor audio with the headphones to identify station. Adjust the ICS Volume control for audible audio level.

g. Monitor the RMI for bearing from the aircraft to the beacon selected.

NOTE

Magnetic heading is indexed on the compass card by the lubber line.

h. Adjust Squelch Control (ARN-30D or ARN-30E) as necessary to eliminate noise.

i. To turn off the VOR set, rotate VOL-OFF Control to OFF and set Receivers NAV Switch on INT control panel to off (down) position.

2-50. FLIGHT SYSTEM - AN/ASN-33.

2-51. GENERAL. The flight system utilizes information supplied by the VOR set (AN/ARN-30A AN/ARN-30D or AN/ARN-30E), the MA-1 system, the glide slope receiver set (AN/ARA-54) when installed and information produced within itself to provide a visual indication of the aircraft's pitch-and-roll attitude, magnetic heading, deviation from selected course, selected VOR and VAR course, lateral displacement from selected course, vertical guidance in ILS, and direction of turn necessary to arrive at a selected course. Operation consists of two modes, designated ILS and HDG. The circuit breakers used in conjunction with this set are called out as FD-105 circuit breakers (Chapter 2, Section II, Figure 2-16). Controls for the flight system are on the course indicator (figure 2-17) and approach horizon indicator (figure 2-18).

2-52. COURSE INDICATOR. The course indicator (figure 2-17) combines compass headings with radio position indications received from other signal electronic navigation equipment to present aircraft bearing information on the face of the instrument. The azimuth ring rotates to reflect aircraft headings indexed on the lubber line. The course bar simulates the selected aircraft course; the course arrow indicates the selected course in respect to the VOR radial or localizer course. The Course Knob at the lower right of the instrument is adjusted by the pilot to indicate the selected course; and deviation from the selected course is shown on the standard five-dot scale by measuring the deflection of the course bar from the central point on

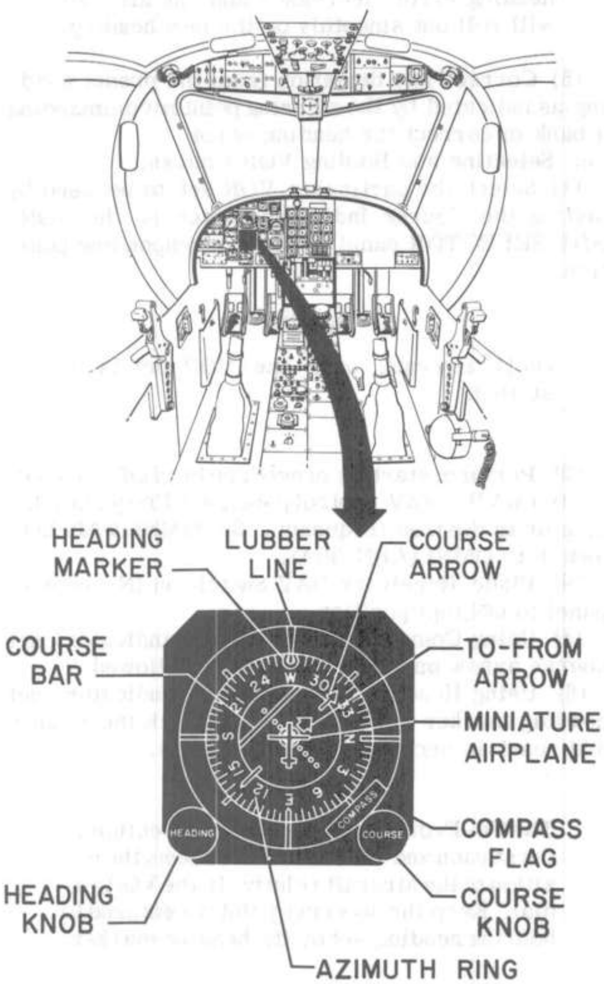


Figure 2-17. Course Indicator

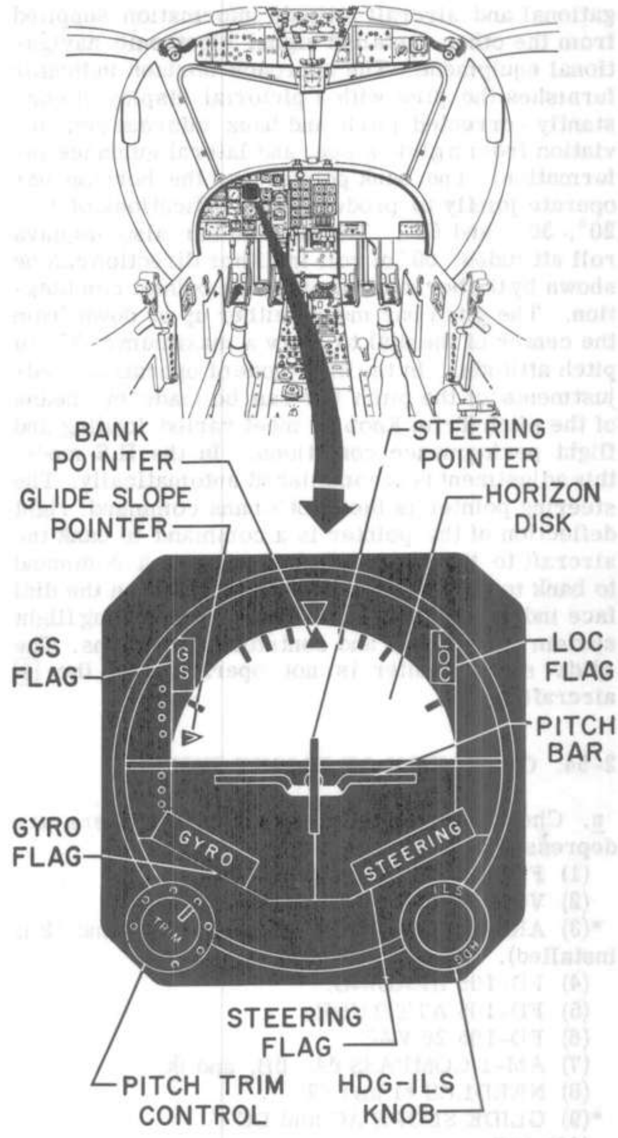


Figure 2-18. Approach Horizon Indicator

the scale. The To-From arrow displays aircraft direction from an omnirange station on the selected radial when referenced with the miniature aircraft. It is not displayed in VAR or localizer operations. The heading marker is adjusted by the Heading Knob, located at the lower left corner of the instrument, and reflects bearing changes in reference to the lubber line. A COMPASS warning flag appears whenever the MA-1 system indicating circuits malfunction. Bearing information is fed from the VOR set, VOR #1 or VOR #2 when installed, as selected on the VOR-ADF SELECTOR panel (figure 2-12).

2-53. APPROACH HORIZON INDICATOR. The approach horizon indicator (figure 2-18) operates with the course indicator to display computer navigational and aircraft attitude information supplied from the other installed signal electronic navigational equipment. The approach horizon indicator furnishes the pilot with a pictorial display of constantly corrected pitch and bank information, deviation from a glide slope, and lateral guidance information. The bank pointer and the horizon bar operate jointly to produce bank indications of 10°, 20°, 30°, and 60°. The horizon bar also displays roll attitudes: 60° of roll in either direction can be shown by the horizon bar and bank pointer combination. The pitch bar moves either up or down from the center of the dial to show a maximum of 85° of pitch attitude. In the HDG mode of operation, adjustments of the pitch bar can be made by means of the pitch Trim Knob to meet varied loading and flight performance conditions. In the ILS mode, this adjustment is accomplished automatically. The steering pointer is the pilot's bank command: right deflection of the pointer is a command to bank the aircraft to the right; left deflection is a command to bank to the left. Four warning flags on the dial face indicate malfunction of the corresponding flight system components and contributing systems. The glide slope pointer is not operative on the [1] aircraft.

2-54. OPERATION OF FLIGHT SYSTEM.

a. Check that the following circuit breakers are depressed:

(1) FD-105 28VDC.
(2) VOR (#1 and #2 if installed)
*(3) ARN-30 COUPLER AC and DC (#1 and #2 if installed).
(4) FD-105 HEADING.
(5) FD-105 ATTITUDE
(6) FD-105 26 VAC
(7) AM-1 COMPASS ØA, ØB, and ØC
(8) NEEDLES #1 and #2
*(9) GLIDE SLOPE AC and DC
(10) ICS

NOTE

Circuit breakers (3) through (10) listed above are red button circuit breakers.

*NOTE

Asterisk denotes breakers installed on [7] aircraft.

b. HDG Mode.

(1) Set HDG-ILS Knob on approach horizon indicator to HDG.

(2) Set Trim Knob on approach horizon indicator to desired attitude as indicated by pitch bar.

(3) With Heading Knob on course indicator, set heading marker to desired magnetic heading.

NOTE

The aircraft heading is indicated by the position of the azimuth ring with respect to the lubber line. The heading marker rides with the azimuth ring as aircraft heading changes. Heading error is indicated by the displacement of the heading marker with respect to the lubber line.

(4) Bank the aircraft toward the steering pointer until the pointer centers.

NOTE

Amount of bank called for by the pointer is limited to a safe bank angle. If the aircraft makes a bank entry steeper than this limit, the steering pointer will move past center on its return and thus advise an easing of bank. When the aircraft is within safe bank limit range of selected heading, the bank angle called for by the steering pointer will decrease gradually as heading error decreases and the aircraft will roll out smoothly on the new heading.

(5) Correct any deviation from the preset heading as indicated by the steering pointer commanding a bank to correct the heading error.

c. Selecting and Holding VOR Course.

(1) Select the particular VOR set to be used by setting the Course Indicator Switch on the VOR-ADF SELECTOR panel to the corresponding position.

NOTE

On [1] aircraft, only one VOR set is installed.

(2) Perform starting procedure for VOR set used.

(3) On VHF NAV control panel, set Frequency Indicator to desired frequency. Set OMNI-VAR LOC Switch to OMNI (ARN-30A).

(4) Place Receivers NAV Switch on INT control panel to ON (up) position.

(5) Using Course Knob of course indicator, set course arrow on VOR course to be followed.

(6) Using Heading Knob of course indicator, set heading marker at heading to approach the course and reset as necessary to hold course.

NOTE

The To-From arrow indicates direction to the station and the course bar shows the position of the aircraft relative to the VOR radial. Keep the steering pointer centered to hold the heading set by the heading marker.

d. Wind Drift in HDG Mode.

(1) Correct for wind drift by offsetting the heading marker upwind from the course arrow.

(2) As the aircraft drifts away from the course bar, adjust the heading marker to the heading which will hold the aircraft on course.

(3) Maintain the heading by keeping the steering pointer centered.

e. ILS Mode.

NOTE

The glide slope receiver set is not installed on [1] aircraft.

(1) Repeat procedure of c. (1) above.

(2) Turn on the glide slope receiver.

(3) Set OMNI-VAR LOC switch on VHF NAV control panel (ARN-30A) to VAR LOC

(4) Set up localizer frequency of runway on VHF NAV control panel and GLIDE SLOPE control panel.

(5) On the ILS final approach, change the HDG-ILS Knob position to ILS after alignment with localizer outside the outer marker, inbound.

(6) Match the pitch bar and glide slope pointer at center of vertical scale to follow glide slope to flareout.

(7) Maintain heading by keeping the steering pointer centered.

NOTE

Wind drift is compensated for automatically. The pitch bar is referenced to the aircraft approach attitude.

NOTE

Crab angle is shown as displacement of the course arrow from the lubber line and is the aircraft's true relation to the runway prior to breakout.

(8) In the event a go-around is necessary, immediately turn the HDG-ILS Knob to HDG and follow normal climb-out and navigation procedures.

NOTE

If there is a published go-around heading, set the heading marker to this heading and keep the steering pointer centered. Manually reset the pitch Trim Knob for climb-out configuration, if desired.

NOTE

The flight system is not normally deenergized; however, the associated equipment (VOR and glide slope) may be turned off.

2-55. FLIGHT SYSTEM MODE MALFUNCTION.

a. If the COMPASS flag shows, the MA-1 system is not working properly. All heading indications and steering pointer deflections should be disregarded.

b. If the GYRO flag shows, the attitude system is not operating properly. All attitude indications should be disregarded.

c. If the STEERING flag shows, the steering computer has no power applied to it. The steering pointer deflections should be disregarded.

d. If there is no signal from the VOR set, the LOC warning flag will show. Set the HDG-ILS Knob to HDG and fly the aircraft independently of the course bar.

e. If there is no signal from the glide slope receiver, the GS warning flag will show. Fly the aircraft independently of the glide slope pointer.

2-56. GLIDE SLOPE RECEIVER SET - AN/ARA-54.

2-57. GENERAL. The glide slope receiver set is a 20-channel, fixed-frequency receiver designed to receive 90/150-cps tone-modulated glide slope information to produce vertical guidance during aircraft ILS operations. The operating frequency range is 329.3 to 335.0 mc. The glide slope pointer is on the approach horizon indicator. Vertical guidance during an ILS landing can be accomplished automatically through the autopilot. In the glide slope portion of the ILS pattern, a 150-cps tone-modulated carrier frequency is radiated in the area below the path of the glide slope and a 90-cps tone-modulated carrier of the same frequency is radiated in the area above the glide slope. When the receiver is tuned to the carrier frequency of the glide slope transmitter, the 90- and 150-cps tone signals are detected, amplified, separated by a filter, and rectified into proportional dc potentials. These dc potentials are governed by the position of the aircraft with respect to the glide slope. When the 90-cps tone proportional dc voltage predominates, the glide slope pointer on the approach horizon indicator will indicate a downward deflection. The pointer will remain in its normal rest position when the dc voltages proportional to the 90- and 150-cps signals are equal, indicating that the aircraft is on the glide slope. Circuitry is also included to operate the glide slope (GS) flag alarm on the approach horizon indicator to indicate weak or faulty information. Power is applied to the glide slope receiver set through the GLIDE SLOPE circuit breakers (Chapter 2, Section II, figure 2-16). Controls for the glide slope receiver set are on the GLIDE SLOPE control panel (figure 2-19).

NOTE

On [28] aircraft, the Glide Slope Receiver is controlled by the VOR #1 control panel. There is no GLIDE SLOPE control panel on these aircraft.

2-58. GLIDE SLOPE CONTROL PANEL. The GLIDE SLOPE control panel (figure 2-19) incorporates a concentric knob type Frequency Selector calibrated directly in frequency. The glide slope receiver channel is set up automatically when the corresponding localizer channel frequency is selected on the GLIDE SLOPE control panel.

2-59. OPERATION OF GLIDE SLOPE RECEIVER SET. The glide slope receiver set is an associate receiver used with the flight system and/or the autopilot. The procedures included in this paragraph cover only turning on and turning off the glide

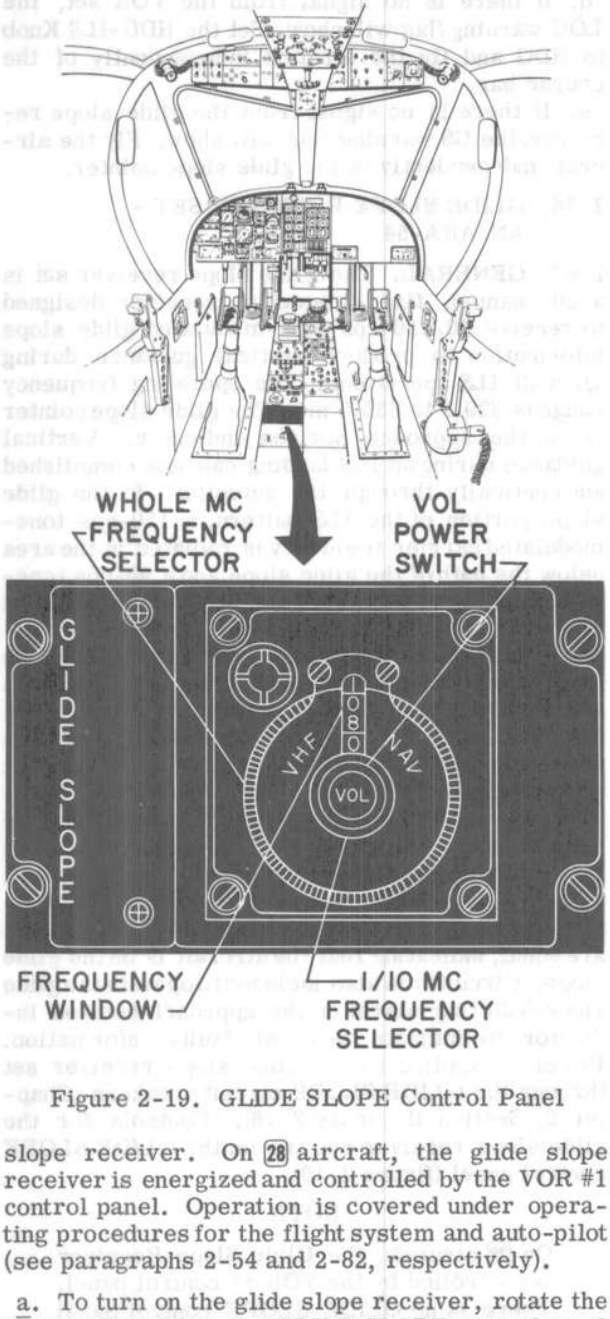


Figure 2-19. GLIDE SLOPE Control Panel

slope receiver. On [28] aircraft, the glide slope receiver is energized and controlled by the VOR #1 control panel. Operation is covered under operating procedures for the flight system and auto-pilot (see paragraphs 2-54 and 2-82, respectively).

a. To turn on the glide slope receiver, rotate the Volume Control on the GLIDE SLOPE control panel clockwise and allow set to warm up.

b. To turn off the glide slope receiver, rotate the Volume Control on the GLIDE SLOPE control panel fully counterclockwise.

NOTE

The GS alarm flag on the approach horizon indicator will appear.

2-60. DOPPLER SYSTEM - AN/APN-129(V)1.

2-61. GENERAL. The doppler system is an airborne groundspeed and drift-angle computer and display system. The operating frequency is 13.5 kmc. The doppler system uses continuous wave doppler radar to automatically and continuously provide the pilot with a visual indication of aircraft groundspeed in knots, and drift angle in degrees, without the aid of ground stations, wind estimates, or true airspeed data. The drift angle and groundspeed information is also fed to the surveillance equipment controlled by the observer. The transmitter radiates two beams, port and starboard, both beams having an angular width of 4°, an outward projection of 11°, and a downward projection of 22° aft of the perpendicular. The antenna system consists of a parabolic reflector with dual antennas for each beam, one antenna for transmitting and the other for receiving. The ground-reflected signals are picked up by the receiving antennas, which are isolated from the transmitting antennas by a dividing wall called a septum. The difference between the transmitter reference signal and the ground-reflected signal (doppler frequency shift) results in a frequency proportional to the aircraft velocity. The difference between the port and starboard frequency shifts indicates the amount of drift. The sense of drift is identified by the beam that registers the lesser frequency change. Visual indications are displayed on the drift angle-groundspeed indicator (figure 2-20), and controls for the doppler system are on the NAV control panel (figure 2-20). Power is distributed to the doppler system through the RADAR APN-129 circuit breakers (Chapter 2, Section II, figure 2-16).

2-62. DRIFT ANGLE-GROUNDSPEED INDICATOR. The drift angle-groundspeed indicator (figure 2-20) determines and displays groundspeed and drift angle right or left of the aircraft heading. An electrically operated red signal flag marked OFF is located at the lower left edge of the dial. The information is also supplied in the form of 400-cps synchro output signals for utilization in the SLAR System.

2-63. NAV CONTROL PANEL. The NAV control panel (figure 2-20) mounts all the operating controls for the doppler system and two panel lights to indicate the mode of operation.

2-64. OPERATION OF DOPPLER SYSTEM.

a. Check that the RADAR APN-129 ØA, ØB, and ØC circuit breakers are depressed.

b. Set PWR-OFF Switch on NAV control panel to PWR and allow set to warm up for 3 minutes.

NOTE

The STBY light will glow as long as the XMTG-STBY switch is in the STBY position and for 3 minutes after the PWR-OFF switch has been placed in the PWR position (unless a malfunction exists in the equipment). When this light extinguishes, it indicates that the 3-minute time delay (after PWR-OFF switch is energized) has operated, the XMTG-STBY switch is in the XMTG position, and the equipment is transmitting normally. The MEMORY light will remain on until set is placed in operation.

c. Set XMTG-STBY Switch on NAV control panel to XMTG.

NOTE

The doppler system is now in operation. Normal system accuracy and output indications will become available at a groundspeed of 50 knots or more.

d. Control Indicator Operation (NAV control panel).

(1) Set the LAND-SEA Switch to compensate for terrain as follows:

Over land - LAND

Over water - SEA

(2) If the MEMORY light goes on during operation, set the XMTG-STBY Switch momentarily to STBY (STBY light goes on) and then to XMTG. If the STBY light does not go out, equipment failure is indicated.

NOTE

The illumination of the MEMORY light indicates a loss of doppler signals. The STBY and MEMORY lights will not go on when normal doppler signals are received.

(3) If the STBY light goes on with the XMTG-STBY Switch in XMTG, set the switch to STBY momentarily and return to XMTG.

NOTE

The illumination of the STBY light indicates that the receiver-transmitter power supply interlock circuit is open. By momentarily holding the XMTG-STBY Switch in STBY, the interlock circuit is reset.

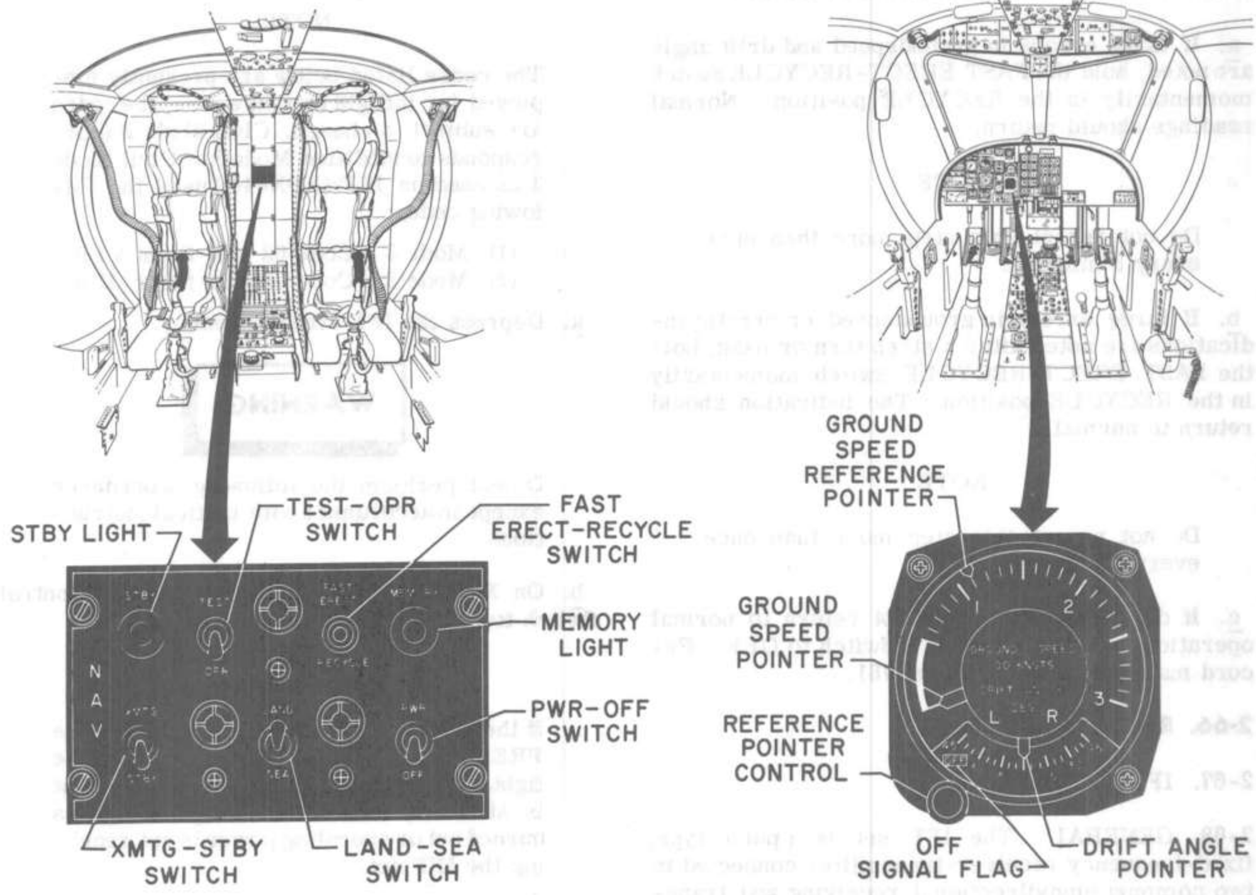


Figure 2-20. NAV Control Panel and Drift Angle-Groundspeed Indicator

e. Drift Angle-Groundspeed Indicator Interpretation.

(1) The drift angle-groundspeed indicator is read within a groundspeed range of 50 to 300 knots and a drift angle range of 0° to 45° left or right of the course.

(2) The drift angle is measured between the aircraft heading and the ground track of the aircraft.

NOTE

When the drift angle pointer indicates zero (track and heading coincide), a headwind, tailwind, or zero wind exists.

(3) Using the reference pointer control, position the groundspeed reference pointer to the desired groundspeed to aid in monitoring the groundspeed.

f. To turn off the doppler system, perform the following steps:

(1) Set XMTG-STBY Switch on NAV control panel to STBY.

(2) Set LAND-SEA Switch to LAND.

(3) Set PWR-OFF Switch to OFF.

(4) Pull the RADAR APN-129 ØA, ØB, and ØC circuit breakers.

2-65. DOPPLER SYSTEM MALFUNCTION.

a. If large errors in groundspeed and drift angle are noted, hold the FAST ERECT-RECYCLE Switch momentarily in the RECYCLE position. Normal readings should return.

NOTE

Do not repeat this step more than once every 3 minutes.

b. If large errors in groundspeed or erratic indications are noted after a steep turn or bank, hold the FAST ERECT-RECYCLE Switch momentarily in the RECYCLE position. The indication should return to normal.

NOTE

Do not repeat this step more than once every 15 minutes.

c. If doppler system does not return to normal operation, set the PWR-OFF Switch to OFF. Record malfunction in DD Form 781.

2-66. RADAR EQUIPMENT.

2-67. IFF - AN/APX-44.

2-68. GENERAL. The IFF set is a pulse-type, fixed-frequency receiver-transmitter connected to two common omnidirectional receiving and transmitting antennas. The IFF set operates in conjunction with ground-based identification-friend-or foe equipment and identifies the aircraft at all of the ground-based radar stations and sites that are equipped with IFF interrogator-responders. The equipment receives 1090-mc interrogation pulses from the ground-based equipment and automatically transmits a 1130-mc specially coded reply signal to the ground station. The type of reply and code combinations that are transmitted are determined by the characteristics of the interrogation and the settings on the XPDR control panel. Specially coded emergency signals or position identification signals can be transmitted without interrogations. Power for the IFF set is supplied through the IFF circuit breaker (Chapter 2, Section II, figure 2-16). Controls for the IFF set are on the XPDR control panel (figure 2-21).

2-69. XPDR CONTROL PANEL. The XPDR control panel (figure 2-21) consists of a U-shaped chassis and plastic front panel on which are mounted all the controls required to operate the IFF set. Power and control lines are connected to the control panel through a multipin connector on the rear of the chassis. Four Dzus fasteners secure the control panel to the center overhead console.

2-70. OPERATION OF IFF SET.

NOTE

The codes listed below are presently employed for inflight use; however, the codes are subject to change. Civil Mode A (corresponds to modified Mode 3 or Civil Mode 3 as used on IFF (APX-44)) uses the following codes:

(1) Mode 3 - Code 62 - In-flight VFR
(2) Mode 3 - Code 02 - In-flight IFR

a. Depress the IFF circuit breaker.

WARNING

Do not perform the following procedures except in accordance with tactical instructions.

b. On XPDR control panel, set Master Control Switch to STBY. The pilot light will go on.

NOTE

If the pilot light does not go on, press the PRESS TO TEST assembly covering the light. The light must go on. If the light is still out, then either the pilot light is burned out or operating power is not reaching the IFF set.

c. Rotate the PRESS-TO-TEST assembly for the desired brightness.

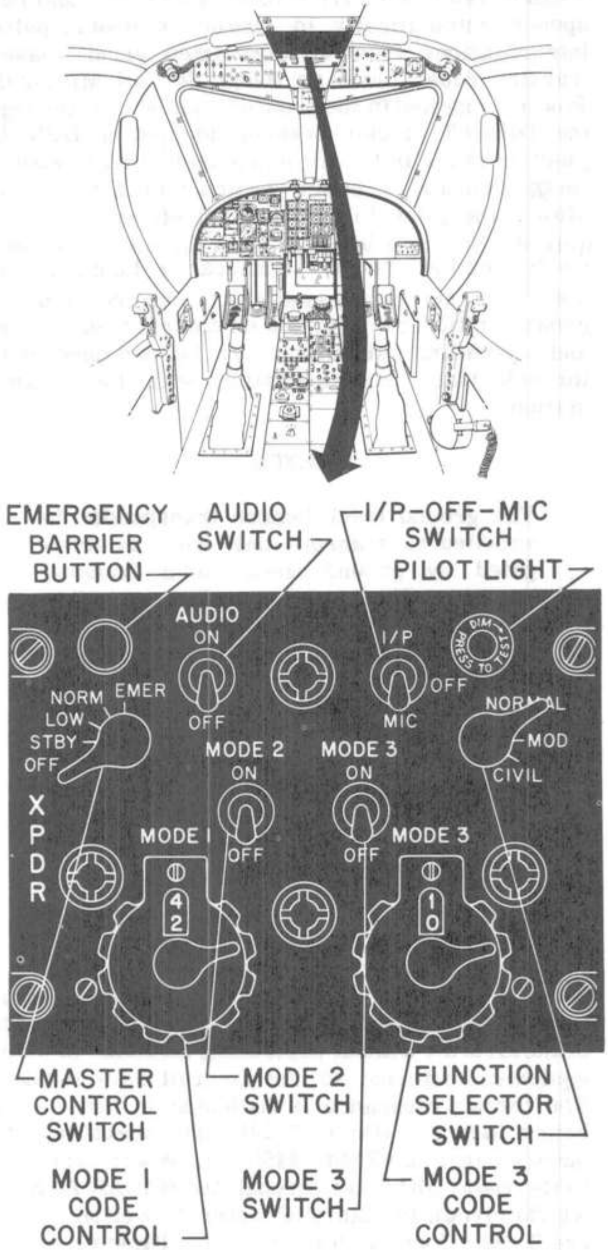


Figure 2-21. XPDR Control Panel

d. Allow the set to warm up for several minutes.

e. Normal Operation.

NOTE

The IFF set always accepts and answers Mode 1 interrogations regardless of the positions of the Mode 2 and Mode 3 Switches. All modes of operation are independent of each other and any combination of the three is possible.

(1) For normal mode 1 operation, set controls as follows:

(a) Function Selector Switch - NORMAL.
(b) Master Control Switch - LOW or NORM.
(c) I/P-OFF-MIC Switch - see step h.
(d) Audio Switch - see step i.
(e) Mode 2 Switch - OFF.
(f) Mode 3 Switch - OFF.

(2) For combined mode operation, set controls as described in step e. (1) above, and as follows:

Mode Combination Desired	Mode 2 Switch	Mode 3 Switch
1 and 2	ON	OFF
1 and 3	OFF	ON
1, 2, and 3	ON	ON

f. Modified (SIF) Operation.

(1) For Mode 1 operation, set controls as follows:

(a) Function Selector Switch - MOD
(b) Master Control Switch - LOW or NORM.
(c) I/P-OFF-MIC Switch - see step h.
(d) Audio Switch - see step i.

(2) For combined mode operation, set controls as described in step e. (1) above, and as follows:

g. Civil Operation.

(1) For combined Civil and Military Mode 1 operation, set controls as follows:

(a) Function Selector Switch - CIVIL.
(b) Mode 3 Code Control - assign 2-digit code.
(c) Mode 3 Switch - ON.
(d) Mode 1 Code Control - assign 2-digit code.
(e) Master Control Switch - LOW or NORM.
(f) I/P-OFF-MIC Switch - see step h.
(g) Audio Switch - see step i.
(h) Mode 2 Switch - OFF.

Mode Combination Desired	Mode 2 Switch	Mode 3 Switch	Mode 1 Code Control	Mode 3 Code Control
1 and 2	ON	OFF	*	"00"
1 and 3	OFF	ON	*	*
1, 2, and 3	ON	ON	*	*
*NOTE: The asterisk indicates: "set 2-digit code".				

(2) For combined Civil and Military Mode 1 and 2 operation, set controls as described in steps (1)(a) through (1)(h) above, and set Mode 2 Switch to ON.

h. I/P Operation. Aircraft position identification can be accomplished without being interrogated by a ground-based IFF system. This type of operation is initiated by the pilot upon receipt of request through communication or upon arrival at pre-established points. The IFF set will transmit position identifying signals when either of the following two procedures is used:

(1) To transmit position identifying signals, momentarily hold the I/P-OFF-MIC Switch in the I/P position. On completion, release the switch.

(2) Set the I/P-OFF-MIC Switch to MIC and depress the RADIO-ICS Button on pilot's stick grip to RADIO. The IFF set is now transmitting position identifying signals. Release RADIO-ICS Button on completion and set the I/P-OFF-MIC Switch to OFF.

i. Monitoring Relay Pulses. Monitor relay pulses transmitted by IFF set as follows:

(1) Set the Audio Switch to ON.

NOTE

Transmitted reply pulses, following interrogation, will be audible in the headset.

(2) Immediately following completion of monitoring, set Audio Switch to OFF.

j. Aircraft Distress Emergency Operation. During an aircraft emergency or distress condition, the IFF set may be used to transmit specially coded emergency signals. To transmit emergency signals, proceed as follows:

(1) Depress and hold in the Emergency Barrier Button.

(2) Turn the Master Control Switch to EMER.

NOTE

Emergency signals will be transmitted as long as the Master Control Switch is in the EMER position, regardless of whether or not the IFF set is being interrogated by an IFF system.

(3) Release Emergency Barrier Button.

(4) When emergency is over, return Master Control Switch to NORM or LOW.

k. To turn off IFF set proceed as follows:

(1) Set the Audio, I/P-OFF-MIC, Mode 2, and Mode 3 Switches to OFF.

(2) Set the Mode 1 and Mode 3 Code Controls to "00".

(3) Set the Function Selector Switch to NORMAL.

(4) Set the Master Control Switch to OFF.

2-71. GROUND TRACK BEACON - AN/DPN-62(V).

2-72. GENERAL. The ground track beacon is a miniature transponder beacon used as a tracking aid for aircraft. The transponder operates at X-band frequencies from 8500 to 9600 mc, and responds automatically to single- or double-pulse interrogations from an associated ground-based tracking radar (such as Radar Set AN/MPQ-29). Power is applied to the ground track beacon through the DPN-62 circuit breaker located on DPN-62 junction panel in the aft equipment compartment. On 30 aircraft, a power switch (see figure 2-7) allows the pilot to turn the set off or on as required. No other aircraft have the means for de-energizing the ground track beacon during flight. Since the set is automatically triggered from a ground station, the pilot has no control over the set and operation indication may be obtained only through voice communication with the ground station.

NOTE

The ground track beacon transponder is actuated to transmit only when interrogated by ground-based radar tracking systems. The ground crew is responsible for preflight and operational checks with the use of test equipment. Prior to flight, check with the ground crew as to the condition of the DPN-62 circuit breaker. This circuit breaker is inaccessible during flight and must be depressed for beacon operation. On 30 aircraft, the ground track beacon will energize when the DPN-62 Power Switch is ON and the DPN-62 circuit breaker is depressed.

2-73. RADAR ALTIMETER - AN/APN-22.

2-74. GENERAL. The radar altimeter is a microwave altimeter used to measure terrain clearance of the aircraft without protruding antennas or other equipment external to the aircraft skin surface. The terrain clearance is indicated in feet on the height indicator (figure 2-22). The operating frequency range is 4200 to 4400 mc. Power is applied to the radar altimeter through the RADAR APN-22 ALTM circuit breakers (Chapter 2, Section II, figure 2-16). Controls for the radar altimeter are on the height indicator.

2-75. HEIGHT INDICATOR. The height indicator (figure 2-22) is housed in a small case which is mounted on the pilot's instrument panel. A system control switch is incorporated in the height indicator. This control is a single knob that operates the system on-off switch and selects the limit altitude.

2-76. OPERATION OF RADAR ALTIMETER.

NOTE

The radar altimeter is accurate at 0 to 10,000 feet over land and 0 to 20,000 feet over water. The indication degree of accuracy is ±2 feet from 0 to 40 feet and ±5% of the indicated altitude from 40 to 20,000 feet.

NOTE

The radar altimeter can be turned on before or after takeoff.

a. Depress the RADAR APN-22 ALTM AC and DC circuit breakers.
b. On the height indicator, turn the ON-LIMIT Control Switch clockwise to start the equipment.

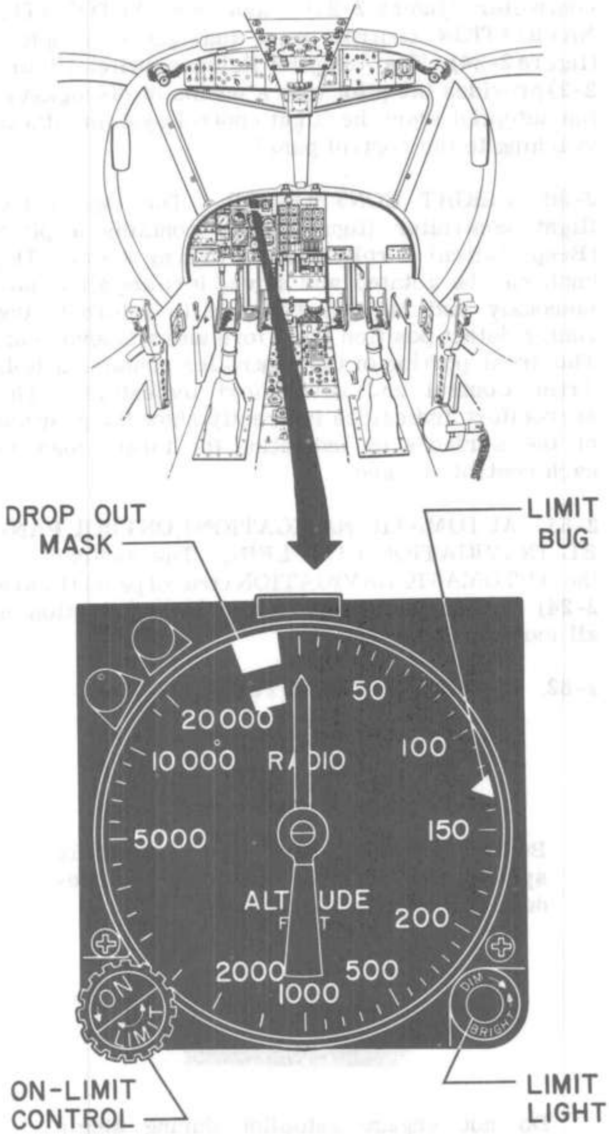


Figure 2-22. Height Indicator

NOTE

The equipment will start operating approximately 3 minutes after the control is turned on, but allow at least 12 minutes warmup to insure final accuracy. If the air temperature is below -40°C, allow 25 minutes warmup.

c. If the aircraft is on the ground, observe that the height indicator pointer moves to some point slightly above zero and fluctuates 2 or 3 feet while taxiing.

NOTE

This condition is normal and accurate readings will be obtained after takeoff.

If the radar altimeter is started in the air, normal operation will commence after the usual warmup provided the aircraft is below the drop-out altitude. See Note after step f. below.

d. Read the terrain-to-aircraft altitude as indicated by the height indicator pointer.
e. To use the altitude limit feature of the radar altimeter, turn the ON-LIMIT Control Switch until the limit bug is adjacent to the desired limit flight altitude.

NOTE

At or below the preset limit altitude, the red limit light will go on. This indicates that the aircraft is at or below the terrain-to-aircraft limit altitude.

f. To fly at a preset altitude, set the limit bug to the desired flight altitude and fly aircraft so that the height indicator pointer lines up with the limit bug. The scale reading need not be considered.

NOTE

Drop-out is caused by weak signals and is recognized when the altitude pointer moves behind the drop-out mask located between 0 and 20,000 on the indicator. Drop-out should not occur at altitudes below 10,000 feet over land or below 20,000 feet over water; however, a climb, bank, or dive of 60° or more will reduce the drop-out altitude.

g. If drop-out occurs, reduce altitude to a point below that at which drop-out occurred or level out from the maneuver that caused drop-out.

NOTE

A period of several seconds (10 seconds maximum) will elapse before system resumes normal operation.

NOTE

If a reduction in drop-out altitude is encountered, there are no corrective actions that can be taken; however, normal use of the equipment can be continued under the drop-out altitude.

h. To turn off the radar altimeter, turn the ON-LIMIT Control Switch fully counterclockwise.

2-77. AUTOPILOT EQUIPMENT.

2-78. AUTOPILOT - AN/ASW-12(V).

2-79. GENERAL. The functions of the autopilot include attitude stabilization, heading stabilization, automatic altitude control, and automatic steering control from the navigation equipment. Selection of preferred attitude or heading can be commanded by the pilot with the use of the flight controller. The autopilot provides operating modes and control features as indicated below:

Pitch attitude	- automatic or command, up to ±35°.
Roll attitude	- automatic or command, up to ±45°.
Heading	- automatic coordinated turns, or command.
Altitude	- automatic (barometric or glide path).
Navigation	- automatic path or enroute automatic control (integrated flight control, VOR, and ILS approach).

a. Signal flow is divided into control channels for the pitch (longitudinal), roll (lateral), and yaw (directional) flight axes. While each control channel is electrically independent of the others on a signal basis, the operation of the roll control channel for command of banked turns is coordinated with the yaw control channel to accomplish coordinated turns.

b. Pitch control is accomplished through the attitude reference control, which differentiates between the attitude selected on the flight controller and the actual attitude as sensed by the vertical gyro. Differences that exist between the selected and actual attitudes are fed to the pitch actuator, which positions the elevators to maintain the selected pitch attitude.

c. Either barometric altitude or glide slope signals (as selected on the navigational coupler) can be sent through the altitude control to the pitch control channel in order to maintain a constant altitude or a control approach.

d. Roll control is accomplished through the attitude reference control, which differentiates between the selected roll attitude (Turn Knob on flight controller) and the actual roll attitude as sensed by the vertical gyro. Differences that exist between the selected roll and actual roll attitudes are fed to the roll actuator, which positions the ailerons to maintain the selected roll attitude. Alternate signals can be introduced into the roll control channel through the navigation coupler to the attitude reference control to maintain a selected path of navigation (VOR, ILS approach, or flight system).

e. The yaw control channel maintains constant heading in level flight and provides turn coordination in banked flight. The MA-1 system is used for heading stabilization. Signals are fed to the attitude reference control where a comparison is made with the reference heading. The difference between the actual and reference headings is fed to the yaw actuator, which positions the rudders to maintain the reference heading.

f. Power for the autopilot is applied through the AUTOPILOT circuit breakers located on the pilot's circuit breaker panel (Chapter 2, Section II, figure 2-16). Controls for the autopilot are on the flight controller (figure 2-23) and the AUTOMATIC NAVIGATION control panel (navigation coupler) (figure 2-24). The Autopilot Release switch (figure 2-2) provides the pilot with a means of disengaging the autopilot from the flight control system without reaching to the control panel.

2-80. FLIGHT CONTROLLER. The top of the flight controller (figure 2-23) contains a pitch (Beep Switch) - roll control (Turn) knob. The knob can be rotated and moved fore and aft simultaneously and is spring-loaded to return to the center detent position from fore and aft movement. The front portion of the controller contains a Roll Trim Control and servoeffort indicators. The servoeffort indicators indirectly show the position of the surfaces by indicating the torque load on each control surface.

2-81. AUTOMATIC NAVIGATION CONTROL PANEL (NAVIGATION COUPLER). The switches on the AUTOMATIC NAVIGATION control panel (figure 2-24) turn the autopilot on and allow selection of all modes of operation.

2-82. OPERATION OF AUTOPILOT.

CAUTION

Before applying power to the autopilot system, check all flight controls for freedom of motion and full travel.

WARNING

Do not engage autopilot during single engine operation with partial or full flaps down.

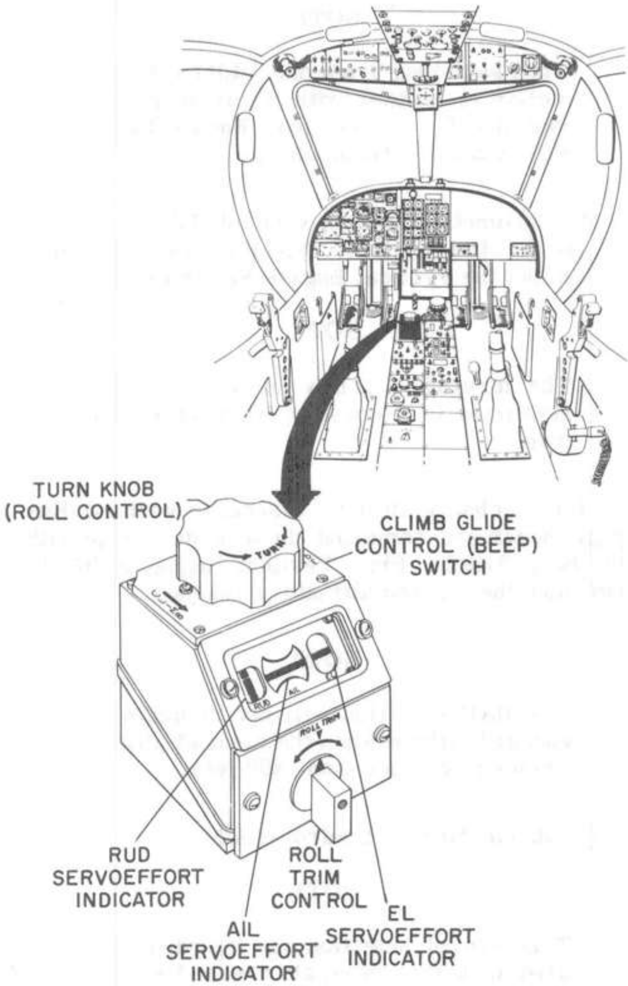


Figure 2-23. Flight Controller

WARNING

Disengage the autopilot for single engine flight below 130 knots IAS. The limited authority of the autopilot as single engine minimum control speeds are approached results in decreasing lateral control. Should the autopilot then be disengaged and an out of trim condition exists, an unusual attitude can occur. An unusual attitude can be avoided if the pilot trims the autopilot servoeffort indicators to neutral prior to disengagement. Should available trim control be insufficient to do this, the pilot must be ready to apply immediate corrective control upon autopilot disengagement.

a. Energizing and engaging autopilot.

(1) Depress the AUTOPILOT circuit breakers on the pilot's circuit breaker panel.

(2) Allow approximately 3 minutes for warmup.

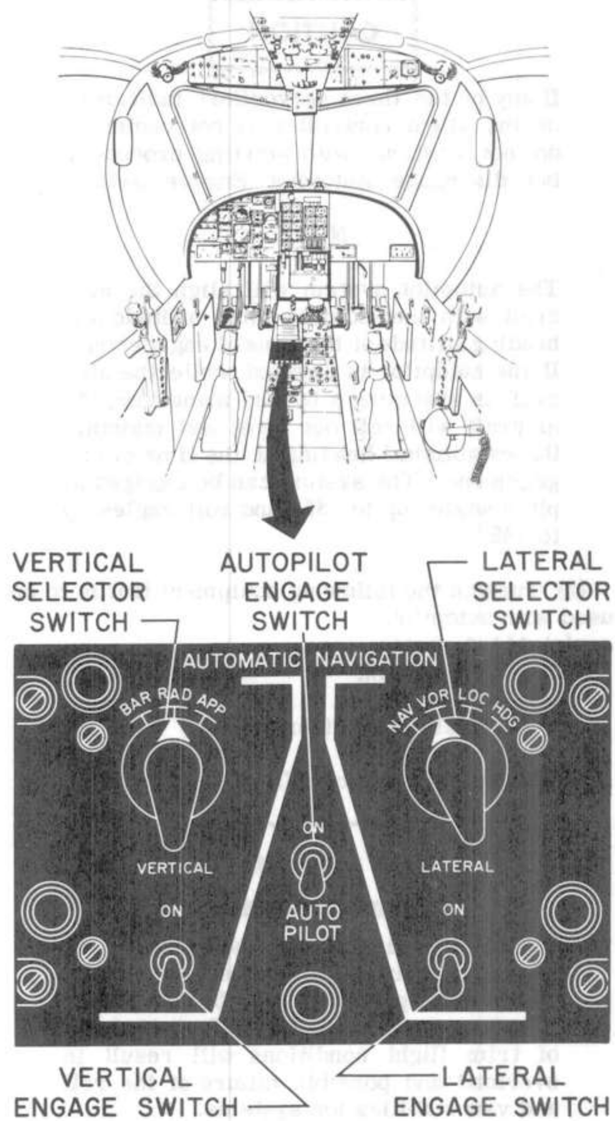


Figure 2-24. Navigation Coupler

NOTE

The 3-minute time delay allows fast erection of the gyroscope and permits the gyroscope to reach the proper speed. The Autopilot Engage Switch cannot be actuated until the time delay ends.

(3) Check that Turn Knob on flight controller is in the center detent position.

NOTE

The Autopilot Engage Switch cannot be actuated unless the Turn Knob is in the center detent position.

(4) Set the Autopilot Engage Switch on navigation coupler to ON.

CAUTION

If any of the three servoeffort indicators on the flight controller is not centered, do not continue with starting procedure but disengage Autopilot Engage Switch.

NOTE

The autopilot system will align the aircraft with the existing pitch attitude and heading attitude at the time of engagement. If the autopilot is engaged while the aircraft is executing a banked maneuver, the aircraft will roll out level and maintain the established heading at the time of engagement. The system can be engaged at pitch angles up to ±35° and roll angles up to ±45°

(5) Turn on the following equipment if it is to be used with autopilot:

(a) MA-1 system.
(b) Flight system.
(c) VOR set.
(d) Glide slope receiver set.

b. Command Operation (Flight Controller).

WARNING

To insure trim being maintained, the servoeffort indicators must be closely monitored, particularly when changing speed or power settings. Sustained out of trim flight conditions will result in overload and possible failure of the roll and yaw stabilization systems.

(1) Set the pitch attitude by pulling the pitch control (Beep Switch) aft for nose-up or pushing Beep Switch forward for nose-down.

NOTE

When the Beep Switch is released, the system will maintain the command pitch attitude.

(2) To establish a coordinated turn, rotate the roll control Turn Knob right for a right turn or left for a left turn. Return to a level attitude by rotating the roll control back to the center detent position.

(3) To trim the aircraft roll attitude without a heading change, adjust the Roll Trim Control to the right or left proportional to the amount of roll trim needed.

c. Vertical Navigation Coupler Operation.

NOTE

When switching from one VERTICAL selection to another (with Vertical Engage Switch ON), the Vertical Engage Switch will automatically disengage.

(1) Barometric Altitude Control (BAR).

(a) Set the Vertical Selector Switch to BAR.
(b) Set the Vertical Engage Switch to ON.

NOTE

The aircraft will now be automatically stabilized to a constant barometric altitude.

(c) To change altitude, disengage Vertical Engage Switch and command the altitude change with the Beep Switch. Place Vertical Engage Switch to ON when the desired altitude is reached.

NOTE

The BAR selection will not maintain its engaged altitude when the aircraft altitude change is greater than ±400 feet.

(2) Radar Altitude Control (RAD).

NOTE

This control selection was intended to be used with the radar altimeter; however, the radar altimeter is not connected to the autopilot in this aircraft. The Vertical Engage Switch will not hold in the ON position with the Vertical Selector Switch in RAD.

(3) Approach Control (APP).

NOTE

The constant altitude portion of the landing approach should be made with the Vertical Selector Switch in the BAR position.

WARNING

Do not engage autopilot for ILS operation during single engine approach condition. Limits of autopilot authority may be exceeded during the approach or as a result of power change in the event of a go-around.

(a) Set the Vertical Selector Switch to APP.

NOTE

The Vertical Engage Switch will not hold in the ON position unless the glide slope receiver set is energized.

(b) When the glide slope pointer on the approach horizon indicator shows zero glide path error, set the Vertical Engage Switch to ON.

WARNING

Failure to allow the glide slope pointer to be fully centered (zero glide path error indicated), before setting the Vertical Engage Switch to ON will cause the aircraft to pitch abruptly upon APP mode engagement.

CAUTION

If vertical autopilot control is engaged at too great a deviation from the glide path, the autopilot will give a hard-over signal that can be dangerous at low altitudes.

NOTE

The aircraft will now automatically fly the glide path beam.

d. Lateral Navigation Coupler Operation.

NOTE

When switching from one LATERAL selection to another (with Lateral Engage Switch ON), the Lateral Engage Switch will automatically disengage.

(1) Heading Select (HDG).

(a) Set Lateral Selector Switch to HDG.

(b) Set HDG-ILS Knob on approach horizon indicator to HDG.

(c) Set Heading Knob on course indicator to desired heading.

(d) Position Lateral Engage Switch to ON.

NOTE

The aircraft will now automatically perform coordinated turns to maintain the selected heading.

(2) VOR Select (VOR).

(a) Set the Lateral Selector Switch to VOR.

(b) Tune VOR #1 or VOR #2 (if installed) to desired station.

(c) Select HDG mode with HDG-ILS Knob on approach horizon indicator and note that the LOC flag is out of sight.

(d) Select desired course with course knob on course indicator.

(e) Select desired heading with Heading Knob on course indicator.

(f) Operate the roll control Turn Knob to manually bracket the VOR beam to less than 20° of the heading error and less than a half-scale indication on the course indicator.

(g) Set Lateral Engage Switch to ON.

(3) Localizer Select (LOC).

CAUTION

Do not engage the LATERAL LOC mode on back course ILS.

(a) On VHF NAV control panel, set OMNI-VAR LOC Switch (ARN-30A) to VAR LOC.

(b) Tune the VOR set to select ILS station.

(c) On GLIDE SLOPE control panel, select the localizer frequency of ILS. On [28] aircraft, the localizer frequency for the glide slope receiver is set by the VOR #1 control panel.

(d) Turn Lateral Selector Switch to LOC.

(e) Turn Vertical Selector Switch to APP.

NOTE

The constant altitude portion of the ILS approach should be made with the Vertical Selector Switch in BAR.

(f) Set HDG-ILS Knob on approach horizon indicator to ILS.

(g) Fly the aircraft to intercept the ILS localizer beam at a 45° angle and set Lateral Engage Switch to ON. The aircraft will not perform coordinated turns to automatically fly the localizer beam.

(h) Trim and adjust aircraft for final approach.

(i) Set Vertical Engage Switch to ON when glide path is intercepted. The aircraft will fly the glide path beam automatically to a minimum altitude.

CAUTION

If vertical autopilot control is engaged at too great a deviation from the glide path, the autopilot will give a hard-over signal that can be dnagerous at low altitudes.

NOTE

The Vertical Engage Switch will not hold in the ON position unless the glide slope receiver is energized.

(4) Navigation Select (NAV).

NOTE

This selection on the navigation coupler was intended to be used with the doppler system but is not connected in this aircraft. The Lateral Engage Switch will not hold in the ON position with the Lateral Selector Switch in NAV.

e. Turning Off Autopilot.

(1) Monitor the flight controls and prepare to take over manual operation.

(2) The autopilot system can be turned off by either of the following two methods:

(a) Place Autopilot Engage Switch on navigation coupler in the off position (down).

(b) Momentarily press the Autopilot Release Switch on the pilot's stick grip.

2-83. AUTOPILOT MALFUNCTION.

a. Overpowering System.

(1) The individual control channels can be overpowered with the system functioning in any mode of operation.

(2) If the autopilot has been overpowered because of malfunction, disengage Autopilot Engage Switch on navigation coupler or momentarily depress Autopilot Release Switch on control stick.

b. Command Mode Malfunction. If the action of the flight controller is lost, the autopilot system can still be used for stabilization. If automatic stabilization is desired, use the following procedure.

(1) Center the roll control Turn Knob on flight controller to detent position.

(2) Center the Roll Trim Control on flight controller.

(3) Manually establish the pitch, roll, and yaw attitudes.

(4) Set the Autopilot Engage Switch on navigation coupler to ON.

(5) Change attitudes by disengaging the Autopilot Engage Switch and manually positioning the aircraft to the new attitude. Set the Autopilot Engage Switch to ON to automatically hold the new attitude.

c. Operation With Other Modes Malfunctioning.

(1) If one of the lateral or vertical modes malfunctions, select another mode if possible or disengage the Vertical and Lateral Engage Switches.

(2) If the Vertical and Lateral Engage Switches are disengaged, continue flight in the command mode (Autopilot Engage Switch ON). Command changes in flight attitude by means of the flight controller.

d. When the AFCS caution light on center instrument panel goes on, ac or dc power loss is indicated; the Autopilot Engage Switch will automatically disengage under this condition.

2-84. SURVEILLANCE EQUIPMENT.

2-85. SLAR SYSTEM - AN/APS-94.

2-86. The SLAR system is an airborne radar system operated by the observer to obtain recorded map information. This system is classified and no other information is presented in this manual. See Appendix I for reference manuals.

2-87. DATA LINK - AN/AKT-16.

2-88. The data link is operated by the observer to transmit map information obtained from the SLAR system to Radar Data Receiving Set AN/TKQ-1. The data link encodes radar target information and map orientation data obtained by the SLAR system and transmits the encoded signal to AN/TKQ-1 by means of an FM radio transmitter. The AN/TKQ-1, located within line-of-sight distance of the data link, decodes the map information and records it on photographic film. The map information is available to a ground observer within seconds after it is obtained by the SLAR system. Power is supplied to data link from the SLAR system through the DATA TRANS circuit breakers, located on the observer's circuit breaker panel (Chapter 2, Section II, figure 2-17). Controls for the data link are on the RADAR DATA XMTG SET control panel (figure 2-25).

2-89. RADAR DATA XMTG SET CONTROL PANEL. The RADAR DATA XMTG SET control panel (figure 2-25) is a modified FM control panel. It includes all the controls necessary to operate the data link. Controls include an FM Frequency Selector and a Power Switch.

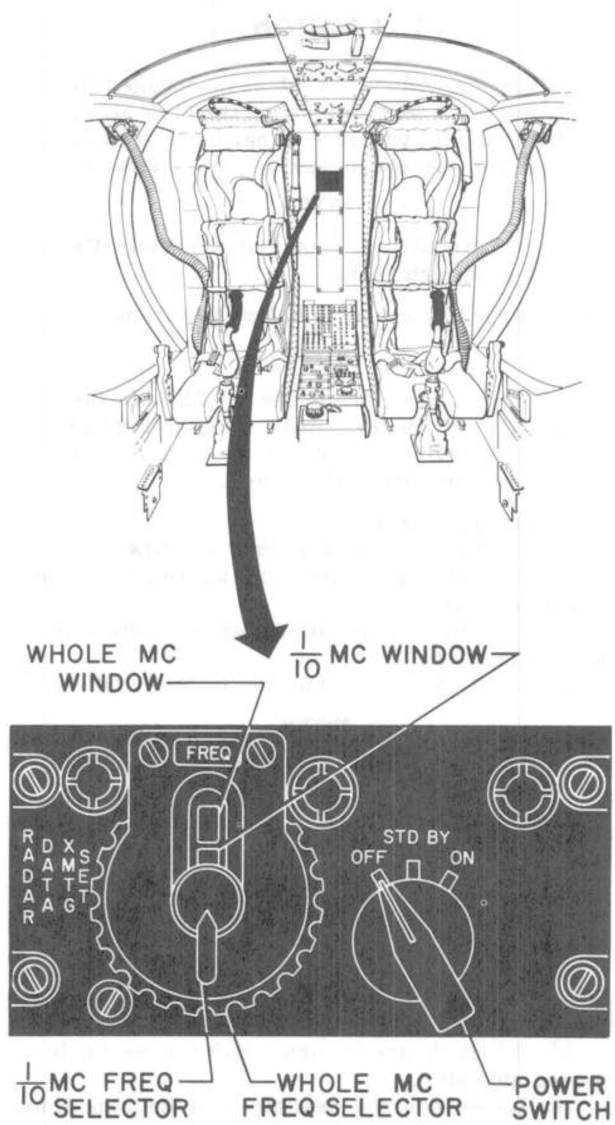


Figure 2-25. RADAR DATA XMTG SET Control Panel

2-90. OPERATION OF DATA LINK.

NOTE

The data link power switch is normally left in the ON position at all times. When the SLAR system is energized, power is automatically made available to the data transmitting set.

CAUTION

When temperatures exceeding 170° F are expected within the aircraft, inform ground crew to remove the data link video encoder. High temperature can cause permanent damage to the photomultiplier tubes in the video encoder. Do not operate data transmitting set without video encoder.

a. Depress the DATA TRANS AC and DC circuit breakers on observer's circuit breaker panel.
b. Set the Frequency Selectors on RADAR DATA XMTG SET control panel to assigned frequency as indicated in FREQ windows.
c. Place Power Switch to ON.

NOTE

When SLAR system is energized, power is available to the data link.

d. Place the Power Switch to STDBY when a temporary suspension of transmission is required.

NOTE

In this switch position, only the transmitter portion of the system is deenergized.

e. To turn off the data link, set the Power Switch on the RADAR DATA XMTG SET control panel to OFF.

2-91. RECORDER PROCESSOR-VIEWER - RO-166/UP.

2-92. GENERAL. The recorder processor-viewer (observer's console) is an optional replacement for Radar Mapping Recorder RO-127/APS-94. The processor-viewer records on a single strip of film the maps and map orientation data produced by the SLAR system. The observer can relay to a ground station certain target information immediately upon noting the information on the map. Once the processor-viewer is installed properly, only minor adjustments are required by the observer. Power is applied to the recorder processor-viewer through the SLAR system. All controls are located on the unit itself (figure 2-26). The recorder processor-viewer is attached and connected to the SLAR target indicator by four bolts. A control panel is located on the front face of the recorder processor-viewer. Internal components include the following:

a. Camera. The camera includes optical and film transport systems integrally mounted on the recorder processor-viewer chassis. Access to the camera can be gained by opening the upper and lower front covers (figure 2-27) of the unit.
b. Processing Station. (See figures 2-27 and 2-28.) The processing station includes a processor assembly, developer tank, supply and drain pumps and connecting hoses. When the lower front cover is open, the processing station can be removed as a unit. The power connector for the pump motor is located at the left rear corner of the developer tank just behind the pump housing. The power connector for the processing assembly is connected to the recorder processor-viewer housing at the lower left corner.
c. Viewing Station. (See figure 2-27.) The viewing station includes a lamp house, diffuser, and filter. The power connector is located on the rear face of the viewer lamp house. A blower, mounted on the rear panel of the processor-viewer, directs air through the lamp house and out the exhaust vents.
d. Film Cassette. The film cassette is a container for the spools of unexposed film used in the recorder processor-viewer. It is loaded in the dark-room and accepts 9-1/2 by 2-5/8 inch spools of film. The cassette protects the film from fogging or accidental damage.
e. Takeup Spool. The takeup spool is identical to the film spool inside the film cassette. This spool receives and stores the exposed partially-processed film containing the radar mapping data.

NOTE

The spool supplied with the recorder processor-viewer is the same as 9-1/2 by 4 inch aerial film spool except for flange diameter. The AN spool may be substituted for the supplied takeup spool if the flange diameter is reduced to 2-1/32 inches.

f. Viewing Hood. A viewing hood serves to shield the viewing area surface from unwanted reflections.
g. Magnifier. The magnifier (figure 2-26) is a simple lens mounted on a set of guide rods. The magnifier can be moved to cover any part of the viewing area.
h. Data Chamber. (See figure 2-29.) The data chamber is a removable, self-contained unit consisting of a compass repeater drum dial, a hand-wound 24-hour clock, a drift-angle indicator, a groundspeed indicator, two radar range signal lights, three radar range delay signal lights, and a removable data card holder. The data chamber is plugged in place in the lower right section of the recorder processor-viewer chassis (figure 2-27).

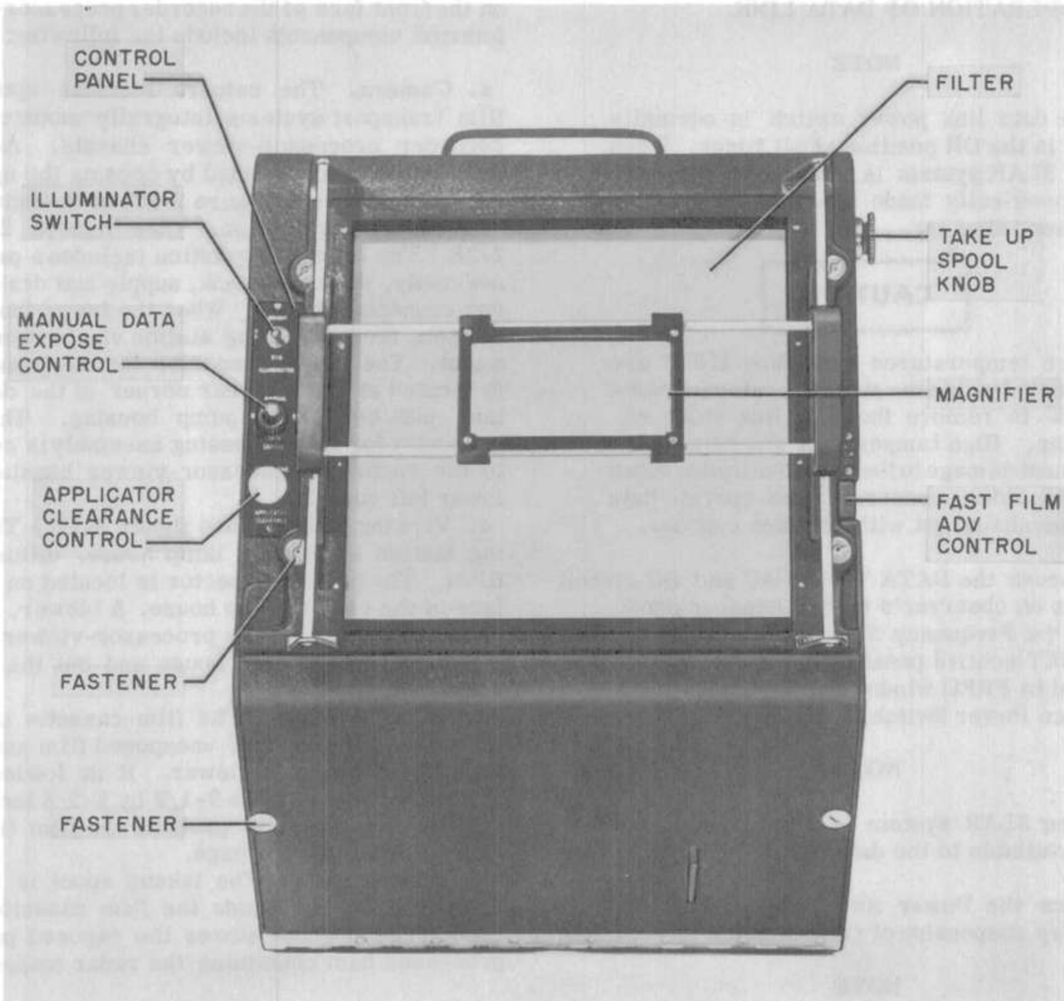


Figure 2-26. Recorder Processor-Viewer

2-93. OPERATION OF RECORDER PROCESSOR-VIEWER.

2-94. PREPARATION. If processing solution is low and/or a new film cassette must be threaded, refill tank and/or thread new film as follows:

a. Refilling Tank with Processing Solution (see figures 2-27 and 2-28) (to be accomplished during power-off preflight):

NOTE

Monobath solution has limited keeping qualities; therefore a fresh solution should be mixed for each day's use. The ground crew is responsible for the mixing process.

(1) Open the lower front cover of the processor-viewer by turning the two fasteners one-quarter turn counterclockwise.

(2) Slide tank and pump assembly out of processor-viewer.

(3) Release hose connection by unscrewing knurled knob counterclockwise.

(4) Remove tank filler cap by turning counterclockwise.

(5) Remove waste solution bladder.

CAUTION

Do not pull bladder out so far that connecting tube is pulled loose.

(6) Pour freshly mixed and filtered solution into tank.

(7) Insert waste solution bladder in tank and replace tank filler cap.

(8) Fasten hose connection and turn knurled knob clockwise until fingertight.

b. Film Threading Procedure (see figure 2-30):

(1) Tilt processor block to the open position by retracting index pin located on inside of processor assembly right end plate.

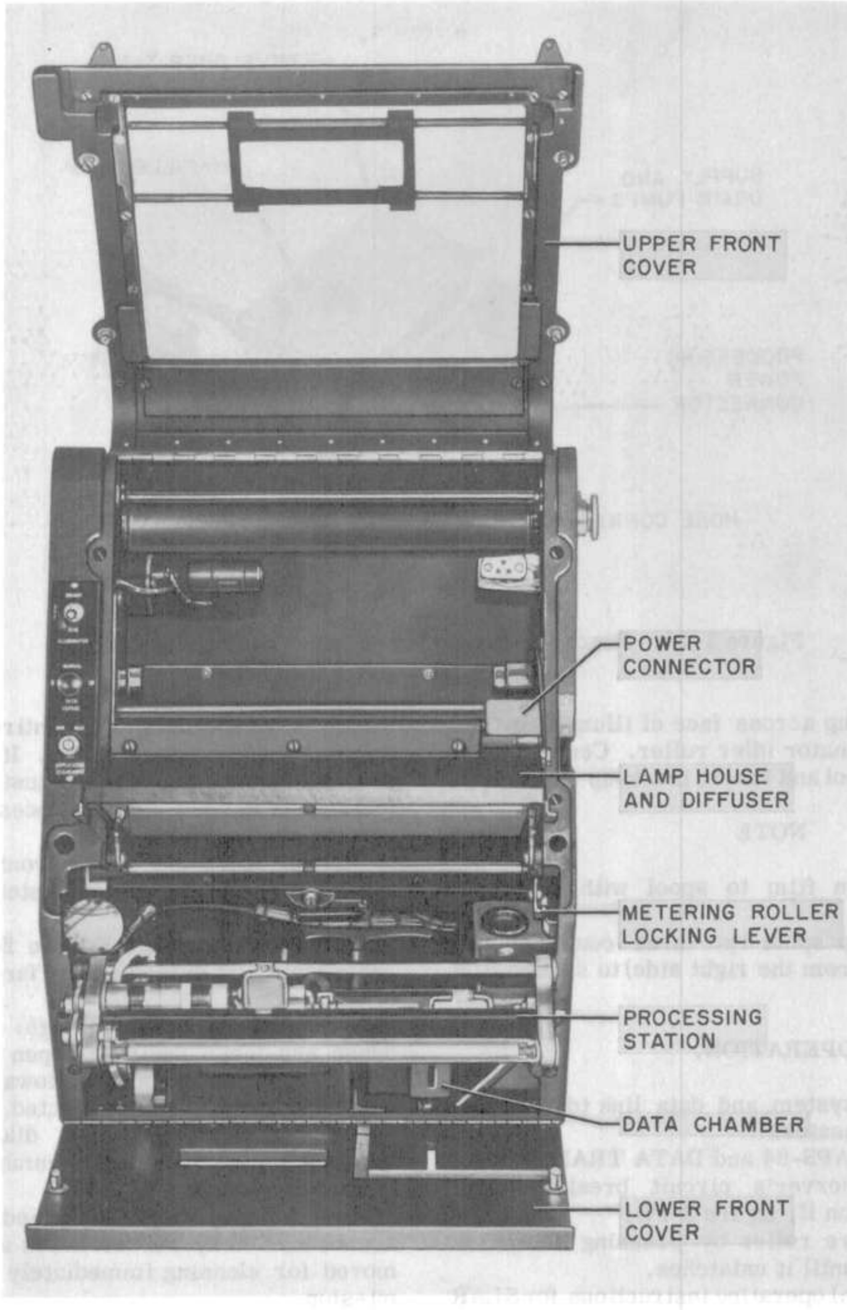


Figure 2-27. Recorder Processor-Viewer, Covers Open

(2) Release metering roller assembly by pressing upward on the metering roller locking lever (figure 2-27) until the lever latches.

(3) Swing the illuminator outward by inserting index finger behind illuminator upper idler roller and pulling illuminator outward (as shown in figure 2-27).

(4) Hold the cassette with the knurled knob to the left and thread film down around metering roller (between metering roller and pressure roller). Thread film behind and over first idler roller and down behind second idler roller to the processor roller.

(5) Insert cassette in processor-viewer, right end first; orient cassette so that the right end seats properly in slotted boss on inside of right end plate. Drop left end of cassette down and back into holding boss on left end plate.

(6) Thread film between lower illuminator idler roller and processor roller and pull to front of unit.

(7) Lift illuminator up to closed position.

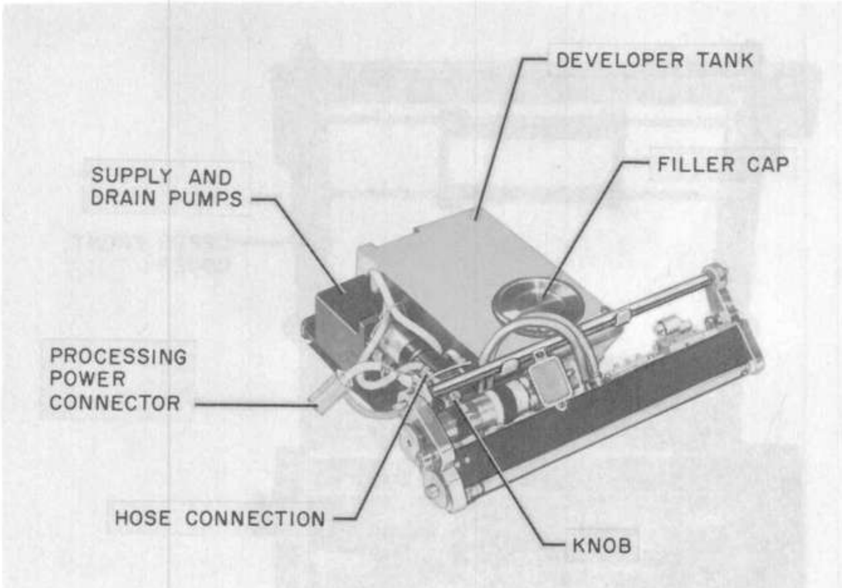


Figure 2-28. Recorder Processor-Viewer Processing Station

(8) Guide film up across face of illuminator and over upper illuminator idler roller. Center end of film in takeup spool and insert in takeup spool core.

NOTE

Do not fasten film to spool with tape.

(9) Turn takeup spool two turns counterclockwise (as viewed from the right side) to secure film to spool.

2-95. NORMAL OPERATION.

a. Start SLAR system and data link to energize processor block heaters.
b. Depress the APS-94 and DATA TRANS circuit breakers on observer's circuit breaker panel (Chapter 2, Section II, figure 2-17).
c. Lock pressure roller by pressing downward on locking lever until it unlatches.
d. Follow normal operating instructions for SLAR system and data link.
e. Depress Fast Film Advance Lever to take up any slack in the film transport system.
f. Retract index pin on processor assembly and immediately swing into place to prevent spillage of processing solution from processor assembly. Before releasing index pin, observe that processing roller clears film surface. Adjust Applicator Clearance Control if necessary to introduce clearance. Release index pin which locks processor assembly in place.
g. Check that film is being transported smoothly and that no leaks are present in the processing solution supply and drain systems.
h. Observe processed film for proper processing. If film is not wetted across entire surface, adjust Applicator Clearance Control. If film is wetted on one edge and not the other, adjust Applicator Alignment Control (right side of processor-viewer) until condition is corrected.
i. Close upper and lower front covers and lock in place by turning cover fasteners one-quarter turn clockwise.
j. Press Manual Data Expose Button. Check for reproduction of data chamber face on right margin of film.
k. Observe processed image. If image is too dense and lacks contrast, open lower cover and adjust diaphragm clockwise toward higher f-numbers until condition is corrected. If image is less dense than desired, adjust diaphragm counterclockwise toward lower f-numbers. Close and lock lower cover.
l. The pumps, supply tank, and processing block are connected by rubber hoses and should be removed for cleaning immediately after finishing a mission.

2-96. IN-FLIGHT ADJUSTMENTS. The best indication of improper operation of the recorder-processor-viewer is the processed negative. Table 2-II lists symptoms of improper operation, probable causes, and in-flight adjustments used for corrective action.

2-97. STOP AND/OR RESTART.

a. To stop processing, turn Applicator Clearance Control clockwise to MAX. This increases clearance between film and processor roller to the point where processing solution no longer contacts the film; it does not stop the circulation of processing

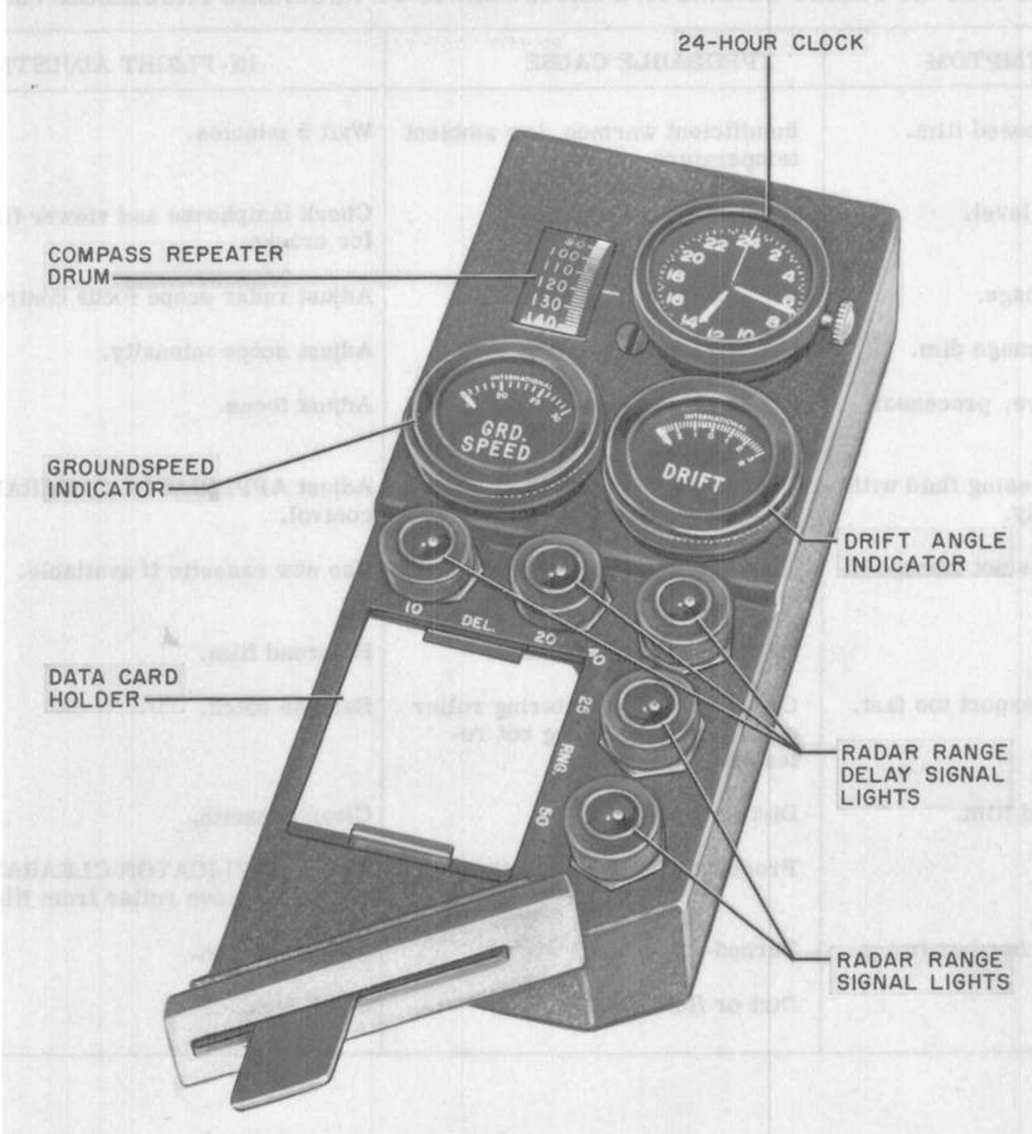


Figure 2-29. Recorder Processor-Viewer, Data Chamber

solution or the film transport system. It is advisable to pump solution through the supply and drain systems to prevent their becoming clogged with processing solution chemicals.

b. If the processed film on the takeup spool is to be removed, depress the Fast Film Advance Lever until approximately 1 inch of unprocessed film appears along the bottom edge of the illuminator.

c. Open upper and lower covers.

d. Cut across the film in the unprocessed area exposed in step b. above. Wind film manually onto takeup spool.

e. Remove takeup spool by pulling out on knob (figure 2-26) and removing filled takeup spool.

f. Remount an empty takeup spool in the recorder and rethread film as described in paragraph 2-93b. Close upper and lower covers and lock. Adjust Applicator Clearance Control counterclockwise until film processing is resumed.

2-98. IR SYSTEM.

2-99. The IR system is classified and is not covered in this manual. See Appendix I for reference manuals.

2-100. ANTENNAS.

2-101. See figures 2-31, 2-32, and 2-33 for location of all signal electronic equipment antennas and radomes.

TABLE 2-II. IN-FLIGHT CORRECTIVE ADJUSTMENTS OF RECORDER PROCESSOR-VIEWER

SYMPTOM	PROBABLE CAUSE	IN-FLIGHT ADJUSTMENT
Underexposed film.	Insufficient warmup, low ambient temperature.	Wait 5 minutes.
High fog level.	Light leak.	Check lamphouse and viewer fillers for cracks.
Fuzzy image.	Crt image out of focus.	Adjust radar scope focus control.
Viewer image dim.	Crt intensity too low.	Adjust scope intensity.
No picture, processor working.	Crt signal out of focus.	Adjust focus.
No processing fluid with full supply.	Processing block too far back.	Adjust APPLICATOR CLEARANCE control.
Film does not transport.	Film improperly loaded in cassette.	Use new cassette if available.
	Improperly threaded film.	Rethread film.
Film transport too fast.	Catch that holds metering roller open during threading not released.	Release catch.
Scratched film.	Dirt in cassette.	Clean cassette.
	Processor roller touching film.	Adjust APPLICATOR CLEARANCE control to move roller from film.
No data chamber image.	Burned-out lamps.	Replace lamps.
	Dirt or fluid on lens.	Clean lens.

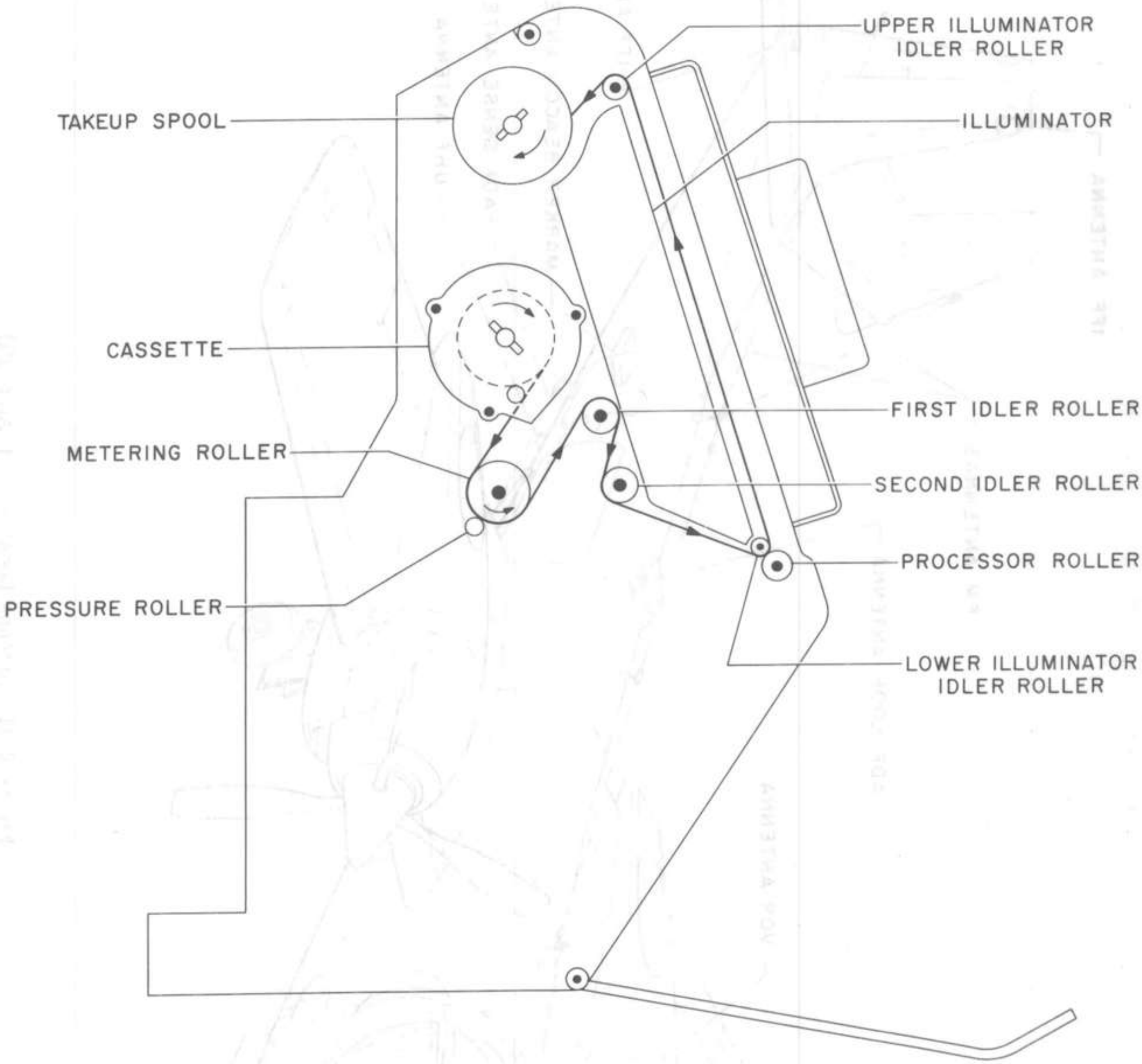


Figure 2-30. Recorder Processor-Viewer, Film Threading Diagram

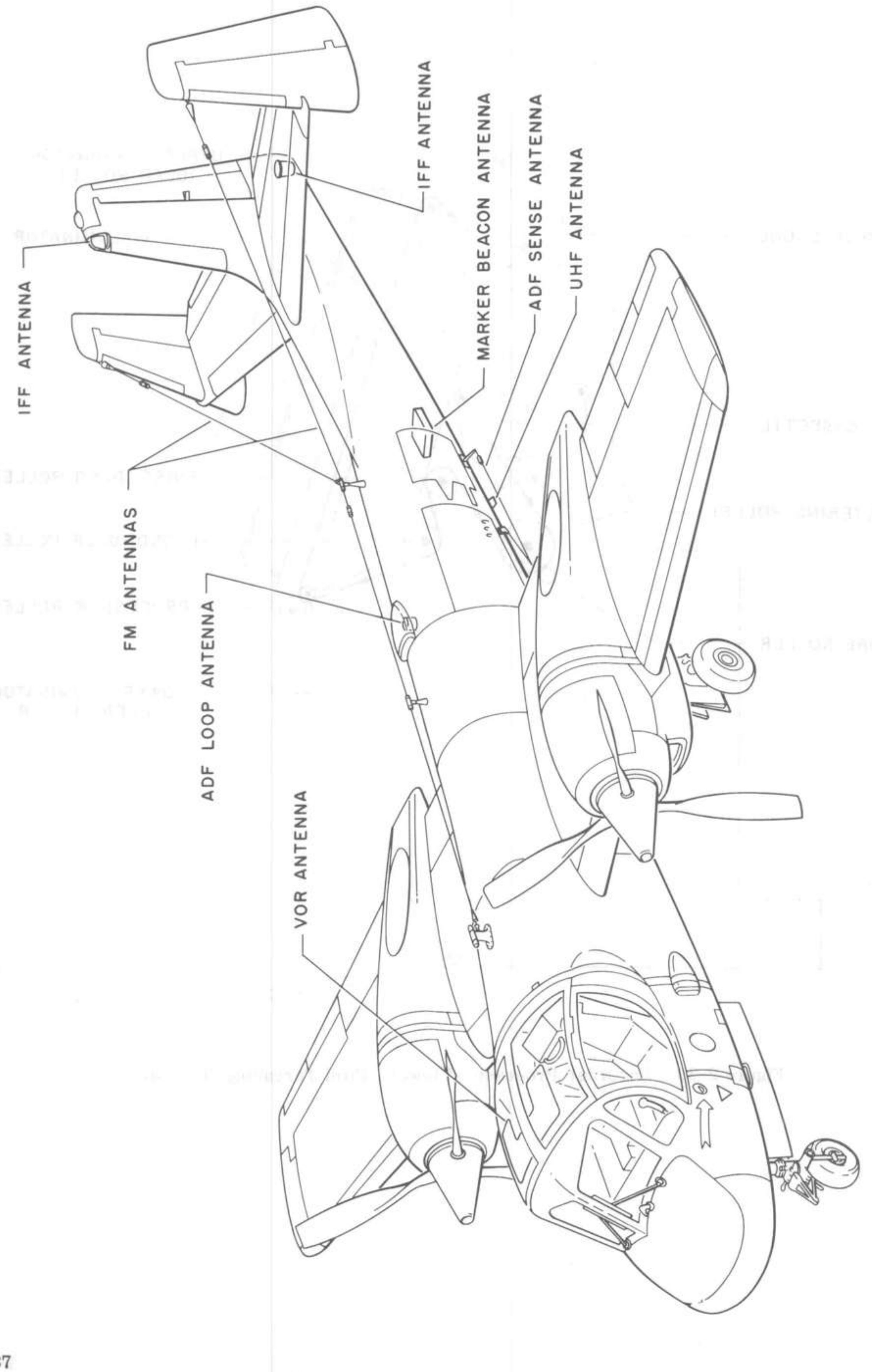
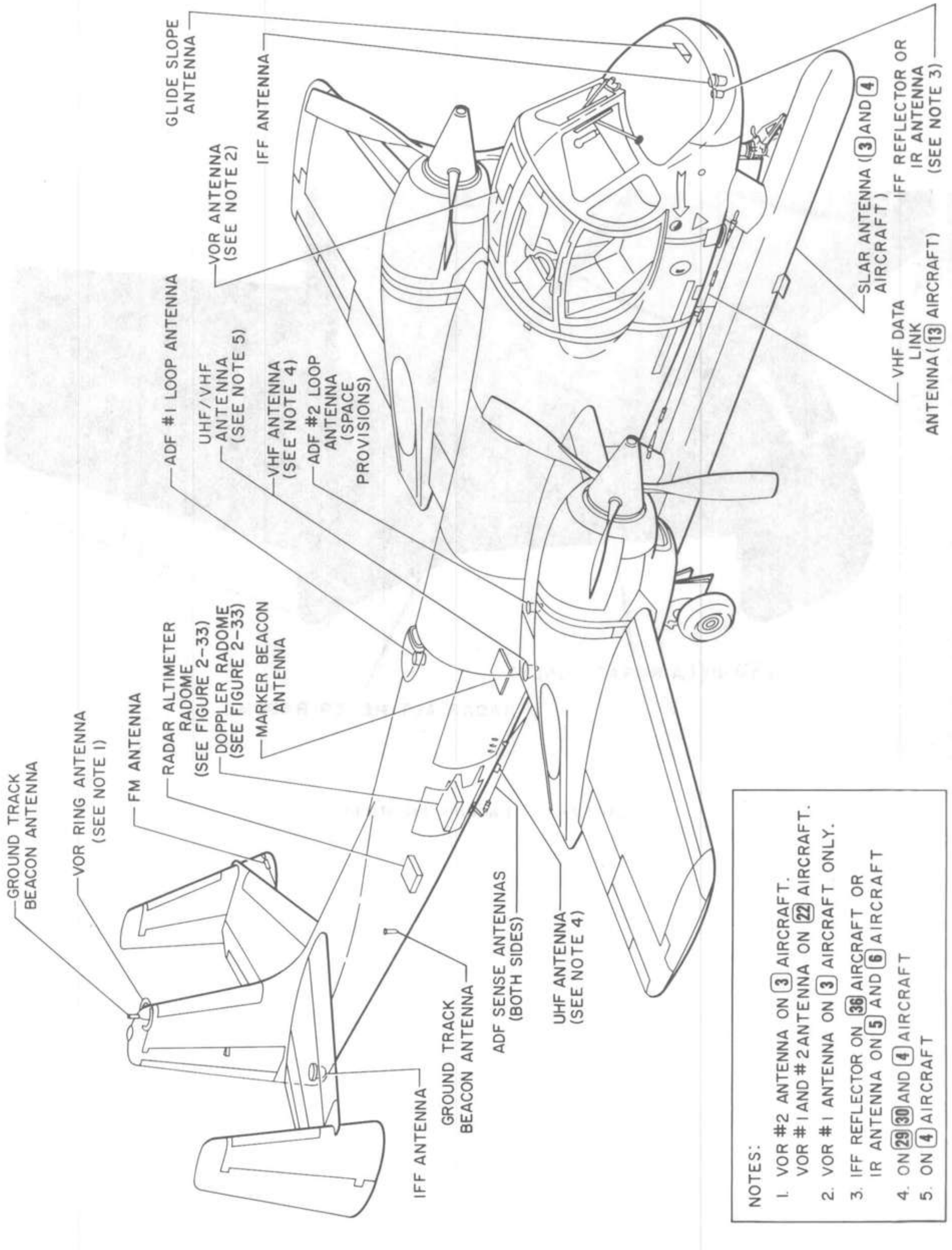


Figure 2-31. Antenna Locations ([1] Aircraft)



NOTES:

1. VOR #2 ANTENNA ON [3] AIRCRAFT.
   VOR #1 AND #2 ANTENNA ON [22] AIRCRAFT.
2. VOR #1 ANTENNA ON [3] AIRCRAFT ONLY.
3. IFF REFLECTOR ON [36] AIRCRAFT OR IR ANTENNA ON [5] AND [6] AIRCRAFT
4. ON [29] [30] AND [4] AIRCRAFT
5. ON [4] AIRCRAFT

Figure 2-32. Antenna Locations ([7] Aircraft)

Figure 2-33. Radome Locations

CHAPTER 6
AUXILIARY EQUIPMENT

Section I. Scope

1-1. Chapter 6 contains information on all auxiliary equipment, i.e., any equipment that is not electronically operated, and which does not affect the flying characteristics of the aircraft. The information is of a nontechnical nature, being designed merely to instruct the pilot and observer on the basic operation of the equipment and any emergency instructions that may apply.

1-2. When the equipment discussed contributes to the ability of the aircraft to perform a specialized mission, a description of that mission is also included.

Section II. Heating and Ventilation System

2-1. HEATING AND VENTILATION SYSTEM.

(See figure 2-1.)

2-2. DESCRIPTION.

2-3. GENERAL. The heating and ventilation system provides for heating and defogging of the cockpit and camera compartments by means of engine bleed air. Catalytic filters (10, figure 2-2) have been installed on [41] aircraft to remove toxic fumes from the bleed air prior to entering the heating and ventilation system. During normal operation, cockpit temperature (as selected by the pilot or observer) is controlled automatically and does not require continuous monitoring. Manual control is also available when desired. The temperature controlled air is also used for defogging the cockpit windshield, entrance hatches, escape hatch and camera windows. Defogging of the camera compartment windows and V/H scanner window ([19] and [31] aircraft) is accomplished automatically without cockpit controls. Ventilation of the cockpit is provided by two means; ram air, and/or an auxiliary vent system. The aft equipment compartment is also vented for electronic equipment cooling.

2-4. Heating and Defogging - Cockpit. Flow of the hot engine bleed air is controlled by the bleed air shutoff valve, the flow control valve, and the venturi. Bleed air temperature (entering the cockpit) is controlled by the heat exchanger, temperature control valve, temperature sensors, and temperature controller.

a. Flow Control. The bleed air shutoff valve (22, figure 2-2) is an on-off unit which allows bleed air to enter, or prevents bleed air from entering, the cockpit supply ducts (28, figure 2-2). The flow control valve (13) is a two position valve; fully open (maximum heat and defog), and restricted (normal heat and defog). When maximum heat and defog is selected by the pilot or observer, the valve is fully open and the venturi (14) limits the mass air flow. With the valve fully open, the airflow is approximately three times that of the normal system flow (restricted).

b. Temperature Control. The temperature control valve (11, figure 2-2) is a dual-barreled valve which proportions the amount of bleed air passed to the heat exchanger for cooling. This valve is electrically controlled by a signal from the temperature controller. The temperature controller (12) combines information from the cockpit control panel (Heating and Ventilation control panel (figure 2-3)), duct temperature sensor (27), and cockpit temperature sensor (4), and translates this information for positioning of the temperature control valve. As cockpit temperature is satisfied, the signal to the temperature control valve is removed and the valve remains static until the temperature controller commands a change. This operation is continuous; cycling the valve in the proper proportion to attain the selected temperature. This valve can also be controlled manually with a switch on the control panel. The heat exchanger (9) cools the hot air passed through it with the use of ram air ducted from the ram air scoop (24). Ram air can be selected to bypass the heat exchanger for ventilation of the cockpit. Either the conditioned air or the ram air is distributed to the pilot's and observer's face outlets (Chapter 2, Section II, 25 and 34, figure 2-3), foot air diffusers (19 and 21), and all windshield defog nozzles (15). Cockpit temperature, while heating, is controllable within 13 ±3°C (55 ±5°F) and 29 ±3°C (85 ±5°F) and is maintained within ±1°C (±2°F) of selected temperature.

c. Defogging. For normal defogging of the windshield and hatches, the flow control valve is in the restricted position and the defog shutoff valve (8, figure 2-2) is opened. The defog shutoff valve is electrically controlled by a switch on the cockpit control panel. In the open position, conditioned air is allowed to flow to the top and side defog nozzles (6) as well as the face outlets, windshield defog nozzles, and foot air diffusers (2). Maximum defogging is accomplished by opening the flow control valve and closing the face outlets and foot air diffusers so that all the conditioned air will be concentrated on only the windshield and hatches.

d. Exhausting. Air in the cockpit is exhausted to the forward equipment compartment through an exhaust louver on the sloping bulkhead. On [23] aircraft, this air is dumped overboard through exhaust louvers (25, figure 2-2) but on [37] aircraft the air is passed through the baggage compartment and then overboard through an exhaust scoop (21).

2-5. Heating and Defogging - Camera Compartment. Camera compartment heating and defogging air is ducted directly from the engine bleed air manifold. Flow is restricted through a temperature control valve (15, figure 2-2) which limits the flow to a quantity as determined by the temperature controller. A camera bay temperature indicator (Chapter 2, Section II, figure 2-10) is provided for monitoring the temperature in the camera compartment. Air is distributed through defogging diffusers (19, figure 2-2) on each of the three camera windows, thereby heating the camera compartment as well as defogging the windows. On [19] and [31] aircraft, this air is also ducted to the V/H scanner window defogging diffuser (18). Exhaust air is directed through louvers (17) on both sides of the fuselage.

2-6. Ventilation. Ventilation for the cockpit is provided when the ram air valve (23, figure 2-2) is positioned to allow the ram air to bypass the heat exchanger and supply ram air to the cockpit. In

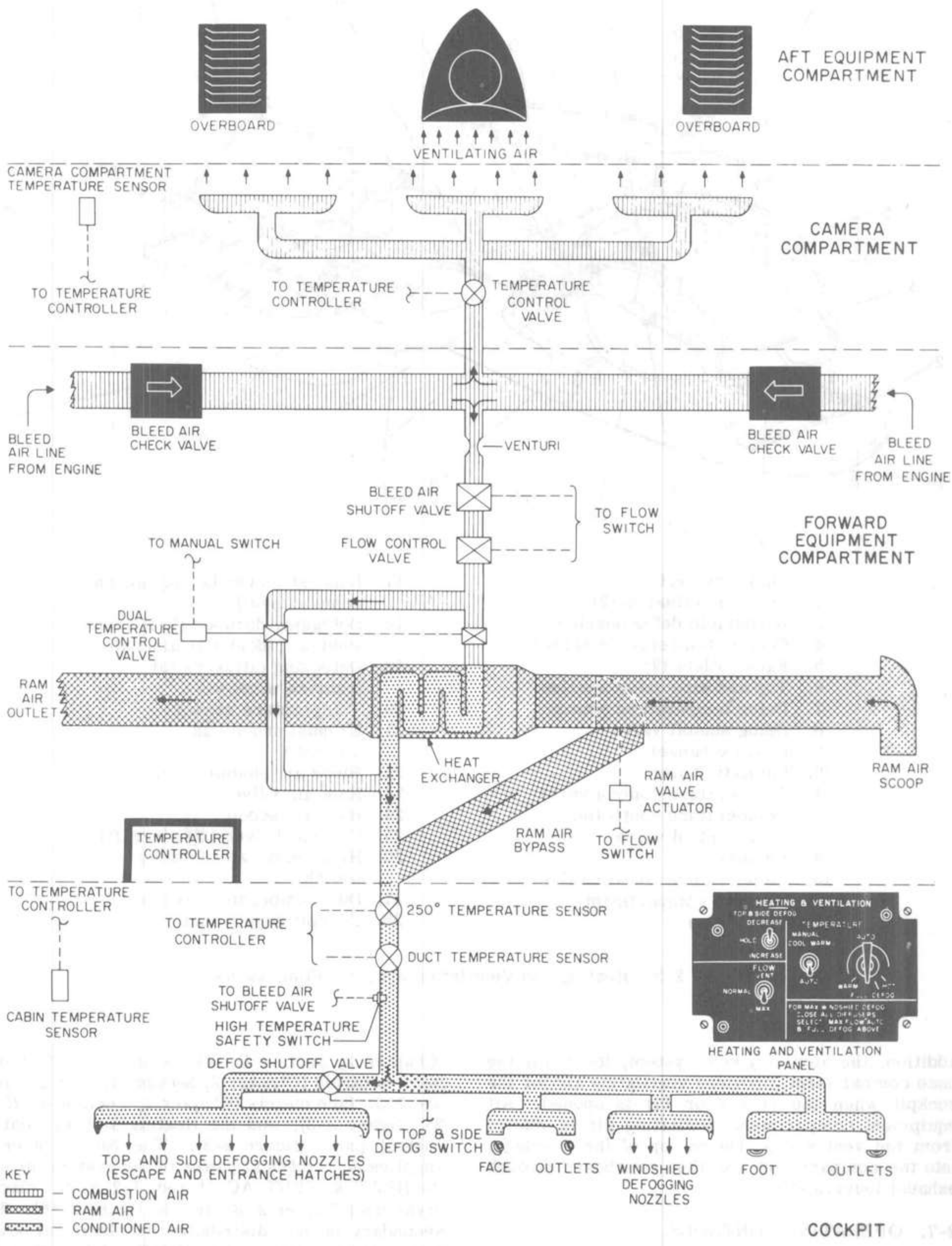
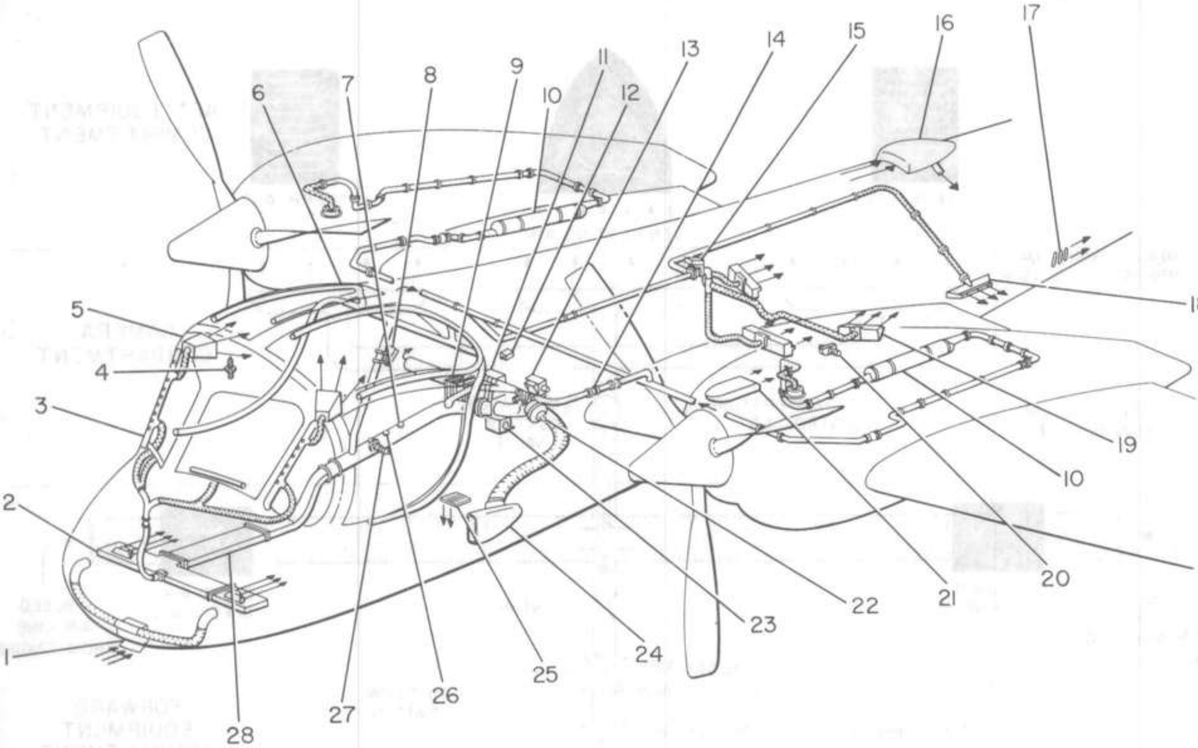


Figure 2-1. Heating and Ventilation System, Schematic Diagram.



1. Auxiliary vent door
2. Foot air diffusers (2)
3. Windshield defog nozzles
4. Cockpit temperature sensor
5. Face outlets (2)
6. Top and side defog nozzles
7. Defog temperature sensor
8. Defog shutoff valve
9. Heat exchanger
10. Catalytic filter
11. Temperature control valve
12. Temperature controller
13. Flow control valve
14. Venturi
15. Temperature control valve (camera compartment)
16. Vent scoop
17. Exhaust louver (aft equipment compartment)
18. Defogging diffuser (V/H scanner window) (19 and 31 aircraft)
19. Defogging diffusers (3) (camera windows)
20. Temperature sensor
21. Exhaust scoop (37 aircraft)
22. Bleed air shutoff valve
23. Ram air valve
24. Ram air scoop
25. Exhaust louver (23 aircraft)
26. High temperature safety switch
27. Duct temperature sensor
28. Cockpit supply duct

Figure 2-2. Heating and Ventilation System, Components

addition, the auxiliary vent system, located in the nose compartment, provides ventilating air for the cockpit when the vent door (1) is opened. Aft equipment compartment ventilating air is ducted from the vent scoop (16) on top of the fuselage, into the compartment and then overboard through exhaust louvers (17).

2-7. OPERATING CONTROLS.

2-8. GENERAL. Controls for the heating and ventilation system include the auxiliary vent handle (Chapter 2, Section II, 24, figure 2-3), foot diffuser controls (Chapter 2, Section II, 2 or 17, figure 2-3), face outlets (Chapter 2, Section II, 25 or 34, figure 2-3), and the Heating and Ventilation control panel (figure 2-3). The No. 1 inverter supplies ac electrical power to the system through the HEAT & VENT AC (1 and 1/2 amp) circuit breakers (Chapter 2, Section II, figure 2-16). The secondary dc bus distributes dc electrical power to the system through the HEAT & VENT DC (1/2 amp) circuit breaker (Chapter 2, Section II, figure 2-16).

2-9. AUXILIARY VENT HANDLE. The auxiliary vent handle is used to open or close the auxiliary vent door (1, figure 2-2). To open the vent, pull the handle out.

2-10. FOOT DIFFUSER CONTROLS. The pilot and observer have individual controls for their respective foot air diffuser (Chapter 2, Section II, 19 or 21, figure 2-3). The foot diffuser control varies the amount of foot diffuser opening. The opening will increase as the handle is pulled aft.

2-11. FACE OUTLETS. The pilot and observer have individual face outlets. To open the face outlet, pull out.

2-12. HEATING AND VENTILATION CONTROL PANEL. The Heating and Ventilation control panel (figure 2-3), located on the center overhead console, contains all the electrical controls required to operate the heating and ventilation system.

a. Flow Switch. The Flow Switch is a three-position toggle switch with VENT, NORMAL, and MAX positions. In the VENT position, the bleed air shutoff valve is fully closed and the ram air valve is in the bypass heat exchanger position, allowing the ram air to flow through the ducts for ventilation. When the switch is in NORMAL, the bleed air shutoff valve is in the full open position and the flow control valve is in the closed (restricted) position. The ram air valve is also repositioned to allow all the ram air to enter the heat exchanger for cooling of the bleed air. With the toggle switch in the MAX position, the flow control valve is positioned to full open, allowing a higher flow rate to enter the system. The venturi then controls the flow rate.

b. Top and Side Defog Switch. This is a three-position switch with DECREASE, HOLD, and INCREASE positions. The switch is momentarily in the INCREASE position opening the defog shutoff valve to any desired position. The HOLD position holds the valve in the selected position. Placing the switch in the DECREASE position closes the valve opening.

c. Auto Temperature Control Knob. The Auto Temperature Control Knob regulates the cockpit heat from the WARM position to the HOT position when the Flow Switch is in NORMAL or MAX. For maximum defogging the knob is rotated past HOT to the FULL DEFOG position.

d. Manual-Auto Switch. The Manual-Auto Switch is a three-position switch. Placing the switch in the MANUAL position allows for changes to be made with the temperature control valve directly without going through the temperature controller. The cockpit temperature can be regulated by momentarily selecting the WARM or COOL position.

2-13. NORMAL OPERATION. Although the camera compartment temperature is controlled automatically, monitoring the camera bay temperature

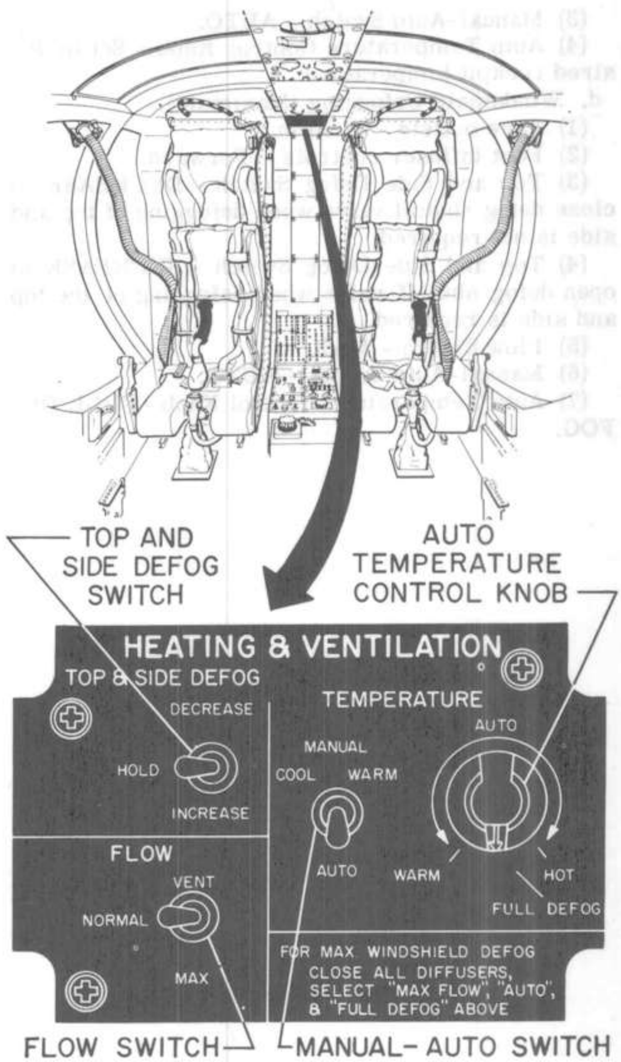


Figure 2-3. Heating and Ventilation Control Panel

indicator (Chapter 2, Section II, figure 2-10) is important. Windshield defogging can be accomplished with or without top and side defogging but the reverse is not true.

a. Heating.

(1) Flow Switch - NORMAL.

(2) Manual-Auto Switch - AUTO.

(3) Auto Temperature Control Knob - Set to desired cockpit temperature.

b. Ventilating.

(1) Flow Switch - VENT.

(2) Auxiliary Vent Handle - Pull for further ventilation.

c. Windshield Defogging (Normal).

(1) Flow Switch - NORMAL.

(2) Top and Side Defog Switch - DECREASE or INCREASE for desired defogging of top and side.

(3) Manual-Auto Switch - AUTO.
(4) Auto Temperature Control Knob - Set to desired cockpit temperature.

d. Windshield Defogging (Maximum).
(1) Face outlets - Push in.
(2) Foot diffuser controls - Forward.
(3) Top and Side Defog Switch - DECREASE to close defog shutoff valve when defogging of top and side is not required.
(4) Top and Side Defog Switch - INCREASE to open defog shutoff valve when defogging of the top and side is required.
(5) Flow Switch - MAX.
(6) Manual-Auto Switch - AUTO.
(7) Auto Temperature Control Knob - FULL DEFOG.

2-14. EMERGENCY OPERATION. If there is a failure in the automatic function of the heating system, use the following procedure:

a. Manual-Auto Switch - COOL or WARM, as required.

NOTE

The temperature control valve will now be controlled by the MANUAL positioning of this switch.

b. Flow Switch - NORMAL or MAX, as required.
c. Top and Side Defog Switch - As required.

Section III. Anti-icing and Deicing System

3-1. DEICING SYSTEMS.

3-2. PNEUMATIC DEICING SYSTEM.

3-3. DESCRIPTION. The pneumatic deicing system consists of the deicer control valve, the pneumatic deicer boots, and the necessary lines to complete the system. The rubber boots are installed on the leading edges of the wings and empennage and are pressurized by engine bleed air taken from a line in the heating and ventilation system. The system is controlled in the cockpit by a three-position Wing and Tail De-Ice Switch. Selection may be made for either LIGHT or HEAVY ice with this switch. In the LIGHT position, the tail boots are inflated for 5 seconds and then deflated. There is a 10-second pause, and then the wing boots are inflated for 5 seconds and deflated. There is then a pause of 3 minutes and 40 seconds before the cycle begins again. In the HEAVY position, the cycle is the same except that the pause between cycles is reduced to 40 seconds. To insure complete deicing of wing and empennage, the pneumatic deicing system should be activated before ice has accumulated to 1/2-inch thickness.

3-4. CONTROLS. The Wing and Tail De-Ice Switch is a three-position toggle switch located on the weather control panel of the right overhead console (figure 3-1).

3-5. ENGINE DEICING SYSTEM.

3-6. DESCRIPTION. The engine deicing system prevents icing of the compressor air inlet area and removes ice formed on the engine cowling, the propeller blades, and propeller spinner. The system is divided into the following subsystems: engine anti-icing, propeller deicing, and engine cowl deicing. For engine anti-icing, hot air from the annular manifold within the centrifugal compressor housing flows forward through the air flow regulator valve into the hollow annulus located on top of the air inlet housing. This hot air is then directed through five of the six hollow inlet housing supporting struts to heat the air inlet areas. In addition, hot air also flows into the inlet guide vane area and through an annulus to the temperature sensing element of the fuel control unit. Small openings in the bottom of the inlet guide vanes allow hot air to bleed back into the compressor area. The air flow regulator is controlled by the Engine De-Ice Switch. In the event of an electrical power failure, the air flow regulator valve automatically switches to the open position and hot air flows continuously. The proppeller and engine cowl deicing subsystems utilize electric heating elements to remove accumulated ice from critical surfaces. Both subsystems are actuated by placing the Engine De-Ice Switch in the ON position.

3-7. CONTROLS. The Engine De-Ice Switch is an ON-OFF toggle switch located on the weather control panel of the right overhead console (figure 3-1). In the ON position, the deicer relay is energized, applying 115 vac (supplied by the deicer generator) to the propeller, stationary and removable cowling, and air duct heating elements.

3-8. WINDSHIELD WASHING AND ANTI-ICING SYSTEM.

3-9. DESCRIPTION.

3-10. This system is designed for the dual purpose of both washing and anti-icing of the windshield. Engine bleed air is tapped and brought forward to a control valve which regulates the flow of air passing into the fluid tank. The tank is vented to the atmosphere and is pressurized to 8±5 psig when the system is energized. When the cockpit switch is actuated, fluid is forced through either the wash or the anti-ice restrictor, whichever has been selected, and then on to the windshield. A greater flow of fluid is obtained through the wash restrictor. The fluid used in this system is a mixture of 50% alcohol and 50% water; however, either 100% water or 100% alcohol can be used. For servicing instructions, see Chapter 2, Section II, figure 2-33.

3-11. CONTROLS.

3-12. The Windshield Switch is a three-position toggle switch located on the weather control panel of the right overhead console (figure 3-1). The switch is spring-loaded to the OFF position and momentary to the other two positions. In the WASH position, fluid is forced through the wash restrictor and onto the windshield. In the ANTI-ICE position, the fluid flows through the anti-ice restrictor, at a reduced rate.

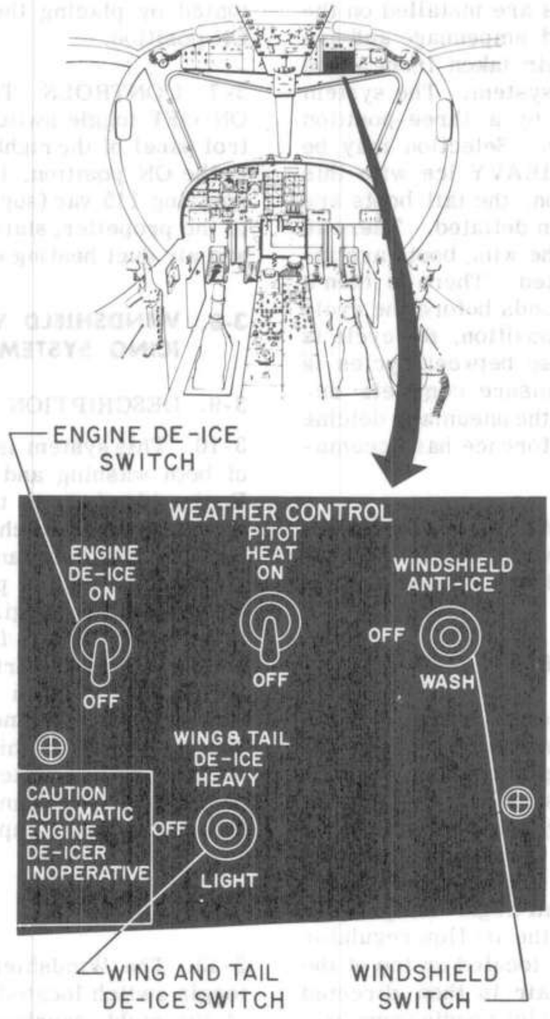


Figure 3-1. Weather Control Panel

Section IV. Armament System

4-1. EXTERNAL STORES SYSTEM.

4-2. DESCRIPTION.

4-3. GENERAL. The external stores system allows for installation of two external drop tanks or two external resupply containers (see figure 4-2) with normal and emergency means of release. A safety feature is included in the system to prevent accidental release of external stores when the aircraft landing gear is down. With the Landing Gear Handle in the down position, power is prevented from reaching the normal release system by the landing gear handle switch. To facilitate necessary ground release of external stores, normal release is available when the Armament Safety Disabling Switch is placed in the ARM position. Normal release power is applied to the stores selector panel through the DROP TANK REL and DROP TANK PWR circuit breakers. These circuit breakers receive power from the armament bus which is energized by the ARMT MASTER circuit breaker (Chapter 2, Section II, figure 2-16). Emergency release is accomplished through the Emergency Stores Release Handle which, when pulled, mechanically releases the stores. To prevent accidental release of external stores when the aircraft is on the ground, a safety pin is inserted through the SAFE hole of each bomb rack (see Chapter 3, Section II, figure 2-5). These safety pins must be removed prior to takeoff. The Aero 65A racks are used to carry either drop tanks or resupply containers.

4-4. AERO 65A RACK. The Aero 65A rack (figure 4-1) is a multipurpose installation. It provides adequate suspension and positive release for external stores in the 1000-pound class. Each rack includes an electrical release assembly, a linkage assembly, and appropriate wiring. All components are contained in or mounted on the rack frame. The action of the release plunger, controlled by switches on the stores selector panel, causes the rack hooks to open, releasing the external stores. The rack hooks can also be opened mechanically by pulling the Emergency Stores Release Handle.

4-5. OPERATING CONTROLS.

4-6. GENERAL. Controls for release of external stores are located on the stores selector panel (figure 4-3) and the pilot's stick grip (Chapter 6, Section V, figure 5-15).

4-7. STORES SELECTOR PANEL. (See figure 4-3.)

a. On 38 aircraft.

(1) Armament Power Switch. The Armament Power Switch must be placed in the ON position for the normal release system to be energized. Power is applied to the normal release system through the landing gear handle switch (No. 2). In flight, the Landing Gear Handle must be in the up position to close this switch and energize a power relay which in turn supplies power to the normal release system. The Armament Power Switch also supplies power to the FLARE ARM circuit breaker to arm the flare ejector subsystem of the photo system.

(2) Drop Tank Release Switch. The Drop Tank Release Switch provides a means of selecting the external store to be released. In the SAFE position, the normal release circuit is open; therefore, the external stores cannot be released electrically. In the LEFT or RIGHT position, the circuit is closed to either left or right external store and when the Stores Switch on the pilot's stick grip is depressed, power is applied to the release relay of the applicable rack. The rack hooks open when

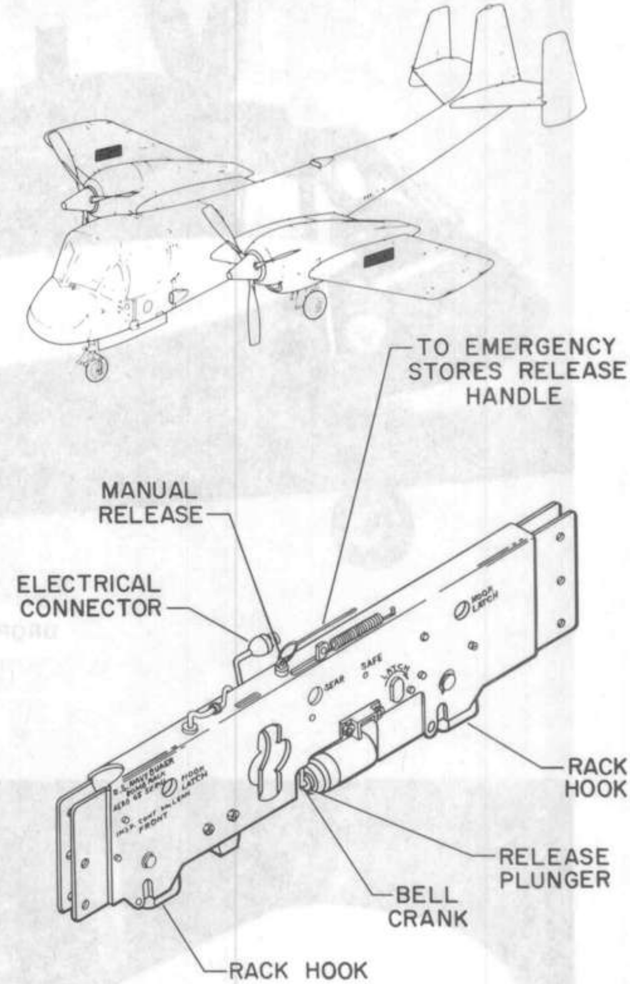


Figure 4-1. Aero 65A Rack

Figure 4-2. External Stores

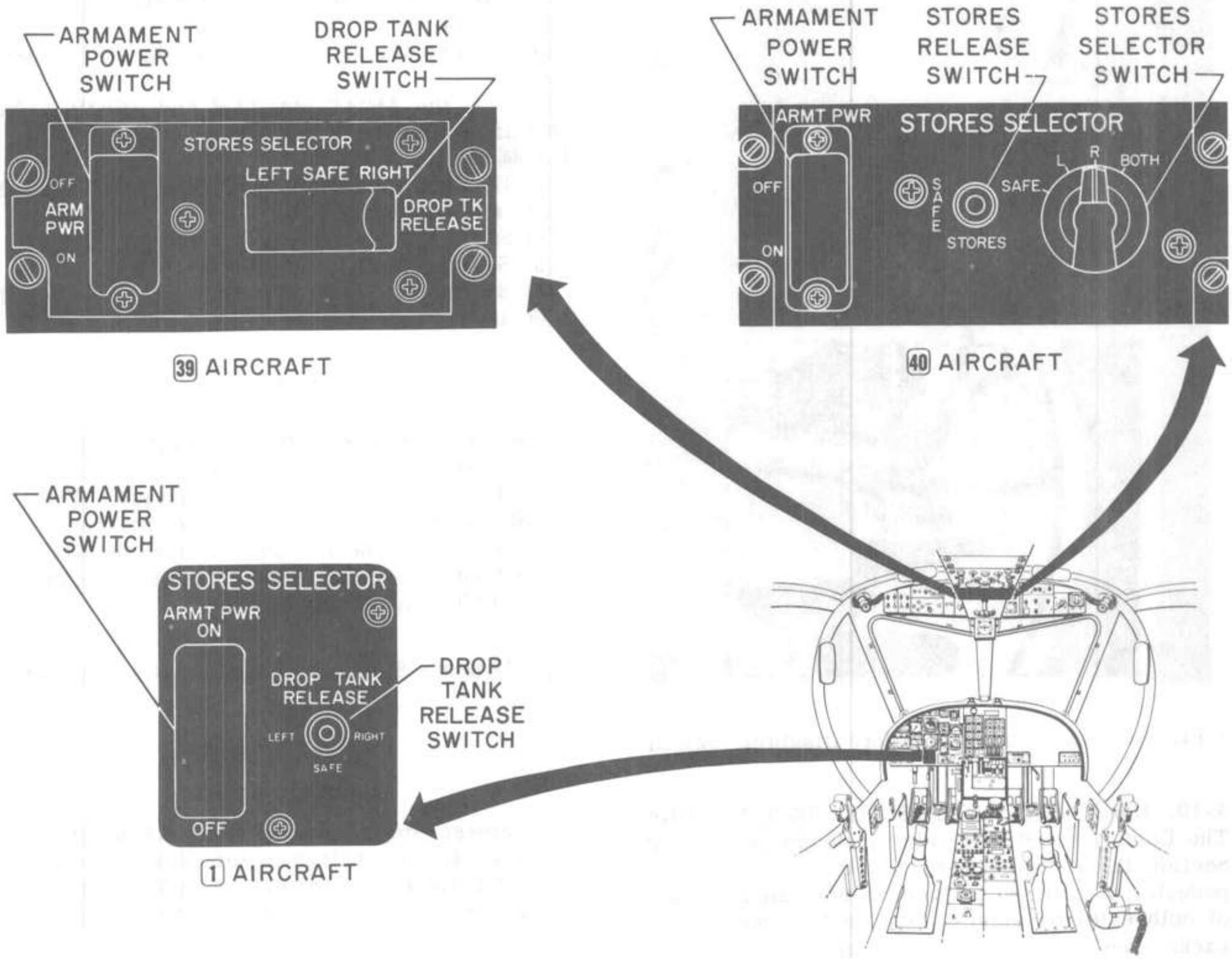


Figure 4-3. Stores Selector Panel

the release plunger extends by the energizing of the plunger solenoid.

b. 40 aircraft.

(1) Armament Power Switch. The armament power switch for these aircraft is as described in paragraph 4-7a. (1) above.

(2) Stores Release Switch. The stores release switch, in the SAFE position, opens the normal release circuit which does not permit the external stores to be released electrically. In the STORES position the circuit is closed to the external store selected on the stores selector switch.

(3) Stores Selector Switch. The stores selector switch is a stepping switch with which the external store to be released is selected. If L (left external store) is selected, the stores selector switch will step to R (right external store) when the stores switch on the pilot's stick grip is depressed. Each time the stores switch is depressed, the switch will step to the next selection. In SAFE, the circuit is open and no external store can be released.

4-8. ARMAMENT SAFETY DISABLING SWITCH. The Armament Safety Disabling Switch (figure 4-4) is located on the aft junction panel and provides the ground crew with a means of releasing external stores normally. With Landing Gear Handle in the down position, the landing gear handle switch in the normal release circuit is open; however, by placing the Armament Safety Disabling Switch to ON, the armament safety disabling relay energizes a power relay which in turn supplies power to the normal release system.

4-9. STORES SWITCH. The Stores Switch, located on the pilot's stick grip (Chapter 6, Section V, figure 5-15), allows power to be applied to the Drop Tank Release Switch. Power to the Stores Switch is made available through the DROP TANK REL circuit breaker. The ARMT MASTER circuit breaker must be depressed and the Armament Master Switch must be in the ON position in order for power to reach the Stores Switch.

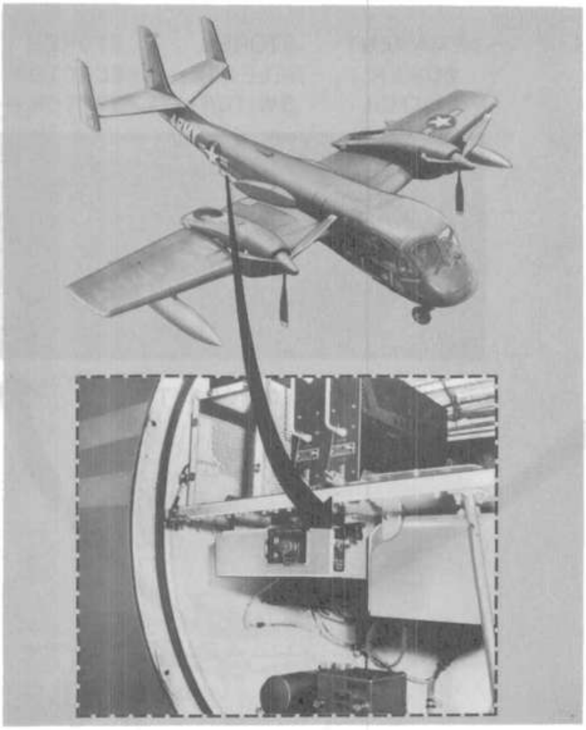


Figure 4-4. Armament Safety Disabling Switch

4-10. EMERGENCY STORES RELEASE HANDLE. The Emergency Stores Release Handle (Chapter 2, Section II, 3, figure 2-8), located on the control pedestal, provides simultaneous mechanical release of both external stores. The rack hooks on both racks open when the handle is pulled.

4-11. NORMAL OPERATION.

4-12. Power-off preflight inspection for the external stores system is accomplished as part of "Interior Check (All Flights)" in Chapter 3. Power-on preflight inspection is accomplished by the ground crew prior to loading external stores. For normal in-flight operation of the external stores system, proceed as follows:

a. 38 Aircraft.

(1) Depress the ARMT MASTER, DROP TANK PWR, and DROP TANK REL circuit breakers.
(2) Set Drop Tank Release Switch to LEFT or RIGHT as desired.
(3) Set Armament Power Switch to ON.
(4) Depress Stores Switch on pilot's stick grip to release store.

WARNING

Release empty external drop tanks only when the aircraft is in zero side slip and level flight. The trajectory path is erratic and is in close proximity to the aircraft.

(5) Place drop tank release switch in SAFE (guard down).
(6) Set armament power switch to OFF (guard down).
(7) Pull the ARMT MASTER and DROP TANK PWR and REL circuit breakers.

b. 40 aircraft.

(1) Depress the ARMT MASTER, DROP TANK PWR, and DROP TANK REL circuit breakers.
(2) Set Stores Release Switch to STORES.
(3) Set Armament Power Switch to ON.
(4) Set Stores Selector Switch to L, R or BOTH as desired.

NOTE

When the Stores Switch on the pilot's stick grip is depressed, the external store, as set in step (4) above, will release. The Stores Selector Switch will then step clockwise to the next selection and the next external store will release when the Stores Switch is again depressed.

(5) Depress Stores Switch on pilot's stick grip.

WARNING

Release empty external drop tanks only when the aircraft is in zero side slip and level flight. The trajectory path is erratic and is in close proximity to the aircraft.

(6) If the next external store is to be released, depress the Stores Switch again, and proceed with steps (7) through (9). If it is not desirable to release the next external store, proceed with steps (7) through (9), but do not depress Stores Switch.
(7) Place Stores Release Switch in SAFE.
(8) Set Armament Power Switch in OFF (guard down).
(9) Pull the ARMT MASTER and DROP TANK PWR and REL circuit breakers.

4-13. EMERGENCY OPERATION.

4-14. To release external stores from both left and right racks, pull the Emergency Stores Release Handle to its limit.

WARNING

Release empty external drop tanks only when the aircraft is in zero side slip and level flight. The trajectory path is erratic and is in close proximity to the aircraft.

Section V. Photographic Equipment

5-1. OVERALL DESCRIPTION OF PHOTO SYSTEM.

5-2. GENERAL.

5-3. The photo system installed in the AO-1 aircraft (Photographic Surveillance System KS-61) can perform both day and night (photoflash) aerial photography. A choice of operating modes can be selected to suit the particular requirements of the planned mission. The photo system consists of a camera system and a camera control system, which are described below.

5-4. CAMERA SYSTEM.

5-5. The camera system includes Still Picture Camera KA-30A and Lens Cone Group LA-136A. Still Picture Camera KA-30A is a compact aerial reconnaissance camera capable of taking exposures over a wide range of altitudes and groundspeeds during day or night mission. When a wider angle of view is needed to provide greater terrain coverage, Lens Cone Group LA-136A is used. Automatic, semiautomatic, or manual operation for day or night photography is accomplished by selecting one of the following operating modes:

a. Autocycle (Camera Mode Selector at AUTO REMOTE). In the Autocycle mode, the camera control system scans the terrain for brightness and image motion, and automatically sets the camera for correct exposure, image motion compensation (IMC), and exposure interval to produce 60% forward overlap for stereoscopic coverage.

b. Pulse without IMC (Camera Mode Selector at PULSE). In the Pulse without IMC mode, the operator must set the camera for correct exposure and set the exposure interval to produce any desired forward overlap. IMC is not used in this mode.

c. Pulse with IMC (Camera Mode Selector at PULSE W/IMC). In the Pulse with IMC mode, operator must set the camera for correct exposure, IMC rate, and exposure interval to produce any desired forward overlap up to 80%.

d. Night (Camera Mode Selector at NITE). In the mode, the operator must set the camera for correct exposure, IMC rate, and control equipment to release flares (photoflash cartridges) at the correct interval to produce any desired forward overlap up to 80%. The camera shutter is automatically opened before each cartridge is released and is closed after the flare cartridge explodes.

5-6. CAMERA CONTROL SYSTEM.

5-7. The camera control system operates the camera and flares and tells the operator how they are functioning. The system also provides timed pulses for stereo coverage (approximately 60% overlapping), vertical photography, and/or a servo drive voltage to move the film in the camera at the same speed as the ground image is expected to move (IMC). The pulse interval rate or the IMC rate with synchronization angle correction is manually controlled by the values of velocity and ground clearance set on the photo control panel or automatically oontrolled by the V/H scanner subsystem. In-flight selection must be made for either manual (COMPUTER) or automatic (SCANNER) V/H input. The automatic V/H scanner subsystem can be used for day photography only. In flight, mode selection may be made only to the extent of choosing between the Autocycle and Pulse without IMC modes. Of the four modes of camera operation, all modes except the Night mode are used for day photography.

5-8. DESCRIPTION OF SUBSYSTEMS AND COMPONENTS.

5-9. CAMERA SYSTEM.

5-10. GENERAL. Camera system components include the camera (with integral 6-inch lens cone), the alternate 3-inch lens cone, and the filters supplied with both lens cones. The camera (figure 5-1) consists of the camera body, a 6-inch lens cone, and minor components.

5-11. CAMERA BODY. The camera body houses the mechanisms for film transport, image motion compensation, and mode selection. The upper part of the camera body holds the cassettes in place, and controls the cassette film spools through spool couplings. Control voltages and power are received from the lens cone through a connector at the bottom of the camera body. A data unit aperture in the camera body records information on the film from the lens cone data unit. The camera cycle counter and Mode Selector Switch are located on the rear of the camera body.

5-12. LENS CONES. The lens cone (figure 5-2) houses the lens assembly, data unit, shutter, and the mechanisms to adjust the diaphragm and operate the shutter. The 3-inch lens cone and 6-inch lens cone are functionally similar except for terrain coverage. Primary and secondary control cables provide control voltages and power to the lens cone and camera body. The S/C control provides film speed and filter correction information to the exposure determination circuits.

5-13. CASSETTES. Two identical cassettes (figure 5-2) are used during operation of the camera. One cassette is loaded with a spool of unexposed film and is mounted on the left side of the camera body. The other cassette contains an empty spool and is mounted on the right side of the camera body. The film FEET REMAINING indicator is visible on the supply side but is not visible on the cassette that is mounted on the takeup side of the camera body.

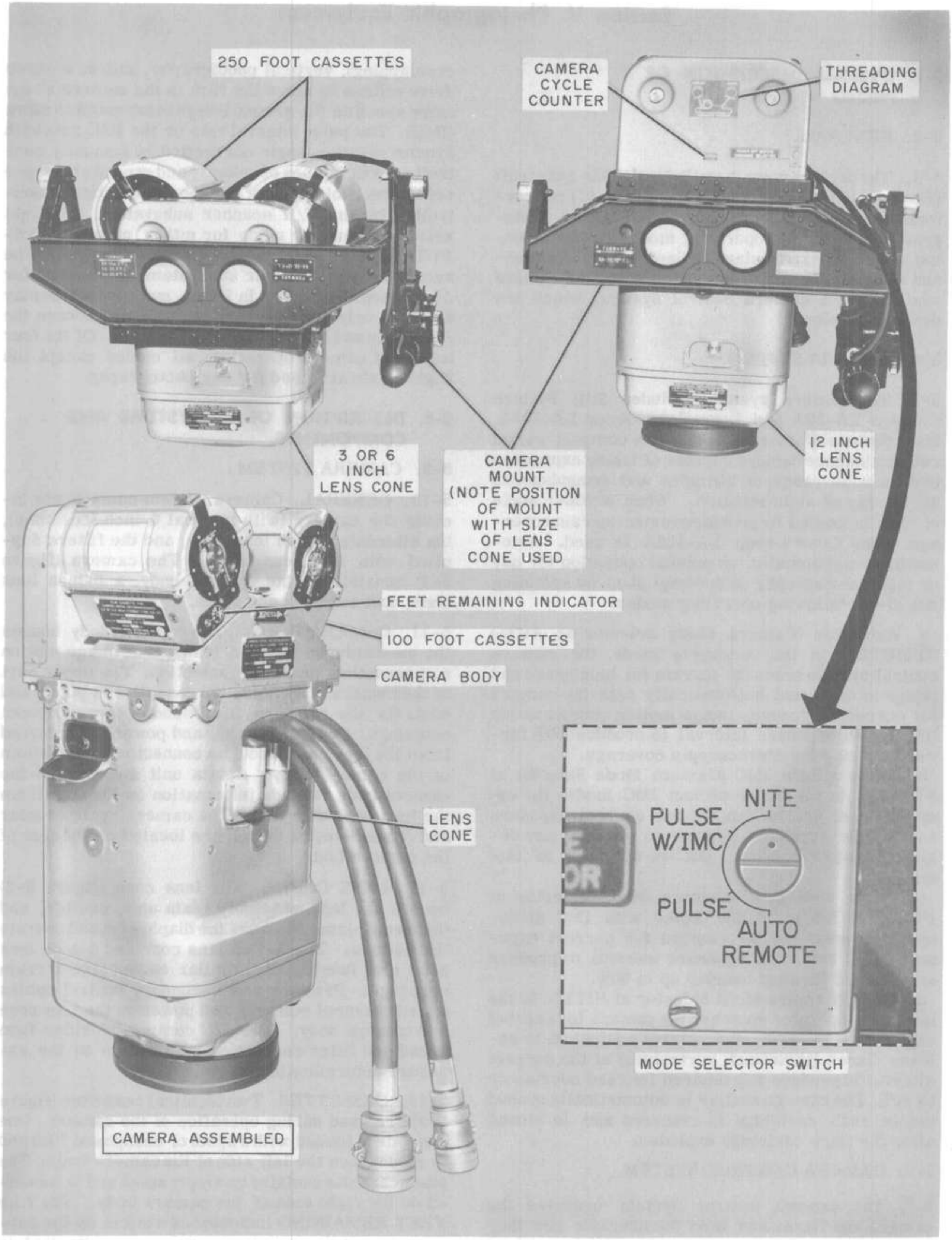


Figure 5-1. Camera Assembled

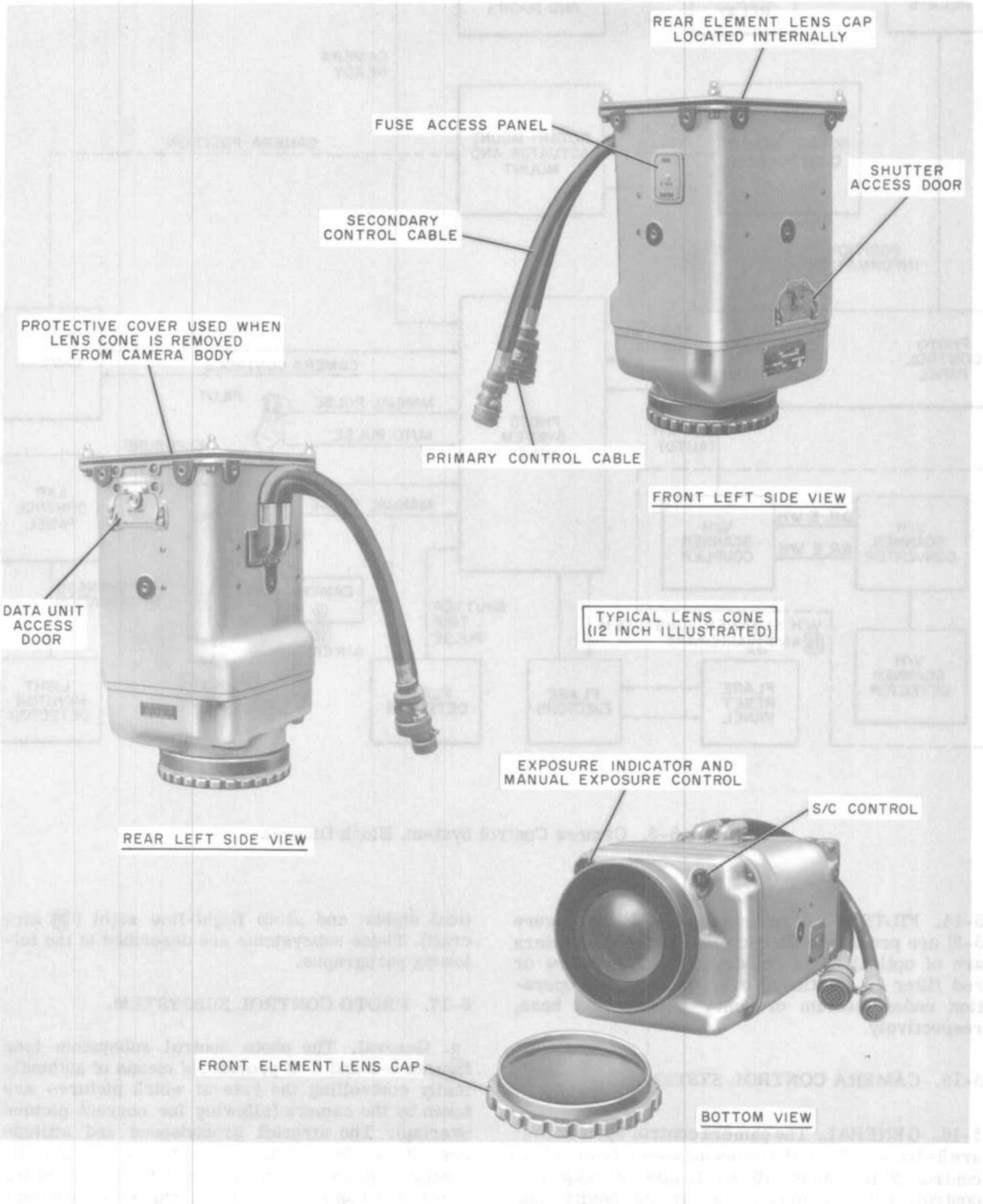


Figure 5-2. Lens Cone

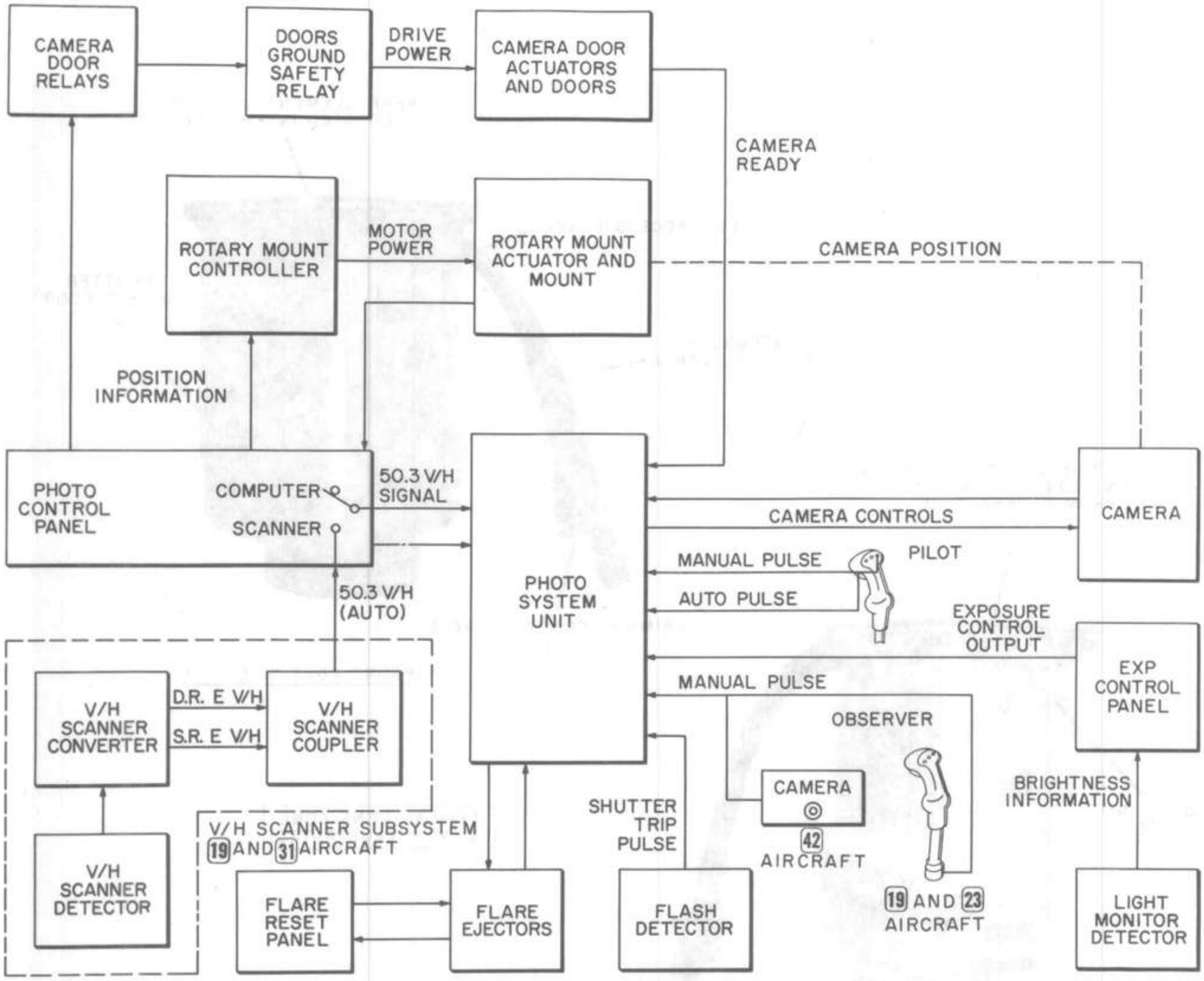


Figure 5-3. Camera Control System, Block Diagram

5-14. FILTERS. A yellow and red filter (figure 5-2) are provided with each lens cone. The filters are of optical glass construction. The yellow or red filter is positioned over the lens for operation under medium or heavy atmospheric haze, respectively.

5-15. CAMERA CONTROL SYSTEM.

5-16. GENERAL. The camera control system (figure 5-3) consists of the following subsystems: photo control; V/H scanner 19 and 31 aircraft; exposure control; camera mount and mount positioning; camera window doors; flare ejection; oblique optical sights; and photo flight-line sight (20 aircraft). These subsystems are described in the following paragraphs.

5-17. PHOTO CONTROL SUBSYSTEM.

a. General. The photo control subsystem (see figures 5-3 and 5-4) provides a means of automatically controlling the rate at which pictures are taken by the camera (allowing for correct picture overlap). The aircraft groundspeed and altitude are set into the control system by the operator by means of an antilog type potentiometer, the setting of which is controlled by positioning two drum-type controls mounted on the photo control panel. Con-

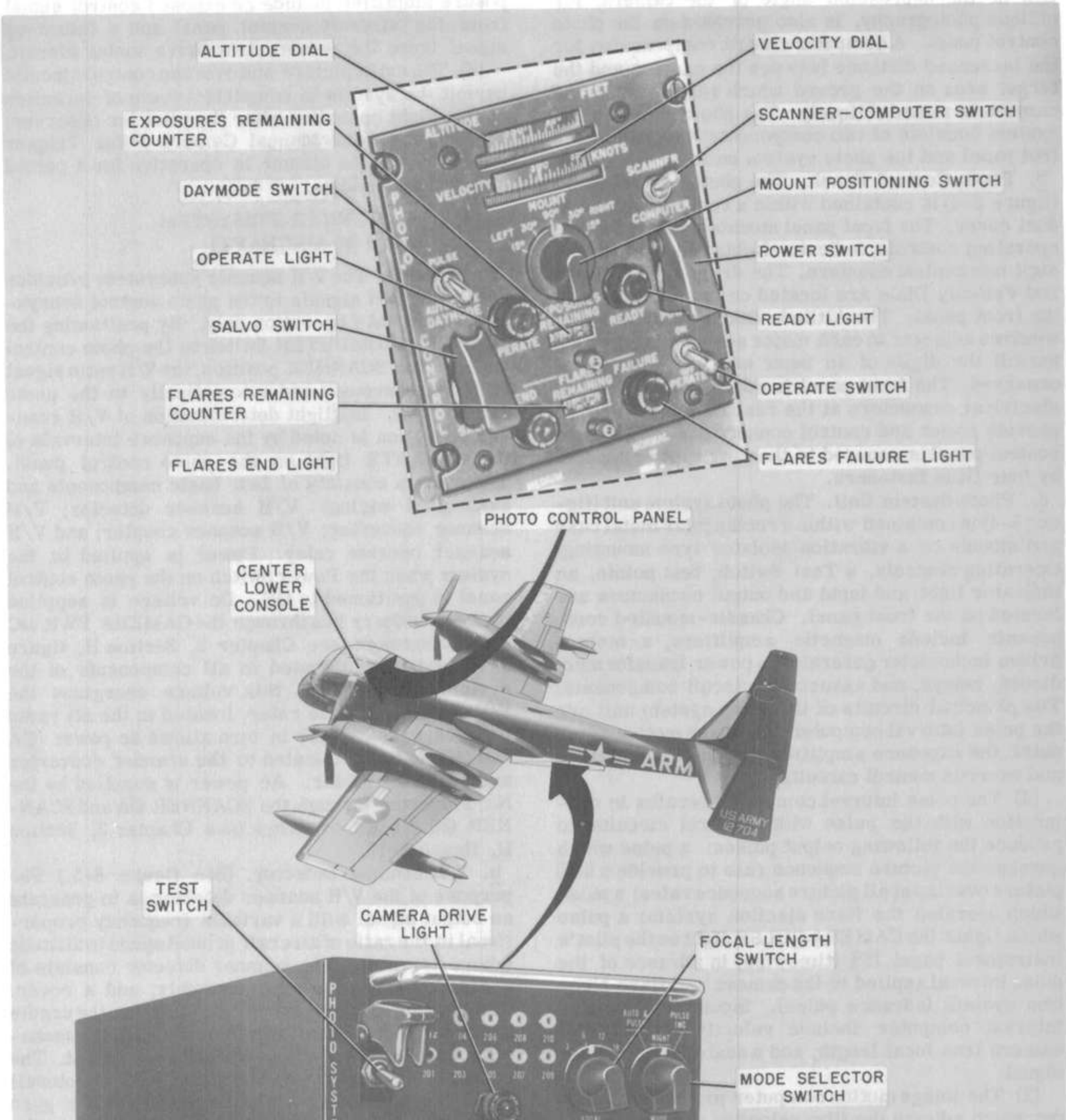


Figure 5-4. Photo Control Subsystem Components

trol of the depression angle of the camera, for oblique photography, is also provided on the photo control panel. A computer circuit compensates for the increased distance between the camera and the target area on the ground which results when the camera is aimed obliquely. The photo control subsystem consists of two components: the photo control panel and the photo system unit.

b. Photo Control Panel. The photo control panel (figure 5-4) is contained within a rectangular metal dust cover. The front panel mounts a Power Switch, operating controls, indicator lights, and two three-digit mechanical counters. The drum-type Altitude and Velocity Dials are located on the upper part of the front panel. The Altitude Dial is provided with windows adjacent to each major scale division which permit the digits of an inner multiplier dial to be observed. The front panel is edge-lighted, and two electrical connectors at the rear of the dust cover provide power and control connections. The photo control panel is secured to the center lower console by four Dzus fasteners.

c. Photo System Unit. The photo system unit (figure 5-4) is contained within a rectangular metal case and mounts on a vibration-isolator type mounting. Operating controls, a Test Switch, test points, an indicator light, and input and output connectors are located on the front panel. Chassis-mounted components include magnetic amplifiers, a motor-driven tachometer generator, a power transformer, diodes, relays, and associated circuit components. The principal circuits of the photo system unit are the pulse interval computer, the image motion computer, the exposure amplifier, and the extra picture and overrun control circuits.

(1) The pulse interval computer operates in conjunction with the pulse width control circuits to produce the following output pulses: a pulse which governs the picture sequence rate to provide a 60% picture overlap at all picture sequence rates; a pulse which operates the flare ejection system; a pulse which lights the CAMERA PULSE light on the pilot's instrument panel 15% (timewise) in advance of the pulse interval applied to the camera and flare ejection system (advance pulse). Inputs to the pulse interval computer include velocity/height data, camera lens focal length, and a scale factor change signal.

(2) The image motion computer produces an output which adjusts the film velocity, during the exposure interval, at a rate corresponding to the motion of the film. Thus, an essentially stable image is recorded on the film. The image motion computer is provided with control and signal inputs which originate in the photo control panel, the photo system unit, and the camera. These signals are as follows: velocity/height; camera lens focal length; camera depression angle; camera film speed (a follow-up signal).

(3) The exposure amplifier produces an output which causes the camera iris drive motor to adjust the camera iris diaphragm to the proper opening to insure correct film exposure. Inputs to the exposure amplifier include an exposed control signal from the aircraft control panel and a follow-up signal from the camera iris drive motor circuit.

(4) The extra picture and overrun control circuits permit the system to complete a cycle of operation during night operation after the pilot (or observer) has depressed the Manual Camera Pulse Trigger (or Button). The circuit is operative for a period of 6 to 10 seconds.

5-18. V/H SCANNER SUBSYSTEM (19 and 31 AIRCRAFT).

a. General. The V/H scanner subsystem provides automatic V/H signals to the photo control subsystem during DAY operation only. By positioning the SCANNER-COMPUTER Switch on the photo control panel to the SCANNER position, the V/H ratio signal is fed continuously and automatically to the photo system unit. In-flight determination of V/H scanner operation is noted by the exposure intervals of the OPERATE light on the photo control panel. The system consists of four basic components and associated wiring: V/H scanner detector; V/H scanner converter; V/H scanner coupler; and V/H scanner operate relay. Power is applied to the system when the Power Switch on the photo control panel is positioned to ON. Dc voltage is supplied by the secondary bus through the CAMERA PWR DC circuit breaker (see Chapter 2, Section II, figure 2-16) and is distributed to all components of the system. In addition, this voltage energizes the V/H scanner operate relay, located in the aft radio junction panel, which in turn allows ac power (ØA and ØB) to be distributed to the scanner converter and scanner coupler. Ac power is supplied by the No. 1 inverter through the SCANNER ØA and SCANNER ØB circuit breakers (see Chapter 2, Section II, figure 2-16).

b. V/H Scanner Detector. (See figure 5-5.) The purpose of the V/H scanner detector is to generate an output signal with a variable frequency proportional to the ratio of aircraft ground speed to altitude (above terrain). The scanner detector consists of a cast housing, a cradle assembly, and a cover. The housing affords: two pivot points for the cradle assembly; support for a gyroscopic caging mechanism and electrical components; and a mount. The cradle assembly includes two lens-grid-photocell assemblies, a single stage amplifier, and a gyro stabilizer. The scanner detector is located in the V/H scanner equipment compartment, and a glass window mounted in the fuselage skin beneath the scanner detector permits light images to pass through to the lens-grid-photocell assemblies.

(1) Scanning. (See figure 5-6.) The output signal of the scanner detector is developed by the two lens-grid-photocell assemblies and the single stage amplifier. Each of the lens-grid-photocell assemblies consists of an objective lens, an optical grid (common to both lens-grid-photocell assemblies). condensing lenses, and a photocell. Each objective lens, having a 2-inch focal length, produces an image of the terrain on the optical grid. The optical

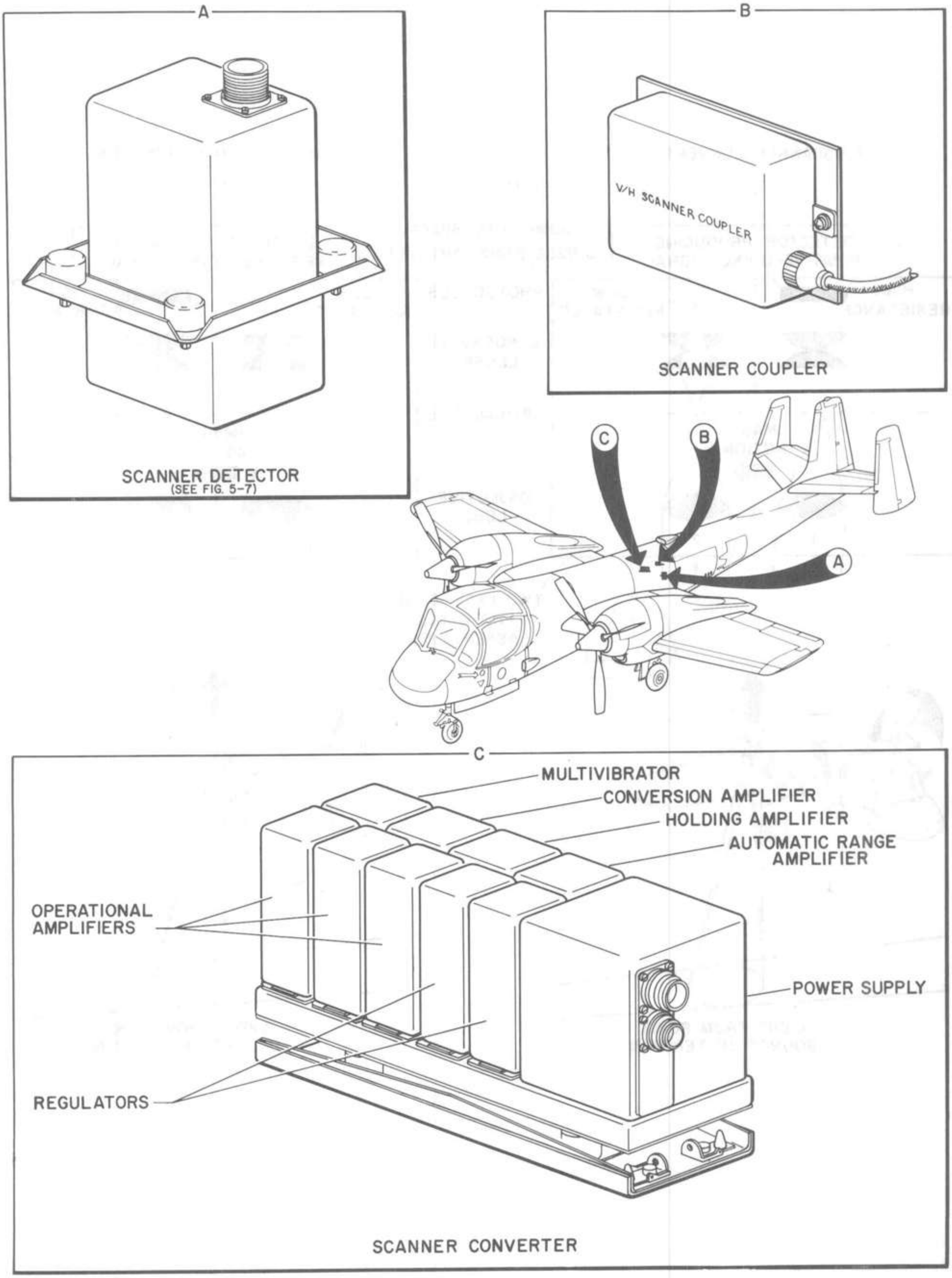


Figure 5-5. V/H Scanner Subsystem Components (19 and 31 Aircraft)

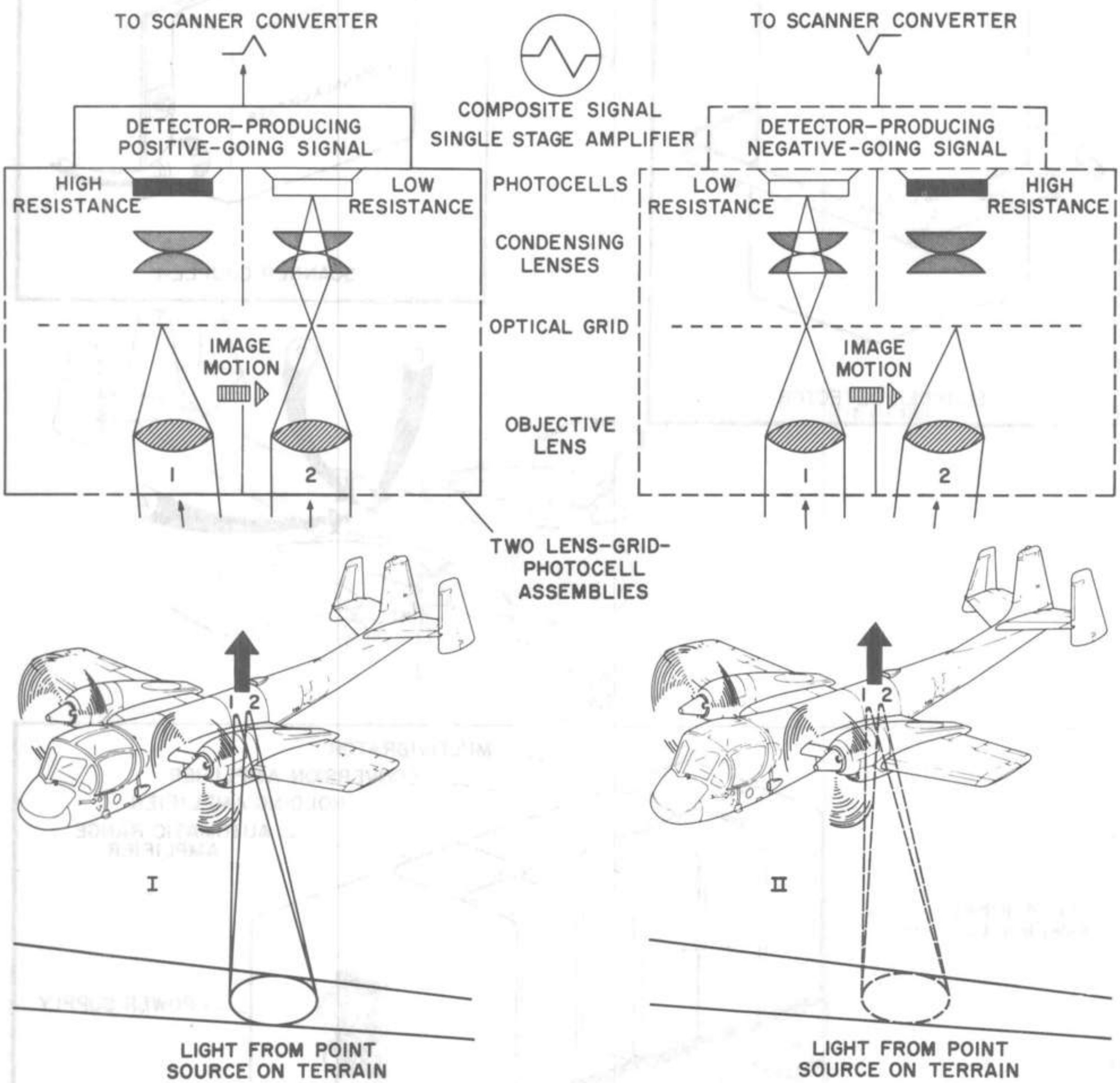


Figure 5-6. V/H Scanner Detector, Schematic (19 and 31 Aircraft)

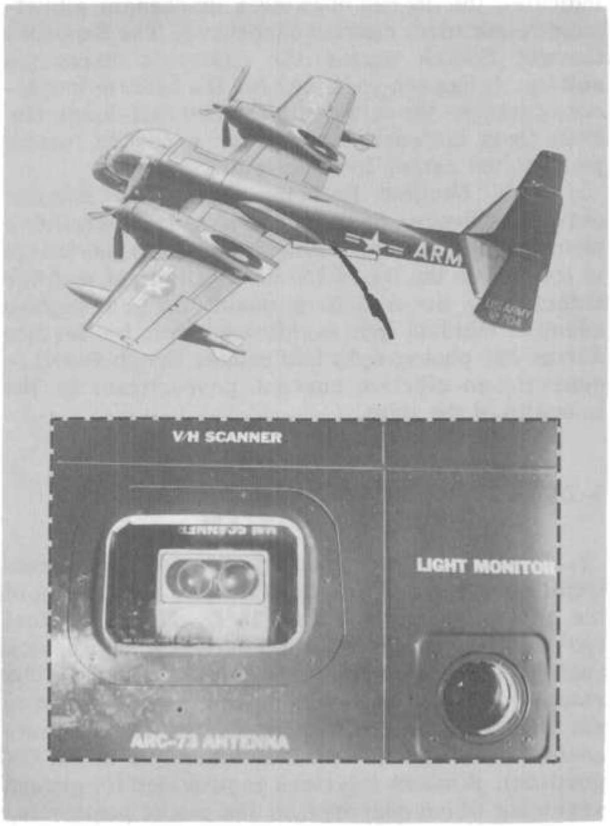


Figure 5-7. Scanner Detector and Light Monitor Detector, Exterior View

grid consists of a glass plate which is etched with a series of parallel opaque lines of equal width and spacing (0.010 inch) placed at right angles to the aircraft flight direction. The pair of condensing lenses are used to focus each grid image on the surface of the corresponding photocell. The photocell acts as a variable resistor which varies its resistance inversely with the intensity of the light striking its surface. The opaque lines on the optical grid prevent light from reaching the photocell. The two objective lenses are phased so that sections of the terrain image focused by one lens on the clear areas of the optical grid are focused by the other objective lens on the opaque areas of the optical grid (see configuration I, figure 5-6). Forward movement of the aircraft (see configuration II, figure 5-6), sufficient to change the angular aspect of the detector objective lenses to a point on the terrain by approximately one-quarter of a degree, causes an 0.010-inch advance of each grid image. As objects of different brightness on the ground move through the field of vision of the detector, their images are impressed alternately on clear and opaque areas of the optical grid and alternately activate each photocell. The electrical resistance of the photocells increases and decreases inversely to the amount of light reaching them, and the output V/H signal varies in frequency corresponding to the resistance changes of both photocells. The circuit which actually produces this variable frequency (the single stage amplifier) has been represented in figure 5-6 as a box, and its theory of operation has been omitted to avoid lengthy circuit analysis. The scanner detector scans many light sources on the earth's surface, and the reflected light from these sources striking the lenses results in a detector output which resembles a sinusoidal wave. The approximate waveform as an output signal is a measure of V/H in terms of frequency, and is expressed by the formula:

$$f = 168.9\ V/H$$

where: f = frequency in cycles per second
V = ground speed in knots
H = altitude in feet

Examination of the formula shows that with a constant altitude, the output signal frequency will increase as the aircraft ground speed increases, and with a constant ground speed, the output frequency will decrease with an increase in altitude.

(2) Gyro Stabilization and Caging. Since it is the function of the detector to sense the angular passage of the terrain produced by the forward motion of the aircraft, any factor which affects this rate introduces an error. At high altitudes, the motion of the aircraft about its pitch axis would tend to render the output of a rigidly mounted detector uneven and unreliable. This source of error is eliminated by means of a gyroscope which stabilizes the scanning components of the detector. The gyroscope operates as long as the photo system power is on. Any motion of the aircraft about its pitch axis will cause the housing of the detector to tilt but will not change the position of the gyroscope and the lens-grid-photocell scanning components unless the caging mechanism is activated. The caging mechanism erects the gyroscope and the scanning components whenever the axis of the gyroscope varies approximately 5 degrees from its previous caged position (approximately 5 degrees from the axis of the detector normal to its mounting surface). The caging mechanism also holds the scanning components stationary when the photo system power is turned off. The purpose of the caging action is to prevent erratic and possibly damaging motion of the movable scanning components during takeoff and landing, and to reposition these components during flight in the event of a change in altitude or if the gyroscope drifts beyond the specified 5 degrees.

c. V/H Scanner Converter. (See figure 5-5.) The purpose of the scanner converter is to convert the variable frequency signal from the scanner detector into dc voltage proportional to the aircraft ground-speed-to-altitude ratio, suitable to drive IMC controlled components of the photo control subsystem and control the picture-taking rate of the camera. The scanner converter is located in the V/H scanner equipment compartment and is composed of ten individually packaged units which are plugged into a chassis assembly containing the necessary interconnecting circuitry. The units are identified in figure 5-5. All the plug-in units are hermetically sealed except the power supply. The scanner converter is fully automatic and operates when the photo system power is turned on. The converter will not respond immediately to any large changes in detector output signals until it has determined whether the signal change is spurious or true. Erroneous signals or false indications can be caused by clouds, and the converter will hold on to the last reliable signal until it receives another true signal. The dc output signal voltage level, E V/H, from the converter is equal to 50.3 V/H (Single Range) or 503 V/H (Dual Range).

d. V/H Scanner Coupler. (See figure 5-5.) The V/H scanner coupler, located in the photo equipment compartment, consists of a relay, a synchroverter, and a transformer. In addition to being an impedance matching device for the V/H scanner subsystem, the scanner coupler steps down the 503 V/H signal from the converter to 50.3 V/H so that the output signal to the photo system unit will always be 50.3 V/H when the converter is operating in single or dual range (see figure 5-3).

5-19. EXPOSURE CONTROL SUBSYSTEM.

a. General. The exposure control subsystem (see figures 5-3 and 5-8) provides indication of terrain illumination and remote setting of the camera lens exposure. This system is used for day photography. For a night mission, the camera diaphragm will be set to widest opening by setting the Exposure Control Switch fully clockwise to the DULL position. The camera exposure control is set manually on the ground, but in-flight exposure control is provided with the use of the light monitor detector. The light monitor detector is a photocell which generates a signal which can be observed on the Exposure Meter. By rotating the Exposure Control Switch, the signal indicated on the meter can be centered, indicating a normal exposure, and the camera diaphragm and timing mechanism are remotely adjusted. The camera exposure setting will then be equivalent to the terrain brightness. The operator may under- or overexpose as much as two light stops indicated on the Exposure Meter. The camera provides exposure correction for the film speed and filters used by adjusting the S/C Control. The S/C ratio is determined by the following equation:

$$S/C = \frac{\text{film speed}}{\text{filter factor}}$$

Filter factor is equal to 1 when no filter is being used. The exposure control subsystem includes the exposure control panel and the light monitor detector.

b. Exposure Control Panel. The exposure control panel (figure 5-8) contains an Exposure Meter and Exposure Control Switch. The Exposure Meter indicates the degree of camera diaphragm adjustment required for correct exposures. The Exposure Control Switch varies the camera's diaphragm setting. It has ten positions for the terrain brightness covering the range of 4 to 2200 foot-lamberts. Four Dzus fasteners secure the exposure control panel to the center lower console.

c. Light Monitor Detector. The light monitor detector (figure 5-8) contains a light-sensitive photocell and a lens. A single electrical receptacle is located on the top of the unit. The light monitor detector is secured to a mount by four captive screws. Incident light is reflected from the terrain during day photography and causes the photocell to generate an electric current proportional to the intensity of the light.

5-20. ROTARY MOUNT AND MOUNT POSITIONING SUBSYSTEM.

a. General. The mount positioning subsystem (figure 5-3 and 5-9) provides remote positioning of the rotary mount to either 15°L, 30°L, vertical (90°), 30°R, or 15°R for optical-axis depression angles below the horizontal reference line. The rotary mount automatically drives to a position preset by the Mount Positioning Switch on the photo control panel (the Power Switch must be in the ON position). A mount interlock is provided for ground servicing which deenergizes the mount positioning drive power when the camera access door is open. When the rotary mount is nulled at its preset depression angle, the READY light on the photo control panel will go on. The mount positioning subsystem consists of a rotary mount controller, and a rotary mount actuator.

b. Rotary Mount Controller. The rotary mount controller (figure 5-9) functions in conjunction with the rotary mount and the Mount Positioning Switch. It is electrically connected to the rotary mount actuator and causes the rotary mount to rotate to the preset position.

c. Rotary Mount and Rotary Mount Actuator. The rotary mount and rotary mount actuator (figure 5-9) position the camera to within ±0.5° of each of the positions selected with the Mount Positioning Switch. No more than 20 seconds is required to transfer the camera from one extreme oblique position to the other. The camera window doors operate in conjunction with the actuator. The camera is secured to the rotary mount by screws. The number of screws depends on the type of lens cone being used. The rotary mount is installed in an inverted position when the 12-inch lens cone is used.

5-21. CAMERA WINDOW DOORS SUBSYSTEM.

a. General. The camera window doors subsystem (figures 5-3 and 5-10) provides remote control of the left, right, and center doors to uncover the respective optical window for the selected camera de-

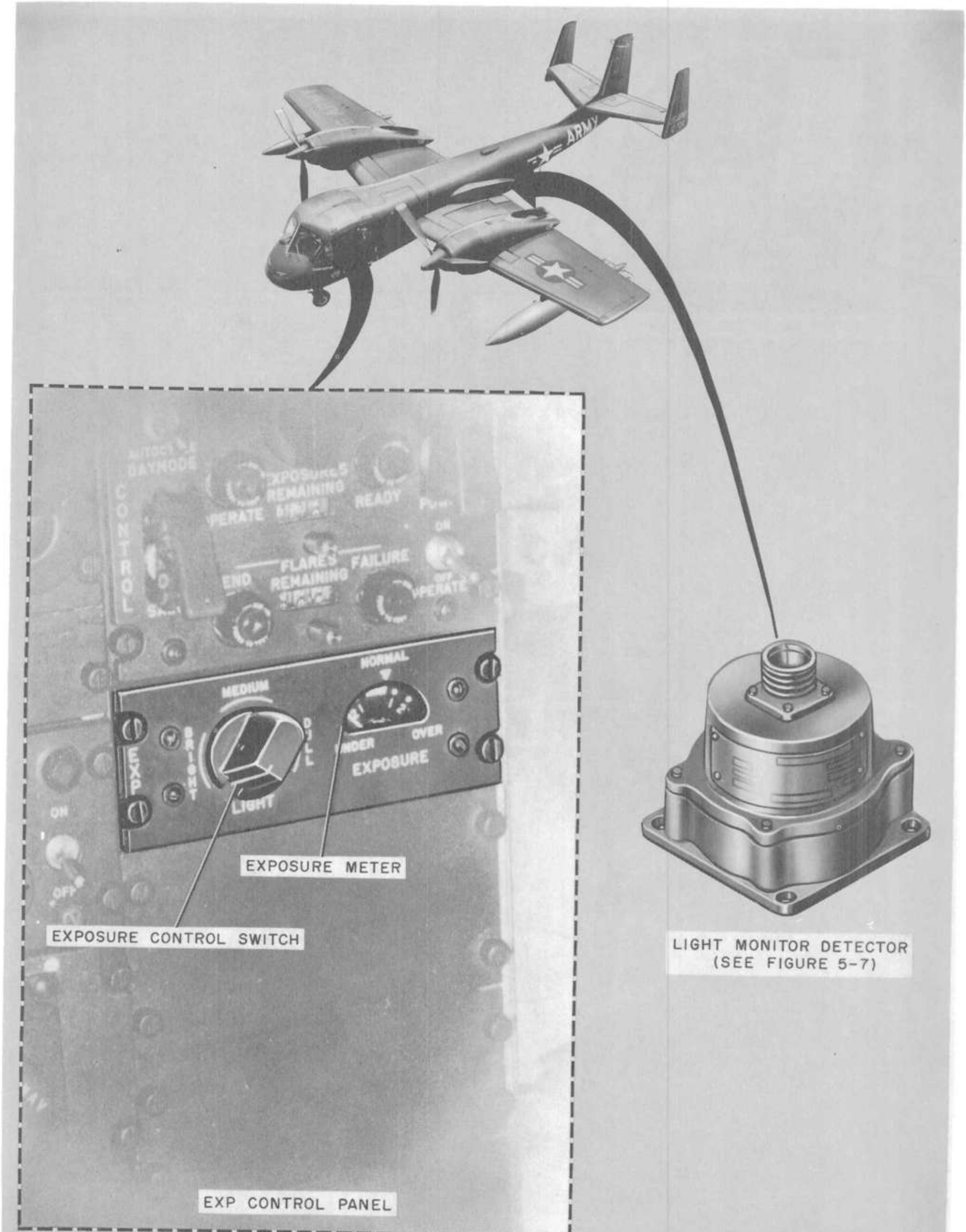


Figure 5-8. Exposure Control Subsystem Components

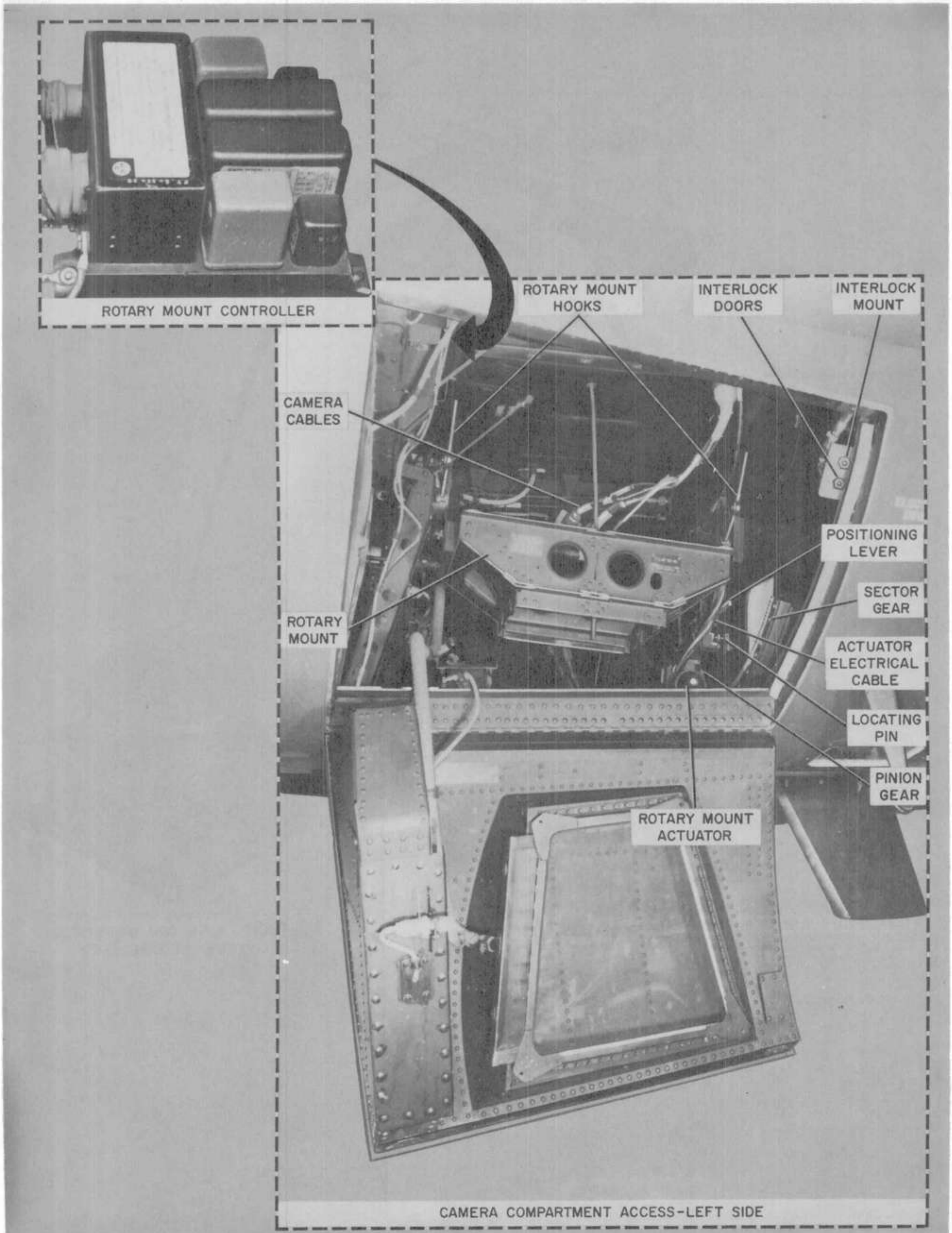


Figure 5-9. Rotary Mount and Mount Positioning Subsystem Components

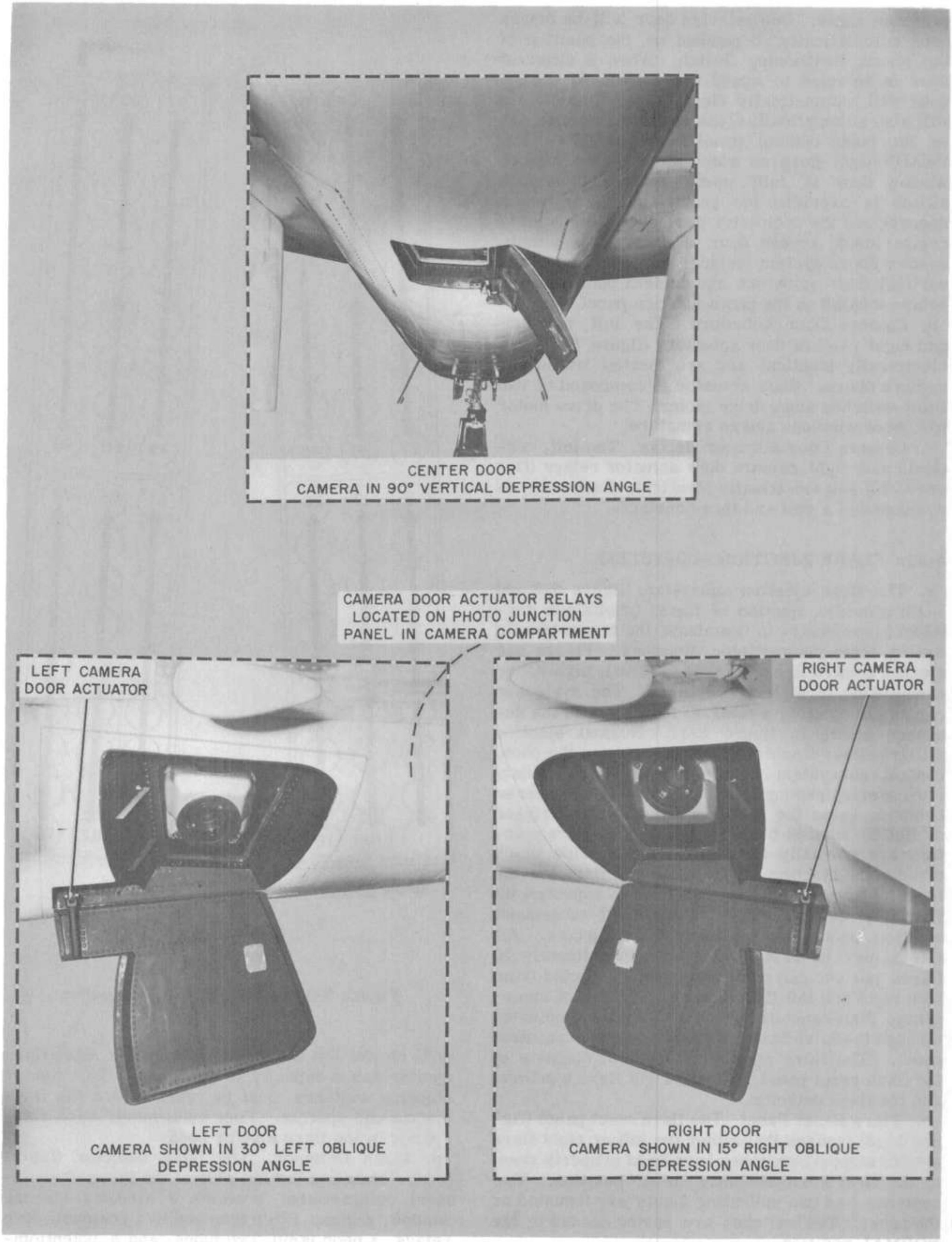


Figure 5-10. Camera Window Doors Subsystems Components

pression angle. One selected door will be driven open automatically, dependent on the position of the Mount Positioning Switch. When a different door is selected to open, the previously opened door will automatically close. The window doors will also automatically close when the Power Switch on the photo control panel is set to OFF. The READY light goes on when the selected camera window door is fully open. A doors interlock switch is provided for ground servicing which deenergizes the door drive power when the camera compartment access door is open. The camera window doors system includes the left, right, and vertical door actuators and camera door actuator relays located on the photo junction panel.

b. Camera Door Actuators. The left, vertical, and right camera door actuators (figure 5-10) are electrically identical and are located within the camera doors. Each actuator is composed of two limit switches and a drive motor. The drive motor has three windings and an armature.

c. Camera Door Actuator Relays. The left, vertical, and right camera door actuator relays (figure 5-10) are electrically identical. Each relay is composed of a coil and three contacts.

5-22. FLARE EJECTION SUBSYSTEM.

a. The flare ejection subsystem (figure 5-3 and 5-13) provides ejection of flares (photoflash cartridges) necessary to illuminate the target terrain during night photographic missions. Flares are ejected upward to extend the low-level, high-speed capabilities of night photography. The system is capable of ejecting a total of 104 flares in the sequence shown in figure 5-11. Normal ejection utilizes either timed ejection pulses from the photo control subsystem in accordance with V/H data (60% overlap photographs) or single flare release override using the Manual Camera Pulse Trigger or Button (figures 5-15 and 5-16). The flare ejectors are normally fired in the train mode which directs the ejection pulses to the left flare ejector first. After the left flare ejector has expended its flares, it automatically transfers all subsequent ejection pulses to the right flare ejector. All flares may be rapidly ejected (approximately 10 flares per second) or simultaneously ejected from both right and left flare ejectors in case of emergency. Simultaneous flare ejection is accomplished through the Salvo Switch located on the photo control panel. The flare ejection subsystem consists of the flare reset panel, left and right flare ejectors, and the flash detector.

b. Flare Reset Panel. The flare reset panel (figure 5-13) insures that either the left or right flare ejector stepping switches have been properly reset to the first available flare firing position. Two switches and two indicating lights are mounted on the panel. The switches are spring-loaded to the NORMAL position.

c. Left and Right Flare Ejectors. The left and right flare ejectors (figure 5-13) are mounted in

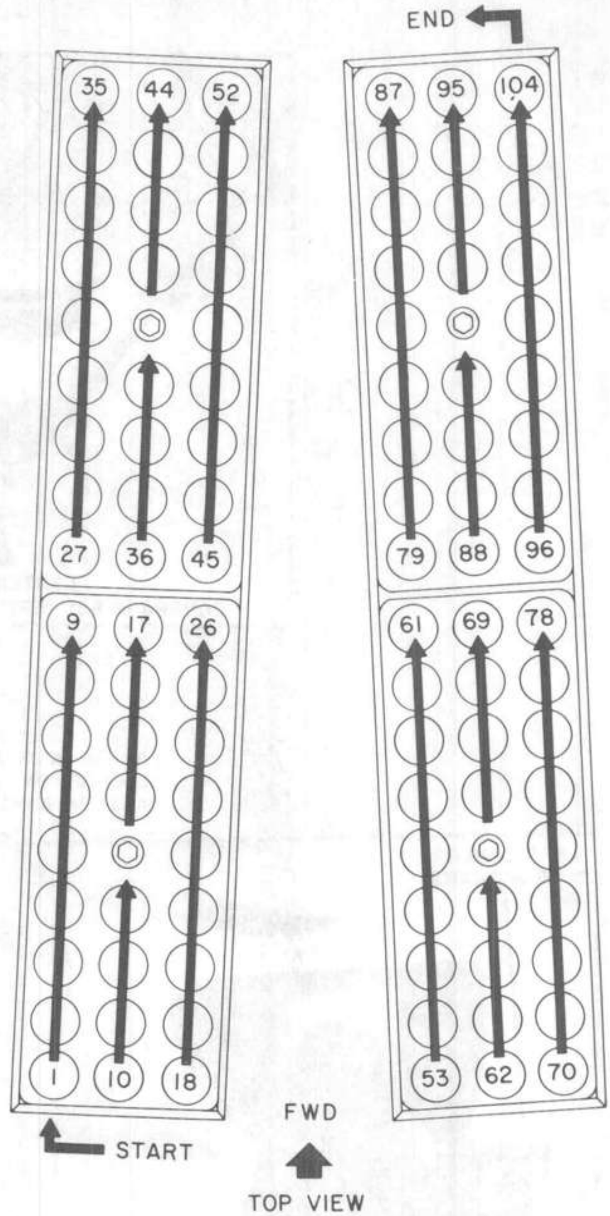


Figure 5-11. Flare Ejection Sequence

pods on the left and right wing roots. Each flare ejector has a capacity of 52 flares. The ejector stepping switches must be reset before the flare ejector can operate. Four bolts mount each flare ejector to the flare ejector pods.

d. Flash Detector. The flash detector (figure 5-13), located on the left side of the forward equipment compartment, contains a circular viewing window, a glass filter attached to a photocell, two relays, a neon lamp, two tubes, and a potentiometer. An electrical connector is located on top of the cylindrical housing. The flash detector is

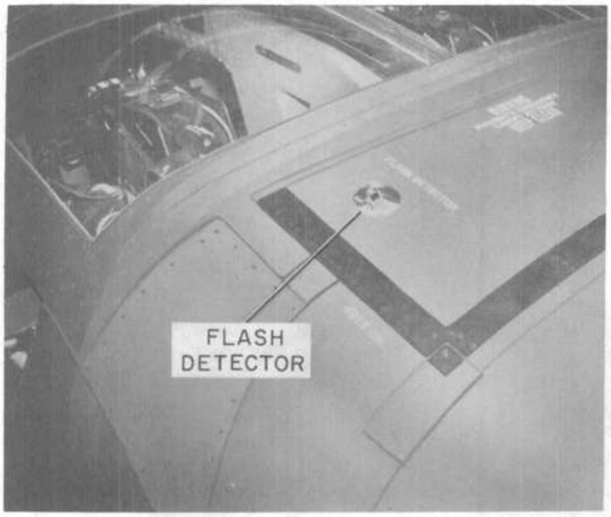


Figure 5-12. Flash Detector, Exterior View

mounted to the aircraft structure by four screws. The flash detector senses the burst of light generated by the flares and transmits a pulse to the camera.

5-23. OBLIQUE OPTICAL SIGHTS.

a. The left and right oblique optical sights (figure 5-14) are located in the cockpit with one sight for the pilot (left obliques) and one sight for the observer (right obliques). Each oblique optical sight is an optical lens used in oblique photography to aid in the location of the terrain area which is in the optical center of the camera format. The sight does not show the field of coverage of the camera but indicates the central area of the field by means of concentric rings produced by optical interference. By means of parallel movable arms, the sight is positioned for viewing. The scale is set to correspond with the selected depression angle of the camera.

b. During automatic camera operation, the sights are used by controlling the aircraft flight attitude so that the image of a point or object to be photographed passes through the approximate center of either sight lens ring pattern. In the manual (extra picture) mode, the Manual Camera Pulse Trigger or Button is depressed when the point to be photographed is centered within the lens ring pattern.

5-24. PHOTO FLIGHT-LINE SIGHT. The photo flight-line sight (figure 5-17) is essentially a non-optic collapsible viewfinder used by the pilot for sighting during vertical photography. Sighting is accomplished by aligning the pointer and vertical wire reference with an imaginary straight line between the target and a reference point (or other target) in the line of flight. When the imaginary straight line between the target and reference point moves in line with the wire reference and pointer, the target will pass under the aircraft within the camera field of view. Rotation of the sight about the vertical axis allows the pilot to sight when crabbing to compensate for crosswinds. If after aligning the sight with the target, the imaginary line crosses the wire gage diagonally, the pilot must compensate by correcting the aircraft's attitude.

5-25. CAMERA PULSE SWITCHES. The pilot's Auto Camera Pulse Button and Manual Camera Pulse Trigger are located on the control stick grip (figure 5-15). The Observer's Manual Camera Pulse Button is located either on the observer's control stick ([19] and [23] aircraft) (figure 5-15) or on the observer's console ([42] aircraft) (figure 5-16).

5-26. OPERATING INSTRUCTIONS.

5-27. GENERAL.

5-28. The following paragraphs describe the controls and their uses, modes of operation, and normal and emergency operating procedures of the photo system.

NOTE

See TM 11-6720-208-12 for procedures to be followed in planning a photographic mission. These procedures include methods of determining the following:

a. Attitude and coverage.
b. V/H ratio (velocity/altitude).
c. IMC speed.
d. Interval between exposures.
e. Camera mode and limitations.
f. Filter selection.
g. S/C index number.
h. Exposure.

5-29. CONTROLS AND INDICATORS.

5-30. Table 5-I lists all photo system controls and indicators and their uses. In most cases, under the "Control or Indicator" column, the exact equipment marking is used to designate the control or indicator. Where the control or indicator has no panel marking, a functional designation is used. The reference figure illustrates the control panel or instrument on which the control or indicator is located.

5-31. MODES OF OPERATION.

5-32. See figure 5-18 for calculating V/H ratios. For photo control system operational limits, see

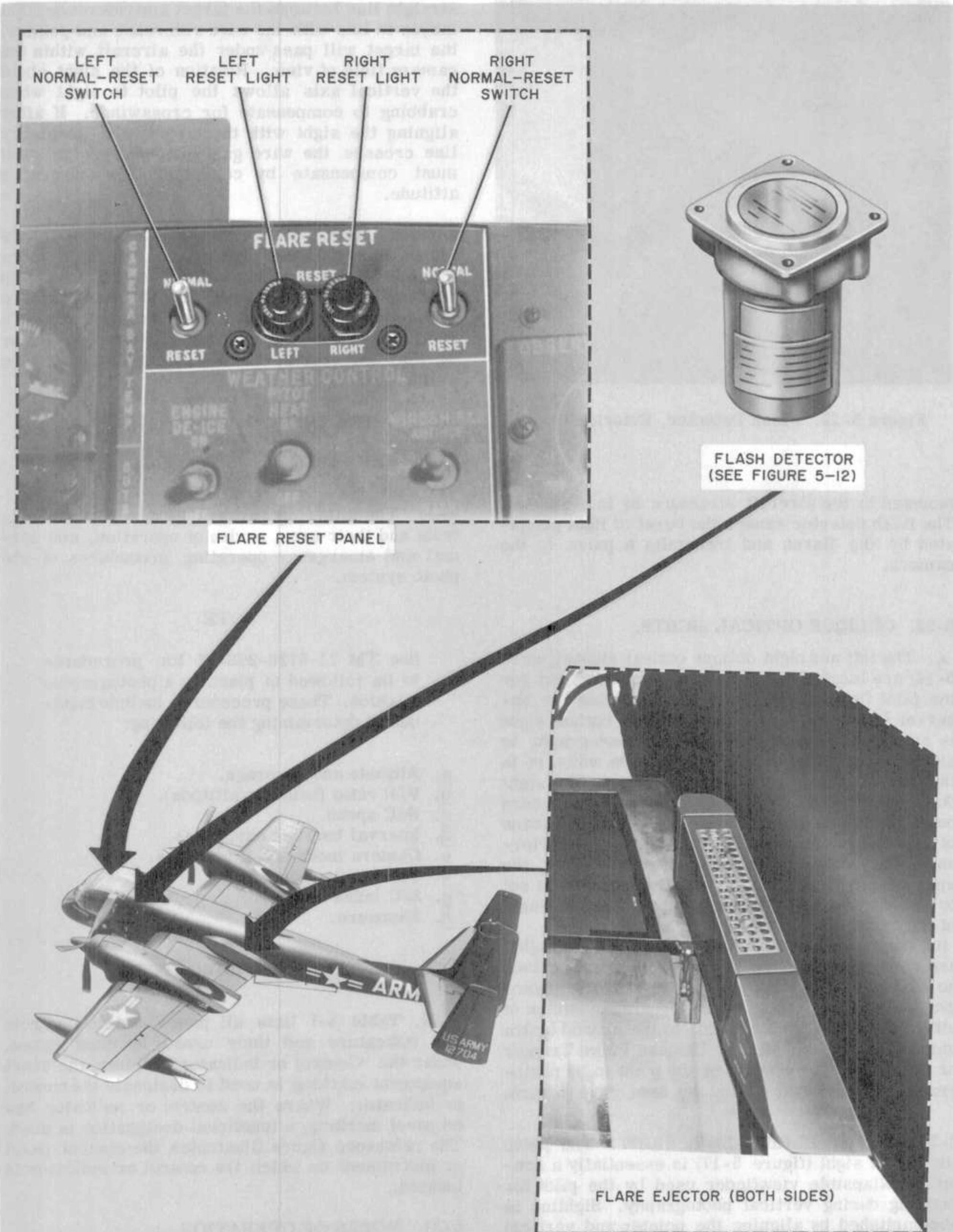


Figure 5-13. Flare Ejection Subsystem Components

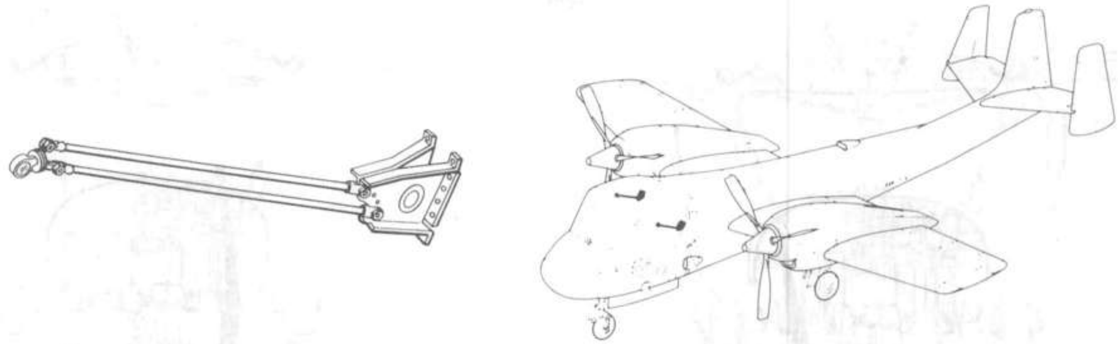


Figure 5-14. Oblique Optical Sight

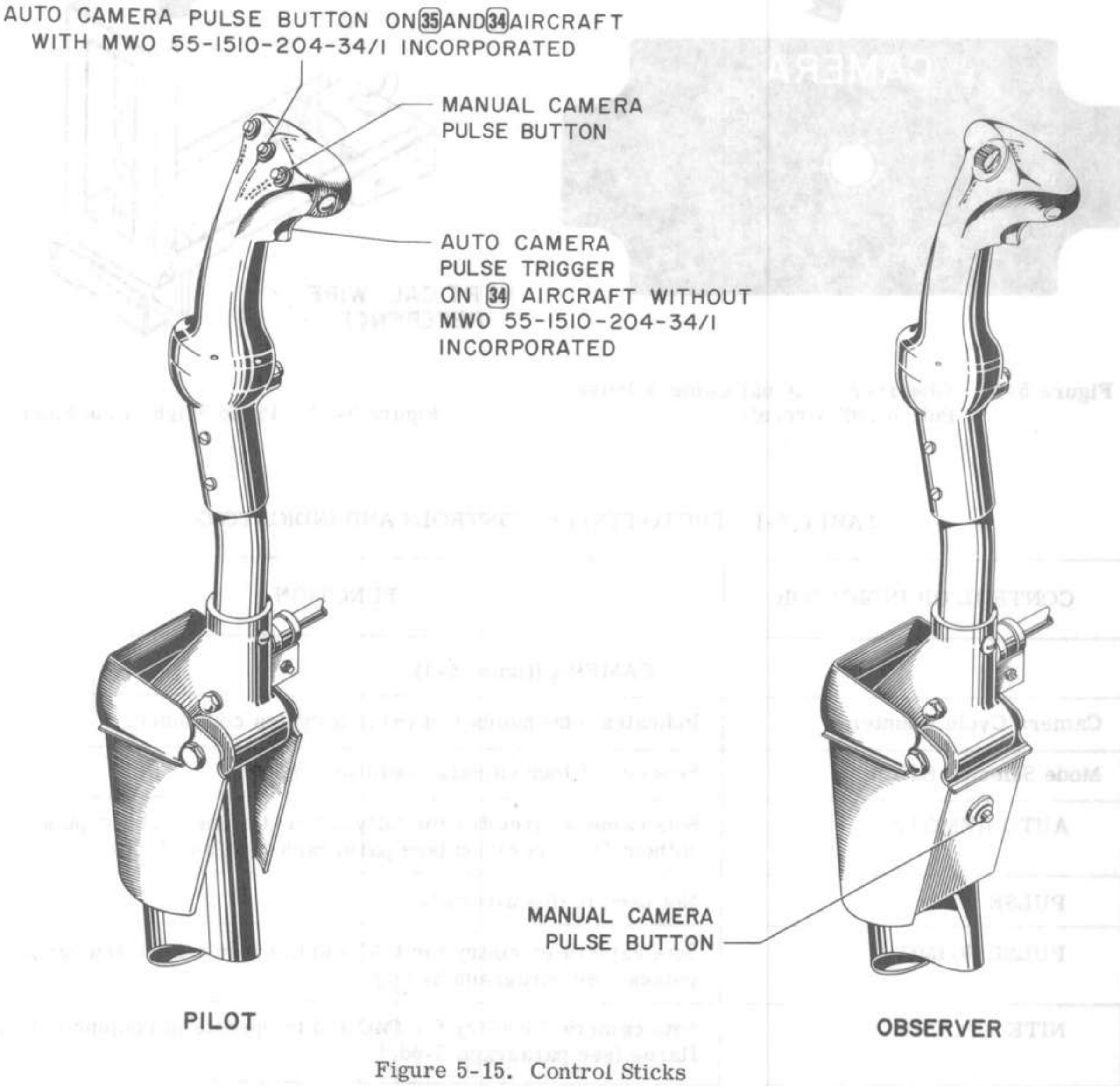


Figure 5-15. Control Sticks

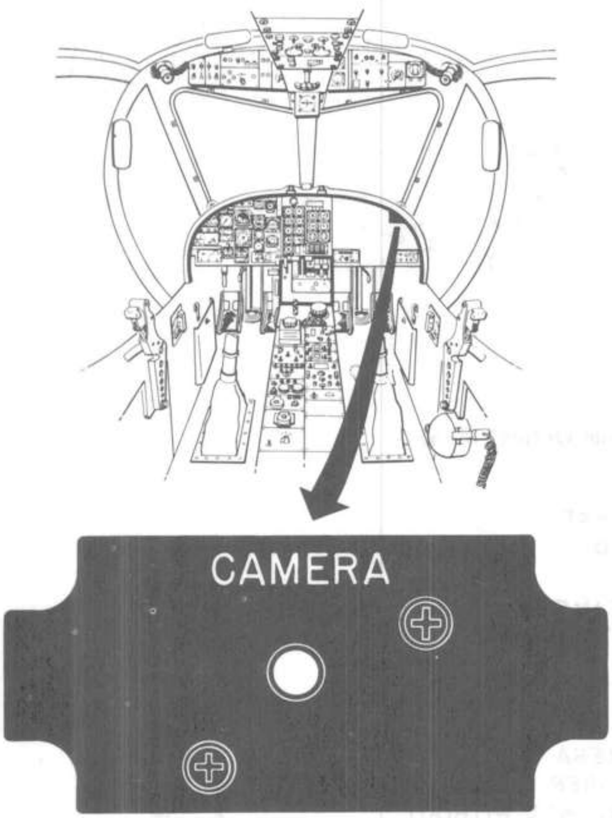


Figure 5-16. Observer's Manual Camera Pulse Button (42 Aircraft)

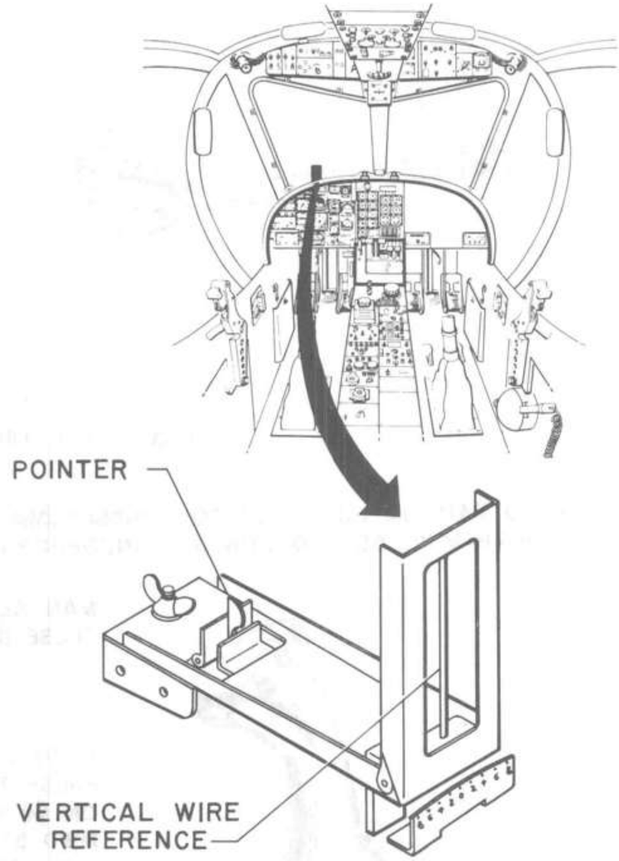


Figure 5-17. Photo Flight-Line Sight

TABLE 5-I. PHOTO SYSTEM CONTROLS AND INDICATORS

CONTROL OR INDICATOR	FUNCTION
	CAMERA (figure 5-1)
Camera Cycle Counter	Indicates total number of camera cycles completed.
Mode Selector Switch:	Sets one of four camera operating modes.
AUTO REMOTE	Sets camera circuitry for fully automatic autocycle or pulse without IMC operation (see paragraph 5-5a and 5-5b).
PULSE	Not used in this aircraft.
PULSE W/IMC	Sets camera circuitry for IMC and to operate from triggering pulses (see paragraph 5-5c.)
NITE	Sets camera circuitry for IMC and to operate in conjunction with flares (see paragraph 5-5d.)

TABLE 5-I. PHOTO SYSTEM CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
CAMERA (figure 5-1) (cont)	
Exposure indicator and manual exposure control (figure 5-2)	For manual setting of shutter speed and aperture.
S/C Control	Used to compensate exposure for filter factor and film speed when automatic exposure control is used.
PHOTO CONTROL PANEL (figure 5-4)	
Altitude Dial	Manually set to the aircraft's altitude (terrain clearance) to introduce altitude or height (H) information to the computer.
Velocity Dial	Manually set to the aircraft's groundspeed to introduce velocity (V) information to the computer.
SCANNER-COMPUTER Switch	Provides switching of the velocity/height ratio information from either the manual V/H control dials or the V/H scanner subsystem (19 and 31 aircraft only).
Daymode Switch	Permits in-flight selection of either Pulse without IMC (PULSE) or Autocycle mode.
Mount Positioning Switch	Manually set to select desired camera angular position.
OPERATE light	Flashes each time the photo system unit indicates a normal camera operation and remains on when a camera and/or film failure occurs.
Power Switch	Applies power to the camera equipment so that it is in a condition ready to operate.
READY light	Remains on if: (a) camera-ready power is available; (b) the rotary mount has rotated to the desired position setting; and (c) the proper camera window door is fully open and access door closed.
Flares Remaining Counter	Resettable subtractive counter, which is initially set for the number of flares available and subtracts one each time a flare is ejected.
Exposures Remaining Counter	Resettable subtractive counter, which is initially set for the number of exposures available and subtracts one each time an exposure is made.
Salvo Switch	Used for rapidly discharging all remaining flares under emergency conditions.
FLARES END light	Goes on when all available flares have been fired.
FLARES FAILURE light	Remains on in Night mode operation when the flare ejector retainers are not properly seated or there is a failure of flare ejector arming power.
OPERATE Switch	Initiates operation of the photo system.

TABLE 5-I. PHOTO SYSTEM CONTROLS AND INDICATORS (cont)

CONTROL OR INDICATOR	FUNCTION
EXPOSURE CONTROL PANEL (figure 5-8)	
Exposure Meter	Provides a visual comparison of camera setting selected by Exposure Control Switch and setting recommended by light monitor detector based on average terrain brightness.
Exposure Control Switch	Remotely adjusts camera diaphragm and shutter timing mechanism through a range of nine settings.
FLARE RESET PANEL (figure 5-13)	
Left NORMAL-RESET Switch	In RESET position, causes stepping switch of left flare ejector to be reset. In NORMAL position, enables operator to fire flares. It may have to be depressed a number of times to secure reset indications.
LEFT RESET light	Goes on when Left NORMAL-RESET Switch is depressed and left wing flare ejector stepping-switch has been reset.
RIGHT RESET light	Goes on when Right NORMAL-RESET Switch is depressed and the right wing flare ejector stepping-switch has been reset.
Right NORMAL-RESET Switch	In the RESET position, causes the stepping Switch of the right flare ejector to be reset. In the NORMAL position, enables the operator to fire the flares. It may have to be depressed a number of times to secure reset indications.
PHOTO SYSTEM UNIT (figure 5-4)	
Test Switch	Permits a self-test of all components including cabling and wiring, except for the firing of flares, exposure of film, and flash detector.
CAMERA DRIVE light (operates under self-test conditions only)	Goes on to indicate presence of camera drive voltages. Light is dim during pulsed operation without IMC. Light is bright during other modes of operation.
Focal Length Switch	Must be preset to correspond to the focal length of the lens cone being used; to introduce correct pulse interval and IMC rate to the camera system.
Mode Selector Switch:	Preselects mode of camera operation.
PULSE-IMC	Provides command pulse to camera and IMC computer. Also disables function of photo control panel Daymode Switch.
NIGHT	Provides pulsed operation with IMC and energizes the overrun unit. Function of the photo control panel Daymode Switch remains disabled.
AUTO & PULSE	Restores function of photo control panel Daymode Switch.
OTHER CONTROLS AND INDICATORS	
CAMERA PULSE light (Chapter 2, Section II, figure 2-5 or 2-6)	Goes on 15% in advance of each exposure alerting the operator to level the aircraft during exposure.
Pilot's Manual Camera Pulse Trigger (figure 5-15) and observer's Manual Camera Pulse Button (figure 5-15 or 5-16)	Enables pilot or observer to make single exposures by momentarily depressing switch, or to take pictures at camera's maximum cyclic rate (runaway operation) by holding switch down while in Pulse modes. In Night mode, enables pilot to override the pulse interval computer, thereby instantly firing one flare.
Auto Camera Pulse Button (figure 5-15)	When depressed, the switch overrides the photo control panel Operate Switch.

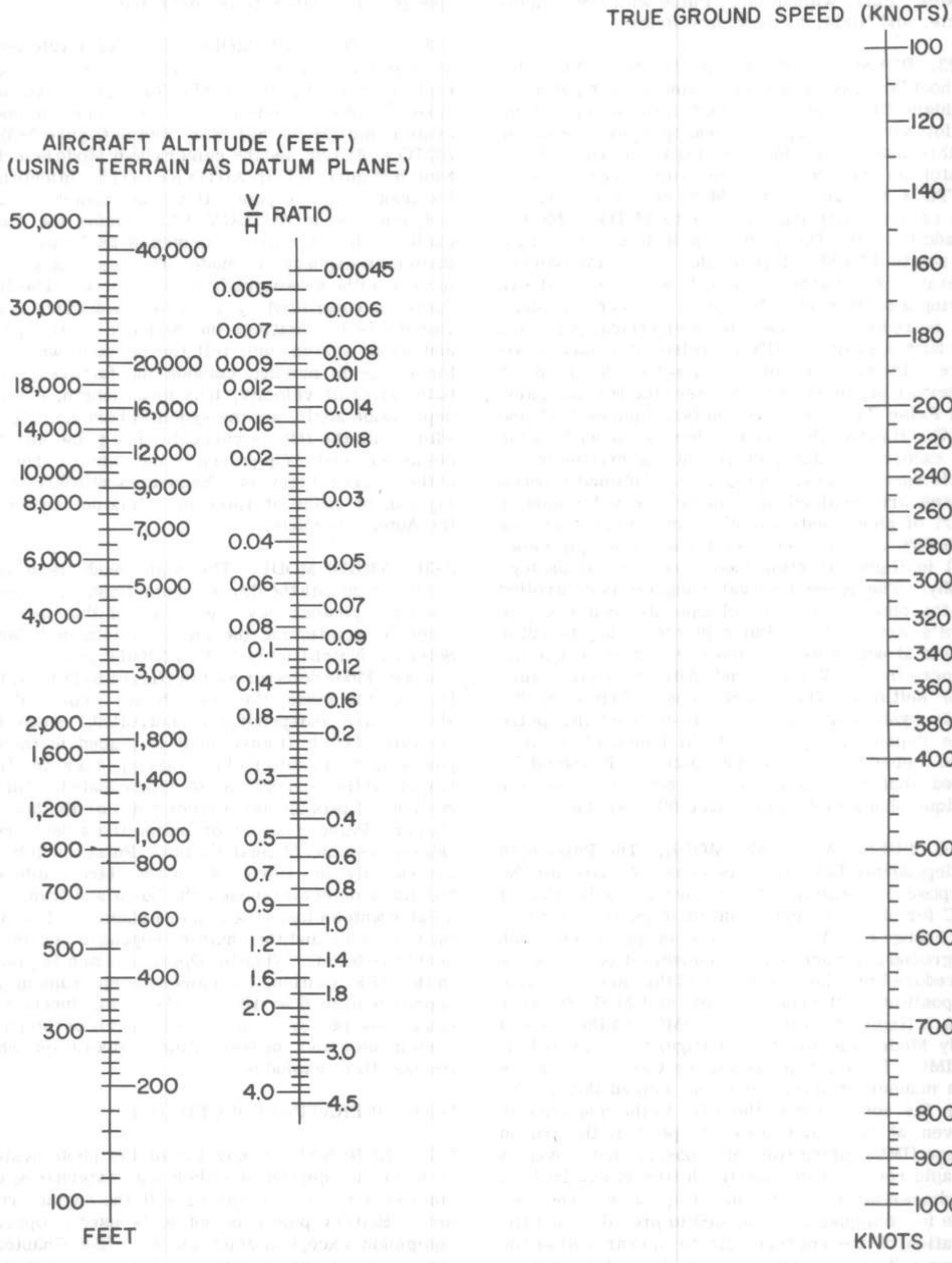


Figure 5-18. Nomograph for Calculating Altitude and Velocity Relationships

figure 5-19. The photo system operates in four modes: Pulse without IMC, Pulse with IMC, Autocycle, and Night, as described below.

5-33. PULSE WITHOUT IMC MODE. The Pulse without IMC mode is utilized primarily for purposes of high-oblique and very-high altitude operation, or for air-to-air spotting photography. Selection of this mode is made by setting the Mode Selector Switch on the photo system unit (figure 5-4) to AUTO & PULSE and the Mode Selector Switch on the camera body (figure 5-1) to AUTO REMOTE. In addition, the Daymode Switch (figure 5-4) must be set to PULSE. During this mode, the camera operates in a manner similar to a Brownie camera having a shutter and film spool; however, the shutter is remotely tripped by an electrical pulse and the film is automatically recycled after each exposure. To make a single exposure, the pilot or observer depresses and releases the Manual Camera Pulse Trigger or Button (see figures 5-15 and 5-16). Holding this switch depressed will cause the camera to take pictures at its maximum recycle speed (runaway operation). Automatic timed pulses are obtained by a pulse interval computer (part of photo system unit) to provide photographs with 60% overlap (required for stereoscopic viewing) in flight direction based on vertical photography. The pulse interval computer is controlled by the photo control panel Operate Switch or the pilot's Auto Camera Pulse Button. The computer is told at what rate the pulses should be sent to the camera by the Velocity and Altitude Dial (figure 5-4) settings. The Focal Length Switch on the photo system unit (figure 5-4) changes the pulse rate depending upon the focal length of the lens cone being used with the camera. It should be noted that the pulse rate is not corrected for oblique photography to produce 60% overlap.

5-34. PULSE WITH IMC MODE. The Pulse with (independent) IMC mode is generally used for the purpose of obtaining stereo coverage with correct IMC for obliques, and variation of pulse rate without change of IMC rate for special purposes, such as ground coverage and film conservation by means of reduced overlap. Selection of this mode is made by positioning the photo system unit Mode Selector Switch (figure 5-4) to PULSE-IMC and the camera body Mode Selector Switch (figure 5-1) to PULSE W/IMC. During this mode, the Camera operates in a manner similar to the Pulse without IMC mode, with the addition that the film in the magazine is driven at the same rate of speed as the ground image (IMC) during time of exposure, but moves at a rapid recycle rate until fresh film is available in readiness for the next timed trip pulse. The IMC rate for obliques is computed to provide synchronization of the correct rate to appear within the lower 1/3 to 1/6 format area of the picture, rather than synchronized along the conventional optical axis. This provides IMC in a more desirable area of the photograph. It should be noted that for oblique photography, although the pulse rate remains unchanged, the IMC rate is corrected.

5-35. AUTOCYCLE MODE. The Autocycle mode is used for high-speed, low-altitude precision operation providing 60% overlap for stereo coverage. Selection of this mode is made by setting the photo system unit Mode Selector Switch (figure 5-4) to AUTO & PULSE and the camera body Mode Selector Switch (figure 5-1) to AUTO REMOTE. In addition, the photo control panel Daymode Switch (figure 5-4) must be in AUTOCYCLE. During the Autocycle mode, the film is driven at IMC rate at the instant an exposure is made. The result is a sharp picture without using high shutter speed. The film speed is controlled by a servo power drive in the camera body. Settings on the photo control panel and photo system unit tell the servo at what rate the image is moving, considering factors of altitude, aircraft velocity, lens focal length, camera depression angle, and the synchronized angle along which axis the IMC is correct. The pulse interval computer sends trip pulses to the camera shutters at the correct intervals. Exposures with 60% overlap can be made at rates up to six per second in the Autocycle mode.

5-36. NIGHT MODE. The Night mode is used in combination with the flares (photo-flash cartridges) for night photography. Selection of this mode is made by positioning the photo system unit Mode Selector Switch (figure 5-4) to NIGHT and the camera body Mode Selector Switch (figure 5-1) to NITE. During this mode, the two shutter planes of the shutter are independently controlled. When the Operate Switch (figure 5-4) is placed in the ON position, both shutter planes are open and the film travels at the correct rate to compensate for image motion. The pulse interval computer or the Manual Camera Pulse Trigger or Button fires the flares. Depressing the Manual Camera Pulse switch releases only one flare. When the flare explodes, the flash detector senses the burst and transmits a pulse which closes the camera shutter. The film then recycles and the shutter reopens to accept the next flare burst. When the Operate Switch is placed in the OFF position, the camera keeps running for approximately 6 to 10 seconds. This function is caused by the overrun control circuit of the photo system unit and insures camera operation when the last flare explodes.

5-37. OPERATING PROCEDURES.

5-38. GENERAL. Operation of the photo system is to be accomplished either with external power connected to the aircraft or with the engines running. Battery power is not to be used to operate equipment except in emergencies. (See Chapter 3 for engine ground operation.) Connecting external power to the aircraft energizes the primary, secondary, and monitor buses supplying the dc voltage required for equipment operation. The ac power

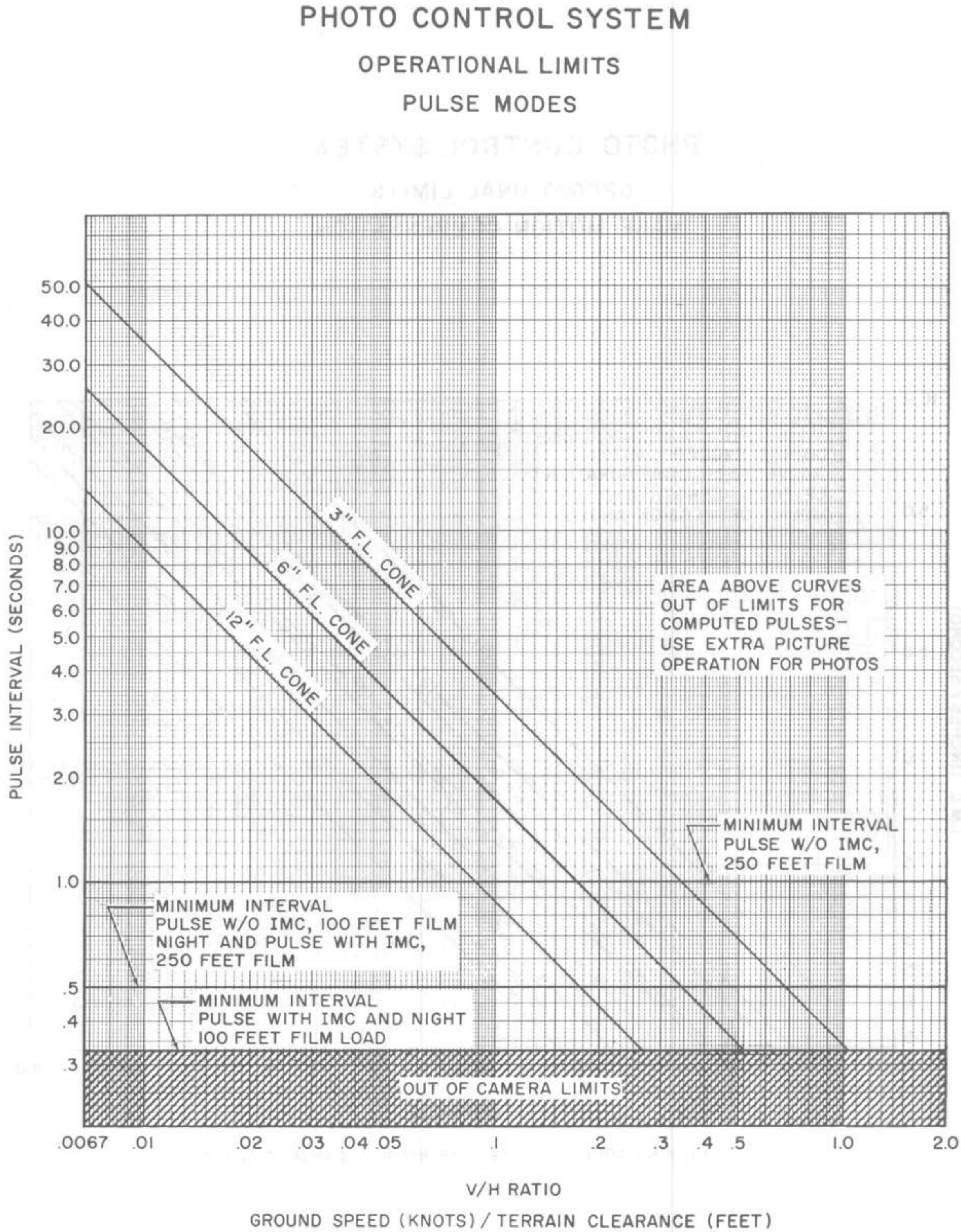


Figure 5-19. Photo Control System Operational Limits (Sheet 1 of 3)

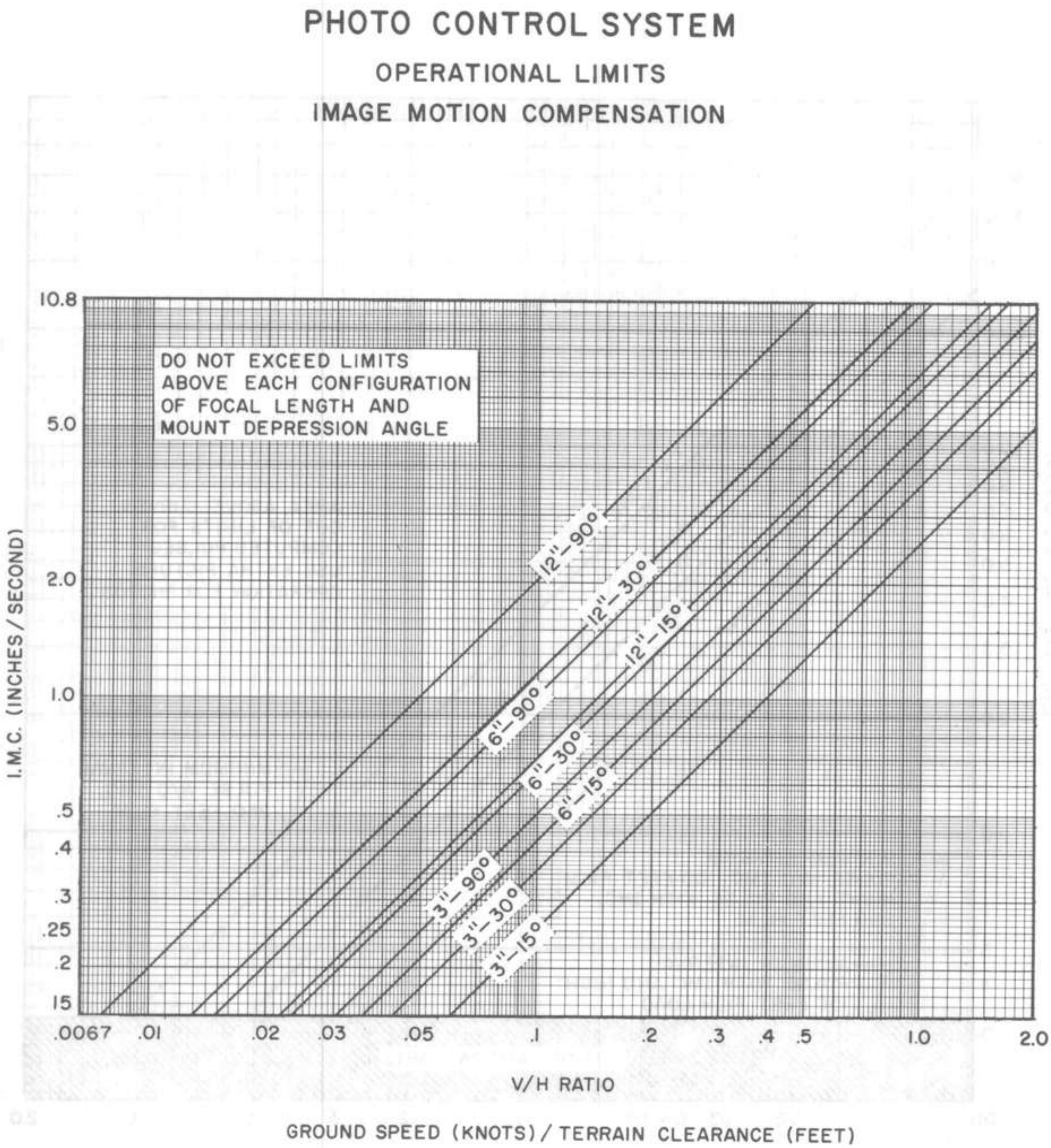
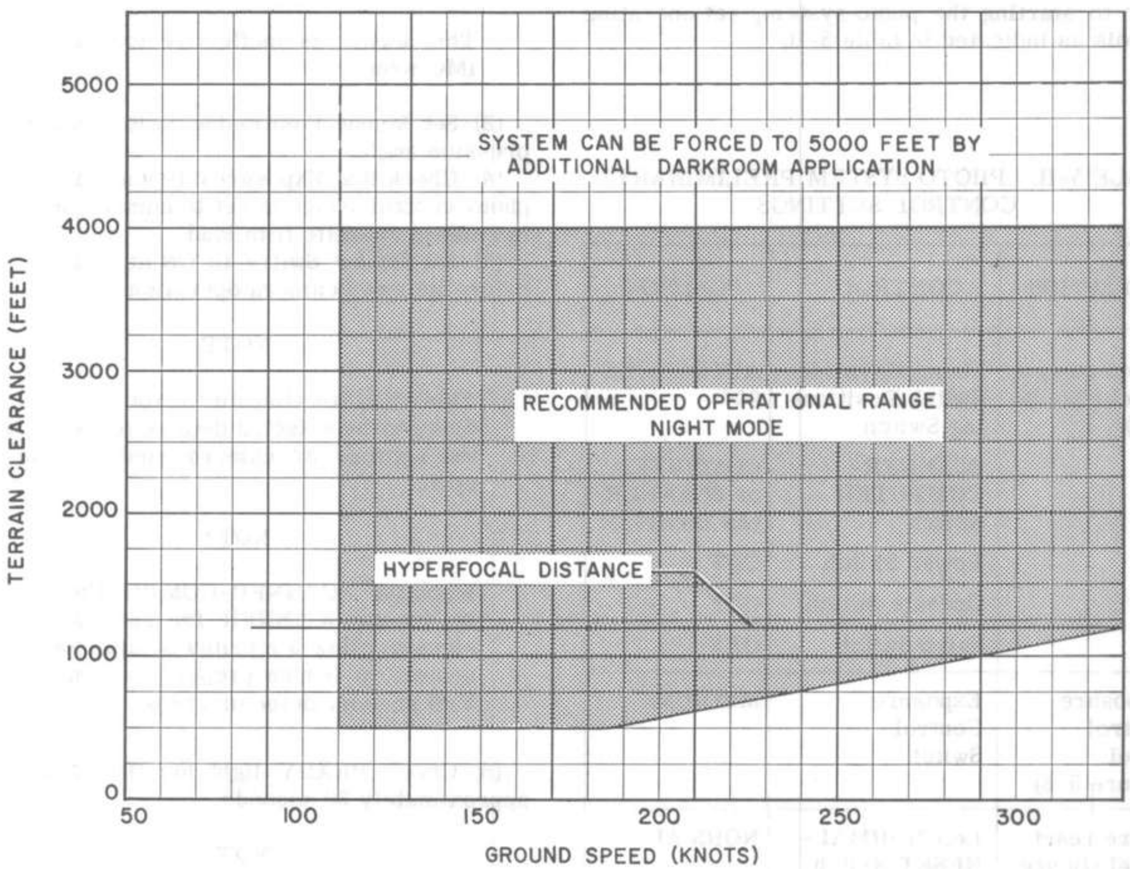


Figure 5-19. Photo Control System Operational Limits (Sheet 2 of 3)

PHOTO CONTROL SYSTEM

OPERATIONAL LIMITS
NIGHT PHOTOGRAPHY
6 INCH LENS CONE – 100 FOOT MAGAZINE
M-112 FLARES



NOTE:

1. ILLUMINATION IS ADEQUATE FOR OPERATION TO 5000 FEET. EXCELLENT RESULTS ARE OBTAINED AT 4000 AND BELOW.
2. HYPERFOCAL DISTANCE IS NOT CONSIDERED AS IMPORTANT FOR NIGHT PHOTOGRAPHY.

Figure 5-19. Photo Control System Operational Limits (Sheet 3 of 3)

requirements are supplied by the inverters. To energize the inverters, set inverter Switch to NORMAL and depress INVERTER #1 and #2 circuit breakers.

CAUTION

Before connecting external power to the aircraft, pull the BATTERY RELAY circuit breaker. Damage to components or electrical fire can result if the polairty of the external power unit and aircraft electrical system are not matched.

5-39. PRELIMINARY STARTING PROCEDURE. Prior to starting the photo system, set operating controls as indicated in table 5-II.

TABLE 5-II. PHOTO SYSTEM PRELIMINARY CONTROL SETTINGS

LOCATION	CONTROL	POSITION
Photo control panel (figure 5-4)	Mount Daymode Switch Positioning Switch	AUTOCYCLE 90°
	SCANNER-COMPUTER Switch	COMPUTER or SCANNER (As Desired)
	Power Switch	OFF
	Operate Switch	OFF
	Salvo Switch	OFF
Exposure control panel (figure 5-8)	Exposure Control Switch	MEDIUM
Flare reset panel (figure 5-13)	Left NORMAL-RESET Switch	NORMAL
	Right NORMAL-RESET Switch	NORMAL
Stores selector panel (Chapter 6, Section IV, figure 4-3) (part of external stores system)	Armament Power Switch	OFF
	Drop Tank Release Switch	SAFE

5-40. DAY OPERATION. The photo system modes applicable for daytime missions are Autocycle, Pulse without IMC, and Pulse with IMC. Cockpit operating controls are located on the photo control panel (figure 5-4), control sticks (figure 5-15), observer's console (figure 5-16), and exposure control panel (figure 5-8). Power is applied to the system through the CAMERA PWR (AC and DC), CAMERA DOOR, and CAMERA MOUNT circuit breakers (See Chapter 2, Section II, figure 2-16).

a. Starting Procedure (Pretarget).

(1) Depress CAMERA PWR, CAMERA DOOR, and CAMERA MOUNT circuit breakers.

(2) Set Daymode Switch on photo control panel to AUTOCYCLE or PULSE.

NOTE

This switch is ineffective for Pulse with IMC mode.

(3) Set Mount Positioning Switch to desired depression angle.

(4) Check that Exposures Remaining Counter on photo control panel is set to number of exposures in camera cassette film load.

(5) Set Power Switch to ON at least 30 seconds before intended camera operation.

NOTE

This will allow time for the rotary mount to drive to the selected depression angle and the appropriate camera window door to open.

NOTE

When the SCANNER-COMPUTER switch is set to SCANNER for automatic V/H signals, allow 3 minutes before operating system to insure proper erection of the V/H scanner detector gyroscope.

(6) Check READY light for illumination within approximately 20 seconds.

NOTE

The READY light may flash several times momentarily due to the pulsing process by which the mount positioning drives the rotary mount to null.

(7) Check that OPERATE light is out.

NOTE

If the OPERATE light goes on and the READY light goes out, a film or camera failure has occurred.

NOTE

Steps (8) and (9) need not be accomplished when the SCANNER-COMPUTER switch is set to SCANNER.

(8) Check Altitude Dial for correct terrain clearance setting.

(9) Check Velocity Dial for correct true ground-speed setting.

(10) Check indication of Exposure Meter on exposure control panel for UNDER or OVER exposure. Set Exposure Control Switch so that the Exposure Meter indicates NORMAL exposure.

NOTE

This automatically causes camera diaphragm to be controlled for correct exposure. The operator has a choice of setting the camera for UNDER or OVER exposure by as much as two f/stops deviation from the Exposure Meter NORMAL indication.

b. Normal Operation (On-Target).

(1) Initiating Operation.

(a) To take pictures continuously, set Operate Switch to ON or depress the Auto Camera Pulse Button on pilot's control stick grip.

NOTE

This provides time interval pulses to actuate the camera exposure.

(b) For one picture, momentarily depress pilot's or observer's Manual Camera Pulse switch. If several pictures are desired, depress and hold Manual Camera Pulse switch depressed (runaway operation at maximum recycle rate).

NOTE

In the Autocycle mode, the Manual Camera Pulse switch is functionally in parallel with the Operate Switch. The switch should be held depressed until an operation indication occurs.

(2) Operation Indications.

(a) Check Exposures Remaining Counter for subtraction of 1 digit per exposure.

(b) Check OPERATE light.

NOTE

OPERATE light will flash once for each exposure. If OPERATE light remains on and READY light goes out, either the camera has failed, the film has failed, or the film has reached the end.

(c) Pilot - check operation of CAMERA PULSE light on pilot's instrument panel.

NOTE

Stabilize the aircraft when CAMERA PULSE light goes on. The light goes on 15% in advance of the timed pulse interval of camera exposure pulse. Disregard operation of CAMERA PULSE light when operating in Autocycle mode. This light does not function when the camera is operated manually.

c. Stopping Procedure.

(1) Set Operate Switch to OFF.

(2) Reset Mount Positioning Switch to 90°.

(3) After READY light goes on, indicating 90° rotary mount position, set Power Switch to OFF.

(4) Pull the CAMERA PWR, CAMERA DOOR, and CAMERA MOUNT circuit breakers.

5-41. NIGHT OPERATION. The Night mode of photo system operation is applicable for night missions. Cockpit operating controls are located on the photo control panel (figure 5-4), control sticks (figure 5-15), observer's console (figure 5-16), flare reset panel (figure 5-13), and exposure control panel (figure 5-8). Power is applied to the system through the circuit breakers listed in step a. (1) below (see Chapter 2, Section II, figure 2-16). In addition, armament power is energized through the Armament Power Switch located on the stores selector panel (Chapter 6, Section IV, figure 4-3).

a. Starting Procedures (Pretarget).

(1) Depress the CAMERA PWR (AC and DC), CAMERA MOUNT, CAMERA DOOR, ARMT MASTER, FLARE ARM, and INST DC circuit breakers.

(2) Depress and hold Left NORMAL-RESET Switch on flare reset panel in RESET position until LEFT RESET light goes on.

(3) Depress and hold Right NORMAL-RESET Switch in RESET position until RIGHT RESET light goes on.

NOTE

Steps (2) and (3) above insure that the stepping switches in the flare ejectors reset to the "1" firing position (see figure 5-8).

(4) Check that FLARES END light on photo control panel is out.

(5) Check that Flares Remaining Counter on photo control panel is set to flare load.

NOTE

A total of 104 flares are available with 52 flares in each flare ejector.

(6) Check FLARES FAILURE light.

NOTE

The FLARES FAILURE light will remain on unless armament power is energized or an ejector flare retainer is not properly seated.

(7) Set Armament Power Switch on stores selector panel to ON.

NOTE

Landing gear must be in up position during flight in order to energize armament power.

(8) Check that FLARES FAILURE light goes out.
(9) Check that Exposures Remaining Counter is set to number of exposures in camera cassette film load.
(10) Set Daymode Switch in either position.

NOTE

The Daymode Switch is ineffective in Night mode camera operation.

(11) Set Mount Positioning Switch to 90°.
(12) Set Power Switch to ON at least 30 seconds before intended camera operation.

NOTE

This will allow time for the rotary mount to drive to the selected depression angle and for the appropriate camera window door to open.

(13) Check that READY light goes on within approximately 20 seconds.

NOTE

The READY light may flash several times momentarily due to the pulsing process by which the mount positioning system drives the rotary mount to null.

(14) Check that OPERATE light is out.

NOTE

If OPERATE light goes on and READY light is out, either the camera or film has failed.

(15) Check Altitude Dial for correct terrain clearance setting.
(16) Check Velocity Dial for correct true groundspeed setting.
(17) On the exposure control panel, set Exposure Control Switch fully clockwise to the DULL position.

b. Normal Operation (On-Target).
(1) Initiating Operation.
(a) To take pictures, set Operate Switch to ON or depress the Auto Camera pulse button on pilot's control stick.

NOTE

This provides time integral trip pulses which eject the flares upward. When the flare explodes, the burst is detected by the flash detector which actuates the camera exposure.

(b) Pilot or observer - momentarily depress Manual Camera Pulse switch for one picture.

NOTE

Instead of actuating the camera directly, as in daymodes, the Manual Camera Pulse switch releases one flare each time it is depressed.

NOTE

Upon release of any initiation, the photo system unit overrun control circuits maintain camera operation for an additional 8 to 10 seconds to insure exposure for the last flare burst.

(2) Operation Indications.
(a) Check flare bursts.

NOTE

There will be a delay between time of initiation and flare burst. The flares have time delays of 1 second, 2 seconds, 3 seconds, and 4 seconds.

NOTE

If a flare fails, the flare ejector will step to the next available flare in readiness for the next flare ejection pulse.

(b) Check Flares Remaining Counter for subtraction of 1 digit for each flare ejection pulse.
(c) Check that the Exposures Remaining Counter subtracts 1 digit for each flare burst.
(d) Check OPERATE light. The OPERATE light will flash once per each exposure.
(e) Pilot - check operation of CAMERA PULSE light on pilot's instrument panel.

NOTE

Stabilize the aircraft upon illumination of the CAMERA PULSE light. The light illuminates 15% in advance of the timed interval of the flare pulse. This light does not function when the camera is operated manually.

(3) End-of-Operation Indications.
(a) Flare bursts cease.
(b) FLARES END light goes on.

NOTE

FLARES END light will remain on until Operate Switch is placed in the OFF position.

(c) Flares Remaining Counter reaches zero.
(d) Exposures Remaining Counter ceases to subtract.
(e) OPERATE light ceases to flash.

NOTE

If OPERATE light goes on and READY light goes out, this indicates camera failure, film failure, or end of film. Camera power is automatically deenergized when any of these conditions occurs.

c. FLARES EMERGENCY JETTISON.
(1) Lift guard over photo control panel Salvo Switch and hold Salvo Switch depressed for 12 seconds.

NOTE

This sends rapid ejection pulses (approximately 11 pulses per second) simultaneously to both the left and right flare ejectors. All flares are expended when the counter subtracts 52 flares. At this time the FLARES END light will go on.

(2) Observe FLARES END light.

NOTE

The FLARES END light will go on when the last flare is ejected.

(3) If desired, reset the stepping switches by placing the Left and Right NORMAL-RESET Switches to RESET and repeat steps (1) and (2).

d. STOPPING PROCEDURE.
(1) Check that the guard is pushed down over the Salvo Switch.
(2) Set Operate Switch to OFF.
(3) Allow minimum delay of 10 seconds to allow release of overrun.
(4) Set Power Switch to OFF (guard down).

NOTE

The vertical camera window door will automatically close.

(5) Set Armament Power Switch on stores selector panel to OFF (guard down).

(6) Pull the CAMERA PWR, CAMERA MOUNT, CAMERA DOOR, ARMT MASTER, FLARE ARM, and INST DC circuit breakers.

5-42. PREFLIGHT INSPECTION.

5-43. GENERAL.

5-44. The following power-off and power-on preflight checks must be accomplished to insure photo system readiness. Refer to TM 11-6720-208-12 for planning a photographic mission. The ground crew is responsible for lens cone installation, camera settings, photo system unit settings, and all operational checks. The pilot and observer must check with the ground crew to insure the proper lens cone, camera, and photo system unit settings for the planned mission.

5-45. POWER OFF.

5-46. EXTERIOR. While performing exterior inspection described in Chapter 3, check with ground crew to confirm the following:

a. Day Mission:
(1) Camera lens cone correct for mission (3-, 6-, or 12-inch).
(2) Camera lens covers (internal and external) removed.
(3) Lens clean.
(4) Camera Mode Selector Switch set for mission.
(5) Data unit clock wound and set.
(6) Data card filled out with the following information: mission number, focal length, lens serial, mode, film type, and filter type.
(7) Lens filter installed (if required).
(8) S/C Control properly set.
(9) Film cassettes loaded, installed, and locked on camera.
(10) ASA rating recorded.
(11) Quantity of film recorded.
(12) Camera secure in rotary mount.
(13) Rotary mount with camera installed and lockpins inserted in mount hooks.
(14) Proper electrical connections made: camera (2) and mount (1).
(15) Vacuum hose connected.
(16) Window covers removed and inside window surfaces cleaned.
(17) Mount positioning system tested.
(18) Camera compartment access door secured.
(19) Camera exterior window surfaces cleaned.
(20) V/H scanner window clean.
(21) V/H scanner detector objective lens clear.
(22) Photo system unit Mode Selector Switch properly set for mission mode.
(23) Photo system unit Focal Length Switch properly set for lens cone used.
(24) Photo system unit Test Switch guard closed (down position).
(25) Light monitor detector glass clean.
(26) Photo control system tested.
(27) V/H scanner system tested.
(28) Exposure control system tested.

(29) Camera window doors system tested.

b. Night Mission:

(1) Camera lens cone correct for mission (6-inch).

(2) Camera lens covers (internal and external) removed.

(3) Lens clean.

(4) Camera Mode Selector Switch set to NITE.

(5) Data unit clock wound and set.

(6) Data card filled out with the following information: mission number, focal length, lens serial, mode, film type, and filter type.

(7) Lens filter installed (if required).

(8) S/C Control properly set.

(9) Film cassettes loaded, installed, and locked on camera.

(10) ASA rating recorded.

(11) Quantity of film recorded.

(12) Camera secure in rotary mount.

(13) Rotary mount with camera installed, and lockpins inserted in mount hooks.

(14) Proper electrical connections made: camera (2) and mount (1).

(15) Vacuum hose connected.

(16) Window covers removed and window interior surfaces cleaned.

(17) Mount positioning system tested.

(18) Camera compartment access door secured.

(19) Camera exterior window surfaces cleaned.

(20) Photo system unit Mode Selector Switch set to NIGHT.

(21) Photo system unit Focal Length Switch set to "6".

(22) Photo system unit Test Switch guard closed (down position).

(23) Flash detector glass clean.

(24) Photo control system checked.

(25) Camera window doors system tested.

(26) Proper electrical connections made to flare ejector pods for ejectors and flash detector.

(27) Armament power and ejector salvo operation tested.

(28) Test set removed from flare ejectors and loaded flare retainers installed in flare ejector mounts.

(29) Flare ejector stepping switches reset.

(30) Exposure Control Switch set to DULL and lens dial driven to maximum exposure stop.

5-47. INTERIOR. The interior inspection of the photo system is performed as item BF of the "Interior Check (All Flights)" checklist in Chapter 3. Both pilot and observer check the following:

a. Completeness of equipment.

b. Photo control, flare reset, stores selector, and exposure control panels for loose or binding control knobs, switches, and indicator lights.

c. Set all controls as indicated in paragraph 5-38.

d. On photo control panel, set Exposures Remaining Counter according to film load. (Check number of feet of film loaded in cassette with ground crew.) Set counter as indicated below:

No. of feet of film loaded in cassette	Counter setting
25	63
50	126
100	253
150	379
200	506
250	633

NOTE

The above settings are calculated by the following equation:

$$\text{No. of frames} = \frac{\text{No. of feet x 12}}{\text{4 3/4 inches per exposure}}$$

e. Check oblique optical sights for cleanliness and damage.

f. For night missions only - on photo control panel, check for Flares Remaining Counter set at 104.

5-48. POWER ON.

5-49. The complete operational check is performed by the ground crew with the use of test equipment; however, the following can be accomplished by the pilot or observer:

a. Depress CAMERA PWR DC and AC, CAMERA MOUNT, CAMERA DOOR, and INVERTER #1 circuit breakers.

b. Set Inverter Switch on left overhead console to NORMAL.

c. Set Power Switch on photo control panel to ON.

d. Press to test the following:

CAMERA PULSE light
OPERATE light
READY light

e. Adjust brightness of the indicator lights to desired level.

f. Check that control panel edge lights are illuminated.

g. Set Power Switch to OFF (guard down).

h. Pull the CAMERA PWR circuit breakers.

i. Set Inverter Switch to OFF if desired.

Section VI. Miscellaneous

6-1. WINDSHIELD WIPER SYSTEM.

6-2. DESCRIPTION.

6-3. The windshield wiper system is a hydraulic system that consists essentially of a speed control, a control unit, two window units, and an arm and blade assembly for each window. These units are interconnected by hydraulic tubing and supplied with hydraulic fluid from the aircraft hydraulic system. The speed control functions as a valve for starting and stopping the system and regulates the wiper blade speed by metering the rate of flow of hydraulic fluid to the control unit. The control unit alternately directs the flow of hydraulic fluid to opposite ends of the window units, directs the fluid discharged from the window units through the return line to the source, and locks the window units in the PARK position when the system is turned off. The window units convert the hydraulic energy, directed from the control unit, into rotary motion to drive the wiper blades. Each window unit contains a double-acting relief valve so that if the stroke of either wiper blade is limited by ice formation, or for any other reason, the impeded blade continues to operate within its limited scope while the other blade functions normally. The motion of both blades remains synchronized and continues in synchronization when the impeded blade is completely free. The arm and blade assemblies are designed to wipe an area conforming as closely as possible to the shape of the aircraft windshield. The blades are controlled from the cockpit by the windshield wiper speed control valve.

6-4. CONTROLS.

6-5. The Windshield Wiper control (Chapter 2, Section II, 27, figure 2-3) is located on the upper portion of the center instrument panel. This control turns the wipers on and off and also controls the speed of the wipers. Placing the control in the OFF position automatically parks and locks the wiper blades.

6-6. OXYGEN SYSTEM.

6-7. DESCRIPTION.

6-8. GENERAL. A high-pressure oxygen system, consisting of two 514-cubic inch oxygen cylinders, two MD-2 regulators, and two ejection disconnect assemblies, is installed in the aircraft. The cylinders are installed behind the seat support bulkhead, aft of the cockpit. The oxygen is stored in the cylinders under a pressure of 1800±50 psi. The system is filled through the oxygen filler cap located on the left side of the fuselage below the entrance hatch. The MD-2 regulators are installed on below each instrument panel. The lines from the regulators run to the ejection disconnect assemblies and from there to the face masks. For oxygen duration, see figure 6-1.

6-9. OXYGEN REGULATORS. AN MD-2 automatic pressure demand regulator (figure 6-2) is installed on the pilot's and observer's instrument panel in the cockpit. The regulator is designed for use by the crewmembers in high-altitude flight. It is installed in the oxygen system between the oxygen supply and the crewmember's mask. Oxygen at 1800±50 psi is admitted to the regulator through the inlet assembly. This oxygen passes through a reducer assembly that drops the pressure to between 37 and 45 psi when there is flow through the regulator, making regulator operation substantially independent of inlet pressure. Air is admitted to the regulator through an air valve on the side of the case. The air/oxygen mixture is delivered to the mask (or helmet) by a flexible hose attached to the regulator outlet.

a. With the Diluter-Demand Switch set at NORMAL OXYGEN, the regulator will deliver a mixture of air and oxygen in the quantity demanded by inhalation at the mask. The ratio of air to oxygen varies with the altitude and is automatically regulated by an aneroid assembly. As the altitude is increased, the quantity of air mixed with the oxygen is decreased until, at an altitude of approximately 30,000 feet, 100% oxygen is delivered to the mask. At any time that the Diluter-Demand Switch is positioned at 100% OXYGEN, the regulator will deliver undiluted oxygen as demanded by inhalation.

b. Automatic safety pressure of 0.1 to 2.0 inches of water is maintained at the outlet of the regulator at altitudes of 30,000 to 39,500 feet. Any possibility of a negative pressure in the mask above 30,000 feet is eliminated. Above altitudes of approximately 40,000 feet, an aneroid mechanism automatically raises the regulator outlet pressure, causing a high pressure to be delivered to the mask and facilitating breathing. In the EMERGENCY position, the Flow Switch on the left side of the regulator panel provides positive pressure at the regulator outlet at altitudes where positive pressure is not automatically provided. Movement of the Flow Switch to the TEST MASK position provides an outlet pressure of 11 inches of water.

c. The Oxygen Pressure Gage is calibrated in psi and is designed for use with a maximum inlet oxygen pressure of 2000 psi. When the oxygen cylinders are connected and the Supply Switch is turned ON, oxygen at cylinder pressure is admitted to the regulator. The oxygen flows through the inlet valve and is simultaneously introduced into the pressure reducing chamber and the pressure gage channel, thus indicating the actual pressure in the cylinders.

d. The oxygen Flow Indicator incorporates a blinker plate which operates with each breath of

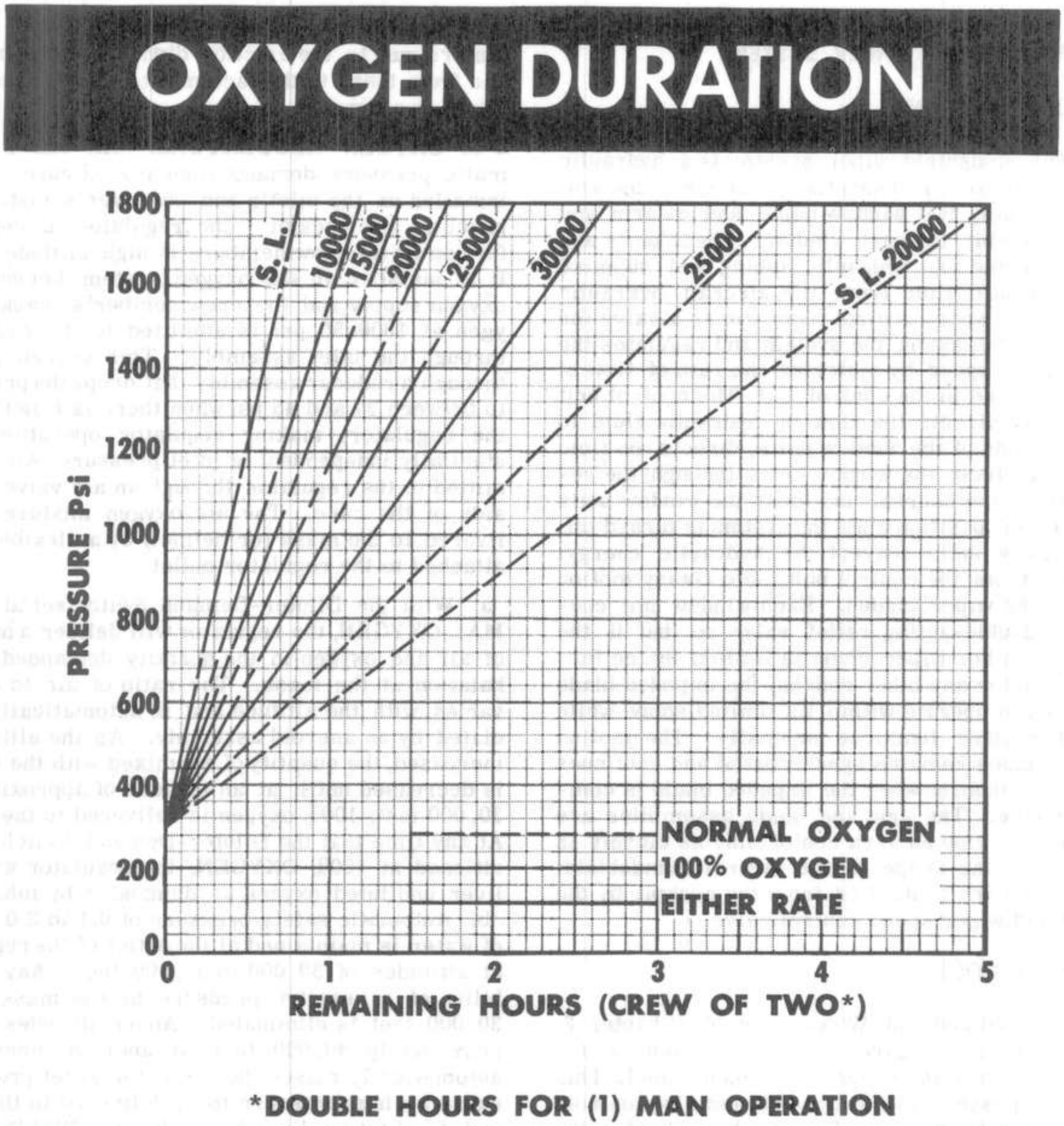


Figure 6-1. Oxygen Duration Chart

the mask wearer, exposing a fluorescent segment in the window on the regulator panel. Oxygen pressure in the flow indicator channel moves a diaphragm outward, which actuates a linkage causing the blinker plate to move and expose the fluorescent segment.

6-10. NORMAL OPERATION.

6-11. PREFLIGHT CHECK. Preflight check of the oxygen system is accomplished as step af. of the "Interior Check" in Chapter 3. Check the following:

a. Pressure - 1800 ±50 psi.

b. Mask - Securely attached, condition of rubber, proper installation of valves.

c. Connections at mask - Metal end intact, rubber gasket in place, clamp tight to between 10 and 20 pounds pull.

d. Regulator - Each crewmember must check the oxygen regulator at his station before takeoff. Check the NORMAL OXYGEN position and then the 100% OXYGEN position as follows: Remove mask and blow gently into end of the regulator hose as during normal exhalation. If there is a resistance to blowing, the system is satisfactory. Little or

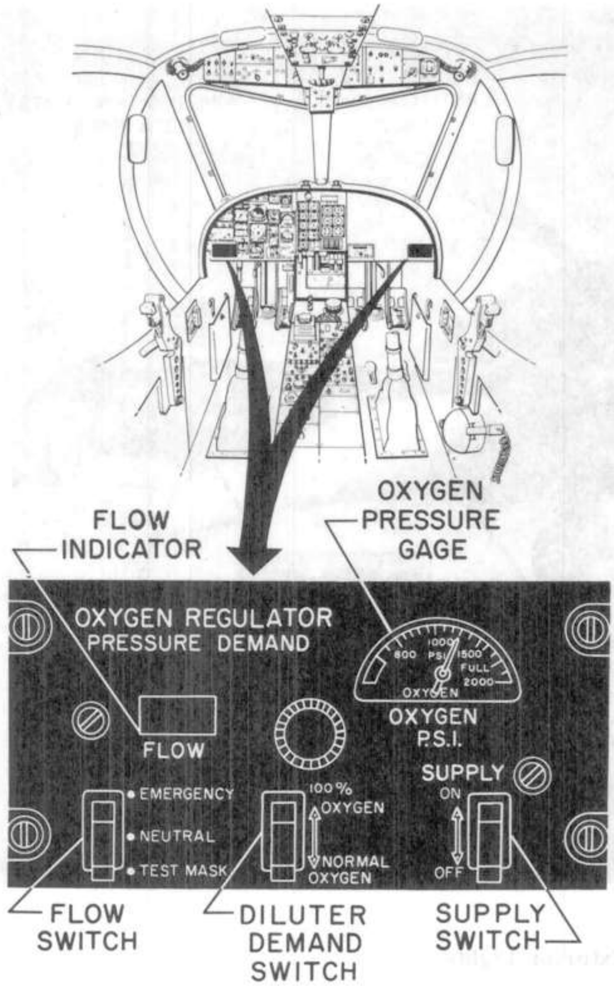


Figure 6-2. Oxygen Regulator

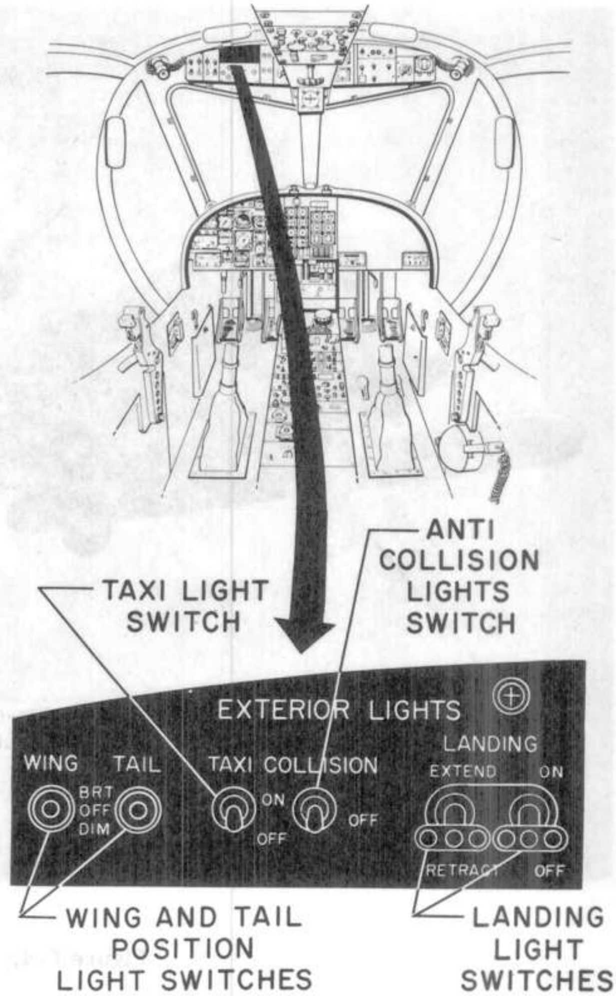


Figure 6-3. Exterior Lights Panel

no resistance indicates a faulty system and this condition must be corrected before flight.

e. Flow Indicator - Check for blink.

f. Pressure test:

(1) Test mask for exhale leaks.

(2) With Flow Switch at the TEST MASK position, hold breath; continued flow into tight mask indicates a leak.

(3) Return Flow Switch to NORMAL and exhale to check exhalation valve for sticking.

6-12. EMERGENCY OPERATION.

6-13. If any symptoms occur suggestive of the onset of anoxia, immediately turn the Flow Switch to the EMERGENCY position and descend below 10,000 feet. Whenever excessive carbon monoxide or other noxious gas is present or suspected, set the Diluter-Demand Switch to 100% OXYGEN and continue breathing undiluted oxygen until the danger is past.

6-14. LIGHTING EQUIPMENT.

6-15. EXTERIOR LIGHTS SYSTEM.

6-16. DESCRIPTION. The exterior lights system consists of the wing tip and tail position lights, anti-collision lights, taxi light, and left landing light. Controls for the exterior lights are located on the exterior lights panel (figure 6-3) of the left overhead console. Electric power for the system is supplied from the primary dc bus. Circuit protection is provided by the appropriate circuit breakers in the LIGHTS section of the center circuit breaker panel (Chapter 2, Section II, figure 2-16).

a. Wing Position Lights. The wing position lights (see figure 6-4) are recessed in the wingtip of each wing. Both lights are equipped with round, nondiffusing covers, the left one red and the right one green. These lights are controlled from the cockpit by a Wing Position Light Switch.

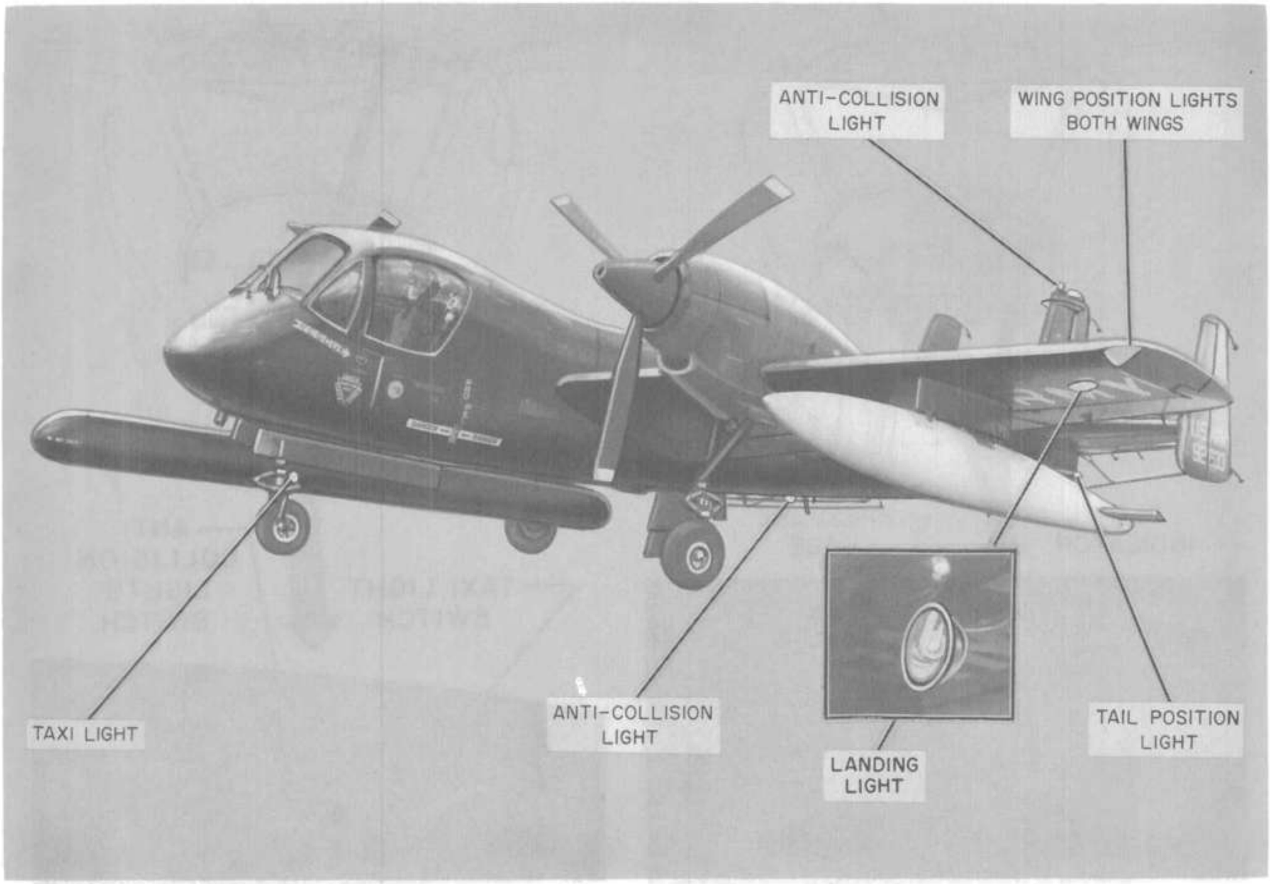


Figure 6-4. Exterior Lights

b. Tail Position Light. The tail position light (see figure 6-4) is a white light on the middle stabilizer of the tail section. This light is controlled from the cockpit by a Tail Position Light Switch.

c. Anti-Collision Lights. The anti-collision lights (see figure 6-4) are rotating red warning beacons installed for navigational purposes. The anti-collision lights are installed on the top of the center rudder and the underside of the fuselage, to the rear of the wings. Each assembly is fitted with two reflector lamps and rotates at 45 rpm, thus providing 90 flashes per minute. These lights are controlled in the cockpit by the Anti-Collision Lights switch.

d. Landing Light. The landing light (see figure 6-4) is installed flush in the left wing outer panel. When in use, the light is extended down and forward and is energized by the Landing Lights Switches in the cockpit.

e. Taxi Light. The taxi light (see figure 6-4) is located on the nosewheel strut and is controlled from the cockpit by the Taxi Light Switch (figure 6-3). The taxi light is rigid and will not turn with the turning of the nose gear.

6-17. CONTROLS.

a. Wing and Tail Position Light Switches. Both the Wing and the Tail Position Light Switches (figure 6-3) are three-position toggle switches located on the exterior lights panel of the left overhead console. Switch positions are BRT, OFF, and DIM. Intensity of the wing and tail position lights is controlled by the BRT and DIM switch positions.

b. Anti-Collision Lights Switch. The Anti-Collision Lights Switch (figure 6-3) is an ON-OFF toggle switch controlling the anti-collision lights. The switch is located on the exterior lights panel of the left overhead console.

c. Landing Light Switches. The Landing Light switches are two-position toggle switches located on the exterior lights panel (figure 6-3) of the left overhead console. One switch has EXTEND and RETRACT positions to lower and raise the landing light, while the second is used to turn the light ON or OFF.

d. Taxi Light Switch. The Taxi Light Switch is an ON-OFF toggle switch located on the exterior lights panel of the left overhead console (figure 6-3).

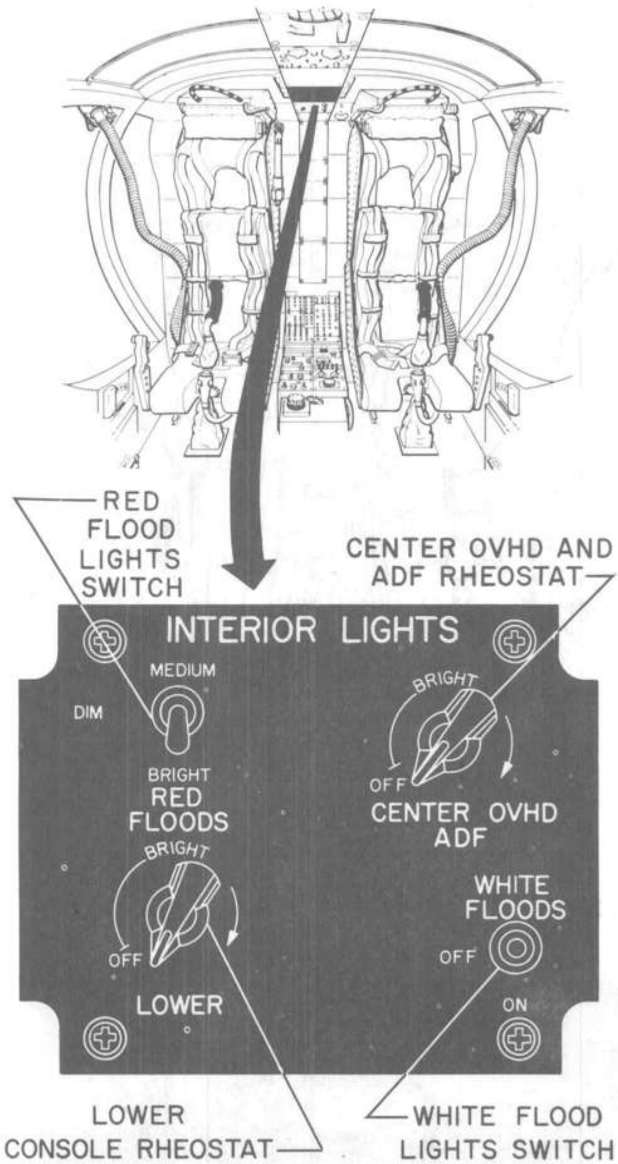


Figure 6-5. Interior Lights Panel

6-18. INTERIOR LIGHTS SYSTEM.

6-19. DESCRIPTION. The interior lights system (figure 6-6) consists of the primary ac instrument lights, the secondary dc instrument lights, the red floodlights, the white floodlights, the utility lights, the warning lights, and the signal light. This system provides for direct red floodlighting of the instrument panels and also for individual red lighting for all instruments and consoles. In addition, the lower console may be floodlighted by the white floodlights located on the seat support bulkhead between the pilot and observer. The intensity of the instrument and console lights may be varied from dim to bright by means of the appropriate rheostats. When the instrument lights are on, all warning lights except those of the fire detection system are automatically dimmed. The Master Caution Light Test Switch is used to test all of the warning lights, since the individual warning lights are not equipped for testing. Controls for the interior lights system are located on the pilot's instrument panel, observer's console, and the interior lights panel of the center overhead console.

6-20. CONTROLS.

a. The Center Overhead and ADF Rheostat. The Center Overhead and ADF Rheostat (figure 6-5) controls the center overhead console and the ADF receiver panel lights (located on the center lower console). This rheostat must be rotated clockwise from the OFF position (in the BRIGHT direction) before the red floodlights can be turned on and their intensity controlled by the Red Floodlights Switch.

b. Lower Console Rheostat. The Lower Console Rheostat (figure 6-5) controls the intensity of the center lower console panel lights with the exception of the ADF receiver panel lights.

c. Red Floodlights Switch. The Red Floodlights Switch (figure 6-5) is a three-position toggle switch with DIM, MEDIUM, and BRIGHT positions. In the DIM and MEDIUM positions only, the two floodlights over the circuit breaker panel and the one on the center overhead console go on. With the switch in the BRIGHT position, the remaining floodlights go on.

d. White Floodlights Switch. The white floodlights switch (figure 6-5) is an ON-OFF toggle switch that controls the white floodlights. These are used to illuminate the center lower console. They are very helpful in counteracting the effects of high-altitude glare.

e. Engine Instruments Rheostat. The Engine Instrument's Rheostat (figure 6-6) is located on the electric master panel of the left overhead console. This rheostat together with the Pilot's Instruments Rheostat controls the intensity of all instrument lights on the pilot's and center instrument panels.

f. Right and Left Overhead Rheostat. The Right and Left Overhead Rheostat (figure 6-6) is located on the electric master panel of the left overhead console. This rheostat controls the intensity of all left and right overhead console lights.

g. Observer's Lights Rheostat. The Observer's Instruments Rheostat (figure 6-6) is located on the observer's console on [1] aircraft. The Observer's Lights Rheostat (figure 6-6) is located on the right overhead console on the [7] aircraft. This rheostat controls the intensity of all instrument lights on the observer's console.

h. Pilot's Instrument Rheostat. The Pilot's Instrument Rheostat (figure 6-6) is located on the pilot's instrument panel. This rheostat together with the Engine Instruments Rheostat controls the intensity of all instrument lights on the pilot's and

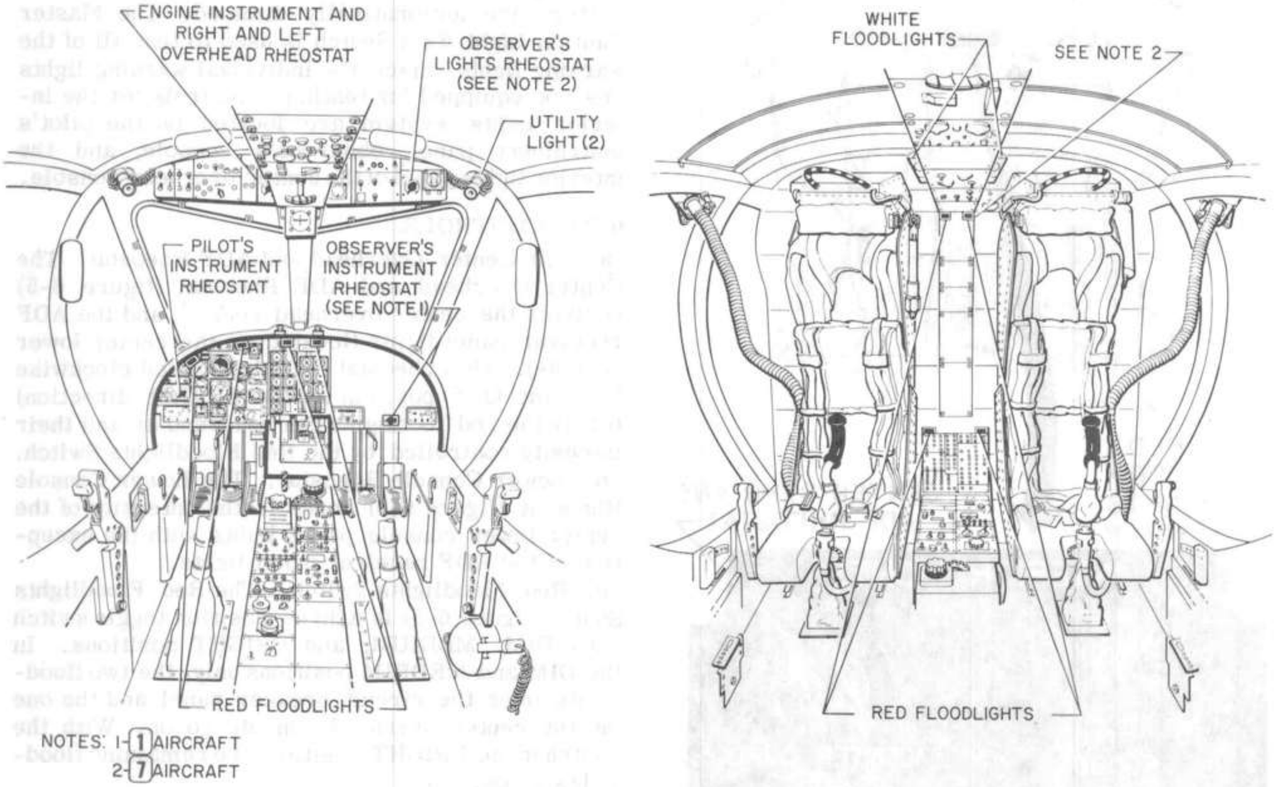


Figure 6-6. Interior Lights System

center instrument panels. In addition, the Pilot's Instrument Rheostat controls the intensity of all warning and caution lights with the exception of the fire detection system. Turning the Pilot's Instrument Rheostat clockwise from OFF towards BRIGHT dims the warning and caution lights.

i. Utility Lights. Utility lights (figure 6-6) are provided in the cockpit for the pilot and observer and are detachable from clip-type mounts located outboard of the left and right overhead consoles. The lens section of each light can be rotated to provide red or white illumination. Rotation of the rear section of the light provides ON-OFF and intensity control. In addition, a pushbutton switch on the rear section of the light can be depressed for intermittent illumination. The primary dc bus provides 28 vdc for the lights through the COCKPIT LIGHTS circuit breaker on the center circuit breaker panel.

6-21. ARMOR PLATE AND FLAK CURTAINS. (See figure 6-7.) Personnel armor protection is afforded by removable flak curtains located forward and aft of the cockpit, a 1/4-inch aluminum armor plate cockpit floor, and a one-inch thick plastic windshield.

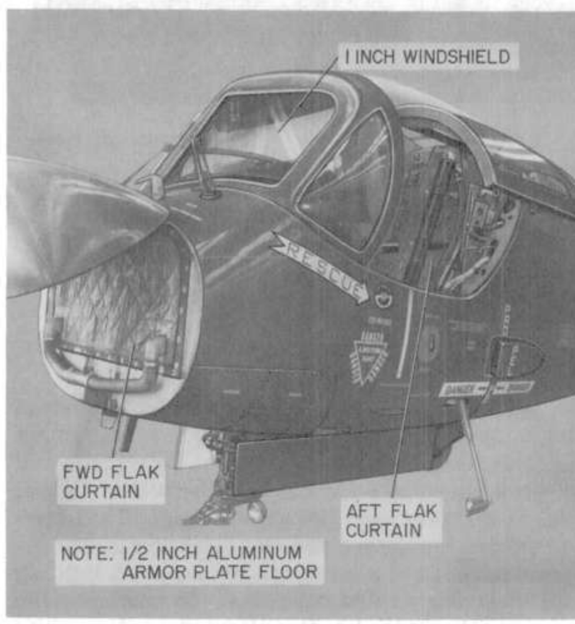


Figure 6-7. Armor Plate and Flak Curtains

CHAPTER 7
OPERATING LIMITATIONS

Section I. Scope

1-1. The information contained in this chapter covers all important limitations that must be observed during normal flight operations.

1-2. Limitations that are characteristic of specialized phases of operation are not covered in this chapter, but may be found either in Chapter 3, Emergency Procedures, or Chapter 10, Weather Operations.

Section II. Limitations

2-1. GENERAL.

2-2. Operating limitations are derived from extensive flight testing and operational experience to insure safety and to help obtain maximum utility from the equipment. The instrument dials are marked as shown on figure 2-1 as a constant reminder of airspeed and engine limitations. Cognizance must be taken of these markings since they represent limitations that are not necessarily repeated elsewhere. Whenever necessary, further explanation of the instrument markings will be covered in the text under the appropriate headings. Additional limitations on operational procedures, acrobatics, and aircraft loading are given in the following paragraphs.

2-3. MINIMUM CREW REQUIREMENT.

2-4. The minimum crew requirement for this aircraft under normal nontactical missions is one pilot. An additional crewmember, as required, will be added at the discretion of the Commanding Officer.

2-5. INSTRUMENT MARKINGS. (See figure 2-1.)

2-6. ENGINE LIMITATIONS.

2-7. GENERAL. The following paragraphs cover alternate fuels and their limitations, as well as definitions of engine powers referenced in this manual. Normal engine limitations are illustrated in figure 2-1. Additional information concerning engine operating limitations is given in table 2-I.

TABLE 2-I. ENGINE OPERATING LIMITATIONS

POWER RATING	MAX TIME	PROPELLER RPM MAX	PROPELLER RPM MIN	MAX TORQUE-METER DIFF PRESS. (psig)	MAX EGT (°C)	MAX OIL INLET TEMP (°C)	MAX OIL PRESS. (psig)
Takeoff	5 min	1678±15	1175±25	73 (T53-L-3) 100 (T53-L-7)	611 (T53-L-3) 638 (T53-L-7)	93	70±10
Mil	30 min	1678±15	1175±25	73 (T53-L-3) 100 (T53-L-7)	600 (T53-L-3) 621 (T53-L-7)	93	70±10
Normal	Continuous	1678±15	1175±25	67 (T53-L-3) 78 at 1700 RPM (T53-L-7) 92 at 1550 RPM (T53-L-7) 92 at 1150 RPM (T53-L-7)	589 (T53-L-3) 604 (T53-L-7)	93	70±10
Starting	Through-out start	(Min time between ground start attempts = 2 minutes starter generator limit)			622* 760***	93	10 psi (min) at Ground Idle
Acceleration (fwd or reverse thrust)	5 sec	--	--	--	649*	93	70±10
	Remainder of transient	1800	--	--	760*** 649	93	70±10
	2 sec	--	--	116	--	93	70±10
	3 sec	--	--	--	--	93	70±10
Full reverse (below 130 knots)	5 min	1700		73 (T53-L-3) 100 (T53-L-7)	611 (T53-L-3) 638 (T53-L-7)	93	70±10

NOTES:

*622°C may be exceeded momentarily three times before first stage blades must be inspected.
**649°C may be exceeded for 5 seconds.
***Every case of temperature in excess of 760°C requires inspection of the first stage blades.

2-8. ALTERNATE FUEL AND LIMITATIONS. For continuous operation, the approved fuel is JP-4 Military Specification MIL-J-5624. When this fuel is not available, the alternate fuels listed in table 2-III will be used. Accumulated use of alternate fuel is limited to 50 hours of weighted time (see paragraph 2-9). A thorough inspection of the combustion section must be accomplished within the delayed operating time as shown in table 2-II, subject to the following considerations:

a. Unleaded gasoline can be used at any time and in any quantity without restriction.

b. When gasoline containing tetraethyl lead is used as a fuel, the type of gasoline must be recorded for maintenance records. This includes all aviation gasoline and most automobile gasolines.

c. Gasolines can be mixed with each other or with JP-4 fuel, Military Specification MIL-J-5624. For established weighted time, the entire mixture will be considered as fuel of the highest octane rating used.

d. JP-5 can be used with the T53L-7 engines on (9) aircraft.

TABLE 2-II. INSPECTION SCHEDULING

OPERATING TIME ON ALTERNATE FUEL (hours)	PERMISSIBLE DELAY BEFORE INSPECTION (operating hours)
1 - 50	40
51 - 100	30
101 - 150	20
151 - 200	10
200 -	0

2-9. WEIGHTED TIME. Weighted time is the actual time the engine has operated on leaded fuel multiplied by a constant assigned to the fuel. The constant is established according to the percent of tetraethyl lead and the octane rating of the alternate fuel used. Weighted time is calculated by the formula T = tc, where: T = Weighted time, t = Actual operating time on leaded fuel, c = Constant assigned to specific fuel (see table 2-III).

2-10. ENGINE POWER DEFINITIONS. Definitions of engine powers referenced in this manual are as follows:

a. Takeoff Power. The maximum horsepower the engines will deliver at standard sea level static conditions for a duration of 5 minutes (Power Lever at TAKEOFF position).

b. Military Power. The maximum horsepower specified for the engine as allowable in flight under specific operating conditions for periods of 30 minutes duration (Power Levers at MIL POWER position).

TABLE 2-III. LEADED FUEL CONSTANTS

TYPE OF GASOLINE	GRADE	CONSTANT
Aviation Gasoline, Military Specification MIL-G-5572	80/87	2
Aviation Gasoline, Military Specification MIL-G-5572	90/96	4
Aviation Gasoline, Military Specification MIL-G-5572	115/145	5
Automobile Gasoline, Federal Specification VV-G-76, VV-M-61, and Military Specification MIL-G-3056	Any leaded	5

c. Normal Rated Power. The maximum horsepower specified for the engine as allowable for continuous operation under specified conditions. Obtained when operating at normal rated speed and exhaust gas temperature.

2-11. PROPELLER LIMITATIONS.

2-12. There are no propeller limitations on the AO-1 aircraft other than those shown on table 2-I.

NOTE

Transient propeller rpm peaks will occasionally approach 1800 rpm under normal conditions, but operation beyond this limit is evidence of deteriorating performance and requires investigation as to the cause, e.g., improper servicing, rigging, etc.

2-13. AIRSPEED LIMITATIONS.

2-14. The maximum allowable airspeeds are as follows:

a. In smooth or moderately turbulent air, with landing gear and flaps retracted, speed brakes extended or retracted in symmetrical and unsymmetrical flight see figure 2-2.

b. In severe turbulence - Maximum sustained level flight speeds.

NOTE

In severe turbulent conditions, speeds in the range of 100 to 150 knots are recommended.

c. With landing gear and/or flaps extended - 153 knots.

d. Unfeathering of propellers above 150 knots is prohibited.

2-15. PROHIBITED MANEUVERS.

2-16. With this aircraft, rapid pullups are permissible but care should be exercised, especially

INSTRUMENT MARKINGS

FUEL GRADE JP-4 OR JP-5

AIRSPEED

MAXIMUM: 385 KNOTS

MAXIMUM WITH GEAR AND FLAPS EXTENDED: 153 KNOTS

ENGINE TACHOMETER

MAXIMUM: 102 %

60-101 %

40-60 %

OIL PRESSURE

MAXIMUM: 80 PSI

NORMAL: 10-80 PSI

MINIMUM: 10 PSI

OIL TEMPERATURE

93° C-UP

MAXIMUM: 93°C

FUEL FLOW

MAXIMUM: 810 LBS./HR. (WITH MAXIMUM GAGE ERROR)

NORMAL: 110-810 LBS/HR

Figure 2-1. Instrument Markings (Sheet 1 of 2)

INSTRUMENT MARKINGS

FUEL GRADE JP-4 OR JP-5

ACCELEROMETER

- MAXIMUM: +5.0
  MINIMUM: - 1.6
- - 1.6 - 0.0
- 0.0 - +5.0

PROPELLER TACHOMETER

- 1800-UP RPM (NEVER EXCEED)
  MAXIMUM: 1678 RPM (STEADY)
- 1775 RPM MAXIMUM (TRANSIENT)
- NORMAL: 1175 - 1678 RPM

EXHAUST GAS TEMPERATURE

T53-L-3

T53-L-7

T53-L-3	T53-L-7
611-760°C	638-760°C
589-611°C	604-638°C
300-589°C	300-604°C

MAXIMUM 760°C

HYDRAULIC PRESSURE

- MAXIMUM: 3200 PSI
- NORMAL: 2800 - 3200 PSI
- MINIMUM: 2800 PSI

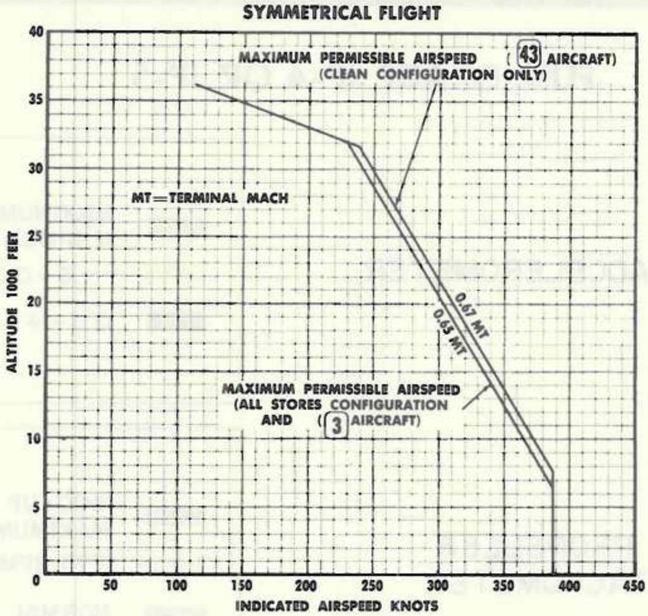
TORQUE PRESSURE

T53-L-3

T53-L-7

T53-L-3	T53-L-7
73-116 PSI	100-116 PSI
67-73 PSI	78-100 PSI
20-67 PSI	28-78 PSI

Figure 2-1. Instrument Markings (Sheet 2 of 2)



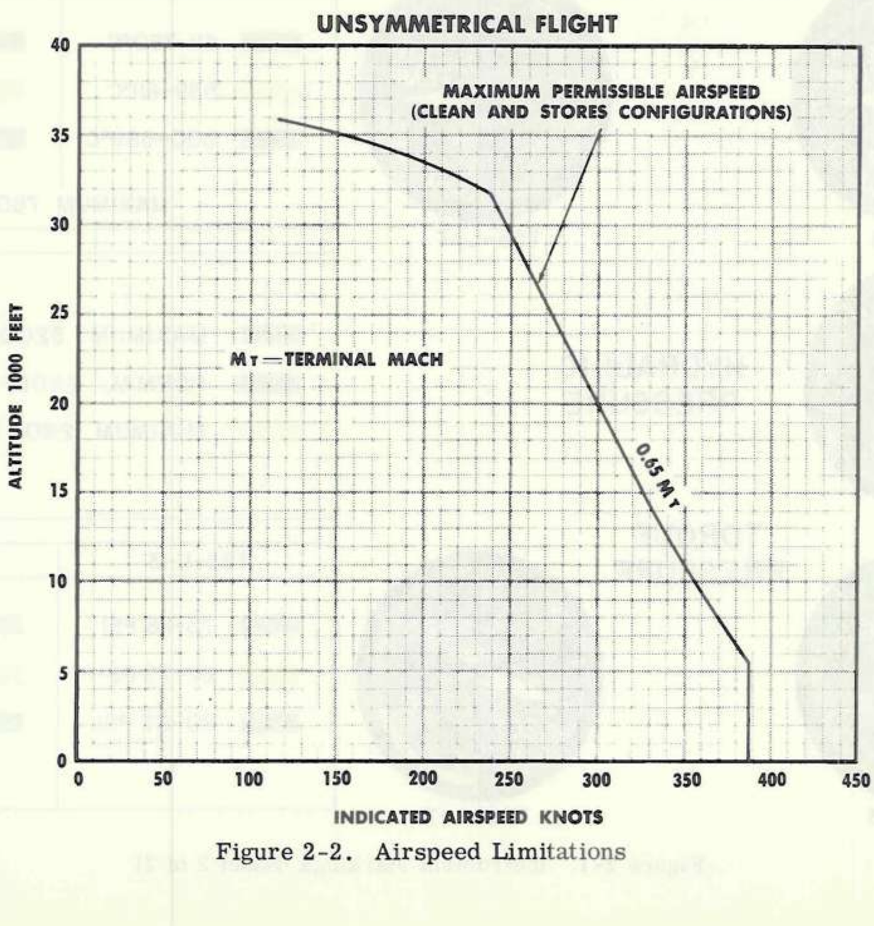
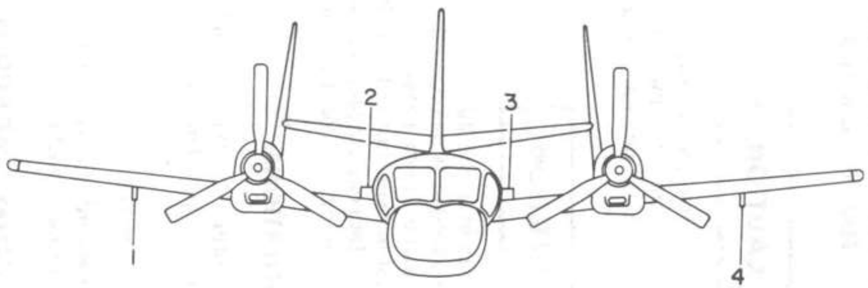


Figure 2-2. Airspeed Limitations



INDEX

- □ Aero 1C Tanks (Empty)
- △ Aero 1C Tanks (Full)
- ○ Flare Pods
- ▲ Resupply Containers (Empty)
- ☆ Resupply Containers (Full)

Store Configuration		Store Station 1	2	3	4	Remarks
"LIGHT" Stores Configs	A		○	○		1. Max Airspeed (See figs. 2-2, 2-3) 2. Max 'g' Symmetrical 4.8 3. Max 'g' Unsymmetrical 3.8 4. Max Negative 'g' -1.5
	B		○	○		
	C		○	○		
	D	▲ □	○	○	▲ □	
	E	▲ □	○	○	▲ □	
	F	▲ □	○	○	▲ □	
Heavy Stores Configs	H	☆△	○	○	☆△	1. Max Airspeed (See figs. 2-2, 2-3) 2. Max 'g' Symmetrical 4.0 3. Max 'g' Unsymmetrical 3.2 4. Max Negative 'g' -1.3 5. Max Sink Speed = 8 ft/sec. 6. Rough Field Landings are Prohibited.
	I	☆△	○	○	☆△	
	J	☆△	○	○	☆△	

NOTES

a. Aero 1C external tanks may be dropped in +1.0 'g' wings level flight at speeds up to 220 knots.

b. Empty resupply containers may be released at speeds up to 240 knots. In this configuration, the release lanyard should not be attached to the cone.

c. Full resupply containers may be released at speeds up to 240 knots provided a 200 pound test 4 foot chord is attached to the cone and chute release cable.

d. Other stores may be dropped at speeds up to 385 knots at dive angles up to 45 degrees.

Figure 2-3. External Stores Loading and Limitations with aft centers-of-gravity, at airspeeds over 275 knots, and at altitudes above 15,000 feet. A stick force lightening can be expected beyond these limits. Maneuvers that are prohibited for this aircraft are as follows:

a. Abrupt, full lateral stick deflection, 360° bank angle rolls above the maximum permissible airspeeds for unsymmetrical flight (see figure 2-2.)
b. Steady sideslips of over 300 pounds rudder pedal force up to maximum permissible air-speeds for unsymmetrical flight (see figure 2-2).
c. Abrupt yaws at speeds in excess of 170 knots.
d. Intentional spins.
e. Abrupt large control reversals.

WARNING

Abrupt lightening of rudder pedal forces for rudder pedal deflections greater than 1/2 full displacement is encountered in all flaps-down flight conditions and flaps-up flight conditions at airspeeds less than 170 knots. This force lightening is indicative of the reduced directional stability which occurs at large sideslip angles. Maneuvers requiring greater than 1/2 full rudder pedal deflection can be accomplished safely at airspeeds less than 170 knots IAS but should be avoided during normal operation of the aircraft.

WARNING

A stron yawing tendency exists below 185 knots and is most pronounced on [3] and [4] aircraft.

2-17. ACCELERATION LIMITATIONS.

2-18. The maximum permissible acceleration for flight in smooth air at gross weights of 12,000 pounds or less is as follows:

Symmetrical flight - 5.0 g [8] aircraft;
4.0 g [9] aircraft
Unsymmetrical flight - 4.0 g [8] aircraft;
3.2 g [9] aircraft

a. At gross weights in excess of 12,000 pounds, the maximum permissible acceleration should be reduced to maintain a constant product of gross weight times acceleration.

NOTE

Reduce load factor 0.1 g for every 250 pounds increase in gross weight.

b. When flying in turbulent air, it is essential that accelerations, due to deliberate maneuvers, be limited to the range of +0.5 g to +1.5 g in order to minimize the possibility of overstressing the aircraft as a result of the combined effects of gusts and maneuvering loads. Negative load factors are permissible from -1.6 g at 280 knots varying linearly to 0 g at maximum airspeed.

CAUTION

Sustained flight operation at load factors less than +0.3 g should be avoided since excessive oil loss occurs during a push-over between 0 g and -1.0 g.

c. A maximum load factor of +2 g is permitted with flaps and slats and/or landing gear extended.

2-19. CENTER OF GRAVITY LIMITATIONS.

2-20. Refer to Chapter 12 Weight and Balance Computation, for latest operating weight and balance information. The recommended center of gravity limits are 22% MAC to 29.3% MAC ([3] and [4] aircraft) and 22% MAC to 33% MAC ([43] aircraft.

CAUTION

On OV-1B aircraft, loadings incorporating flare pods and only one crewmember can exceed the aft c.g. limit unless ballast is installed.

CAUTION

On [43] aircraft, flight in the 30 to 33% MAC region shall be avoided if practicable, but the aircraft can be flown safely in this region if the pilot is familiar with the flight characteristics. Increasing caution should be observed as the cg approaches the aft limit.

2-21. WEIGHT LIMITATIONS.

2-22. Refer to Chapter 12, Weight and Balance Computation for latest operating weight and balance information.

NOTE

Weight limitations information and charts will be supplied when available.

2-23. EXTERNAL STORES LIMITATIONS.

2-24. External stores may be carried and released single or in combination under the same restrictions that apply without such stores, with the exceptions noted in figure 2-3.

CHAPTER 8
FLIGHT CHARACTERISTICS

Section I. Scope

1-1. The purpose of this chapter is to inform the operator of any unique flight characteristics of the aircraft.

1-2. The information contained in this chapter is based on flight operations at maximum gross weight.

NOTE

Stall charts, dive recovery charts, angle of attack relationship curves, and velocity gravity charts will be supplied when available.

Section II. Maneuvers

2-1. GENERAL.

2-2. At all allowable gross weights, the aircraft is stable at all normal speeds. In two-engine flying, there is noticeable torque effect in the lateral sense but nevertheless the aircraft is easily controlled in single-engine flight. Very little change of rudder trim is necessary for changes in power and speed.

2-3. STALLS.

2-4. The handling characteristics of this aircraft at low speeds are excellent, with good control response at all recommended minimum speeds of the aircraft. This aircraft has a very mild stall characteristic in which there is a mild nose-down pitch. It maintains the stall attitude and will fly out of the stalled condition when back pressure is released. Although wing heaviness may be encountered in the cruise configuration stalls, no abrupt wing drop tendencies are exhibited.

2-5. SPINS.

2-6. FLAPS-UP. If an unintentional spin should occur, use the following procedure for recovery from the spin:

a. Power Levers - FLIGHT IDLE.
b. Ailerons - Neutral.
c. Control stick - Forward
d. Rudders - Against the spin until rotation has stopped, then neutralize or center.
e. Control Stick - Release forward pressure after rotation has stopped.
f. Allow build-up to safe flying speed then smoothly raise the nose to the horizon.

CAUTION

Avoid secondary stall during recovery.

2-7. FLAPS DOWN. If an unintentional spin should occur, use the following procedure for recovery from the spin:

a. Power Levers - FLIGHT IDLE.
b. Ailerons - WITH SPIN DIRECTION (i.e., spin-nose left, lateral control stick left).
c. Rudders - Against the spin until rotation has stopped, then neutralize or center.
e. Control Stick - Release forward pressure after rotation has stopped.
f. Allow build-up to safe flying speed then smoothly raise the nose to the horizon.

CAUTION

Avoid secondary stall during recovery.

2-8. DIVING.

2-9. (This information will be supplied when available.)

2-10. MANEUVERING FLIGHT.

2-11. (This information will be supplied when available.)

Section III. Control Characteristics

3-1. FLIGHT CONTROLS.

3-2. The flight controls have proved to be effective at all airspeeds and no unusual reactions will be encountered during normal flight operations. However, care should be exercised when bringing the rudder to neutral from large yaw angles to make the action a normal, smooth push-type maneuver rather than an abrupt kick. During slow, cruising, and high speed flights, a full deflection roll causes aileron oscillation in the control stick. Up to 180 knots airspeed, a rudder force lightening occurs at maximum side slip (this condition is most outstanding on [3] and [4] aircraft).

3-3. LEVEL FLIGHT CHARACTERISTICS UNDER VARIOUS SPEED CONDITIONS.

3-4. Lateral trim changes occur with changes in speed and power.

NOTE

Further information will be supplied when available.

3-5. FLIGHT WITH EXTERNAL LOADS.

3-6. The drop tanks and flare pods have little effect on the aircraft's flying characteristics. Uneven transfer of fuel from the drop tanks causes wing heaviness, but this can be trimmed out with the aileron trim tab control.

3-7. FLIGHT WITH ASYMMETRICAL LOADS.

3-8. (This information will be supplied when available.)

CHAPTER 9
SYSTEMS OPERATION

Section I. Scope

1-1. The purpose of this chapter is to supply additional information regarding the operation of systems already covered in preceding chapters.

1-2. Special problems involved in the operation of various aircraft systems are also covered.

Section II. Systems

2-1. PROPELLER SYNCHROPHASER SYSTEM.

NOTE

On [21] AIRCRAFT the synchrophaser switch is a single ON-OFF toggle switch (Chapter 2, Section II, 14, figure 2-8). On [22] AIRCRAFT, the synchrophaser switch is a three position switch, combined with the autofeather arming switch (Chapter 2, Section II, 19, figure 2-8).

2-2. The synchrophaser is designed for use during stabilized climb, cruise, and descent. During takeoff and landing, the synchrophaser switch is placed in the OFF position. The synchrophaser assembly, located in the nose compartment, receives operating power directly from the SYNC AC circuit breaker (see Chapter 2, Section II, figure 2-17 or 2-18). The synchrophaser switch isolates the servo motor in the slave (No. 2) engine.

a. Takeoff. Use of the propeller synchrophaser on takeoff is not recommended because a severe loss of power on the master engine (No. 1) could cause a drop of almost 70 rpm in the slave propeller, giving a false indication of trouble.

b. Landing. Use of the propeller synchrophaser for landing is not recommended because operation of the propeller at landing pattern airspeed and power setting usually results in blade angles at or near the mechanical low pitch setting. Interference of the low pitch stop with normal blade angle changes (when synchrophaser is on) would cause undesirable rpm hunting of the slave propeller.

2-3. Slave propeller (No. 2) rpm will probably vary from the master propeller (No. 1) rpm in turbulent air, or during large or rapid change of power, rpm, or aircraft attitude; but synchronization will be restored automatically within 5 to 10 seconds. Because of the transient rpm disturbance, the pilot must use his own discretion as to whether he should turn off the synchrophaser switch in preparation for acrobatics, or any other sustained period of transient powerplant or flight condition. It is not recommended to turn off the synchrophaser switch for isolated power changes, rpm changes, turns, etc. This merely increases the time necessary for the synchrophaser to automatically restore synchronization. With the synchrophaser switch in ON, and with the power levers and propeller levers locked in the proper relationship, smooth lever movements will often not result in any loss of synchronization.

2-4. For synchronization to be effective, slave propeller rpm must be mechanically set to within 2% (approximately 35 rpm) of the master propeller rpm. Slave rpm can follow master rpm within plus or minus 2% of slave rpm as set with the propeller lever. Therefore, synchrophasing will be most effective when slave rpm has been mechanically matched with the master rpm. Otherwise the synchrophaser may be holding slave rpm to master rpm at one extreme of the 2% range, and relatively slight variations in flight conditions can cause the slave propeller to lose synchronization.

2-5. Synchrophasing will not necessarily operate satisfactorily on a ground check because of the difference in wind conditions which the propellers experience on the ground. There may be evidence that the synchrophaser is operating, as indicated by automatic changes in slave propeller rpm to match the master propeller rpm, but operation may not be sufficiently stable to determine whether the entire system is satisfactory.

2-6. MANUAL (EMER) FUEL SYSTEM OPERATION.

NOTE

The "automatic" and "emergency" fuel control systems are called "primary" and "manual" systems respectively, on [10] AIRCRAFT without MWO 55-1510-204-34/10 incorporated.

2-7. In the event of failure of the automatic fuel control system, changeover to the emergency system should be immediately effected. When the emergency system is being utilized, the main fuel flow regulator is bypassed and fuel is metered to the engine by the emergency metering valve, which is positioned from the cockpit by the power levers. Acceleration and deceleration control is not provided in the emergency system; therefore, it is imperative that rapid movement of the throttle be avoided to eliminate the possibility of engine overspeed or possible flameout. If a flameout occurs, the normal air start procedures will apply since the emergency fuel control system does not affect the operation of the starting fuel system.

2-8. SINGLE POINT PRESSURE FUELING.

2-9. Complete operation of the single-point pressure fueling system, including selective filling and shutoff precheck on all tanks, can be accomplished at the pressure fueling station (figure 2-1). The pressure fueling station also provides for single-point pressure defueling if the fuel in both drop tanks has been transferred to the main tank. The following switches, on the pressure fueling station, control the entire operation of pressure fueling and defueling:

a. Fuel-Defuel Master Switch. The fuel-defuel master switch (2, figure 2-1) is a two position ON-OFF toggle switch. Setting this switch in the ON position energizes the fuel-defuel relay, which opens the main tank fueling shutoff valve. The ON position also arms the left and right drop tank fueling switches and main tank fueling switch through the OFF position of the drop tanks defuel switch. This means that with the drop tank defuel switch in ON the fueling circuit is de-energized.

b. Drop Tanks Defuel Switch. The drop tanks defuel switch (7), is an ON-OFF toggle switch. Placing this switch in the ON position energizes the drop tanks transfer pumps, transferring the fuel from the drop tanks to the main tank.

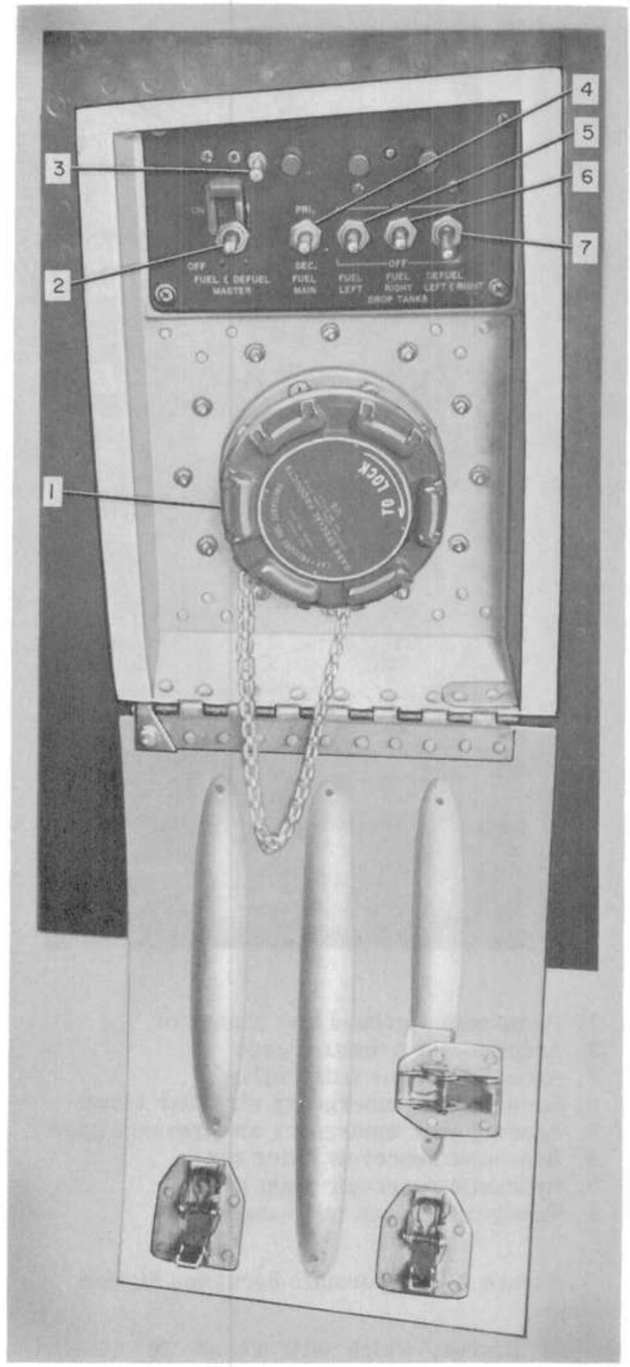
c. Fuel Main Selector Switch. The fuel main selector switch (4), is a three-position switch with PRI-OFF-SEC positions. The primary and secondary positions control two solenoids in the main tank pilot valve used to test the operation of the primary and secondary diaphragms in the main tank fuel shutoff valve. The secondary system exists only as an alternate system for use in the event of failure in the primary system.

d. Drop Tanks Fuel Left and Right Selector Switches. The left and right drop tanks fuel selector switches (5 and 6) are ON-OFF toggle switches. They control solenoid operated diaphragm drop tank shutoff valves which are normally controlled by a float switch in each drop tank. With these switches in the ON position, the valves are opened allowing the drop tanks to be pressure fueled. Selective pressure fueling of all tanks may be accomplished by use of these switches and the main fueling selector switch.

e. Pressure Fueling Door Interlock Switch. The pressure fueling door interlock switch (3) is a plunger-operated microswitch (spring-loaded to the closed position). When the pressure fueling station door is closed, the switch is held in the open position and the circuit to the pressure fueling switches is broken. Opening the door allows the switch to spring closed, completing the circuit to the fueling switches and supplying power to the three post lights which illuminate the panel.

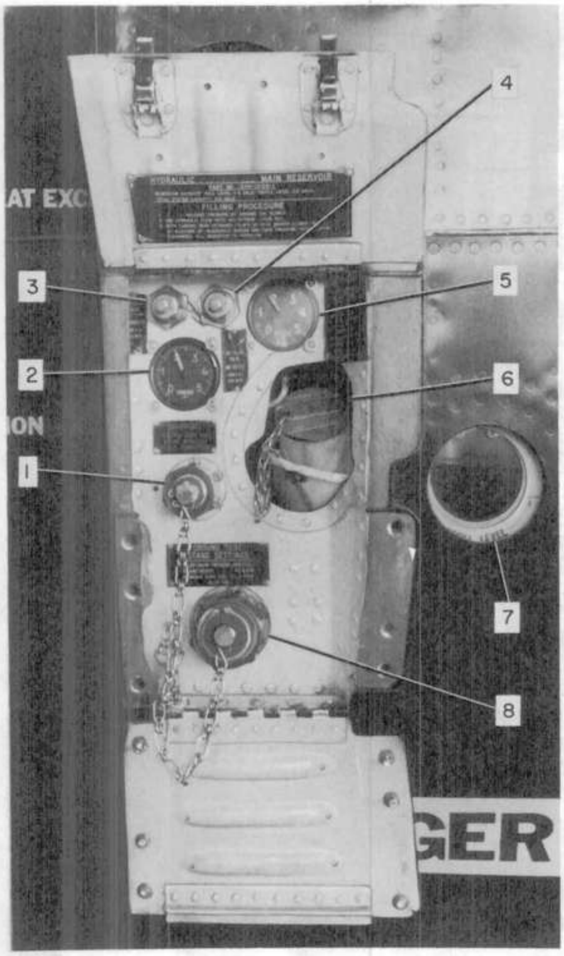
2-10. USE OF LANDING WHEEL BRAKES.

2-11. To reduce maintenance difficulties and accidents due to wheel and brake failure, it is desired to emphasize the importance of using aircraft landing wheel brakes for the purpose for which they were designed and intended. The fundamental purpose of brakes is to retard motion by transforming mechanical energy into heat energy through friction. Therefore, to obtain maximum efficiency it is absolutely necessary that aircraft brakes be treated with an amount of respect comparable to the respect given brakes on any motor vehicle. Repeated excessive application of brakes without allowing sufficient time for cooling between applications will cause temperature increases to a dan-



1. Pressure fueling adapter
2. Fuel-defuel master switch
3. Pressure fueling door interlock switch
4. Fuel main selector switch
5. Drop tanks fuel left selector switch
6. Drop tanks fuel right selector switch
7. Drop tanks defuel switch

Figure 2-1. Pressure Fueling Station



1. Pump output ground test connector
2. Accumulator pressure gage
3. Accumulator air filler valve
4. Landing gear emergency air filler valve
5. Landing gear emergency air pressure gage
6. Hydraulic reservoir filler cap
7. Hydraulic reservoir sight gage
8. Reservoir ground test connector

Figure 2-2. Hydraulic Servicing Station

gerous degree, which will result in complete breakdown of the brake structure, failure of brake drum and wheel structure, blowing of tires, and in extreme cases the complete wheel and brake installations are destroyed by fire. This also applies to excessively short stops from high rates of speed and dragging brakes for an appreciable distance while taxiing at slow speeds. The following precautions should be observed insofar as is practicable.

a. Immediately after landing or at any time when there is considerable lift on the wings, extreme care should be used during any brake applications to prevent skidding the tires and causing flat spots. Proper traction cannot be expected until the tires are carrying heavy loads. In the event that maximum braking is required after touchdown, propeller should be reversed immediately and the brakes applied smoothly and evenly until the aircraft is stopped.

b. With the landing wheels remaining in the slipstream (extended), at least 10 minutes should be allowed to elapse between landings where maximum braking is applied in order to allow adequate time for cooling between brake applications. This time restriction is not applicable to "touch and go" type landings, when no brake application is involved.

c. With the landing wheels retracted into wheel wells, at least 30 minutes should be allowed to elapse between landings in order to allow adequate time for cooling between brake applications. This time limit may be reduced to 5 minutes between "touch and go" landings, when no brake application is involved.

d. At the first indication of brake malfunction, the aircraft should be maneuvered off the active runway. The aircraft should be controlled through the use of both forward and reverse thrust or nose-wheel steering (if incorporated). Reversing the propellers permits the pilot to park the aircraft without the use of brakes.

e. Full advantage should be taken of the length of the runway during the landing roll in order that the brakes can be used as little and as lightly as possible when bringing the aircraft to a stop.

f. The brakes should not be dragged when taxiing, either intentionally or inadvertently. Personnel should insure that toe brake pressure is not applied when operating the rudder pedals. Normally the brake linkage is adjusted to prevent inadvertent toe pressure when operating the rudder pedals.

g. For short landing rolls, reversing the propellers and a single, smooth application of the brakes with constantly increasing pedal pressure is most desirable.

h. To prevent damage during landing, brakes must not be set and locked during flight. It is advisable to apply and release the brakes a few times prior to landing to determine by feel whether the brake system is functioning properly. If the pedals feel spongy or soft, it may be possible to pump up the brakes prior to landing to insure the best possible operation.

i. Unless new wheel brakes are properly burned in, adequate braking action may not be available for ground engine run-up. Overheat new brakes four times during taxiing, allowing them to cool each time. When brake fading occurs, the brakes have burned in sufficiently.

2-12. Hydraulic System Servicing Station. Servicing of the hydraulic system, including the landing gear emergency air bottle is accomplished through the hydraulic servicing station (figure 2-2).

CHAPTER 10
WEATHER OPERATIONS

Section I. Scope

1-1. The purpose of this chapter is to inform the pilot and observer of the special precautions and procedures to be followed during the various weather and climatic conditions that may be encountered in flight.

1-2. With the exception of some possible repetition of text necessary for emphasis, clarity, or continuity of thought, this chapter contains only those procedures that differ from, or are in addition to, the normal operating instructions found in Chapter 3. Any discussions relative to systems operation are covered in Chapter 9.

Section II. Instrument Flight

2-1. NIGHT FLYING.

2-2. For night flying, the pilot must check the lighting equipment thoroughly and be familiar with the location of all switches in the cockpit. It is imperative that a flashlight be carried by each crewmember. Oxygen should be used from the ground up on all night flights. The use of the white floodlights should be avoided to prevent the loss of night vision.

2-3. OPERATION UNDER INSTRUMENT FLIGHT CONDITIONS.

2-4. GENERAL.

2-5. This aircraft has the same stability and flight handling characteristics during instrument conditions as when flown under VFR conditions. The aircraft is equipped with adequate navigation and communication equipment to cover practically all conditions of instrument flight. In preflight planning, allowance should be made for any delay and also for additional fuel required for departure, letdown, and approach.

2-6. INSTRUMENT TAKEOFF.

2-7. Prior to instrument takeoff, complete all preflight checks as prescribed in Chapter 3 and check all lighting facilities, pitot heaters, anti-icing, deicing, and heating systems. The normal takeoff procedures apply with special emphasis given to the following:

a. Maintain directional control by the use of nosewheel steering (if incorporated) or use of the rudders and ailerons which are effective at all speeds.

NOTE

The observer should be prepared to give the pilot visual corrections throughout the takeoff roll.

b. Apply back pressure to lift the nosewheel off the runway at the recommended takeoff speed for the gross weight involved as indicated in Chapter 14. Maintain takeoff attitude by reference to the vertical gyro indicator.

c. When the rate of climb indicator and the altimeter indicate a positive rate of climb, retract the landing gear.

2-8. INSTRUMENT CLIMB.

2-9. Use normal climbing speeds and attitudes that have been found to be satisfactory under visual flight operations. See Chapter 14 for climb speeds.

2-10. DURING INSTRUMENT CRUISING FLIGHT.

2-11. GENERAL. During cruising flight, no unusual discomfort should be experienced by either the pilot or the observer. The pilot should not suffer undue fatigue under instrument flying conditions.

2-12. SPEED RANGE. This aircraft handles well at all altitudes and airspeeds from the maximum allowable airspeed down to 10 knots above stalling speed. During automatic flight, a steep-bank low speed turn at heavy gross weights will decelerate the aircraft, cause loss of lateral trim, and "bottom" the roll actuator. Therefore, power must be increased in order to prevent excessive bank angles (normal, approximately 40°).

2-13. RADIO AND NAVIGATION EQUIPMENT. The ADF set (AN/ARN-59) is very susceptible to static, particularly precipitation and ice crystal static when flying at high airspeeds and altitudes where static causes aural signals to become inaudible. Reception can usually be improved by switching to the loop position and rotating the azimuth pointer 90° to the station or area of maximum reception. Occasionally, it will be necessary to use the loop position for navigation by aural null procedures when automatic direction finding becomes erratic and unreliable. The use of COMP position to receive radio range aural signals should be avoided as the automatic volume control will cause distortion of the signal pattern.

2-14. DESCENT.

2-15. The same techniques that are outlined for descents under visual flight conditions in Chapter 3 of this manual apply to flight under instrument conditions. The heating and ventilating system should be turned on for maximum defogging of the windshield.

2-16. HOLDING.

2-17. For holding patterns, keep the gear and flaps up and maintain power for level flight at airspeeds shown in Chapter 14.

2-18. INSTRUMENT APPROACHES.

2-19. GENERAL. The aircraft is equipped for any type of instrument approach now in common use. The only exception is that the glide slope receiver for the ILS is not installed on [1] aircraft, in which case, only localizer information is provided in an ILS approach.

2-20. AUTOMATIC LANDINGS (ILS). In reducing speed from cruise to approach, retrim the lateral and directional controls since this is not an automatic function of the autopilot. For automatic landings using the autopilot, extend the approach pattern outbound to allow sufficient time to establish the normal ILS final approach configuration, power setting, and airspeed prior to interception of the glide slope. The autopilot requires the use of inboard ailerons under low-speed flight in order to operate satisfactorily; therefore the flaps must be extended during the approach. Before reaching the outer marker, manually intercept the glide slope and establish the proper approach attitude to keep the aircraft on course and on the glide slope. Upon reaching the outer marker, engage autopilot for ILS operation (see Chapter 5).

CAUTION

If vertical autopilot control is engaged at too great a deviation from the glide path, the autopilot will give a hard-over signal that can be dangerous at low altitudes.

NOTE

The autopilot should not be engaged until the correct heading and glide slope have been established to prevent excessive searching by the autopilot when engaged for ILS operation.

Section III. Cold Weather Operations

3-1. COLD WEATHER PROCEDURES.

3-2. GENERAL.

3-3. During cold weather operations, the following precautions should be observed. Before flight, all ice, snow, and frost should be removed from the aircraft with special attention being devoted to the control surfaces and the leading edges of the wings and empennage. To remove ice, apply sufficient heat to loosen ice particles and remove them with a stiff brush. When removing ice with heat, do not melt the ice completely, as water may get into control surfaces and freeze. Before starting engines, make sure hot air has been ducted into the engines for at least 10 minutes. This prevents the engine seals from cracking during starting in cold weather. Moisture may accumulate in the compressor housing, especially if the engines have been shut down during a snowfall. Do not stop when taxiing in deep snow or slush, as moisture may collect and freeze on brake drums. If the autopilot is to be used in flight, be sure that the ambient temperature is -67°F or above.

3-4. TAKEOFF.

3-5. On cold days, it may be necessary to place the Power Levers aft of the TAKEOFF setting to prevent exceeding maximum allowable torque. Failure of either engine will not result in feathering of that propeller (with autofeather circuit armed) since the Power Lever must be in the TAKEOFF position to complete the auto-feather circuit.

NOTE

Further information concerning cold weather procedures will be supplied when available.

3-6. ICE, SNOW, AND RAIN.

3-7. GENERAL. The problems presented by the occurrence of ice, snow, or rain during operation are such that provisions must be incorporated in the aircraft to reduce and eliminate the adverse effects produced by each. Engine power output and response of flight control surfaces are particularly vulnerable. Since these two factors and the associated systems are ultimately responsible for flight, it is imperative that operation of each for maximum effectiveness be maintained. Although the presence of ice, snow, or rain constitutes an undesirable environment for operation, the countermeasures and procedures provided are adequate to permit the continuance of approximately normal flight. Emergencies encountered during flight in ice, snow, or rain are almost solely confined to failure or malfunctioning of the anti-icing and deicing equipment or modifications of operating procedure required under extremely hazardous atmospheric conditions. To meet as many of these problems as possible, the aircraft incorporates appropriate design features and auxiliary equipment. The aircraft is equipped with the necessary wing and empennage deicer boots, pitot heaters, engine strut anti-icing, engine cowl anti-icing, propeller deicing, and windshield anti-icing to enable it to fly with safety under icing conditions. (Description of these systems is given in Chapter 6.) Planning and preparation for operation in ice, snow, or rain conditions should be accomplished in advance whenever possible. Windshield wipers, heating system, radio equipment, and navigation aids should be thoroughly tested before takeoff.

3-8. EXTERIOR INSPECTION. When performing the exterior inspection in icing conditions, the pilot should insure that all ice is removed from the aircraft. In particular, the flight controls should be carefully checked for freedom of movement and operation.

3-9. TAXIING. Extreme care should be exercised when taxiing on ice. A combination of brakes and forward and reverse power setting or nosewheel steering (if incorporated) is required to maintain proper control. The use of high rpm should be avoided during taxiing as this will produce a blinding propeller wash of ice or light snow. Damage may also occur from particles of ice picked up by the propeller blast.

3-10. TAKEOFF. If takeoff must be accomplished on an icy runway, the nosewheel should be centered before beginning the takeoff roll.

a. Pitot heat - ON.
b. Windshield anti-icing - ON.

NOTE

Ice formation may be expected during takeoff in visible moisture at temperatures near freezing.

3-11. CRUISING FLIGHT. Deicing equipment should be put into operation as soon as the possibility of ice formation is encountered. Actuate the pneumatic deicing system before ice has had a chance to accumulate to a thickness of 1/2 inch. This will insure complete deicing of wings and empennage. In the event that severe icing conditions occur and the deicers prove inadequate, the pilot should effect an immediate change of altitude to bring the aircraft clear of the icing zone.

3-12. LANDING. Holding operation in heavy icing conditions should be kept to a minimum. Maintain sufficient power to insure that engines do not cool excessively. Before the final approach, the windshield anti-icing and the engine deicing should be turned on and the windshield defog should be turned to maximum in order to keep the windshield free of ice. Extreme care should be exercised when landing on ice. A combination of brake and reverse power setting or nosewheel steering (if incorporated) is required. When landing and applying reverse thrust on icy runways, the pilot should apply power to both engines equally to prevent unbalanced thrust on one engine forcing the aircraft to slide sideways. When landing on a runway covered with light snow or standing water, the pilot should be prepared for a blinding propeller wash when reversing the propellers.

WARNING

Stall speeds under icing conditions are higher due to the disfiguration of lifting surfaces and increased weight of ice on the aircraft. A stall should be expected at higher airspeeds than in normal conditions. Therefore, approach and landing speeds must be increased accordingly.

Section IV. Desert and Hot Weather Operations

4-1. DESERT AND HOT WEATHER PROCEDURES.

4-2. Hot weather and desert procedures differ from normal procedures mainly in that added precautions must be taken to protect the aircraft from damage due to high temperature and dust. Particular care should be taken to prevent the entrance of sand into the various airplane parts and systems (engine, fuel system, pitot-static system, etc). All filters should be checked more frequently than under normal conditions. Units incorporating plastic or rubber parts should be protected as much as possible from wind-blown sand and excessive temperatures. Tires should be checked frequently for blistering, cracking, and proper inflation.

4-3. BEFORE ENTERING THE AIRCRAFT.

4-4. Check exposed portions of the shock strut pistons for dust and sand, and have them cleared if necessary. Check ducts for accumulations of dust and sand. Make sure all filters have been cleaned and that the aircraft has been thoroughly inspected for fuel or hydraulic leaks caused by the swelling of seals or expansion of fittings. Inspect area directly behind aircraft to make sure sand and dust will not be blown onto personnel or equipment during starting operations. Check the inflation of shock struts and tires which may have become overinflated from the heat.

4-5. ON ENTERING THE AIRCRAFT.

4-6. Check the cockpit for excessive accumulation of dust and sand. Check instruments and controls for moisture due to high humidity.

4-7. ENGINE STARTING.

4-8. To prevent hot starts in desert operations, face the aircraft into the wind when wind velocities are 10 knots or more. A necessity may arise for unfeathering at ground idle.

4-9. TAXIING.

4-10. When taxiing in desert operations the pilot must avoid rolling over the same area repeatedly. The weight of the aircraft will tend to break the crust of the desert surface and drop the landing gear into the hole.

4-11. TAKEOFF.

4-12. Do not attempt to take off in a sandstorm or duststorm. When the outside air temperature is high, do not lift from runway too soon, as more than usual takeoff distance will be required to obtain takeoff speed.

CAUTION

Avoid repeated roll in the same area, as this will tend to break the crust of the desert surface.

4-13. DURING FLIGHT.

4-14. If the autopilot is to be used during the flight, be sure that the ambient temperature is 131°F or below.

4-15. DESCENT.

4-16. Check that the windshield defog system is on several minutes before making any rapid descent from altitude to prevent fogging and frosting of the windshield.

4-17. APPROACH.

4-18. Maintain the recommended indicated airspeeds for approach and touchdown. Because of high outside air temperatures, the true airspeed will be higher than normal, and a longer landing roll will result.

4-19. LANDING.

4-20. Avoid heavy braking during the landing roll. Small increments of braking will stop the aircraft in a reasonably short distance without excessive tire wear. Heavy braking may cause brake grabbing and tire failure.

4-21. ON LEAVING THE AIRCRAFT.

4-22. Leave the entrance hatches slightly open to permit air circulation in the cockpit unless blowing sand or dust is expected. Make sure all intakes and openings are covered.

Section V. Altitude Operations

5-1. TURBULENT AIR AND THUNDERSTORMS.

5-2. GENERAL.

5-3. Power setting and pitch attitude are the keys to proper flight technique in turbulent air. If the proper power setting and pitch attitude required for the desired penetration airspeed is established before entering the storm and maintained throughout the storm, this will result in a constant airspeed, regardless of any readings of the airspeed indicator. The pilot should not attempt to change power settings every time the airspeed indicator fluctuates. Rapid changes in horizontal gust velocity or heavy rain clogging the pitot tubes may cause the airspeed indicator to fluctuate momentarily.

5-4. APPROACHING THE STORM.

5-5. It is imperative that the pilot prepare the aircraft before entering a zone of turbulent air. If the storm cannot be seen, its proximity can be detected by radio static. The following procedures apply:

a. Adjust throttles to establish desired penetration speed.
b. Check gyro instruments for proper settings.
c. Tighten shoulder harness.
d. Turn off radio equipment rendered useless by static.
e. At night, turn up cockpit lights to full bright to minimize the blinding effect of lightning.

CAUTION

Do not lower gear or flaps as this will result in a loss of aerodynamic efficiency.

5-6. IN THE STORM.

5-7. The following procedures apply:

a. Maintain power setting and pitch attitude throughout the storm. By holding these constant, the airspeed will remain approximately constant.
b. Although turbulence, heavy precipitation, and lightning will be experienced, it should not cause undue alarm to the pilot.
c. Avoid using the elevators and rudder as much as possible to minimize the stresses imposed on aircraft. Sudden maneuvers should be avoided.
d. Operate deicing and anti-icing equipment as necessary to prevent the formation of ice.

CHAPTER 11
CREW DUTIES

Section I. Scope

1-1. The information contained in this chapter covers the responsibilities of the observer and includes a discussion of his primary and alternate functions.

1-2. Preflight, mission, and after landing duties are included.

Section II. Crew Duties

2-1. OBSERVER DUTIES.

2-2. PREFLIGHT.

2-3. The observer aids the pilot in performing preflight checks for the aircraft. In addition, it is his responsibility to perform all preflight checks for the photographic surveillance system (see Chapter 6) when preparing for photographic missions. On the [3] and [4] aircraft, the observer must perform a preflight check of the SLAR system (the SLAR system preflight checks are classified information and are not included in this manual). On [5] and [6] aircraft, the preflight check of the IR system must be accomplished by the observer (the IR system preflight checks are classified information and are not included in this manual). The observer also has the responsibility of performing the preflight checks on his ejection seat (follow pilot's ejection seat preflight) and for making certain that the face blind locking mechanism and secondary firing handle are in the unlocked position before takeoff.

2-4. MISSION.

2-5. The observer operates the applicable equipment to accomplish various surveillance missions. These missions include visual, photographic, radar [3] and [4] aircraft, and infrared [5] and [6] aircraft surveillance. If qualified, the observer can also assume control of the [23] aircraft, since flight controls are provided. The observer has access to the signal light and can operate the light when required.

2-6. AFTER LANDING.

2-7. Check that the face blind locking mechanism and secondary firing handle are in the locked position. The observer must fill out the applicable forms if any equipment discrepancies are noted during the mission.

CHAPTER 12
WEIGHT AND BALANCE COMPUTATION

Section I. Scope

1-1. This chapter provides appropriate information required for the computation of weight and balance for loading the AO-1 aircraft. For Charts and Forms, see Weight and Balance Control Data MIL-W-25140.

1-2. Sufficient data has been provided so that the pilot or observer knowing the basic weight and moment of the aircraft, can compute any combination of weight and balance.

Section II. Introduction

2-1. PURPOSE.

2-2. The data to be inserted on weight and balance charts and forms are applicable only to the individual aircraft, the serial number of which appears on the title page of the TM 55-405-9 and on the various forms and charts which remain with the aircraft in accordance with existing directives. The charts and forms referred to in this chapter may differ in nomenclature and arrangement from time to time, but the principle on which they are based will not change.

2-3. CHARTS AND FORMS.

2-4. The standard system of weight and balance control requires the use of several different charts and forms. They are identified as follows:

a. Chart C - Basic Weight and Balance Record, DD Form 365C.

b. Chart E - Loading Data, Charts and Graphs.

c. Form F - Weight and Balance Clearance Form F, DD form 365F.

2-5. RESPONSIBILITY.

2-6. The aircraft manufacturer inserts all aircraft identifying data on the title page of the TM 55-405-9 and on the various charts and forms. He completes all charts, including one sample Weight and Balance Clearance Form F if applicable, at time of delivery. This record is the basic weight and balance data of the aircraft at delivery. All subsequent changes in weight and balance are compiled by the weight and balance technician.

2-7. AIRCRAFT WEIGHINGS.

2-8. The aircraft must be weighed periodically as required by pertinent directives or when: (1) the pilot reports unsatisfactory flight characteristics (nose or tail heaviness); (2) major modifications or repairs are made; (3) the basic weight data contained in the records are suspected to be in error. The basic weight and cg location can only be as accurate as the scale equipment employed. The crewmember has available the current basic weight and moment in the Form 781 binder.

Section III. Definitions

3-1. WEIGHT DEFINITIONS.

3-2. BASIC WEIGHT. The "basic weight" of an aircraft is that weight which includes all fixed operating equipment and trapped fuel and oil, to which it is only necessary to add the "variable" or "expendable" load items for the various missions.

NOTE

The basic weight of an aircraft varies with the structural modifications and changes in the fixed operating equipment. The term "basic weight," when qualified with a word indicating the type of mission such as "Basic Weight for Combat," "Basic Weight for Ferry," etc, may be used in conjunction with directives stating what the equipment shall be for these missions. For example, extra fuel tanks and various items of equipment installed for long range ferry flights which are not normally carried on combat missions will be included in "Basic Weight for Ferry" but not in "Basic Weight for Combat."

3-3. OPERATING WEIGHT. The "operating weight" of an aircraft is the "basic weight" plus those "variable" items which remain substantially constant for the type mission. These items include oil, crew, crew's baggage, emergency and extra equipment that may be required.

3-4. GROSS WEIGHT. The "gross weight" is the total weight of an aircraft and its contents.

a. The "takeoff gross weight" is the "operating weight" plus the "variable" and "expendable" load items which vary with the mission. These items include fuel, external fuel tanks (if to be disposed of during flight), etc.

b. The "landing gross weight" is the "takeoff gross weight" minus the expended load items.

3-5. BALANCE DEFINITIONS.

3-6. REFERENCE DATUM. "Reference datum" is an imaginary vertical plane at or forward of the nose of the aircraft from which all horizontal distances are measured for balance purposes. Diagrams of each aircraft show this reference datum as balance station zero.

3-7. ARM. "Arm" for balance purposes is the horizontal distance in inches from the reference datum to the cg of the item. Arms may be determined from the aircraft diagram in Chart E.

3-8. MOMENT. "Moment" is the weight of an item multiplied by its arm. Moment divided by a constant is generally used to simplify balance calculations by reducing the number of digits. For this aircraft, inches and moment/1000 have been used.

3-9. AVERAGE ARM. "Average arm" is the arm obtained by adding the weights and adding the moments of a number of items and dividing the total moment by the total weight.

3-10. BASIC MOMENT. "Basic moment" is the sum of the moments of all items making up the basic weight. When using data from an actual weighing of an aircraft, the basic moment is the total moment of the basic aircraft with respect to the reference datum.

3-11. CENTER OF GRAVITY (CG). "Center of gravity" is the point about which an aircraft would balance if suspended. Its distance from the reference datum is found by dividing the total moment by the gross weight of the airplane.

3-12. CG LIMITS. "Cg limits" are the extremes of movement which the cg can have without making the aircraft unsafe to fly. The cg of the loaded aircraft must be within these limits at takeoff, in the air, and on landing. In some cases, separate takeoff and landing limits may be specified.

Section IV. Chart Explanations

4-1. CHART C—BASIC WEIGHT AND BALANCE RECORD.

4-2. Chart C is a continuous history of the basic weight and moment resulting from structural and equipment changes in service. At all times, the last weight and moment/1000 entry is considered the current weight and balance status of the basic aircraft. See figure 4-1 for sample Chart C.

4-3. CHART E LOADING DATA. (See figures 4-2 and 4-3.)

4-4. The loading data in Chart E are intended to provide information necessary to work a loading problem for the aircraft. From the loading graphs or tables, weight and moment/1000 are obtained for all variable load items and are added arithmetically to the current basic weight and moment/1000 (from Chart C) to obtain the gross weight and moment. The cg of the loaded airplane is represented by a moment figure in the center of gravity table. If the airplane is loaded within the forward and aft cg limits, the moment figure will fall numerically between the limiting moments. The effect on the cg of the expenditure in flight of such items as fuel may be checked by subtracting the weights and moments of such items from the takeoff gross weight and moment and checking the new moment with the cg table. This check should be made to determine whether or not the cg will remain within limits during the entire flight.

CHART C—BASIC WEIGHT AND BALANCE RECORD
(CONTINUOUS HISTORY OF CHANGES IN STRUCTURE OR EQUIPMENT AFFECTING WEIGHT AND BALANCE)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

AIRPLANE MODEL: AO-1A | SERIAL NO.: 60-3742 | PAGE NO.: 1

DATE	ITEM NO. IN	ITEM NO. OUT	DESCRIPTION OF ARTICLE OR MODIFICATION	ADDED (+) WEIGHT	ADDED (+) ARM (in.)	ADDED (+) MOMENT[1] /1000	REMOVED (−) WEIGHT	REMOVED (−) ARM (in.)	REMOVED (−) MOMENT[1] /1000	RUNNING TOTAL BASIC AIRPLANE WEIGHT	RUNNING TOTAL MOMENT[1] /1000	RUNNING TOTAL C.G. (in.)
1/1/61			DELIVERY BASIC WEIGHT - ASSUMED							9950	1634.8	164.3
2/20/61		F-5	AERO 1A SWAY BRACES (2 SETS)-INBOARD				44	162	7.1			
		F-6	AERO 65A BOMB RACK (2)-INBOARD				30	163	4.9			
		F-8	PYLON (2)-INBOARD				60	170	10.2			
			TOTALS				134	166	22.2	9816	1612.6	164.3
2/24/61	E-32		ARN-68 RECEIVER-FILTER ADAPTER & MOUNT	3	284	0.8				9819	1613.4	164.3
8/1/61			CALCULATED BASIC WEIGHT							9819	1613.4	164.3
8/1/61			AS WEIGHED							9812	1605.1	163.6

[1] Enter constant used below line. [2] Balance computer index.

DD FORM 1 SEP 54 365C — PREVIOUS EDITIONS OF THIS FORM MAY BE USED UNTIL STOCKS ARE EXHAUSTED. 16—70874-1 U. S. GOVERNMENT PRINTING OFFICE

SAMPLE

Figure 4-1. Form DD-365C, Chart C - Basic Weight and Balance Record (Sample)

Chart Date: 9-30-61

WEIGHING INSTRUCTIONS

1. Aircraft Condition

A. The basic weight condition is established with wheels down, and speed brakes, flaps, and slats retracted.

2. Oil Draining

A. Placing the aircraft in the static ground attitude, open the oil drain located on the aft bottom portion of the oil tank.

B. Oil remaining aboard after draining in the above manner is the "Trapped Oil". Since all oil in the tank is considered to be "Usable", the "Trapped" and "Unusable" oil in the lines and coolers are one and the same in this aircraft. (See item F-3 of Chart A for quantity.)

3. Fuel Draining

A. Place the aircraft in the static ground attitude. Either operate the fuel boost pumps until no more fuel can be pumped out or use the pressure fueling adapter to defuel until no more fuel can be withdrawn. When the drop tanks are aboard, the normal transfer system should be operated simultaneously with either of the above defueling procedures.

B. Fuel remaining aboard after defueling in the above manner is the unusable fuel included in aircraft basic weight. (See item C-18 of Chart A for quantity.)

4. Leveling

A. General

(1) Plumb bob leveling suspension fitting and target are located at the door in the forward equipment compartment. (See detail on Sheet 3 of Chart E.)

(2) To reduce the aircraft ground angle for ease in leveling, inflate main gear struts to fully extended position and deflate nose gear strut to approximately 1 inch from fully compressed.

(3) If equipment to do item (2) above is not available, raise aircraft to a slightly nose down attitude by wing jacks and shore up main wheels with wooden shoring. Lower wind jacks until aircraft rests on main wheels.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 1 of 14)

Chart Date: See Sheet 1

WEIGHING INSTRUCTIONS

4. Leveling (cont)

B. Weighing on Jacks

(1) Place electric weighing cells on jack at forward fuselage jack point and on wing jacks. Raise jacks until wheels are clear and aircraft is in an accurate level attitude.

(2) Alternate to item A-(3) above: Raise aircraft with overhead hoist and lower onto shoring placed under main wheels to approximate level attitude. Proceed with item B-(1).

C. Weighing on Wheels

If portable platform scales are used, raise aircraft on jacks, or by overhead hoist, insert scales under wheels and lower onto scales. Use shoring as required to attain an accurate level attitude.

5. Measuring

A. The "Jig Point" is located in the nosewheel well. The jigged hole for the plumb bob cord is through the angle bracket mounted at the aircraft center-line on the forward side of the aft nosewheel door frame at fuselage station 97.0.

B. For "letter" dimensions referred to below, see the diagram on sheet 3 of Chart E.

C. When weighing on jack points, actual measurements during weighing are not necessary. After leveling, the following dimensions for "E" and "F" may be inserted directly in the weighing form:

(Wing)	-	Aft jack point to reference datum. Dimension to be used for "E" = 195.0
(Fuselage)	-	Forward jack point to reference datum. Dimension to be used for "F" = 113.9

D. When weighing on wheels, measure dimensions "B" and "D" during weighing and after leveling. Using these actual dimensions and the jig point dimension "I", determine "E" and "F". For checking purposes, approximate dimensions "E" and "F" are given in the Landing Gear Dimensions table of Chart E.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 2 of 14)

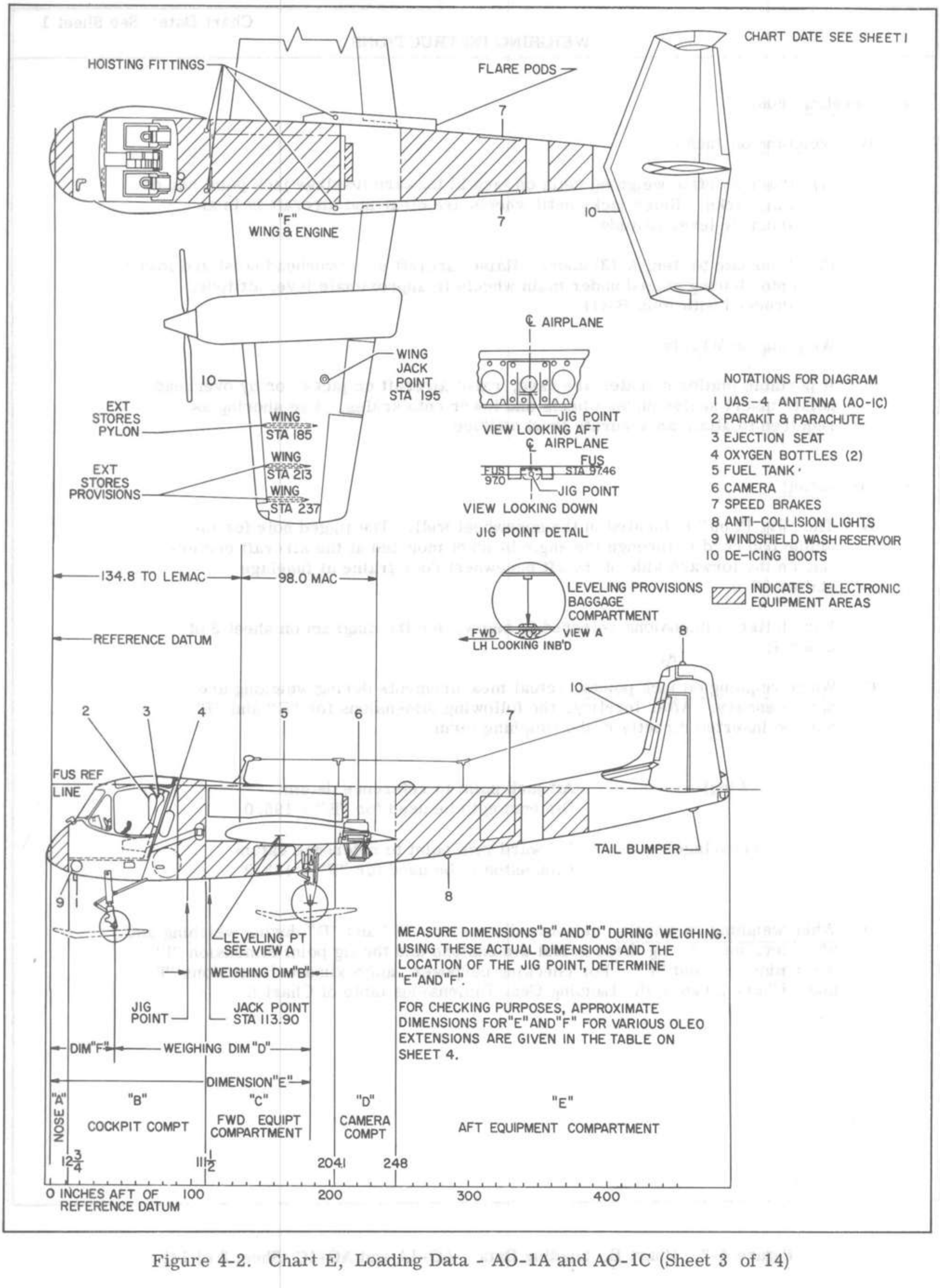


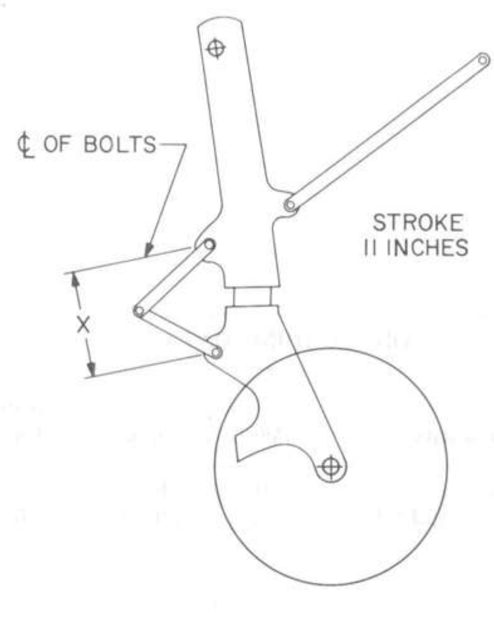
Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 3 of 14)

CHART DATE: SEE SHEET 1

LANDING GEAR DIMENSIONS

NOSE WHEEL			MAIN WHEELS		
X		* DIM. F	Y		* DIM. E
Fully Compressed	4.38	46.84	Fully Compressed	4.00	184.94
	5.00	46.90		5.00	184.91
	6.00	47.00		6.00	184.89
Static Condition	6.38	47.04	Static Condition	7.00	184.86
	7.00	47.10		8.00	184.84
	8.00	47.20		9.00	184.81
	9.00	47.30		10.00	184.78
	10.00	47.40		11.00	184.76
	11.00	47.50		12.00	184.73
	12.00	47.60		13.00	184.71
	13.00	47.70		14.00	184.68
	14.00	47.80		15.00	184.65
	15.00	47.90		16.00	184.63
Fully Extended	15.38	47.94		17.00	184.60
				18.00	184.57
			Fully Extended	19.00	184.55

* Approximate: determine actual dimensions during weighing



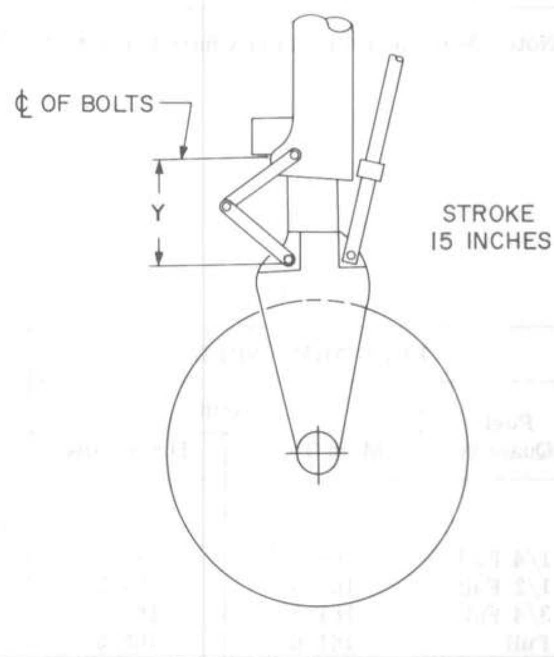


Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 4 of 14)

CHART DATE: SEE SHEET 1

TABLE OF FUEL LOADING DATA

Pounds	Moment/1000			Pounds	Moment/1000
	Main Tank Cap. 297 Gal. Arm Varies	R. H. Drop Tank Cap. 150 Gal. Arm Varies	L. H. Drop Tank Cap. 150 Gal. Arm Varies		Main Tank Cap. 297 Gal. Arm Varies
0	0			1200	193.7
50	9.8	8.8	8.8	1250	201.6
100	18.1	17.5	17.5	1300	209.7
150	25.9	26.1	26.1	1350	217.6
200	33.9	34.6	34.6	1400	225.7
250	41.9	43.1	43.1	1450	233.7
300	49.8	51.5	51.5	1500	241.8
350	57.8	59.8	59.8	1550	249.7
400	65.8	68.1	68.1	1600	257.8
450	73.8	76.4	76.4	1650	265.8
500	81.8	84.5	84.5	1700	273.9
550	89.8	92.6	92.6	1750	281.8
600	97.7	100.6	100.6	*1782	*286.9
650	105.7	108.5	108.5	1800	289.8
700	113.7	116.4	116.4	1850	297.8
750	121.7	124.2	124.2	1900	305.9
800	129.6	131.9	131.9	**1930	**310.6
850	137.6	139.6	139.6	1950	313.8
* 900		*146.2	*146.2		
900	145.6	147.2	147.2	2000	321.6
950	153.6	154.7	154.7	***2020	***324.5
** 975		**158.4	**158.4	2050	328.8
1000	161.6	162.5	162.5	2100	335.6
***1020		***165.8	***165.8	2150	341.8
1050	169.7	170.6	170.6	2200	347.6
1100	177.6	178.8	178.8		
1150	185.6				

Note: See sheet 6 of 14 of Chart E for *, **, *** notes.

FUEL ARM TABLE

Fuel Quantity	Arm	
	Main Tank	Drop Tank
1/4 Full	163.5	172.5
1/2 Full	161.6	169.2
3/4 Full	161.2	165.9
Full	161.0	162.5

OIL LOADING DATA

Oil Quantity	Wt.	Arm	Mom./1000
Full (5 gal/pl.)	38	140.0	5.3
Trapped (0.7 gal/pl.)	5	136.0	0.7

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 5 of 14)

CHART DATE: SEE SHEET 1

NOTES

CAUTION: This aircraft is equipped with a capacitor type fuel quantity gaging system. The upper half of the fuel quantity indicator indicates individual tank quantity by pointer, while the lower portion indicates total fuel quantity by counter. The pointer normally registers main tank fuel quantity unless the selector switch is operated, in which case the pointer will indicate either R. H. drop tank or L. H. drop tank quantity as selected. Since the gaging system is calibrated in pounds and the fuels vary in weight per gallon dependent upon the specific gravity and the temperature of the fuel used, the notation "FULL" does not appear on the instrument dial, and variations in the instrument readings should be anticipated when the tanks are full.

(*) Indicates approximate weights and moments for full main and full drop tanks under standard conditions (60°F) for aviation gasoline (MIL-F-5572) and automotive gasoline (MIL-G-3056) based on 6. 0 lb/gal.

(**) Indicates approximate weights and moments for full main and full drop tanks under standard conditions (60°F) for JP-4 fuel (MIL-F-5624) based on 6. 5 lb/gal.

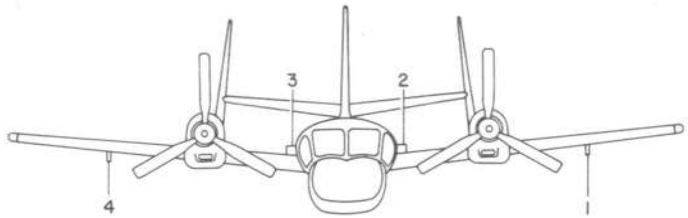
(***) Indicates approximate weights and moments for full main and full drop tanks under standard conditions (60°F) for JP-5 fuel (MIL-F-5624) based on 6. 8 lb/gal.

ABOVE NOTES APPLICABLE TO SHEET 5 OF CHART E.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 6 of 14)

EXTERNAL STORES TABLE

CHART DATE: SEE SHEET 1



Suspension Device Code

A: Chart A Items F-5, F-6, F-8
B: Chart A Items F-5, F-7, F-8

Items	Weight of Pair	Wing Station 185 Positions 1 and 4 (Max Loading/Position = 1225 lb)			Upper Wing Root Positions 2 and 3 (Max Loading/Position = 132 lb)		
		Arm	Mom./1000	Susp. Code	Arm	Mom./1000	Susp. Code
750 lb Resupply Container Aero 1C 150 gal. Fuel Tank Flare Pod Empty*	1500 274 44	162.0 175.0	243 48	A or B A or B	 230.0	 10	 (NONE)

*See Table of Individual Camera and Equipment Weights, Sheet 8 of Chart E, for A-6 Flare Ejector Components and MK-112 Flares, and see Caution note on Sheet 13 of Chart E when Flare Pods are aboard.

SKI TABLE (L. G. EXTENDED)

Items	Weight**	Arm	Moment/1000
Nose Wheel Ski Installation	66	34.7	3.3
Main Wheel Ski Installations (2)	312	176.8	55.2
Total - Planing Ski Installation	378	152.1	57.5

**Nose Wheel Ski Installation includes the removal of 2 N.W. Doors, 15 lb at Fuselage Sta 66.
Main Wheel Ski Installation includes the removal of 2 Main Gear Fairings, 13 lb at Fuselage Sta 186.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 7 of 14)

CHART DATE: SEE SHEET 1

TABLE OF INDIVIDUAL CAMERA AND EQUIPMENT WEIGHTS

Item	Weight	Arm	Mom/1000
Cameras			
KA-30-3 with Magazine & 250 ft of film	42	220.0	9.2
KA-30-6 with Magazine & 250 ft of film	40	220.0	8.8
KA-30-12 with Magazine & 250 ft of film	49	220.0	10.8
Miscellaneous			
MK-112 Flares (104)	104	225.5	23.4
A-6 Photo Flare Cartridge Ejectors (2) without Photo Flare Cartridge Retainers*	83	225.5	18.7
Photo Flare Cartridge Retainers (4)**	31	225.5	7.0
Flare Pod Covers (2)**	7	225.5	1.6

* See External Stores Table, Sheet 7 of Chart E, for Empty Flare Pod.

**Each Flare Pod accommodates either one Flare Pod Cover or two Photo Flare Cartridge Retainers.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 8 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Lb	Moment/1000				30% - Caution Zone* - 33%		
	22% MAC T.O. & Ldg Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	30% MAC 164.20 In.	32% MAC 166.16 In.	33% MAC Aft Limit Whls Up** 167.14 In.
9500	1485	1504	1523	1541	1560	1579	1585
9550	1493	1512	1531	1549	1568	1587	1594
9600	1501	1520	1539	1558	1576	1595	1602
9650	1509	1528	1547	1566	1585	1603	1611
9700	1517	1536	1555	1574	1593	1612	1619
9750	1525	1544	1563	1582	1601	1620	1627
9800	1532	1551	1571	1590	1609	1628	1636
9850	1540	1559	1579	1598	1617	1637	1644
9900	1548	1567	1587	1606	1626	1645	1652
9950	1556	1575	1595	1614	1634	1653	1661
10000	1564	1583	1603	1622	1642	1662	1669
10050	1571	1591	1611	1631	1650	1670	1677
10100	1579	1599	1619	1639	1658	1678	1686
10150	1587	1607	1627	1647	1667	1687	1694
10200	1595	1615	1635	1655	1675	1695	1702
10250	1603	1623	1643	1663	1683	1703	1711
10300	1611	1631	1651	1671	1691	1711	1719
10350	1618	1639	1659	1679	1699	1720	1728
10400	1626	1647	1667	1687	1708	1728	1736
10450	1634	1654	1675	1695	1716	1736	1744
10500	1642	1662	1683	1704	1724	1745	1753
10550	1650	1670	1691	1712	1732	1753	1761
10600	1657	1678	1699	1720	1741	1761	1769
10650	1665	1686	1707	1728	1749	1770	1778
10700	1673	1694	1715	1736	1757	1778	1786
10750	1681	1702	1723	1744	1765	1786	1794
10800	1689	1710	1731	1752	1773	1795	1803
10850	1697	1718	1739	1760	1782	1803	1811
10900	1704	1726	1747	1768	1790	1811	1819
10950	1712	1734	1755	1777	1798	1819	1828
11000	1720	1742	1763	1785	1806	1828	1836
11050	1728	1749	1771	1793	1814	1836	1844
11100	1736	1757	1779	1801	1823	1844	1853
11150	1743	1765	1787	1809	1831	1853	1861
11200	1751	1773	1795	1817	1839	1861	1870

Notes * and ** see Sheet 13 of Chart E.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 9 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Lb	Moment/1000				30% - Caution Zone* - 33%		
	22% MAC T.O. & Ldg Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	30% MAC 164.20 In.	32% MAC 166.16 In.	33% MAC Aft Limit Whls Up** 167.14 In.
11250	1759	1781	1803	1825	1847	1869	1878
11300	1767	1789	1811	1833	1855	1878	1886
11350	1775	1797	1819	1841	1864	1886	1895
11400	1783	1805	1827	1850	1872	1894	1903
11450	1790	1813	1835	1858	1880	1903	1911
11500	1798	1821	1843	1866	1888	1911	1920
11550	1806	1829	1851	1874	1897	1919	1928
11600	1814	1837	1859	1882	1905	1927	1936
11650	1822	1844	1867	1890	1913	1936	1945
11700	1829	1852	1875	1898	1921	1944	1953
11750	1837	1860	1883	1906	1929	1952	1961
11800	1845	1868	1891	1914	1938	1961	1970
11850	1853	1876	1899	1923	1946	1969	1978
11900	1861	1884	1907	1931	1954	1977	1987
11950	1869	1892	1915	1939	1962	1986	1995
12000	1876	1900	1923	1947	1970	1994	2003
12050	1884	1908	1931	1955	1979	2002	2012
12100	1892	1916	1939	1963	1987	2011	2020
12150	1900	1924	1947	1971	1995	2019	2028
12200	1908	1932	1955	1979	2003	2027	2037
12250	1915	1939	1963	1987	2011	2035	2045
12300	1923	1947	1971	1996	2020	2044	2053
12350	1931	1955	1979	2004	2028	2052	2062
12400	1939	1963	1987	2012	2036	2060	2070
12450	1947	1971	1995	2020	2044	2069	2078
12500	1954	1979	2004	2028	2052	2077	2087
12550	1962	1987	2012	2036	2061	2085	2095
12600	1970	1995	2020	2044	2069	2094	2104
12650	1978	2003	2028	2052	2077	2102	2112
12700	1986	2011	2036	2060	2085	2110	2120
12750	1994	2019	2044	2069	2094	2119	2129
12800	2001	2026	2052	2077	2102	2127	2137
12850	2009	2034	2060	2085	2110	2135	2145
12900	2017	2042	2068	2093	2118	2143	2154
12950	2025	2050	2076	2101	2126	2152	2162

Notes* and ** see Sheet 13 of Chart E.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 10 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Lb	Moment/1000				30% - Caution Zone* - 33%		
	22% MAC T.O. & Ldg Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	30% MAC 164.20 In.	32% MAC 166.16 In.	33% MAC Aft Limit Whls Up** 167.14 In.
13000	2033	2058	2084	2109	2135	2160	2170
13050	2040	2066	2092	2117	2143	2168	2179
13100	2048	2074	2100	2125	2151	2177	2187
13150	2056	2082	2108	2133	2159	2185	2195
13200	2064	2090	2116	2142	2167	2193	2204
13250	2072	2098	2124	2150	2176	2202	2212
13300	2080	2106	2132	2158	2184	2210	2221
13350	2087	2114	2140	2166	2192	2218	2229
13400	2095	2121	2148	2174	2200	2227	2237
13450	2103	2129	2156	2182	2208	2235	2246
13500	2111	2137	2164	2190	2217	2243	2254
13550	2119	2145	2172	2198	2225	2251	2262
13600	2126	2153	2180	2206	2233	2260	2271
13650	2134	2161	2188	2215	2241	2268	2279
13700	2142	2169	2196	2223	2250	2276	2287
13750	2150	2177	2204	2231	2258	2285	2296
13800	2158	2185	2212	2239	2266	2293	2304
13850	2166	2193	2220	2247	2274	2301	2312
13900	2173	2201	2228	2255	2282	2301	2321
13950	2181	2209	2236	2263	2291	2318	2329
14000	2189	2216	2244	2271	2299	2326	2338
14050	2197	2224	2252	2279	2307	2335	2346
14100	2205	2232	2260	2288	2315	2343	2354
14150	2212	2240	2268	2296	2323	2351	2363
14200	2220	2248	2276	2304	2332	2359	2371
14250	2228	2256	2284	2312	2340	2368	2379
14300	2236	2264	2292	2320	2348	2376	2388
14350	2244	2272	2300	2328	2356	2384	2396
14400	2252	2280	2308	2336	2364	2393	2404
14450	2259	2288	2316	2344	2373	2401	2413
14500	2267	2296	2324	2352	2381	2409	2421
14550	2275	2304	2332	2361	2389	2418	2429
14600	2283	2311	2340	2369	2397	2426	2438
14650	2291	2319	2348	2377	2406	2434	2446
14700	2298	2327	2356	2385	2414	2443	2455

Notes * and ** see Sheet 13 of Chart E.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 11 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Lb	Moment/1000				30% - Caution Zone* - 33%		
	22% MAC T.O. & Ldg Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	30% MAC 164.20 In.	32% MAC 166.16 In.	33% MAC Aft Limit Whls Up** 167.14 In.
14750	2306	2335	2364	2393	2422	2451	2463
14800	2314	2343	2372	2401	2430	2459	2471
14850	2322	2351	2380	2409	2438	2467	2480
14900	2330	2359	2388	2417	2447	2476	2488
14950	2338	2367	2396	2425	2455	2484	2496
15000	2345	2375	2404	2434	2463	2492	2505
15050	2353	2383	2412	2442	2471	2501	2513
15100	2361	2391	2420	2450	2479	2509	2521
15150	2369	2399	2428	2458	2488	2517	2530
15200	2377	2406	2436	2466	2496	2526	2538
15250	2384	2414	2444	2474	2504	2534	2546
15300	2392	2422	2452	2482	2512	2542	2555
15350	2400	2430	2460	2490	2520	2551	2563
15400	2408	2438	2468	2498	2529	2559	2572
15450	2416	2446	2476	2507	2537	2567	2580
15500	2424	2454	2484	2515	2545	2575	2588
15550	2431	2462	2492	2523	2553	2584	2597
15600	2439	2470	2500	2531	2562	2592	2605
15650	2447	2478	2508	2539	2570	2600	2613
15700	2455	2486	2516	2547	2578	2609	2622
15750	2463	2494	2524	2555	2586	2617	2630
15800	2470	2501	2532	2563	2594	2625	2638
15850	2478	2509	2540	2572	2603	2634	2647
15900	2486	2517	2548	2580	2611	2642	2655
15950	2494	2525	2556	2588	2619	2650	2663
16000	2502	2533	2564	2596	2627	2659	2672
16050	2510	2541	2572	2604	2635	2667	2680
16100	2517	2549	2581	2612	2644	2675	2689
16150	2525	2557	2589	2620	2652	2683	2697
16200	2533	2565	2597	2628	2660	2692	2705
16250	2541	2573	2605	2636	2668	2700	2714
16300	2549	2581	2613	2645	2676	2708	2722
16350	2556	2588	2621	2653	2685	2717	2730
16400	2564	2596	2629	2661	2693	2725	2739
16450	2572	2604	2637	2669	2701	2733	2747

Notes * and ** see Sheet 13 of Chart E.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 12 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE NOTES

1. All data given for wheels down condition.

2. *

> **CAUTION**
>
> Flight in the 30 to 33% MAC region shall be avoided if practicable, but the aircraft can be flown safely in this region if the pilot is familiar with its flight characteristics (see Flight Manual TM 55-1510-204-10). Increasing caution should be observed as the cg approaches the aft limit.

3.** Landing gear retraction without skis increases the moment/1000 by +2. Moment/1000 values listed in this column are the moments corresponding to 33.0% MAC reduced by the moment for retraction of the landing gear and are equivalent to 32.8% MAC at 9500 pounds and to 32.9% MAC at 16,450 pounds. Loadings based on the wheels down condition, which fall within the limiting moments listed in the table, will be satisfactory when the landing gear without skis is retracted. When the aircraft is equipped with skis, reduce this column by an additional 4 moment/1000 to insure satisfactory balance when the landing gear is retracted.

4. Maximum Takeoff Gross Weight . . . . ________ lb ***

Maximum Landing Gross Weight . . . . ________ lb ***

*** Service activities shall insert, or substitute, current figures from latest applicable Dept. of Army Technical Manual (TM 55-1510-204-10) covering operating restrictions.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 13 of 14)

CHART DATE: SEE SHEET 1

TYPICAL SERVICE LOAD CONDITIONS*

Item	Arm	Observation Surveillance		Night Photo		Maximum G.W.		Air Emergency Resupply		Pilot Familiarization		Ferry G. W.	
		Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000
Pilot (less chute)**	61.0	200	12	200	12	200	12	200	12	200	12	200	12
Observer (less chute)**	61.0	200	12	200	12	200	12	200	12			200	12
Personel Effects of Crew (2)	346.0											40	14
Oil (at 7.5 lb/gal.)	140.0	38	5	38	5	38	5	38	5	38	5	38	5
Fuel (JP-4 at 6.5 lb/gal.)													
Main Tank 297 gal.	161.0	1930	311	1930	311	1930	311	1930	311	1930	311	1930	311
Drop Tanks (2) 300 gal.	162.5					1950	317					1950	317
Drop Tanks (2)	175.0					274	48					274	48
KA-30-3 Camera, Mag & Film	220.0	42	9										
KA-30-6 Camera, Mag & Film	220.0			40	9								
KA-30-12 Camera, Mag & Film	220.0					49	11						
Flare Pods (2)	230.0			44	10	44	10						
A-6 Flare Ejectors (2)	225.5			83	19	83	19						
Flare Ctg Retainers (4)	225.5			31	7	31	7						
M-112 Flares (104)	225.5			104	23	104	23						
Resupply Containers (2)	162.0							1500	243				
Planing Ski Instl*	152.1					378	58						
Totals		2410	349	2670	408	5281	833	3868	583	2168	328	4632	719

* The Planing Ski Installation may be added to any of the load conditions listed, except for the Maximum Gross Weight condition, which is shown with the ski installation. See ** Note, Sheet 7 of Chart E.

** For Crew Members' Parachutes and Equipments, see Chart A.

Figure 4-2. Chart E, Loading Data - AO-1A and AO-1C (Sheet 14 of 14)

CHART DATE: 10-10-61

WEIGHING INSTRUCTIONS

1. Airplane Condition

A. The basic weight condition is established with wheels down, and speed brakes, flaps and slats retracted.

2. Oil Draining

A. Placing the airplane in the static ground attitude, open the oil drain located on the aft bottom portion of the oil tank.

B. Oil remaining aboard after draining in the above manner is the "Trapped Oil". Since all oil in the tank is considered to be "Usable", the "Trapped" and "Unusable" oil in the lines and coolers are one and the same in this aircraft (See item F-3 of Chart A for quantity).

3. Fuel Draining

A. Place the aircraft in the static ground attitude. Either operate the fuel boost pumps until no more fuel can be pumped out or use the pressure fueling adapter to defuel until no more fuel can be withdrawn. When the drop tanks are aboard, the normal transfer system should be operated simultaneously with either of the above defueling procedures.

B. Fuel remaining aboard after defueling in the above manner is the unusable fuel included in aircraft basic weight (see item C-14 of Chart A for quantity).

4. Leveling

A. General

(1) Plumb bob leveling suspension fitting and target are located at the door in the forward equipment compartment (see detail on Sheet 3 of Chart E).

(2) To reduce the aircraft ground angle for ease in leveling, inflate main gear struts to fully extended position and deflate nose gear strut to approximately 1 inch from fully compressed.

(3) If equipment to do item (2) above is not available, raise aircraft to a slightly nose down attitude by wing jacks and shore up main wheels with wooden shoring. Lower wing jacks until aircraft rests on main wheels.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 1 of 14)

CHART DATE: SEE SHEET 1

WEIGHING INSTRUCTIONS (Cont.)

4. Leveling (Cont.)

B. Weighing on Jacks

(1) Place electric weighing cells on jack at forward fuselage jack point and on wing jacks. Raise jacks until wheels are clear and aircraft is in an accurate level attitude.

(2) Alternate to item A-(3) above: Raise aircraft with overhead hoist and lower onto shoring placed under main wheels to approximate level attitude. Proceed with item B-(1).

C. Weighing on Wheels

If portable platform scales are used, raise aircraft on jacks, or by overhead hoist, insert scales under wheels and lower onto scales. Use shoring as required to attain an accurate level attitude.

5. Measuring

A. The "Jig Point" is located in the nose wheel well. The jigged hole for the plumb bob cord is through the angle bracket mounted at the aircraft centerline on the forward side of the aft nose wheel door frame at fuselage station 97.0.

B. The "letter" dimensions referred to below, see the diagram on sheet 3 of Chart E.

C. When weighing on jack points, actual measurements during weighing are not necessary. After leveling, the following dimensions for "E" and "F" may be inserted directly in the weighing form:

(Wing) - Aft jack point to reference datum.
Dimension to be used for "E" = 195.0.

(Fuselage) - Forward jack point to reference datum.
Dimension to be used for "F" = 113.9.

D. When weighing on wheels, measure dimensions "B" and "D" during weighing and after leveling. Using these actual dimensions and the jig point dimension "I", determine "E" and "F". For checking purposes, approximate dimensions "E" and "F" are given in the table on Sheet 4 of Chart E.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 2 of 14)

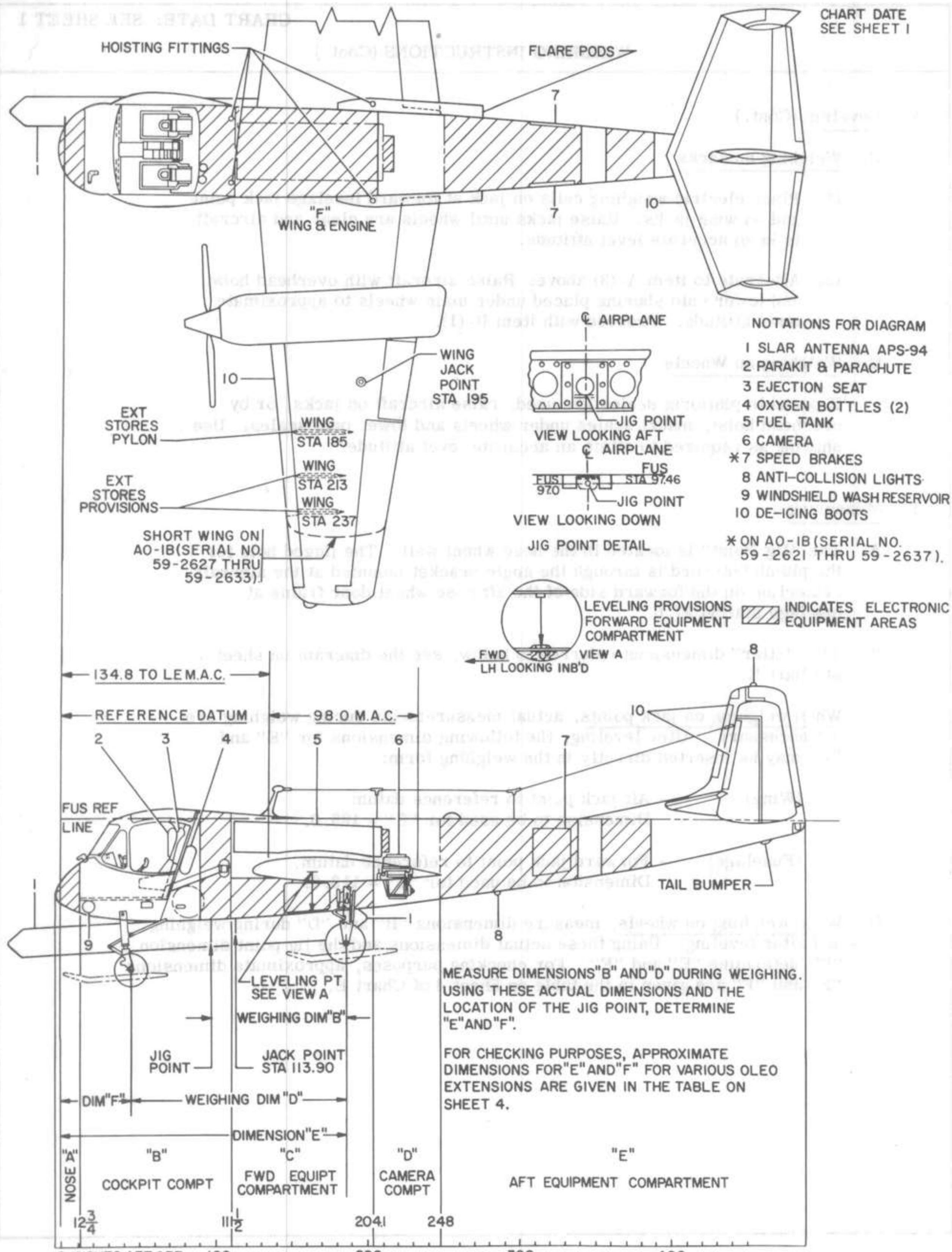


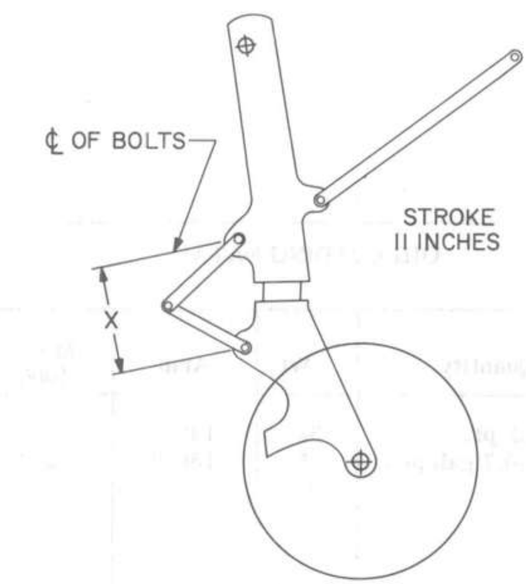
Figure 4-3. Chart E, Loading Data AO-1B (Sheet 3 of 14)

CHART DATE: SEE SHEET 1

LANDING GEAR DIMENSIONS

NOSE WHEEL	X	* DIM. F	MAIN WHEELS	Y	* DIM. E
Fully Compressed	4.38	46.84	Fully Compressed	4.00	184.94
	5.00	46.90		5.00	184.91
	6.00	47.00		6.00	184.89
Static Condition	6.38	47.04	Static Condition	7.00	184.86
	7.00	47.10		8.00	184.84
	8.00	47.20		9.00	184.81
	9.00	47.30		10.00	184.78
	10.00	47.40		11.00	184.76
	11.00	47.50		12.00	184.73
	12.00	47.60		13.00	184.71
	13.00	47.70		14.00	184.68
	14.00	47.80		15.00	184.65
	15.00	47.90		16.00	184.63
Fully Extended	15.38	47.94		17.00	184.60
				18.00	184.57
			Fully Extended	19.00	184.55

* Approximate; determine actual dimensions during weighing.



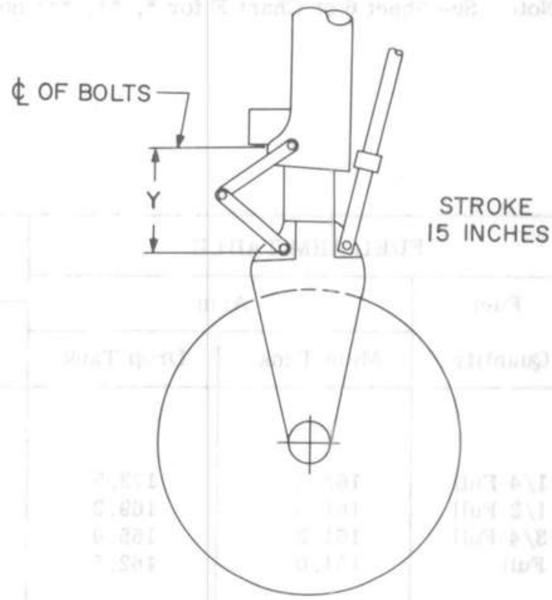


Figure 4-3. Chart E, Loading Data AO-1B (Sheet 4 of 14)

CHART DATE: SEE SHEET 1

TABLE OF FUEL LOADING DATA

Pounds	Moment/1000			Pounds	Moment/1000
	Main Tank Cap. 297 Gal. Arm Varies	R.H. Drop Tank Cap. 150 Gal. Arm Varies	L.H. Drop Tank Cap. 150 Gal. Arm Varies		Main Tank Cap. 297 Gal. Arm Varies
0	0			1200	193.7
50	9.8	8.8	8.8	1250	201.6
100	18.1	17.5	17.5	1300	209.7
150	25.9	26.1	26.1	1350	217.6
200	33.9	34.6	34.6	1400	225.7
250	41.9	43.1	43.1	1450	233.7
300	49.8	51.5	51.5	1500	241.8
350	57.8	59.8	59.8	1550	249.7
400	65.8	68.1	68.1	1600	257.8
450	73.8	76.4	76.4	1650	265.8
500	81.8	84.5	84.5	1700	273.9
550	89.8	92.6	92.6	1750	281.8
600	97.7	100.6	100.6	*1782	*286.9
650	105.7	108.5	108.5	1800	289.8
700	113.7	116.4	116.4	1850	297.8
750	121.6	124.2	124.2	1900	305.9
800	129.6	131.9	131.9	**1930	**310.6
850	137.6	139.6	139.6	1950	313.8
* 900		*146.2	*146.2		
900	145.6	147.2	147.2	2000	321.6
950	153.6	154.7	154.7	***2020	***324.5
** 975		**158.4	**158.4	2050	328.8
1000	161.6	162.5	162.5	2100	335.6
***1020		***165.8	***165.8	2150	341.8
1050	169.7	170.6	170.6	2200	347.6
1100	177.6	178.8	178.8		
1150	185.6				

Note: See Sheet 6 of Chart E for *, **, *** notes.

FUEL ARM TABLE

Fuel Quantity	Arm	
	Main Tank	Drop Tank
1/4 Full	163.5	172.5
1/2 Full	161.6	169.2
3/4 Full	161.2	165.9
Full	161.0	162.5

OIL LOADING DATA

Oil Quantity	Wt.	Arm	Mom./1000
Full (5 gal/pl.)	38	140.0	5.3
Trapped (0.7 gal/pl.)	5	136.0	0.7

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 5 of 14)

CHART DATE: SEE SHEET 1

NOTES

CAUTION: This aircraft is equipped with a capacitor type fuel quantity gaging system. The upper half of the fuel quantity indicator indicates individual tank quantity by pointer, while the lower portion indicates total fuel quantity by counter. The pointer normally registers main tank fuel quantity unless the selector switch is operated, in which case the pointer will indicate either R. H. drop tank or L. H. drop tank quantity as selected. Since the gaging system is calibrated in pounds and the fuels vary in weight per gallon dependent upon the specific gravity and the temperature of the fuel used, the notation "FULL" does not appear on the instrument dial, and variations in the instrument readings should be anticipated when the tanks are full.

(*) Indicates approximate weights and moments for full main and full drop tanks under standard conditions (60°F) for aviation gasoline (MIL-F-5572) and automotive gasoline (MIL-G-3056) based on 6. 0 lb./gal.

(**) Indicates approximate weights and moments for full main and full drop tanks under standard conditions (60°F) for JP-4 fuel (MIL-F-5624) based on 6. 5 lb./gal.

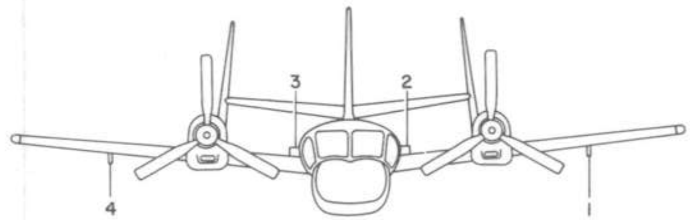
(***) Indicates approximate weights and moments for full main and full drop tanks under standard conditions (60°F) for JP-5 fuel (MIL-F-5624) based on 6. 8 lb./gal.

ABOVE NOTES APPLICABLE TO SHEET 5 OF CHART E.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 6 of 14)

CHART DATE: SEE SHEET 1

EXTERNAL STORES TABLE



Suspension Device Code

A: Chart A Items F-5, F-6, F-8
B: Chart A Items F-5, F-7, F-8

Items	Weight of Pair	Wing Station 185 Positions 1 and 4 (Max. Loading/Position = 1225 lb.)			Upper Wing Root Positions 2 and 3 (Max. Loading/Position = 132 lb.)		
		Arm	Mom./1000	Susp. Code	Arm	Mom./1000	Susp. Code
750 lb. Resupply Container Aero 1C 150 Gal. Fuel	1500	162.0	243	A or B			
Tank Flare Pod Empty*	274	175.0	48	A or B			
	44				230.0	10	(NONE)

* See Table of Individual Camera and Equipment Weights, Sheet 8 of 14 of Chart E, for A-6 Flare Ejector Components and MK-112 Flares, and see Caution Note on Sheet 13 of 14 of Chart E when Flare Pods are aboard.

SKI TABLE (L. G. EXTENDED)			
Items	Weight**	Arm	Moment/1000
Nose Wheel Ski Installation	129	39.5	5.1
Main Wheel Ski Installations (2)	556	174.6	97.1
Total - Planing Ski Installation	685	149.2	102.2

**Nose Wheel Ski Installation includes the removal of (2) N.W. Doors, 15 pounds at Fuselage Station 66.
Main Wheel Ski Installation includes the removal of (2) Main Gear Fairings, 13 pounds at Fuselage Station 186.

Figure 4-3. Chart E, Loading Data OV-1B (Sheet 7 of 14)

CHART DATE: SEE SHEET 1

TABLE OF INDIVIDUAL CAMERA AND EQUIPMENT WEIGHTS

Item	Weight	Arm	Mom/1000
Cameras			
KA-30-3 with Magazine & 250' of film	42	220.0	9.2
KA-30-6 with Magazine & 250' of film	40	220.0	8.8
KA-30-12 with Magazine & 250' of film	49	220.0	10.8
Miscellaneous			
MK-112 Flares (104)	104	225.5	23.4
A-6 Photo Flare Cartridge Ejectors (2) without Photo Flare Cartridge Retainers*	83	225.5	18.7
Photo Flare Cartridge Retainers (4)**	31	225.5	7.0
Flare Pod Covers (2)**	7	225.5	1.6

* See External Store Table, Sheet 7 of Chart E, for Empty Flare Pod.

** Each Flare Pod accommodates either one Flare Pod Cover or two Photo Flare Cartridge Retainers.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 8 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Pounds	Moment/1000 22% MAC T.O. & Ldg Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	29.3% MAC Aft Limit* Whls Up** 163.51 In.	Gross Weight Pounds
10500	1642	1662	1683	1704	1715	10500
10550	1650	1670	1691	1712	1723	10550
10600	1657	1678	1699	1720	1731	10600
10650	1665	1686	1707	1728	1739	10650
10700	1673	1694	1715	1736	1748	10700
10750	1681	1702	1723	1744	1756	10750
10800	1689	1710	1731	1752	1764	10800
10850	1697	1718	1739	1760	1772	10850
10900	1704	1726	1747	1768	1780	10900
10950	1712	1734	1755	1776	1788	10950
11000	1720	1742	1763	1785	1797	11000
11050	1728	1749	1771	1793	1805	11050
11100	1736	1757	1779	1801	1813	11100
11150	1743	1765	1787	1809	1821	11150
11200	1751	1773	1795	1817	1829	11200
11250	1759	1781	1803	1825	1837	11250
11300	1767	1789	1811	1833	1846	11300
11350	1775	1797	1819	1841	1854	11350
11400	1782	1805	1827	1850	1862	11400
11450	1790	1813	1835	1858	1870	11450
11500	1798	1821	1843	1866	1878	11500
11550	1806	1829	1851	1874	1886	11550
11600	1814	1837	1859	1882	1895	11600
11650	1822	1844	1867	1890	1903	11650
11700	1829	1852	1875	1898	1911	11700
11750	1837	1860	1883	1906	1919	11750
11800	1845	1868	1891	1914	1927	11800
11850	1853	1876	1899	1922	1936	11850
11900	1861	1884	1907	1931	1944	11900
11950	1868	1892	1915	1939	1952	11950
12000	1876	1900	1923	1947	1960	12000
12050	1884	1908	1931	1955	1968	12050
12100	1892	1916	1939	1963	1976	12100
12150	1900	1924	1947	1971	1985	12150
12200	1908	1932	1955	1979	1993	12200

See *, ** Notes, Sheet 13 of 14.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 9 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Pounds	Moment/1000					Gross Weight Pounds
	22% MAC T.O. & Ldg Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	29.3% MAC Aft Limit* Whls Up** 163.51 In.	
12250	1915	1939	1963	1987	2001	12250
12300	1923	1947	1971	1996	2009	12300
12350	1931	1955	1979	2004	2017	12350
12400	1939	1963	1987	2012	2026	12400
12450	1947	1971	1995	2020	2034	12450
12500	1954	1979	2004	2028	2042	12500
12550	1962	1987	2012	2036	2050	12550
12600	1970	1995	2020	2044	2058	12600
12650	1978	2003	2028	2052	2066	12650
12700	1986	2011	2036	2060	2074	12700
12750	1994	2019	2044	2068	2083	12750
12800	2001	2026	2052	2077	2091	12800
12850	2009	2034	2060	2085	2099	12850
12900	2017	2042	2068	2093	2107	12900
12950	2025	2050	2076	2101	2115	12950
13000	2033	2058	2084	2109	2124	13000
13050	2040	2066	2092	2117	2132	13050
13100	2048	2074	2100	2125	2140	13100
13150	2056	2082	2108	2133	2148	13150
13200	2064	2090	2116	2142	2156	13200
13250	2072	2098	2124	2150	2164	13250
13300	2080	2106	2132	2158	2173	13300
13350	2087	2114	2140	2166	2181	13350
13400	2095	2121	2148	2174	2189	13400
13450	2103	2129	2156	2182	2197	13450
13500	2111	2137	2164	2190	2205	13500
13550	2119	2145	2172	2198	2214	13550
13600	2126	2153	2180	2206	2222	13600
13650	2134	2161	2188	2214	2230	13650
13700	2142	2169	2196	2223	2238	13700
13750	2150	2177	2204	2231	2246	13750
13800	2158	2185	2212	2239	2254	13800
13850	2166	2193	2220	2247	2263	13850
13900	2173	2201	2228	2255	2271	13900
13950	2181	2209	2236	2263	2279	13950

See *, ** Notes, Sheet 13 of 14.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 10 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Pounds	Moment/1000					Gross Weight Pounds
	22% MAC T.O. & Ldg. Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	29.3% MAC Aft Limit* Whls Up** 163.51 In.	
14000	2189	2216	2244	2271	2287	14000
14050	2197	2224	2252	2279	2295	14050
14100	2205	2232	2260	2288	2303	14100
14150	2212	2240	2268	2296	2312	14150
14200	2220	2248	2276	2304	2320	14200
14250	2228	2256	2284	2312	2328	14250
14300	2236	2264	2292	2320	2336	14300
14350	2244	2272	2300	2328	2344	14350
14400	2252	2280	2308	2336	2352	14400
14450	2259	2288	2316	2344	2361	14450
14500	2267	2296	2324	2352	2369	14500
14550	2275	2304	2332	2360	2377	14550
14600	2283	2311	2340	2369	2385	14600
14650	2291	2319	2348	2377	2393	14650
14700	2298	2327	2356	2385	2402	14700
14750	2306	2335	2364	2393	2410	14750
14800	2314	2343	2372	2401	2418	14800
14850	2322	2351	2380	2409	2426	14850
14900	2330	2359	2388	2417	2434	14900
14950	2338	2367	2396	2425	2442	14950
15000	2345	2375	2404	2434	2451	15000
15050	2353	2383	2412	2442	2459	15050
15100	2361	2391	2420	2450	2467	15100
15150	2369	2399	2428	2458	2475	15150
15200	2377	2406	2436	2466	2483	15200
15250	2384	2414	2444	2474	2492	15250
15300	2392	2422	2452	2482	2500	15300
15350	2400	2430	2460	2490	2508	15350
15400	2408	2438	2468	2498	2516	15400
15450	2416	2446	2476	2507	2524	15450
15500	2424	2454	2484	2515	2532	15500
15550	2431	2462	2492	2523	2540	15550
15600	2439	2470	2500	2531	2549	15600
15650	2447	2478	2508	2539	2557	15650
15700	2455	2486	2516	2547	2565	15700

See *, ** Notes, Sheet 13 of 14.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 11 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE

Gross Weight Pounds	Moment/1000					Gross Weight Pounds
	22% MAC T.O. & Ldg. Fwd Limit Whls Down 156.36 In.	24% MAC 158.32 In.	26% MAC 160.28 In.	28% MAC 162.24 In.	29.3% MAC Aft Limit* Whls Up** 163.51 In.	
15750	2463	2494	2524	2555	2573	15750
15800	2470	2501	2532	2563	2581	15800
15850	2478	2509	2540	2572	2590	15850
15900	2486	2517	2548	2580	2598	15900
15950	2494	2525	2556	2588	2606	15950
16000	2502	2533	2564	2596	2614	16000
16050	2510	2541	2572	2604	2622	16050
16100	2517	2549	2580	2612	2630	16100
16150	2525	2557	2588	2620	2639	16150
16200	2533	2565	2596	2628	2647	16200
16250	2541	2573	2604	2636	2655	16250
16300	2549	2581	2612	2644	2663	16300
16350	2556	2588	2620	2653	2671	16350
16400	2564	2596	2628	2661	2680	16400
16450	2572	2604	2637	2669	2688	16450
16500	2580	2612	2645	2677	2696	16500
16550	2588	2620	2653	2685	2704	16550
16600	2596	2628	2661	2693	2712	16600
16650	2603	2636	2669	2701	2720	16650
16700	2611	2644	2677	2709	2729	16700
16750	2619	2652	2685	2718	2737	16750
16800	2627	2660	2693	2726	2745	16800
16850	2635	2668	2701	2734	2753	16850
16900	2642	2676	2709	2742	2761	16900
16950	2650	2684	2717	2750	2769	16950

See *, ** Notes, Sheet 13 of 14.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 12 of 14)

CHART DATE: SEE SHEET 1

CENTER OF GRAVITY TABLE NOTES

1. All data given for wheels down condition.

2. CAUTION

   Loadings incorporating flare pods and only one crewman may exceed the aft C. G. limit unless ballast is installed.

3.** Landing gear retraction without skis increases the moment/1000 by +2. Moment/1000 values listed in this column are the moments corresponding to 29.3% MAC reduced by the moment for retraction of the landing gear and are equivalent to 29.1% MAC at 10,500 pounds and to 29.2% MAC at 16,950 pounds. Loadings based on the wheels down condition, which fall within the limiting moments listed in the table, will be satisfactory when the landing gear, without skis, is retracted. When the aircraft is equipped with skis, reduce this column by an additional 4 moment/1000 to insure satisfactory balance when the landing gear is retracted.

4. Maximum Takeoff Gross Weight . . . . ________ lb ***

   Maximum Landing Gross Weight . . . . ________ lb ***

*** Service activities shall insert, or substitute, current figures from latest applicable Dept. of Army Technical Manual (TM 55-1510-204-10) covering operating restrictions.

Figure 4-3. Chart E, Loading Data AO-1B (Sheet 13 of 14)

CHART DATE: SEE SHEET 1

TYPICAL SERVICE LOAD CONDITIONS*

Item	Arm	Observation Surveillance		Night Photo		Maximum G.W.		Air Emergency Resupply		Pilot Familiarization		Ferry G. W.	
		Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000	Weight	Mom./1000
Pilot (less chute)**	61.0	200	12	200	12	200	12	200	12	200	12	200	12
Observer (less chute)**	61.0	200	12	200	12	200	12	200	12			200	12
Personal Effects of Crew(2)	346.0											40	14
Oil (at 7.5 lb/gal.)	140.0	38	5	38	5	38	5	38	5	38	5	38	5
Fuel (JP-4 at 6.5 lb./gal.)													
Main Tank 297 gal.	161.0	1930	311	1930	311	1930	311	1930	311	1930	311	1930	311
Drop Tanks (2) 300 gal.	162.5					1950	317					1950	317
Drop Tanks (2)	175.0					274	48					274	48
KA-30-3 Camera, Mag. & Film	220.0	42	9										
KA-30-6 Camera, Mag. & Film	220.0			40	9								
KA-30-12 Camera, Mag, & Film	220.0					49	11						
Flare Pods (2)	230.0			44	10	44	10						
A-6 Flare Ejectors (2)	225.5			83	19	83	19						
Flare Cart. Retainers (4)	225.5			31	7	31	7						
M-112 Flares (104)	225.5			104	23	104	23						
Resupply Containers (2)	162.0							1500	243				
Planing Ski Install. *	152.1					149.2	102						
Totals		2410	349	2670	408	5588	877	3868	583	2168	328	4632	719

* The Planing Ski Installation may be added to any of the load conditions listed, except for the Maximum Gross Weight condition, which is shown with the ski installation. See ** note, Sheet 7 of 14, Chart E.

**For Crew Members' Parachutes and Equipments, see Chart A.

Figure 4-3. Chart E, Loading Data OV-1B (Sheet 14 of 14)

Section V. Weight and Balance Clearance Form F, DD Form 365F

5-1. DESCRIPTION.

5-2. Form F is the summary of the actual disposition of load in the aircraft. It records the balance status of the aircraft step by step. It serves as a work sheet on which to record weight and balance calculations and any corrections that must be made, to insure that the aircraft will be within weight and cg limits. Form F is furnished in expendable pads, or as separate sheets, which can be replaced when exhausted. An original and carbon are prepared for each loading. The original sheets, carrying the signature of responsibility, can be removed to serve as certificates of proper weight and balance as required by existing clearance directives. The duplicate copy must remain in the aircraft for the duration of the flight. On a cross-country flight this aids the weight and balance technician at refueling bases and stopover stations. There are two versions of this form: "SPECIAL MISSION" and "TACTICAL." They were designed to provide for the respective loading arrangements of these two type aircraft. The general use and fulfillment of either version is the same. Specific instructions for filling out the version for TACTICAL type aircraft are given below.

5-3. USE-TACTICAL AIRCRAFT. (See figure 5-1.)

5-4. Follow the steps given below to fill out Form F for TACTICAL type aircraft.

a. Insert the necessary identifying information at the top of the form. In the blank spaces of the LIMITATIONS table, enter the gross weight and cg restrictions obtained from Chapter 7.

b. REF 1: Enter the aircraft basic weight and moment/1000. Obtain these figures from the last entry on the Chart C, Basic Weight and Balance Record.

c. REF 2: Enter the amount and weight of oil.

d. REF 3: Using the compartment letter designations, as shown on the Chart E (aircraft diagram), enter the number and weight of the crew at their takeoff positions, baggage, cargo, and miscellaneous items. Use actual crew weights if available. Enter the total of each compartment in the WEIGHT column.

e. REF 4: Enter the sum of the weights for REF 1 through REF 3 to obtain OPERATING WEIGHT.

f. REF 5: Not applicable.

g. REF 6: Enter the distribution and weight of all flares, and resupply containers, if applicable.

h. REF 7: Enter the number of gallons and weight of the fuel. When external fuel is carried, make the appropriate entries in the space provided. When external fuel tanks are to be expended during flight, these items and their weight should also be entered as part of REF 7.

i. REF 8: Not applicable.

j. REF 9: Not applicable.

k. REF 10: Enter the sum of the weights for REF 4 through REF 9 opposite TAKEOFF CONDITION (Uncorrected). At this point, if not already done, calculate and enter the moment/1000 values for REF 1 through REF 10 inclusive.

l. Check the weight figure opposite REF 10 against the GROSS WT TAKEOFF in the LIMITATIONS table. Check the moment/1000 figure opposite REF 10 by means of Chart E, to ascertain that the indicated cg is within allowable limits.

m. If changes in the amount or distribution of load are required, indicate necessary adjustments by proper entries in the CORRECTIONS table at the lower left side of the form. Enter a brief description of the adjustments made in the column marked ITEM. Add all the weight and moment decreases and insert the totals in the space opposite TOTAL WEIGHT REMOVED. Add all the weight and moment increases and insert the totals in the space opposite TOTAL WEIGHT ADDED. Subtract the smaller from the larger of the two totals and enter the difference (with applicable + or - sign) opposite NET DIFFERENCE. Transfer the NET DIFFERENCE figures to the space opposite REF 11.

n. REF 12: Enter the sum of, or the difference between, REF 10 and REF 11. Recheck to assure that these figures do not exceed allowable limits.

o. REF 13: By referring to the cg table in the Chart E, determine the takeoff cg position. Enter this figure in the space provided opposite TAKE-OFF C. G.

p. REF 14: Estimate the weight of fuel (including external fuel tanks that are to be dropped) and any other items which may be expended before landing. Enter figures together with moment/1000 in the spaces provided.

NOTE

Do not consider reserve fuel as expended when determining ESTIMATED LANDING CONDITION.

q. REF 15: Enter the differences in weights and moment/1000 between REF 12 and the total of REF 14.

r. REF 16: By again referring to the cg table in the Chart E, determine the estimated landing cg position. Enter this figure opposite ESTIMATED LANDING C. G.

s. The necessary signatures must appear at the bottom of the form.

WEIGHT AND BALANCE CLEARANCE FORM F
TACTICAL
(USE REVERSE FOR TRANSPORT MISSIONS)

FOR USE IN T. O. 1-1B-40 & AN 01-1B-40

DATE	AIRPLANE TYPE	FROM	HOME STATION
8/2/61	AO-1A	FT. RUCKER	FT. RUCKER
MISSION/TRIP/FLIGHT/NO.	**SERIAL NO.**	**TO**	**PILOT**
OBSERVATION	60-3742	FT. RUCKER	CAPT. S. ROBERTS

REMARKS

COMPUTER PLATE NO. *(If used)*

REF	ITEM	WEIGHT	MOM/1000
1	BASIC AIRPLANE *(From Chart C)*	9812	1605.1
2	OIL (5 *Gal.*)	38	5.9
3	DISTRIBUTION OF LOAD		

COMPT.	CREW NO.	CREW WEIGHT	BAGGAGE	CARGO AND MISC.	WEIGHT	MOM/1000
B	2	400			400	24.4

REF	ITEM	WEIGHT	MOM/1000
4	OPERATING WEIGHT	10250	1634.8
5	AMMUNITION: COMPT. / ROUNDS / CALIBER		
6	BOMBS, ROCKETS, ETC.: FORWARD		
	AFT		
	EXTERNAL		
	ROCKETS		
7	FUEL: BUILT IN (154 *Gal.*)	1000	161.6
	BOMB BAY (*Gal.*)		
	EXTERNAL (*Gal.*)		
8	WATER INJ. FLUID (*Gal.*)		
9	JATO OR RATO		
10	TAKEOFF CONDITION *(Uncorrected)*	11250	1796.4
11	CORRECTIONS *(If required)*		
12	TAKEOFF CONDITION *(Corrected)*	11250	1796.4
13	TAKEOFF C. G. IN % M. A. C. ~~OR IN.~~	25.4% M.A.C.	
14	LESS EXPENDABLES: JATO OR RATO		
	BOMBS		
	AMMUNITION		
	FUEL	850	135.7
15	ESTIMATED LANDING CONDITION	10400	1660.7
16	ESTIMATED LANDING C. G. IN % M. A. C. OR IN.	25.4% M.A.C.	

Pertinent instructions to the pilot for shifting load or crew during takeoff and landing should be noted above.

CORRECTIONS (Ref. 11)

COMPT.	ITEM	WEIGHT (+ or −)	INDEX OR MOM/
TOTAL WEIGHT REMOVED		−	−
TOTAL WEIGHT ADDED		+	+
NET DIFFERENCE *(Ref. 11)*			

LIMITATIONS

[1] GROSS WT. TAKEOFF *(lb.)*	[1] GROSS WT. LANDING *(lb.)*

	FROM	TO (% M. A. C. ~~or IN.~~)
[3] PERMISSIBLE C. G. TAKEOFF	22%	30%
[4] PERMISSIBLE C. G. LANDING	22%	30%

[1] *Enter constant used.*
[2] *Enter values from current applicable T. O.*
[3] *Applicable to gross weight (Ref. 12).*
[4] *Applicable to gross weight (Ref. 15).*

COMPUTED BY *(Signature)* Donald Olson, 2nd Lt.
WEIGHT AND BALANCE AUTHORITY *(Signature)* Michael Smith, 1st Lt.
PILOT *(Signature)* Stanley Roberts, Capt.

DD FORM 1 SEPT 54 365F

SAMPLE

Figure 5-1. DD Form 365F, Weight and Balance Clearance Form F (Sample)

CHAPTER 13
AIRCRAFT LOADING

Section I. Scope

1-1. This Chapter contains all essential information and instructions for securing and loading of baggage.

1-2. General description of the baggage compartments and appropriate illustrations are also provided.

Section II. Loading Instructions

2-1. AIRCRAFT LOADING FEATURES.

2-2. GENERAL. The AO-1 aircraft has been designed primarily as a surveillance aircraft; therefore, the provisions for cargo and baggage are not extensive. The small amount of baggage space incorporated serves mainly for luggage stowage, and is used by the pilot and observer on ferry flights and other flights of a non-tactical nature.

2-3. FORWARD BAGGAGE COMPARTMENT. (See figure 2-1.) The [1] aircraft has space for baggage in the forward baggage compartment, which is located in the fuselage just aft of the cockpit. Access to this area is provided by an outward opening door mounted on the left side of the aircraft. Provisions for baggage consist of a 28 by 30 inch shelf, a webbed baggage cover, and D-rings for securing the cover over the baggage. A buckle attached to each strap on the baggage cover allows it to be adjusted to prevent baggage shifting during flight. The forward baggage compartment is designed for a maximum weight of 40 pounds.

2-4. AFT BAGGAGE COMPARTMENT. (See figure 2-2.) On [7] aircraft, the installation of additional electronic equipment has necessitated the relocation of the baggage space further aft in the fuselage. A canvas baggage bag has been hung in the fuselage of these aircraft, and an access door has been installed just aft of the speed brakes. The maximum allowable baggage to be stowed in this bag is limited to 40 pounds when the aircraft is operated with a pilot and observer, or 20 pounds when only a pilot is aboard.

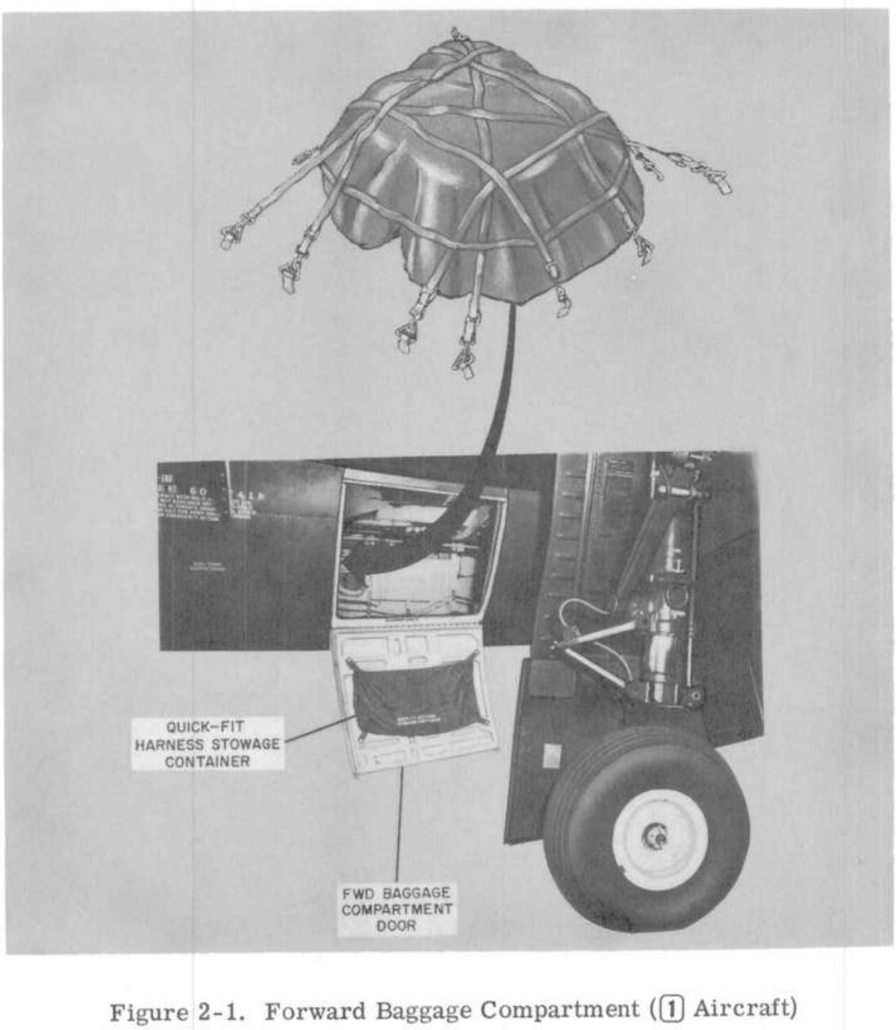


Figure 2-1. Forward Baggage Compartment ([1] Aircraft)

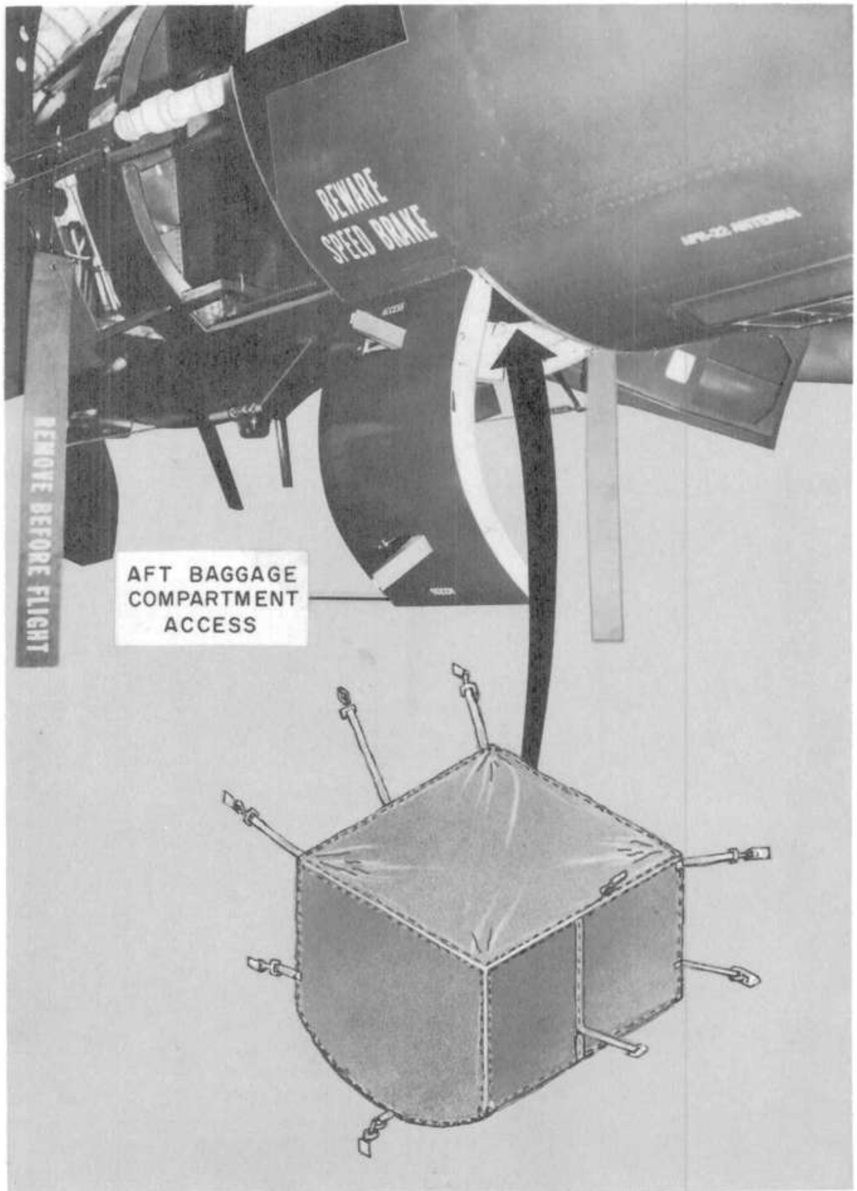


Figure 2-2. Aft Baggage Compartment (7 Aircraft)

CHAPTER 14
PERFORMANCE DATA

Section I. Scope

1-1. The tables and charts presented in this chapter contain the performance data necessary for accurate and complete flight planning and are applicable to aircraft operating with a clean configuration, two 150-gallon drop tanks, and/or SLAR installation (OV-1B). Wherever applicable, read all remarks listed in the charts and check for applicable aircraft by group codes. All applicable units of measure used are listed.

1-2. A density altitude chart and a standard atmosphere table are included in this charter (refer to paragraphs 2-29 and 2-30).

Section II. Charts

2-1. AIRSPEED INSTALLATION CORRECTION. Several corrections must be applied to the airspeed indicator reading in order to obtain correct aircraft speeds. The first correction is made for the error in the individual instrument. The airspeed correction card (left overhead console) notes the value of this correction. This value is applied to the instrument reading to provide indicated airspeed (IAS). The second correction is made for airspeed installation error. This correction is taken from table 2-I and, when applied to the indicator airspeed, provides a calibrated airspeed (CAS). The airspeed installation corrections are listed for various weights and aircraft configurations.

2-2. ALTIMETER INSTALLATION CORRECTION. As in airspeed correction, several corrections must be applied to the altimeter reading in order to obtain correct aircraft altitude. One first correction is made for the error in the individual instrument. The altitude correction card notes the value of this correction. The second correction is made for altimeter installation error (table 2-II). The altimeter installation corrections are given for various airspeeds and weights.

2-3. OUTSIDE AIR TEMPERATURE CORRECTION. Compressibility effects will cause an erroneous free air temperature indication on the outside air temperature indicator. Table 2-III lists the corrections that must be applied to the indicated temperature at various pressure altitudes and calibrated airspeeds.

2-4. POWER AVAILABLE FOR TAKEOFF. The power available for takeoff chart (table 2-IV) is a plot of shaft horsepower available for takeoff versus outside air temperature (runway) with parameters of pressure altitude ranging from sea level to 8000 feet. The temperature range is -60°F to +120°F. A sample problem is provided below to illustrate the use of the power available for takeoff chart:

a. Problem. Determine the shaft horsepower required for takeoff and corresponding torque reading under the following conditions:

(1) Ambient pressure - 28.86" Hg.
(2) Ambient temperature - 81°F.
(3) Propeller rpm - 1678.

b. Procedure.

(1) From table 2-IV Power Available for Takeoff) select the ambient temperature.

(2) Plotting upward on the graph, intersect the ambient pressure curve (28.86" Hg).

(3) Project this intersection point to the left and determine that the shaft horsepower available for takeoff is 817 SHP.

(4) To convert this power value to the corresponding torque value, use table 2-V (Power Conversion). Project the SHP value to the right until the propeller rpm curve is intersected. Project this intersection point downward and determine the torque reading to be 52 psig.

2-5. POWER CONVERSION. The power conversion chart (table 2-V) presents, in graphical form, the relationship between torque pressure, propeller rpm, and shaft horsepower. Data covers the operational power range of the engine. See the sample problem under paragraph 2-4 for converting shaft horsepower to the corresponding torque pressure.

2-6. POWER SCHEDULE AND FUEL FLOW. The fuel flow schedule chart (table 2-VI) consists of plots of torque pressure and fuel flow versus shaft horsepower with parameters of propeller rpm and pressure altitude ranging from sea level to 25,000 feet. A sample problem is provided below to illustrate the use of the fuel flow schedule chart.

a. Problem. Determine the fuel flow under the following conditions:

(1) Altitude - 5000 feet.
(2) Torque pressure - 48 psig.
(3) Propeller rpm - 1400.

b. Procedure.

(1) From table 2-VI (Fuel Flow Schedule) select the torque pressure.

(2) Plotting upward on the graph, intersect the propeller rpm curve (1400).

(3) Project the intersection point to the left until the pressure altitude curve (5000) is intersected.

(4) Plot this point downward and determine that the fuel flow is 460 lb/hr/eng.

2-7. TAKEOFF GROSS WEIGHT LIMIT. This chart will be supplied when available.

2-8. TAKEOFF AND LANDING CROSSWIND. The takeoff and landing crosswind chart (table 2-VII) presents headwind and crosswind components in knots for crosswind directions from 0 degrees to 90 degrees in 5-degree increments and wind velocities of 0 to 60 knots in 5-knot increments. The right ordinate is a scale for minimum touchdown or nosewheel lift-off speed in knots. A sample problem is provided below to illustrate the use of the takeoff and landing crosswind chart. The procedure for using the crosswind chart is identical for both landings and takeoffs except that the recommended takeoff speed is determined from the takeoff distance chart and the recommended landing speed is determined from the landing distance chart.

a. Problem. Determine if it is safe to land an OV-1C aircraft, having a gross weight of 13,500 pounds, in a crosswind of 20 knots at 60° to the runway.

b. Procedure.

(1) Enter the takeoff and landing crosswind chart (table 2-VII) along the wind direction (60°) plot until

the wind velocity (20 knots) is reached. The vertical coordinate of this point is the crosswind component.

(2) Determine the recommended speed for landing from the landing distance chart (table 2-XXXI). For a gross weight of 13,500 pounds the recommended speed is 90 knots.

(3) Enter the crosswind chart from the right with the recommended landing speed (90 knots). Determine that it is safe to land since the intersection of the recommended speed and crosswind component falls within the recommended (safe) area.

NOTE

The intersection of the recommended landing or takeoff speed and the crosswind component must fall within the recommended area of the crosswind chart for a safe landing or takeoff.

2-9. TAKEOFF DISTANCE. These charts (tables 2-VIII and 2-IX) show the takeoff distances and speeds for various weights and configurations at varying temperatures, and altitudes. A sample problem is provided below to illustrate the use of the takeoff distance charts.

NOTE

The accelerate-stop distance chart (table 2-XIII) indicates the total distance needed if engine failure occurs during takeoff run. This chart shows the stop distance for various engine failure speeds and gross weights.

a. Problem. Determine the ground run and takeoff speed for OV-1A aircraft under the following conditions:

(1) Flaps - 15°.
(2) Runway - hard surface at sea level.
(3) Configuration - clean.
(4) Gross weight - 13,000 pounds.
(5) Outside air temperature - +20°C.
(6) Wind - 0 knots.
(7) Pressure altitude - sea level.

b. Procedure.

(1) From table 2-VIII (sheet 1 of 2) (Takeoff Distance) select configuration, gross weights and pressure altitude.

(2) Reading horizontally from left to right determine the following: That the ground run is 1110 feet and the takeoff speed is 89.5 knots.

2-10. MAXIMUM EFFORT TAKEOFF DISTANCE. The maximum effort takeoff distance charts (tables 2-X and 2-XI) are used to determine ground roll distance and distance to clear a 50 foot obstacle (with or without headwind) with weight, altitude, temperature, headwind, and torque pressure at takeoff power as variables. In addition, the rotation and takeoff speeds are plotted with gross weight and calibrated airspeeds as variables. A sample problem is provided below to illustrate the use of the maximum effort takeoff chart.

NOTE

The minimum distance takeoff chart (table 2-XI) indicates total distance required to clear a 50 foot obstacle.

a. Problem. Determine the ground roll distance (no headwind), distance required to clear a 50 foot obstacle (with and without headwind), takeoff and rotation speeds and the expected static torque pressure for the following conditions:

(1) Gross weight - 13,000 pounds.
(2) Runway pressure altitude - 6000 feet.
(3) Runway ambient temperature - 20°C.
(4) Static torque pressure - 40 psig.
(5) Headwind - 20 knots.

b. Procedure.

(1) From sheet 1 of table 2-X (Maximum Effort Takeoff Distance) determine that the takeoff and rotation speeds are 74 knots and 70.8 knots respectively.

(2) From sheet 1 also determine that the torque pressure should be 46.2 psig. at takeoff power.

(3) On sheet 2 plot the available static torque pressure horizontally across to the gross weight curve (13,000 lbs). Plot this point down following the guide lines with the conditions outlined in the problem. Determine the following: Ground roll distance (no headwind) is 1680 feet; distance to clear 50 foot obstacle (no headwind) is 2520 feet; distance to clear 50 foot obstacle (20 knot headwind) is 1845 feet.

2-11. VELOCITY DURING TAKEOFF GROUND RUN. The velocity during takeoff ground run chart (table 2-XII) is a plot of ground run distance versus indicated airspeed (IAS), with speed and distance relationships. Several guide lines, representing the momentary distance-speed relationship during the takeoff run, are plotted. The gross weight versus takeoff speed curve is located on the left side of the chart. A sample problem is provided below to illustrate the use of the velocity during takeoff ground run chart.

a. Problem. Determine the required IAS during the entire takeoff run in 500 foot increments for the following conditions:

(1) Gross weight - 13,000 pounds.
(2) Runway pressure altitude - 4000 feet.
(3) Runway ambient temperature - 20°C.

b. Procedure.

(1) From table 2-VIII (Takeoff Distance), determine that the takeoff ground run distance is found to be 1675 feet.

(2) From table 2-XII (Velocity During Takeoff Ground Run), plot the gross weight (13,000) up to the lift-off speed curve. Lift-off speed is 86.5 knots.

(3) Plot the ground roll distance (1675), determined in step (1) above, vertically.

(4) Project a horizontal line from the lift-off curve to the vertical line plotted in step (3) above. From the intersection of these two lines follow the guide lines.

(5) Determine that at 500, 1000, and 1500 feet of ground roll the IAS should be 54.5 knots, 72.5 knots, and 83.5 knots respectively.

2-12. CLIMBOUT FLIGHT PATH. This chart will be supplied when available.

2-13. CLIMBOUT FLIGHT PATH - ONE ENGINE INOPERATIVE. This chart will be supplied when available.

2-14. CLIMB CONTROL. The climb control charts included are for normal rated power (tables 2-XIV and 2-XV) and military rated power (tables 2-XVI and 2-XVII). These charts indicate the maximum rate-of-climb, and the best rate-of-climb speed at standard temperature with various weight and altitude combinations. Also shown is the time to climb from sea level to any altitude, the fuel used, and the distance in nautical miles. A sample problem is provided below to illustrate the use of the climb charts.

a. Problem. Determine the best climbing speed, fuel consumed, time required, distance traveled, and rate of climb to climb an OV-1A aircraft to 15,000 feet from sea level, at military power, under the following conditions:

(1) Configuration - two 150-gallon tanks.

(2) Gross weight - 12,000 pounds.

b. Procedure.

(1) From table 2-XVI (sheet 3 of 5) (Climb Control), select the configuration, gross weight, and pressure altitude.

(2) Reading horizontally from left to right, determine the following: that the climbing speed is 122 knots, the fuel consumed is 135 pounds, the time required is 7.5 minutes, the distance traveled is 18 nautical miles, and the rate of climb is 1390 feet-per minute.

2-15. SINGLE ENGINE CLIMB. The single engine climb charts (tables 2-XVIII and 2-XIX) represent climb control for single engine operation. Two sample problems are provided below to illustrate the use of single engine climb charts.

a. Problem One.

(1) Determine the single engine rate of climb for an OV-1A aircraft at a pressure altitude of 2,000 feet for an ambient temperature of -5°C under the following conditions:

(a) Configuration - Operative engine at TAKEOFF power and inoperative engine with feathered propeller, gear up and flaps up.

(b) Gross weight - 12,000 pounds.

(2) Procedure

(a) From table 2-XVIII (sheet 1 of 4) (Single Engine Climb), enter the upper left hand portion of the curve at T equals -5°C and proceed vertically to the pressure altitude line of 2,000 feet. Going horizontally across and to the right, intercept the torque pressure correction line at 67.5 psig. Proceed horizontally across and to the right, intercepting a gross weight line of 12,000 pounds. Drop a vertical line and read a single engine rate of climb of 980 fpm. To determine the calibrated climb speed, enter the lower left hand portion of the curve at T equals -5°C and proceed vertically, intercepting a gross weight line of 12,000 pounds. Read the calibrated climb speed horizontally across and to the right of 125.5 knots.

b. Problem Two.

(1) Determine the single engine rate of climb at a pressure altitude of 2,000 feet and an ambient temperature of -5°C under the following conditions:

(a) Configuration - Operative engine at TAKEOFF power and inoperative engine with feathered propeller. Gear up and flaps up.

(b) Gross weight - 12,000 pounds.

(c) Torque pressure - 54 psig*

(2) Procedure.

(a) From table 2-XVIII (sheet 1 of 4) (Single Engine Climb) proceed exactly as in Problem One except upon reaching the torque pressure correction line, follow the line to a torque pressure of 54 psig. Then proceed horizontally across and to the right, intercepting a gross weight line of 12,000 pounds. Drop a vertical line and read a single engine rate of climb of 455 fpm. The climb speed is identical to that in Problem One since climb speed is only a function of ambient temperature and gross weight.

2-16. NAUTICAL MILES PER POUND OF FUEL. This chart will be supplied when available.

2-17. MAXIMUM RANGE SUMMARY. The maximum range summary charts (tables 2-XX and 2-XXI) show the power settings that will produce the maximum range for various weight and altitude combinations with various airspeeds and rates of fuel consumption. A sample problem is provided below to illustrate the use of maximum range summary charts.

a. Problem. Determine the maximum range per pound of fuel, speed for maximum range, mach no., propeller rpm, and torque pressure for an OV-1A aircraft at an altitude of 10,000 feet under the following conditions:

(1) Configuration - two 150-gallon drop tanks.

(2) Gross weight - 12,000 pounds.

*For the stated conditions, the torque pressure should be 67.5 psig at TAKEOFF power. However, assuming that an engine deficiency results in a torque pressure of 54 psig the procedure for determining the single engine rate of climb is defined in Procedure Two.

b. Procedure.

(1) From table 2-XX (sheet 2 of 4) (Maximum Range Summary) select the configuration, gross weight, and pressure altitude.

(2) Reading horizontally from left to right determine the following: that the speed for maximum range is 164 knots, the mach no. is .2999, the maximum range per pound of fuel is .2630 nautical miles, the propeller rpm is 1525, and the torque pressure is 35 psig.

(3) Note that the results are for zero wind condition. To determine the effect of wind on fuel and time, the range per pound of fuel must be corrected to ground conditions.

2-18. SINGLE ENGINE MAXIMUM RANGE SUMMARY. The single engine maximum range summary charts (table 2-XXII and table 2-XXIII which will be supplied when available) represent maximum range for single engine operation. These charts are used following the same procedure as in normal maximum range summary (paragraph 2-17).

2-19. RANGE PREDICTION. This chart will be supplied when available.

2-20. MAXIMUM ENDURANCE SUMMARY. The maximum endurance summary charts (tables 2-XXIV and 2-XXV) show the power settings that will produce maximum endurance at various weight and altitude combinations. Fuel consumption, airspeeds, and endurance for various quantities of fuel are shown for each gross-weight-altitude combination. A sample problem is provided below to illustrate the use of the maximum endurance charts.

a. Problem. Determine the speed, propeller rpm, torque pressure, and fuel consumption rate for maximum endurance of an OV-1A aircraft at an altitude of 5000 feet under the following conditions:

(1) Configuration - clean.
(2) Gross weight - 10,000 pounds.
(3) Fuel load - 1735 pounds (assumed).

Also determine the endurance with a desirable reserve fuel quantity of 50 pounds.

b. Procedure.

(1) From table 2-XXIV (sheet 1 of 4) Maximum Endurance Summary) select the configuration, gross weight, and pressure altitude.

(2) Reading horizontally from the right to left, determine the following: that the speed for maximum endurance is 107 knots, the propeller rpm is 1175, the torque pressure is 20 psig, and the fuel consumption rate is 525 lb/hr.

(3) To determine the endurance, it will be noted from the climb chart (table 2-XIV sheet 1 of 4) that approximately 98 pounds of fuel are consumed for taxiing and takeoff and 33.5 pounds of fuel are consumed to climb to an altitude of 5000 feet. Subtracting desired fuel reserve, fuel consumed for taxiing and takeoff, and fuel consumed during climb to 5000 feet from total fuel load (1735 pounds, clean configuration), gives a fuel balance for cruise of 1554 pounds. Dividing the fuel balance by the fuel consumption rate for maximum endurance at 5000 feet, the endurance is calculated to be 2.86 hours or 2 hours and 57.5 minutes.

2-21. SINGLE ENGINE MAXIMUM ENDURANCE SUMMARY. The single engine maximum endurance summary charts (table 2-XXVI and table 2-XXVII which will be supplied when available) represent maximum endurance for single engine operation. These charts are used following the same procedure as in normal maximum endurance summary (paragraph 2-20).

2-22. CRUISE WITH ONE ENGINE INOPERATIVE. This chart will be supplied when available.

2-23. COMBAT ALLOWANCE. These charts (table 2-XXVIII and table 2-XXIX which will be supplied when available) show fuel flow at military power from sea level to 25,000 feet pressure altitude. The time limit for military power is also listed.

2-24. DESCENT CONTROL. These charts (table 2-XXX and table 2-XXXI which will be supplied when available) indicate the maximum range descent at best speed for descent with various weight and altitude combinations. Also shown is the time elapsed, the quantity of fuel used in pounds, and the distance in nautical miles. These figures are based on a power setting of flight idle. A sample problem is provided below to illustrate the use of the descent chart. Note that descents are made at flight idle power.

a. Problem. Determine the best descent speed, fuel consumed, time required, distance traveled, and rate of descent from 15,000 feet to sea level, for an OV-1A aircraft under the following conditions:

(1) Configuration - two 150-gallon tanks.
(2) Gross weight - 13,100 pounds.

b. Procedure.

(1) From table 2-XXX (Descent Control), select the configuration, gross weight, and pressure altitude.

(2) Reading horizontally from right to left, determine the following: that the descent speed is 136 knots, the fuel consumed is 56 pounds, the time required is 13 minutes, the distance traveled is 32 nautical miles, and the rate of descent is 1410 feet per minute.

2-25. DESCENT WITH ONE ENGINE INOPERATIVE. This chart will be supplied when available.

2-26. LANDING DISTANCE. The landing distance charts (tables 2-XXXII and 2-XXXIII) consist of landing ground roll distance with and without reverse thrust, and landing air distance to clear a 50-foot obstacle. The varying conditions to which these distances are plotted are: gross weight; pressure altitude; ambient temperature; and headwind.

Included on each chart is the approach speed plotted in terms of calibrated airspeed, versus aircraft gross weight. A sample problem is provided below to illustrate the use of the landing distance charts.

a. Problem. Determine the landing ground roll distance and minimum total landing distance to clear a 50-foot obstacle and stop for the following conditions:

(1) Gross weight 11,500 pounds.
(2) Runway pressure altitude - 2000 feet.
(3) Runway ambient temperature - 22°C.
(4) Runway wind component - 10 knot headwind.
(5) Configuration - Empty external fuel tanks, gear down, flaps 45°

b. Procedure.

(1) From figure 2-1 (sample chart) the approach speed is found to be 83 knots.

(2) The ground roll distance from touchdown to stop is found to be 1460 feet without reverse thrust.

(3) From figure 2-2 (sample chart) the limit sink speed is found to be 16.4 fps.

(4) The air distance from 50-foot obstacle to touchdown is then found to be 390 feet.

(5) The total landing distance to clear a 50-foot obstacle is 1850 feet.

2-27. EMERGENCY CEILING. This chart will be supplied when available.

2-28. MINIMUM SAFE SINGLE-ENGINE AIRSPEEDS. The minimum safe single-engine airspeeds chart (table 2-XXXIV and table 2-XXXV which will be supplied when available) consists of single-engine control speeds (sheet 1) and single-engine rate of climb (sheet 2) under various weights and configurations. Read all remarks and notes when using these charts.

2-29. DENSITY ALTITUDE CHART. See table 2-XXXVI.

2-30. STANDARD ATMOSPHERE TABLE. See table 2-XXXVII.

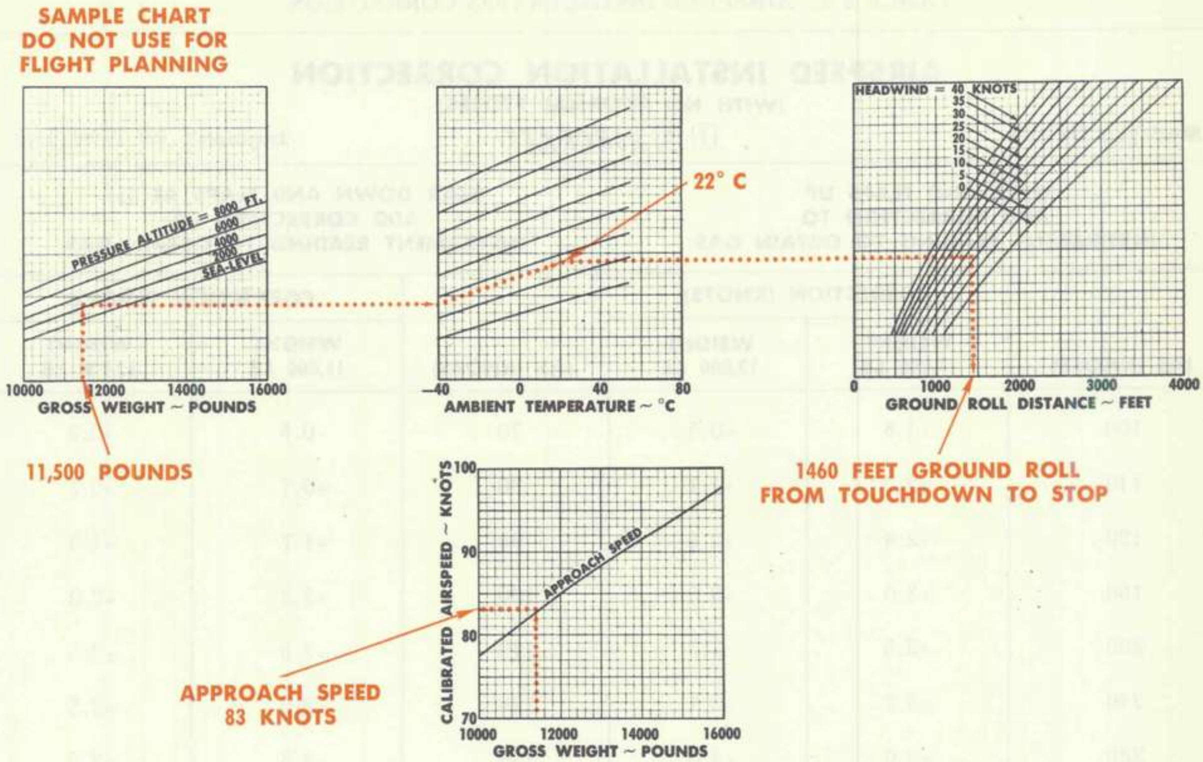


Figure 2-1. Landing Ground Roll Distance, Sample

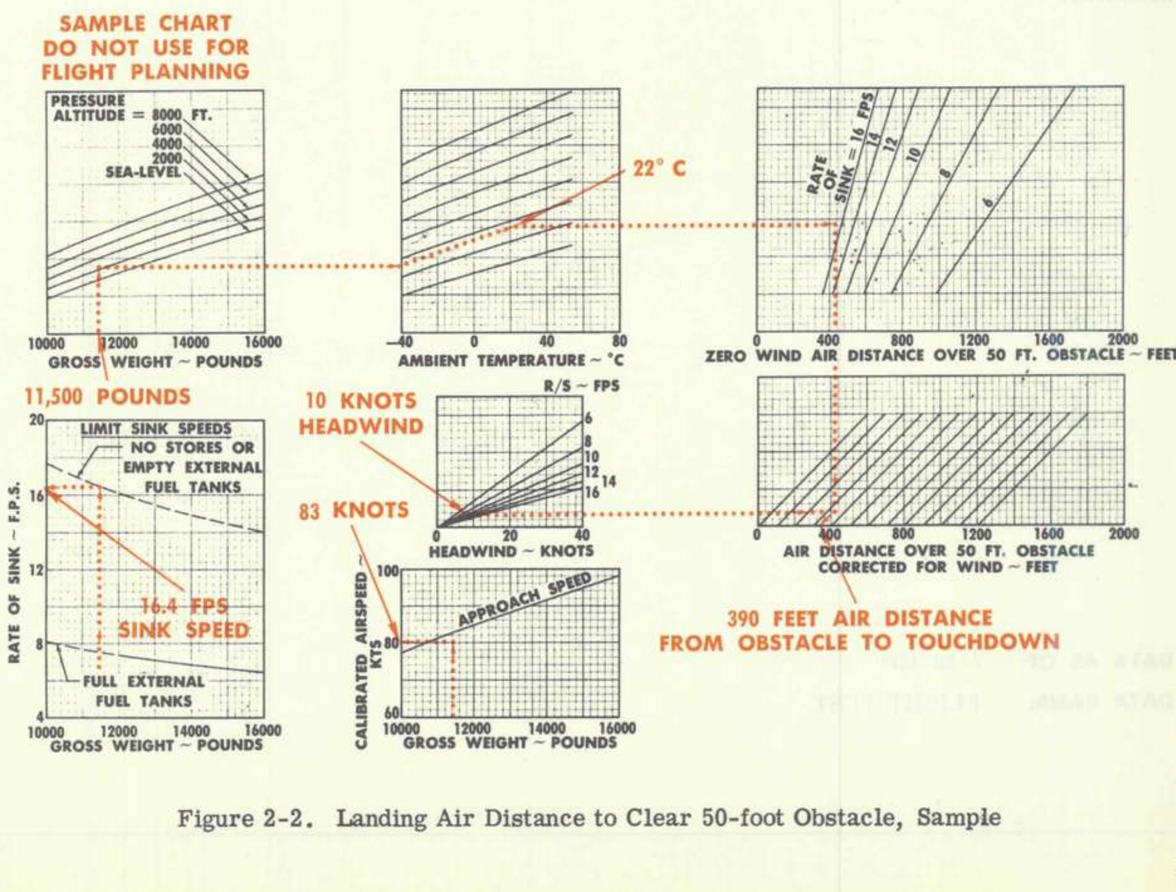


Figure 2-2. Landing Air Distance to Clear 50-foot Obstacle, Sample

TABLE 2-I. AIRSPEED INSTALLATION CORRECTION

AIRSPEED INSTALLATION CORRECTION

(WITH NO EXTERNAL STORES)

Model(s): OV-1A

1 2 AIRCRAFT

Engine(s): (2) T-53-L-3

GEAR AND FLAPS UP ADD CORRECTION TO INSTRUMENT READING TO OBTAIN GAS			GEAR DOWN AND FLAPS AT 45° ADD CORRECTION TO INSTRUMENT READING TO OBTAIN GAS		
	CORRECTION (KNOTS)			CORRECTION (KNOTS)	
IAS (KNOTS)	WEIGHT 11,000 LB	WEIGHT 13,000 LB	IAS (KNOTS)	WEIGHT 11,000 LB	WEIGHT 13,000 LB
100	+1.8	+0.5	70	-0.8	-2.2
110	+2.0	+1.7	80	+0.7	-0.2
120	+2.4	+2.4	90	+1.7	+1.3
160	+3.0	+3.0	100	+2.2	+2.2
200	+3.5	+3.5	110	+2.5	+2.5
240	+3.7	+3.7	120	+2.5	+2.5
280	+4.0	+4.0	130	+2.5	+2.5

REMARKS:

DATA AS OF: 7/29/60

DATA BASIS: FLIGHT TEST

TABLE 2-II. ALTIMETER INSTALLATION CORRECTION (SHEET 1 OF 4)

ALTIMETER INSTALLATION CORRECTION

43 AIRCRAFT

Model(s): OV-1A/OV-1C   Configuration: Clean   Engine(s): (2)T53-L-3

INDICATED AIRSPEED (KNOTS)	CORRECTION (FEET) ADD TO INSTRUMENT READING					
	SEA LEVEL		5,000 FEET		25,000 FEET	
	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB
100	-10	---	-10	---	-16	---
110	0	-12	0	-12	0	-25
120	+5	0	+6	0	+11	-5
140	+6	+8	+8	+8	+15	+15
160	+5	+8	+6	+8	+12	+15
200	-3	+2	-3	+2	-5	+5
220	-5	-2	-7	-2	-10	-2

REMARKS:

DATA AS OF: 12/26/62   FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST   FUEL DENSITY: 6.5 Lb/Gal

TABLE 2-II. ALTIMETER INSTALLATION CORRECTION (SHEET 2 OF 4)

ALTIMETER INSTALLATION CORRECTION

43 AIRCRAFT

Model(s): OV-1A/OV-1C

Configuration: No External Stores
Flaps at 45°
Gear Down

Engine(s): (2)T53-L-3

INDICATED AIRSPEED (KNOTS)	CORRECTION (FEET) ADD TO INSTRUMENT READING					
	SEA LEVEL		5,000 FEET		25,000 FEET	
	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB
75	-18	---	-20	---	-40	---
80	-12	-25	-15	-28	-28	-54
90	-5	-10	-5	-14	-10	-25
100	0	-5	0	-5	+2	-10
110	+4	0	+5	0	+8	0
120	+5	+4	+7	+4	+13	+7

REMARKS:

DATA AS OF: 12/26/62

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 Lb/Gal

TABLE 2-II. ALTIMETER INSTALLATION CORRECTION (SHEET 3 OF 4)

ALTIMETER INSTALLATION CORRECTION

[15] AIRCRAFT

Model(s): OV-1B   Configuration: Clean   Engine(s): (2)T53-L-3

INDICATED AIRSPEED (KNOTS)	CORRECTION (FEET) ADD TO INSTRUMENT READING							
	SEA LEVEL		5,000 FEET		15,000 FEET		25,000 FEET	
	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB
100	-5	-10	-4	-14	-6	-20	-7	-25
110	-2	-5	0	-5	-2	-6	-2	-7
120	-2	-2	-1	-1	-3	-3	-4	-1
140	-7	-4	-6	-5	-10	-5	-15	-5
160	-14	-8	-14	-8	-20	-12	-29	-16
200	-30	-20	-30	-20	-45	-32	-62	-44
220	-41	-26	-42	-30	-60	-43	-85	-58

REMARKS:

DATA AS OF: 12/26/62   FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST   FUEL DENSITY: 6.5 Lb/Gal

TABLE 2-II. ALTIMETER INSTALLATION CORRECTION (SHEET 4 OF 4)

ALTIMETER INSTALLATION CORRECTION

15 AIRCRAFT

Model(s): OV-1B

Configuration: No External Stores
Flaps at 45°
Gear Down

Engine(2): (2)T53-L-3

INDICATED AIRSPEED (KNOTS)	CORRECTION (FEET) ADD TO INSTRUMENT READING					
	SEA LEVEL		5,000 FEET		25,000 FEET	
	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB	WEIGHT 12,000 LB	WEIGHT 15,000 LB
75	-11	-25	-14	-27	-25	-55
80	-9	-17	-9	-19	-17	-35
90	-5	-7	-5	-9	-8	-16
100	-4	-3	-5	-5	-6	-7
110	-5	-3	-7	-4	-14	-5
120	-12	-5	-15	-5	-28	-9

REMARKS:

DATA AS OF: 12/26/62

FUEL GRADE: JP-4

DATA BASIS: FLIGHT TEST

FUEL DENSITY: 6.5 Lb/Gal

TABLE 2-III. OUTSIDE AIR TEMPERATURE CORRECTION

TEMPERATURE CORRECTION

ADD CORRECTION TO INDICATED TEMPERATURE
TO OBTAIN APPROXIMATE FREE AIR TEMPERATURE

PRESSURE ALTITUDE	CAS-KNOTS				
	100	150	200	250	300
SEA LEVEL	-1	-3	-4	-7	-9
5000	-2	-3	-5	-8	-11
10,000	-2	-4	-6	-9	-13
15,000	-3	-4	-7	-10	-15
20,000	-3	-5	-8	-12	-17
25,000	-3	-6	-9	-14	-20

REMARKS:

1. 80% adiabatic temperature rise assumed.
2. Indicated temperatures read high.

DATA AS OF: 9/14/60

DATA BASIS: FLIGHT TEST

TABLE 2-IV. POWER AVAILABLE FOR TAKEOFF

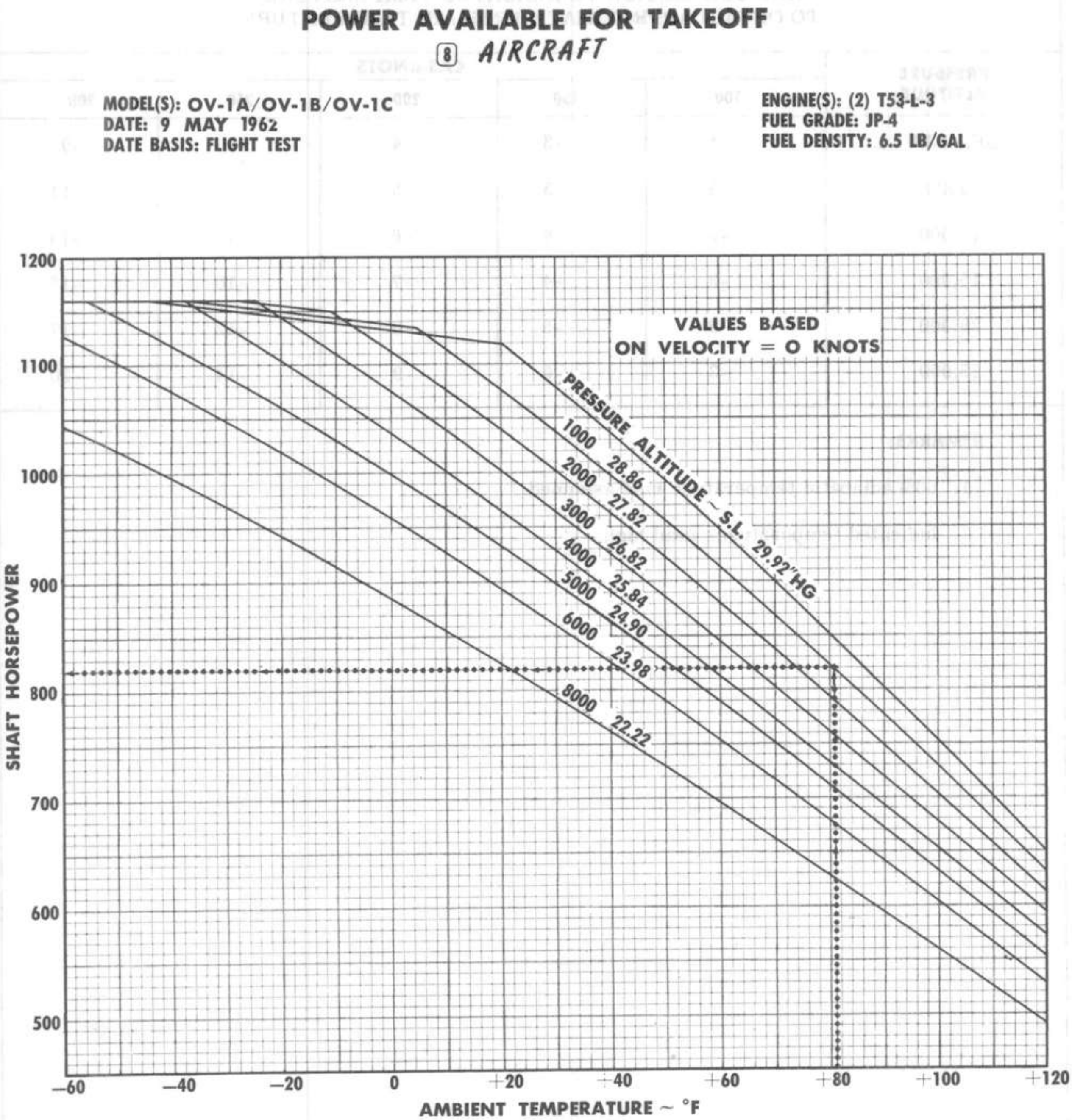


TABLE 2-V. POWER CONVERSION

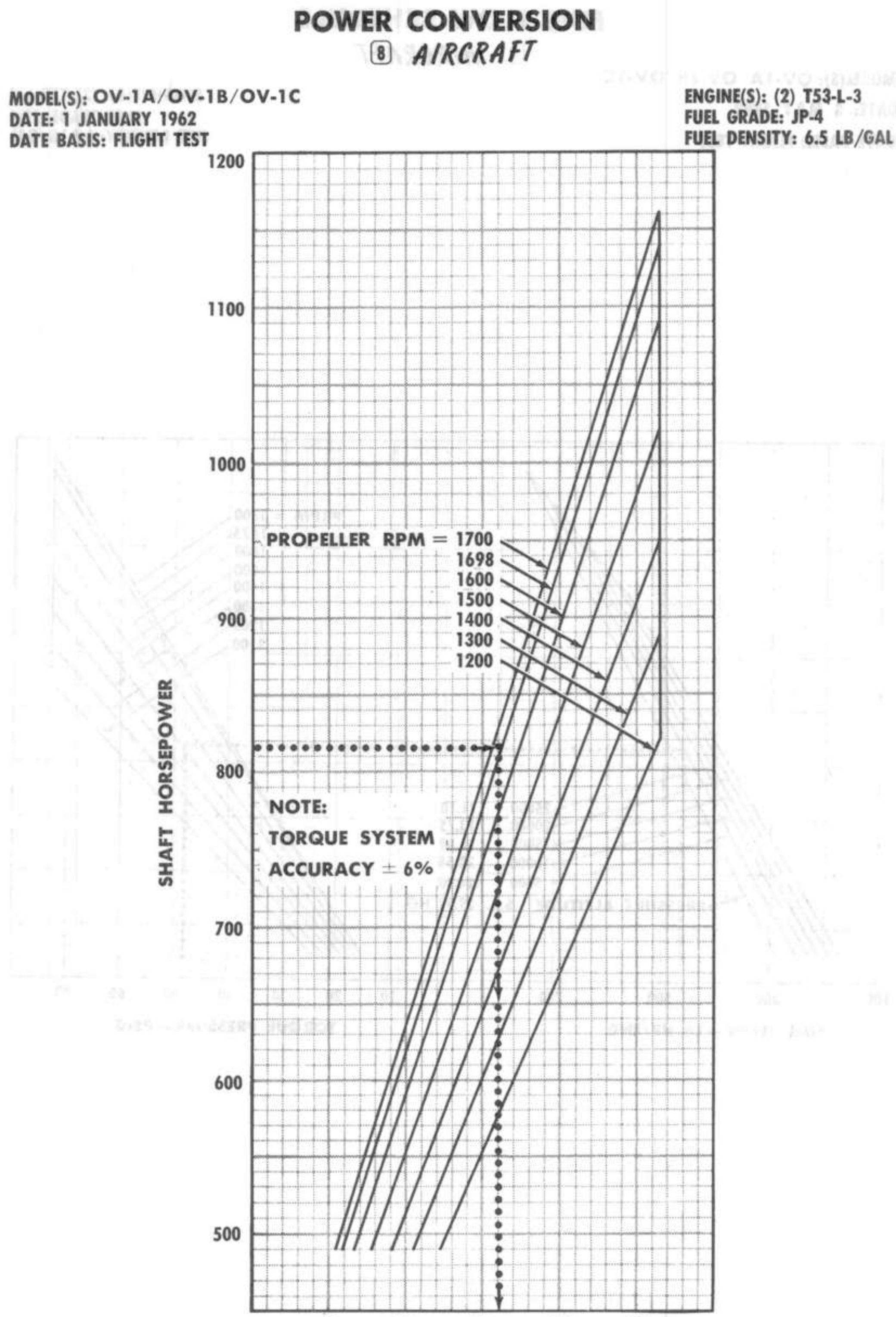


TABLE 2-VI. POWER SCHEDULE AND FUEL FLOW

FUEL FLOW SCHEDULE

8 AIRCRAFT

MODEL(S): OV-1A/OV-1B/OV-1C
DATE: 8 MAY 1962
DATE BASIS: FLIGHT TEST

ENGINE(S): (2) T53-L-3
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

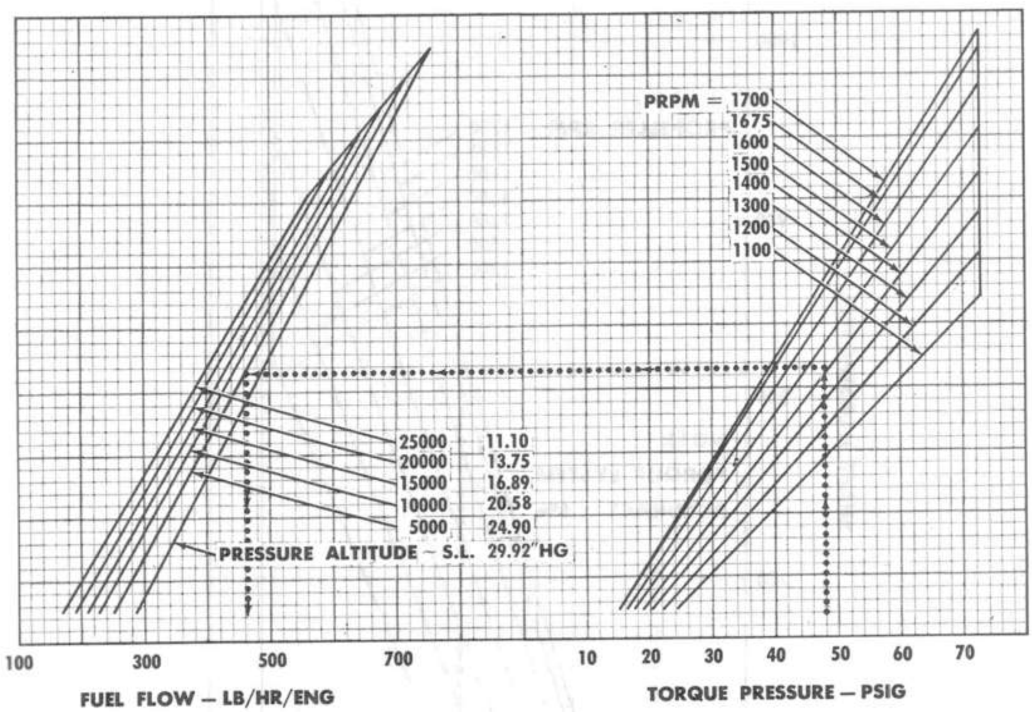


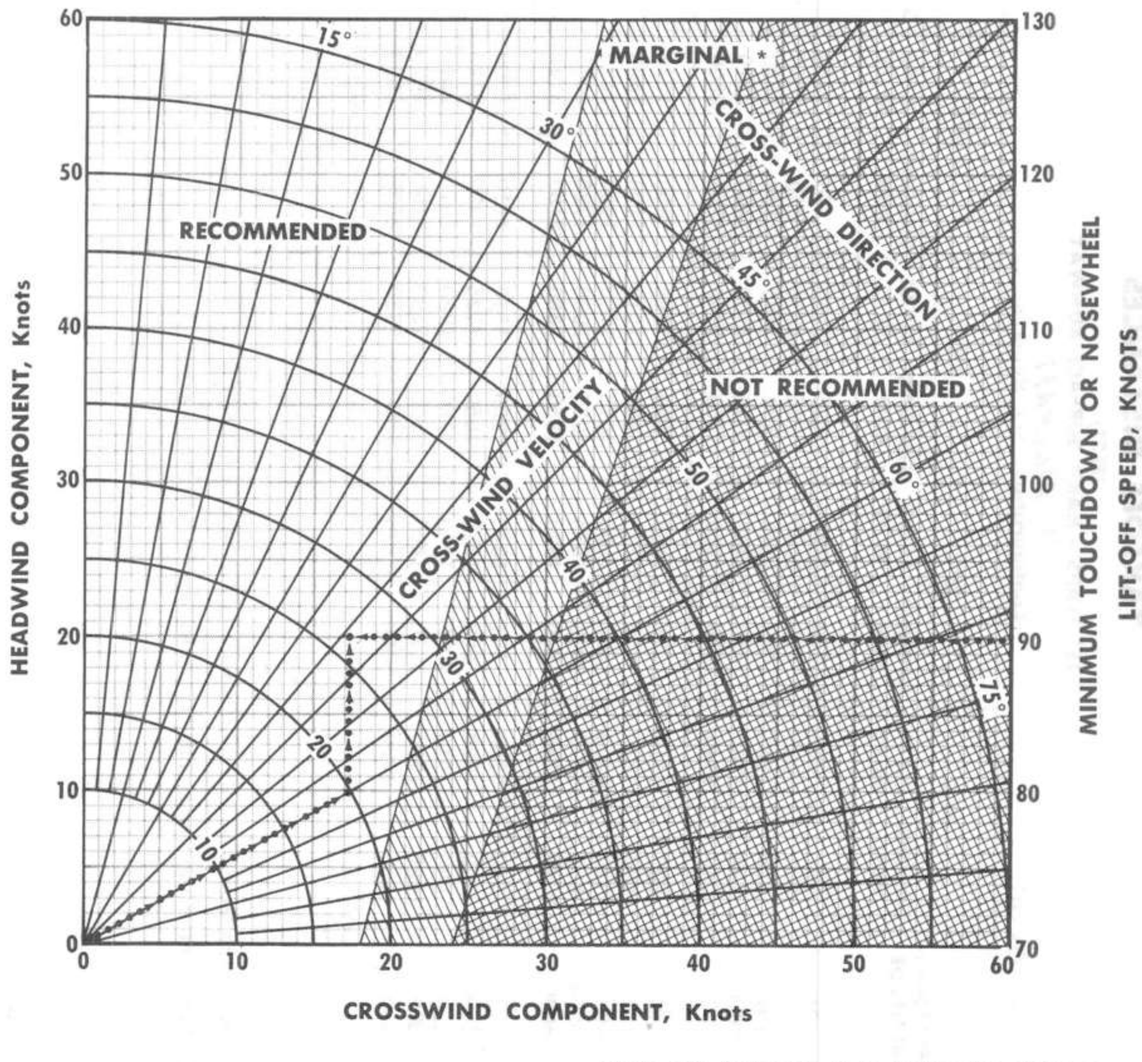
TABLE 2-VII. TAKEOFF AND LANDING CROSSWIND

TAKEOFF AND LANDING CROSSWIND

(8) AIRCRAFT

MODEL(S): OV-1A/OV-1B/OV-1C
DATE: 7 FEBRUARY 1962
DATE BASIS: FLIGHT TEST

ENGINE(S): (2) T53-L-3
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



NOTE: SEE TAKEOFF AND LANDING CHARTS FOR RECOMMENDED TOUCHDOWN AND LIFTOFF SPEEDS

* MARGINAL AREA SHOULD BE USED WITH CAUTION.

TABLE 2-VIII. TAKEOFF DISTANCE (SHEET 1 OF 2)

TAKEOFF DISTANCES

(FEET)
15° FLAPS – HARD SURFACE RUNWAY
8 AIRCRAFT

Model(s): OV-1A, OV-1B, OV-1C   **Configuration:** See Remarks 2.   **Engine(s):** (2) T-53-L-3

GROSS WEIGHT LB / LIFT-OFF SPEED CAS KNOTS	PRESSURE ALTITUDE	-40°C		-20°C		0°C		+20°C		+40°C		+55°C	
		GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT
11,000	SL	500	950	550	1025	625	1150	770	1330	1025	1700	1320	2070
	2000	560	1045	625	1150	735	1300	940	1565	1250	1980	1625	2450
	4000	625	1150	700	1240	870	1465	1130	1820	1600	2425	2130	3075
82.2	6000	720	1265	810	1400	1025	1700	1400	2175	2050	2970	2925	4000
	8000	840	1440	1000	1650	1250	1980	1750	2600	2790	3835	4560	5845
12,000	SL	605	1110	675	1185	720	1265	950	1570	1275	2000	1635	2455
	2000	690	1230	720	1265	900	1510	1150	1850	1550	2360	2020	2940
	4000	720	1265	860	1450	1075	1700	1400	2175	1990	2880	2650	3675
85.9	6000	880	1475	1010	1675	1275	2000	1725	2575	2550	3570	3650	4820
	8000	1040	1720	1240	1970	1550	2360	2180	3115	3480	4625	5700	7090
13,000	SL	710	1250	775	1340	900	1510	1110	1800	1500	2300	1980	2880
	2000	800	1380	900	1510	1050	1725	1370	2125	1870	2730	2475	3470
	4000	900	1510	1000	1650	1260	1980	1675	2510	2440	3435	3300	4425
89.5	6000	1025	1700	1180	1880	1500	2300	2100	3025	3175	4280	4640	5945
	8000	1220	1930	1460	2230	1870	2730	2690	3600	4420	5700	7410	8900

REMARKS:

1. Takeoff distances are based on a lift-off speed of 1.2 power-off stall.
2. Above data is presented for most critical configuration and zero wind.

DATA AS OF: 11/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-VIII. TAKEOFF DISTANCE (SHEET 2 OF 2)

TAKEOFF DISTANCES

(FEET)

15° FLAPS – HARD SURFACE RUNWAY

8 AIRCRAFT

Model(s): OV-1A, OV-1B, OV-1C **Configuration:** See Remarks 2. **Engine(s):** (2) T53-L-3

GROSS WEIGHT LB / LIFT-OFF SPEED CAS KNOTS	PRESSURE ALTITUDE	−40°C		−20°C		0°C		+20°C		+40°C		+55°C	
		GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT
14,000	SL	820	1410	890	1500	1040	1720	1300	2050	1820	2700	2425	3420
	2000	925	1550	1040	1720	1245	1975	1640	2475	2290	3250	3110	4210
	4000	1040	1720	1175	1875	1500	2300	2040	2960	3060	4150	4300	5560
92.8	6000	1200	1920	1400	2175	1820	2700	2600	3625	4100	5330	6220	7650
	8000	1450	2225	1760	2620	2290	3250	3420	4565	5900	7310	-	-
15,000	SL	980	1600	1080	1750	1260	1980	1580	2390	2220	3160	3000	4090
	2000	1120	1820	1260	1980	1500	2300	1990	2880	2815	3875	3900	5100
	4000	1260	1980	1425	2210	1825	2705	2500	3500	3840	5040	5525	6910
96.2	6000	1470	2240	1700	2545	2220	3160	3200	4300	5260	6525	8200	-
	8000	1760	2620	2150	3080	2815	3875	4320	5570	7710	9210	-	-
16,000	SL	1175	1875	1290	2030	1500	2300	1900	2780	2650	3675	3600	4760
	2000	1330	2080	1500	2300	1780	2635	2375	3350	3375	4500	4800	6120
	4000	1500	2300	1700	2545	2175	3115	3000	4090	4700	6000	7000	8480
99.2	6000	1750	2610	2025	2945	2650	3675	3875	5075	6640	8100	-	-
	8000	2100	3025	2575	3585	3375	4500	5350	6720	-	-	-	-

REMARKS:

1. Takeoff distances are based on a lift-off speed of 1.2 power-off stall.
2. Above data is presented for most critical configuration and zero wind.

DATA AS OF: 11/1/61 **FUEL GRADE:** JP-4

DATA BASIS: FLIGHT TEST **FUEL DENSITY:** 6.5 lb/gal

TABLE 2-IX. TAKEOFF DISTANCE (SHEET 1 OF 2)

TAKEOFF DISTANCES

TAKEOFF FLAPS—HARD SURFACE RUNWAY

9 AIRCRAFT

MODEL(S): OV-1B

ENGINE(S): (2) T53-L-7

CONFIGURATION

GROSS WEIGHT LB / LIFT-OFF SPEED CAS KNOTS	PRESSURE ALTITUDE	−40°C		+20°C		0°C		−20°C		−40°C		+55°C	
		GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT	GROUND RUN	CLEAR 50 FT
11000	S.L.	435	900	490	975	530	1030	630	1175	815	1430	1025	1705
	2000	485	970	540	1050	625	1160	755	1345	980	1650	1225	1970
	4000	530	1030	615	1150	725	1300	910	1565	1200	1940	1520	2345
	6000	610	1150	700	1275	860	1490	1080	1780	1450	2255	1850	2755
78.7	8000	690	1260	830	1450	1030	1720	1325	2100	1770	2670	2340	3355
12000	S.L.	555	1075	600	1180	675	1240	795	1400	1015	1690	1280	2045
	2000	615	1150	675	1240	775	1375	950	1605	1235	1985	1560	2400
	4000	675	1240	765	1360	900	1550	1140	1855	1510	2330	1950	2890
	6000	765	1360	895	1545	1075	1775	1370	2155	1840	2750	2400	3430
82.1	8000	870	1500	1050	1745	1300	2065	1675	2545	2290	3300	3070	4240
13000	S.L.	670	1235	730	1320	815	1430	955	1615	1230	1975	1580	2425
	2000	745	1340	820	1440	930	1580	1150	1875	1500	2320	1950	2890
	4000	815	1430	920	1575	1090	1790	1390	2180	1875	2790	2470	3505
	6000	920	1575	1075	1775	1300	2065	1690	2570	2320	3335	3060	4225
85.5	8000	1040	1730	1275	2040	1600	2450	2100	3070	2920	4050	4000	5375

REMARKS:

1. TAKE-OFF DISTANCES ARE BASED ON A LIFT OFF SPEED OF 1.2 POWER-OFF STALL
2. ABOVE DATA IS PRESENTED FOR MOST CRITICAL CONFIGURATION AND ZERO WIND

DATA AS OF: 12/15/62

DATA BASIS: Flight Test

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB./GAL.

TABLE 2-IX. TAKEOFF DISTANCE (SHEET 2 OF 2)

TAKEOFF DISTANCES

TAKEOFF FLAPS—HARD SURFACE RUNWAY

(9) *AIRCRAFT*

MODEL(S): OV-1B

ENGINE(S): 2) T53-L-7

Configuration:

GROSS WEIGHT LB / LIFT-OFF SPEED CAS KNOTS	PRESSURE ALTITUDE	+40°C GROUND RUN	+40°C CLEAR 50 FT	−20°C GROUND RUN	−20°C CLEAR 50 FT	0°C GROUND RUN	0°C CLEAR 50 FT	+20°C GROUND RUN	+20°C CLEAR 50 FT	−40°C GROUND RUN	−40°C CLEAR 50 FT	+55°C GROUND RUN	+55°C CLEAR 50 FT
14000	S.L.	800	1410	875	1510	975	1635	1150	1875	1500	2320	1930	2855
	2000	900	1550	980	1650	1120	1830	1375	2165	1845	2750	2390	3425
	4000	975	1635	1110	1825	1320	2090	1690	2570	2300	3310	3050	4220
	6000	1110	1825	1300	2065	1575	2420	2060	3020	2865	3995	3800	5125
88.8	8000	1250	2000	1540	2370	1950	2890	2590	3665	3620	4905	5000	6590
15000	S.L.	950	1610	1025	1700	1150	1875	1350	2130	1765	2655	2300	3310
	2000	1050	1745	1160	1890	1310	2075	1625	2475	2190	3175	2870	3995
	4000	1150	1875	1300	2065	1550	2380	2000	2950	2765	3865	3700	5000
	6000	1300	2065	1525	2350	1870	2785	2450	3490	3460	4710	4675	6200
91.9	8000	1475	2290	1820	2725	2320	3330	3110	4280	4445	5925	6250	8075
16000	S.L.	1125	1840	1225	1970	1350	2130	1600	2450	2120	3090	2775	3880
	2000	1230	1975	1370	2155	1550	2380	1935	2870	2625	3700	3460	4710
	4000	1350	2130	1545	2375	1840	2750	2400	3430	3335	4560	4500	6000
	6000	1540	2370	1800	2700	2240	3240	2975	4125	4200	5620	5675	7400
94.8	8000	1760	2650	2175	3150	2800	3910	3770	5090	5390	7060	--	--

REMARKS:

1. TAKE-OFF DISTANCES ARE BASED ON A LIFT OFF SPEED OF 1.2 POWER-OFF STALL
2. ABOVE DATA IS PRESENTED FOR MOST CRITICAL CONFIGURATION AND ZERO WIND

DATA AS OF: 12/15/62

DATA BASIS: Flight Test

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 LB./GAL.

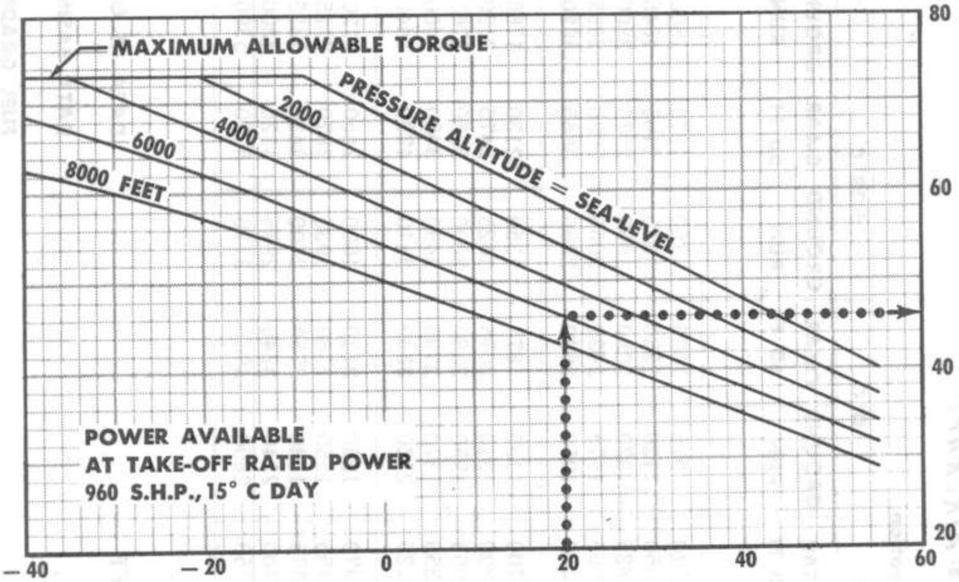
TABLE 2-X. MAXIMUM EFFORT TAKEOFF DISTANCE (SHEET 1 OF 2)

MAXIMUM EFFORT TAKEOFF DISTANCE

8 AIRCRAFT

MODEL(S): OV-1A/OV-1B/OV-1C
DATE: 12 JUNE 1962
DATA BASIS: FLIGHT TEST

ENGINE(S): (2) T53-L-3
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL



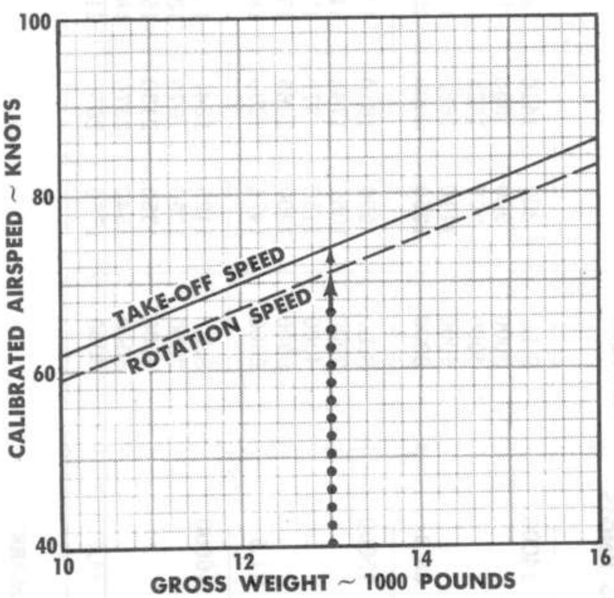


TABLE 2-X. MAXIMUM EFFORT TAKEOFF DISTANCE (SHEET 2 OF 2)

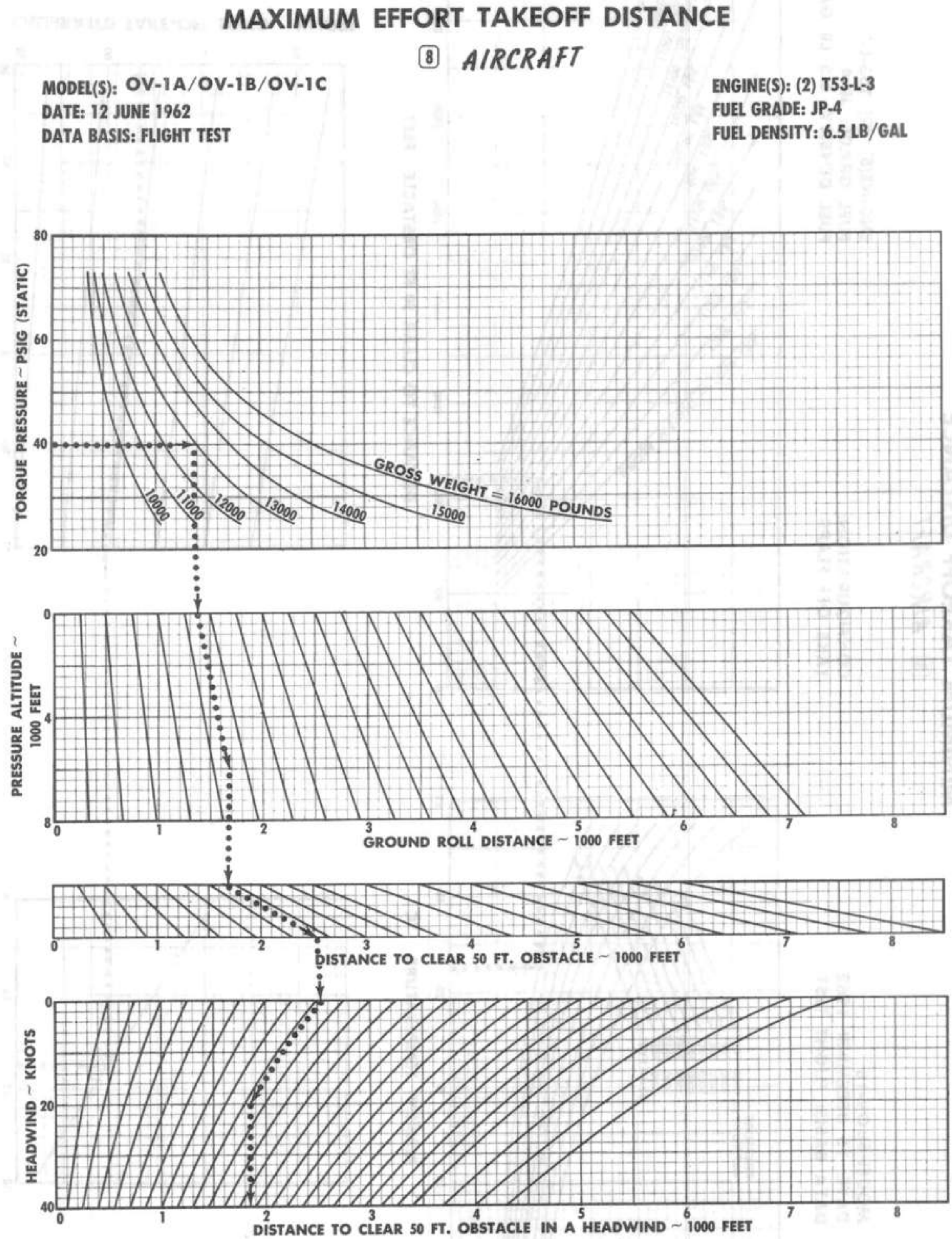


TABLE 2-XI. MINIMUM TAKEOFF DISTANCE

MINIMUM TAKEOFF DISTANCE

9 AIRCRAFT

MODEL(S): OV-1B
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

CONFIGURATION:
TAKE OFF FLAPS

ENGINE(S): (2) T53-L-7
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

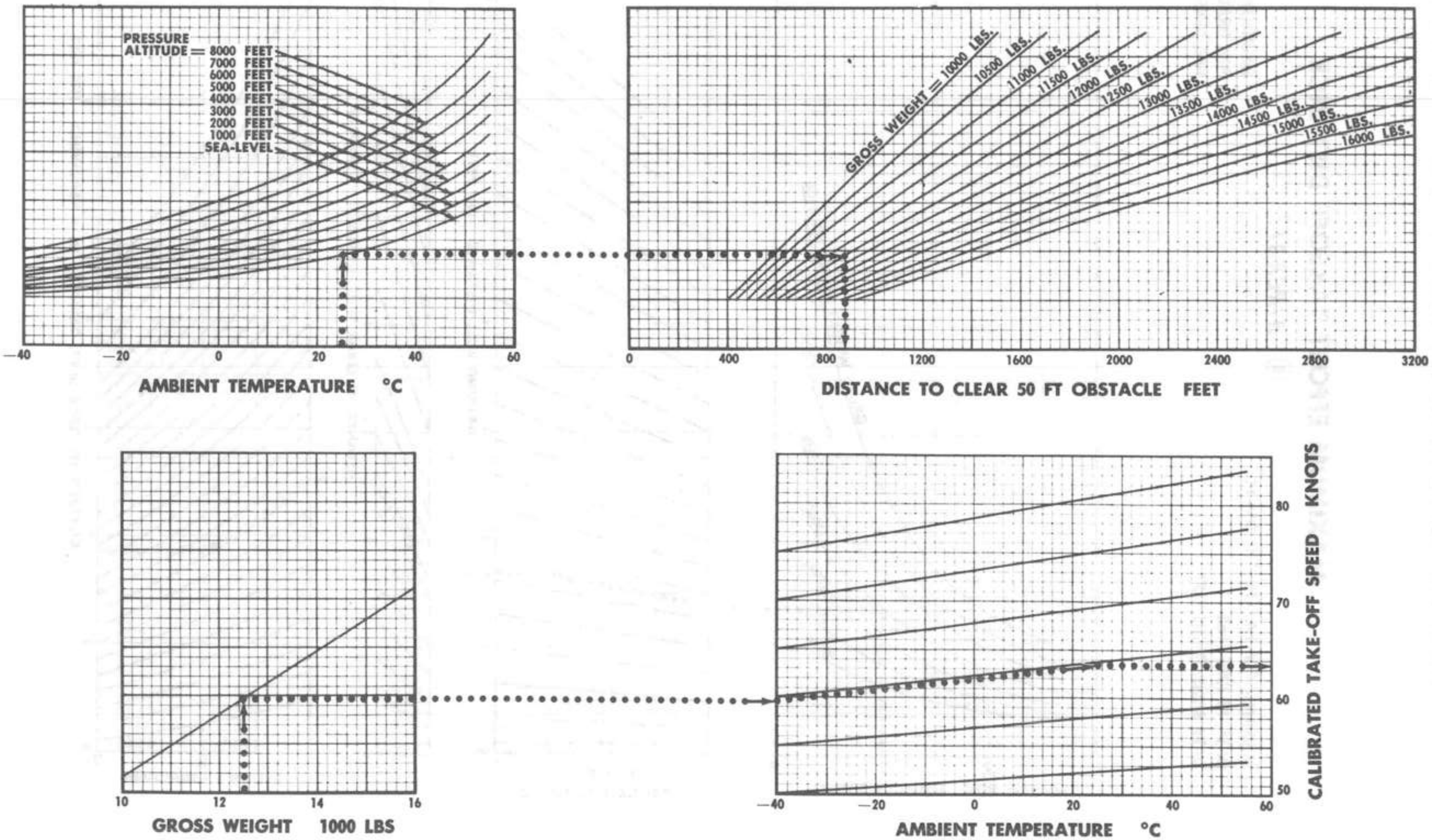


TABLE 2-IX. VELOCITY DURING TAKEOFF GROUND RUN

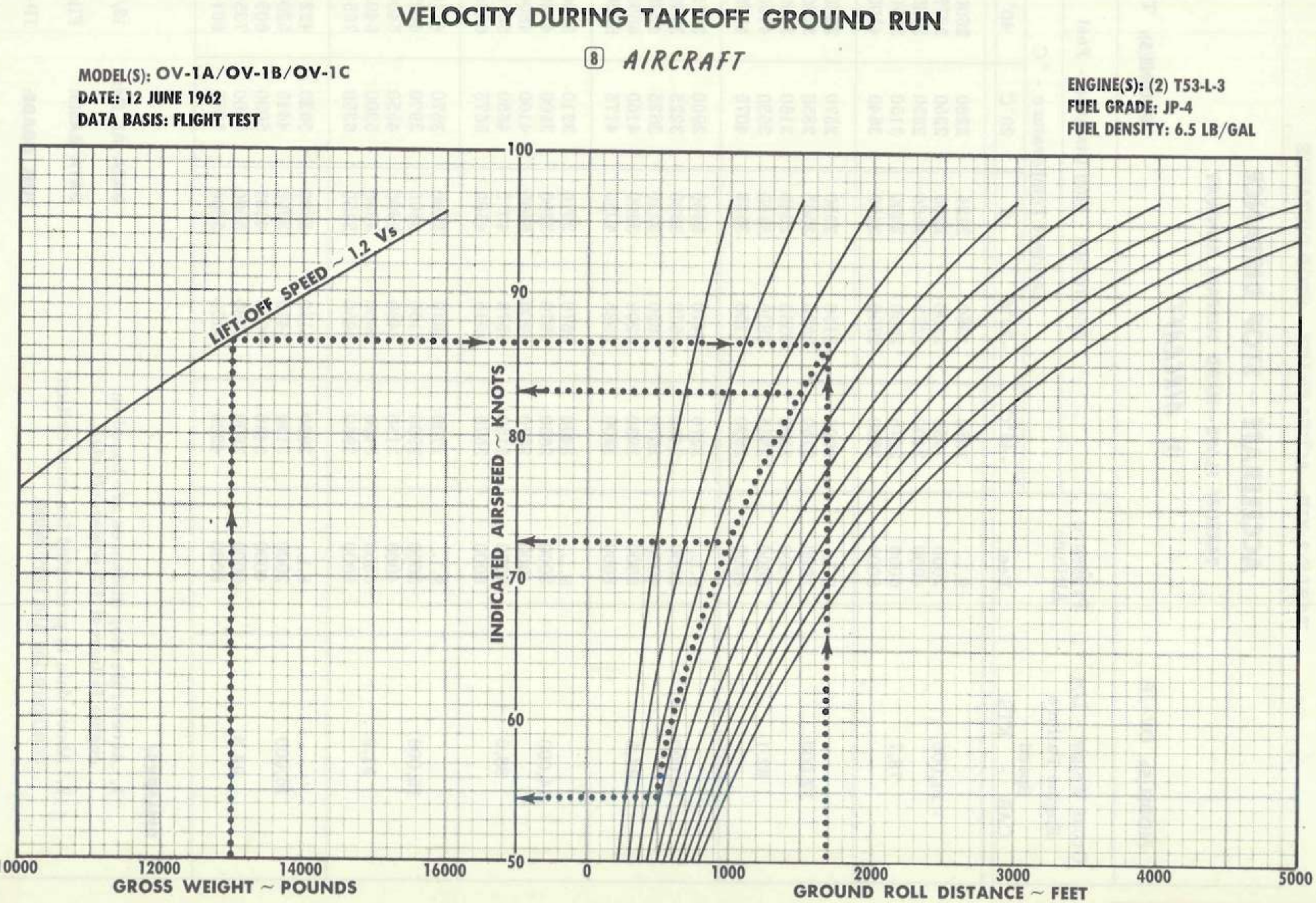


TABLE 2-XIII. ACCELERATE - STOP DISTANCE

ACCELERATE – STOP DISTANCE

TAKEOFF FLAPS—HARD SURFACE RUNWAY

9 AIRCRAFT

MODEL(S): OV-1B

ENGINE(S): T53-L-7

Gross Weight - Lbs. Engine Failure Speed CAS - KTS.	Pressure Altitude Feet	Accelerate - Stop Distance - Feet Ambient Temperature - °C					
		-40°C	-20°C	0	20°C	40°	55°
11,000	S.L.	1850	1960	2125	2280	2600	2900
	2000	1960	2100	2280	2250	2875	3225
	4000	2100	2275	2560	2850	3225	3660
78.7	6000	2275	2550	2800	3150	3650	4100
	8000	2550	2790	3150	3640	4100	4700
12,000	S.L.	2025	2150	2350	2570	2880	3260
	2000	2150	2320	2565	2850	3260	3650
	4000	2320	2565	2840	3160	3650	4200
82.1	6000	2565	2830	3150	3550	4190	4775
	8000	2830	3150	3535	4075	4775	5550
13,000	S.L.	2270	2410	2600	2900	3275	3750
	2000	2400	2570	2890	3225	3700	4200
	4000	2570	2830	3210	3625	4200	4880
85.5	6000	2830	3200	3600	4100	4850	5600
	8000	3200	3525	4050	4775	5600	6600
14,000	S.L.	2490	2670	2870	3210	3700	4225
	2000	2650	2870	3200	3600	4220	4800
	4000	2870	3200	3600	4100	4800	5675
88.8	6000	3150	3575	4075	4650	5675	6575
	8000	3575	4015	4600	5675	6575	7880
15,000	S.L.	2700	2910	3200	3570	4110	4630
	2000	2900	3160	3560	3970	4625	5400
	4000	3150	3460	3960	4550	5400	6450
91.9	6000	3460	3960	4550	5200	6400	7650
	8000	3960	4450	5150	6350	7650	----
16,000	S.L.	2950	3170	3500	3920	4525	5250
	2000	3150	3475	3850	4415	5200	6050
	4000	3460	3800	4385	5090	6050	7410
94.8	6000	3800	4385	5000	5900	7350	8875
	8000	4385	4950	5800	7075	8875	----

REMARKS:

1. Accelerate stop distances are based on engine failure at 1.2 power-off stall.
2. Above data is presented for most critical configuration and zero wind.

DATA AS OF: 12/15/62

DATA BASIS: Flight Test

FUEL GRADE: JP-4

FUEL DENSITY: 6/5 Lb./Gal.

TABLE 2-XIV. CLIMB CONTROL (SHEET 1 OF 4)

CLIMB CHART FOR NORMAL RATED POWER

STANDARD DAY

43 *AIRCRAFT*

Model(s): OV-1A, OV-1C **Engine(s):** (2) T53-L-3

Configuration: Clean **Weight:** 10,000 lb							**Configuration:** Clean **Weight:** 10,900 lb			
	APPROXIMATE						APPROXIMATE			
	FROM SEA LEVEL						FROM SEA LEVEL			
RATE OF CLIMB	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	RATE OF CLIMB
3240				140	SL	140				2850
2780	3.9	1.65	33.5	137	5000	137	37.0	1.85	4.4	2430
2340	8.7	3.60	65.0	133	10,000	133	75.0	4.00	10.0	2010
1870	14.5	5.80	105.0	130	15,000	130	117.0	7.00	17.0	1590
1410	23.0	9.00	150.0	124	20,000	124	165.0	10.00	27.0	1150
900	34.5	13.00	192.0	120	25,000	120	222.0	15.00	41.0	630

Configuration: Clean **Weight:** 11,800 lb							**Configuration:** Clean **Weight:** 12,700 lb			
	APPROXIMATE						APPROXIMATE			
	FROM SEA LEVEL						FROM SEA LEVEL			
RATE OF CLIMB	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	RATE OF CLIMB
2550				140	SL	140				2270
2130	5.0	2.10	42.0	137	5000	137	48.0	2.40	5.75	1870
1740	10.1	4.50	85.0	133	10,000	133	97.0	5.04	10.3	1520
1340	20.0	8.00	135.0	130	15,000	130	158.0	9.00	23.2	1110
920	31.0	12.00	190.0	124	20,000	124	225.0	14.00	38.0	700
420	50.0	18.00	270.0	120	25,000	120	341.0	24.50	65.0	230

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE 2-XIV. CLIMB CONTROL (SHEET 2 OF 4)

CLIMB CHART FOR NORMAL RATED POWER

STANDARD DAY

43 *AIRCRAFT*

Model(s): OV-1A, OV-1C

Engine(s): (2) T53-L-3

Configuration: (2) 150-gal tanks — **Weight:** 10,500 lb (left) | **Configuration:** (2) 150-gal tanks — **Weight:** 12,000 lb (right)

APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL				FUEL	TIME	DIST	
2900				132	SL	132				2370
2470	4.15	1.89	37.0	129	5000	129	45.5	2.30	5.20	1970
2050	9.40	4.10	75.0	126	10,000	126	94.0	5.20	11.80	1580
1600	16.00	7.00	115.0	123	15,000	123	147.0	8.80	20.80	1160
1150	25.00	10.00	170.0	118	20,000	118	218.0	13.50	33.00	750
630	41.00	16.00	230.0	114	25,000	114	315.0	22.50	58.50	260

Configuration: (2) 150-gal tanks — **Weight:** 13,500 lb (left) | **Configuration:** (2) 150-gal tanks — **Weight:** 15,000 lb (right)

APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL				FUEL	TIME	DIST	
1950				132	SL	132				1580
1570	6.50	2.85	56.0	129	5000	129	72.5	3.65	8.40	1220
1200	14.80	6.50	119.0	126	10,000	126	155.0	8.50	19.80	850
780	27.50	10.10	180.0	123	15,000	123	263.0	15.80	38.00	470
400	47.00	19.00	290.0	118	20,000	118	480.0	34.00	85.00	75
				114	25,000	114				

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE 2-XIV. CLIMB CONTROL (SHEET 3 OF 4)

CLIMB CHART FOR MILITARY RATED POWER

STANDARD DAY

15 AIRCRAFT

Model(s): OV-1B **Engine(s):** (2) T53-L-3

Configuration: SLAR **Weight:** 10,300 lb | **Configuration:** SLAR **Weight:** 11,300 lb

APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	
3050				130	SL	130				2650
2600	4.03	1.75	35.0	133	5000	133	40.0	2.02	4.63	2250
2170	9.00	3.70	70.0	130	10,000	130	83.0	4.03	10.05	1840
1720	15.50	6.00	110.0	126	15,000	126	125.0	7.00	18.85	1420
1270	23.00	9.00	150.0	122	20,000	122	180.0	11.00	28.00	970
750	36.50	14.50	208.0	117	25,000	117	250.0	16.50	46.50	480

Configuration: SLAR **Weight:** 12,300 lb | **Configuration:** SLAR **Weight:** 13,300 lb

APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL						FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	
2340				130	SL	130				2050
1950	5.43	2.35	45.5	133	5000	133	53.5	2.65	6.30	1680
1550	10.25	5.00	95.0	130	10,000	130	108.0	5.90	10.45	1300
1150	22.00	8.50	150.0	126	15,000	126	175.0	10.00	26.00	900
730	35.00	13.50	220.0	122	20,000	122	265.0	16.50	44.00	500
250	60.00	23.00	320.0	117	25,000	117	430.0	33.00	84.00	70

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE 2-XIV. CLIMB CONTROL (SHEET 4 OF 4)

CLIMB CHART FOR NORMAL RATED POWER

STANDARD DAY

⑮ *AIRCRAFT*

Model(s): OV-1B **Engine(s):** (2) T53-L-3

Configuration: SLAR +(2) 150-gal tanks **Weight:** 11,700 lb										**Configuration:** SLAR +(2) 150-gal tanks **Weight:** 13,000 lb
APPROXIMATE							APPROXIMATE			
	FROM SEA LEVEL						FROM SEA LEVEL			
RATE OF CLIMB	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	RATE OF CLIMB
2420				129	SL	129				2030
2030	4.90	2.25	45.0	126	5000	126	54.5	2.75	6.0	1650
1620	11.00	5.10	85.0	124	10,000	124	115.0	6.20	13.8	1270
1250	19.50	8.50	145.0	121	15,000	121	185.0	11.00	25.0	850
760	31.00	13.00	205.0	116	20,000	116	275.0	17.50	40.0	460
	57.00	22.00	315.0	112	25,000	112				

Configuration: SLAR +(2) 150-gal tanks **Weight:** 14,300 lb										**Configuration:** SLAR +(2) 150-gal tanks **Weight:** 15,600 lb
APPROXIMATE							APPROXIMATE			
	FROM SEA LEVEL						FROM SEA LEVEL			
RATE OF CLIMB	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	RATE OF CLIMB
1700				129	SL	129				1400
1340	7.30	3.35	66.0	126	5000	126	81.0	4.12	9.1	1050
950	17.10	7.80	145.0	124	10,000	124	182.0	10.00	22.2	680
560	33.00	14.20	235.0	121	15,000	121	325.0	19.50	45.0	300
180	61.00	26.00	396.0	116	20,000	116	685.0	44.50	110.0	
				112	25,000	112				

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE 2-XV. CLIMB CONTROL (SHEET 1 OF 2)

CLIMB CHART FOR NORMAL RATED POWER

STANDARD DAY

Model(s): OV-1B — [9] *AIRCRAFT* — **Engine(s):** (2) T53-L-7

Configuration: Clean or (2) A6 Ejector Pods — **Weight:** 14,000 lbs. (left) | **Configuration:** Clean or (2) A6 Ejector Pods — **Weight:** 13,200 lbs. (right)

APPROXIMATE				TOR PRESS. PSIG	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TOR PRESS. PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL						FUEL	TIME	DIST	
2350			111	78	129	SL	129	78	111			2560
2070	5.0	2.3	159	73	124	5,000	124	73	155	2.1	4.6	2250
1650	11.5	4.9	211	65	119	10,000	119	65	198	4.2	10.0	1850
1290	19.0	8.0	263	58	115	15,000	115	58	246	7.0	17.5	1470
880	30.0	11.4	323	51	108	20,000	108	51	296	10.5	27.0	1050
420	49.5	21.0	411	44	104	25,000	104	44	361	18.0	42.0	590

Configuration: Clean or (2) A6 Ejector Pods — **Weight:** 12,400 lbs. (left) | **Configuration:** Clean or (2) A6 Ejector Pods — **Weight:** 11,600 lbs. (right)

APPROXIMATE				TOR PRESS. PSIG:	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TOR PRESS PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL						FUEL	TIME	DIST	
2800			111	78	129	SL	129	78	111			3060
2470	4.2	1.9	152	73	124	5,000	124	73	148	1.7	3.8	2730
2040	9.2	4.0	191	65	119	10,000	119	65	186	3.8	8.3	2280
1650	16.0	6.8	233	58	115	15,000	115	58	226	6.0	14.0	1850
1240	24.5	10.0	273	51	108	20,000	108	51	261	9.5	22.0	1450
760	36.5	15.5	331	44	104	25,000	104	44	315	13.5	32.0	950

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 111 lb
3. Propeller at full increase 1678 RPM

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 12/15/62

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE 2-XV. CLIMB CONTROL (SHEET 2 OF 2)

CLIMB CHART FOR NORMAL RATED POWER

STANDARD DAY

Model(s): OV-1B — (9) AIRCRAFT — **Engine(s):** (2) T53-L-7

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 16,000 lbs.

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 14,700 lbs.

APPROXIMATE				TORQUE PRESS. PSIG	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TORQUE PRESS. PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME:	FUEL						FUEL	TIME:	DIST:	
1800			111	78	127	SL	127	78	111			2100
1570	6.3	2.9	147	73	122	5,000	122	73	165	2.5	5.4	1830
1190	14.5	6.5	246	66	117	10,000	117	66	223	5.5	12.0	1450
850	26.0	12.0	326	58	113	15,000	113	58	281	9.5	22.0	1100
450	44.5	19.6	441	51	106	20,000	106	51	361	15.2	34.5	680

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 13,400 lbs.

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 12,100 lbs.

APPROXIMATE				TORQUE PRESS. PSIG	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TORQUE PRESS. PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL						FUEL	TIME	DIST	
2440			111	78	127	SL	127	78	111			2810
2150	4.7	2.1	157	73	122	5,000	122	73	150	1.9	4.0	2520
1740	10.5	4.5	201	66	117	10,000	117	66	190	4.0	9.0	2090
1380	17.5	8.0	251	58	113	15,000	113	58	231	7.0	15.2	1690
940	28.0	11.9	311	51	106	20,000	106	51	271	10.0	24.0	1250
500	45.0	20.0	401	44	102	25,000	102	44	281	15.0	35.0	750

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 111 lb
3. Propeller at full increase 1678 RPM

RATE OF CLIMB: Feet per minute
DIST: Distance in nautical miles
TIME: Minutes
FUEL: Pounds
CAS: Calibrated airspeed

DATA AS OF: 12/15/62
DATA BASIS: FLIGHT TEST

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

TABLE XVI. CLIMB CONTROL (SHEET 1 OF 4)

CLIMB CHART FOR MILITARY RATED POWER

STANDARD DAY

(43) *AIRCRAFT*

Model(s): OV-1A, OV-1C

Engine(s): (2) T53-L-3

Configuration: Clean
Weight: 10,000 lb

Configuration: Clean
Weight: 10,900 lb

RATE OF CLIMB	APPROXIMATE FROM SEA LEVEL DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE FROM SEA LEVEL FUEL	TIME	DIST	RATE OF CLIMB
3680				145	SL	145				3275
3110	3.6	1.46	31	139	5000	139	35.4	1.68	4.1	2750
2610	8.1	3.18	63	133	10,000	133	72	3.6	9.3	2270
2110	13.6	5.26	97	128	15,000	128	111	6.0	15.5	1840
1620	20.7	7.87	134	121	20,000	121	151	9.0	23.8	1330
1050	30.7	11.46	178	115	25,000	115	211	14.0	36.7	790

Configuration: Clean
Weight: 11,800 lb

Configuration: Clean
Weight: 12,700 lb

RATE OF CLIMB	APPROXIMATE FROM SEA LEVEL DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE FROM SEA LEVEL FUEL	TIME	DIST	RATE OF CLIMB
2930				145	SL	145				2625
2440	4.6	1.87	40.0	139	5000	139	44.5	2.1	5.1	2160
1980	10.4	4.1	82	133	10,000	133	93	4.7	11.8	1720
1570	17.8	6.9	127	128	15,000	128	147	7.9	20.0	1310
1050	28.0	11.0	179	121	20,000	121	213	13.0	33.3	800
550	44.0	16.8	252	115	25,000	115	303	20.0	53.8	325

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE XVI. CLIMB CONTROL (SHEET 2 OF 4)

CLIMB CHART FOR MILITARY RATED POWER

STANDARD DAY

(43) *AIRCRAFT*

Model(s): OV-1A, OV-1C — **Engine(s):** (2) T53-L-3

Configuration: (2) 150-gal tanks — **Weight:** 10,500 lb (left) / **Configuration:** (2) 150-gal tanks — **Weight:** 12,000 lb (right)

APPROXIMATE							APPROXIMATE			
	FROM SEA LEVEL						FROM SEA LEVEL			
RATE OF CLIMB	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	RATE OF CLIMB
3320				138	SL	138				2750
2780	3.9	1.6	34	132	5000	132	42	1.95	4.7	2250
2320	8.7	3.5	70	127	10,000	127	84	4.8	10.6	1820
1860	14.7	5.8	106	122	15,000	122	135	7.5	18.0	1390
1310	22	8.6	147	115	20,000	115	196	11.2	29	870
775	34	13.0	209	110	25,000	110	285	19.0	48.3	360

Configuration: (2) 150-gal tanks — **Weight:** 13,500 lb (left) / **Configuration:** (2) 150-gal tanks — **Weight:** 15,000 lb (right)

APPROXIMATE							APPROXIMATE			
	FROM SEA LEVEL						FROM SEA LEVEL			
RATE OF CLIMB	DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FUEL	TIME	DIST	RATE OF CLIMB
2270				138	SL	138				1870
1810	5.7	2.4	51	132	5000	132	62.5	2.95	6.9	1430
1400	13.0	5.4	109	127	10,000	127	138	6.9	16.5	1025
950	23.0	9.5	173	122	15,000	122	225	12.5	30.5	590
500	39.5	16	217	115	20,000	115	389	23	59.5	160
				110	25,000	110				

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE XVI. CLIMB CONTROL (SHEET 3 OF 4)

CLIMB CHART FOR MILITARY RATED POWER

STANDARD DAY

(15) *AIRCRAFT*

Model(s): OV-1B

Engine(s): (2) T53-L-3

Configuration: SLAR — **Weight:** 10,300 lb (left) / **Configuration:** SLAR — **Weight:** 11,300 lb (right)

APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FROM SEA LEVEL FUEL	TIME	DIST	RATE OF CLIMB
3470				141	SL	141				3050
2930	3.75	1.54	32.5	136	5000	136	38	1.76	4.3	2530
2440	8.5	3.5	67	130	10,000	130	78	3.8	9.7	2090
1975	14.3	5.4	100	125	15,000	125	120	6.2	16.5	1660
1440	21.5	8.0	140	118	20,000	118	165	10.0	25.4	1110
900	32.5	12.0	195	112	25,000	112	237	15.0	40.0	600

Configuration: SLAR — **Weight:** 12,300 lb (left) / **Configuration:** SLAR — **Weight:** 13,300 lb (right)

APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL DIST	TIME	FUEL	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FROM SEA LEVEL FUEL	TIME	DIST	RATE OF CLIMB
2750				141	SL	141				2380
2210	4.9	2.0	42.5	136	5000	136	48	2.25	5.5	1920
1780	11.0	4.4	90	130	10,000	130	100	5.1	12.8	1550
1360	19.0	7.2	137	125	15,000	125	162	8.6	22.0	1075
840	31.0	12.0	202	118	20,000	118	245	14.5	37.5	600
350	50.3	19.5	291	112	25,000	112	371	25.5	65.5	110

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE XVI. CLIMB CONTROL (SHEET 4 OF 4)

CLIMB CHART FOR MILITARY RATED POWER

STANDARD DAY

15 *AIRCRAFT*

Model(s): OV-1B **Engine(s):** (2) T53-L-3

Configuration: SLAR +(2) 150-gal tanks **Weight:** 11,700 lb							**Configuration:** SLAR +(2) 150-gal tanks **Weight:** 13,000 lb			
APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL				FUEL	TIME	DIST	
2800				134	SL	134				2370
2300	4.54	1.95	41.8	129	5000	129	50	2.35	5.4	1900
1860	10.3	4.4	82	123	10,000	123	104	5.4	12.4	1480
1420	17.5	7.5	135	119	15,000	119	167	9.3	21.4	1040
920	28.0	11.2	194	112	20,000	112	255	15.2	36.3	585
380	46.0	18.5	280	107	25,000	107				50

Configuration: SLAR +(2) 150-gal tanks **Weight:** 14,300 lb							**Configuration:** SLAR +(2) 150-gal tanks **Weight:** 15,600 lb			
APPROXIMATE							APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL				FUEL	TIME	DIST	
2000				134	SL	134				1700
1550	6.4	2.8	59	129	5000	129	71	3.37	7.65	1250
1150	15.0	6.5	130	123	10,000	123	160	8.1	19.0	860
700	27.2	11.5	209	119	15,000	119	274	15.3	35.8	430
275	50.0	20.0	335	112	20,000	112	526	32.5	82.0	
				107	25,000	107				

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 98 lb

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb/gal

TABLE 2-XVII. CLIMB CONTROL (SHEET 1 OF 2)

CLIMB CHART FOR MILITARY RATED POWER

STANDARD DAY

Model(s): OV-1B

9 *AIRCRAFT*

Engine(s): (2) T53-L-7

Configuration: Clean or (2) A6 Ejector Pods | **Weight:** 14,000 lbs. (left) — **Configuration:** Clean or (2) A6 Ejector Pods | **Weight:** 13,200 lbs. (right)

APPROXIMATE				TOR PRESS. PSIG	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TOR PRESS. PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL						FUEL	TIME	DIST	
2710			111	88	134	SL	134	88	111			2960
2380	4.4	2.0	157	80	129	5,000	129	80	153	1.8	4.1	2580
1980	9.6	4.1	201	72	123	10,000	123	72	193	3.9	9.0	2190
1500	12.8	7.0	254	63	118	15,000	118	63	241	6.2	12.5	1700
1060	26.0	10.5	313	55	112	20,000	112	55	294	9.0	23.5	1240
600	42.5	17.0	402	47	107	25,000	107	47	367	15.0	37.0	760

Configuration: Clean or (2) A6 Ejector Pods | **Weight:** 12,400 lbs. (left) — **Configuration:** Clean or (2) A6 Ejector Pods | **Weight:** 11,600 lbs. (right)

APPROXIMATE				TOR PRESS. PSIG.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TOR PRESS. PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL						FUEL	TIME	DIST	
3240			111	88	134	SL	134	88	111			3550
2830	3.7	1.6	150	80	129	5,000	129	80	146	1.5	3.4	3090
2400	8.2	3.5	188	72	123	10,000	123	72	181	3.1	7.5	2640
1900	11.8	5.8	231	63	118	15,000	118	63	219	5.4	11.2	2120
1420	21.0	8.0	278	55	112	20,000	112	55	262	7.5	19.5	1630
930	33.0	13.0	341	47	107	25,000	107	47	311	12.0	29.0	1130

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 111 lb.
3. Propeller at full increase 1678 RPM

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA BASIS: 12/15/62

DATA AS OF: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb./gal

TABLE 2-XVII. CLIMB CONTROL (SHEET 2 OF 2)

CLIMB CHART FOR MILITARY RATED POWER

STANDARD DAY

9 *AIRCRAFT*

Model(s): OV-1B

Engine(s): (2) T53-L-7

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 16,000 lbs.

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 14,700 lbs.

APPROXIMATE				TOR PRESS. PSIG.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TOR PRESS. PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL						FUEL	TIME	DIST	
2150			111	88	131	SL	131	88	111			2450
1840	5.5	2.6	169	80	126	5,000	126	80	162	2.2	4.8	2120
1500	12.0	5.2	261	72	121	10,000	121	72	210	4.6	10.5	1780
1040	22.0	9.2	305	63	116	15,000	116	63	276	7.5	18.4	1290
630	37.0	15.0	395	55	110	20,000	110	55	348	12.0	29.0	860
180	70.0	28.0	560	47	105	25,000	105	47	455	21.0	50.0	400

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 13,400 lbs.

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers
Weight: 12,100 lbs.

APPROXIMATE				TOR PRESS. PSIG.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	TOR PRESS. PSIG	APPROXIMATE			
RATE OF CLIMB	FROM SEA LEVEL								FROM SEA LEVEL			RATE OF CLIMB
	DIST	TIME	FUEL						FUEL	TIME	DIST	
2830			111	88	131	SL	131	88	111			3270
2450	4.2	1.9	156	80	126	5,000	126	80	149	1.6	3.6	2850
2070	9.0	3.9	195	72	121	10,000	121	72	184	3.4	7.9	2420
1590	15.5	6.5	250	63	116	15,000	116	63	230	5.8	13.2	1940
1140	24.0	9.5	310	55	110	20,000	110	55	280	8.0	20.5	1440
660	39.0	16.0	390	47	105	25,000	105	47	335	13.0	31.5	970

REMARKS:

1. Climb at recommended CAS
2. Taxi and takeoff fuel allowance: 111 lb
3. Propeller at full increase 1678 RPM

RATE OF CLIMB: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 12/15/62

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY: 6.5 lb./gal

TABLE 2-XVIII. SINGLE ENGINE CLIMB (SHEET 1 OF 4)

SINGLE ENGINE CLIMB

MODEL(S): OV-1A/OV-1B/OV-1C
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

8 AIRCRAFT
CONFIGURATION:
0° FLAPS GEAR UP

ENGINE(S): (2) T53-L-3
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

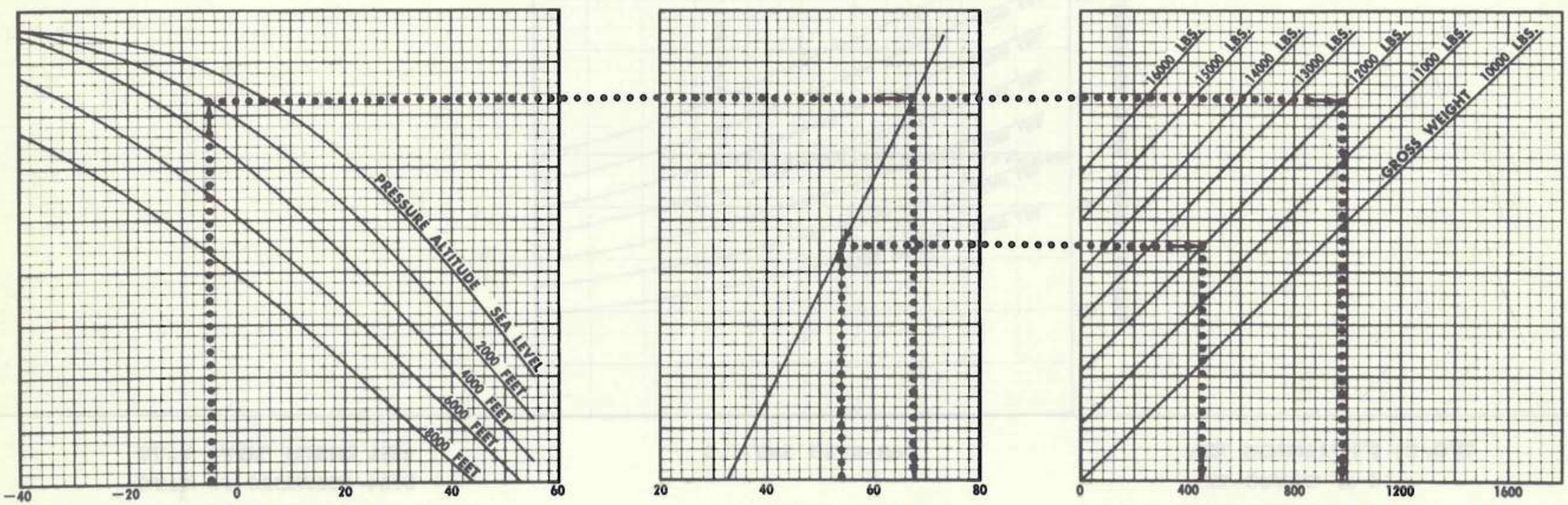


TABLE 2-XVIII. SINGLE ENGINE CLIMB (SHEET 2 OF 4)

SINGLE ENGINE CLIMB

8 *AIRCRAFT*

MODEL(S): OV-1A/OV-1B/OV-1C
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

0° FLAPS, GEAR-UP

ENGINE(S): T53-L-3
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

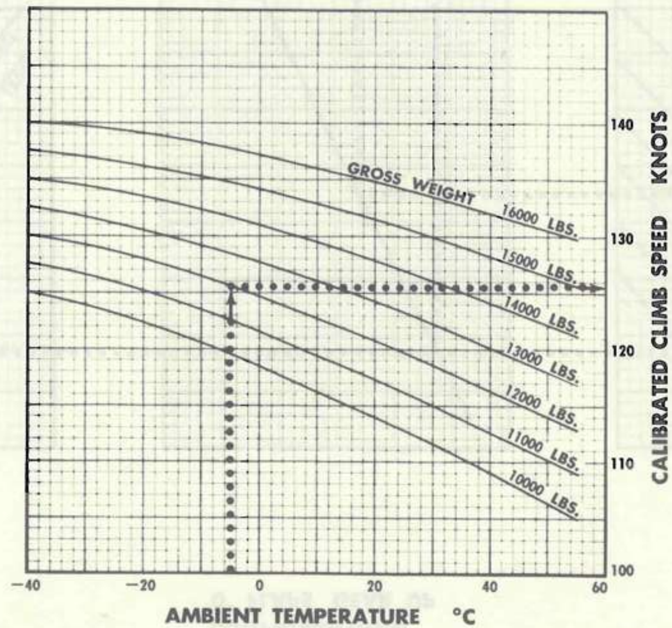


TABLE 2-XVIII. SINGLE ENGINE CLIMB (SHEET 3 OF 4)

SINGLE ENGINE CLIMB
8 *AIRCRAFT*

Model(s): OV-1A/OV-1B/OV-1C
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

15° FLAPS, GEAR UP

Engine(s): T53-L-3
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

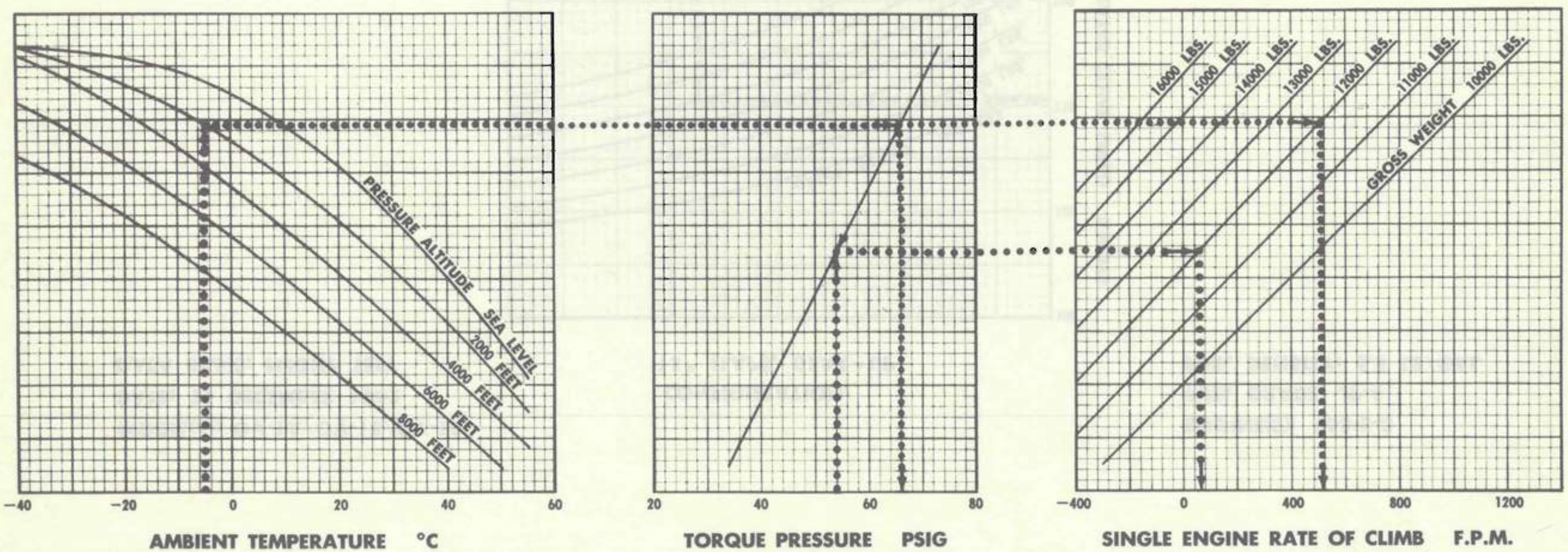


TABLE 2-XVIII. SINGLE ENGINE CLIMB (SHEET 4 OF 4)

SINGLE ENGINE CLIMB
(8) AIRCRAFT

MODEL(S): OV-1A/OV-1B/OV-1C
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

CONFIGURATION:
15° FLAPS, GEAR-UP

ENGINE(S): T53-L-3
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

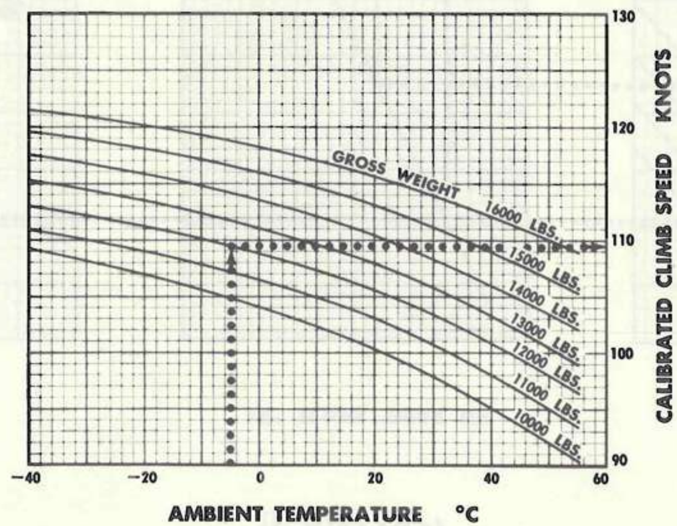


TABLE 2-XIX. SINGLE ENGINE CLIMB (SHEET 1 OF 4)

SINGLE ENGINE CLIMB

MODEL(S): OV-1B
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

[9] AIRCRAFT
CONFIGURATION:
NO FLAPS GEAR UP

ENGINE(S): (2) T53-L-7
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

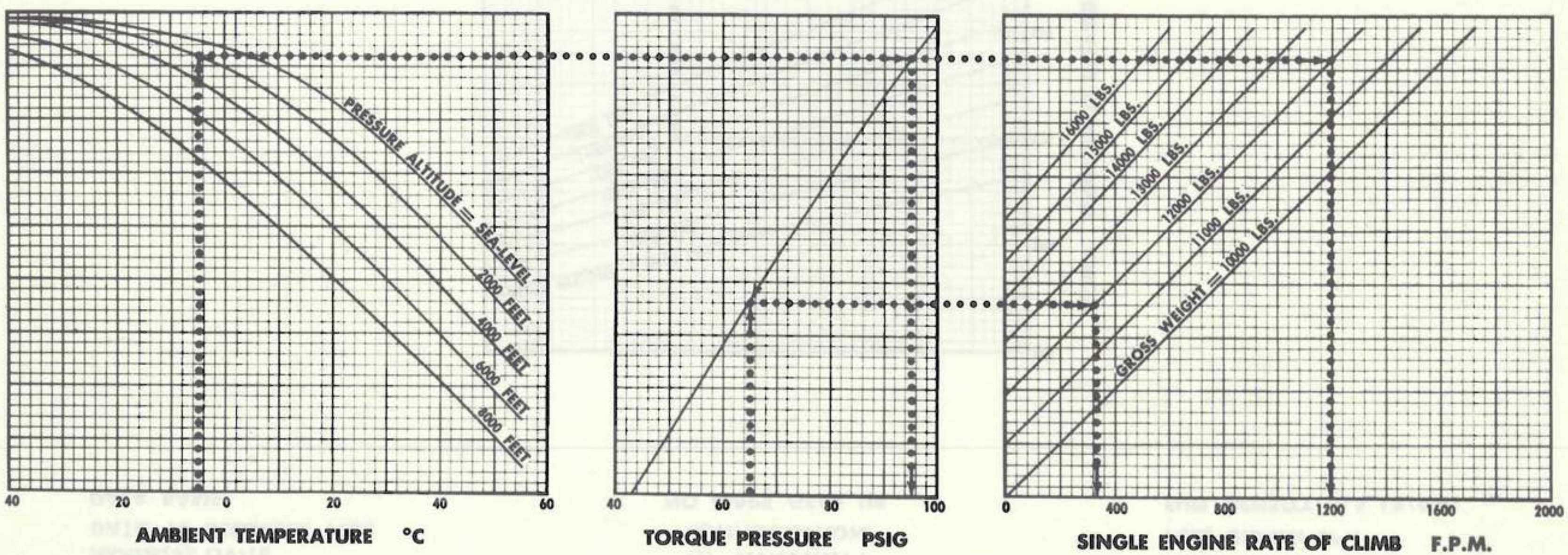


TABLE 2-XIX. SINGLE ENGINE CLIMB (SHEET 2 OF 4)

SINGLE ENGINE CLIMB

MODEL(S): OV-1B
DATE: 15 DECEMBER 1962
DATA BASIS:

9 *AIRCRAFT*
CONFIGURATION:
NO FLAPS GEAR UP

ENGINE(S): (2) T53-L-7
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

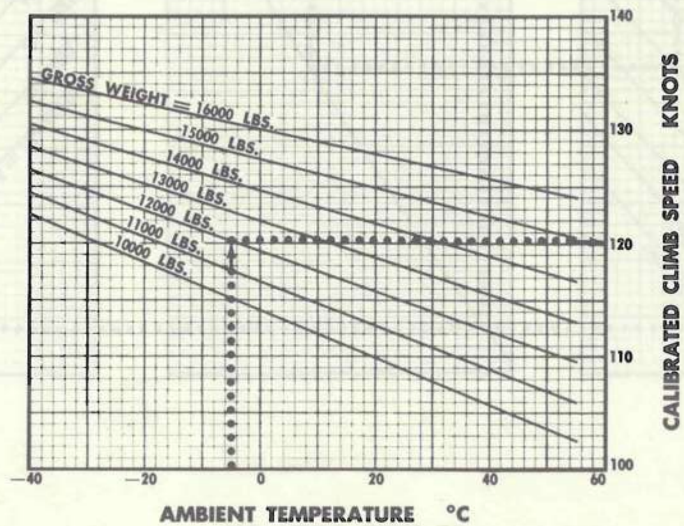


TABLE 2-XIX. SINGLE ENGINE CLIMB (SHEET 3 OF 4)

SINGLE ENGINE CLIMB

9 AIRCRAFT

CONFIGURATION:
TAKEOFF FLAPS GEAR UP

MODEL(S): OV-1B
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

ENGINE(S): (2) T53-L-7
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

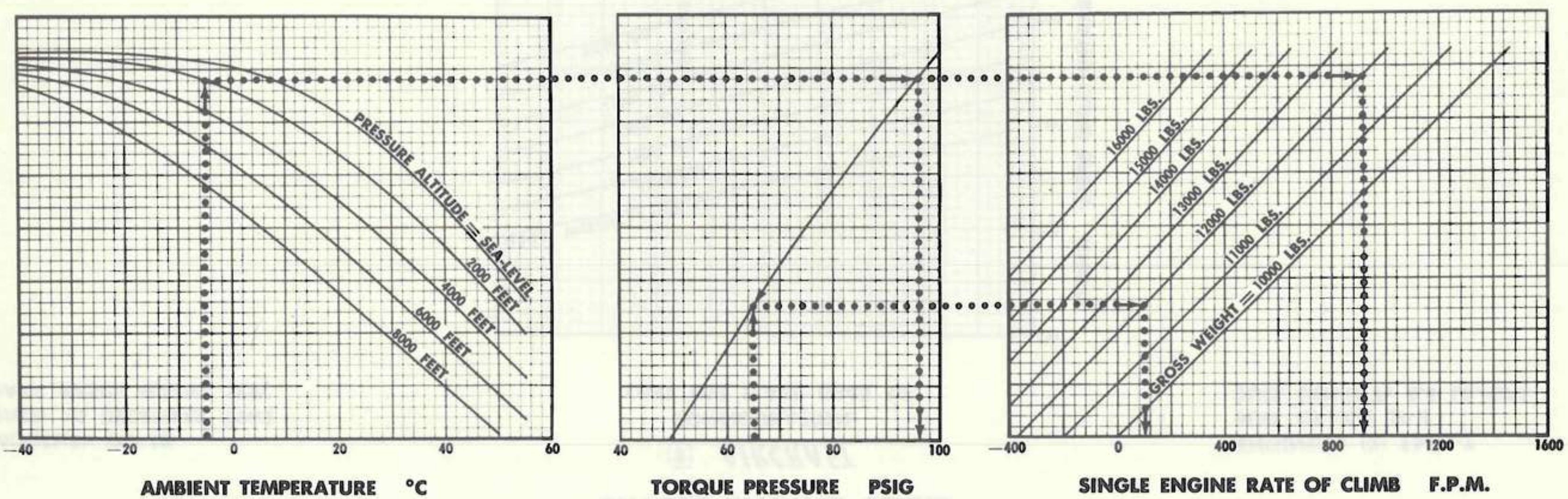


TABLE 2-XIX. SINGLE ENGINE CLIMB (SHEET 4 OF 4)

SINGLE ENGINE CLIMB

9 *AIRCRAFT*

MODEL(S): OV-1B
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

CONFIGURATION:
TAKE OFF FLAPS GEAR UP

ENGINE(S): (2) T53-L-7
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

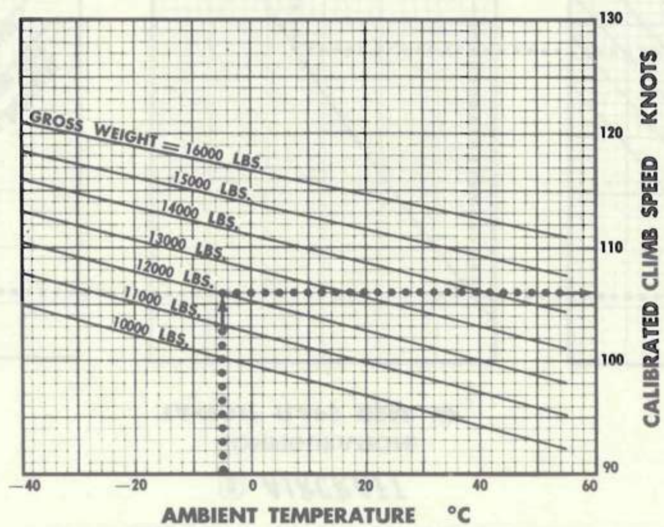


TABLE 2-XX. MAXIMUM RANGE SUMMARY (SHEET 1 OF 4)

MAXIMUM RANGE SUMMARY

STANDARD DAY

43 AIRCRAFT

Model(s): OV-1A, OV-1C

Engine(s): (2) T53-L-3

Configuration: Clean — **Weight:** 10,000 lb (left) | **Configuration:** Clean — **Weight:** 10,900 lb (right)

APPROXIMATE								APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/ LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	NMI/ LB	PROP. RPM	TOR PRESS. PSIG
35	1275	.2375	.2725	180	SL	184	.2780	.2320	1325	37
33	1300	.2680	.2850	173	5000	176	.2910	.2605	1375	34
30	1400	.3050	.3000	165	10,000	169	.3065	.2950	1450	31
28	1525	.3360	.3190	160	15,000	163	.3250	.3250	1550	29
27	1600	.3800	.3450	155	20,000	159	.3510	.3615	1625	29
26	1678	.4060	.3650	148	25,000	148	.3650	.3820	1678	28

Configuration: Clean — **Weight:** 11,800 lb (left) | **Configuration:** Clean — **Weight:** 12,700 lb (right)

APPROXIMATE								APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/ LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	NMI/ LB	PROP. RPM	TOR PRESS. PSIG.
38	1350	.2265	.2835	188	SL	192	.2893	.2210	1400	41
35	1425	.2535	.2970	180	5000	184	.3030	.2465	1475	37
33	1500	.2850	.3130	172	10,000	176	.3190	.2755	1550	35
31	1600	.3135	.3320	167	15,000	170	.3380	.3020	1625	32
31	1675	.3430	.3580	161	20,000	164	.3645	.3240	1675	33
30	1678	.3590	.3650	148	25,000	148	.3650	.3360	1678	32

REMARKS:

CAS: Calibrated Airspeed

NMI/LB Nautical miles per pound

PROP. RPM: Propeller rev. per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XX. MAXIMUM RANGE SUMMARY (SHEET 2 OF 4)

MAXIMUM RANGE SUMMARY

STANDARD DAY

(43) AIRCRAFT

Model(s): OV-1A, OV-1C

Engine(s): (2) T53-L-3

Configuration: (2) 150-gal tanks (left) / (2) 150-gal tanks (right)

Weight: 10,500 lb (left) / 12,000 lb (right)

APPROXIMATE TOR PRESS. PSIG	APPROXIMATE PROP. RPM	APPROXIMATE NMI/LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	APPROXIMATE NMI/LB	APPROXIMATE PROP. RPM	APPROXIMATE TOR PRESS. PSIG
37	1325	.2165	.2645	175	SL	180	.2720	.2080	1375	40
34	1375	.2460	.2768	168	5000	172	.2845	.2350	1450	37
32	1450	.2785	.2913	160	10,000	164	.2999	.2630	1525	35
31	1575	.3030	.3175	159	15,000	163	.3255	.2847	1650	33
29	1650	.3400	.3280	148	20,000	151	.3350	.3120	1675	32
28	1675	.3600	.3460	140	25,000	140	.3460	.3200	1675	31

Configuration: (2) 150-gal tanks (left) / (2) 150-gal tanks (right)

Weight: 13,500 lb (left) / 15,000 lb (right)

APPROXIMATE TOR PRESS. PSIG	APPROXIMATE PROP. RPM	APPROXIMATE NMI/LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	APPROXIMATE NMI/LB	APPROXIMATE PROP. RPM	APPROXIMATE TOR PRESS. PSIG.
43	1450	.1990	.2796	185	SL	191	.2887	.1910	1550	47
39	1525	.2230	.2922	176	5000	182	.3014	.2115	1600	42
37	1600	.2480	.3069	169	10,000	174	.3163	.2330	1650	40
37	1675	.2664	.3335	167	15,000	167	.3320	.2480	1675	40
36	1675	.2850	.3420	154	20,000					
					25,000					

REMARKS:

CAS: Calibrated Airspeed

NMI/LB: Nautical miles per pound

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XX. MAXIMUM RANGE SUMMARY (SHEET 3 OF 4)

MAXIMUM RANGE SUMMARY

STANDARD DAY

(15) AIRCRAFT

Model(s): OV-1B **Engine(s):** (2) T53-L-3

Configuration: SLAR **Weight:** 10,300 lb (left) | **Configuration:** SLAR **Weight:** 11,300 lb (right)

APPROXIMATE									APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/ LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	NMI/ LB	PROP. RPM	TOR PRESS. PSIG
37	1300	.2250	.2690	178	SL	182	.2743	.2200	1350	38
34	1350	.2565	.2806	169	5000	173	.2867	.2490	1400	34
31	1425	.2910	.2943	162	10,000	166	.3006	.2810	1500	32
30	1575	.3175	.3220	162	15,000	166	.3303	.3055	1600	32
29	1650	.3570	.3400	153	20,000	154	.3420	.3370	1675	30
30	1675	.3800	.3740	152	25,000	152	.3740	.3540	1675	31

Configuration: SLAR **Weight:** 12,300 lb (left) | **Configuration:** SLAR **Weight:** 13,300 lb (right)

APPROXIMATE									APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/ LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	NMI/ LB	PROP. RPM	TOR PRESS. PSIG.
39	1400	.2140	.2796	185	SL	189	.2856	.2080	1425	42
36	1475	.2410	.2922	176	5000	180	.2976	.2335	1500	39
35	1525	.2700	.3077	169	10,000	173	.3140	.2595	1575	37
34	1650	.2940	.3366	169	15,000	172	.3415	.2820	1675	36
33	1675	.3180	.3460	156	20,000	158	.3510	.3010	1675	35
					25,000					

REMARKS:

CAS:	Calibrated Airspeed
NMI/LB	Nautical miles per pound
PROP. RPM:	Propeller rev per minute
TOR PRESS. PSIG:	Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61 **FUEL GRADE:** JP-4

DATA BASIS: FLIGHT TEST **FUEL DENSITY:** 6.5 lb/gal

TABLE 2-XX. MAXIMUM RANGE SUMMARY (SHEET 4 OF 4)

MAXIMUM RANGE SUMMARY

STANDARD DAY

15 *AIRCRAFT*

Model(s): OV-1B

Engine(s): (2) T53-L-3

Configuration: SLAR +(2) 150-gal tanks **Weight:** 11,700 lb						**Configuration:** SLAR +(2) 150-gal tanks **Weight:** 13,000 lb				
APPROXIMATE								APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	NMI/LB	PROP. RPM	TOR PRESS. PSIG
36	1400	.2030	.2660	176	SL	180	.2720	.1955	1450	42
36	1475	.2280	.2775	168	5000	172	.2853	.2185	1525	39
35	1550	.2555	.2936	162	10,000	164	.2999	.2425	1600	37
33	1650	.2790	.3151	158	15,000	162	.3223	.2630	1675	36
32	1675	.3030	.3260	147	20,000	149	.3300	.2800	1675	35
		.3140	.3300	134	25,000	134	.3300	.2800		

Configuration: SLAR +(2) 150-gal tanks **Weight:** 14,300 lb						**Configuration:** SLAR +(2) 150-gal tanks **Weight:** 15,600 lb				
APPROXIMATE								APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/LB	MACH NO.	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	MACH NO.	NMI/LB	PROP. RPM	TOR PRESS. PSIG.
44	1500	.1880	.2781	184	SL	189	.2856	.1810	1575	47
42	1575	.2090	.2922	176	5000	181	.2991	.1990	1625	44
39	1650	.2300	.3054	168	10,000	171	.3108	.2170	1675	42
39	1675	.2475	.3220	162	15,000	168				
37	1675	.2590	.3210	144	20,000	134				
					25,000					

REMARKS:

CAS: Calibrated Airspeed

NMI/LB: Nautical miles per pound

PROP. RPM: Propeller rev per pound

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXI. MAXIMUM RANGE SUMMARY (SHEET 1 OF 2)

RANGE SUMMARY

STANDARD DAY

[9] *AIRCRAFT*

Model(s): OV-1B **Engine(s):** (2) T53-L-7

Configuration: Clean or (2) A6 ejector pods
Weight: 14,000 lbs.

Configuration: Clean or (2) A6 ejector pods
Weight: 13,200 lbs.

APPROXIMATE			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/LB				NMI/LB	PRPM REV./MIN	TOR PRESS. PSIG
50	1370	.206	177	SL	175	.210	1350	48
50	1440	.228	170	5,000	168	.233	1420	48
48	1510	.260	164	10,000	162	.266	1485	46
44	1580	.285	158	15,000	156	.295	1555	42
43	1670	.309	150	20,000	148	.321	1640	41
44	1678	.317	144	25,000	142	.335	1678	41

Configuration: Clean or (2) A6 ejector pods
Weight: 12,400 lbs.

Configuration: Clean or (2) A6 ejector pods
Weight: 11,600 lbs.

APPROXIMATE			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/LB				NMI/LB	PRPM REV./MIN	TOR PRESS. PSIG
48	1340	.214	174	SL	172	.217	1320	46
46	1395	.238	166	5,000	164	.243	1370	44
44	1460	.274	160	10,000	158	.281	1440	42
41	1525	.306	154	15,000	152	.316	1500	39
38	1615	.333	146	20,000	144	.345	1585	37
38	1678	.354	140	25,000	138	.373	1678	36

REMARKS:

CAS: Calibrated airspeed knots

NMI/ LB Naut. miles per lb.

PROP. RPM: Propeller rev. per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 12/15/62 **FUEL GRADE:** JP-4

DATA BASIS: FLIGHT TEST **FUEL DENSITY:** 6.5 lb/gal

TABLE 2-XXI. MAXIMUM RANGE SUMMARY (SHEET 2 OF 2)

RANGE SUMMARY

STANDARD DAY

9 AIRCRAFT

Model(s): OV-1B **Engine(s):** (2) T53-L-7

Configuration: (2) 150 gal tanks or (2) 750 lbs. resupply containers **Weight:** 16,000 lbs.								**Configuration:** (2) 150 gal tanks or (2) 750 lbs. resupply containers **Weight:** 14,700 lbs.
APPROXIMATE						**APPROXIMATE**		
TOR PRESS. PSIG	**PROP. RPM**	**NMI/ LB**	**CAS KNOTS**	**PRESSURE ALTITUDE FEET**	**CAS KNOTS**	**NMI/ LB**	**PROP. RPM**	**TOR PRESS. PSIG**
56	1430	.190	177	SL	174	.196	1400	53
54	1505	.209	171	5,000	167	.217	1470	52
53	1580	.231	164	10,000	160	.242	1540	50
50	1655	.250	159	15,000	156	.266	1605	46
50	1678	.264	150	20,000	147	.284	1678	46
				25,000				

Configuration: **Weight:**								**Configuration:** **Weight:**
APPROXIMATE						**APPROXIMATE**		
TOR PRESS. PSIG	**PROP. RPM**	**NMI/ LB**	**CAS KNOTS**	**PRESSURE ALTITUDE FEET**	**CAS KNOTS**	**NMI/ LB**	**PROP. RPM**	**TOR PRESS. PSIG**
50	1365	.202	172	SL	170	.208	1335	47
48	1425	.225	163	5,000	160	.233	1390	44
46	1485	.254	156	10,000	152	.265	1450	42
44	1565	.281	151	15,000	147	.298	1520	40
42	1678	.304	144	20,000	140	.324	1615	38
42	1678	.314	140	25,000	136	.344	1678	38

REMARKS:

CAS:	Calibrated airspeed knots
LB/HR:	Naut. miles per lb.
PROP. RPM:	Propeller rev. per minute
TOR PRESS. PSIG:	Torque pressure lb per sq inch gage

DATA AS OF: 12/15/62 **FUEL GRADE:** JP-4

DATA BASIS: FLIGHT TEST **FUEL DENSITY:** 6.5 lb/gal

TABLE 2-XXII. SINGLE ENGINE MAXIMUM RANGE SUMMARY (SHEET 1 OF 2)

SINGLE-ENGINE MAXIMUM RANGE SUMMARY

STANDARD DAY

(8) *AIRCRAFT*

Model(s): OV-1A, OV-1B, OV-1C **Engine(s):** (2) T-53-L-3

Configuration: Clean (OV-1A/OV-1C) SLAR (OV-1B) — **Weight:** 10,500 lb (left) | **Configuration:** Clean (OV-1A/OV-1C) SLAR (OV-1B) — **Weight:** 11,500 lb (right)

APPROXIMATE						APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/LB	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	NMI/LB	PROP. RPM	TOR PRESS. PSIG
48	1590	.2920	159	SL	164	.2785	1642	51
46	1660	.3180	154	5000	157	.3010	1675	50
44	1675	.3415	142	10,000	136	.3180	1675	45

Configuration: Clean (OV-1A/OV-1C) SLAR (OV-1B) — **Weight:** 12,500 lb (left) | **Configuration:** Clean (OV-1A/OV-1C) SLAR (OV-1B) — **Weight:** 13,500 lb (right)

APPROXIMATE						APPROXIMATE		
TOR PRESS. PSIG.	PROP. RPM	NMI/LB	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	NMI/LB	PROP. RPM:	TOR PRESS. PSIG
51	1675	.2670	167	SL	162	.2560	1675	55
50	1675	.2850	150	5000	144	.2685	1675	50

REMARKS:

CAS: Calibrated Airspeed

NMI/LB Nautical miles per pound

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 3/5/62
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXII. SINGLE ENGINE MAXIMUM RANGE SUMMARY (SHEET 2 OF 2)

SINGLE-ENGINE MAXIMUM RANGE SUMMARY

STANDARD DAY

(8) AIRCRAFT

Model(s): OV-1A, OV-1B, OV-1C **Engine(s):** (2) T53-L-3

Configuration: (2) 150 gal tanks (OV-1A/OV-1C) SLAR + (2) 150-gal tanks (OV-1B) — **Weight:** 10,750 lb (left); 11,500 lb (right)

APPROXIMATE						APPROXIMATE		
TOR PRESS. PSIG.	PROP. RPM	NMI/ LB	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	NMI/ LB	PROP. RPM	TOR PRESS. PSIG
51	1637	.2660	155	SL	157	.2570	1663	53
49	1675	.2870	147	5000	153	.2740	1675	49
45	1675	.3090	132	10,000	140	.2830	1675	45

Configuration: (2) 150 gal tanks (OV-1A/OV-1C) SLAR + (2) 150-gal tanks (OV-1B) — **Weight:** 12,250 lb (left); 13,000 lb (right)

APPROXIMATE						APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	NMI/ LB	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	NMI/ LB	PROP. RPM	TOR PRESS. PSIG
55	1675	.2480	157	SL	151	.2390	1675	55
50	1675	.2615	137	5000	132	.2490	1675	50

REMARKS:

CAS:	Calibrated airspeed
NMI/LB:	Nautical miles per pound
PROP. RPM:	Propeller rev per minute
TOR PRESS PSIG:	Torque pressure pounds per sq inch gage

DATA AS OF: 3/5/62
DATA BASIS: FLIGHT TEST
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 lb/gal

TABLE 2-XXIV. MAXIMUM ENDURANCE SUMMARY (SHEET 1 OF 4)

MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

(43) *AIRCRAFT*

Model(s): OV-1A, OV-1C **Engine(s):** (2) T-53-L-3

Configuration: Clean — **Weight:** 10,000 | **Configuration:** Clean — **Weight:** 10,900 lb

APPROXIMATE						APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	PROP. RPM	TOR PRESS. PSIG	LB/HR
561	19	1175	105	SL	108	1175	22	592
525	20	1175	107	5000	108	1200	22	542
480	20	1225	102	10,000	106	1250	23	509
461	21	1275	100	15,000	102	1325	23	494
441	21	1375	105	20,000	107.5	1450	23	474
430	21	1550	103	25,000	107	1600	23	469

Configuration: Clean — **Weight:** 11,800 lb | **Configuration:** Clean — **Weight:** 12,700 lb

APPROXIMATE						APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	PROP. RPM	TOR PRESS. PSIG	LB/HR
623	24	1175	111	SL	115	1200	27	769
567	25	1200	111.5	5000	114	1200	28	601
542	25	1300	109	10,000	113	1325	27	577
529	25	1400	106	15,000	110	1475	26	567
512	25	1525	110	20,000	114	1600	26	555
518	25	1675	112	25,000				

REMARKS:

CAS: Calibrated airspeed

LB/HR: Fuel consumption pounds per hour

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXIV. MAXIMUM ENDURANCE SUMMARY (SHEET 2 OF 4)

MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

(43) *AIRCRAFT*

Model(s): OV-1A, OV-1C

Engine(s): (2) T53-L-3

Configuration: Clean +(2) 150-gal tanks Weight: 10,500 lb					Configuration: Clean +(2) 150-gal tanks Weight: 12,000 lb			
APPROXIMATE						APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	PROP. RPM	TOR PRESS. PSIG	LB/HR
596	22	1175	102	SL	107.5	1175	26	645
544	22	1175	101	5000	105.5	1200	27	587
511	24	1250	99	10,000	105	1325	26	567
493	23	1325	101	15,000	107	1450	26	556
475	22	1475	102	20,000	107	1575	25	544
				25,000				

Configuration: Clean +(2) 150-gal tanks Weight: 13,500 lb					Configuration: Clean +(2) 150-gal tanks Weight: 15,000 lb			
APPROXIMATE						APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	PROP. RPM	TOR PRESS. PSIG	LB/HR
703	30	1200	113	SL	119.7	1250	34	761
655	31	1250	110	5000	116	1350	33	738
632	30	1375	112	10,000	120	1500	33	700
627	29	1550	114	15,000	122	1675	33	705
622	29	1675	114	20,000				
				25,000				

REMARKS:

CAS: Calibrated airspeed

LB/HR: Fuel consumption pounds per hour

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE XXIV. MAXIMUM ENDURANCE SUMMARY (SHEET 3 OF 4)

MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

⑮ *AIRCRAFT*

Model(s): OV-1B

Engine(s): (2) T53-L-3

Configuration: SLAR
Weight: 10,300 lb

Configuration: SLAR
Weight: 11,300 lb

APPROXIMATE (10,300 lb)							APPROXIMATE (11,300 lb)		
LB/HR	**TOR PRESS. PSIG**	**PROP. RPM**	**CAS KNOTS**	**PRESSURE ALTITUDE FEET**	**CAS KNOTS**	**PROP. RPM**	**TOR PRESS. PSIG**	**LB/HR**
581	20	1150	104	SL	107	1175	23	615
535	22	1175	104	5000	107	1175	24	558
497	22	1250	101	10,000	105	1250	25	534
479	22	1325	100	15,000	104	1375	24	517
459	21	1450	103	20,000	106	1525	24	500
				25,000				

Configuration: SLAR
Weight: 12,300 lb

Configuration: SLAR
Weight: 13,300 lb

APPROXIMATE (12,300 lb)							APPROXIMATE (13,300 lb)	
LB/HR	**TOR PRESS. PSIG**	**PROP. RPM**	**CAS KNOTS**	**PRESSURE ALTITUDE FEET**	**CAS KNOTS**	**PROP. RPM**	**TOR PRESS. PSIG**	**LB/HR**
650	28	1175	111	SL	115	1200	28	686
592	27	1200	110	5000	113	1225	30	636
572	26	1325	109	10,000	114	1375	28	614
560	26	1450	108	15,000	113	1525	28	606
546	26	1575	110	20,000	114	1650	28	596
				25,000				

REMARKS:

CAS: Calibrated airspeed

LB/HR: Fuel consumption pounds per hour

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE XXIV. MAXIMUM ENDURANCE SUMMARY (SHEET 4 OF 4)

MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

⑮ *AIRCRAFT*

Model(s): OV-1B

Engine(s): (2) T53-L-3

Configuration: SLAR +(2) 150-gal tanks — **Weight:** 11,700 lb (left) / **Configuration:** SLAR +(2) 150-gal tanks — **Weight:** 13,000 lb (right)

APPROXIMATE						APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	PROP. RPM	TOR PRESS. PSIG	LB/HR
644	26	1175	104	SL	109	1200	29	695
582	27	1175	101	5000	105	1250	29	636
566	26	1300	101.5	10,000	107.5	1375	29	621
549	25	1425	105.7	15,000	111.5	1525	28	611
539	25	1575	104	20,000	109.5	1675	28	607
				25,000				

Configuration: SLAR +(2) 150-gal tanks — **Weight:** 14,300 lb (left) / **Configuration:** SLAR +(2) 150-gal tanks — **Weight:** 15,600 lb (right)

APPROXIMATE						APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	PROP. RPM	TOR PRESS. PSIG	LB/HR
746	33	1250	115	SL	120	1300	35	798
706	32	1350	110	5000	114	1425	35	786
681	32	1475	114	10,000	120	1550	35	744
681	32	1600	118	15,000	124.5	1650	35	756
				20,000				
				25,000				

REMARKS:

CAS: Calibrated airspeed

LB/HR: Fuel consumption pounds per hour

PROP. RPM: Propeller rev per minute

TOR PRESS: PSIG. Torque pressure pounds per sq inch gage

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXV. MAXIMUM ENDURANCE SUMMARY (SHEET 1 OF 2)

MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

Model(s): OV-1B

9 AIRCRAFT

Engine(s): (2) T53-L-7

Configuration: Clean or (2) A6 ejector pods
Weight: 14,000 lbs.

Configuration: Clean or (2) A6 ejector pods
Weight: 13,200 lbs.

APPROXIMATE			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM				PROP. RPM	TOR PRESS. PSIG	LB/HR
650	34	1220	103	SL	100	1145	31	629
602	34	1285	105	5,000	100	1265	32	576
566	36	1375	105	10,000	102	1345	34	540
546	36	1470	106	15,000	104	1435	34	514
538	37	1590	106	20,000	104	1550	34	504
557	38	1678	108	25,000	105	1678	34	518

CONFIGURATION: Clean or (2) A7 Ejector Pods
WEIGHT: 12400 lbs.

CONFIGURATION Clean or (2) A6 Ejector Pods
WEIGHT: 11,300 lbs.

APPROXIMATE			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM				PROP. RPM	TOR PRESS. PSIG	LB/HR
609	29	1175	97	SL	94	1155	26	589
551	30	1245	98	5,000	95	1215	28	526
515	32	1320	99	10,000	96	1290	29	490
484	31	1400	100	15,000	98	1375	29	456
473	32	1510	100	20,000	97	1475	30	442
480	32	1635	100	25,000	98	1600	30	444

REMARKS:

CAS: Calibrated airspeed

LB/HR: Fuel consumption pounds per hour

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 12/15/62
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXV. MAXIMUM ENDURANCE SUMMARY (SHEET 2 OF 2)

MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

Model(s): OV-1B

Engine(s): (2) T53-L-3

Configuration: (2) 150 gal tank or (2) 750 lbs. resupply containers
Weight: 16,000 lbs.

Configuration: (2) 150 gal tanks or (2) 250 lbs. resupply containers
Weight: 14,700 lbs.

APPROXIMATE			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP. RPM				PROP. RPM	TOR PRESS. PSIG	LB/HR
711	40	1280	108	SL	103	1240	36	674
680	41	1355	110	5,000	104	1315	38	633
642	42	1455	111	10,000	106	1410	38	597
642	42	1560	112	15,000	106	1510	39	588
645	43	1678	110	20,000	106	1625	39	583

CONFIGURATION: (2) 150 gal tanks or (2) 750 lbs. resupply containers
WEIGHT: 13,400 lbs.

CONFIGURATION: (2) 150 gal tanks or (2) 750 lbs. resupply containers
WEIGHT: 12,100 lbs.

APPROXIMATE			CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE		
LB/HR	TOR PRESS. PSIG	PROP.				PROP. RPM	TOR PRESS. PSIG	LB/HR
640	32	1210	98	SL	94	1175	28	607
588	34	1275	99	5,000	94	1240	30	547
555	35	1360	100	10,000	96	1315	31	513
533	35	1460	102	15,000	97	1400	31	483
525	36	1570	100	20,000	96	1510	32	471
541	36	1678	100	25,000	96	1640	32	475

REMARKS:

CAS: Calibrated airspeed

LB/HR: Fuel consumption pounds per hour

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG: Torque pressure pounds per sq inch gage

DATA AS OF: 12/15/62

DATA BASIS: FLIGHT TEST

FUEL GRADE: JP-4

FUEL DENSITY 6.5 lb/gal

TABLE 2-XXVI. SINGLE ENGINE MAXIMUM ENDURANCE SUMMARY (SHEET 1 OF 2)

SINGLE-ENGINE MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

(8) *AIRCRAFT*

Model(s): OV-1A, OV-1B, OV-1C **Engine(s):** (2) T53-L-3

Configuration: Clean (OV-1A/OV-1C) SLAR (OV-1B) — **Weight:** 10,500 lb (left) / **Weight:** 11,500 lb (right)

APPROXIMATE TOR PRESS. PSIG	APPROXIMATE PROP. RPM	APPROXIMATE LB/HR	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE LB/HR	APPROXIMATE PROP. RPM	APPROXIMATE TOR PRESS. PSIG
38	1380	427	111	SL	116	468	1452	41
37	1514	418	113	5000	117	461	1586	40
37	1640	411	112	10,000	118	462	1675	42

Configuration: Clean (OV-1A/OV-1C) SLAR (OV-1B) — **Weight:** 12,500 lb (left) / **Weight:** 13,500 lb (right)

APPROXIMATE TOR PRESS. PSIG	APPROXIMATE PROP. RPM	APPROXIMATE LB/HR	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE LB/HR:	APPROXIMATE PROP. RPM	APPROXIMATE TOR PRESS. PSIG
43	1524	511	121	SL	126	553	1590	47
44	1645	503	121	5000	124	547	1675	49

REMARKS:

CAS:	Calibrated airspeed
LB/HR	Fuel consumption pounds per hour
PROP. RPM:	Propeller rev per minute
TOR PRESS. PSIG	Torque pressure pounds per sq inch gage

DATA AS OF: 3/5/62
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXVI. SINGLE ENGINE MAXIMUM ENDURANCE SUMMARY (SHEET 2 OF 2)

SINGLE-ENGINE MAXIMUM ENDURANCE SUMMARY

STANDARD DAY

8 AIRCRAFT

Model(s): OV-1A, OV-1B, OV-1C **Engine(s):** (2) T53-L-3

Configuration (left): (2) 150 gal tanks (OV-1A/OV-1C) SLAR + (2) 150-gal tanks (OV-1B) — **Weight:** 10,750 lb

Configuration (right): (2) 150 gal tanks (OV-1A/OV-1C) SLAR + (2) 150-gal tanks (OV-1B) — **Weight:** 11,500 lb

APPROXIMATE						APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	LB/HR	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	LB/HR	PROP. RPM	TOR PRESS. PSIG
40	1435	462	107	SL	110	493	1500	43
39	1570	453	111	5000	114	485	1620	42
40	1670	450	110	10,000	114	492	1675	43

Configuration (left): (2) 150 gal tanks (OV-1A/OV-1C) SLAR + (2) 150-gal tanks (OV-1B) — **Weight:** 12,250 lb

Configuration (right): (2) 150 gal tanks (OV-1A/OV-1C) SLAR + (2) 150-gal tanks (OV-1B) — **Weight:** 13,000 lb

APPROXIMATE						APPROXIMATE		
TOR PRESS. PSIG	PROP. RPM	LB/HR	CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	LB/HR	PROP. RPM	TOR PRESS. PSIG
45	1546	525	114	SL	118	558	1596	47
45	1656	517	117	5000	119	549	1675	50

REMARKS:

CAS: Calibrated airspeed

LB/HR: Fuel consumption pounds per hour

PROP. RPM: Propeller rev per minute

TOR PRESS. PSIG Torque pressure pounds per sq inch gage

DATA AS OF: 3/5/62
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXVIII. COMBAT ALLOWANCE (SHEET 1 OF 4)

COMBAT ALLOWANCE
MILITARY POWER

STANDARD DAY

(43) *AIRCRAFT*

Model(s): OV-1A, OV-1C **Configuration:** Clean **Engine(s):** (2) T53-L-3

PRESSURE ALTITUDE FEET	PROPELLER RPM	TORQUE PRESSURE PSIG	TIME LIMIT MINUTES	FUEL FLOW LB/HR
SL	1678	66	30	1390
5000	1678	59	30	1230
10,000	1678	52	30	1086
15,000	1678	46	30	930
20,000	1678	40	30	810
25,000	1678	33	30	692

REMARKS:

RPM: Rev per minute

PSIG: Pounds per sq inch gage

LB/HR: Pounds per hour

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXVIII. COMBAT ALLOWANCE (SHEET 2 OF 4)

COMBAT ALLOWANCE
MILITARY POWER
STANDARD DAY
43 AIRCRAFT

Model(s): OV-1A, OV-1C **Configuration:** (2) 150-gal tanks **Engine(s):** (2) T53-L-3

PRESSURE ALTITUDE FEET	PROPELLER RPM	TORQUE PRESSURE PSIG	TIME LIMIT MINUTES	FUEL FLOW LB/HR
SL	1678	64	30	1380
5000	1678	58	30	1222
10,000	1678	51	30	1074
15,000	1678	45	30	928
20,000	1678	39	30	802

REMARKS:

RPM: Rev per minute
PSIG: Pounds per sq inch gage
LB/HR: Pounds per hour

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXXVIII. COMBAT ALLOWANCE (SHEET 3 OF 4)

COMBAT ALLOWANCE

MILITARY POWER

STANDARD DAY

(15) *AIRCRAFT*

Model(s): OV-1B **Configuration:** SLAR **Engine(s):** (2) T53-L-3

PRESSURE ALTITUDE FEET	PROPELLER RPM	TORQUE PRESSURE PSIG	TIME LIMIT MINUTES	FUEL FLOW LB/HR
SL	1678	65	30	1386
5000	1678	59	30	1226
10,000	1678	51	30	1080
15,000	1678	45	30	930
20,000	1678	39	30	808
25,000	1678	33	30	690

REMARKS:

RPM: Rev per minute

PSIG: Pounds per sq inch gage

LB/HR: Pounds per hour

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXXVIII. COMBAT ALLOWANCE (SHEET 4 OF 4)

COMBAT ALLOWANCE

MILITARY POWER

STANDARD DAY

15 AIRCRAFT

Model(s): OV-1B **Configuration:** SLAR +(2) 150-gal tanks **Engine(s):** (2) T53-L-3

PRESSURE ALTITUDE FEET	PROPELLER RPM	TORQUE PRESSURE PSIG	TIME LIMIT MINUTES	FUEL FLOW LB/HR
SL	1678	63	30	1376
5000	1678	57	30	1220
10,000	1678	50	30	1070
15,000	1678	44	30	924
20,000	1678	38	30	798

REMARKS:

RPM: Rev per minute
PSIG: Pounds per sq inch gage
LB/HR: Pounds per hour

DATA AS OF: 8/1/61
DATA BASIS: FLIGHT TEST

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

TABLE 2-XXX. DESCENT CONTROL

DESCENT CONTROL

STANDARD DAY
43 AIRCRAFT

Model(s): OV-1A/OV-1C

Engine(s): (2) T-53-L-3

Configuration: Clean
Weight: 12,100 lb

Configuration: Clean
Weight: 10,615 lb

APPROXIMATE				CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE			
RATE OF DESCENT	TO SEA LEVEL						TO SEA LEVEL			RATE OF DESCENT
	DIST	TIME	FUEL				FUEL	TIME	DIST	
1695	55	21	81	132	25,000	122	97	25	59	1525
1490	45	18	73	133	20,000	124	89	21	49	1324
1380	35	14	63	138	15,000	123	77	17	38	1140
1130	24	12	49	132	10,000	121	60	13	26	956
960	12	6	29	127	5000	118	36	7	14	800
805				124	SL	113				660

Configuration: (2) 150-gal tanks
Weight: 13,100 lb

Configuration: (2) 150-gal tanks
Weight: 10,947 lb

APPROXIMATE				CAS KNOTS	PRESSURE ALTITUDE FEET	CAS KNOTS	APPROXIMATE			
RATE OF DESCENT	TO SEA LEVEL						TO SEA LEVEL			RATE OF DESCENT
	DIST	TIME	FUEL				FUEL	TIME	DIST	
1780	51	19	72	131	25,000	120	89	23	56	1565
1666	42	16	65	137	20,000	122	81	20	46	1380
1410	32	13	56	136	15,000	122	70	16	36	1200
1246	22	9	43	135	10,000	121	54	11	25	1030
1100	11	5	25	135	5000	120	32	6	13	870
955				133	SL	116				735

REMARKS:
1. Descent at flight idle power.

RATE OF DESCENT: Feet per minute

DIST: Distance in nautical miles

TIME: Minutes

FUEL: Pounds

CAS: Calibrated airspeed

DATA AS OF: 8/1/61
DATA BASIS: ESTIMATED

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

TABLE 2-XXXII. LANDING DISTANCE (SHEET 1 OF 3)

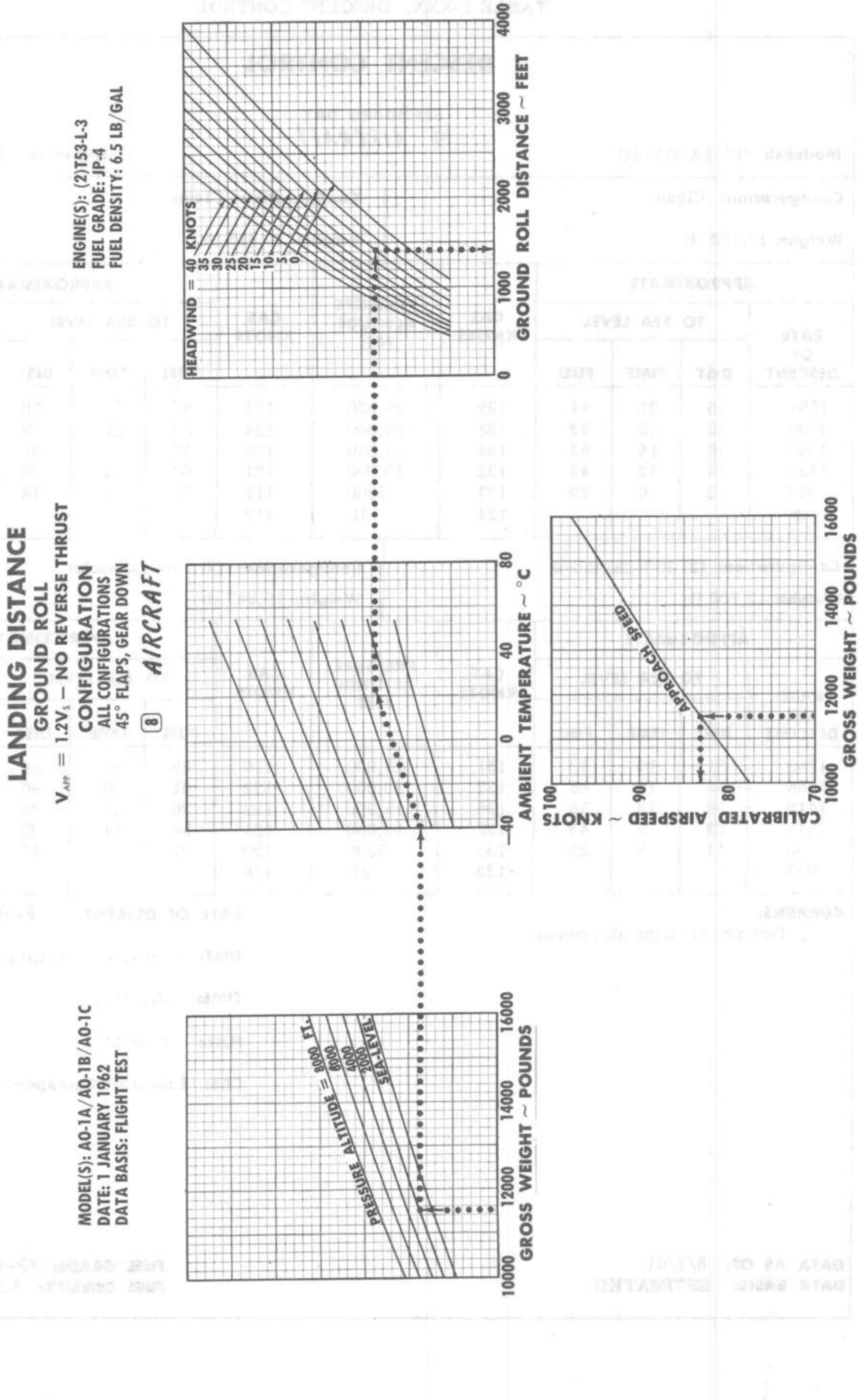


TABLE 2-XXXII. LANDING DISTANCE (SHEET 2 OF 3)

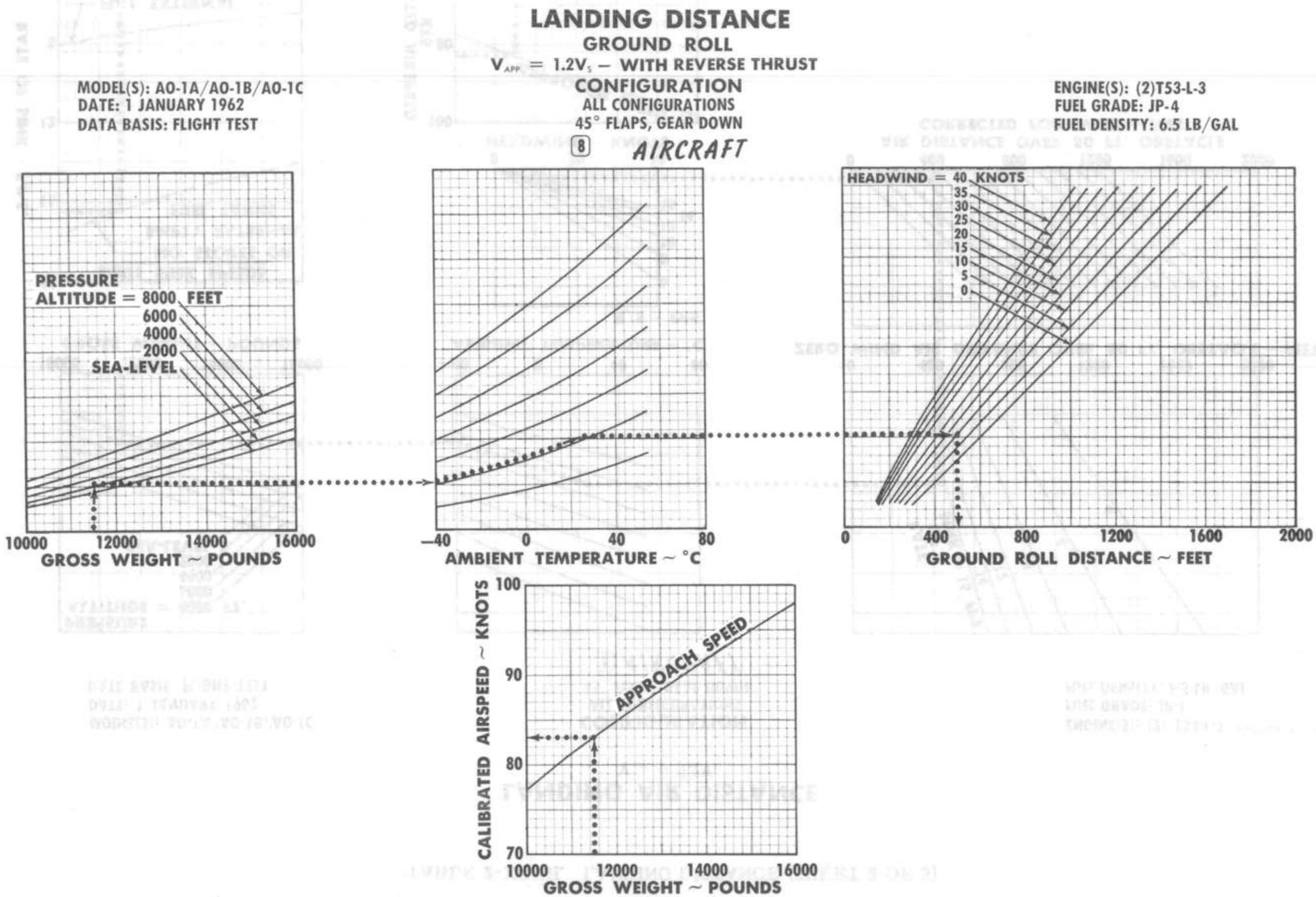


TABLE 2-XXXII. LANDING DISTANCE (SHEET 3 OF 3)

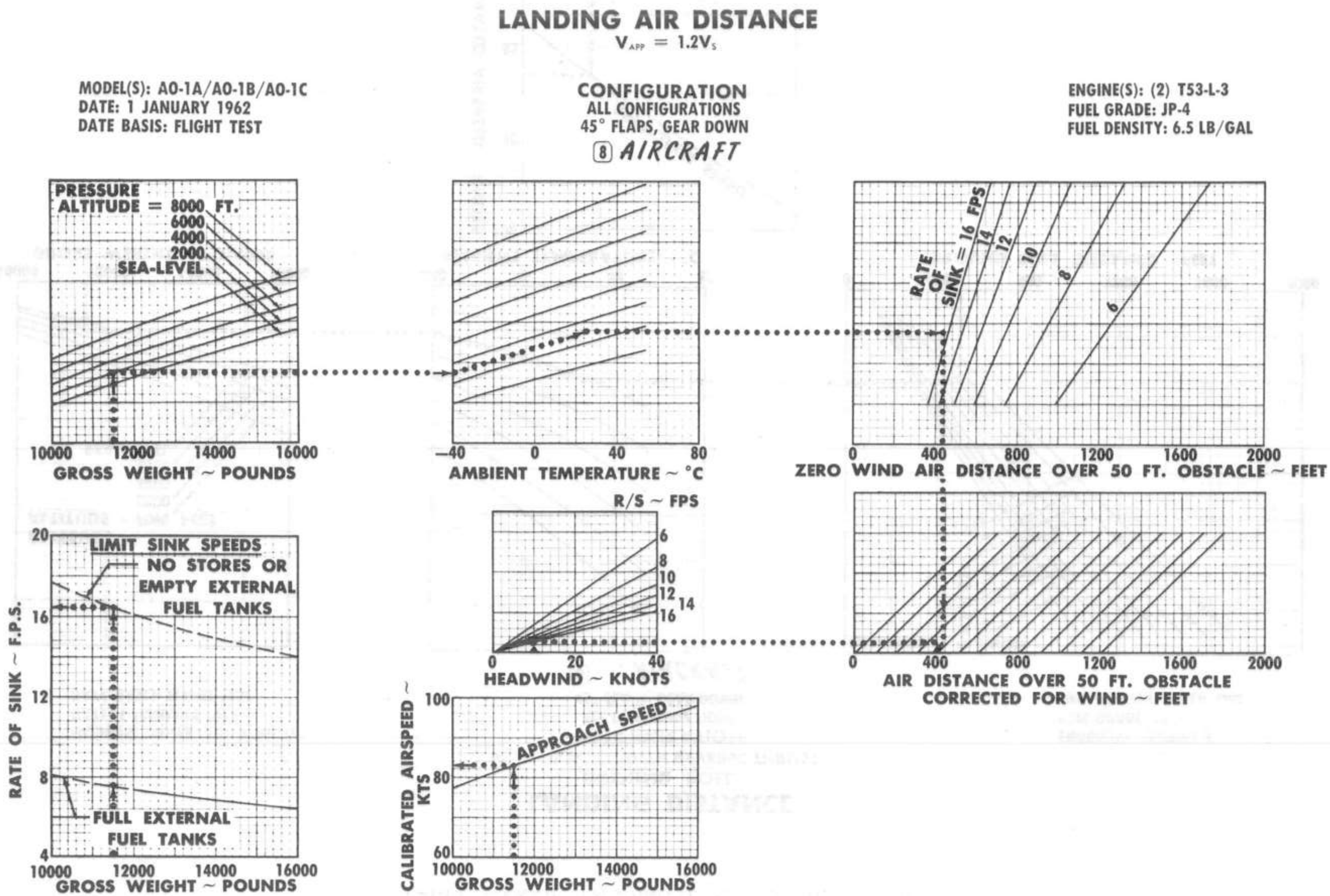


TABLE 2-XXXIII. LANDING DISTANCE (SHEET 1 OF 3)

LANDING DISTANCE

GROUND ROLL
Vapp = 1.2 Vs NO REVERSE THRUST
CONFIGURATION ALL
45° FLAPS, GEAR DOWN
9 AIRCRAFT

MODEL(S): OV-1B
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

ENGINE(S): (2) T53-L-7
FUEL GRADE: JP-4
FUEL DENSITY 6.5 LB/GAL

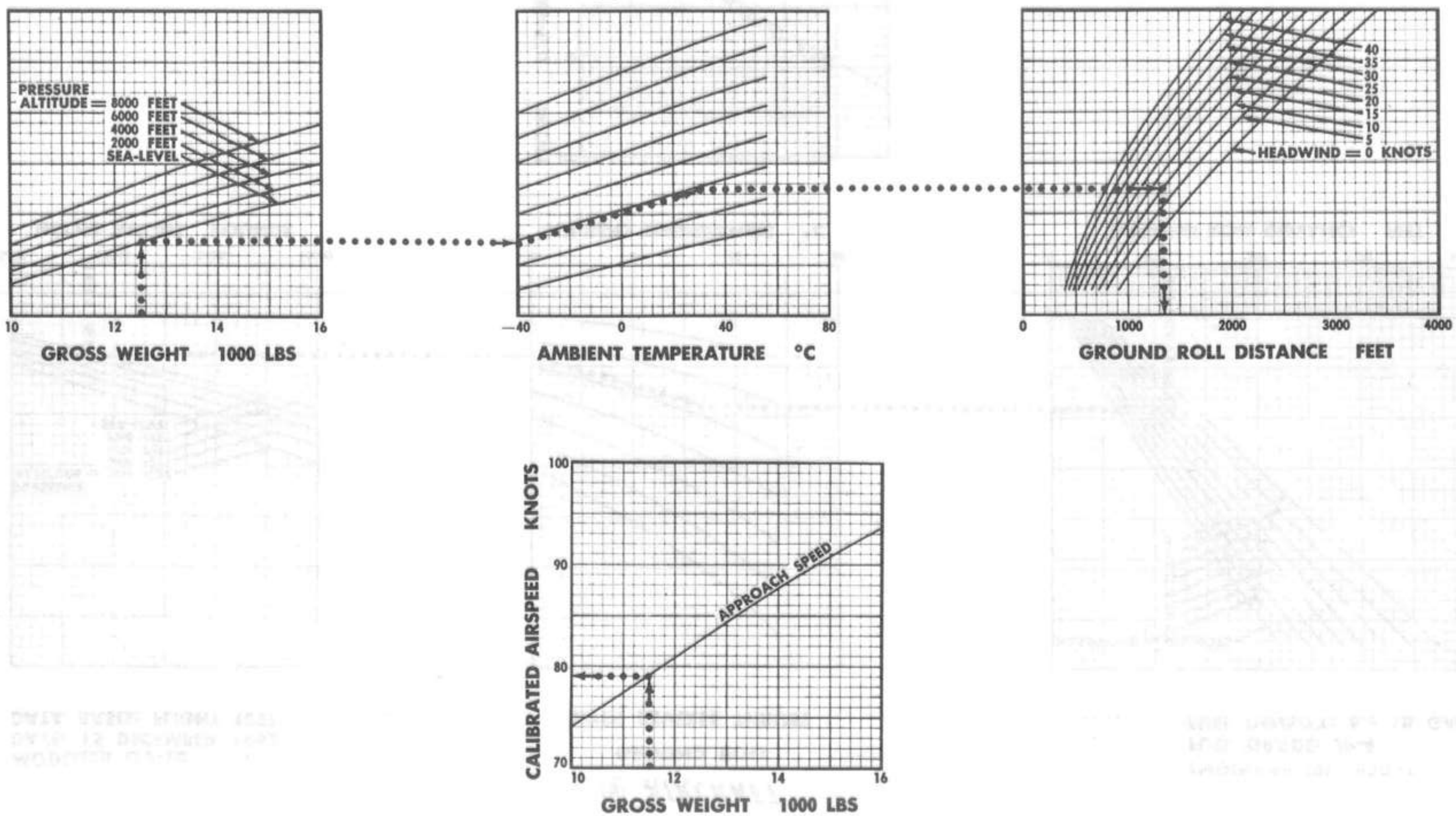


TABLE 2-XXXIII. LANDING DISTANCE (SHEET 2 OF 3)

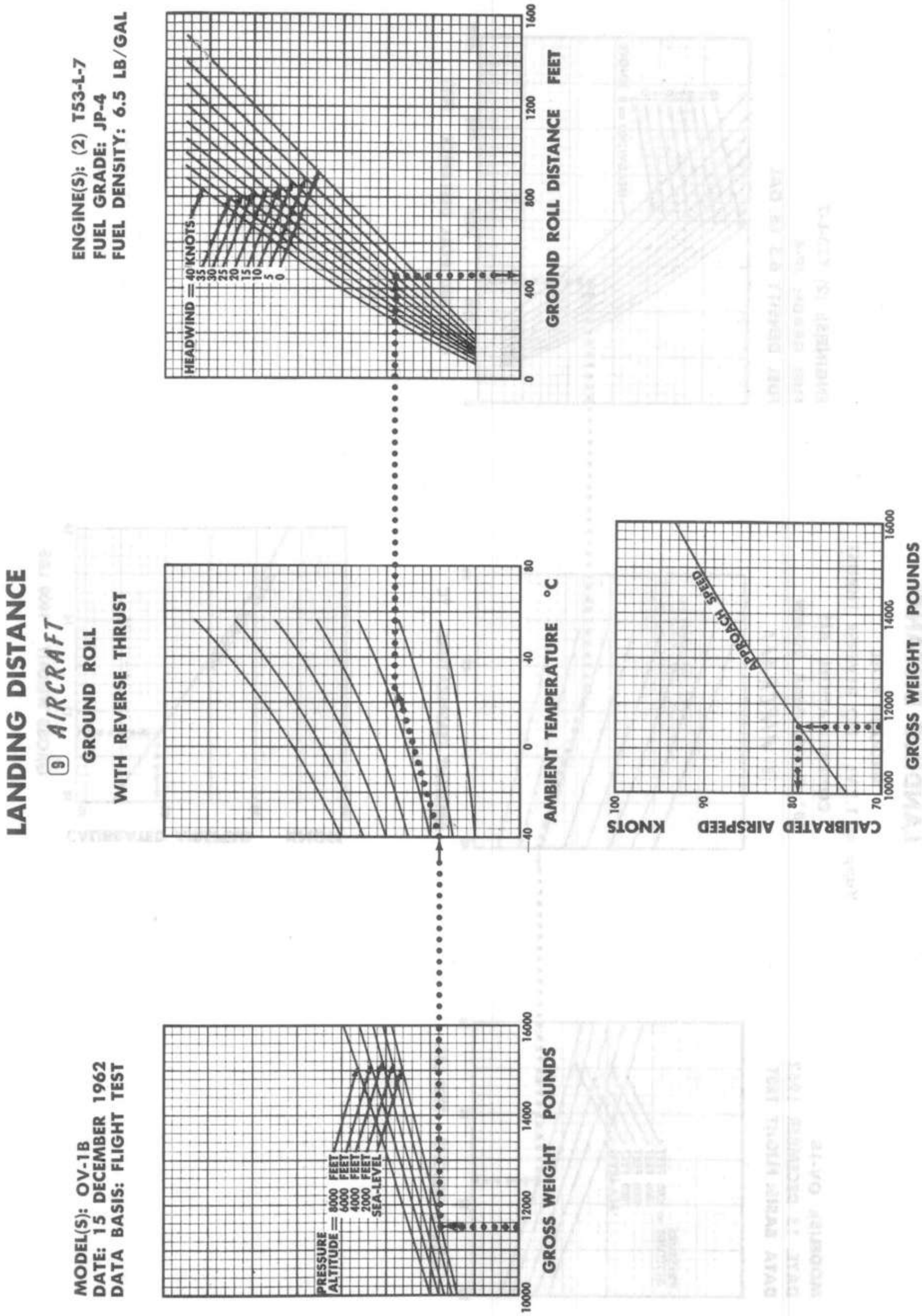


TABLE 2-XXXIII. LANDING DISTANCE (SHEET 3 OF 3)

LANDING AIR DISTANCE

Vapp = 1.2 Vs
CONFIGURATION:
45° FLAPS, GEAR DOWN
9 AIRCRAFT

MODEL(S): OV-1B
DATE: 15 DECEMBER 1962
DATA BASIS: FLIGHT TEST

ENGINE(S): (2) T53-L-7
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 LB/GAL

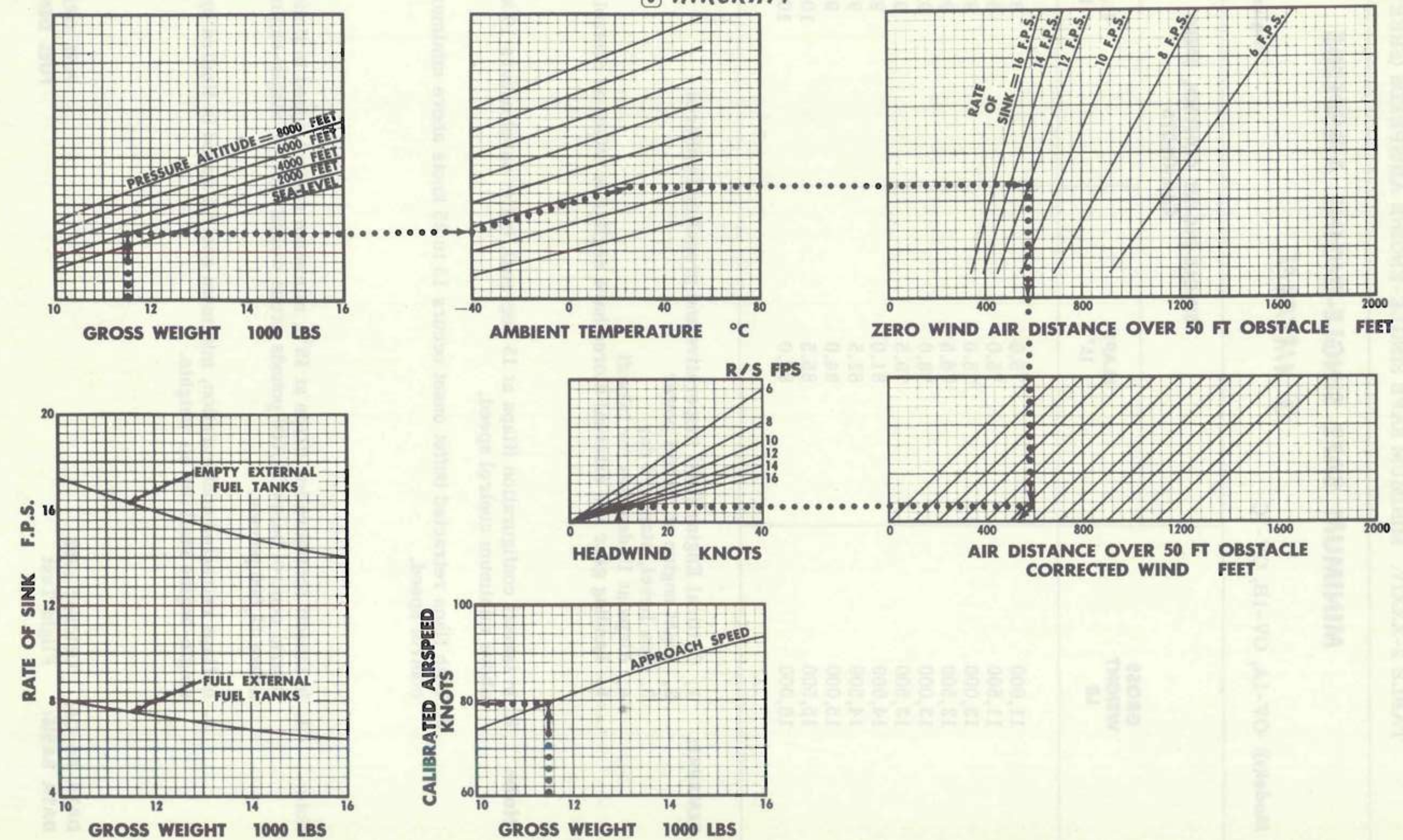


TABLE 2-XXXIV. MINIMUM SAFE SINGLE-ENGINE AIRSPEEDS (SHEET 1 OF 2)

MINIMUM SAFE SINGLE-ENGINE AIRSPEEDS

(B) AIRCRAFT

Model(s): OV-1A, OV-1B, OV-1C

Engine(s): (2) T53-L-3

GROSS WEIGHT LB	SINGLE-ENGINE CONTROL SPEED CAS, KNOTS	
	FLAPS 15°	FLAPS UP
11,000	75.0	85.0
11,500	75.0	86.8
12,000	75.0	88.5
12,500	76.5	90.3
13,000	78.0	92.0
13,500	79.5	93.8
14,000	81.0	95.5
14,500	82.5	97.3
15,000	84.0	99.0
15,500	85.5	100.8
16,000	87.0	102.5

REMARKS:
1. Critical Engine (left) inoperative and propeller feathered
2. Right engine at takeoff power
3. Sea Level, standard day
4. Flaps at 15 degrees for takeoff
5. Landing gear and external stores have negligible effect on control speed

Note:
1. In takeoff configuration (flaps at 15 degrees), buffet onset occurs 10 knots above minimum control speed.
2. With flaps retracted buffet onset occurs 15 to 25 knots above minimum control speed.

Note:
1. In takeoff configuration (flaps at 15°), minimum control speed is limited by lateral control below 12,000 pounds gross weight, and by single-engine stall above 12,000 pounds.
2. In flaps retracted configuration, minimum control speed is limited by single-engine stall for all weights.

DATA AS OF: October 1962
DATA BASIS: Flight Test

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

TABLE 2-XXXIV. MINIMUM SAFE SINGLE-ENGINE AIRSPEEDS (SHEET 2 OF 2)

MINIMUM SAFE SINGLE-ENGINE AIRSPEEDS

(43) *AIRCRAFT*

Model(s): OV-1A, OV-1C **Engine(s):** (2) T53-L-3

GROSS WEIGHT LB	SINGLE-ENGINE RATE OF CLIMB CAS, KNOTS			
	GEAR EXTENDED		GEAR UP	
	FLAPS UP	FLAPS 15°	FLAPS UP	FLAPS 15°
11,000	85.0*	75.0*	85.0	75.0*
11,500	86.8*	76.5	88.0	75.0*
12,000	88.5*	82.0	90.5	75.0*
12,500	90.3*	90.0	93.0	78.0
13,000	92.0	(2)	96.0	83.5
13,500	98.5	--	99.0	89.0
14,000	(1)	--	102.0	96.5
14,500	--	--	105.5	(3)
15,000	--	--	109.0	--
15,500	--	--	112.5	--
16,000	--	--	116.5	--

REMARKS:
a. Critical engine (left) inoperative and propeller feathered.
b. Right engine at takeoff power.
c. Data valid for standard day, sea level only.

Note:
1. There is no single engine rate of climb above a gross weight of 13850 pounds in this configuration.
2. There is no single engine rate of climb above a gross weight of 12700 pounds in this configuration.
3. There is no single engine rate of climb above a gross weight of 14400 pounds in this configuration.

*Single engine minimum control speed used as criteria. Single engine rate of climb speed is below this value.

DATA AS OF: October 1962
DATA BASIS: Flight Test
FUEL GRADE: JP-4
FUEL DENSITY: 6.5 lb/gal

TABLE 2-XXXVI. DENSITY ALTITUDE CHART

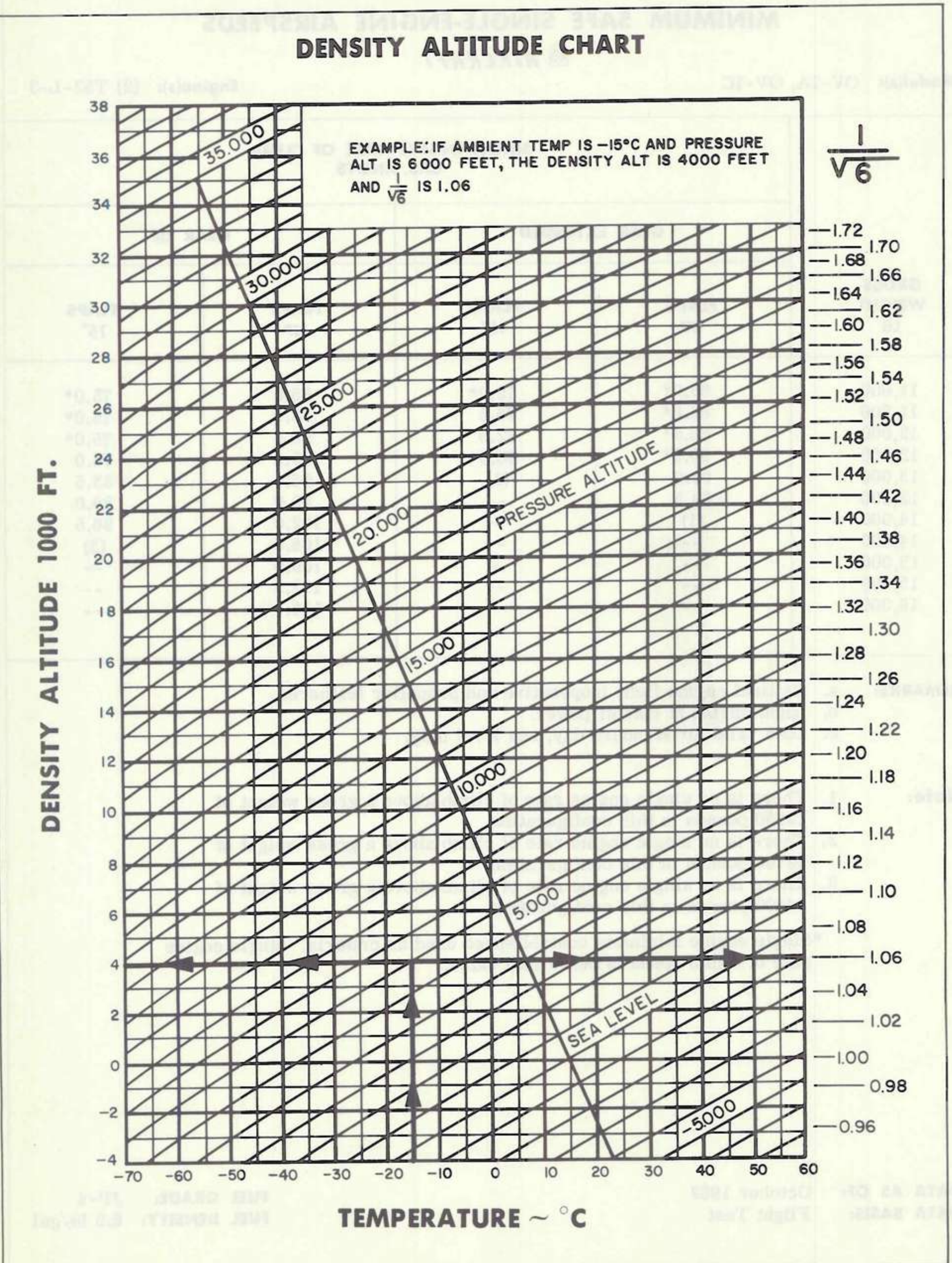


TABLE 2-XXXVII. STANDARD ATMOSPHERE TABLE

STANDARD ATMOSPHERE TABLE

This table is based on NACA Technical Report No. 218

Standard Sea Level Air:

T = 15°C. W = 07651 lb/cu ft ρ_o = .002378 slugs/cu ft

P = 29.921 inches of Hg 1 inch of Hg = 70.732 lb/sq ft = 0.4912 lb/sq in a_o = 1115 ft/sec

Altitude feet	Density Ratio ρ/ρ_o	$1\sqrt{\sigma}$	Temperature °C	Temperature °F	Speed of Sound Ratio a/a_o	Pressure In. of Hg	Pressure Ratio p/p_o
0	1.0000	1.0000	15.000	59.000	1.0000	29.92	1.0000
1000	.9710	1.0143	13.019	55.434	.997	28.85	.9644
2000	.9428	1.0299	11.038	51.868	.993	27.82	.9298
3000	.9151	1.0454	9.056	48.301	.990	26.81	.8962
4000	.8881	1.0611	7.075	44.735	.986	25.84	.8636
5000	.8616	1.0773	5.094	41.169	.983	24.89	.8320
6000	.8358	1.0938	3.113	37.603	.979	23.98	.8013
7000	.8106	1.1107	1.132	34.037	.976	23.09	.7716
8000	.7859	1.1280	-0.850	30.471	.972	22.22	.7427
9000	.7619	1.1456	-2.831	26.904	.968	21.38	.7147
10000	.7384	1.1637	-4.812	23.338	.965	20.58	.6876
11000	.7154	1.1822	-6.793	19.772	.962	19.79	.6614
12000	.6931	1.2012	-8.774	16.206	.958	19.03	.6359
13000	.6712	1.2206	-10.756	12.640	.954	18.29	.6112
14000	.6499	1.2404	-12.737	9.074	.950	17.57	.5873
15000	.6291	1.2608	-14.718	5.507	.947	16.88	.5642
16000	.6088	1.2816	-16.699	1.941	.943	16.21	.5418
17000	.5891	1.3029	-18.680	-1.625	.940	15.56	.5202
18000	.5698	1.3247	-20.662	-5.191	.936	14.94	.4992
19000	.5509	1.3473	-22.643	-8.757	.932	14.33	.4790
20000	.5327	1.3701	-24.624	-12.323	.929	13.75	.4594
21000	.5148	1.3937	-26.605	-15.890	.925	13.18	.4405
22000	.4974	1.4179	-28.586	-19.456	.922	12.63	.4222
23000	.4805	1.4426	-30.568	-23.022	.917	12.10	.4025
24000	.4840	1.4681	-32.549	-26.588	.914	11.59	.3874
25000	.4480	1.4940	-34.530	-30.154	.910	11.10	.3709
26000	.4323	1.5209	-36.511	-33.720	.908	10.62	.3550
27000	.4171	1.5484	-38.493	-37.287	.903	10.16	.3397
28000	.4023	1.5768	-40.474	-40.853	.899	9.720	.3248
29000	.3879	1.6056	-42.455	-44.419	.895	9.293	.3106
30000	.3740	1.6352	-44.435	-47.985	.891	8.830	.2968
31000	.3603	1.6659	-46.417	-51.651	.887	8.483	.2834
32000	.3472	1.6971	-48.399	-55.117	.883	8.101	.2707
33000	.3343	1.7296	-50.379	-58.684	.879	7.732	.2583
34000	.3218	1.7628	-52.361	-62.250	.875	7.377	.2465
35000	.3098	1.7966	-54.342	-65.816	.871	7.036	.2352
36000	.2962	1.8374	-55.000	-67.000	.870	6.708	.2242
37000	.2824	1.8818	-55.000	-67.000	.870	6.395	.2137
38000	.2692	1.9273	-55.000	-67.000	.870	6.096	.2037
39000	.2566	1.9738	-55.000	-67.000	.870	5.812	.1943
40000	.2447	2.0215	-55.000	-67.000	.870	5.541	.1852
41000	.2332	2.0707	-55.000	-67.000	.870	5.283	.1765
42000	.2224	2.1207	-55.000	-67.000	.870	5.036	.1683
43000	.2120	2.1719	-55.000	-67.000	.870	4.802	.1605
44000	.2021	2.2244	-55.000	-67.000	.870	4.578	.1530
45000	.1926	2.2785	-55.000	-67.000	.870	4.364	.1458
46000	.1837	2.3332	-55.000	-67.000	.870	4.160	.1391
47000	.1751	2.3093	-55.000	-67.000	.870	3.965	.1325
48000	.1669	2.4478	-55.000	-67.000	.870	3.781	.1264
49000	.1591	2.5071	-55.000	-67.000	.870	3.604	.1205
50000	.1517	2.5675	-55.000	-67.000	.870	3.438	.1149

APPENDIX I
REFERENCES

SUBJECT OR EQUIPMENT	TECHNICAL MANUALS
AN/AIC-12	TM 11-5831-201-12
AN/APN-22	TM 11-5841-216-10
AN/APN-129(V)1	TM 11-5841-217-12
AN/APS-94	TM 11-5895-284-12
AN/APX-44	TM 11-5895-217-12
AN/ARC-44	TM 11-517
AN/ARC-55B	TM 11-5821-225-10
AN/ARC-73	TM 11-5821-217-12
AN/ARA-54	TM 11-5826-200-12
AN/ARN-30A	TM 11-5826-207-10
AN/ARN-30D	TM 11-5826-207-12
AN/ARN-59(V)	TM 11-5826-204-12
AN/ARN-68	TM 11-5826-208-12
AN/ASW-12(V)	TM 11-6615-204-12
AN/DPN-62(V)	TM 11-5895-252-12
KA-30A	TM 11-6720-208-12
KS-61	TM 11-6720-212-35
MA-1 (Lear)	TM 11-6615-214-15
R-1041/ARN	TM 11-5826-208-12
T-366A/ARC	TM 11-525-10
WEIGHT AND BALANCE	TM 55-405-9

APPENDIX II
MAINTENANCE ALLOCATION CHART

The Maintenance Allocation Chart will be found only in Part II of the Technical Manual TM 55-1510-204-20.

APPENDIX III
BASIC ISSUE ITEM LIST

For basic issue items, refer to the DD780, Aircraft Inventory Record Forms.

APPENDIX IV
OPERATOR'S CHECK LISTS

The operator's condensed check list is printed separately from Part I of the Technical Manual and is designated TM 55-1510-204-10CL.

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