NAVAER 01-40AVB-1

Flight Handbook

NAVY MODEL

A4D-2N

AIRCRAFT

PUBLISHED BY DIRECTION OF
THE CHIEF OF THE BUREAU OF AERONAUTICS

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1 October 1959

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TABLE OF CONTENTS

SECTION I	DESCRIPTION	PAGE 1
SECTION II	NORMAL PROCEDURES	PAGE 33
SECTION III	EMERGENCY PROCEDURES	PAGE 47
SECTION IV	AUXILIARY EQUIPMENT	PAGE 63
SECTION V	OPERATING LIMITATIONS	PAGE 101
SECTION VI	FLIGHT CHARACTERISTICS	PAGE 101
SECTION VII	SYSTEMS OPERATION	PAGE 103
SECTION VIII	CREW DUTIES	PAGE 107
SECTION IX	ALL-WEATHER OPERATION	PAGE 109

IMPORTANT

In order that you will gain the maximum benefits from this handbook, it is imperative that you read this page carefully.

FOREWORD

This handbook is written as a text for the pilot for immediate study and later reference in order that he may gain familiarity with the airplane he is assigned to fly. It is not the function of this handbook to teach the pilot how to fly the aircraft, as it is assumed he is competent in this respect; however, the handbook contains information regarding behavior peculiar to the airplane in various conditions of flight and ground operation.

The handbook is divided into nine sections. Section I, II and III are closely interrelated and contain complete information relative to the physical act of flying the airplane. Section I provides a description of the aircraft and its systems, instruments and controls. Emergency equipment that is not a part of an auxiliary system is also described.

Section II contains information for the normal operation of the aircraft and describes procedures to be accomplished by the pilot from the time the aircraft is approached prior to flight until it is left parked on the ramp after completing one non-tactical flight under ordinary conditions. Section III describes the procedures to be followed in meeting any emergency, except those in connection with auxiliary equipment, that could reasonably be expected to be encountered.

Section IV contains the description and operation of the auxiliary equipment which does not actually contribute to flight but enables the aircraft to perform specialized functions. All limitations and restrictions that must be observed during normal operations are discussed in Section V. Section VI attempts to evaluate flight characteristics, both favorable and unfavorable, which the aircraft may possess. In Section VII, operation of the various aircraft systems is discussed. Section VIII is not applicable to single-place aircraft. Section IX contains procedures and information pertaining to all-weather operation.

Note

Performance and flight characteristics of the A4D-2N are calculated to be the same as for the A4D-2 at the present time.

The nomenclature used to identify the controls and other equipment is identical, wherever possible, to that used in the airplane. Such nomenclature is capitalized. Also capitalized, and enclosed in quotation marks, are the positions of the controls as they are identified in the airplane. For example, the "UP" or "DOWN" positions of the SEAT ADJUST switch.

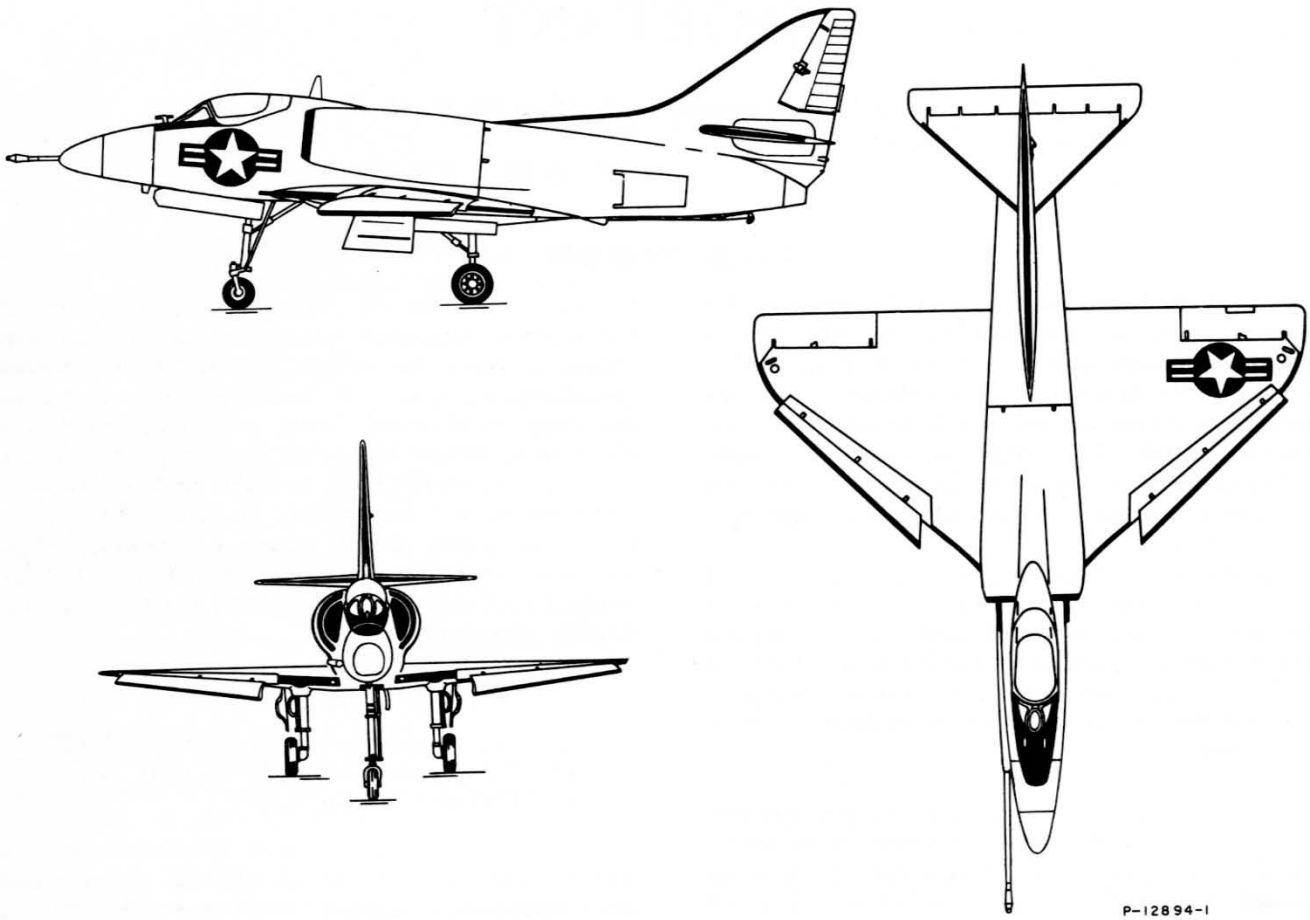




Figure 1-1. Model A4D-2N Airplane

SECTION I
DESCRIPTION

THE AIRPLANE

The Navy Model A4D-2N Skyhawk is a jet-propelled, single-place monoplane with a modified delta-planform wing, and is manufactured by the Douglas Aircraft Company, El Segundo Division. Designed as a high performance, light weight attack airplane, the Model A4D-2N mounts two 20-mm guns internally, carries a variety of external stores, and is capable of operating either from a carrier or from a shore base.

MAIN DIFFERENCES

The basic differences between the A4D-2N and later A4D-2 airplanes are that the A4D-2N has:

a. A new automatic flight control system.

b. A new radar system.

c. A new angle of attack-approach lights system.

d. An All Attitude Flight Reference and Loft Bombing System, including a spherical-all-attitude-indicator.

e. A 10-liter liquid oxygen capacity.

f. Improved fuel gaging, including more sensing probes internally and sensing probes in the drop tanks.

g. Extensively revised cockpit arrangement.

h. Tanker store hose jettisoning capabilities when on emergency generator.

i. The extendable control stick eliminated and a stick force sensor added.

j. An improved power rudder control mechanism.
Visible exterior differences are:

k. A longer nose radome and inflight fueling probe.

l. Colored approach lights mounted in a transparent section of the leading edge of the left wing.

The A4D-2N weighs approximately 600 pounds more than the A4D-2. Its center of gravity is approximately 1.5% mean aerodynamic chord forward of that of the A4D-2.

Performance and flight characteristics of the A4D-2N and the A4D-2 are similar.

DIMENSIONS. The principal three-point dimensions of the airplane are as follows:

Span	27.5 feet
Length, with probe	42.9 feet
Length, exclusive of probe	40.1 feet
Height	15.0 feet

ENGINE

The airplane is powered by a Wright J65-W-16A turbojet engine with a multi-stage, axial-flow compressor driven by a two-stage turbine. Engine accessories are driven through an accessory gear box by the compressor. Components driven by the gear box are the engine-driven fuel pump, hydraulic pump, fuel control governor, tachometer generator, and the ignition generator. Cooling of the engine is accomplished by the routing of compressor air through various parts of the engine. The main bearings of the engine are cooled by air bled from the fifth compressor stage and are lubricated by oil from the oil system. The Wright J65-W-16A engine is rated at standard sea level static conditions as follows:

RATING	THRUST	RPM
Military	7700	100%–8300
Normal—continuous	6780	96.5%–8010

ENGINE FUEL CONTROL SYSTEM

The engine fuel control system consists of a fuel pump, fuel control unit, six flow dividers, a fuel primer solenoid, and two fuel primers.

FUEL PUMP. The engine-driven fuel pump comprises a centrifugal booster element and two parallel gear-type elements operating in series. Should either gear element fail, the operative element is capable of supplying the engine with enough fuel for full power requirements under static sea level conditions. There is no engine fuel pump failure warning light.

FUEL CONTROL UNIT. The engine fuel control unit contains two control systems: a primary system for normal operation, and a manual system for use if the primary system should fail. When the engine is operating on the primary fuel control system, the engine fuel control unit provides fuel governing for all engine speeds, including idle. Operating schedules provide optimum rates of acceleration and deceleration for all throttle movements under any ambient condition. The acceleration schedule insures a safe surge margin during

rapid advancing of the throttle, and the deceleration schedule prevents flame-out during rapid retarding of the throttle. When compressor discharge pressure exceeds a pre-determined value, a limiter causes a reduction in fuel flow and a minute reduction in rpm. This reduction in rpm normally occurs at low altitudes, high airspeeds, and at temperatures below standard, and should not be misconstrued as malfunctioning of the fuel control unit. Basically, the fuel control unit consists of two main valves in series: a governor valve, and a contoured regulator valve. The governor valve is adjusted by throttle position, which spring-loads the valve against a balancing force from a fly-ball governor. The fly-ball governor senses engine rpm and acts to open or close the governor valve as necessary to maintain the throttle-selected rpm. The correct fuel pressure drop across the governor valve is maintained by the regulator valve, which is positioned by, and compensated for, ambient conditions and engine speed.

When the engine is operating on the manual fuel control system, all fuel metering is accomplished manually by the throttle through direct linkage with an emergency throttling valve in the fuel control, but with no compensation for ambient conditions or engine speed. An emergency solenoid valve, actuated electrically by the FUEL CONTROL switch in the cockpit, isolates the automatic metering features of the fuel control unit by re-routing the flow of fuel to the engine and de-activating the compressor pressure limiter.

CAUTION

Operation on the manual fuel control system requires that the throttle be moved slowly and smoothly to prevent overspeeding and excessive exhaust temperatures.

FAIL-SAFE FUEL CONTROL POSITIONER. On airplanes incorporating J65 Engine Bulletin 240, if throttle linkage fails, a throttle positioner automatically positions the fuel control at approximately the 87% rpm position, which normally allows safe flight and controllable landing, including wave-off. The engine can be shut down by moving the FUEL valve to "EMER OFF." (Refer to MANUAL FUEL SHUT-OFF CONTROL in this section.)

FUEL PRIMERS. When the throttle is moved from "OFF" to "IDLE" during starting, priming fuel is supplied automatically from the fuel control unit through the primer solenoid valve to the fuel priming tubes.

The primer tube nozzles are installed in conjunction with the igniter plugs to supply fuel for ignition. When a centrifugal switch within the ignition generator closes at 17.5% rpm, the fuel primer solenoid valve is closed, thus stopping the flow of priming fuel and breaking the circuit to the igniters.

Key to figure 1-2 →

1. Inflight fueling probe
2. Radome
3. Total temperature sensor
4. Brake fluid level window
5. Pitot tube
6. Liquid oxygen overboard vent
7. AN/ARC-27A (UHF) radio antenna
8. Normal cockpit entry handle
9. External canopy jettison handle
10. Approach lights
11. External power receptacle and access door
12. Taxi light (provisions only)
13. Missile guidance antenna (when carried)
14. Angle of attack vane and transducer
15. AN/ARN-21 (TACAN) antenna
16. Static orifice
17. AN/ARA-25 (UHF-ADF) antenna cover
18. Nose compartment access door
19. Oil tank filler cap
20. Oil tank
21. Fuel nozzle grounding receptacle
22. Fuselage fuel tank filler cap
23. Cockpit canopy air bungee cylinder
24. AN/ASQ-17 integrated electronic central
25. AN/APG-53A radar transmitter and receiver group
26. Emergency generator
27. Fuselage fuel tank
28. Catapult hook
29. Wing tank filler cap
30. Slat
31. Barricade engagement detent
32. Vortex generators
33. Integral wing fuel tank
34. Arresting hook
35. Speedbrake

FLOW DIVIDERS. The flow dividers are fuel manifolds which are connected by lines to the fuel burner. Each of the six flow dividers contains an inlet port with filter, a pressure regulating piston, and an outlet port with pressure tap.

FUEL CONTROL SWITCH. A two-position FUEL CONTROL switch on the ENGINE control panel (22, figure 1-3) is used to select the mode of operation of the engine fuel control unit. With the switch at "PRIMARY," the automatic metering devices in the fuel control unit regulate the flow of fuel to the engine to maintain a given rpm setting as established by the position of the throttle. Pressure, temperature, and engine speed sensing devices are continuously acting to maintain the selected rpm condition, regardless of existing ambient conditions. With the switch at "MANUAL," fuel flow is routed around the automatic metering mechanisms and all fuel metering is accomplished directly by manipulation of the throttle.

MANUAL FUEL WARNING LIGHT. The MANUAL FUEL warning light located on the ENGINE control panel (22, figure 1-3) illuminates when the FUEL CONTROL switch is moved to "MANUAL." Illumination of the light indicates only that the switch has been moved.

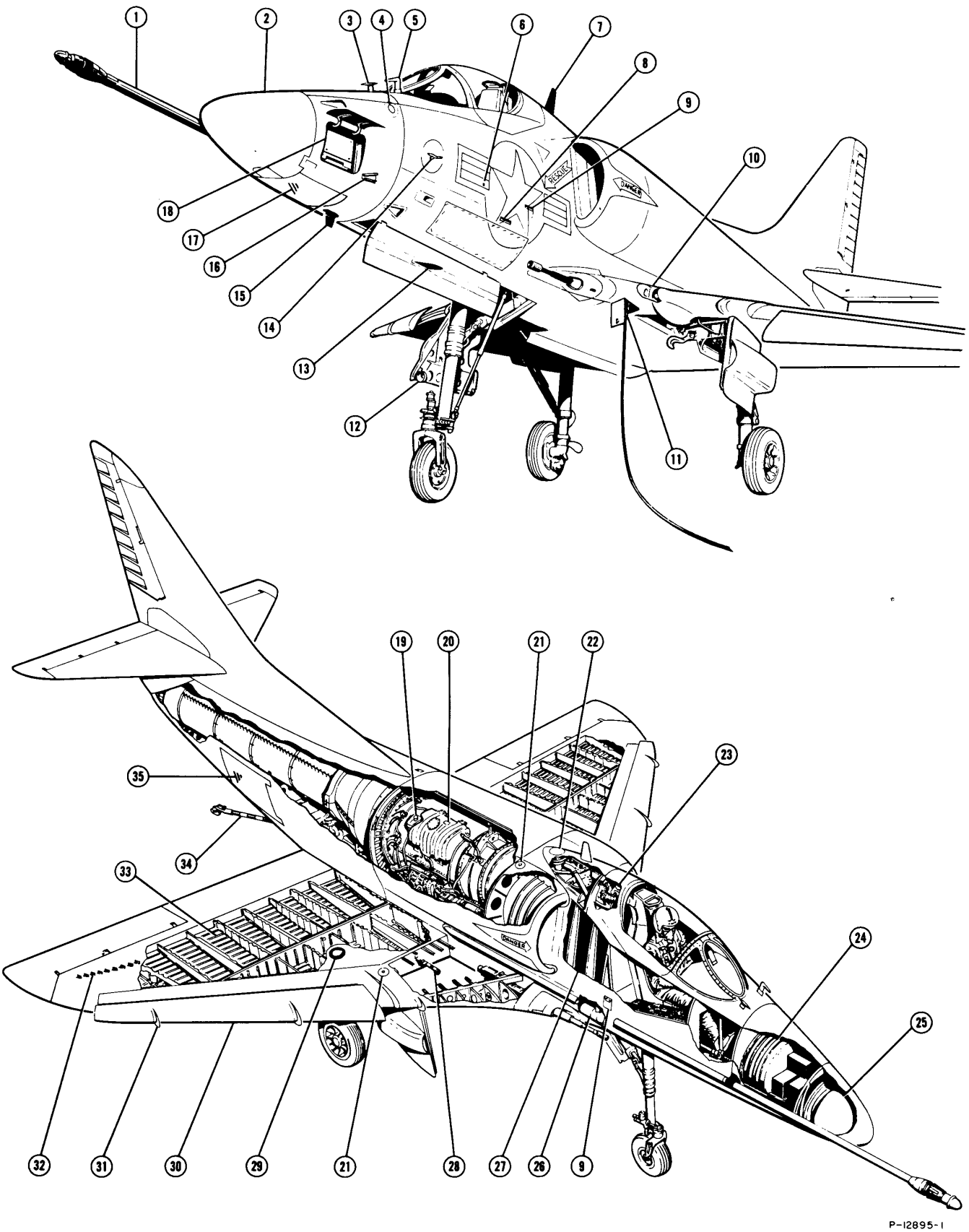


Figure 1-2. General Arrangement

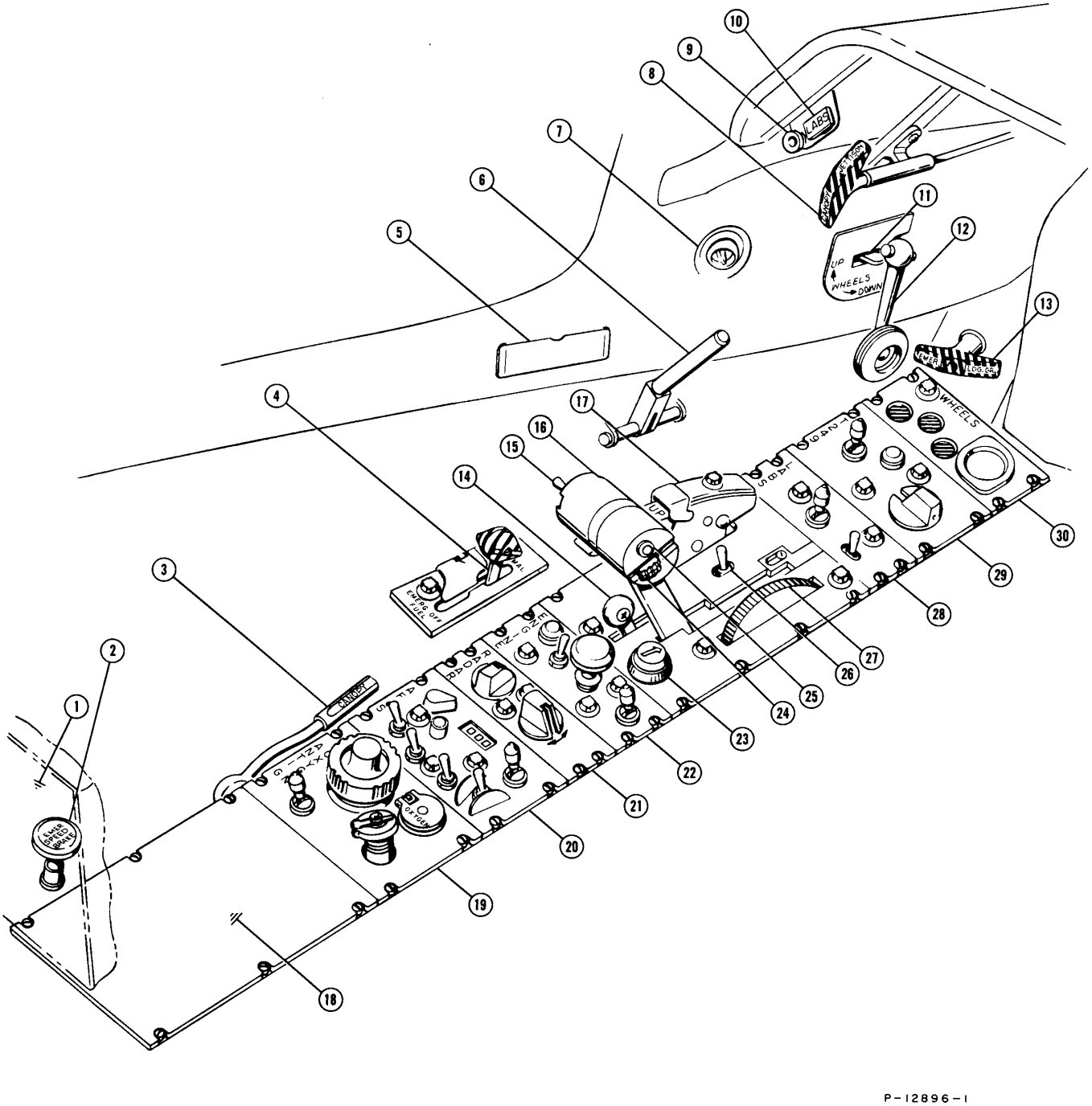


Figure 1-3. Cockpit—Left Console

← *Key to figure 1-3*

1. Relief bag container
2. Emergency speedbrake control
3. Canopy control (manual)
4. Manual fuel shut-off control
5. Airspeed calibration card
6. Catapult handgrip
7. Air conditioning eyeball diffuser
8. Canopy jettison handle
9. TO light
10. LABS light
11. Landing gear retraction release switch
12. Landing gear control
13. Emergency landing gear release handle
14. Horizontal stabilizer manual override control
15. Exterior lights master switch
16. Throttle
17. Wing flaps control
18. Blank panel
19. Anti-G and oxygen panel
20. Automatic flight control panel
21. Radar control panel
22. Engine control panel
23. Rudder trim switch
24. Speedbrakes switch
25. Radio microphone switch
26. Air starting ignition switch
27. Throttle friction wheel
28. LABS control panel (when carried)
29. T-249 control panel (when carried)
30. Wheels and flaps position indicators

ENGINE CONTROLS

THROTTLE. The throttle (16, figure 1-3), on the left console, is mechanically linked to the engine fuel control unit and provides a means of selecting rpm conditions for which the fuel control unit meters fuel to the engine. When the engine is operating on the manual fuel system, the throttle, through linkage with an emergency throttling valve, manually meters fuel with no compensation for engine speed or ambient conditions. Marked positions of the throttle are "OFF," "IDLE," "NORMAL" and "MILITARY." The "OFF" position closes a fuel cut-off valve in the fuel control unit, stopping all fuel flow to the engine. The "IDLE" position incorporates a detent to prevent inadvertent movement of the throttle to the "OFF" position. At "NORMAL," the engine should develop the maximum rpm allowed for continuous operation, and at "MILITARY" should develop maximum rpm. On the inboard side of the throttle grip are located switches for the operation of the radio microphone and speedbrakes, and on the outboard side is the exterior lights master switch. On the left console, inboard of the throttle, is the THROTTLE FRICTION wheel (27, figure 1–3), which is rotated forward to increase friction on the throttle. To prevent retarding the throttle during catapulting, a hand-grip (6, figure 1-3), which extends from its spring-loaded position against the cockpit rail, is grasped in conjunction with the throttle.

ENGINE CONTROL PANEL. The ENGINE control panel, just aft of the throttle on the left console, contains all other controls for the operation of the engine. On the panel are the MANUAL FUEL warning light, the DROP TANKS switch, the START-ABORT switch, and the FUEL CONTROL switch.

ENGINE PERFORMANCE INDICATOR. The engine performance indicator (14, figure 1-4), on the instrument panel, is part of an integrated performance indicating system which presents engine speed, exhaust temperature, fuel boost pressure, and engine oil pressure readings on one instrument. Engine speed is presented in terms of engine operating conditions as well as in percentage of maximum rpm. These conditions are "START," "IDLE," 100–101%, and 106%.

Fuel boost pressure and engine oil pressure are shown in small windows at the top and bottom, respectively, of the indicator. Fuel boost pressure is indicated by the words "OUT" and "NORM"; oil pressure is shown by the words "OUT," "NORM" and "HIGH." An oil pressure gage, installed adjacent to the engine performance indicator, is calibrated between 0 and 70 psi.

Instrument indications and their interpretations are listed below:

INDICATION	*INTERPRETATION*
	% RPM
"START" (10-12)	830-995 rpm
"IDLE" (42-48)	3525-3985 rpm
96.5	8010 rpm (normal-continuous)
100	8300 rpm (military)
101	8385 rpm (military)
106	8800 rpm (acceleration)
	TEMP °C
600 (605)[1]	normal-continuous
650 (660)[1]	military
800 (810)[1]	acceleration
900 (910)[1]	maximum indication
	FUEL BOOST
"OUT"	below 4 psig
"NORM"	6 psig and above
	OIL PRESS
"OUT"	below 20 psig
"NORM"	20-40 psig
"HIGH"	above 40 psig

STARTER

The engine is started on the ground by use of an external pneumatic starter driven by compressed air from a mobile gas turbine compressor. The starter shaft is inserted into a receptacle located inboard of the right main wheel well, where it engages the hydraulic ball pump generator drive, completing both mechanical and electrical connections and allowing actuation of the starter from the cockpit. Crew members should be cau-

[1] Applicable only to engines incorporating NEB 197 and 196.

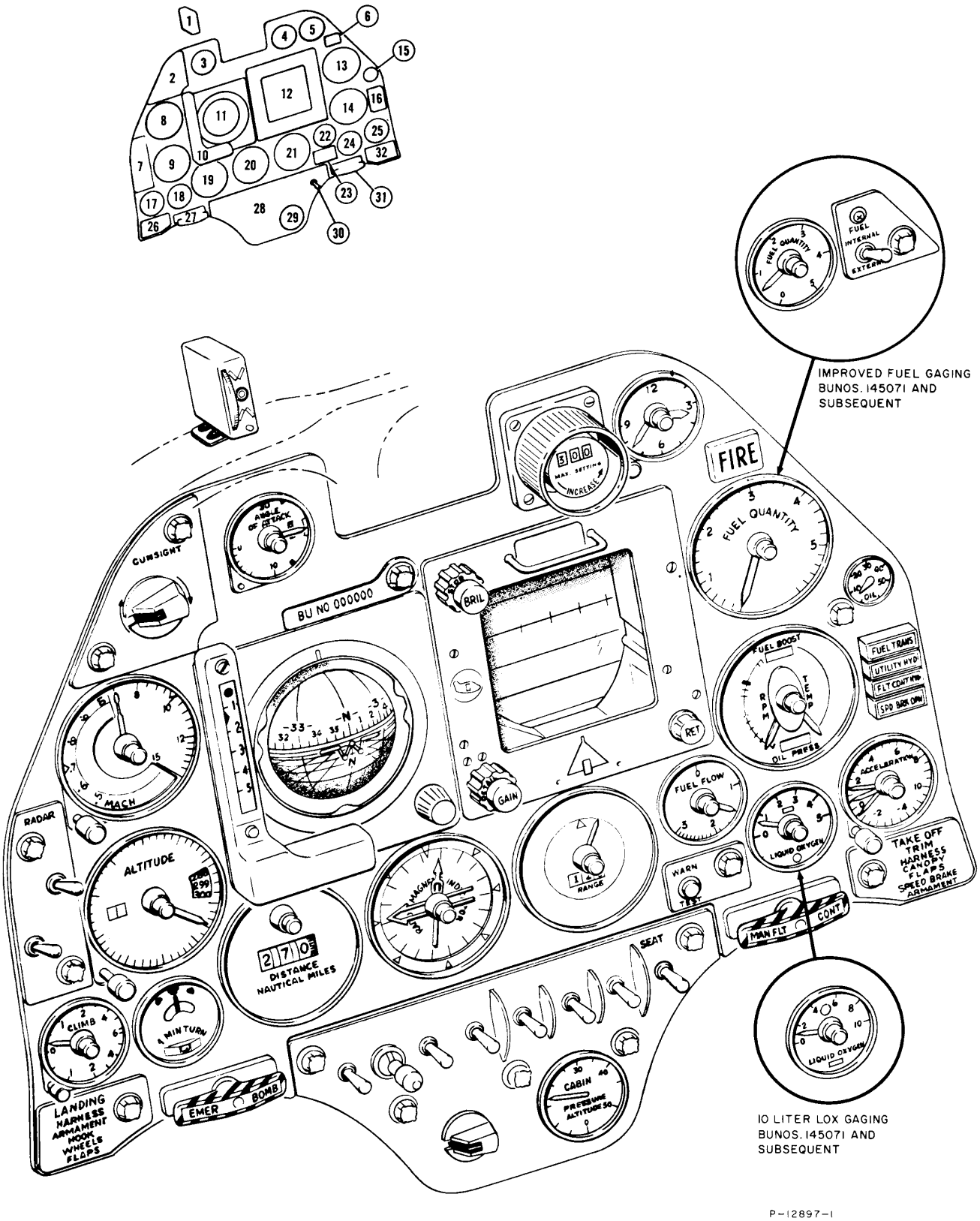


Figure 1-4. Cockpit—Instrument Panel

← *Key to figure 1-4*

1. Angle of attack index light
2. Gunsight dimming switch
3. Angle of attack indicator
4. Intervalometer
5. Clock
6. Fire warning light
7. Radar terrain clearance control panel
8. Airspeed indicator and mach meter
9. Altimeter
10. G-programmer and G-indicator
11. All-attitude indicator
12. Radar indicator (scope)
13. Fuel quantity gage
14. Engine performance indicator
15. Oil pressure indicator
16. Caution lights panel
17. Rate of climb indicator
18. Turn and slip indicator
19. ID-310A/ARN (TACAN) range indicator
20. ID-250A/ARN (TACAN) course indicator
21. ID-623/ASN-19 bearing, distance and track indicator
22. Fuel flow indicator
23. Warning test button
24. Liquid oxygen indicator
25. Accelerometer
26. Landing check-off list
27. Emergency manual bomb release
28. Armament panel
29. Cabin pressure altimeter
30. Seat adjusting control switch
31. Manual flight control
32. Take-off check-off list

tioned to remove the starter probe assembly immediately following completion of a successful start in order to prevent damage to starting equipment. Provision is made for carrying the starter internally in the aft fuselage under the engine for use when landing away from base. The gas turbine compressor can be carried externally on any store rack.

START-ABORT SWITCH. Actuation of the starter is controlled by the START-ABORT switch on the ENGINE control panel (22, figure 1-3). When the switch is depressed, the starter air supply solenoid valve opens, allowing compressed air from the gas turbine compressor to rotate the starter shaft. When the engine speed reaches a predetermined rpm, a starter over-speed switch opens, allowing the START-ABORT switch to pop out, thus stopping the air supply to the starter. Manually pulling out the START-ABORT switch will also stop the starter air supply.

IGNITION

Components of the ignition system are: a throttle lever switch, actuated by movement of the throttle from "OFF" to "IDLE"; an ignition generator; a dual ignition unit; a rectifier and filter assembly; and two igniter plugs. As the engine turns during starting, the ignition generator charges the dual ignition unit. When the throttle is advanced to "IDLE," the throttle ignition switch is opened, causing the dual ignition unit to discharge through the igniter plugs, thus igniting the primer fuel which began to flow when the throttle was opened. At 17.5% rpm, the centrifugal switch in the ignition generator closes, stopping ignition and closing the fuel priming valve.

AIR START SWITCH. The AIR START switch (26, figure 1-3), outboard of the throttle, allows the normal ignition system to function *above* the normal engine rpm cutoff point of 17.5%. Should the throttle be advanced into the normal operating area of the quadrant, the ignition is shut off. The throttle must be moved to "OFF" and the AIR START switch cycled before ignition is supplied again. Therefore, for inflight starting of the engine, when the switch is moved to "ON" and the throttle is in the "IDLE" position, ignition is supplied through the igniter plugs. The "OFF" position discontinues the ignition cycle, and may be selected manually. (Refer to Section III for air starting procedure.)

OIL SYSTEM

The oil system is automatic in operation whenever the engine is running. The oil tank (20, figure 1–2) is located on the upper right side of the engine compressor housing. Earlier airplanes[1] have a capacity of 3.25 gallons of usable oil when filled to the top of the screen in the normal 6° nose-up ground attitude. These earlier airplanes will have a four-gallon capacity after ASC 118. Later airplanes[2] have a four-gallon capacity. A flapper valve arrangement provides oil during inverted flight. An engine-driven gear-type pump and two metering pumps supply oil to all main bearings and accessory drives. A scavenging pump in the accessory gear box returns the oil, which has passed through a strainer, to the oil tank for re-circulation through the system. The OIL PRESS window of the engine performance indicator displays "OUT," "NORM," and "HIGH" oil pressure conditions. The gage (15, figure 1-4), located on the right side of the instrument panel, presents actual oil pressure. Normal oil consumption is approximately 0.4 gallon per hour. (See figure 1-13 for oil specification.)

FUEL SYSTEM

The engine fuel supply is carried in two tanks containing a total of 810 U.S. gallons. These tanks can be serviced by means of two gravity fuel tank fillers or a single point pressure fueling system. Three drop tanks can be carried externally to increase the total fuel quantity to 1710 U.S. gallons. Fuel is transferred by means of tank pressurization and a fuel transfer pump. All fuel is delivered to the fuselage tank, from which an electrically driven fuel boost pump delivers the fuel under pressure to the engine driven fuel pump. A manual fuel shut-off control is provided in the cockpit. See figure 1-13 for fuel grades and specifications of recommended and

[1] Airplanes BuNo. 145062 through 145070.
[2] Airplanes BuNo. 145071 and subsequent.

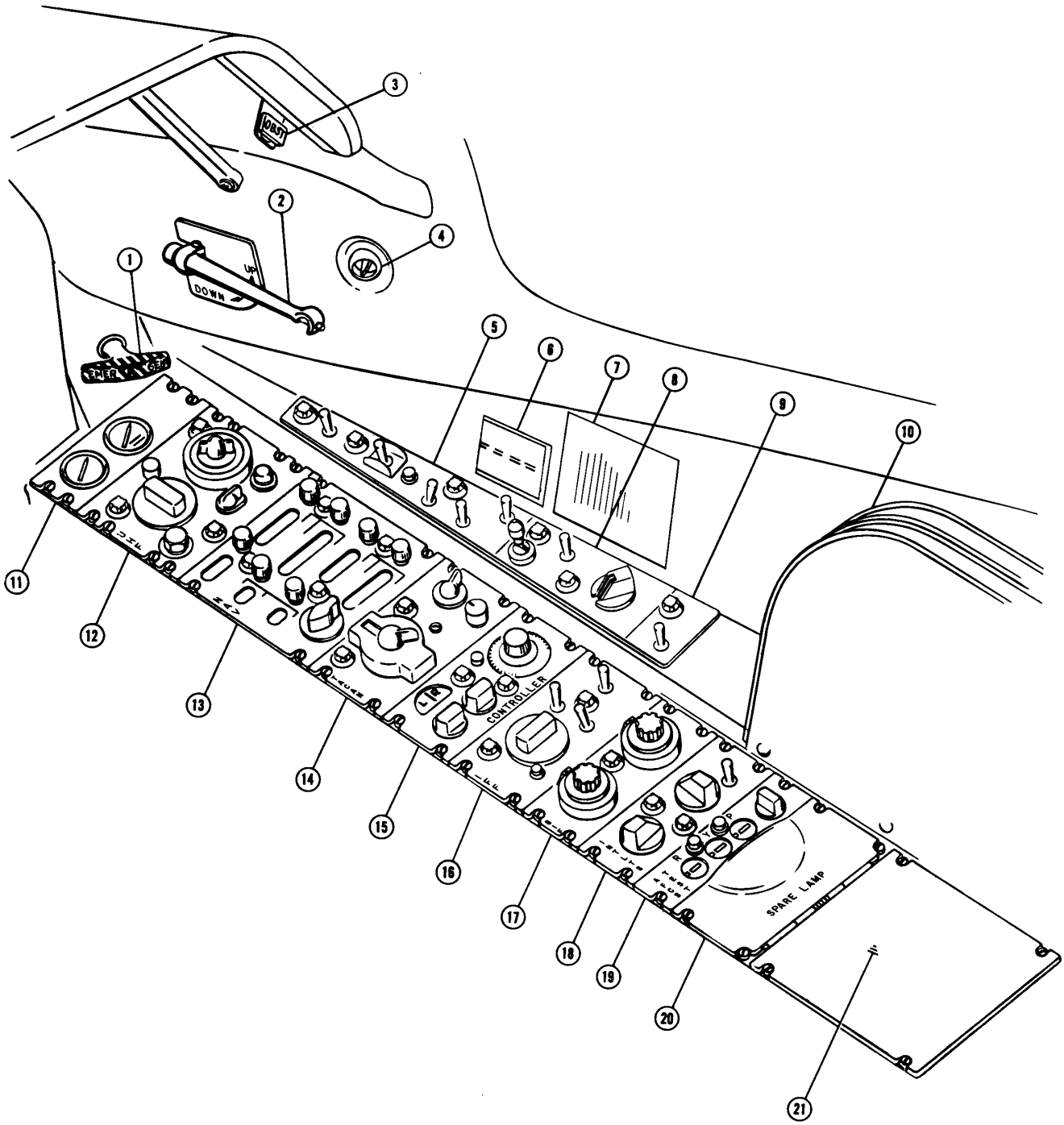


Figure 1-5. Cockpit—Right Console

← Key to figure 1-5

1. Emergency generator release handle
2. Arresting hook control
3. Obstacle light
4. Air conditioning eyeball diffuser
5. Exterior lights control panel
6. Compasses correction cards
7. Radio channels frequencies card
8. Air conditioning and pressurization control panel
9. Pitot heat switch
10. Map case
11. Trim position indicators panel
12. AN/ARC-27A UHF radio control panel
13. AN/ARN-19 NAV control panel
14. AN/ARN-21 (TACAN) control panel
15. Compass controller panel
16. AN/APX-6B IFF radar control panel
17. AN/APA-89 SIF control panel
18. Interior lights control panel
19. Automatic flight control system pre-flight test panel
20. Spare lamps receptacle
21. Blank panel

alternate fuels, and figure 1-7 for a schematic presentation of the fuel system.

FUEL TANKS

INTERNAL TANKS. Internal tanks comprise an integral wing tank and a self-sealing type fuselage tank mounted between the cockpit and the engine bay. The fuselage tank contains the control valve for regulation of transfer fuel flow, the fuel boost pump which delivers fuel to the engine, and a fuel sump with flapper valves. The flapper valves assure a flow of fuel to the fuel pump during all attitudes and maneuvers involving negative g-loads and inverted flight for approximately thirty seconds. All fuel aboard the airplane is transferred to this tank before delivery to the engine. The wing tank fuel transfer pump transfers fuel from the wing tank to the fuselage tank. Both fuel tanks are vented. The vent system exit is located aft of the right main landing gear strut and is designed to provide a small amount of ram air pressure in the fuel vent system to reduce the amount of collapse of the self-sealing type fuselage tank when it is partially full. Both tanks incorporate provisions for gravity filling, pressure fueling and de-fueling, and water and sediment drainage. For information concerning total and usable fuel capacities of each tank, see figure 1-6.

DROP TANKS. Provisions are made for carrying drop tanks singly or in combination. The external stores racks will accommodate either 150-gallon or 300-gallon drop tanks. All drop tanks are vented, and contain provisions for gravity fueling, pressure fueling, and pressurization to effect fuel transfer to the integral wing tank at the option of the pilot. The drop tanks may be jettisoned electrically in the same manner as other droppable external stores. Refer to RELEASING BOMBS, Section IV.

FUEL TRANSFER

WING TANK TRANSFER. The wing tank air turbine driven transfer pump utilizes engine compressor bleed air for power, and operates whenever the engine is running. Since the pump operates continuously, a float valve is placed in the fuselage tank to stop the flow of transfer fuel whenever the fuselage tank is full, in order to prevent transfer fuel being pumped overboard through the fuel vent system. A "FUEL TRANS" failure caution light is provided on the left side of the instrument panel and illuminates when wing tank fuel transfer pressure drops below 2 ($+\frac{1}{4}$ $-\frac{1}{8}$) psi. Steady illumination indicates fuel transfer pump failure or wing tank fuel depletion. Maneuvering flight may induce intermittent illumination by causing the pump to become temporarily unported. Reduced engine rpm settings may provide insufficient bleed air pressure to maintain the required fuel transfer pressure, thus causing the caution light to illuminate. In this situation, fuel may continue to transfer at a reduced rate; an increase in rpm will cause the light to go out, indicating normal fuel transfer has resumed.

DROP TANK TRANSFER. Fuel transfer from the drop tanks to the integral wing tank is effected by means of drop tank pressurization. Placing the DROP TANKS switch on the ENGINE control panel (22, figure 1-3) at "PRESS" opens a solenoid operated air shut-off valve which directs engine compressor bleed air to the drop tanks. Once the tanks are pressurized, the flow of fuel from the drop tanks to the wing tank is controlled by drop tank solenoid pilot valves in the wing tank, which stop the transfer of fuel when the wing tank is full or allow it to continue when space is available. Placing the DROP TANKS switch at "OFF" energizes the drop tank air shut-off valve, thereby closing the valve and discontinuing transfer of fuel from the drop tanks. If electrical failure occurs, the drop tank air shut-off valve is automatically opened, providing immediate and automatic transfer of drop tank fuel as wing tank space permits. To prevent drop tank pressurizing air from being exhausted overboard through the drop tanks vents, each drop tank is equipped with a combination float and diaphragm vent shut-off valve. This valve acts to close the drop tank vent whenever the tank is full or pressurizing air is introduced.

FUEL BOOST PUMP

An electrically driven fuel boost pump, powered by the aft monitored bus, is submerged in the fuselage tank sump. The fuselage tank sump incorporates flapper valves which act to keep the boost pump fuel inlet supplied with fuel at all airplane attitudes, including diving flight and negative "g" or inverted flight of short duration. Operation of the fuel boost pump is automatic whenever the aircraft electrical system is energized by the main generator or external power. In the event of main generator failure the fuel boost pump will be inoperative; however, the fuselage fuel tank is

so situated that gravity flow will supply fuel to the engine pump.

FUEL BOOST PRESSURE INDICATOR. Fuel boost pressure is shown in the FUEL BOOST window of the engine performance indicator (figure 5-1). The indicator is powered by the 28 volt d-c bus and has two positions, "NORM" and "OUT." The "NORM" position indicates that fuel boost pressure is above 6 psi, and the "OUT" position indicates that pressure is below 4 psi.

MANUAL FUEL SHUT-OFF CONTROL

The fuel system incorporates a manually operated emergency FUEL shut-off control (4, figure 1-3) located outboard of the left hand console. This manual FUEL control has two positions, "NORMAL" and "EMERG OFF." The "EMERG OFF" position of the control stops all fuel flow from the airplane fuel system to the engine fuel control system.

FUEL QUANTITY INDICATING SYSTEM

The fuel quantity indicating system is comprised of capacitance-type fuel quantity probes, fuel quantity indicator, low level switch, fuel quantity test switch, and associated wiring. The wing tank contains two[1] fuel quantity probes and the fuselage tank contains one. These probes are wired into the fuel quantity indicator in such a manner as to indicate the total quantity of fuel remaining in both tanks whenever the fuselage tank contains more than 170 gallons (1105 pounds). The fuselage tank contains a low level switch located approximately one-third the distance down the length of the fuel quantity probe at about the 170 gallon

[1] Airplanes BuNo. 145062–145070 prior to ASC 135.

FUEL QUANTITY DATA
(GALLONS)

TANKS	USABLE FUEL	UNUSABLE FUEL—LEVEL FLIGHT	EXPANSION SPACE	TOTAL VOLUME
INTEGRAL WING	570	6	9	585
FUSELAGE	240	0	0	240
LH DROP (EXTERNAL AUXILIARY)				
AERO IA (150)	147	2	1	150
OR				
AERO IA (300)	295	4	1	300
CENTER DROP (EXTERNAL AUXILIARY)				
AERO IA (150)	147	2	1	150
OR				
AERO IA (300)	295	4	1	300
RH DROP (EXTERNAL AUXILIARY)				
AERO IA (150)	147	2	1	150
OR				
AERO IA (300)	295	4	1	300

USABLE FUEL TOTALS

TANKS	TOTAL
FUSELAGE, WING,	810
FUSELAGE, WING, (150) CENTER DROP	957
FUSELAGE, WING, (300) CENTER	1105
FUSELAGE, WING, TWO (150) WING RACK DROP	1104
FUSELAGE, WING, (150) CENTER, TWO (150) WING RACK	1251
FUSELAGE, WING, (300) CENTER, TWO (150) WING PYLON	1399
FUSELAGE, WING, TWO (300) WING PYLON	1400
FUSELAGE, WING, (150) CENTER, TWO (300) WING PYLON	1549
FUSELAGE, WING, (300) CENTER, TWO (300) WING PYLON	1695

P-12899-1

Figure 1-6. Fuel Quantity Data

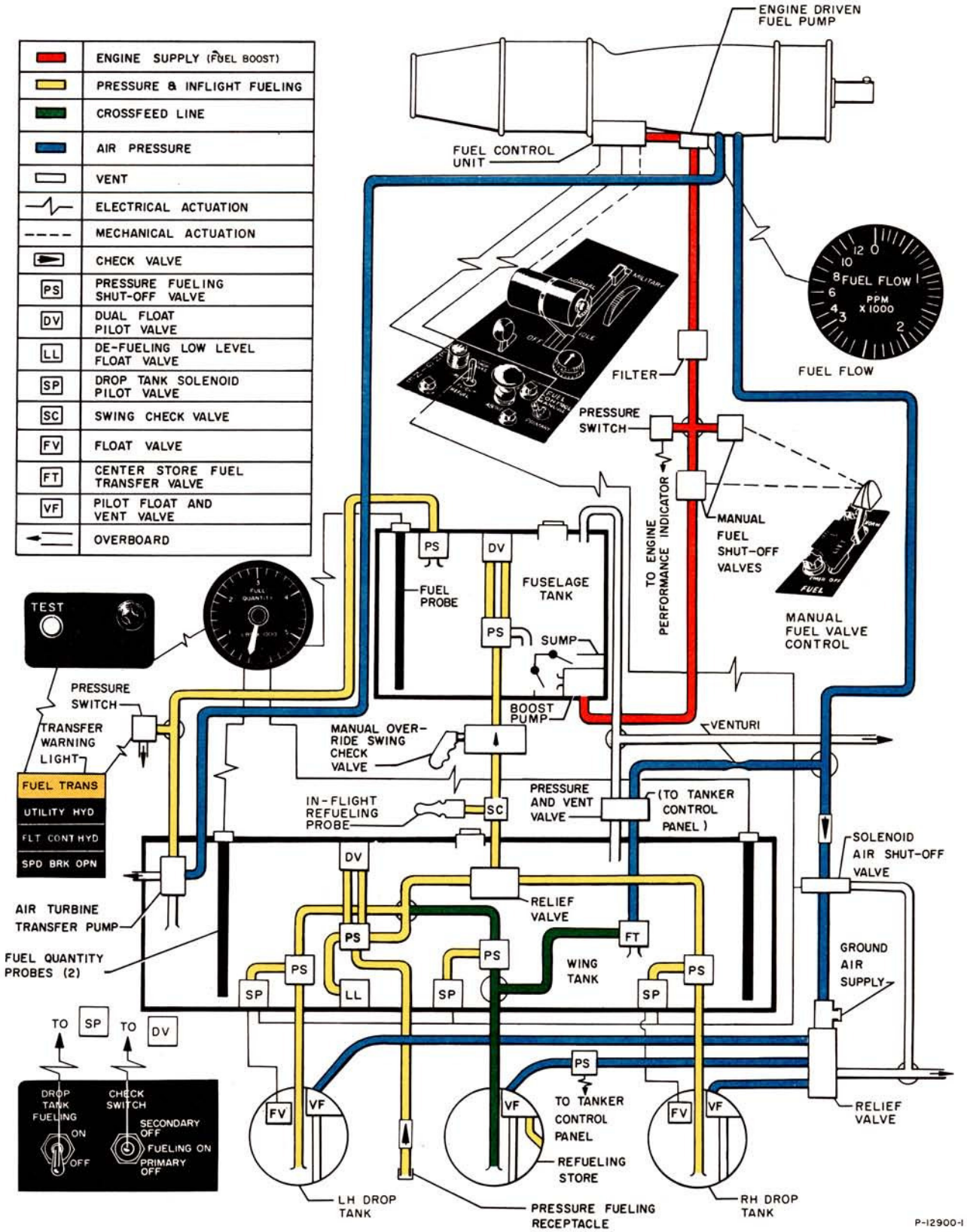


Figure 1-7. Fuel System

level. If the fuel supply in the fuselage tank falls below this level due to malfunction of the wing tank transfer system, or failure or mismanagement of the drop tank transfer system, the low level switch causes the reading of any remaining wing tank transfer fuel to be dropped out, indicating to the pilot that approximately 170 gallons of usable fuel remains. During normal fuel system operation, fuel quantity indication decreases gradually. If the transfer pump fails, the indication drops suddenly when the fuselage tank is depleted to the 170-gallon level. The effect of airplane attitude on the relationship between indicated and actual total fuel quantity is shown by figure 1-8. When the fuselage tank indicated fuel quantity is at or below 1000 pounds, and the airplane attitude is between 4 degrees nose up and 4 degrees nose down, indicated quantity can be considered to be actual quantity.

An improved[1] fuel gaging system has six probes in the wing tank, a probe in each external fuel tank, and a new FUEL-EXTERNAL-INTERNAL test switch.

FUEL QUANTITY INDICATOR. The fuel quantity indicator (13, figure 1-4), located on the instrument panel, indicates the total fuel available in pounds multiplied by 1000.

Note

Expect a sudden indication decrease if, when the fuselage fuel level is low, speed brakes are extended and/or thrust is reduced, as during a carrier approach.

WARN-TEST SWITCH. The fuel quantity indicator gage may be tested by pushing the *multi-purpose* WARN-TEST switch (23, figure 1-4) on the instrument panel. The fuel quantity indicator is powered by the monitored primary bus. When the WARN-TEST switch is depressed, the fuel quantity indicator pointer will move in a counter-clockwise direction. When the switch is released, the pointer will return to the original indication if all units of the fuel quantity measuring circuit are functioning properly. In addition, when the test switch is depressed, the FIRE, FUEL TRANS, UTILITY HYD, FLT CONTROL HYD, and SPD BRK OPN warning lights will illuminate to indicate that the respective circuits and lamps are operative. The WARN-TEST switch also tests the operation of the LIQUID OXYGEN gage; the needle moves to "0" when the switch is pressed.

FUEL FLOWMETER. The fuel flowmeter, labeled FUEL FLOW (22, figure 1-4), on the instrument panel indicates, in pounds per hour, the fuel flow to the engine. The instrument is numbered from one to twelve, with intermediate markings between the numerals. To determine the fuel flow in pounds per hour, multiply the instrument reading by one thousand.

PRESSURE FUELING AND DE-FUELING SYSTEM

The pressure fueling system is designed to permit fueling at a rate of 200 gallons per minute through a single point pressure fueling receptacle, located at the trailing edge of the wing just inside the aft engine compartment access door. The system may be de-fueled through the same receptacle at a rate of approximately 100 gallons a minute. It is necessary to plug in external electrical power to fuel or de-fuel the airplane.

FUELING. When the wing and fuselage tanks are being fueled, fuel pressure opens the fueling shut-off valve in each tank, allowing fuel to enter the tank and also to flow through the sensing lines to the dual float pilot valve. When the tank becomes full, the floats close the pilot valve, causing pressure to increase behind the diaphragm of the shut-off valve and close it. A three-position momentary-contact CHECK SWITCH is provided on the pressure fueling switch panel to check the operation of the dual float shut-off valves. Each shut-off valve consists of a primary float, which is the pilot for the shut-off valve, and a secondary float, which is a standby for the shut-off valve. Moving the CHECK SWITCH to either the "PRIMARY OFF" or "SECONDARY OFF" position causes solenoids to raise the respective float valve to simulate the normal shut-off valve action at the maximum fuel capacity level. This check can be made only after the pressure fueling operation has begun.

To fuel the drop tanks by means of the pressure fueling system, it is necessary to place the DROP TANK FUELING switch on the pressure fueling switch panel at "ON." This action energizes the normally closed solenoid pilot valve, permitting fuel pressure to open the drop tanks shut-off valves and, subsequently, flow to the drop tanks. Under these conditions fuel also flows through the sensing lines to the drop tanks solenoid pilot valves. As each drop tank becomes full, a float valve in the tank rises, breaking the electrical circuit to the energized solenoid pilot valve, causing the pilot valve to close and pressure to build up behind the diaphragm of the shut-off valve, which then also closes, discontinuing the pressure fueling to that tank.

CAUTION

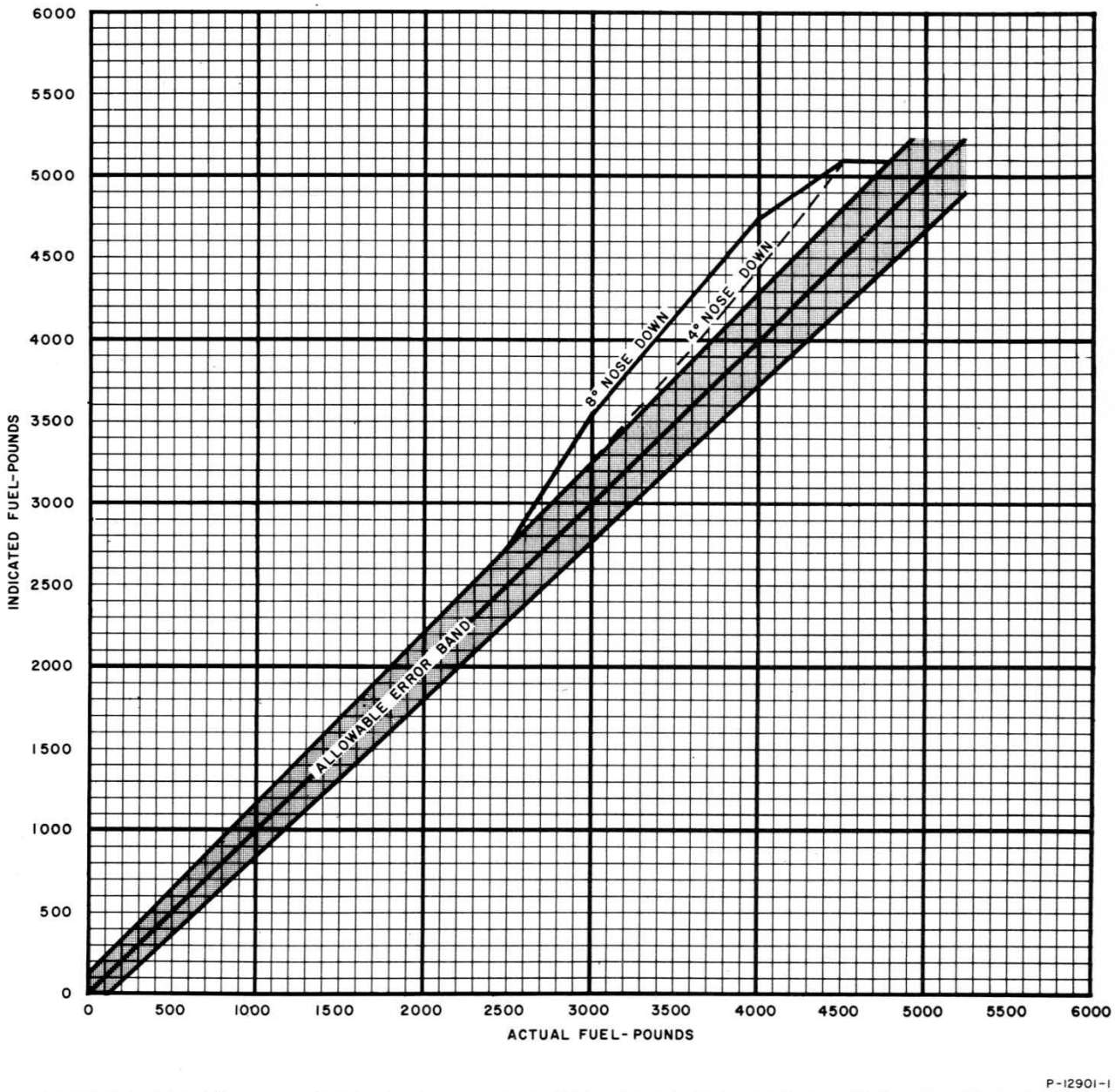
Unless the DROP TANK FUELING switch in the aft compartment is in the "OFF" position after fueling the drop tanks and prior to takeoff, fuel transfer from the drop tanks will not be possible in the air.

Note

The drop tank pilot valves allow free flow of fuel from the drop tank to the wing tank any time the wing tank is not full.

[1] Airplanes BuNo. 145071 and subsequent. 145062–145070 by ASC 135.

FUEL/ATTITUDE CALIBRATION



REMARKS:

(1) Allowable Error Band per MIL-G-7940.

(2) JP-4 Fuel.

EXAMPLE:

Assume aircraft attitude 4° nose down:

(1) Fuel indicator reads 4200 lbs.

(2) Actual fuel aboard is 3800 lbs.

DATA AS OF: 1 June 1957.

DATA BASIS: Contractor's calibration.

Figure 1-8. Fuel/Attitude Calibration Chart

When the inflight fueling store is installed instead of the center drop tank, it is fueled in the same manner as the drop tanks.

DE-FUELING. To de-fuel the integral wing tank requires no procedure other than connecting the de-fueling hose to the pressure fueling receptacle. To de-fuel the fuselage tank it is necessary to operate the manual override check valve between the wing and fuselage tanks. When the de-fueling operation is begun, negative pressure in the pressure fueling shut-off valves will open the valves and allow the fuel to be removed. When either the fuselage or wing tank becomes empty, the de-fueling low level float valve opens, increasing the pressure behind the diaphragm of the shut-off valve, causing the valve to close. This prevents air from entering the de-fueling line and breaking the siphon when one tank empties ahead of the other.

To de-fuel the drop tanks through the pressure fueling system, it is necessary to connect a source of air pressure to the capped tee in the drop tanks pressurizing system, and first transfer the drop tanks fuel into the integral wing tank.

PRESSURE FUELING SWITCH PANEL. The pressure fueling switch panel is located on the left side of the aft engine access compartment just inside the access door. This panel has two switches: the CHECK SWITCH, and the DROP TANK FUELING switch. The CHECK SWITCH is used to test the operation of the dual float pressure fueling pilot valves, and has three positions, "PRIMARY OFF," "FUELING ON," and "SECONDARY OFF." The DROP TANKS FUELING switch has two positions, "ON" and "OFF." The "ON" position of the DROP TANKS FUELING switch energizes the drop tanks solenoid pilot valves, permitting pressure fueling of the drop tanks.

ELECTRICAL SYSTEM

Electrical power is normally supplied by an engine-driven main generator, which furnishes 115/200-volt, 3-phase 400-cycle, constant frequency a-c power, and, through a transformer-rectifier, 28-volt d-c power. No d-c generator or battery is provided. An additional transformer modifies generator power to 26-volt a-c power for the operation of certain equipment. The aft monitored, forward monitored, primary, monitored primary, 28-volt d-c primary, d-c, armament, and 26-volt a-c busses, serve to distribute power to the various electrical units. An airstream-operated emergency generator provides 115/200-volt, 3-phase, 400-cycle a-c power and, through a transformer-rectifier, 28-volt d-c power to essential equipment in the event of main generator or engine failure. External power can be used to energize the system through an external power receptacle located in the lower forward plating of the left-hand wing root. Operation of the electrical system is completely automatic, with the exception of the emergency generator, which must be activated by the pilot upon failure of the main generator. Refer to Section III for emergency operation of the electrical system, and see figure 1-9 for schematic presentations of electrical power distribution.

MAIN GENERATOR

The main generator, rated at 9 kilovolt-amperes, is driven at a constant speed of 4000 rpm by the engine through a hydraulic ball-pump drive assembly. The drive assembly utilizes a separate hydraulic reservoir (figure 1-13), located in the forward engine compartment. The main generator, which delivers full rated capacity at engine idling speed, supplies power to the aft monitored bus, which further distributes power to other electrical busses in the system.

GENERATOR FIELD FLASH SWITCH. The GEN FIELD FLASH switch, for use by the ground crew, is installed adjacent to the hydraulic system pressure gage in the right hand wheel well. The momentary-contact switch is provided for the purpose of restoring or reversing the polarity of the main generator exciter field circuit by the process of "flashing the field." Power for the flashing circuit is supplied by the d-c power source in the external starter compressor store, which is connected to the circuit when the starter is inserted into its receptacle. A test unit provided by the ground crew is plugged into the receptacle on the fuse panel in the nose wheel well during each start, to ascertain that the generator is operating within the prescribed limits.

EXTERNAL POWER SWITCH. When the external power switch is in the "EXTERNAL" position, the aft monitored bus is disconnected from the main generator and is connected to the external power receptacle, in order that power from an external source may be applied to the system. The external power receptacle door cannot be closed when the switch is in the "EXTERNAL" position.

EMERGENCY GENERATOR

The emergency generator, rated at 1.7 kilovolt-amperes, is carried internally in a compartment in the lower right hand side of the forward fuselage. When the generator is released into the aristream, a variable pitch propeller governs the speed of the generator at approximately 12,000 rpm to provide 400-cycle constant frequency power to the primary and monitored primary bus.

When the emergency generator is extended, d-c electrical power from the 28-volt d-c primary bus is available to operate the trim indicators, the landing gear indicator, the emergency fuel control, the cabin pressurization and air conditioning, the AN/APX-6B IFF transponder and the AN/APA-89 SIF equipment. The 28-volt d-c primary bus is energized by the primary bus through a transformer-rectifier. D-c power for the S-2 compass, the landing gear warning light, and the approach light relay is supplied by a separate small transformer-rectifier.

EMERGENCY GENERATOR RELEASE HANDLE. The EMER GEN release handle (1, figure 1-5), on the extreme right side of the cockpit, above the right console, provides the only control of the electrical system that is available to the pilot. When the handle is pulled, the emergency generator drops into the airstream, the main generator becomes inoperative, and the primary, and monitored primary bus are connected to the emergency generator. Once the emergency generator is extended, there is no way to retract it to the normal stowed position while in flight.

A-C POWER DISTRIBUTION

Power from the main generator is sampled by a voltage regulator, which maintains a constant voltage output from the main generator by varying the current in the generator exciter field. The voltage-regulated power moves through the "INTERNAL" position of the external power switch to the aft monitored bus. The aft monitored bus distributes power to the electrical units connected to it, to the forward monitored bus, to the primary bus, and to the monitored primary bus. The primary bus supplies power to a transformer which reduces the voltage to 26 volts to power the 26-volt a-c bus. Each of the busses in the electrical system distributes power through protective fuses to connected electrical units.

EMERGENCY A-C POWER. Extending the emergency generator into the airstream breaks the main generator exciter field circuit, rendering the main generator inoperative, and transfers the primary bus and monitored primary bus from the aft monitored bus to the emergency generator. Thus, only those units powered from the primary bus, the monitored primary bus, the 26-volt a-c bus, and the 28-volt d-c primary bus will be operable when the emergency generator is operating. (See figure 1-9.) If, during emergency generator operation, it becomes necessary to adjust the horizontal stabilizer, the monitored primary bus is temporarily cut out when all emergency generator power is diverted to the primary bus. (Power will temporarily be unavailable for AN/ARC-27A radio, windshield heat (nesa glass), landing gear position indicator, pitot heat, fuel quantity, fire warning and lox quantity during the actuation.)

Stabilizer adjustment can be accomplished only by using the horizontal stabilizer manual override control on the left console. Upon release of the control, the output of the emergency generator is again directed to its bus system.

D-C POWER DISTRIBUTION

The forward monitored bus supplies 115/200-volt, 3-phase, 400-cycle a-c power to a transformer-rectifier, which converts the a-c power to 28-volt d-c power to energize the d-c bus. The d-c bus further distributes power to connected electrical units and to the armament bus.

D-C BUS. The d-c bus is energized when the main generator is operating, or when external power is connected to the aircraft. The emergency generator does not energize the d-c bus.

28-VOLT D-C PRIMARY BUS. The 28-volt d-c primary bus is normally energized by the main generator and, under emergency conditions, is energized by the extended, air-driven, emergency generator.

ARMAMENT BUS. The armament bus receives power from the d-c bus, provided that the MASTER ARMAMENT switch is "ON" and the landing gear control is "UP." An armament safety switch, actuated by the "DOWN" position of the landing gear control, de-energizes the armament bus as a safety feature to prevent inadvertent firing of the guns or release of stores when the aircraft is on the ground or in the landing pattern with the wheels down.

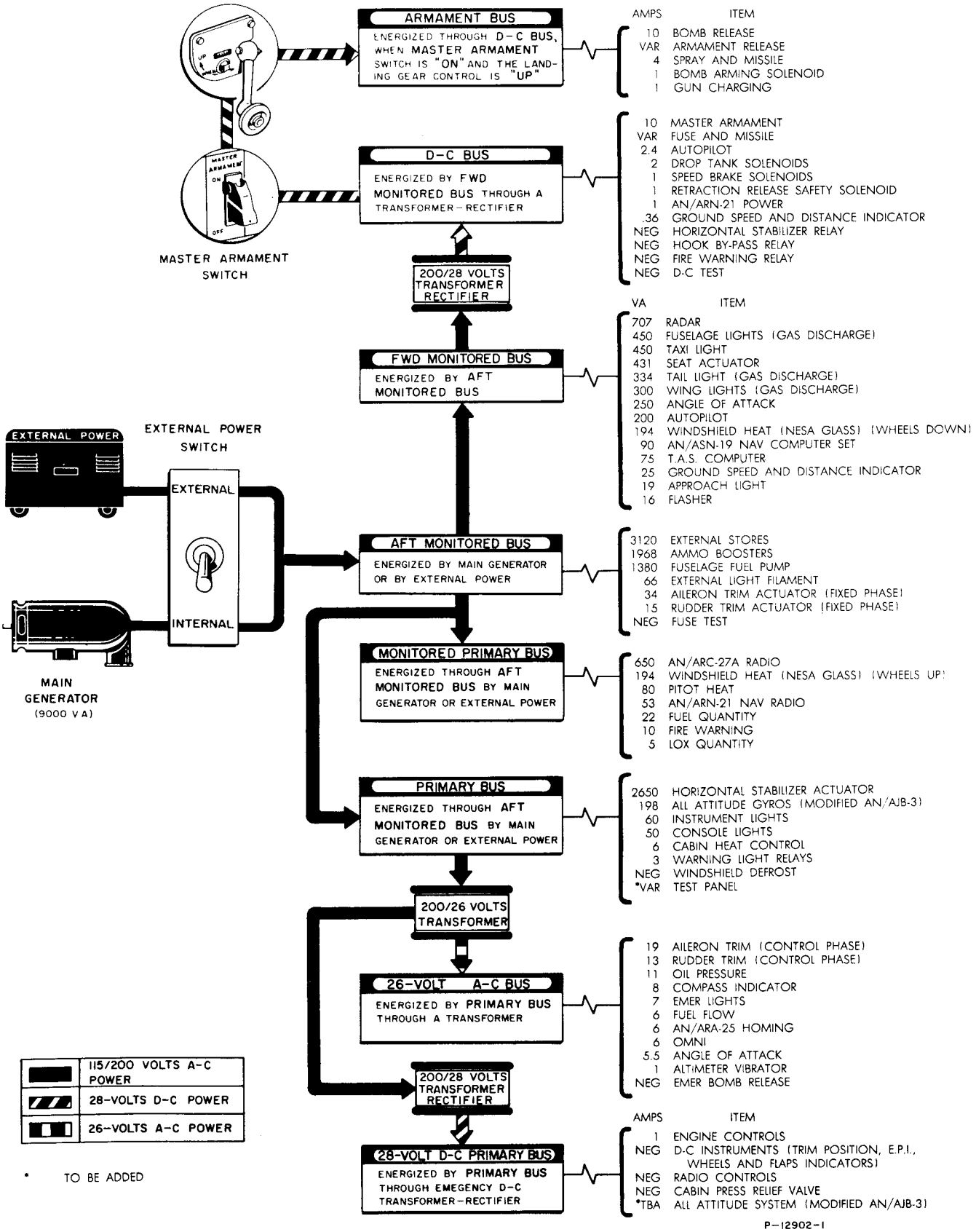
ARMAMENT SAFETY DISABLING SWITCH. The ARM SAFETY DISABLE switch is located on the outboard side of the right-hand wheel well for ground testing of the armament circuit. When the MASTER ARMAMENT switch is "ON" and the ARM SAFETY DISABLE switch is momentarily depressed, an armament safety disabling relay is closed, allowing power to energize the armament bus. The relay is held closed until the MASTER ARMAMENT switch is turned "OFF," or electrical power is disconnected from the aircraft. When this occurs, the armament safety feature is automatically reinstated.

FUSE PANELS

All electrical circuits are protected by fuses in lieu of circuit breakers in order to save weight and to provide better wire protection. The fuses are located on two panels, one in the nose wheel well, the other in the forward engine and accessories compartment. Both panels are inaccessible during flight and therefore should be checked for burned-out or improperly inserted fuses prior to each flight. Fuse testing provisions and spare fuses are provided on each fuse panel.

HYDRAULIC SYSTEM

The tandem hydraulic system utilizes two self-pressurizing fluid reservoirs and two identical engine-driven variable displacement pumps. Both reservoirs are located in the upper right-hand side of the fuselage over the center of the wing, with the flight control system reservoir aft of the utility system reservoir. Capacity of the utility system reservoir is 1.25 gallons of hydraulic fluid; that of the flight control system, 0.30 gallon. Each system operates normally under a pressure of 3000 psi, and relief valves in each system open at 3500 psi to prevent damage to the lines and equipment, should the pump displacement compensator fail. Tandem power cylinders



(Main Generator Operation)

Figure 1-9. Electrical System (Sheet 1)

are used in the aileron, elevator and rudder power controls; one half of each cylinder being operated by flight control system pressure, and the other half by utility system pressure. This arrangement allows the ailerons, elevator and rudder to be power-operated by either system in the event of failure of the other.

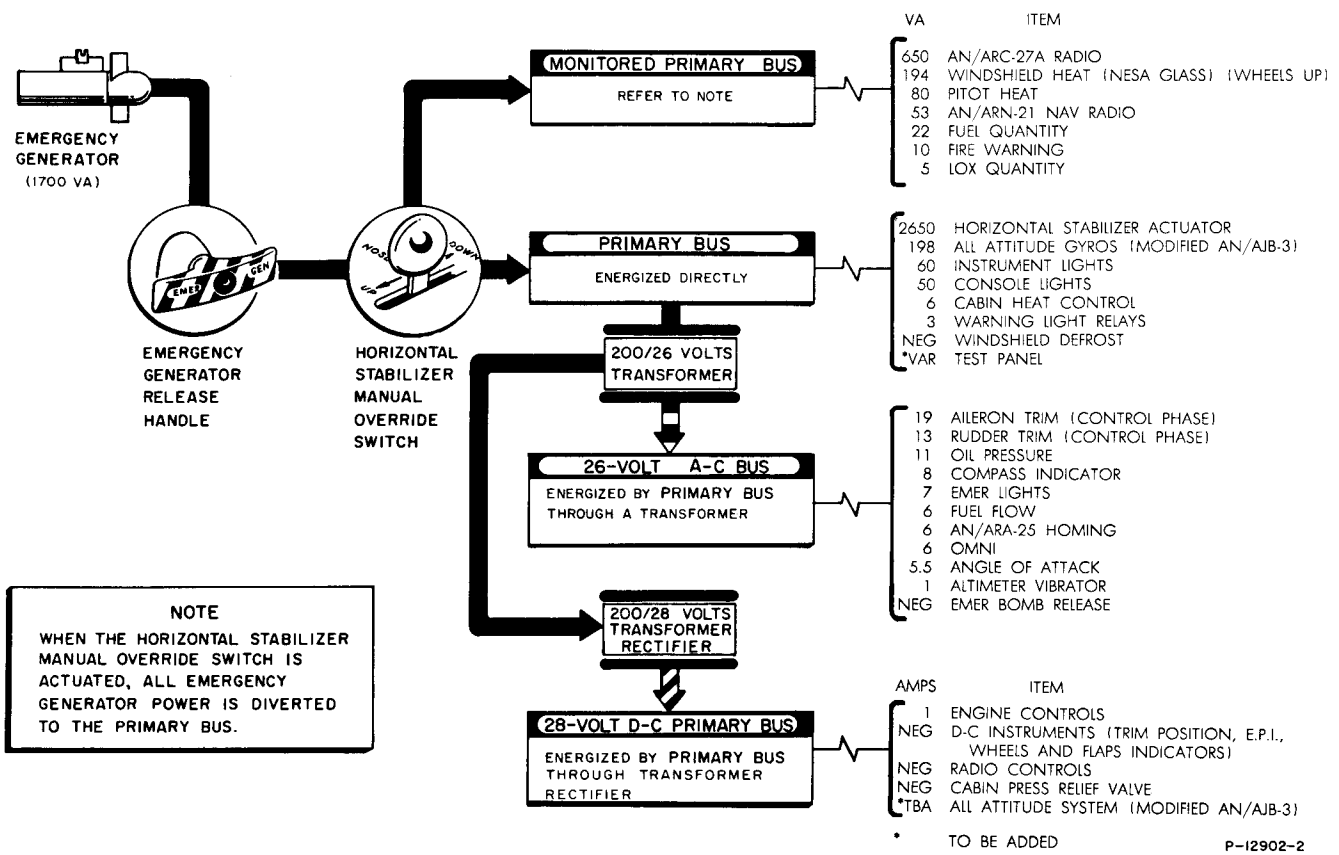
Utility hydraulic system pressure also operates the landing gear, wing flaps, speed brakes, arresting hook and autopilot actuators. Hydraulic pressure warning lights (16, figure 1–4) are provided in the cockpit for each of the two systems. Pressure gages for both systems are installed in the right hand wheel well. There is no auxiliary pump, so no hydraulic pressure is available for ground operation unless the engine is running. Whenever the engine is running, normal pressure is supplied to both the flight control and the utility systems; however, at engine windmilling speeds, fluid flow is greatly reduced, and the time required for hydraulically operated units to respond fully is increased. (See figure 1–10 for a schematic diagram of the tandem hydraulic system, and refer to section III for emergency procedures to be followed in the event of failure of one or both of the hydraulic systems.) (Refer to section VII, HYDRAULIC POWER DISCONNECT, for further information.)

FLIGHT CONTROL SYSTEMS

The primary flight controls systems are full hydraulic power systems with artificial feel supplied by bungee springs in parallel with the pilot's controls. Motion of the stick or rudder pedals is transmitted through linkage and cable systems to the control valve. The valve ports fluid to the power cylinder, which, in turn, actuates the control surfaces. Each of the three systems—aileron, elevator, and rudder—is a tandem hydraulic system, as described above.

Aileron and rudder trim is obtained by repositioning the neutral force point of the feel spring. Longitudinal trim is obtained by positioning the horizontal stabilizer.

In the event of total hydraulic power failure the aileron and elevator power cylinders may be disconnected and control is obtained manually. The rudder system is not disconnected. With a loss of hydraulic power, the rudder control valve ports the two cylinder ports together so that the rudder can be controlled manually through the manual by-pass linkage.



(Emergency Generator Operation)
Figure 1-9. Electrical System (Sheet 2)

Hydraulic servos in parallel with the pilot provide the aileron and elevator control forces required for automatic flight control. A preloaded spring is placed in series with the elevator servo to limit its force output for structural protection.

The rudder control system is provided with a dual input electromechanical control valve so that AFCS commands may be added to pilot commands. With AFCS or STAB AUG engaged the valve operates electrically. With AFCS and STAB AUG disengaged, the valve operates mechanically.

The aileron and rudder control surfaces have rotary viscous dampers to reduce surface buzz.

The rudder pedals are adjusted fore and aft by a lever located on the inboard side of each pedal.

AILERON CONTROL. The ailerons are both aerodynamically and statically balanced. Lateral movement of the control stick positions the aileron control valve so that hydraulic fluid at 3000 psi is ported to the aileron power cylinder. The aileron power cylinder operates push-pull tubes to the ailerons, causing the latter to be deflected in the desired direction. Because the aileron power control is irreversible, there is no feed-back to the pilot of air loads against the ailerons; therefore, artificial "feel" is provided by a spring bungee.

WARNING

Do not attempt maneuvers requiring high control forces (such as high-speed pull-outs) when it is known beforehand that one or both of the hydraulic systems are inoperative.

AILERON TRIM SYSTEM. An electrically powered actuator moves the stick, power system linkages, and, consequently, the ailerons to the desired trim position by changing the neutral position of the aileron load feel and centering bungee. At the same time, it positions a follow-up tab on the left aileron so that the airplane will remain approximately in trim whenever the power system is disconnected. In this event, the pilot continues to trim the ailerons in the same manner, except that now the tab is positioning the surfaces. The trim actuator is controlled by movement of the trim switch (figure 4-10) on the stick grip to "LWD" (left wing down) or "RWD" (right wing down). As the trim actuator receives its fixed phase power from the aft monitored bus, it is inoperative when the emergency generator is in use. No indicator is provided to show the trim position of the ailerons and tab, but the control stick is displaced from center to a new "neutral" position as the trim tab and ailerons are moved from their faired positions by the trim actuator.

ELEVATOR CONTROL

Fore and aft movement of the control stick moves a push rod attached to the elevator control valve, which ports hydraulic pressure to the elevator power control cylinder. The cylinder then, through mechanical linkage, deflects the elevator surface as desired. The elevators are not equipped with trim tabs, as longitudinal trim is provided by a movable horizontal stabilizer. To provide additional nose-up trim, however, a bungee is installed in the elevator control system. This bungee is linked to the horizontal stabilizer so that when the stabilizer is moved to the maximum nose-up position, a detent in the bungee assembly causes the elevators to be deflected upward approximately five degrees. The action also causes the control stick to be moved slightly aft. When elevator hydraulic power is lost, the elevator-stabilizer linkage is ineffective. Additionally, the elevators are interconnected with the operation of the speedbrakes to assist the pilot in overcoming trim changes resulting from speedbrake operation. A system of cables and springs attached to the left speedbrake actuates the control cables between the stick and the elevator control valve. When speedbrakes are opened, this system pulls the "nose-down" elevator cable, moving the stick forward and actuating the elevator to compensate for a "nose-up" trim change. When the speedbrakes are closed, the stick moves aft to its original trimmed position, thus compensating for the "nose-down" trim change.

HORIZONTAL STABILIZER

The entire surface of the horizontal stabilizer is moved by an electrically operated actuator to provide longitudinal trim. The actuator is controlled by forward and aft movement of the TRIM switch (figure 4-10) to "NOSE DOWN" or "NOSE UP." Stabilizer travel is from 11 degrees nose up to 3 degrees nose down. The position of the horizontal stabilizer is shown on the trim position indicator.

Note

Actuation of the horizontal stabilizer may require a percentage of the electrical power supply large enough to cause a momentary drop in volume of the UHF radio, a disturbed radar presentation and autopilot functioning, and a momentary dimming of the external and internal lights.

MANUAL OVERRIDE SWITCH. A horizontal stabilizer manual override switch (14, figure 1-3) on the left console outboard of the throttle, will operate the horizontal stabilizer in the event the TRIM switch becomes inoperative. The positions of the manual override switch correspond to those of the TRIM switch, and as the switch is spring-loaded to the center or "off" position, it must be moved to the full extent of its travel in either direction to operate the horizontal stabilizer. When the emergency generator is operating, the manual override switch is the only means of actuating the horizontal stabilizer.

CAUTION

Use of the horizontal stabilizer manual override switch does not allow the limit switches on the stabilizer stops to cut out the actuator motor when the horizontal stabilizer reaches the full limit of its travel; consequently, continued operation of the manual override switch in one direction when the stabilizer is at the limit of travel in that direction will burn out the actuator motor, and cause complete loss of stabilizer control. Do not run the actuator against the stops during the pre-flight check. Repeated jamming may crack the actuator housing.

RUDDER CONTROL

The airplane is equipped with a rudder system operating at a reduced hydraulic pressure of 1150 psi. The rudder power control is operated by the flight control system and the utility system at the same reduced pressure. Movement of the rudder pedals positions a hydraulic control valve in the vertical stabilizer through the rudder electromechanical dual input servo valve. The control valve, in turn, ports hydraulic pressure to the rudder actuating cylinder as required. Since there is no feedback of air loads on the control surface of a hydraulic power system, a spring bungee is installed in the fin to center and restrain the control valve and rudder pedals, and to provide artificial "feel." Directional trimming is accomplished by displacing the entire rudder surface as a result of repositioning the center or neutral point of the spring bungee through the action of an electric motor controlled by the RUDDER trim switch (23, figure 1-3) on the left hand console. Positions of the trim switch are "NOSE LEFT" and "NOSE RIGHT." The rudder trim actuator is powered by the aft monitored and 26-volt a-c busses. Rudder trim position is shown on the trim position indicator.

HYDRAULIC POWER DISCONNECT

A MAN FLT CONT handle (31, figure 1-4), on the lower right side of the instrument panel, may be used to release the power systems from the flight controls in the event of hydraulic system failure. (Refer to Section VII, HYDRAULIC POWER DISCONNECT, for further information.)

TRIM POSITION INDICATORS

The positions of the rudder trim and the horizontal stabilizer are shown on the trim position indicators (11, figure 1-5) at the forward end of the right-hand console. The trim position indicators panel is labeled TRIM. The rudder trim position indicator is graduated in one-degree units to the "L" (left) and "R" (right) of "0." Total travel of the rudder trim position indicator represents seven degrees of rudder travel left and right of center. All even degree marks are numbered from "0" through "6."

CAUTION

- Loss of rudder hydraulic power results in loss of rudder trim, and, particularly at high airspeeds, in inaccurate trim indications.
- Fluctuating flight system hydraulic pressure results in erratic rudder movement.

The scale for horizontal stabilizer position is graduated in one-degree units from "DN" (down) through "UP." All even numbered degree marks are identified numerically. Maximum indications are three degrees airplane-nose-down and eleven degrees airplane-nose-up.

WING FLAPS

Split flaps are installed on the trailing edges of the wings. Hydraulically actuated by a single cylinder, the wing flaps are mechanically controlled by the FLAP control (17, figure 1-3) on the left console, outboard of the throttle. The wing flaps may be extended 50 degrees maximum by moving the FLAP control to "DOWN," or may be stopped at any intermediate position by placing the FLAP control at "STOP." When "UP" is selected, the flaps will retract fully. The position of the flaps is shown on the wheels and flaps position indicator (30, figure 1-3) on the pilot's instrument panel. A relief valve in the wing flap system allows the flaps to "blow-back" to prevent structural damage when the air load against them causes the hydraulic pressure within the actuating cylinder to exceed the pressure at which the relief valve opens (3500 psi). This automatic retraction will begin at approximately 210 knots IAS, and the flaps will not return automatically to the extended position if the FLAP control is in the "STOP" position.

WING SLATS

Aerodynamically controlled slats are installed on the leading edges of the wings to improve airflow characteristics over the wing surfaces at high angles of attack, primarily during approach and landing. The wing slats will open and close independently and automatically as the aerodynamic loading on them dictates. Because so many variables—airspeed, gross weight, and applied load factor—affect the operation of the wing slats, no fixed airspeeds can be established as the points at which the slats begin to open or close. In general, however, they begin to open at some airspeed below 200 knots, and are fully opened at stalling speed.

WARNING

During the pre-flight inspection (Refer to EXTERIOR INSPECTION, Section II), operate each slat by hand to make certain that each extends and retracts with negligible effort and without binding. Binding which causes asymmetric slat extension requires excessive lateral

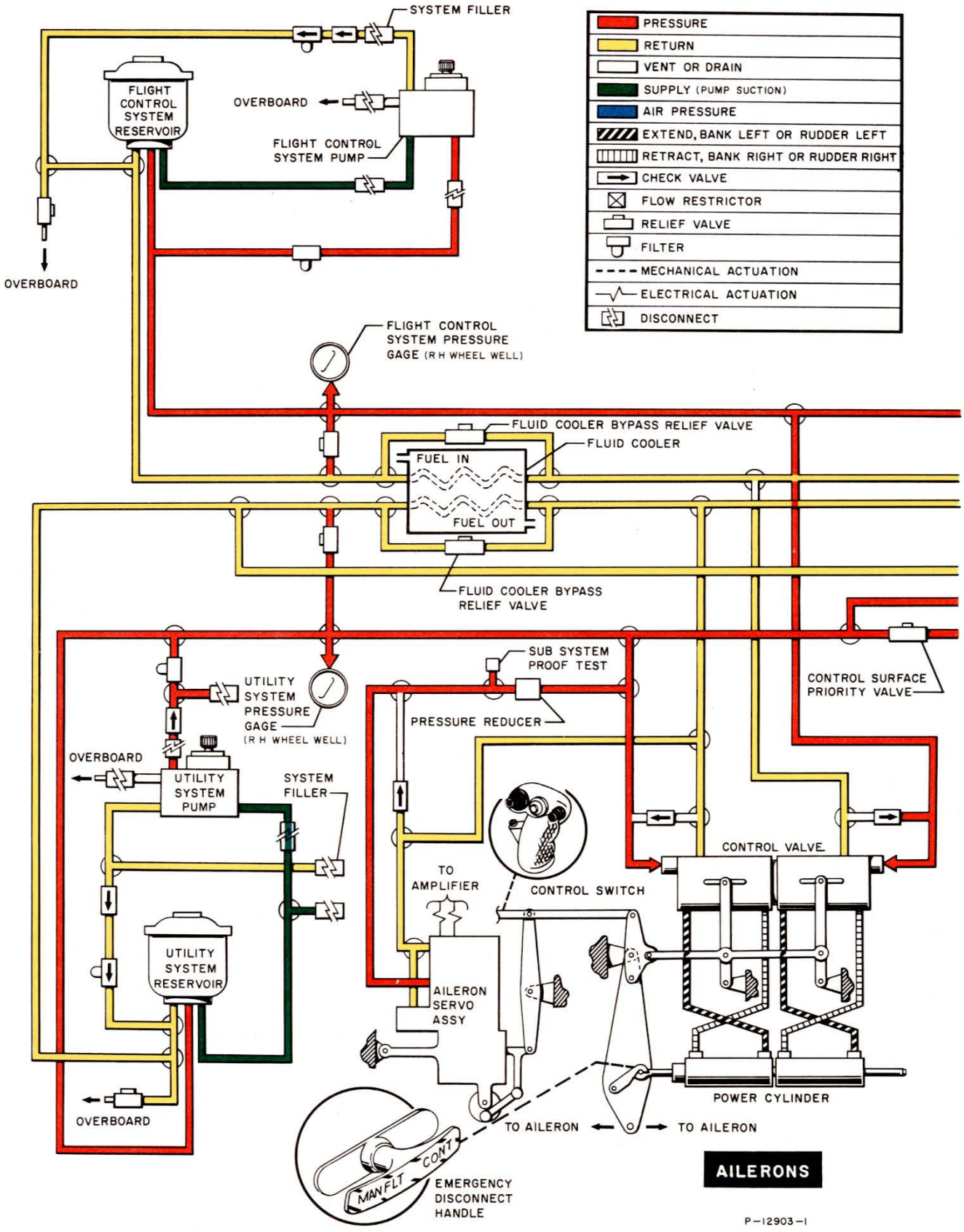


Figure 1-10. Hydraulic System (Sheet 1)

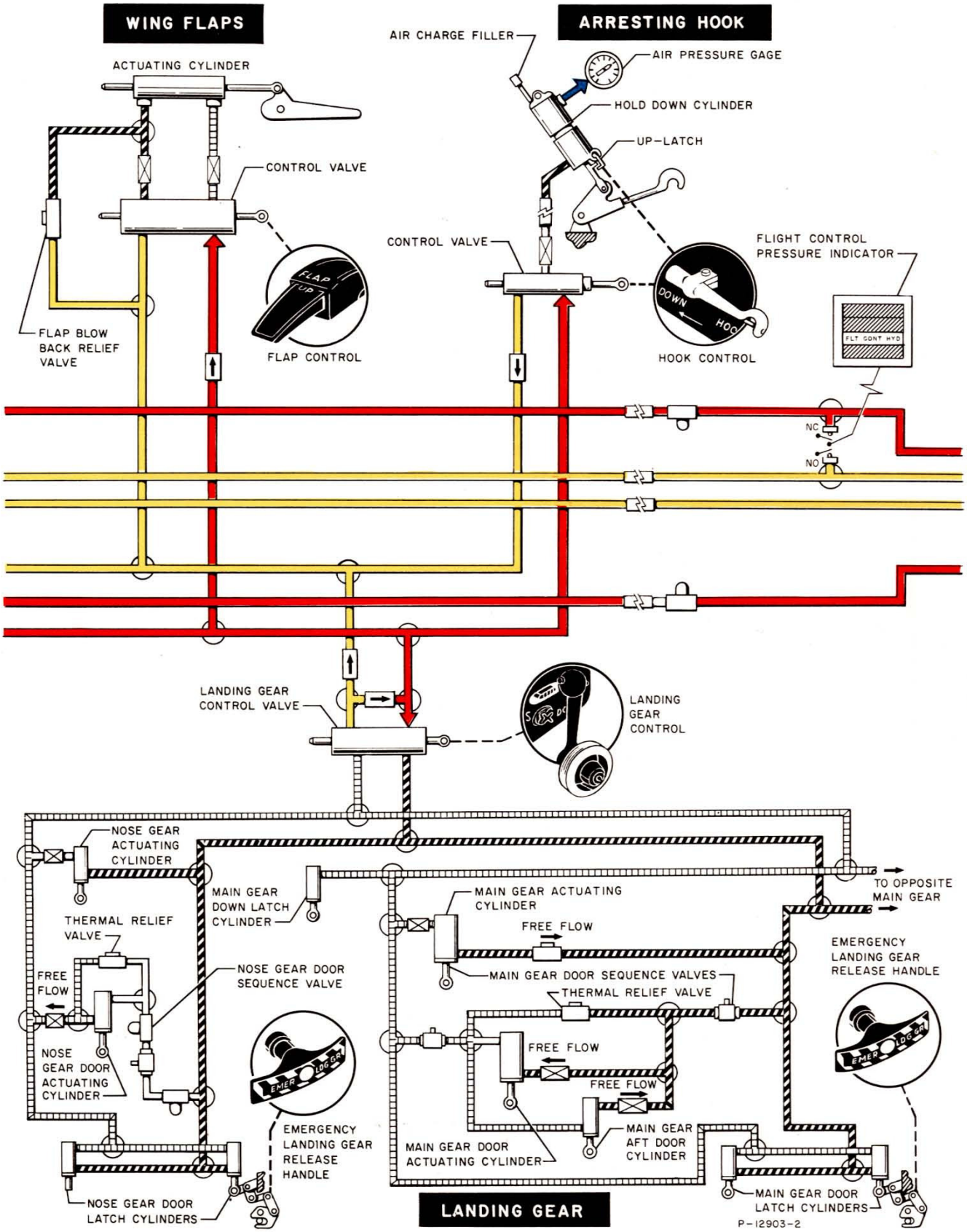


Figure 1-10. Hydraulic System (Sheet 2)

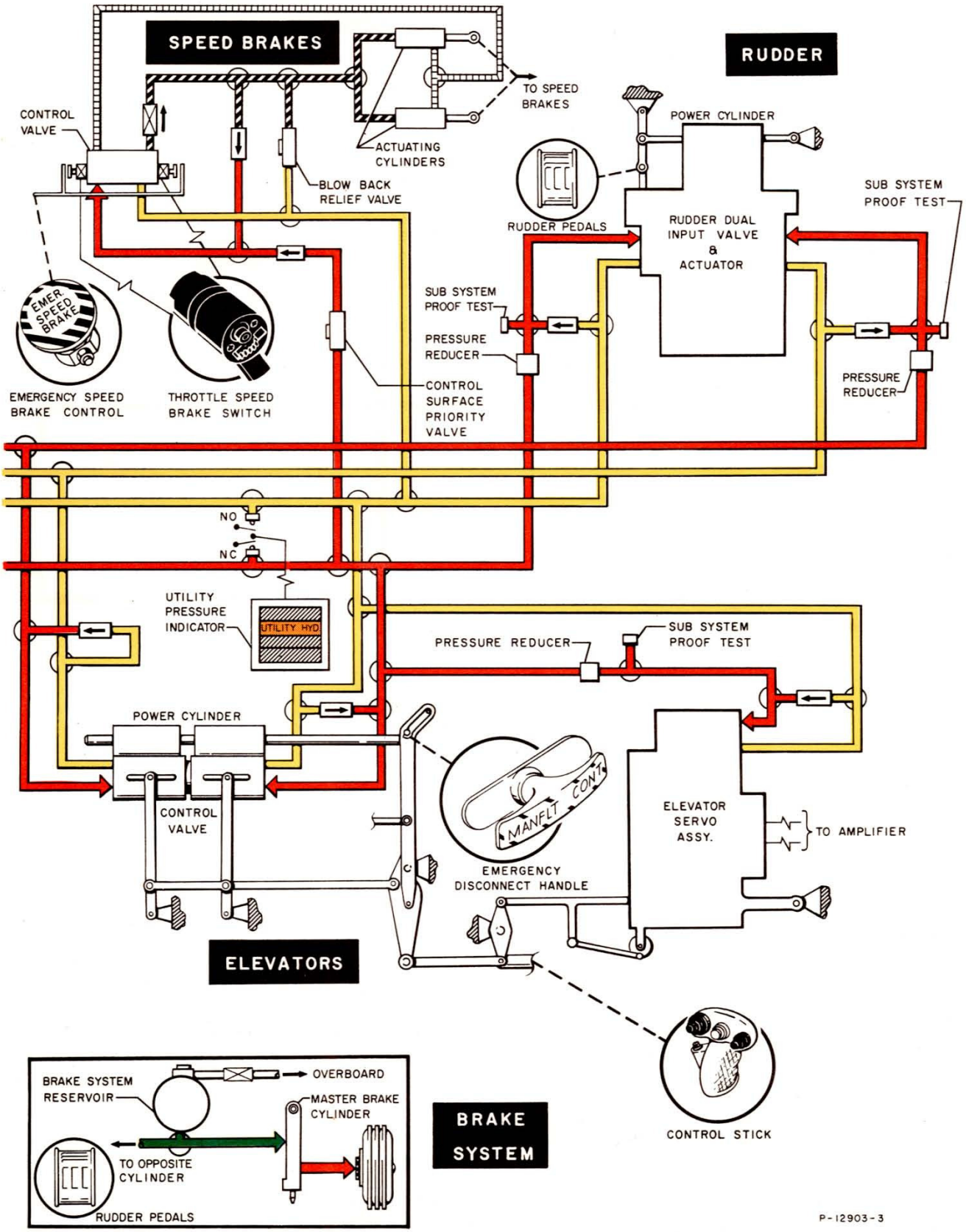


Figure 1-10. Hydraulic System (Sheet 3)

control deflection to maintain wings level after catapulting or during accelerated stalls and landing approaches. (Refer to CARRIER, Section II.)

SPEEDBRAKES

Two flush-mounted speedbrakes (35, figure 1-2), one on each side of the after fuselage, provide deceleration during flight. Hydraulically operated, the speedbrakes are electrically controlled by the SPEEDBRAKE switch (24, figure 1-3) on the inboard side of the throttle grip. Movement of the switch to either "OPEN" or "CLOSE" actuates a solenoid valve which controls the flow of hydraulic pressure to the speedbrake actuating cylinders. As the SPEEDBRAKE switch has only two positions, the speedbrakes cannot be stopped at intermediate positions between fully opened and fully closed. A speedbrake position indicator is installed on the left-hand side of the instrument panel. The indicator illuminates whenever the speedbrakes are in any position other than fully closed. A "blow-back" feature allows the speedbrakes to begin closing when the airload against them causes the hydraulic pressure in the actuating cylinders to exceed the pressure at which the blow-back relief valve opens (3500 psi), thus preventing damage to the speedbrake system. The speedbrakes begin to blow back at an indicated airspeed of approximately 490 knots. The speedbrakes will not open fully effectively above 440 knots IAS.

EMERGENCY SPEEDBRAKE CONTROL

The airplane is equipped with an emergency speedbrake solenoid valve manual override control. The EMER SPEED BRAKE control (2, figure 1-3) at the aft end of the left-hand console can be used to open or close the speedbrakes in the event of complete d-c electrical failure, or failure of one of the speed-brake control valve solenoids. The EMER SPEED BRAKE control is held in a "neutral" position by the action of a spring bungee and must be pulled up or pushed down momentarily to open or close the speedbrakes, respectively.

In the event of hydraulic system and electrical failures with the speedbrakes open, they may be closed to the trail position by the manual control.

SPEEDBRAKE-ELEVATOR INTERCONNECT. A speedbrake-elevator interconnect spring minimizes the tendency of the airplane to change trim when the speedbrakes are opened or closed.

VORTEX GENERATORS

To combat buffet during high g maneuvers, vortex generators, which are small metal vanes set at various fixed angles relative to the normal airflow, are installed along the span of the slats.

LANDING GEAR SYSTEM

The tricycle landing gear is retracted and extended by utility hydraulic system pressure during normal operation. The main gear retracts up and forward, the wheels rotating to fit flush into the wheel wells in the wings. The struts do not retract into the wings, but are housed within the strut doors. When retracted, the main gear is held up by hydraulic pressure in the system and in the case of hydraulic system failure, the gear rests on the doors and is held up by latches on the wheel doors. The nose gear also retracts up and forward, the strut telescoping to allow the wheel to fit into the nose wheel well in the nose section. The nose wheel and strut are completely contained within the nose section when retracted, and are held up similarly by hydraulic pressure in the system. For emergency operation of the landing gear system, the door latches can be mechanically released by the pilot.

LANDING GEAR CONTROL. The landing gear control (12, figure 1-3) on the left cockpit rail controls the normal operation of the landing gear system. Labeled WHEELS, the landing gear control has two positions, "UP" and "DOWN," and is mechanically linked to the landing gear control valve.

CAUTION

Move the landing gear handle firmly into the "UP" or "DOWN" detents.

A warning light in the wheel-shaped handle of the control glows when the control is moved to either of its two positions. The light will remain illuminated until the wheels are locked in either the retracted or extended positions. The position of the wheels is shown on the wheels and flaps position indicator on the left side of the instrument panel. To prevent movement of the landing gear control to "UP" when the aircraft is on the ground, a safety solenoid is actuated by a switch on the left main gear strut when the weight of the aircraft compresses the strut, causing the landing gear control to be latched in the "DOWN" position. In normal operation, the safety solenoid is energized when the aircraft becomes airborne, unlatching the control handle. If the safety solenoid should malfunction, or if it should become necessary, during an emergency, to retract the landing gear while on the ground, a knurled knob (11, figure 1-3) on the landing gear control panel may be moved aft to unlatch the landing gear control.

WHEELS AND FLAPS POSITION INDICATOR

The position of the landing gear and wing flaps is presented on the wheels and flaps position indicator (30, figure 1-3) located on the left console. When the wheels are down and locked, the image of a wheel appears in a small window provided for each wheel on the instrument. When the landing gear is up and locked, the word "UP" appears in each window. During the period when the landing gear is transient, or whenever the wheels are not locked in position, diagonally striped signals are shown in the windows. The position of the wing flaps is shown, with respect to the wing, in units

from "UP" through "½" to "DOWN," each unit corresponding to one-quarter of the total amount of extension possible.

EMERGENCY LANDING GEAR SYSTEM

In the event of utility hydraulic system failure, the landing gear may be lowered manually by means of the EMER LDG GR release handle (13, figure 1-3) on the extreme left side of the cockpit, above the left console. When the landing gear control is moved to "DOWN" and the EMER LDG GR release handle is pulled, the wheel and strut doors are unlatched, allowing the landing gear to drop into the airstream. The gear extends and locks by a combination of ram air force and gravity. Once lowered by the emergency system, the landing gear cannot be retracted again unless utility hydraulic pressure is available. Refer to section III for emergency operation of the landing gear system.

BRAKE SYSTEM

Single-disc, spot-type brakes are installed on the main wheels only. The brake system includes a separate hydraulic reservoir (figure 1-10) located in the nose section of the aircraft. Two master brake cylinders, operated by toe pressure on the upper part of the rudder pedals, provide the pressure necessary for operation of the brakes.

Note

The wheel brakes have a completely independent hydraulic system. Accordingly, the pilot should realize that he will have brakes even though he makes a field landing without hydraulic system power. (Refer to Section III, HYDRAULIC SYSTEM FAILURES and DURING TAKE-OFF for further information.)

ARRESTING HOOK

An externally mounted arresting hook (34, figure 1-2) is installed on the lower aft fuselage. Retraction and extension of the hook are accomplished by a pneumatic-hydraulic hold-down cylinder in the aft engine compartment. The hold-down unit is essentially a reservoir which is divided into two chambers by a relief valve and orifice arrangement. The upper chamber is filled with hydraulic fluid to the full level and then charged with compressed air to 900 ± 50 psi with the hook retracted. The lower chamber contains the actuating piston which is attached to the arresting hook. Utility hydraulic system pressure is applied to the lower side of the piston to effect retraction of the arresting hook, which is then held in the retracted position by a mechanical latch. Compressed air pressure and the weight of the arresting hook cause extension when the latch is released. With the arresting hook extended, the relief valve and orifice provide snubbing action to keep the hook on the deck during arrested landings by restricting the flow of fluid between the lower and upper chambers of the hold-down unit whenever external forces tend to bounce the hook toward the retracted position.

ARRESTING HOOK CONTROL. A HOOK control (2, figure 1-5) on the right cockpit rail, controls the operation of the arresting hook. When the control is moved to "DOWN," the arresting hook is manually unlatched, allowing pressure from the hold-down unit and the force of gravity to extend the hook. A light in the handle of the HOOK control will glow when the control is moved to "DOWN," and will go out before the hook reaches the fully extended position. The "UP" position of the control manually positions the arresting hook control valve so that utility hydraulic fluid at 3000 psi flows into lower part of the arresting hook hold-down cylinder overriding the air pressure and causing the hook to be retracted and latched against the lower surface of the fuselage.

CAUTION

The arresting hook control handle should be firmly placed into position, not flipped nor slammed.

If the cable system to the latching mechanism should fail, the latch will automatically release the arresting hook; however, the HOOK control must be moved to the "DOWN" position before the hook will extend.

INSTRUMENTS

All flight and engine instruments are located either on the instrument panel (figure 1-4), or on the forward panels of the left and right consoles (figure 1-3 and 1-5). The altimeter, rate-of-climb, and airspeed indicators are connected to the pitot-static system; the turn and bank indicator is operated from compressor bleed air pressure, and the attitude gyro, fuel quantity, trim position and wheels and flaps position indicators are electrically operated. The eight-day clock and the accelerometer are independent of other systems in operation. A light is mounted in each instrument lens (except the oil pressure gage) to provide equal illumination over the entire face of the instrument.

ALTIMETER

The pressure altimeter (9, figure 1-4) indicates the altitude of the aircraft above sea level to a height of 50,000 feet. The dial face is marked in increments of 100 feet, each complete revolution of the pointer indicating change in altitude of 1000 feet. On the left of the center of the instrument is a window containing two rotating counters; the inner counter registers altitude in thousands of feet, while the outer registers ten thousands of feet. When the altimeter pointer makes twelve revolutions, for instance, the outer counter will indicate 1, and the inner counter will indicate 2, thus showing that the aircraft is at an altitude of 12,000 feet above sea level. At the extreme right side of the altimeter face is the barometric pressure window. The barometric pressure dial seen through the window is marked from 28.10 to

31.00 inches of mercury, and used to correct for variations in sea level barometric pressure by means of a knob on the lower left corner of the instrument case.

AIRSPEED INDICATOR

A combination airspeed indicator and Mach meter (8, figure 1-4) is mounted on the instrument panel. The airspeed portion of the dial is fixed in position, and is calibrated from 80 to 650 knots. The Mach meter scale is a rotating disc, marked from 0.50 to 2.0, turning beneath the airspeed dial. Only a portion of the disc can be seen through a cutout in the airspeed dial. Both airspeed and corresponding Mach number are indicated simultaneously by a single needle pointer. On the Mach number disc is a movable index which is used to set the limiting Mach number of the aircraft by depressing and turning a PUSH MACH LIMIT knob on the lower left corner of the instrument case. On the edge of the airspeed dial is an airspeed index pointer, which is adjustable through a range of from 80 to 145 knots merely by turning the PUSH MACH LIMIT knob. The airspeed index pointer is used as a reference point to indicate the minimum safe airspeed for a particular gross weight during approach and landing or slow speed flight. See figure 6-1 for stalling speeds at various gross weights and angles of bank.

ALL ATTITUDE INDICATOR

The airplane is equipped with a remote indicating, vertical gyro control with a pictorial sphere presentation gyro INDICATOR (4, figure 1-4) located on the instrument panel. This instrument provides the pilot with a constant visual attitude indication of the pitch, heading and roll of the aircraft. Aircraft attitude reference signals are supplied to the INDICATOR by electrical connection with the remotely mounted master reference platform. Pitch, roll and heading attitudes are indicated by motions of a universally mounted sphere which is displayed as the background for a miniature reference airplane etched on the instrument face, giving improved readability and interpretation even during extreme maneuvers. The horizon is presented on the sphere as a white line dividing the top and bottom halves of the sphere. The upper half, symbolizing sky, is indicated by a light grey area above the horizon line; the lower half, symbolizing earth, is indicated by a dull black area below the horizon line. The sphere is graduated every five degrees in azimuth around the horizon, and every thirty degrees around the rest of the sphere. The sphere is graduated every ten degrees of climb and dive. Thus, the indicator is very determinative of climb or dive angle in maneuvers as well as in instrument climb-outs, G.C.A. and high performance penetrations in instrument weather. The sphere is free to move a full 360 degrees in pitch, roll, or heading without obstruction. Bank angles can be read on a scale located on the instrument case. The miniature reference airplane is always in the logical physical relationship to a simulated earth, horizon or sky areas of the background sphere, and it is sufficiently realistic to enable the pilot to fly the airplane simply by flying the miniature. The indicator is capable of accurate performance in all pitch attitudes, including loops and coordinated Immelmanns. The remote gyro control unit is driven by a 115-volt, 400-cycle, 3-phase, a-c electric motor which receives current from the a-c primary bus and the control amplifier.

An adjusting knob sets the potentiometer controlling the sphere setting to line up the horizon line on the ball with the reference airplane to accommodate different trim, power settings and loading conditions of the aircraft.

The instrument is ready for use shortly after electrical power is switched to the system. Within 90 seconds the gyros are erected, the amplifier channels are warmed up and the "OFF" flag is retracted from the indicator face. Failure at any time of the a-c or d-c power supply, or the erection relay will cause the "OFF" flag to reappear.

WARNING

The indicator is not reliable for flight indications if the power warning flag is visible.

A g-programmer and g-indicator are built into the left-hand side of the face of the ALL ATTITUDE INDICATOR for use with the INDICATOR in performing the wings level bombing maneuvers (improved LABS). (Refer to Section IV and see figure 4-15.)

EMERGENCY EQUIPMENT

FIRE DETECTION SYSTEM

The fire detection system indicates the presence of fire in the area of the engine, tailpipe, and accessories section. If fire occurs in these locations, a push-to-test type FIRE warning light (6, figure 1-4) on the take-off check list panel will glow. The fire detection system may be checked by depressing the TEST switch (23, figure 1-4). When the switch is depressed, the FIRE warning light will glow, indicating a properly functioning circuit.

BAROMETRIC PARACHUTE OPENER

Parachutes used with the integrated flight suit are equipped with a barometric pressure-actuated parachute opener. The opener is designed primarily to deploy the parachute automatically at a predetermined altitude, in case the pilot is incapacitated. In addition, the opener provides a two-second delay before opening the parachute after reaching the preset altitude. When ejection is made below, at, or slightly above, the altitude for which the opener is set, this delay allows the pilot to decelerate prior to the opening of the parachute, thus reducing or eliminating any opening shock damage to the pilot or parachute. The delay also prevents the parachute from

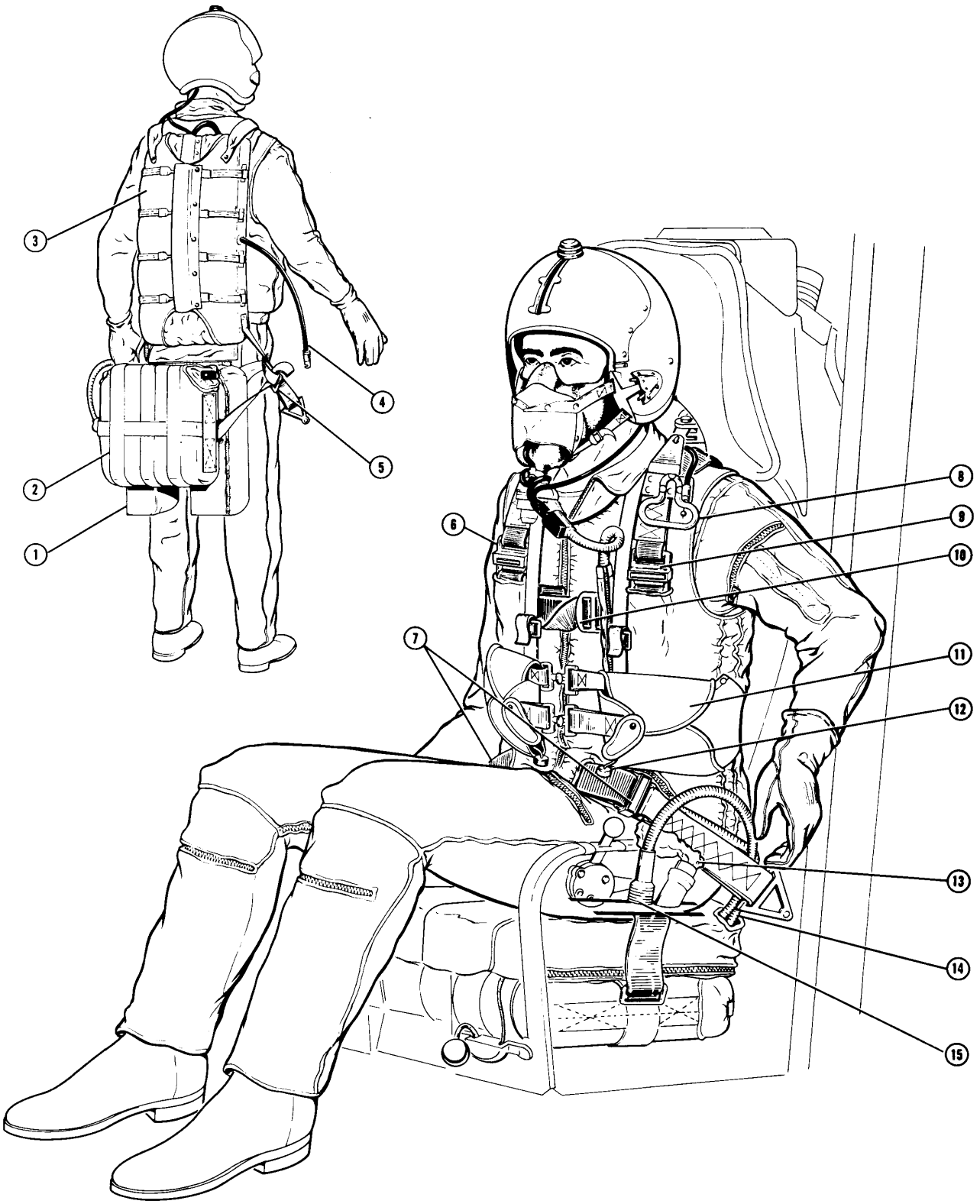


Figure 1-11. Integrated Flight Suit

← *Key to figure 1-11*

1. Seat cushion
2. PK-2 Pararaft
3. Parachute
4. Barometric parachute opener lanyard
5. Lap belt adjustment buckle
6. Shoulder harness and parachute attachment
7. Seat belt and parachute attachments
8. Parachute ripcord grip
9. Shoulder harness and parachute attachment
10. Suit harness adjustment buckle
11. Mk-3C flotation gear
12. Flotation gear actuating lanyard
13. Anti-g suit connection
14. Suit oxygen and radio connection
15. Console oxygen and radio connection

fouling on the seat when ejection is made at altitudes below that for which the opener is set, where deployment would otherwise occur immediately upon separation from the seat. The barometric parachute opener interferes in no way with the normal opening method, and the parachute ripcord grip may be pulled at any time to open the parachute.

An arming pin is inserted through the opener mechanism to prevent inadvertent deployment of the parachute during normal operation whenever the aircraft descends through the altitude for which the opener is set. The arming pin is anchored by a static lanyard to the PILOT RELEASE handle. (10, figure 1-12). When the pilot separates from the seat after ejection, the arming pin is automatically pulled and the opener is then armed.

WARNING

If the pilot's automatic harness releasing mechanism should fail to operate and the PILOT RELEASE handle must be pulled to free the pilot from the seat, the opener will not be armed and the parachute must be opened manually.

COCKPIT ENCLOSURE

The cockpit enclosure consists of a fixed, three-piece windshield and a hinged "clamshell" canopy. The two windshield side panels are of moulded plastic, and the center panel is constructed of alternating layers of glass and vinyl to provide a bullet resistant surface.

WARNING

Ejection *through* the canopy is not possible.

CANOPY

The cockpit canopy, which is hinged at the aft end by shear bolts, moves back and up when opened. When closed, the canopy is held in place on both sides of the canopy rail by latches which engage latch pins on the cockpit rails. An air bungee cylinder (23, figure 1-2), mounted aft of the ejection seat, counterbalances the canopy during normal operation and provides snubbing action. The canopy is closed by grasping the ledge on either side and by pulling down, overriding the air bungee cylinder pressure. The canopy may then be locked by moving the CANOPY control handle forward.

CANOPY CONTROLS

CANOPY CONTROLS. The CANOPY control handle (3, figure 1-3), on the left console, is mechanically linked to the canopy mechanism. Moving the control handle forward slides the canopy forward, causing the latches to engage the latch pins. Moving the handle aft slides the canopy aft, disengaging the latches and allowing air bungee pressure to open the canopy. The canopy mechanism includes an over-center device which causes a noticeable increase in control handle load as the handle approaches the locked position. This load drops off abruptly as the handle is moved past the on-center position to the locked position.

WARNING

To prevent inadvertent opening of the canopy in flight, the canopy control handle must be moved beyond the on-center position to the point of abrupt decrease in handle load.

An external CANOPY release handle, which can be reached from the ground, is set flush in the left side of the fuselage below the cockpit. Pulling the external CANOPY release handle out and forward unlatches the canopy, allowing it to open in the normal manner. To be closed and locked from the outside, the canopy must be manually held down and the external handle moved aft and in until it is flush with the fuselage.

CANOPY BUNGEE SAFETY LOCK. To prevent the cockpit enclosure air bungee from being inadvertently fired while on the ground, a canopy safety lock is provided. This lock indexes between the roller of the bungee assembly and the bracket. Attached to the lock by a chain is a 27 inch red web warning flag stenciled "REMOVE BEFORE FLIGHT."

INTERIOR CANOPY JETTISONING

CANOPY JETTISON HANDLE. The canopy may be jettisoned by pulling the CANOPY-JETTISON[1] handle (8, figure 1-3) on the left side, under the glareshield, or by moving the CANOPY control handle aft—at 200 to 250 knots or above. Below 200 knots, the canopy *may*

[1] Airplanes BuNo. 145080 and subsequent; others after ASC 103.

shear when it is opened by the CANOPY handle. However, if it does not shear, the ejection seat can not be fired. Therefore, use of the CANOPY-JETTISON handle to "blow" the canopy is recommended. When the CANOPY-JETTISON handle is pulled, the canopy slides slightly aft to unlatch, swings open, and shears at the hinges as the full pressure of the air bungee cylinder is released against the canopy structure.

WARNING

When the canopy is jettisoned, the canopy manual control handle will describe a rapid rearward arc, with possible injury to the hand or arm. If the canopy is jettisoned by use of the face curtain or the canopy-harness release, keep the hand and arm clear of the canopy control handle. If the canopy is jettisoned in flight by aft movement of the canopy control handle, anticipate a rapid rearward movement of the handle as the wind raises and shears the canopy.

If the CANOPY-JETTISON handle is pulled after the canopy has been opened manually, the air bungee will break away, allowing the canopy to fall shut. The pilot must keep the head low and the arms inside the cockpit to keep from getting injured.

UNDERWATER CANOPY-JETTISON RELIEF VALVE. Later airplanes[1] have an underwater canopy jettison relief valve which will allow water to flow into the cockpit after a ditching. The pilot can recognize the installation of the relief valve by a circular insert in the outer skin on the left side of the fuselage, alongside the ejection seat, just under the canopy rail and by a circular pad of upholstery above the left console.

The underwater canopy jettison relief valve is a door, normally sealed and held in place by a torsion rod, and designed to open when the outside water pressure head is approximately 15 feet. The flow of water into the cockpit reduces the effective pressure-head on the canopy. The use of the CANOPY-JETTISON handle is recommended—to obtain the power of the bungee. The use of the manual CANOPY handle, as well as the several other methods mentioned in Section III, should be considered as alternative, last resort methods of underwater canopy removal.

EXTERIOR CANOPY JETTISONING

An emergency canopy jettison control (9, figure 1-2) is provided on each side of the fuselage, just forward of the wing root, for jettisoning the canopy during rescue. The control is a red handle, marked PULL CANOPY JETTISON, and is installed in a recess behind a spring-loaded door. This door is plainly pointed out by a RESCUE arrow. When the door is pushed in, the PULL CANOPY JETTISON handle extends and may then be grasped and pulled to fire the air bungee cylinder.

WARNING

The catapult is armed by removal of the canopy.

EJECTION SEAT

The pilot's seat (figure 1-12) is of the ejectable type, and accommodates a back-type parachute, a modified PK-2 pararaft kit and seat pan, and is designed for use with a flight suit which incorporates an integral harness. A non-adjustable head rest is part of the seat structure and houses the face curtain. Although the ejection seat is not equipped with conventional foot rests, the front surface of the seat basin serves as a buffer for the calves of the legs, and the sides of the basin extend above the pilot's thighs to protect the legs from side forces during ejection. Ejection of the seat is accomplished by a catapult which utilizes an explosive cartridge (use ony MK3 MOD 0 cartridges) to separate the seat from the airplane. Upon ejection, a lanyard anchored to the aircraft structure fires a harness release actuator which automatically frees the seat belts and shoulder harness from the seat structure three-quarters of a second after ejection, causing the pilot and the seat to separate. The delayed action of the harness release actuator provides protection for the pilot, in that the feature retains the pilot in the seat during the period of ejection when high velocity windblast could cause premature opening of the parachute with resultant parachute damage and severe opening shock inflicted on the pilot. During the delaying period, the pilot and seat will decelerate to a speed where the stresses placed upon the pilot and parachute are reduced from the critical stage.

The harness release actuator is essentially a cylinder containing a piston, a slow-burning .38 caliber cartridge, and a firing mechanism. The firing mechanism is spring loaded and is held in a safe position by a pin, to which a lanyard is attached. A cable runs from the harness release mechanism through the pulley on the actuator piston and is anchored to the seat structure. Thus, when the seat is ejected, the actuator arming pin is pulled by the lanyard anchored to the aircraft structure, and the firing mechanism detonates the cartridge which, three-quarters of a second later, exerts enough force to actuate the piston. The piston extends, pulling the cable, and the harness release mechanism opens, freeing the seat belts and shoulder harness.

WARNING

Parachutes should be inspected to insure that the proper delay cartridges are used for the belt-harness release and not interchanged with

[1] Airplanes BuNo. 145128 and subsequent. Prior airplanes by ASC 137.

the parachute opener cartridge. There exists the possibility that the .38 caliber cartridge with a ¾-second delay for automatic opening of the belt-harness release may be interchanged with the two-second delay for automatic parachute opener. The physical appearance and size of both cartridges are the same. The seat cartridge is stamped TD-1C-0.75, and is printed red.

SEAT ATTACHMENTS

The pilot is held in the seat by attachments to the integrated flight suit (figure 1-11). This flight suit incorporates within its structure a seat belt, shoulder straps and a parachute harness, thus leaving the pilot with few of the normal encumbrances. The shoulder harness straps are sewn to the parachute risers and attach to the inertia reel connection just below the head rest. The loose ends of the parachute risers have quick-action fittings which engage other fittings that extend from the front shoulders of the flight suit. Short seat belts, which are sewn to the parachute harness on each side, and attached to the seat structure at the after corners of the seat basin, are adjustable in length. The loose ends of the seat belts have quick-action fittings which engage fittings protruding from the hip region of the flight suit. When these connections are made, the pilot is held securely in the seat.

SEAT CONTROLS

SEAT SWITCH. The seat is electrically adjusted in the vertical plane by movement of the SEAT switch (30, figure 1-4) to either of its two positions, "UP" or "DOWN," and is stopped at the desired position by releasing the switch to the center, or "off" position.

SHOULDER HARNESS CONTROL. The SHOULDER HARNESS control (5, figure 1-12), on the left side of the seat basin, controls the movement of the shoulder harness inertia reel. When the control is in the "LOCKED" position, the shoulder harness will not extend and the pilot's freedom of movement is restricted. The "UNLOCKED" position allows the shoulder harness to extend or retract as the pilot moves about. The reel will lock automatically if the airplane is subjected to a deceleration in excess of 2.5g along the thrust line. This safety feature helps to prevent injuries if the shoulder harness is not locked prior to an arrested landing or a crash. If the inertia reel fails to unlock while any load is being applied to the cable, relax the load and recycle the handle.

PILOT RELEASE HANDLE. A D-handle (10, figure 1-12), labeled PILOT RELEASE, is mounted on the right side of the ejection seat basin. From the aft end of the handle protrudes a pin which extends down through the edge of the ejection seat to anchor the arming lanyard of the barometric parachute opener. A spring-loaded latch, which is grasped in conjuction with the PILOT RELEASE handle, serves to retain the handle in the proper position and must be squeezed before the latter can be pulled. When the handle is pulled up, the barometric parachute opener lanyard and the shoulder harness and seat belt attachments are released from the seat, allowing the pilot to leave the cockpit with a parachute and pararaft kit still attached to the flight suit harness (figure 1-11).

WARNING

The PILOT RELEASE handle D-ring should not be pulled while the airplane is airborne or until it comes to a complete stop. Pulling the D-ring releases the shoulder harness and lap belt end fittings, which cannot be re-engaged in flight.

FACE CURTAIN. The ejection seat face curtain (2, figure 1-12) serves not only as a control for jettisoning the canopy and ejecting the pilot's seat, but also positions and supports the pilot during ejection. The face curtain, which is housed in the head rest structure with the handle protruding, is mechanically connected to the air bungee cylinder and the seat catapult firing mechanism. When the face curtain is pulled downward, the first portion of travel jettisons the canopy and the last portion causes the seat to be ejected. The seat will not eject until the canopy is clear of the ejection path.

WARNING

Canopy jettisoning by means of partial face curtain extension is not recommended except during the ejection sequence, since no positive stops are provided which will prevent seat ejection if tension is maintained on the face curtain after the canopy has jettisoned.

PARACHUTE RELEASE RING. In order to remove the parachute for ground inspection and maintenance, a parachute release ring (8, figure 1-12) is installed under the lower right side of the ejection seat. Pulling the ring actuates the pilot release mechanism without operating the canopy jettisoning feature. When the parachute release ring is pulled, the pilot release mechanism will remain in the the "release" position. When the parachute is replaced, a screwdriver or similar object must be inserted in a hole, labeled PUSH TO RESET PILOT RELEASE, in the seat back, in order to reset the release mechanism.

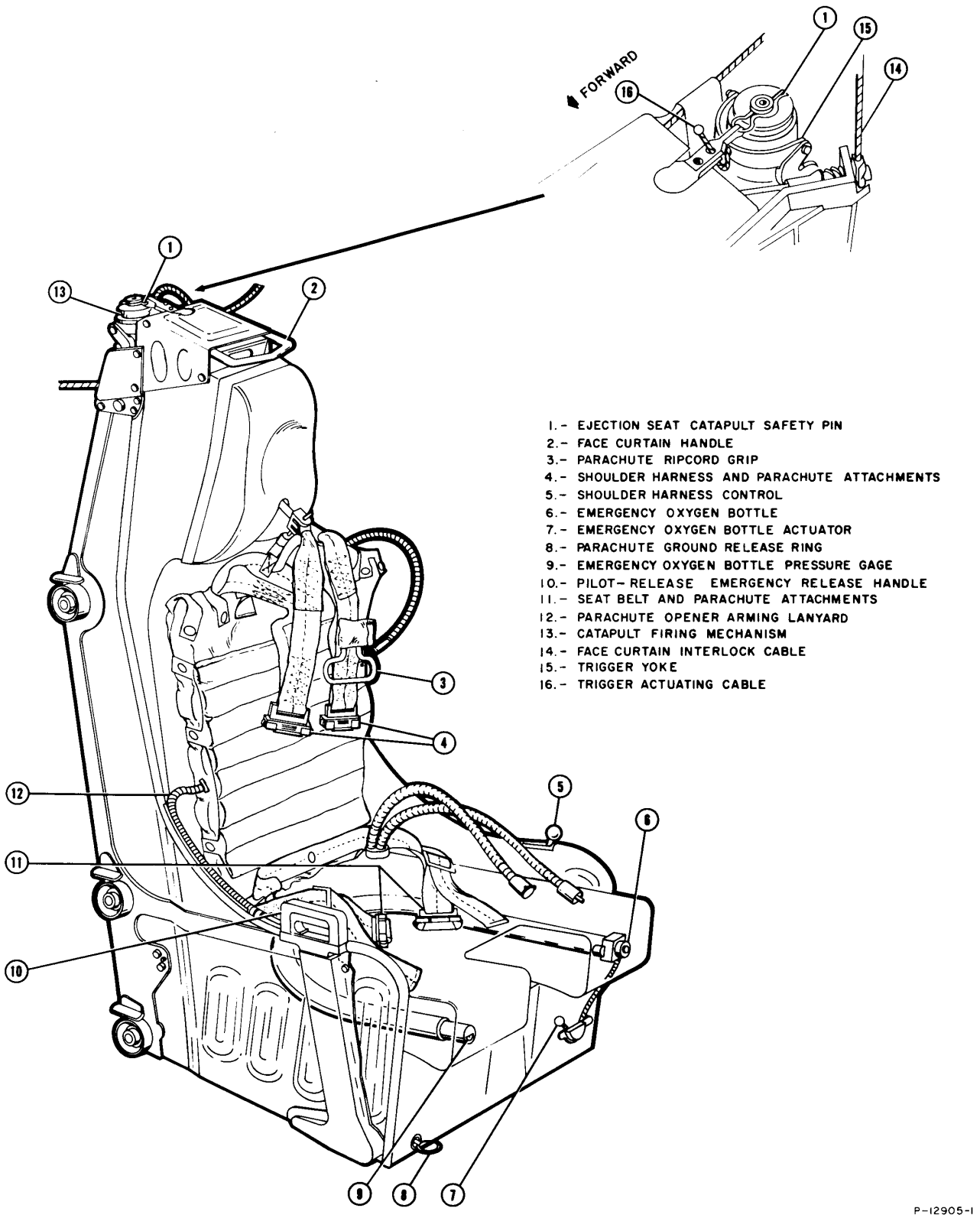


Figure 1-12. Ejection Seat

WARNING

Disconnect the barometric parachute opener arming lanyard from the PILOT RELEASE handle before removing the parachute from the seat. If this action is not taken, the arming pin will be pulled and the parachute will open.

ROCKET CATAPULT GROUND LEVEL ESCAPE SYSTEM[1]

WARNING

Make certain that the alternate ejection handle located in the pilot's seat is not inadvertently kicked or lifted. It is not safety-wired.

The rocket catapult ground level escape system provides escape capability during landing and take-off, at altitude and during such critical situations as a flame-out approach with high rate of descent. Additional features or revisions to the conventional ejection seat include:

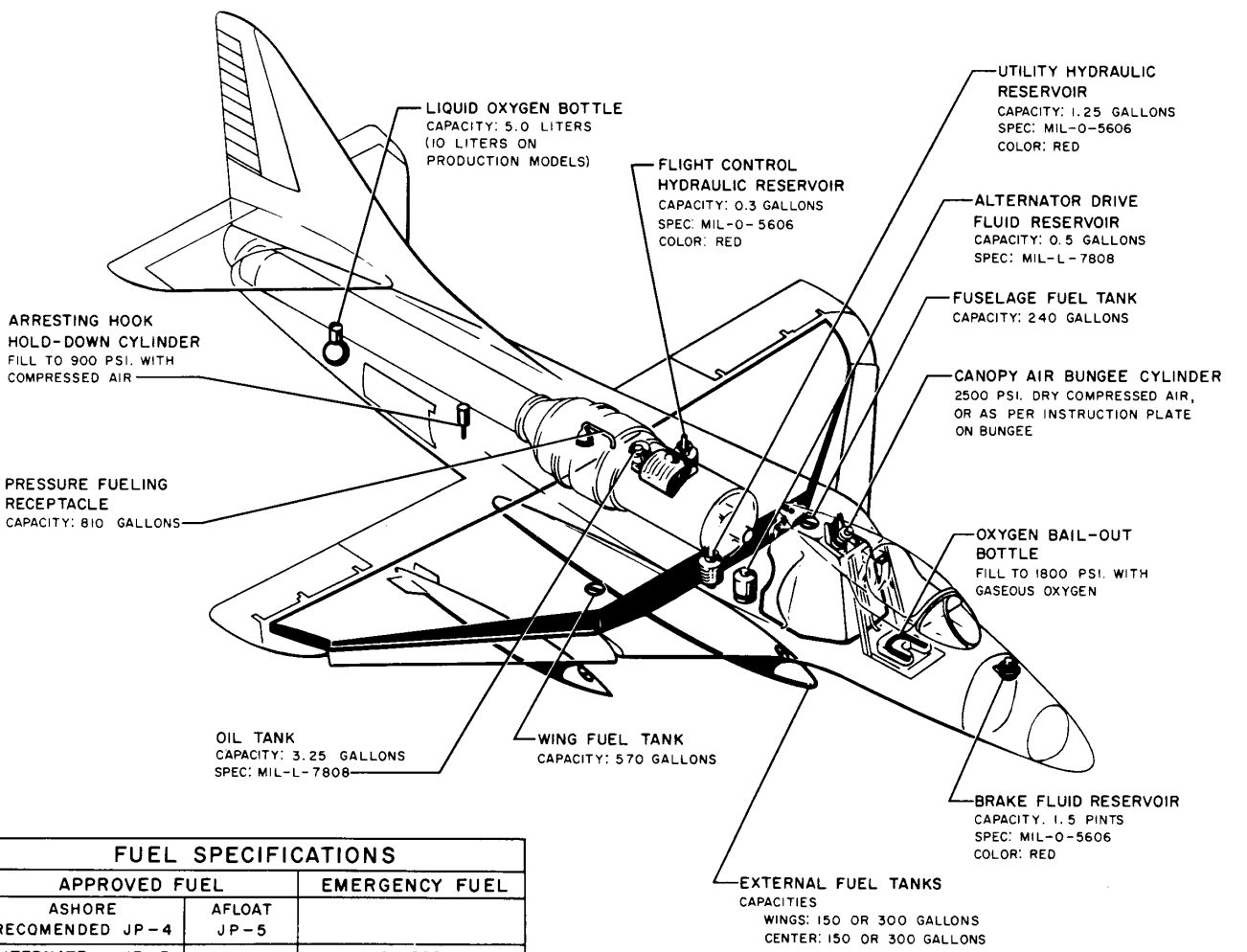
a. A new rocket catapult;

b. An alternate ejection control handle, between the legs, to avoid any undue delay of ejection due to adverse g-loadings on the pilot;

c. Seat sides extended forward and upward to provide improved leg restraint to reduce the possibility of flailing injury during high speed ejection;

d. Energy absorbing tension bars with compression tubes, and the relocation and improvement of the inertia reel, to reduce the possibility of back injuries from survivable crashes or hard arrested landings;

[1] Airplanes BuNo. 147669 and subsequent; prior airplanes by service change.



FUEL SPECIFICATIONS		
APPROVED FUEL		EMERGENCY FUEL
ASHORE RECOMENDED JP-4	AFLOAT JP-5	
ALTERNATE JP-3		AV GAS
SEE CONFIDENTIAL SUPPLEMENT, SECTION V, ENGINE LIMITATIONS, FOR FUEL LIMITATIONS.		

P-12906-1

Figure 1-13. Servicing Diagram

e. Release devices (cable cutters) on the ejection handles to give quick and certain separation of pilot and handle from the seat;

f. A separation bladder to expedite pilot separation from the seat after ejection and prior to parachute opening;

g. More adequate tail clearance in the high speed envelope;

h. A modified NB-7 parachute assembly consisting of a wedge-shaped pack, 28 foot flat parachute, and a 2-second opener time delay.

EJECTION SEQUENCE

a. The pilot initiates the ejection sequence by pulling the face curtain handle *or* alternate ejection handle;

b. The canopy jettisons;

c. The seat is accelerated initially by a catapult propellant charge to a velocity of 50 feet-per-second as it leaves the ejection guide rails. Then the rocket propellant is ignited, further accelerating the seat by a thrust forward and upward through the seat-pilot center-of-gravity, which provides a vertical end velocity of approximately 103 feet-per-second and a vertical height of 160 feet. The maximum design acceleration along the pilot's spine is 16 g's;

d. After a ¾-second delay, the harness release actuator releases the pilot from he seat, disconnects the ejection handles (cable cutters) and inflates the separation bladder;

e. Drag differential and the separation bladder separate the pilot from the seat, thereby arming the parachute opener;

f. After a 2-second delay, the parachute pack opens if it is below the preset altitude;

g. The parachute deploys, fills, and a steady rate of descent is achieved from 160 to 100 feet above the initial altitude.

AUXILIARY EQUIPMENT

Refer to Section IV for description and operational procedures for the following auxiliary systems and equipment:

Air Conditioning and Pressurization System

Defrosting System

Anti-icing System

Communication and Associated Electronic Equipment

Lighting Equipment

Oxygen System

Automatic Flight Control System

Navigation Equipment

Angle of Attack-Approach Lights System

Armament Equipment

In-Flight Fueling System

Miscellaneous Equipment

SECTION II
NORMAL PROCEDURES

BEFORE ENTERING THE AIRPLANE

FLIGHT RESTRICTIONS. Refer to Section V for restrictions to be observed during operation of the aircraft and engine in flight.

CRUISE CONTROL. To determine the required fuel, power settings and airspeeds necessary to accomplish the assigned mission, refer to Appendix I.

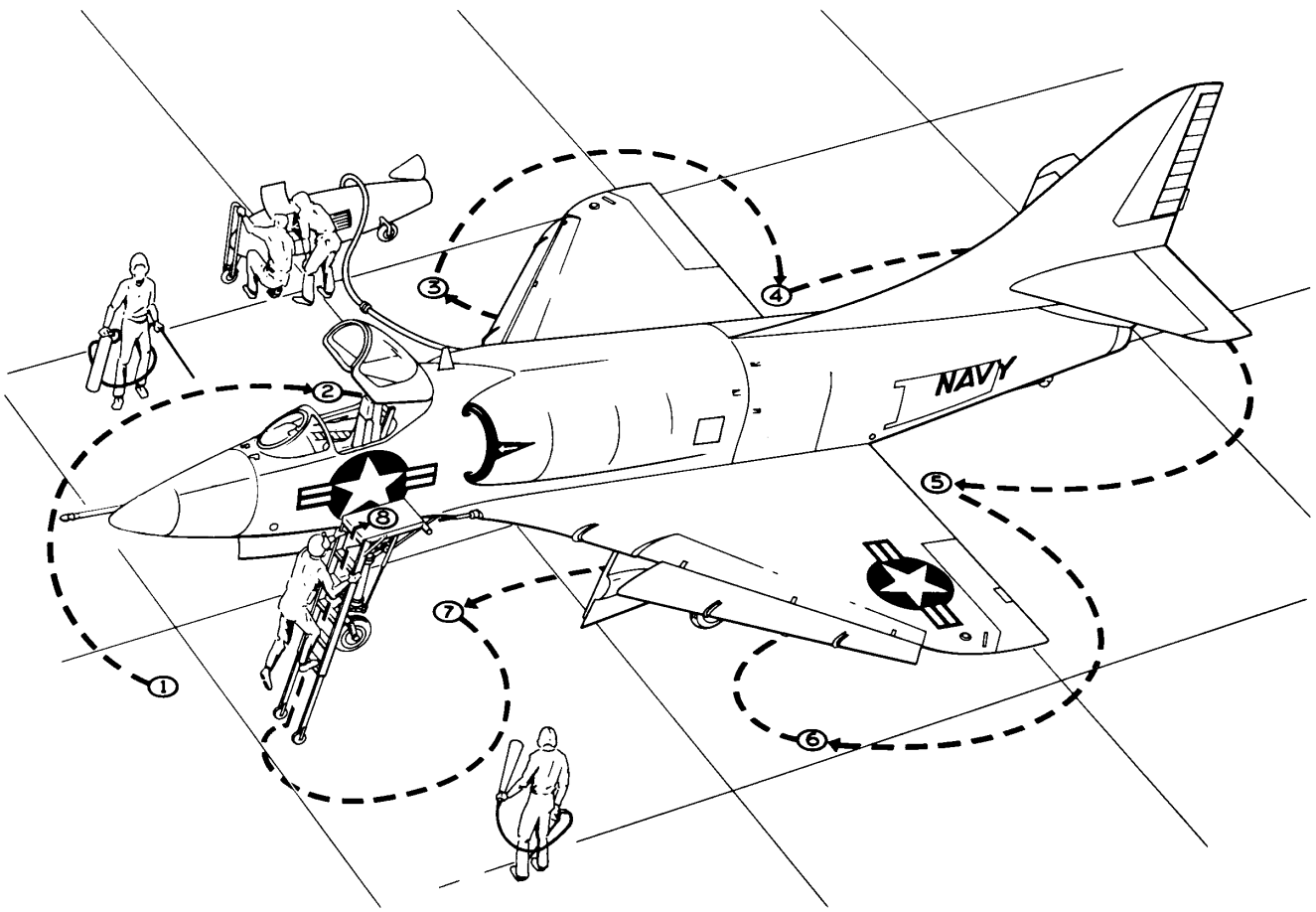
WEIGHT AND BALANCE. Determine the weight of ammunition, bombs and other stores which are loaded. Check gross weight for takeoff and determine the anticipated gross weight for landing by computing the weight of stores to be dropped and fuel to be used during the mission, referring to Section V for weight limitations. Insure that the distribution of loads falls within the center of gravity fore and aft limits as specified in the Handbook of Weight and Balance Data, AN 01-1B-40. It is necessary that a Weight and Balance Form F be completed when the aircraft is loaded in a manner for which no previous form has been filed.

CHECK LISTS

See figure 2-3 for a reproduction of the TAKEOFF and LANDING check lists appearing in the cockpit of the aircraft.

EXTERIOR INSPECTION

Consult the Naval Aircraft Flight Record (yellow sheet) to determine the status of the aircraft and that it has been fully serviced with fuel, oil, oxygen, compressed air, and hydraulic fluid.



P-12907-1

Figure 2-1. Exterior Inspection

Inspect the exterior of the airplane, proceeding as shown in figure 2-1.

1-2. FORWARD FUSELAGE

a. Air conditioning intake and exhaust ducts ..... clear

b. Static pressure vent (left side) ..... clear

c. Angle of attack vane ..... condition, free movement

d. Nose compartment panels .. condition, security

e. Inflight fueling probe cover ..... removed

f. Nose compartment cooling air inlet ..... clear

g. Static pressure vent (right side) ..... clear

h. Controls access panel (right side) ..... secure

i. Nose wheel well door ..... condition, security

j. Nose wheel strut ..... proper extension, no leakage

k. Nose wheel tire ..... proper inflation, no slippage (tube tires)

l. Nose wheel downlock pin .. inserted

m. Emergency generator ..... retracted, secure

n. CANOPY JETTISON handle ..... stowed; access door closed

o. Engine intake plug ..... removed

p. Intake duct ..... free of foreign objects

q. Wing tank filler cap ..... secure

2-3. R-H WHEEL WELL

a. Main wheel well doors .... condition, security

b. GUN PNEUMATIC PKG pressure gage ..... 3200 ± 200 psi

c. ARM SAFETY DISABLE SWITCH ..... "SAFE"

d. Main wheel strut ..... proper extension, no leakage

e. Main wheel tire ..... proper inflation, no slippage (tube tires)

f. Main gear downlock pin ... inserted

g. Fuel system vent ..... clear

3-4. R-H WING

a. General condition ..... wrinkles, cracks, loose rivets; bottom surface free of stains indicating fuel or hydraulic fluid leaks

b. Wing rack store ..... secure

c. Wing slat ..... free movement

d. Starting power ..... connected or available, if required

e. Navigation and formation lights ..... condition

f. Aileron and wing flap .... condition, bonding

4-5. AFT FUSELAGE AND TAIL SECTION

a. Aft engine compartment access door ..... closed

b. Wing tank water/sediment drain cock ..... drained

c. Speed brake ..... condition, security

d. Tailpipe cover ..... removed

e. Tailpipe ..... cracks, wrinkles, burns, fuel deposits

f. Tail light ..... condition

g. Rudder, elevator, and horizontal stabilizer ..... condition, bonding

h. Speed brake ..... condition, security

i. Arresting hook ..... retracted and locked, condition

j. Arresting hook hold-down cylinder pressure gage ..... 900 ± 50 psi

5-6. L-H WING

a. Wing flap and aileron .... condition, bonding

b. Aileron tab ..... condition

c. Navigation and formation lights ..... condition

d. Wing ..... wrinkles, cracks, loose rivets; bottom surface free of stains indicating fuel or hydraulic fluid leaks

e. Wing slat ..... free movement

f. Wing rack store ..... secure

g. Approach lights and cover ..... condition

6-7. L-H WHEEL WELL

a. Main wheel tire ..... proper inflation, no slippage (tube tire)

b. Main wheel strut ..... proper extension, no leakage

c. Main gear downlock pin ... inserted

d. Main gear doors ..... condition, security

7-8. CENTER FUSELAGE UNDERSIDE

a. Fuselage rack store ..... secured

b. GUN PNEUMATIC PKG pressure gage ..... 3200 ± 200 psi

c. Forward engine and accessories section access door ..... closed

d. Link and case ejection chutes ..... clear

e. Fuselage tank water/sediment drain cock ..... drained

8-9. COCKPIT AREA

a. Engine intake plug ..... removed

b. Intake duct ..... free of foreign objects

c. CANOPY JETTISON handle ..... stowed; access door closed

d. Canopy cover ..... removed

e. Entrance ladder ..... in place

f. Controls access panel ..... secure

g. Canopy control ..... pull out and forward to open canopy

h. Fuselage tank filler cap ... secure

i. Pitot tube cover ..... removed

j. Canopy air bungee cylinder air pressure gage ..... 2500 psi or as per instruction plate on the bungee

k. Momentarily depress the canopy bungee drain valve button (on the forward side of the bungee) and observe that no moisture is blown out. If moisture is present, continue bleeding until no moisture is obtained. Then recheck pressure as per item "j."

l. Canopy surface and seal ... condition

m. Ejection seat catapult safety pin and lanyard ..... installed

n. Canopy bungee safety lock removed

AFTER ENTERING THE AIRPLANE

INTERIOR INSPECTION. Check the general appearance of the cockpit, and make sure that all gear is properly stowed and secure. Make proper harness, oxygen, radio, and anti-blackout connections, and perform the following checks before starting the engine:

CAUTION

Before power is supplied to the airplane, make certain that the WHEELS control is "DOWN" and that the HOSE JETTISON switch (tanker only) is off (forward).

a. EMER SPEED BRAKE control ..... "Normal"

b. ANTI-BLACKOUT valve control ..... "HI" or "LO"

c. DROP TANKS switch .... "OFF"

d. START-ABORT switch ... Pulled out

e. FUEL CONTROL switch .. "PRIMARY"

f. FUEL valve control ..... "NORMAL"

g. Throttle ..... "OFF"

h. SPEEDBRAKE switch ..... "CLOSE"

i. Master exterior lights switch ..... Off

j. Horizontal stabilizer manual override switch ..... Centered

k. FLAP control ..... "UP"

l. AIR START switch ..... "OFF"

m. THROTTLE FRICTION wheel ..... As desired

n. OXYGEN control ..... "OFF"

o. Oxygen quantity ..... Full

Bail-out bottle pressure..... 1800 psi

p. All armament switches .... Off

q. Altimeter ..... Field elevation

r. Airspeed indicator ..... Set limiting Mach number and minimum airspeed

s. Accelerometer ..... Push to set

t. Clock ..... Set time

u. PITOT HEAT switch ..... "OFF"

v. HOOK control ..... "UP"

w. IFF MASTER switch ..... "OFF"

x. UHF radio control panel . . Desired frequency

y. Master radio switch . . . . . "T/R"

z. INT LTS control panel . . . . All switches "OFF"

aa. AIR COND control . . . . . "OFF"

ab. Windshield air . . . . . "ON"

ac. EXT LTS control panel . . TAXI light "OFF"

ad. SPARE LAMPS container . Adequate supply

ae. Check operation of interior and exterior lights.

af. ASN-19A . . . . . Set up

BEFORE STARTING THE ENGINE

Ascertain that the areas forward and aft of the aircraft are clear of personnel and loose objects. (See figure 2-2 for danger areas.) Make certain that fire fighting equipment is available and manned. If possible, start the engine with the airplane headed into the wind, as a tailwind will increase exhaust gas temperature and will

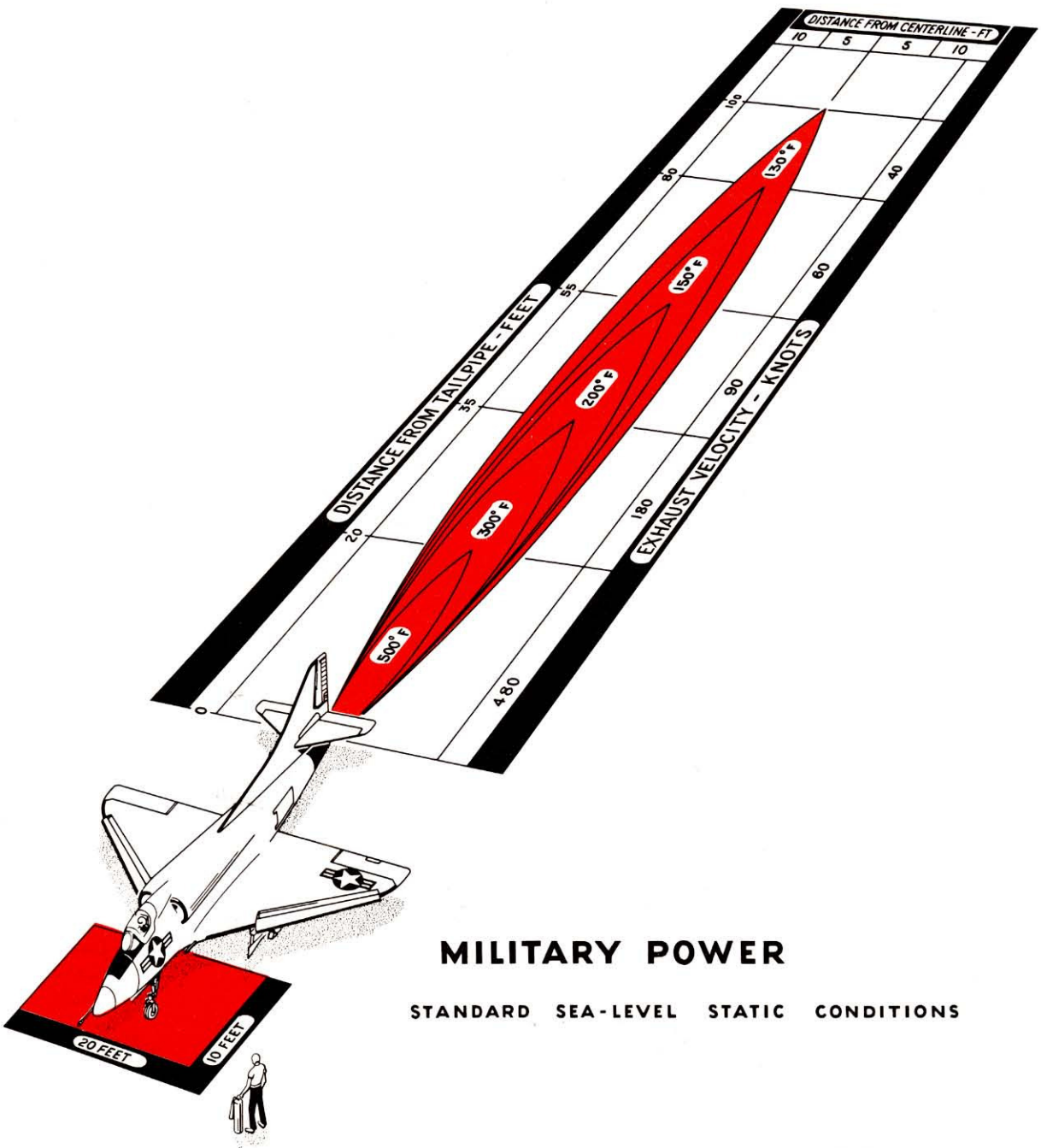


Figure 2-2. Danger Areas

aggravate any engine fire occurring during starting. Check throttle for freedom of movement and full travel.

SUITABLE STARTER UNITS. Suitable starter units for A4D airplanes are:

a. GTC-85 (USN)

b. MA-1TA (Palouste and Continental)

c. MA-1A (AiResearch and Continental)

d. MA-1, MA-2 (Consolidated)

e. MD-1A (Hough Tractor with GTC-85 unit)

f. MD-2A (with GTC-85 unit)

g. ME-1A (with GTC-85 unit)

h. GTCE-85-1 (with GTC-85 unit)

The GTC-15, GTC-24, and GTC-28 units can be used; however, at minimum temperatures (−65°F), the -24 develops torque high enough to damage the engine starter installation.

The following units are *not* usable:

Boeing 502, MC-1, MC-11, and MA-1MP.

STARTING THE ENGINE

The engine should always be started on the ground in the following prescribed manner:

a. Throttle ..... "OFF"

b. START-ABORT switch ... Depress

c. Throttle ..... "IDLE" when the rpm pointer reaches "START"

Note

Move the throttle *promptly* to "IDLE." The turn-up time between "START" RPM and automatic ignition cut-off is very short.

CAUTION

- Pilot controlled starts are recommended. Electrical connection from the starter circuit external receptacle located on the starter probe assembly to the gas turbine ground power unit must be made prior to starting to insure automatic shut-off of the air supply at the correct starter cut-out speed. Hand signals or ground controlled starts are *not* recommended for initiation and/or shut-off of the ground air supply. The time delay inherent in this method may result in starter overspeeding severe enough to cause starter failure or damage. Starter failure due to overspeeding is hazardous to operating personnel. Pilots and crewmen are cautioned that, if the air supply automatic shut-off malfunctions, air to the starter must be shut off manually at a speed not to exceed 30% engine rpm. The 30% engine rpm overspeed cut-off limit will not be reached unless a malfunction occurs.
- Even though the 30% rpm position can only be estimated on the indicator, the fact that the EGT usually peaks at approximately 24% rpm (pointer midway between "START" and "IDLE") during initial engine acceleration can be used to help anticipate the 30% rpm starter cut-off speed in giving the cut-off signal.
- The control valve in the gas turbine ground power unit will *not* shut off the air supply automatically unless the unit is connected *electrically* to the airplane starting circuit.

Note

The ground crew should check the output of the generator on all three phases with the proper electrical test unit during each start.

When the engine starts, it may be necessary to manipulate the throttle to prevent exceeding the starting limitations stated in Section V. Throttle manipulation is effective only in the positions from "IDLE" to about halfway back toward "OFF." Below this position fuel flow to the engine may be cut off. When the engine speed is stabilized with the throttle at "IDLE," check the following:

a. RPM ..... "IDLE"

b. TEMP ..... 660° (670°)[1]C

Note

At "IDLE" rpm, the TEMP pointer will normally stabilize at a position below the maximum indicated above.

c. FUEL BOOST ..... "NORM"

d. OIL PRESS ..... "NORM" (20-40 psi)

Note

If the OIL PRESS window reads "OUT" at "IDLE" rpm, increase rpm to slightly above "IDLE." If "NORM" is not indicated at this higher rpm, shut down the engine and determine the reason for the lack of, or low, oil pressure indication.

CAUTION

- Do not operate the engine without oil pressure for longer than one minute after initiating a start.

[1]Applicable only to engines incorporating NEB 197 and 196.

- Immediately following accomplishment of a successful start, signal ground crew to remove the starter assembly. Running the engine with the starter probe inserted transmits "feed-back torque" to the starter probe, with possible damage to the starter engaging mechanisms.

ABNORMAL STARTS

HOT START. Any start during which the exhaust gas temperature (EGT) exceeds the starting limit (Refer to Section V) is a "hot start". If the starting limit seems likely to be exceeded, retard the throttle as necessary toward "OFF" to reduce starting fuel flow. Continue to monitor EGT. After EGT has decreased, advance the throttle cautiously to "IDLE". If the starting limit is exceeded, immediately move the throttle to "OFF". Before attempting another start, have a crew member check the overboard drain to make sure that fuel has drained completely from the combustion chamber. If the engine's starting temperature consistently exceeds the limit when high ambient air temperatures are not a factor, have the engine inspected to determine the cause. (Refer to the trouble shooting procedure in the engine Handbook of Service Instructions, AN 02B-35AAC-2). For temperatures requiring a special hot section inspection, refer to Flight Handbook Supplement, Section V.

FALSE START. Normally, engine starting speed should be attained within thirty seconds after depressing the START-ABORT switch, and light-off should occur within fifteen seconds after movement of the throttle to "IDLE". If these do not occur within the prescribed times, retard the throttle to "OFF" and pull up on the START-ABORT switch to deactivate the starter.

If the engine does not accelerate to idling speed within 120 seconds and the exhaust temperature does not rise, retard the throttle to "OFF" and have the ground crew investigate.

CHUGS AND STALLS. If chugging is encountered during an acceleration, there will be a momentary rpm hesitation without an exhaust temperature rise. Engine stall may or may not be accompanied by chugging. If a stall is encountered, the rpm will hang-up and then start dropping, with the exhaust gas temperature increasing rapidly. Should either a chug or a stall occur, shut down the engine and investigate.

CAUTION

Present procedures call for replacement of the fuel control unit after the first reported compressor chug, and change of both the engine and the fuel control unit if chugging is encountered during subsequent flights.

CLEAR ENGINE PROCEDURE. To clear the engine of excess fuel after abnormal starts:

a. Throttle ..... "OFF"

b. Depress the START-ABORT switch.

c. Allow the engine to turn for 15 to 20 seconds.

d. Pull up on the START-ABORT switch.

AFTER STARTING THE ENGINE

When electrical power becomes available after starting the engine, check the following items:

a. MANUAL FUEL warning light ..... Push to test

b. LABS light ..... Push to test

c. Marker beacon indicating light ..... Push to test

d. Attitude gyro indicator .... Uncaged and warning flag not in view

e. Check OXYGEN quantity indicator.

f. Depress WARN-TEST switch to check FIRE, FUEL TRANS, UTILITY HYD, CONTROL HYD, and SPD BRK OPN warning lights, OXYGEN quantity FUEL QUANTITY indicating circuits.

g. SEAT switch ..... "UP" or "DOWN" until seat reaches desired position

h. COMPASS CONTROLLER panel ..... Set course indicator

Note

In addition to the normal inspection after starting the engine, check the operation of all interior and exterior lights when flight is to be conducted at night.

ENGINE GROUND OPERATION

No warm-up period is necessary, and engine ground operation should be held to a minimum. Fuel consumption is high, even at low power settings. Certain engine operating checks must be conducted on the ground, however, to insure satisfactory performance.

GROUND TESTS

The following tests should be made to check satisfactory operation of the aircraft systems:

a. FLAP control—Move to "DOWN," checking movement on the flaps position indicator. Move to "UP" and then to "STOP," noting movement. Move to "UP" to retract the flaps completely.

b. SPEEDBRAKE switch — "OPEN"; check SPD BRK OPN indicator light, ascertain that control stick moves forward, have ground crew check speedbrake travel, then move to "CLOSE."

WARNING

Before actuating speedbrakes, be certain the aft area is clear in order to prevent injury to ground personnel.

c. TRIM switch—Select "NOSE UP" and "NOSE DOWN," checking trim position indicator for correct movement. Move to "RWD" and "LWD", checking left aileron for trim movement. Trim for stick centering.

d. Rudder trim switch—Move to "NOSE LEFT" and "NOSE RIGHT", checking correct movement of the trim position indicator and rudder pedals.

e. Horizontal stabilizer manual override switch—Check that manual override switch overrides the stick trim switch. Select "U" or "DOWN", noting proper movement on the trim position indicator.

f. Move all flight controls through their entire range of movement, checking correct deflection with respect to control stick and rudder pedal positions. Direct attention to any abnormal control forces during this check. Abnormal forces may indicate disengagement of hydraulic power control mechanisms or a faulty hydraulic flight control system.

Note

- Prior to taxiing, on the first flight following an inspection during which the tail section has been removed, check for proper flight control deflection and speed brake operation to ensure that hydraulic lines are properly connected.
- Cockpit indications in the above control position checks should be verified by ground personnel.

g. Pre-flight check autopilot, if feasible (See Section IV.)

TAXIING INSTRUCTIONS

When ready to taxi, advance the throttle to some value above "IDLE", and allow thrust to develop before releasing the brakes. Release the brakes, and when the desired taxiing speed is reached, retard the throttle to a point at which that speed is maintained. Under normal conditions, "IDLE" RPM should be adequate to maintain a safe taxiing speed. Do not taxi with the canopy open at speeds which, coupled with headwinds, cause the relative wind to exceed 60 knots. Use the brakes to turn the aircraft, as the rudder will not be effective at normal taxiing speeds. Avoid sharp turns to prevent excessive wear on the tires, and to minimize the risk of overturning in a crosswind. Moreover, sharp turns can, in some instances, lock the nose wheel at full throw, requiring outside help or excessive power application for recovery. Hold taxi time to a minimum to conserve fuel, as fuel consumption is approximately three gallons per minute at idle rpm at sea level.

CAUTION

Do not taxi unless the canopy is either open or is completely latched.

BEFORE TAKE-OFF

PRE-FLIGHT AIRCRAFT CHECK

a. Canopy ..... closed and locked

b. AIR COND control ..... Desired temperature

c. Trim

Aileron ..... Stick centered

Rudder 0

Horizontal stabilizer ..... 8 degrees "UP" for half flaps; 4 degrees "UP" for no-flaps take-off

Note

Horizontal stabilizer trim should be cycled for checking *prior* to leaving the chocks. It should then be set at the recommended position. The trim should not be changed prior to take-off—to assure proper stabilizer position for take-off in the event of failure of the trim position transmitter.

d. Wing flaps ..... as desired

e. SPEEDBRAKE switch .... "CLOSE"

f. EMER SELECT switch .... "ALL"

g. Observe fuel quantity indicator for adequate supply of fuel.

h. SHOULDER HARNESS control ..... "LOCKED"

i. Oxygen ..... "ON" (before donning mask)

WARNING

During periods of engine malfunction, it is possible for highly toxic fumes to enter the cockpit via the air conditioning system; therefore, it is recommended that oxygen be used at all times.

PRE-FLIGHT ENGINE CHECK

Select a run-up spot which is clear of loose objects around the engine air intakes and the tailcone.

Note

Recommended engine checks at "MILITARY" power will generally need to be made during the take-off roll if the airplane can not be tied down. Static engine tests without tie-down will need to be made at the maximum obtainable power settings below which the airplane begins to slide with the brakes locked.

DECELERATION CHECK. To check the fuel control minimum flow stop and the throttle rigging (to minimize the possibility of a flameout in flight), proceed as follows: Move the throttle from "MILITARY" to "IDLE." The engine should stabilize at IDLE.

PRIMARY FUEL CONTROL CHECK

a. FUEL CONTROL switch . . "PRIMARY"

b. RPM . . . . . "IDLE"

c. Advance the throttle to "MILITARY."

Note

During manipulation of the throttle from "IDLE" to "MILITARY," a momentary "flat spot" in the rising exhaust gas temperature curve may occur before military rpm is achieved. This occurrence is a result of engine rpm passing through the best engine cooling speed range, and need not concern the pilot, provided the temperature does not go below 350°C.

d. Check time of acceleration from idle to military rpm at 15 seconds or less.

Note

Following a ground start and before the engine is fully heated, the acceleration from idle to military rpm may take as long as 17 seconds. The engine is not expected to meet the 15-second time limit until it has been operated the equivalent of five minutes at 95% rpm.

e. Retard the throttle to 82% rpm.

f. Again advance the throttle to "MILITARY."

g. Check time of acceleration from 82% to military rpm at five seconds or less and note the following:

(1) RPM . . . . . 100—101%

(2) TEMP . . . . . (660°)[1]C maximum

(3) FUEL BOOST . . . . . "NORM"

(4) OIL PRESS . . . . . "NORM" (20-40 psi)

Note

Rapid manipulation of the throttle back and forth between "IDLE" and "MILITARY" is not recommended.

CAUTION

During accelerations, rpm and exhaust temperature limitations must be observed. Continuous satisfactory operation of the engine is based on strict observance of the prescribed limitations (refer to section V). Any deviations from these limitations will reduce the service life and reliability of the engine.

MANUAL FUEL CONTROL CHECK. A check of the manual fuel control system should be made prior to each flight, after each periodic maintenance inspection, and after each replacement of an engine and/or fuel control unit, as follows:

[1]Applicable only to engines incorporating NEB 197 and 196.

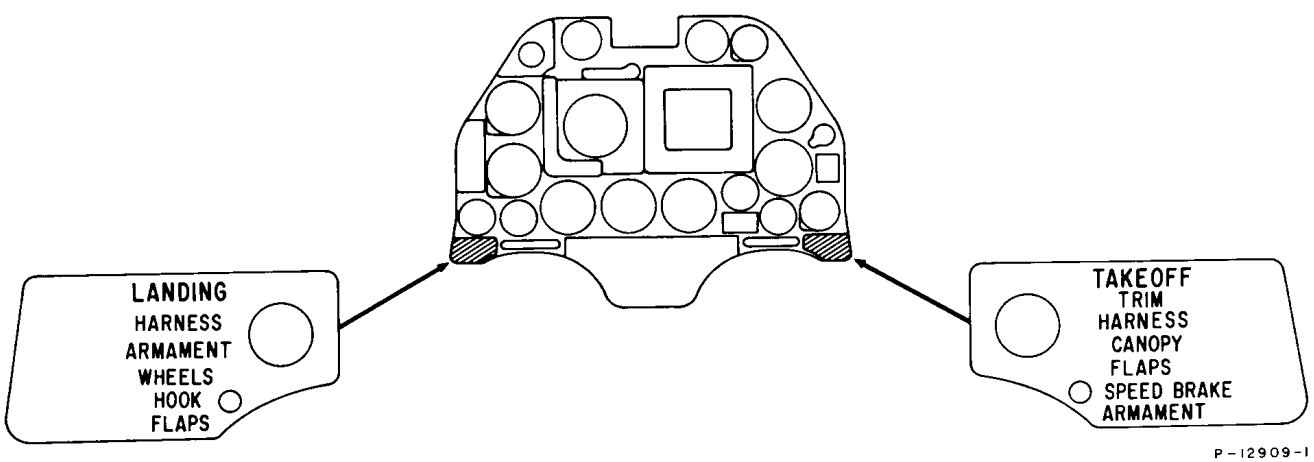


Figure 2-3. Check-off Lists

a. Set throttle to "IDLE."

b. Shift FUEL CONTROL to "MANUAL." Check that the warning light illuminates. (Expect a momentary engine and fuel flowmeter surge.)

c. Slowly and smoothly advance the throttle to maximum power, while monitoring EGT. Under sea level static conditions, rpm should vary with ambient temperature as follows:

Ambient Temperature (°F)	*% RPM (Min.)*
100	98
60	95
0	91

Higher rpm values are satisfactory, but 101% shall not be exceeded.

Note

At low gross weights it may be impossible to check at maximum power without tying down the airplane. Under such conditions, advance the throttle far enough toward maximum to insure that the manual system is functioning. Make the maximum power check when the airplane is tied down.

d. Retard throttle to "IDLE."

e. After rpm stabilizes at IDLE, switch FUEL CONTROL to "PRIMARY." (MANUAL FUEL warning light should go off. A momentary surge of rpm and tailpipe temperature may accompany the switch back to "PRIMARY").

TAKE-OFF

On all takeoffs, recheck flight controls for full throw just prior to rolling.

AIRFIELD

Hold brakes and advance the throttle to the maximum thrust obtainable without sliding on the locked wheels. Check all instruments for satisfactory operation. If the check is satisfactory, release the brakes, advance the throttle to "MILITARY," and begin the take-off run. Observe engine instruments for proper indications during the take-off run. Maintain direction by use of the brakes; only a slight pressure or "tapping" should be necessary for directional control. The rudder will become effective enough for steering at approximately 70 knots IAS. When the speed increases to approximately 115 knots IAS, the nose wheel should be lifted well off the runway to obtain higher lift. At normal take-off gross weight (clean configuration), the aircraft will become airborne at a minimum speed of 120 knots IAS. Refer to section III for procedure to follow in the event of engine failure during take-off.

CAUTION

The throttle friction lock should be set to prevent the throttle from retarding due to the spring-loading of the fuel control.

MINIMUM RUN

To accomplish a minimum run take-off, full nose up trim (6 units) and half flaps should be employed.

Note

Use of full flaps delays nose wheel lift-off.

After brake release, as the aircraft accelerates down the runway, a generous amount of aft stick should be used to effect a nose wheel lift-off at about 105 knots IAS. During airplane lift-off, at approximately 110 knots IAS, a nose up rotation of the aircraft will occur which will require an immediate reduction in aft stick pressure to control. As the airplane accelerates to climbing speed after take-off, almost constant re-trimming of the stabilizer will be necessary. This nose up rotation of the airplane at take-off is reduced in abruptness and severity by an increase in gross weight or by use of less airplane nose up trim. However, if less than full nose up trim is employed, the effect will be to increase the minimum nose wheel lift off speed about 4 knots per unit (2 degrees) of reduced nose up trim, and to increase the take-off run approximately 300 feet per unit of reduced nose up trim.

CARRIER

Use flap settings specified in AIRCRAFT LAUNCHING BULLETIN. Optimum trim settings for full-flap launches, and for all gross weights up to and including 22,500 pounds, are:

End Speed	*Longitudinal Trim*	*Lateral Trim*	*Directional Trim*
Minimum	7.5 degrees nose up	Neutral	0
Minimum plus 10 knots and above	5 degrees nose up	Neutral	0

When the airplane is properly rigged on the catapult, and upon signal from the catapult officer:

a. Advance the throttle to "MILITARY."

b. Throttle friction lock ..... Full forward and locked

c. Grasp the catapult handgrip in conjunction with the throttle.

d. Check all instruments for proper indications.

e. Signal the catapult officer when prepared for launching.

f. Hold the head firmly against the headrest, lay the hand on the lap *aft* of the control stick, and keep the feet against the *lower* portion of the rudder pedals. At the end of the power stroke, grasp the stick and apply slight aft pressure to maintain optimum attitude off the bow. Avoid erratic control movements. Avoid clearing turns until an airspeed well above minimum has been attained.

Note

- The pilot technique and trim settings for full-flap catapult launches are applicable for half-flap catapult launches.
- Aircraft gross weights and ambient temperatures which require the use of half-flap launches are specified in the Aircraft Launching Bulletin.

WARNING

The abrupt rolling movement caused by asymmetric slat opening may require up to full lateral control deflection to maintain wings level at catapult end airspeeds near minimum. Even at end airspeeds up to 20 knots above recommended minimums, successful launches may not be possible in the event of asymmetric slat opening after catapulting. (Refer to WING SLATS, Section I.)

AFTER TAKE-OFF

a. Leave the throttle at "MILITARY" until a safe altitude is reached.

b. Landing gear control ..... "UP"

Note

When the nose gear has fully retracted, a vibration may be felt in the airplane. This is due to unbalance in the spinning nose wheel being transmitted through the nose gear strut when retracted against the stop.

c. FLAP control ..... "UP"

Note

Almost constant trimming of the horizontal stabilizer will be necessary after take-off during the period of acceleration to best climbing speed.

CLIMB

Accelerate to the best climbing speed shown in Appendix I before starting climb. Use the airspeeds recommended in the chart to obtain the best rate of climb; however, speeds may be varied 10 knots above or below those stipulated without appreciably affecting climb performance. Maintain military rpm throughout the climb for best results, observing at all times the engine rpm, exhaust temperature and time limitations as set forth in Section V.

FLIGHT CHARACTERISTICS

Refer to Section VI for information about the flight characteristics of the airplane.

SYSTEMS OPERATION

Section VII contains operating instructions for the various airplane and engine systems.

DESCENT

Descents may be made very rapidly by using power and speedbrakes. Refer to Section V for limiting airspeeds, and to Section VI for diving characteristics of the airplane. For a maximum range descent, throttle back to "IDLE" and maintain the gliding speeds recommended in figure 3-1. See applicable "Maximum Range Descent" charts in APPENDIX I.

PRE-TRAFFIC PATTERN CHECK LIST

Prior to entering the traffic pattern, make the following checks:

a. SHOULDER HARNESS control ..... "LOCKED"

b. Fuel quantity indicator .... Adequate supply for normal entry, approach and landing

c. GUNS switch ..... "SAFE"

d. MASTER ARMAMENT switch and miscellaneous armament switches ..... "OFF"

e. UHF radio ..... Tower frequency

f. Master exterior lights switch ..... On (night)

g. EXT LTS control panel ... All switches "BRIGHT" (night)

h. Trim ..... As desired

i. SPEEDBRAKE switch ..... As desired

TRAFFIC PATTERN CHECK LIST

a. HOOK control ..... Field: "UP"
Carrier: "DOWN"

b. Landing gear control ..... "DOWN"

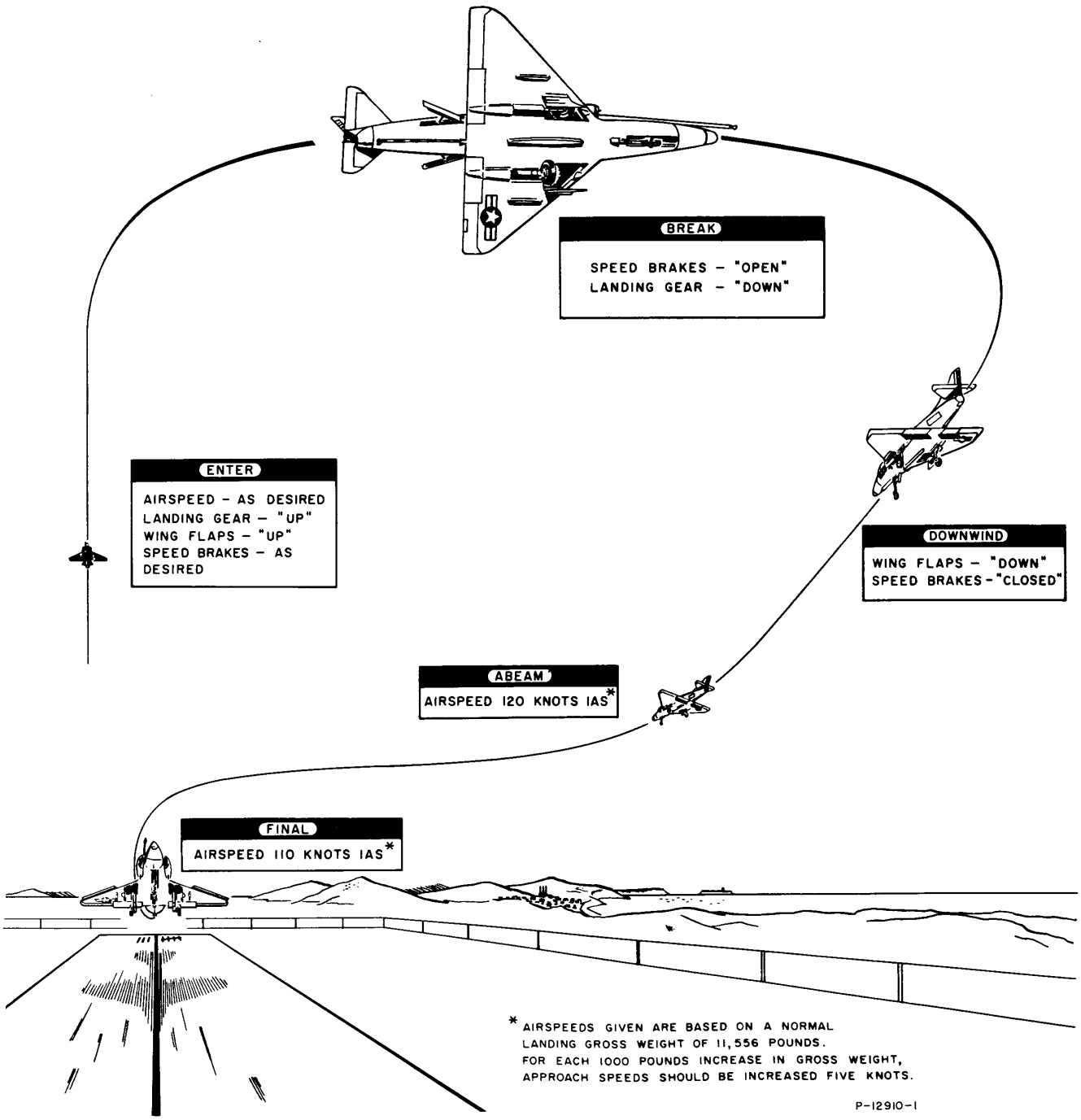


Figure 2-4. Landing Pattern Diagram

CAUTION

Move the landing gear handle firmly into the "UP" or "DOWN" detents.

c. FLAP control ..... "DOWN"

d. SPEEDBRAKE switch ..... "CLOSE"

Note

When normal wind conditions exist, use full flaps for landing on an airfield, but if high wind conditions exist, use half flaps. Full flaps are always used for landing aboard a carrier.

LANDING

AIRFIELD LANDING

At the basic design landing gross weight with power off and wheels and flaps down, the stalling speed is approximately 100 knots IAS. Recommended approach speed is 120 knots IAS at the abeam position (see figure 2-4). Begin the turn into the base leg at a point slightly down-wind of the landing end of the runway in order to have adequate straightaway for corrections of the final approach. Gradually reduce airspeed to approximately 110 to 115 knots IAS on the final leg. Long, low, flat approaches are unnecessary, as the aircraft decelerates rapidly upon taking the "cut," particularly when a combination of a low approach speed and high power setting is used. Full nose-up elevator is required to hold the nose wheel off at touchdown, which should be made at approximately 105 knots IAS. After touchdown, the nose wheel can be held off only to a speed of 5 to 10 knots below that of landing.

CAUTION

- For each 1000-pound increase in gross weight, the approach speed should be increased by five knots.
- Because they raise the stalling speed 3 knots when they are open, the speed brakes should not be opened for additional drag until after touch-down.

MINIMUM RUN. A landing requiring minimum runway distance can be accomplished by simulating a carrier approach to the airfield with speedbrakes retracted. Make the approach as slow as possible, but maintain a safe margin above stalling speed. Attempt to cross the landing end of the runway at an altitude of 5 to 10 feet. On touch-down, immediately retard the throttle, and open the speedbrakes. When the nose wheel drops, hold it firmly on the runway and apply wheel brakes. Raise the landing flaps. An emergency minimum run landing can be accomplished by using the foregoing procedure, then shutting down the engine completely. The drag of the windmilling engine and the absence of idle thrust will reduce the landing run considerably. The wheel brakes are manually operated and are unaffected by loss of utility hydraulic system pressure.

CROSS-WIND. Use standard cross-wind approach methods to effect a landing. In light crosswinds the airplane tracks well after touchdown and can be easily controlled directionally by use of the wheel brakes. In crosswinds above 15 knots, however, the upwind wing rises and the nose tracks toward the downwind side instead of "weather-cocking" into the wind, as is normally to be expected. To correct for this characteristic the following procedure is recommended immediately *after touchdown:*

a. Extend speed brakes to shorten landing roll (*only* after touchdown).

b. Raise the flaps to reduce lift of upwind wing.

c. Apply aileron into the wind.

d. Simultaneously with aileron, apply full down elevator to reduce lift further by decreasing the angle of attack.

e. Apply maximum braking effort obtainable without skidding the tires.

CAUTION

Be careful not to lock the upwind wheel by applying too much brake. Release the brake if the wing rises enough to take the weight off the landing gear. Use only enough aileron to bring down and hold down the upwind wing.

CARRIER LANDING

The downwind leg of the carrier landing pattern should be sufficiently abeam of the carrier to permit a constant bank angle of 17 to 18 degrees throughout the base leg approach. When landing gross weight is under 11,000 pounds it is important to be at final approach speed and on altitude well out on the base leg—because power required is in an rpm range where engine acceleration lags so far behind throttle movement that precise power adjustment is difficult. The longitudinal trim rate is slow. The recommended final approach speed is 115-118 knots IAS at a gross weight of 11,000 pounds. Add to or subtract from this figure 5 knots for each 1,000 pound increase or decrease in gross weight. In the final approach, mild lateral oscillations will be encountered from turbulence created by the ship. Such oscillations have no effect on the airplane flight path therefore, corrective aileron deflections, which invariably are out of phase, serve to aggravate rather than alleviate this condition.

CAUTION

- Carrier landings on angled deck ships should be made with particular attention to achieving

a good line up and avoiding landings with right to left drift, which, when associated with the increased runout of angled deck arresting gear, can result in the aircraft coming to rest in the port catwalk, even though a pendant is engaged.

- A burble effect, present under all wind conditions, produces a definite tendency for the right wing to drop as the airplane passes the approach end of the landing area on angled deck ships.
- To expedite re-swiveling of the nose wheel after an arrested landing roll-back, bounce the nose wheel strut by "tapping" the brakes while applying thrust. Relieving some of the load carried by the gear will permit the wheel to assume the normal trail position.

WAVE-OFF

If it becomes necessary to abort the landing,

a. Advance the throttle rapidly but smoothly to ..... "MILITARY"

b. Landing gear control ..... "UP"

c. FLAP control ..... "UP" (at a safe altitude)

AFTER LANDING

The throttle should be kept at "IDLE" for minimum thrust. Use the wheel brakes as necessary, applying pressure lightly and evenly to prevent excessive wear and the possibility of blowing the tires. When clear of the runway:

a. FLAP control ..... "UP"

b. SPEEDBRAKE switch .... "CLOSE"

c. AIR COND switch ..... "OFF"

d. Canopy ..... Unlock and open if desired and if relative headwind is less than 60 knots

CAUTION

Excessive brake heat is likely to increase tire air pressure and decrease the strength of both tires and wheels sufficiently to cause explosive failure. If excessive braking has been necessary, the airplane should be towed in.

STOPPING THE ENGINE

If the engine is to be stopped after operating above 96.5% rpm, pause at "IDLE" for at least one minute to allow the engine temperatures to stabilize before moving

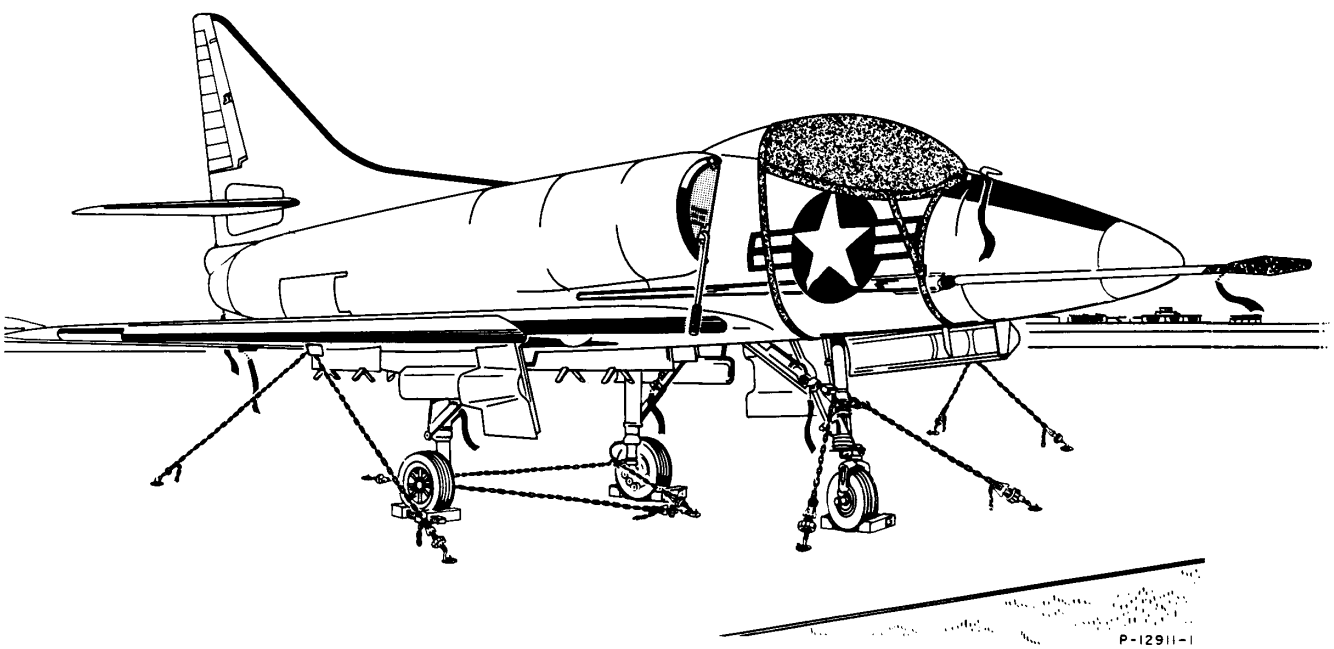


Figure 2-5. Mooring

the throttle to "OFF." If it is to be stopped below that rpm, move the throttle immediately to "OFF."

BEFORE LEAVING THE AIRCRAFT

a. All electrical equipment . . . off

b. OXYGEN control . . . . . "OFF"

MOORING

Ascertain that the following action has been taken:

a. Wheels chocked.

b. Rudder and aileron gust locks installed.

c. Engine intake and exhaust duct covers inserted.

d. Cockpit cover installed.

e. Pitot cover in place.

f. Inflight fueling probe cover in place.

g. Aircraft secured to the deck (see figure 2-5).

Refer to appropriate maintenance handbooks for further tie-down procedures, including heavy-weather securing, auxiliary tie-downs, mooring on jacks, etc.

SECTION III
EMERGENCY PROCEDURES

ENGINE FAILURE

Symptoms of engine malfunctioning or imminent failure are:

a. Loss of thrust

b. Fluctuating rpm and exhaust temperature

Note

Small fluctuations of the RPM pointer, caused when the fuel control moves through its "step function" during engine acceleration, are normal.

c. Drop in engine oil pressure and/or fuel boost pressure

d. Vibration

When any of these symptoms appear, reduce power if conditions permit, and land as soon as possible.

Note

In case chugs and/or stalls have accompanied the fluctuating rpm and exhaust gas temperature, and if reducing power has stabilized engine operation, advance the throttle cautiously to the minimum setting required to complete the flight.

PROCEDURE ON ENCOUNTERING ENGINE FAILURE

FLAME-OUT. In the event of a flame-out, proceed as follows:

a. Throttle . . . . . "OFF"

b. Check for the following evidence of fire:

(1) Presence of smoke or fumes in the cockpit.

(2) Emission of smoke from tailpipe or other areas.

(3) Rising exhaust temperatures and decreasing rpm.

c. If there is evidence of fire pull the EMER GEN release handle.

Note

- If the engine is not running, electrical power for the fire warning light will not be available unless the emergency generator is extended.
- Once the emergency generator is extended it cannot be retracted in flight.

WARNING

If fire is present or existed prior to shutdown, do not attempt to restart the engine (refer to FIRE).

d. If no evidence of fire exists, start the engine in the manner prescribed under AIR START.

ENGINE FUEL CONTROL FAILURE. If engine fuel control unit failure is suspected as the cause for unstable engine operation, proceed as follows:

a. Throttle . . . . . "IDLE"

b. FUEL CONTROL switch . . "MANUAL"

CAUTION

At low altitudes, "MANUAL" fuel control may be selected at any throttle setting during take-off. However, at 6000 feet pressure altitude or above, the throttle should always be retarded to "IDLE" before the FUEL CONTROL is switched to "MANUAL".

c. Advance throttle slowly to obtain desired thrust, observing maximum temperature and rpm limitations.

CAUTION

- At high altitudes, "MANUAL" fuel control may provide 100% rpm with less than full throttle travel. Small movements of the throttle may result in large changes in rpm and EGT.
- Do not return the FUEL CONTROL switch to "PRIMARY" while in flight.

THROTTLE LINKAGE FAILURE. On airplanes incorporating J65 Engine Bulletin 240, if the linkage between the cockpit throttle lever and the engine fuel control unit breaks (at settings above idle), the unit automatically seeks approximately the 87% rpm position (when FUEL CONTROL is on "PRIMARY"), which normally provides sufficient thrust to maintain flight. On airplanes *not* incorporating Bulletin 240, if the linkage breaks, the fuel control unit automatically retards to the idle rpm position. (For landing procedure, refer to LANDING EMERGENCIES in this section.)

AIRSTART

Unless it has been determined that engine failure is not due to failure or malfunction of the primary fuel control system, the first airstart attempt should be made in "PRIMARY". However, if it is suspected that the primary system is faulty, the first attempt should be made in "MANUAL".

Note

Air starts should not be attempted above 20,000 feet. It has been found that unsuccessful attempts above 20,000 feet tend to reduce the likelihood of obtaining successful starts at lower altitudes, due to the presence of residual fuel in the combustion chamber.

a. Throttle ..... "OFF"

b. FUEL CONTROL. "PRIMARY" or "MANUAL"

Note

The emergency generator must be extended for an airstart on the manual fuel control system if sufficient electrical power is not available from the engine driven generator.

c. If altitude permits, nose over momentarily to impose negative g's on the airplane—to throw trapped fuel up into the airstream. It is recommended that this maneuver be preceded by a slight climb to compensate for any altitude loss and turbine speed-up caused by the pushover.

Note

If the emergency generator is extended, the fuel boost pump is inoperative. Hence, to avoid trapping air in the engine driven fuel pump inlet line, do not move the throttle from the "OFF" position during the push-over.

d. Establish recommended airspeed of 170-200 knots.

e. AIR START ignition..... "ON"

f. Throttle ..... "IDLE"

Note

The throttle handle must be brought back firmly against the idle stop to insure that the AIR START switch remains in the "ON" position for a relight.

g. If relight has occurred, check that the AIR START switch has turned "OFF" when the throttle is advanced.

h. If relight has not occurred in 30 seconds, abort the start and repeat start procedure.

i. Advance throttle slowly and smoothly to the desired setting.

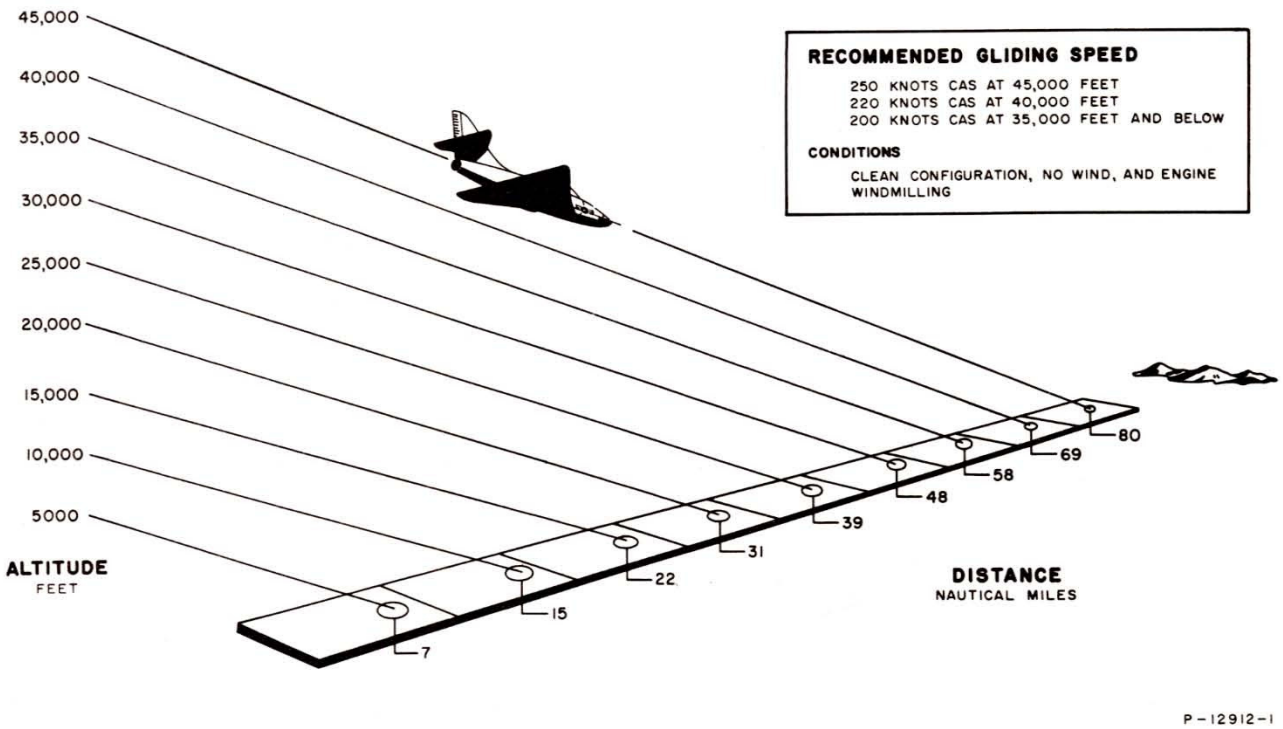


Figure 3-1. Maximum Glide

j. When using manual fuel control, advance throttle slowly *toward* "IDLE" until EGT indicates a relight; then monitor rpm and EGT carefully to keep them within limits.

Windmill engine rpm on these relights should be kept approximately at "START." At altitudes of 12,000-14,000 feet, the light-off time will vary between 10 and 15 seconds. At 20,000 feet, the time will vary from 21 to 30 seconds. The minimum EGT reading on the engine performance indicator is approximately 200°C.

ENGINE FAILURE UNDER SPECIFIC CONDITIONS

DURING TAKE-OFF

CAUTION

The throttle friction lock control must be checked to ascertain that the throttle has not inadvertently retarded, giving the illusion of engine failure.

ABORTING TAKE-OFF. The pilot should program his take-off so that he will have take-off airspeed by the time he is committed at his "go-no go" position. (Refer to Take-off Charts, Appendix I.) In the event that a take-off must be aborted:

a. Speedbrakes extended.

b. Throttle "OFF."

c. Wing flaps to remain extended.

d. Forward stick applied for full tire traction.

e. Maximum braking action applied.

If the airfield has arresting cables, the pilot should use them if necessary, but should extend the hook only just prior to engagement.

WARNING

If overrunning the runway to unprepared terrain seems imminent, jettison external fuel tanks and stores to reduce the danger of fire or explosion.

In the event of fire or structural failure on take-off, the pilot should land straight ahead. Refer to LANDING EMERGENCIES (EXCEPT DITCHING). Should the airplane become airborne with airspeed indicator failure, the wing-slats when half-way out, with gear and flaps down, will serve to indicate a safe landing approach speed of 140 to 145 knots. Wheel brakes will be available even with hydraulic system failure. (Refer to section I, BRAKE SYSTEM).

In the event of engine failure during take-off, but before the airplane becomes airborne:

a. Throttle ..... "OFF"

b. Control stick forward to maintain nose-wheel on runway.

c. FLAP control ..... as required

d. Speedbrakes ..... "OPEN"

e. Apply brakes intermittently as necessary.

f. Arresting hook "DOWN" if runway arresting cable is available.

Note

If the necessary stopping distance (refer to Appendix I) is not available and hazards exist at the end of the runway, the landing gear may be retracted by actuating the retraction release solenoid and moving the landing gear control to "UP."

DURING CATAPULTING. In the event of engine failure during catapulting, immediately switch to "MANUAL" fuel control. If this fails, ditch the airplane straight ahead in a nose-high (but not in a stalling) attitude to prevent diving after contact with the water. Accomplish the following if time permits:

a. Gear ..... "UP"

b. CANOPY-JETTISON handle ..... "PULL"

c. Throttle ..... "OFF"

d. Remain braced until all shocks stop.

e. Pull PILOT RELEASE handle and leave the airplane immediately after it comes to a complete stop.

Refer to DITCHING and UNDERWATER ESCAPE in this section.

AFTER BECOMING AIRBORNE.

If the engine fails after the airplane becomes airborne during take-off, *maintain flying speed.* If time and altitude permit:

a. AIR START ignition switch ..... "ON"

b. FUEL CONTROL switch .. "MANUAL"

Note

The throttle need *not* be moved to "IDLE", below 6000 feet altitude, as no adverse results such as overtemperaturing will occur during airstarts at these lower altitudes.

CAUTION

If engine rpm is at "IDLE" or below, extend emergency generator by pulling EMER GEN release handle, so that manual fuel control will be available.

c. If engine re-lights, advance throttle slowly to prevent over-temperaturing or a flame-out.

If the preceding abbreviated airstart is unsuccessful, *maintain flying speed*. Accomplish as many as possible of the following steps:

a. Throttle ..... "OFF"

b. Landing gear control handle "UP" if insufficient runway remains for a wheels-down landing.

c. Extend emergency generator.

d. Jettison all external stores. (Use EMER BOMB REL.)

e. FLAP control ..... as required

f. FUEL valve ..... "EMER OFF"

g. Land straight ahead.

DURING FLIGHT

a. Throttle ..... "OFF"

b. Attempt to start the engine as outlined under AIR START.

c. If the air starting attempts are unsuccessful, perform the procedure set forth in "ENGINE FLAME OUT LANDINGS" and maintain the recommended gliding speed for maximum range (refer to MAXIMUM GLIDE). Should engine failure occur at night over unfamiliar territory, eject if the engine cannot be started.

MAXIMUM GLIDE

The recommended speed for maximum gliding range is approximately 200 knots IAS for gross weights up to 16,000 pounds, a clean configuration, and altitudes up to 35,000 feet. At 40,000 feet, it is 220 knots; at 45,000 feet, 250 knots. See figure 3-1 for approximate gliding ranges from various altitudes.

ENGINE FLAME-OUT LANDINGS

Air starts can be made from sea level to 20,000 feet at indicated airspeeds from 160 to 260 knots. 170 to 200 knots is the best range.

Air start attempts may be abandoned at about 10,000 feet to permit concentration on the landing pattern; however, leaving the air start switch "ON" and the throttle in the "IDLE" position may result in an air start during the flame-out approach. Prior to touchdown, if no air start occurs, the throttle should be closed and the air-start switch "OFF."

During a flame-out approach:

a. A slight amount of canopy and windshield frosting will form. Even if conditions are conducive (high humidity) to the formation of heavy frost, the canopy *cannot* be 'cracked' to reduce frosting;

b. The engine driven generator becomes inoperative below approximately 18,000 feet in the engine-off descents at normal glide speeds;

c. When the airplane is operating on the manual flight control system lateral control is stiff and only limited corrective maneuvers such as shallow S-turns should be made in the pattern. Slips are not advisable. The elevator is effective throughout the speed range, and touch-down as slow as 125 knots can be made without difficulty. (Refer to FLIGHT CONTROL SYSTEM FAILURE, this section, and also to section VII, HYDRAULIC POWER DISCONNECT, for further information on the power disconnect during engine flame-out landings.)

The recommended pattern for flame-out landings and simulated flame-out landings is shown in figure 3-2. The pattern consists of a 360-degree approach with check points at the initial, the 180-degree and the 90-degree positions. The initial point is defined as a position above and slightly to the right of the intended landing point with the airplane headed in the direction of the landing runway. One third of the distance from the downwind end of the runway should be the intended landing point in order to maintain a margin of error to avoid undershooting. The check point altitudes are presented in figure 3-2.

When a pilot is committed to a flame-out landing either because of an engine failure or fuel exhaustion, he should execute the following general procedure:

a. Throttle ..... "OFF"

Note

If an air start attempt had been made the AIR START switch must also be "OFF".

b. Trim airplane to 170 to 200 knots.

Note

The airplane should be trimmed to 170 to 200 knots before the engine rpm gets below 20%, if possible.

c. MAN FLT CONT handle . . Pull

Note

Hydraulic power cannot be reengaged in flight.

d. EMER GEN release handle ..... Pull

Note

Lateral and directional trimming cannot be accomplished on the emergency system; therefore, the airplane must be trimmed at 170 to 200 knots prior to extending the emergency generator. The longitudinal trim switch on the stick is inoperative when the emergency generator is employed and the manual override trim must be used.

	OPTIMUM	USABLE BAND
APPROACH SPEED-KNOTS	170	160 – 190
INITIAL POINT ALTITUDE	9000'	7500'(GEAR UP)
180° POINT ALTITUDE	4500'	4000'-5000'(GEAR DOWN)
90° POINT ALTITUDE	3000'	2800'-3200'(GEAR DOWN)
FINAL APPROACH ALTITUDE	1000'	500' MINIMUM
OPTIMUM CONFIGURATION: GEAR DOWN-FLAPS UP. ALL ALTITUDES SHOWN ARE TERRAIN CLEARANCE.		

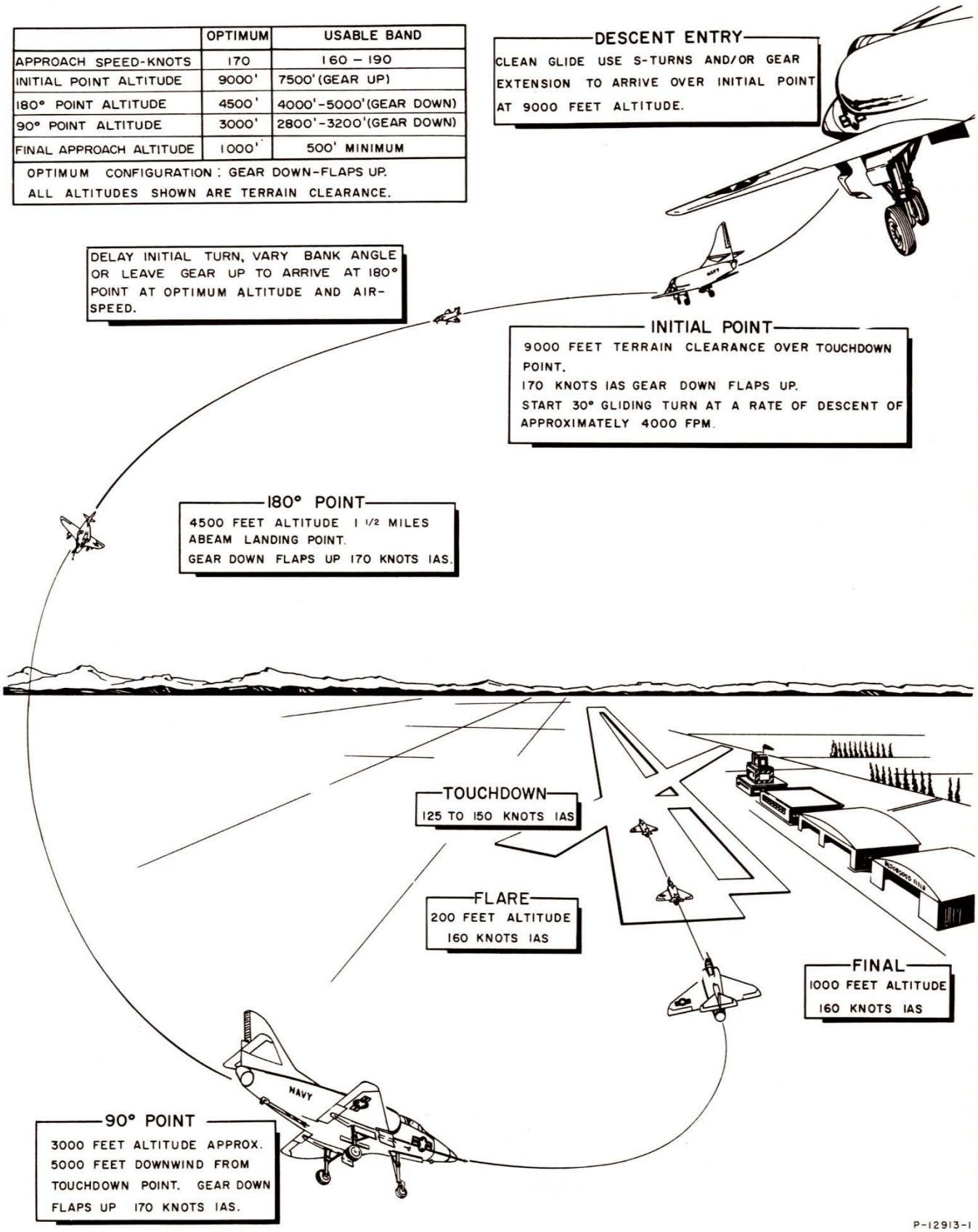


Figure 3-2. Flameout Landing Pattern Diagram

e. Jettison all external stores (Use EMERG BOMB REL).

f. FUEL valve control ..... "EMERG OFF"

g. SHOULDER HARNESS control ..... "LOCKED"

ENTRY. Establish recommended gliding speed and plan a glide to the selected landing field so as to arrive over the initial point at 9000 feet above the runway. Check the surface wind carefully and plan the approach for an 8000 foot runway with a crosswind component less than 15 knots.

CAUTION

Shorter runways or stronger crosswinds will require precise control; and such landings are not recommended unless the pilot is familiar with the aircraft and has recently simulated such landings.

The lowering of the landing gear should be planned to aid in arriving at the initial point at 9000 feet altitude above the terrain.

INITIAL POINT. A 30-degree bank is established at the initial point at 170 to 185 knots IAS, landing gear down and flaps up. A rate of descent of approximately 4000 feet per minute will result.

CAUTION

The use of flaps and speed brakes causes a dangerously high rate of descent during a flame-out landing approach.

If the initial point is reached with less than 9000 feet altitude, the lowering of the gear may be delayed so as to arrive at the 180-degree point with 4500 feet or at the 90-degree point with 3000 feet.

Note

The landing gear must be down and locked at the 90-degree point. The gear requires approximately 25 seconds to extend and lock.

Successful approaches may be made if the altitude at the 180-degree point is in error by 500 feet by varying the pattern. If the altitude over the initial point is higher than recommended, the initial turn may be delayed slightly. When a crosswind prevails, the bank angle at the initial point should be shallowed or steepened as required in order to arrive at the correct distance abeam at the 180-degree point.

180-DEGREE POINT. When the 180-degree point is reached, the pilot should consider the altitude, rate of descent and position to determine if a correction should be made to the bank angle. He should be approximately 1½ miles abeam the runway, at 4500 feet altitude above the terrain, with gear down and flaps up.

90-DEGREE POINT. At the 90-degree point, the aircraft should be approximately 5000 feet downwind of the intended landing point (first one-third point of runway) and at an altitude of about 3000 feet above the terrain with gear down and flaps up. The final turn should be planned to reach the straightaway with about 1000 feet of altitude. The approach speed of 170 knots should be maintained until the final straightaway approach is reached.

FINAL APPROACH AND LANDING. The final approach should start with approximately 1000 feet of terrain clearance (with an allowable minimum of 500 feet), aiming at the intended touchdown point at the first one-third of runway. 160 knots should be maintained until flare is initiated at 200 feet altitude. Excess altitude in the final may be dissipated by shallow S-turns or by nosing over to pick up additional speed.

Slips are not advisable due to high lateral control forces on the manual system and the resulting increased rate of descent, which would make flaring critical. Touchdown speeds following the flare may be varied from 125 to 150 knots.

SIMULATED FLAME-OUT LANDINGS

For training purposes, flame-out landings may be simulated. A procedure for closely approximating a flame-out condition consists of extending the speed brakes, utilizing the manual flight control system and following the rpm schedule shown below:

Altitudes	*RPM*	*Rate of Descent*
20,000-10,000 feet	75 percent	4800 feet per minute
Below 10,000 feet	70 percent	4100 feet per minute

When practicing simulated no-power landings, follow the pattern in figure 3-2.

A simulated flame-out landing is an excellent method of making an emergency landing with a malfunctioning engine or with a low fuel supply. If the engine is lost at any point in the approach, the speed brakes may be closed by means of the manual control and the approach continued to a safe no-power landing.

Note

The pattern described is for an airplane gross weight of 10,500 to 12,500 pounds (no external tanks or stores). If fuel is exhausted, speed and altitude may be lowered slightly. Add approximately five knots for each 1000 pounds increase above this weight.

The longitudinal stick trim is inoperative when the airplane is operating on the emergency generator, and the manual override trim must be used.

With the landing gear down and emergency generator extended, the nesa glass heater (defrosting) circuit is inoperative. Nevertheless, the flame-out approach should be programmed so as to have the gear down and locked at the 180-degree point, utilizing emergency gear extension. Refer to LANDING GEAR SYSTEM in this section.

FIRE

ENGINE FIRE

ON THE GROUND. If fire develops in the engine section while on the ground, perform the following:

a. Throttle ..... "OFF"

b. FUEL valve control ..... "EMERG OFF," if fire persists

CAUTION

It must be definitely established that the fire is in the engine before the starter is used. If the fire is in the accessory section beneath the engine, cranking may intensify combustion by circulating engine compartment cooling air.

c. Make certain that the starter has a source of power.

d. START-ABORT switch ... Depress

e. Allow the starter to motor the engine until the fire has disappeared. If fire persists for a considerable length of time, continue cranking the engine and signal the fire guard to apply CO_2 to the engine air intake duct as required.

IN THE AIR. Should an engine fire occur during flight, proceed as follows:

a. Throttle ..... "OFF"

b. If the fire is extinguished by movement of the throttle to "OFF," as evidenced by the FIRE warning light going out, or by the disappearance of smoke, fumes, or actual fire, do not attempt to restart the engine. Decide whether to attempt an emergency landing without power or to abandon the aircraft.

c. EMER GEN release handle ..... Pull, if decision to land is made.

d. Should the fire continue to burn after moving the throttle to "OFF," move the FUEL valve control to "EMERG OFF." If this procedure does not extinguish the fire, elect either a forced landing or ejection.

FUSELAGE FIRE

There is little that can be done to combat a fire in the fuselage during flight, as no fire fighting equipment is available. There is always the possibility that the fire could be electrical in origin, however, and the procedure for ELECTRICAL FIRE should be followed.

WING FIRE

Because of the location of the integral wing fuel tank, a fire in the wing could be caused by either fuel leakage or defective electrical wiring.

a. Jettison all combustible external stores.

b. Follow the procedure for ELECTRICAL FIRE.

c. If the fire continues to burn, eject, as the fire is probably fuel-fed; and there is no way of stopping the fuel leakage while in flight.

ELECTRICAL FIRE.

When a fire seems to be electrical in origin, proceed as follows:

a. Turn off all electrical equipment.

b. Observe that the fire is extinguished.

c. Turn the switches on one by one to find the defective circuit.

d. Leave the offending circuit off and turn the necessary equipment on.

e. If the fire cannot be extinguished in this manner, the pilot must decide whether to abandon the airplane or attempt an emergency landing.

SMOKE ELIMINATION

If smoke or irritating fumes are present in the cockpit, turn the air conditioning switch to "OFF."

CAUTION

Turning the switch "OFF" also "dumps" the cabin pressure.

LANDING EMERGENCIES (EXCEPT DITCHING)

WARNING

Landing jet airplanes on unprepared terrain is usually extremely hazardous. Provided sufficient altitude is available, ejection is preferable to attempting an emergency landing on any surface other than a runway. If a malfunction occurs during low level flight, it may be possible to convert excess airspeed into enough altitude to permit a safe ejection.

When power is available, more deliberation can usually be given to evaluating the many variables affecting a safe emergency landing, such as direction and speed of the wind and the type of terrain in which the landing is to be made. On areas other than prepared runways and surfaces of known adequate hardness, the landing should always be made with the wheels retracted. If the nature of the emergency is such that all wheels will not fully extend, the landing gear should be left in the retracted position. Prior to any wheels-up landing, all external stores should be jettisoned. Use the recommended approach speeds throughout the landing pattern, and attempt to touch down at, or slightly above, the recommended landing speed.

CAUTION

Airspeeds throughout the approach and landing should be increased five knots for each 1000 pounds increase in the weight of the aircraft over the normal landing gross weight.

EMERGENCY EXIT. If it is necessary that the pilot leave the airplane immediately, the canopy should be jettisoned by pulling the CANOPY JETTISON handle and then pulling the PILOT RELEASE handle.

CAUTION

- Do not use the manual CANOPY control prior to actuation of the CANOPY JETTISON handle as the canopy will not jettison unless it is in the locked position.
- Do not pull the PILOT RELEASE handle while the airplane is moving.

LANDING WITH THROTTLE LINKAGE BROKEN—AIRFIELD. On airplanes incorporating J65 Engine Bulletin 240, if the throttle linkage breaks, the engine fuel control unit (unless it is at idle) automatically seeks approximately the 87% rpm position. Normally, flight can be maintained. Maximum rate of climb can be attained at 210 knots (clean configuration). Field landings and wave-offs can be accomplished. (Refer to Section I, MANUAL FUEL VALVE CONTROL.) The approach should be made without external stores. Fuel remaining should be between 1000 and 2500 pounds to allow for several wave-offs, if necessary.

Perform landing pattern checks as for a normal landing and fly the normal field landing pattern, as described in Section II, with the following exceptions:

a. Down-wind leg .....gear down, full flaps, 140-145 knots

b. Base leg .....130-135 knots

c. Final approach .....125-130 knots

(1) Fly it *long.*

(2) Control rate of descent with speedbrakes.

(3) Control airspeed by varying angle of attack.

d. Wave-off:

(1) Close speed brakes.

(2) Retract gear.

(3) Keep flaps fully extended to provide necessary lift while re-entering landing pattern.

e. After touch-down .....FUEL to "EMER OFF".

Note

The time interval from actuation of the FUEL valve until initial engine deceleration is approximately 4 seconds. This delay tends to increase the landing roll-out; but the absence of idle thrust after the engine runs down tends to decrease it.

LANDING WITH THROTTLE LINKAGE BROKEN—CARRIER.

Pending further flight tests, no carrier landing should be attempted without throttle control.

EMERGENCY ENTRANCE

When it is necessary to gain entrance to the cockpit in an emergency, it may also be necessary to effect the quick and safe removal of the pilot from his seat and parachute. This entry and rescue operation requires that certain procedures be followed and that certain precautions be taken.

An external control for jettisoning the canopy is provided on each side of the fuselage. Push in on the RESCUE access door and pull the red PULL CANOPY JETTISON handle that extends; this will fire the canopy if it is closed and locked.

WARNING

When the canopy is jettisoned, the seat catapult interlock is extracted, and care must be exercised to avoid firing of the seat catapult charge.

To release the pilot from the seat and parachute, unfasten the harness attach fittings or pull the PILOT RELEASE handle.

DITCHING

A forced landing at sea (ditching) should be made only as a last resort; *ejection is recommended whenever feasible.*

The pilot must necessarily choose between either a high sink rate or increased speed, both extremely dangerous approaches to the water. Moreover, the pilot has the difficult problem of determining exactly how high to

flare above the water without stalling, often without any visual references to assist in height determination. Accordingly, ejection should be made if he is more than 600 feet above water (see EJECTION), and ditching should usually be made only during a landing approach, a weak catapult shot or a wave-off failure. If failure occurs during low-level runs, a "zoom" may get the airplane high enough to make ejection possible.

As many as possible of the following operations for ditching procedure should be accomplished:

a. Shoulder Harness ..... "LOCKED"

b. Landing gear ..... "UP"

c. "Blow" the canopy by pulling the CANOPY JETTISON handle, or manually release the canopy by actuating the canopy opening handle on the left-hand console.

WARNING

The canopy may not shear off if the manual CANOPY control is used at airspeeds below 200 knots. Use the CANOPY JETTISON handle first.

d. Jettison all external stores.

e. Lower the seat to the lowest position.

f. IFF ..... "EMERGENCY"

g. Transmit "MAY-DAY" position report.

Note

Present LATITUDE and LONGITUDE may be observed in the ASN-19A Computer-Control POSITION windows.

h. Turn ASN-19A Computer-Control selector switch to "RESET" to erase base position information.

i. Goggles or helmet-mask over eyes.

j. Oxygen ..... "ON"

k. All armament controls .... "SAFE"

l. Arresting-hook "DOWN" for drag and feeling for the water.

Land into the wind if there are no swells and in light seas; land along the top of and parallel to the swells if large roller-swells and if the wind is less than 25 knots; land into the wind in higher force winds to take advantage of the lowered forward speed, but recognize the possibility of ramming a wave or of striking the tail on a wave-crest and nosing in. Remain braced until all shocks stop. Abandon the airplane as soon as possible, using the PILOT RELEASE handle.

UNDER-WATER ESCAPE

In the event of submersion from porpoising, remain braced until all shocks stop. Keep the oxygen mask on. Use the PILOT RELEASE handle to separate from the seat and to retain survival gear. Lean forward to clear the parachute past the headrest and to insure separation of the shoulder harness fittings. Pull with the hands on the upper edge of the windshield bow and push with the feet to escape.

Use of the CANOPY JETTISON handle provides the power of the bungee to blow the canopy. In the event of malfunctioning of the CANOPY JETTISON system, the pilot still has two methods of removing the canopy under water: either by (1) the manual release; and/or (2) by pulling the face curtain and ejecting. However, these are only alternative methods and they are not as safe as using the CANOPY JETTISON and the PILOT RELEASE systems.

CAUTION

Underwater ejection also will deploy the parachute, which may require cutting or releasing to preclude fouling in the sinking plane.

In extreme circumstances, the pilot also has two other methods of getting through the canopy: by using his service revolver and (or his survival knife to crack it open. Use of the revolver should include having the helmet and oxygen mask on, with the helmet-mask or goggles over the eyes and as much of the body as possible covered, for protection from flying plexiglass. The revolver must not be fired if immersed in water. It has been found possible to crack the plexiglass with the survival knife by holding the knife with both hands, the blade pointing up, and striking the canopy above the head with the point of the knife. Underwater pressure should then push in the canopy.

During an underwater escape, survival gear should be retained. Attempting to exit by releasing the 'Rocket-Jet' quick-disconnect fittings will also require unzipping of the oxygen hose channel and separation of the oxygen quick-disconnect fitting. Because this method requires breaking 5 connections, it is recommended that the survival gear be retained. Also, much buoyancy can be gained from the survival gear.

For later airplanes[1], refer to section I, UNDERWATER CANOPY JETTISON RELIEF VALVE, for a description of the underwater pressure relief valve designed to facilitate removal of the canopy in the extreme situation where the canopy remains on prior to ditching. It is still recommended that the canopy be 'blown' by pulling the CANOPY JETTISON handle, prior to hitting the water.

[1] Airplanes BuNo. 145128 and subsequent. Prior airplanes by ASC 137.

UNDER-WATER ESCAPE CHECKLIST

a. Remain braced until all shocks stop.

b. Oxygen mask on.

c. PILOT RELEASE handle . . pull

d. Lean forward to separate the harness linkage and clear the parachute past the headrest.

e. Pull forward with hands from the top of the windshield bow and push with feet.

Note

It is strongly recommended that pilot's periodically practice exiting the cockpit with the parachute and pararaft to ensure separation from the seat and clearing the headrest. The canopy should not actually be blown in practice. Proper oxygen mask fit will prevent water seeping in during the critical under water escape.

EJECTION

In level flight or a climb, ejection can be accomplished at any altitude above 600 feet terrain clearance. Any airspeed up to 570 knots IAS will allow adequate aircraft clearance in level flight or nose up attitude. However, the possibility of windblast damage to personal gear makes it imperative that the airspeed be reduced as much as possible prior to ejection. Inverted and severe yaw positions should be corrected, if feasible, prior to ejection. Ejection (without the rocket catapult system[1]) should not be attempted below 600 feet terrain clearance; the airplane should be landed straight ahead unless a "zoom" can get it above 600 feet.

Usually, the pilot will have time enough to accomplish several things to prepare himself for a successful ejection prior to pulling the face curtain. However, when the emergency condition requiring ejection is such that ejection must be made without hesitation, simply *grasp the face curtain handle and pull down.* (See figure 3-3.)

[1] Airplanes BuNo. 147669 and subsequent; prior airplanes by ASC.

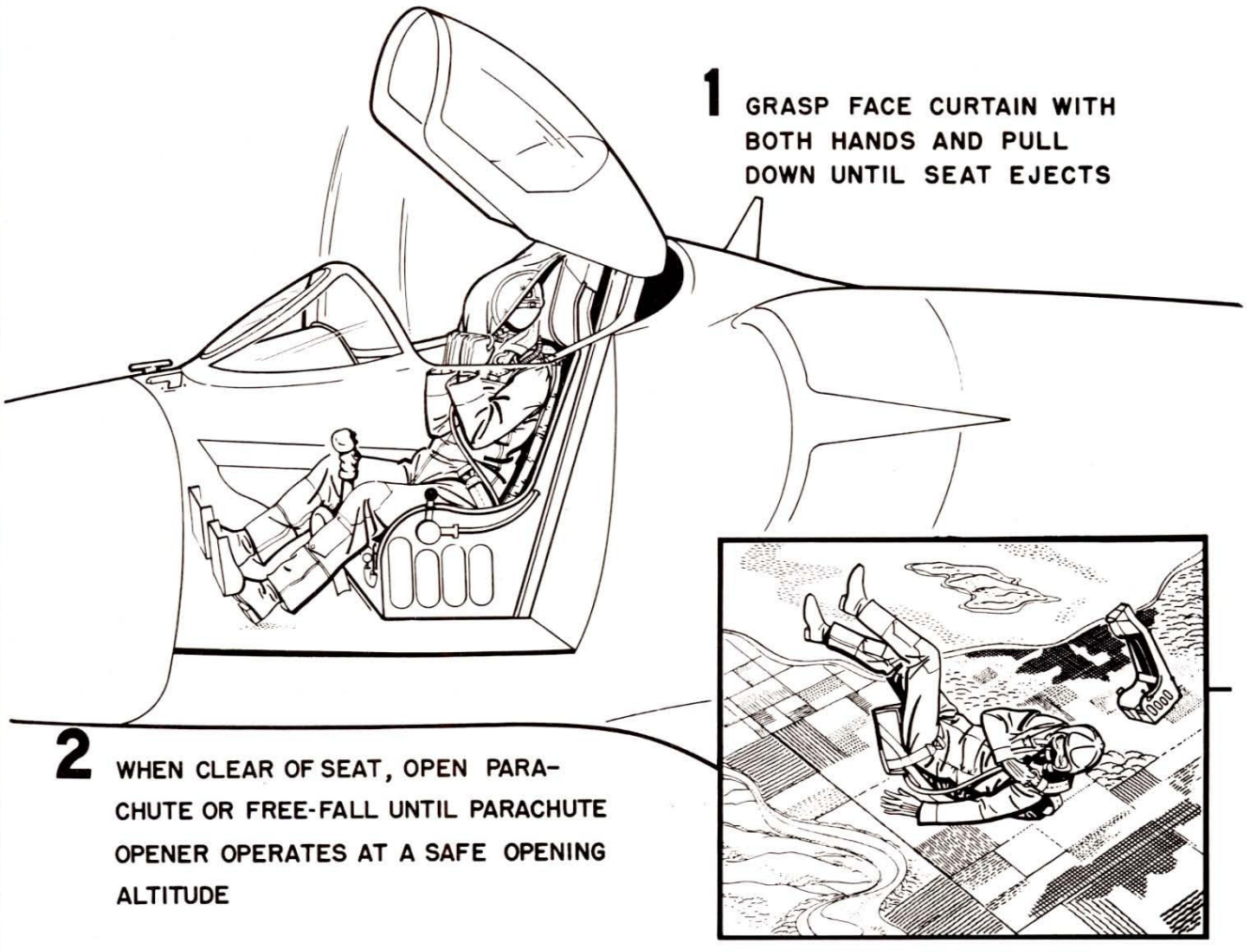


Figure 3-3. Ejection Procedure

The following procedure is recommended, if time permits:

a. Throttle "OFF" and slow the aircraft as much as possible.

b. IFF ......"EMERGENCY"

c. Transmit "MAY DAY" position report.

Note

Preset LATITUDE and LONGITUDE may be observed in the ASN-19A Computer-Control POSITION windows.

d. Turn ASN-19A Computer-Control selector switch to "RESET" to erase base position information.

e. AIR COND switch ....."OFF"

f. Shoulder harness ....."LOCKED"

g. Leave feet on rudder pedals.

h. Sit erect with spine straight and head firmly against headrest.

i. Grasp the face curtain handle with both hands and pull down to the fullest extent and continue applying pressure until the seat fires. The canopy will blow off when the curtain is pulled over the helmet and the catapult will fire when the handle passes the nose or chin.

Note

A safety interlock feature prevents the firing of the catapult before the canopy is blown. If the curtain is pulled very fast, a pause or stop may be felt. Accordingly, it is suggested that a firm and steady pull of the face curtain be made or that the pause be anticipated.

j. If pulling the face curtain fails to jettison the canopy, substitute the following emergency procedure:

(1) Retain a firm grip on the face curtain with the right hand, but do not pull further out; hold elbow inboard.

(2) Pull CANOPY JETTISON handle firmly.

(3) After the canopy leaves, pull the face curtain the rest of the way with *both* hands.

(4) As a last resort, if the canopy still remains, it may be removed by the force of the airstream by unlatching it manually. Beware of a rapid rearward movement of the CANOPY handle when this is done. Retain face curtain handle during this procedure, as above.

WARNING

A minimum airspeed of 200 knots is recommended for this method. Below 200 knots, only the glass may blow out, leaving insufficient drag to remove the frame. In this case, the canopy-face curtain interlock will not be pulled and ejection *cannot be accomplished.* Do not allow the face curtain to blow back and become inaccessible.

k. If ejection occurs above the preset altitude, the parachute will not automatically deploy until after descent below the preset altitude (10,000 feet). If ejection occurs below the preset altitude and the automatic barometric ripcord opener seems not to function (ie: after the time delay of 3 seconds), open the parachute with the manual ripcord ("D-ring") when clear of the seat. The manual ripcord overrides the barometric release.

WARNING

- If high speed ejection is made, wait (3 seconds minimum) until speed is reduced before opening the parachute manually, to prevent parachute canopy damage.
- If high altitude ejection is made, free-fall to approximately 10,000 feet before opening the parachute.

l. In the event the integrated harness is not automatically released following ejection, seat separation may be accomplished while falling, by pulling the PILOT RELEASE handle located on the right side of the pilot's seat.

WARNING

Actuation of the PILOT RELEASE handle following ejection will disconnect the automatic parachute opener and will, therefore, require manual pulling of either the ripcord or the automatic parachute actuating lanyard.

m. The emergency oxygen bottle should be actuated automatically upon ejection. However, should the oxygen appear not to be flowing, pull the green ball on the left front corner of the pararaft kit, or the green ring[1] on the seat bracket between the pilot's legs.

n. During parachute descent, remove ripcord grip ("D-ring") and the end of the ripcord housing from the pocket assembly on the riser. Ripcord and housing must be disconnected from riser/shoulder harness strap to enable subsequent jettisoning of the parachute upon landing.

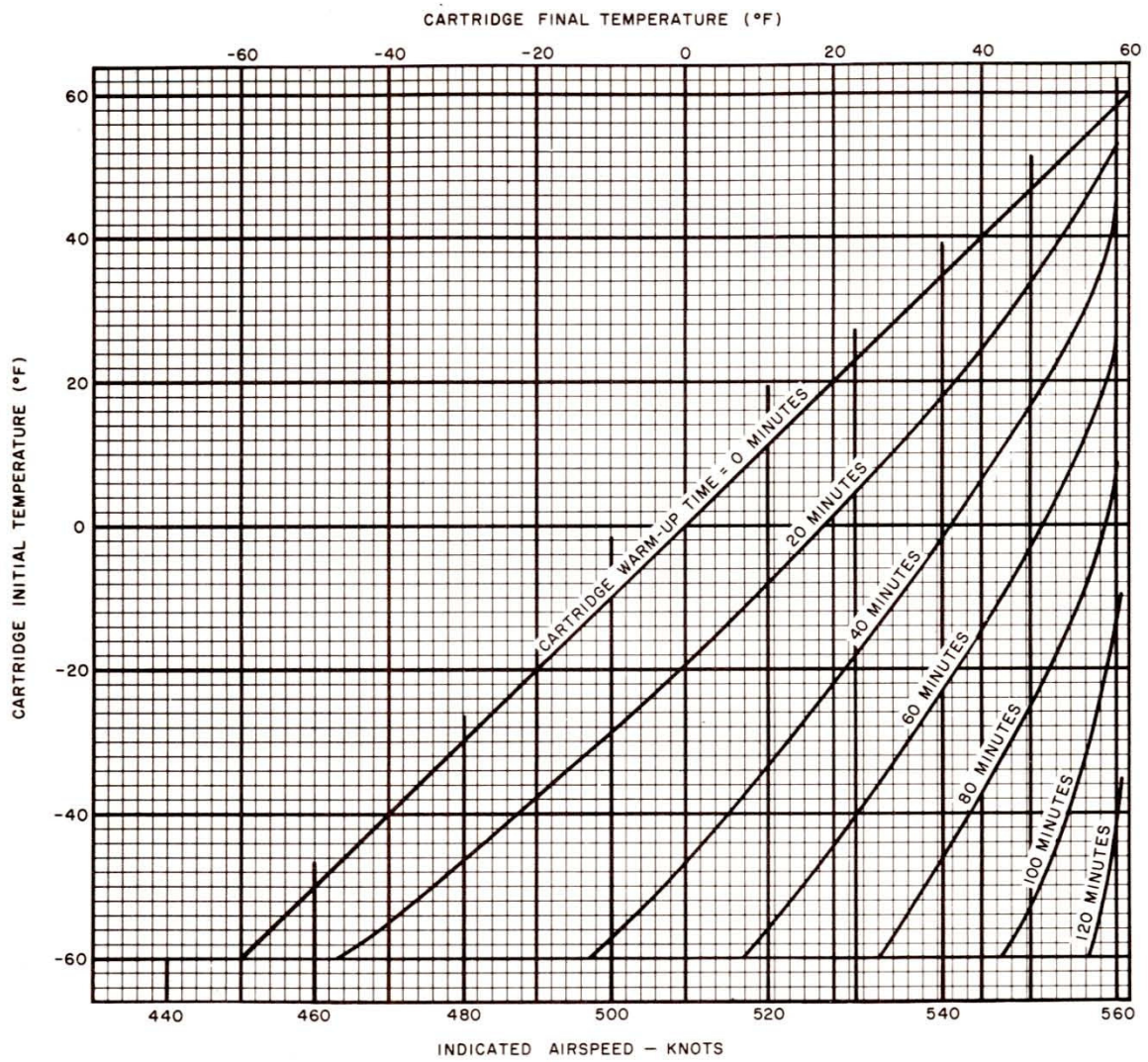
o. In the event parachute landing is made in a high wind, which prevents normal spilling of the parachute

[1] Airplanes BuNo. 145071 and subsequent; others after ASC 114.

EJECTION SEAT COLD CARTRIDGE PERFORMANCE

NAMC TYPE II EJECTION CATAPULT

MODEL: A4D-2N



P-12915-1

REMARKS:

(1) Based on tail fin clearance of 36 inches.

(2) If cartridge has not been kept warm prior to engine start, the initial temperature can assumed to be ambient temperature.

EXAMPLE:

(1) Using cartridge initial temperature before start of engine = —40° F.;

(2) Read across to flight time when high speed maneuver is estimated to occur = assume 20 minutes;

(3) Read down for maximum speed of 488 Knots IAS to achieve safe (36 inches) tail clearance during ejection.

DATA AS OF: 1 August 1957.

DATA BASIS: Contractor's tests.

Figure 3-4. Ejection Seat Cold Cartridge Performance

canopy, disconnect both quick disconnect fittings that attach risers to the torso harness suit, thus jettisoning the parachute canopy.

WARNING

Do not disconnect the parachute riser releases until after landing.

COLD CARTRIDGE OPERATION

Low temperature reduces the effective force of the ejection catapult cartridge and, consequently, affects tail clearance during high speed ejection. The airplane's air conditioning system requires a considerable period of time to warm up a cartridge to normal cockpit temperature. (Refer to figure 3-4, Ejection Seat Cold Cartridge Performance graph, and to Section IX, COLD WEATHER OPERATION.) During extreme cold weather operation, safety precautions should include some means of warming the catapult cartridge to insure that a successful ejection can be made at high speed immediately after take-off.

AIRCRAFT SYSTEMS FAILURE

FUEL SYSTEM

FUEL BOOST PUMP. Failure of the fuel boost pump results in a reading of "OUT" in the FUEL BOOST window of the engine performance indicator. Gravity flow of fuel to the engine-driven fuel pump provides an adequate supply of fuel for all power conditions below 6000 feet altitude; and for continued operation at reduced rpm up to 30,000 feet or higher.

Note

With FUEL BOOST "OUT," avoid zero-g, negative-g, or inverted flight; air trapped in the engine driven fuel pump inlet line is likely to cause a flame out, and may make an air start impossible.

TRANSFER PUMP. If the wing tank transfer pump fails, the only fuel available will be that in the fuselage fuel tank. Fuel transfer pump failure will first be indicated by a steady illumination of the FUEL TRANS caution light on the instrument panel. When the fuel remaining in the fuselage tank falls below approximately 1100 pounds (the fuel level at which the wing tank capacitance units are removed from the indicating circuit), there will be an abrupt drop in fuel quantity indication to a reading corresponding to the fuel remaining in the fuselage tank. When this occurs, land as soon as possible to prevent fuel exhaustion.

ENGINE-DRIVEN FUEL PUMP. Either gear stage of the engine-driven fuel pump is capable of supplying the engine with enough fuel for all operations. Should one gear stage fail, a bypass routes the fuel flow around the defective gear stage, allowing the other stage to function without interference. There will be no indication to the pilot of such failure.

FUEL CONTROL UNIT. A malfunction of the fuel control unit may result in fluctuating rpm and exhaust temperature, or a complete loss of power. When any of these occur, proceed as follows:

a. Throttle (speed and altitude permitting) ..... "IDLE"

b. FUEL CONTROL switch (when rpm begins to decrease) ..... "MANUAL"

c. Check that MANUAL FUEL warning light illuminates.

d. Advance the throttle slowly and smoothly to the desired power setting.

CAUTION

When the engine is operating on the manual fuel control system, the throttle must be moved slowly and smoothly to prevent overspeeding, excessive exhaust temperatures and flame-outs.

OIL SYSTEM

Failure of the oil system is indicated by a reading of "OUT" in the OIL PRESS window of the engine performance indicator and by zero or falling pressure on the direct reading gage. Absence of oil pressure for a maximum period of one minute is permissible, and no damage should result from continued operation if "NORM" (20-40 psi) oil pressure is indicated after such a period.

Note

- The oil pressure indicator may show "OUT" momentarily as pressure increases from "NORMAL" to "HIGH." Before initiating unnecessary emergency action, therefore, when "OUT" appears at a high power setting, reduce power slightly. If "NORMAL" appears, assume that no malfunction exists; if "OUT" persists, plan an immediate landing.
- Some flight maneuvers will cause momentary loss of oil pressure. Operation of the engine at zero oil pressure, up to a maximum of one minute, is permissible.
- Electrical power failure also causes the OIL PRESS window to read "OUT"; this will occur, however, in conjunction with other symptoms of electrical failure. Refer to ELECTRICAL SYSTEM in this section.

ELECTRICAL SYSTEM

MAIN GENERATOR. If the main generator should fail, all electrical equipment will be rendered inoperative immediately. The most easily recognizable indications of main generator failure will occur simultaneously as follows:

a. FUEL BOOST ..... "OUT"

b. OIL PRESS ..... "OUT"

c. Wheels and flaps position indicators ..... Wheels: Unsafe
Flaps: OFF

d. Attitude gyro indicator .... OFF warning flag visible

e. Trim position indicators ... Pointers off scales

f. Radio failure.

g. All lights out.

When the main generator fails, pull the EMER GEN release handle.

CAUTION

- Do not release the emergency generator at airspeeds above 500 knots IAS or 0.91 indicated Mach number to prevent damage to the generator.
- At indicated airspeeds below 140 knots the emergency generator may not be capable of supplying adequate electrical power to support the equipment powered from the primary bus.
- During operation with the emergency generator extended, the following precautions should be observed:

  1. During flight at night or under adverse weather conditions, an indicated airspeed in excess of 140 knots should be maintained until flight can be maintained by visual reference.

  2. During landing approaches an indicated airspeed of 140 knots should be maintained as long as possible to insure that adequate power is available to operate the horizontal stabilizer actuator.

TRANSFORMER-RECTIFIERS. Failure of the main d-c transformer-rectifier (see figure 1-9), energized through the forward monitored bus, is indicated whenever d-c powered equipment malfunctions at the same time that a-c equipment powered through the same bus functions normally. Failure of the primary transformer-rectifier, energized through the primary bus, and the only one energized when the emergency generator is operating, is similarly indicated.

Note

Do not deploy the emergency generator even when electrical system trouble is clearly diagnosed as main transformer-rectifier failure. The main generator energizes *both* the main and the primary d-c power sources.

HYDRAULIC SYSTEM

Failure of any hydraulic system will render all equipment serviced by that system inoperative. Refer to section I, HYDRAULIC POWER SUPPLY SYSTEM, for a list of equipment operated by hydraulic system pressure. Illumination of either the UTIL HYD caution light or the CONT HYD warning light will indicate loss of pressure to one or the other of the tandem hydraulic systems. No stiffening of the control stick will be encountered with the tandem system except with complete failure of both the flight control and the utility hydraulic systems, with both warning lights illuminated.

No means is available to the pilot to correct hydraulic system failure. For action to be taken in the event of failure, refer to FLIGHT CONTROL SYSTEM in this section.

Because the wheel brakes are completely independent of the aircraft's hydraulic system, the pilot should realize that he will have brakes even though he makes a field landing without hydraulic system power. (Refer to Section I, BRAKE SYSTEM and see figure 1-10 sheet 3.)

Should the pilot have hydraulic failure, he can also extend his arresting gear. Compressed air pressure and the weight of the arresting hook cause extension when the latch is released when the HOOK control is moved to the "DOWN" position. (Refer to Section I, ARRESTING HOOK SYSTEM and see figure 1-10 sheet 2.) However, the pilot cannot retract the arresting hook without hydraulic pressure.

CAUTION

The arresting hook should not be extended in flight for a field landing with hydraulic failure. The brakes should be sufficient, and the arresting hook should be used only as a last resort, just prior to engagement. This will preclude dragging the hook on the runway, perhaps damaging it to the extent of complete failure.

FLIGHT CONTROL SYSTEM

In the event of flight control system failure, due to complete failure of both systems in the tandem installation, the following procedure should be followed for power boost disconnect:

a. Terminate any accelerated maneuver.

b. Reduce airspeed to 300 knots IAS or less, if possible.

Note

Control stick forces are high on manual control except at low speeds.

c. Trim the aircraft laterally.

d. MAN FLT CONT handle . Pull

Note

- The MAN FLT CONT handle should not be pulled unless both the flight control and utility systems have failed; or unless intermittent flight control pump operation causes erratic and uncontrollable rudder movement.
- The MAN FLT CONT handle should be pulled fully out with a rapid and positive motion. This action will assure a "clean" disconnect and will aid in preventing a tendency for the airplane to roll as the switch to manual control is made.
- The MAN FLT CONT mechanism cannot be reset in flight once it has been disengaged.

e. Trim immediately, if necessary.

Note

As long as primary (normal) electrical power is available, the aircraft can be trimmed.

f. Terminate flight as soon as practicable.

Note

If, for any reason, the MAN FLT CONT handle is pulled while hydraulic pressure is still available, a metallic thud will be heard when the stick is moved. This sound, caused when hydraulic pressure slams the piston against the end of the cylinder, is normal for the system under the above conditions, and should not be cause for alarm.

(Refer to Section VII, HYDRAULIC POWER DISCONNECT, for further information.)

TRIM SWITCH. Should malfunction of the horizontal stabilizer TRIM switch cause continuous actuation, release the emergency generator to deactivate the switch from the electrical system. Operation of the horizontal stabilizer will then be made by use of the MANUAL OVERRIDE switch on the left console.

AILERON TRIM RUNAWAY. In the event of an aileron trim run-away, proceed as follows:

a. Stop run-away trim by extending the emergency generator.

b. Remain on hydraulic power control system.

c. Reduce speed.

Note

With trim jammed at maximum deflection in either direction, forces required to return stick to neutral will be moderate.

WARNING

Do not disconnect the flight control system. At high speeds, on manual, lateral forces could be large.

RUDDER TRIM RUNAWAY. In the event of rudder trim run-away, proceed as follows:

a. Stop run-away trim by extending the emergency generator.

b. Remain on hydraulic power control system.

c. Reduce speed.

Note

Force required to return rudder to neutral will be moderate.

SPEEDBRAKE FAILURE

In the event of speedbrakes control valve solenoid or d-c electrical failure, operate the speedbrakes as follows:

a. SPEEDBRAKE switch .... "OPEN" or "CLOSE" as required

b. EMER SPEED BRAKE control ..... "Pull" to open, or "Push" to close, as required.

Note

The emergency speedbrake control may be used to override the electrical signal, but the handle must be held in the desired position.

In case of hydraulic and electrical failures when they are open, the speed brakes may be closed to the trail position by the manual control.

LANDING GEAR SYSTEM

Utility hydraulic system failure will necessitate lowering the landing gear with the emergency release system, as follows:

a. Airspeed ..... 130-225 knots

b. WHEELS control ..... "DOWN"

c. EMER LDG GR handle ... Pull

d. If the landing gear does not extend fully or lock down, increase the airspeed.

CAUTION

After lowering the landing gear by the emergency release system, leave the gear handle in the "DOWN" position until the ratchet in the emergency system has been reset and until cavitation in the gear-down hydraulic pressure line has been eliminated by application of hydraulic power. This procedure must be followed to prevent failure of the ratchet and damage caused by premature closing of the gear door.

AUTOPILOT SYSTEM

Refer to Section IV, AUTOMATIC FLIGHT CONTROL SYSTEM, for emergency procedures when operating on autopilot.

RADAR SYSTEM

Refer to Section IV, AN/APG-53A RADAR SET, EMERGENCY OPERATION, for emergency procedures.

SECTION IV
AUXILIARY EQUIPMENT

AIR CONDITIONING AND PRESSURIZATION SYSTEM

A combination air conditioning and pressurization system heats, cools, ventilates, and pressurizes the cockpit. The system comprises an air cycle system refrigeration unit, cockpit pressure regulator, pressure relief valve, and temperature control components. (See figure 4-1 for a schematic of the air conditioning and pressurization system.)

AIR CONDITIONING

Hot high pressure air is bled from the engine compressor section, and is ducted either through or around the refrigeration unit, as governed by a cockpit temperature controller. Air passing through the refrigeration unit is directed through a heat exchanger and turbine, where it is expanded and cooled. The cooled air from the refrigeration unit is further mixed with hot air which has by-passed the unit, and is delivered to the cockpit. The degree of mixing of the conditioned air is controlled automatically by an air temperature control valve, which maintains the air at the temperature selected from the cockpit.

The air conditioning system is a delivered air temperature control system. Since the console control is calling for a fixed temperature of the air as it enters the cockpit, the pilot will be required to change the setting as cockpit heating and cooling loads change. Position of the temperature control knob is not an indicator for pilot comfort. Under certain flight conditions, full cold will provide comfort; under other conditions, full hot may be required. The pilot, therefore, must adjust the control to maintain a comfortable cockpit.

PRESSURIZATION

When the air conditioning system is in normal operation, and the cockpit pressurization switch is in the "NORMAL" position, the air provided for heating, cooling, and ventilating is also used to pressurize the cockpit. Pressure is automatically maintained at a pre-determined schedule by a cockpit pressure regulator. The pressurizing schedule (figure 4-2) provides for cockpit pressure to equal atmospheric pressure from sea level to 8000 feet altitude. The cockpit pressure at 8000 feet is then maintained to an altitude of 17,000 feet. From this point on up, the cockpit pressure is maintained at 3.3 psi above the existing atmosphere pressure. Cockpit pressure is shown in terms of altitude by the cabin altimeter (29, figure 1-4), located on the right side of the armament panel.

In order to prevent excessive positive or negative pressure differentials because of possible malfunctioning of the pressure regulator, a pressure relief valve opens at a positive pressure differential of 3.6 psi and at a negative differential of minus 0.10 psi. The pressure relief valve also incorporates an emergency feature which allows it to dump cockpit pressure when the cockpit pressurization switch is placed in the "RAM" position.

AIR CONDITIONING CONTROL PANEL. The air conditioning control panel (8 figure 1-5) is located on the right-hand console and contains a single rotary switch for operation of the cockpit duct temperature control; a lever lock toggle switch for the operation of the cabin pressurization system, and a single toggle switch for the operation of the cockpit air proportioning system. Marked positions of the duct temperature control switch are "MANUAL COLD," "MANUAL HOT" and "WARMER." The cabin pressure switch is marked "RAM" and "NORMAL." The "RAM" position electrically opens the pressure relief valve to dump cockpit pressure and electrically opens a valve in the ram air line, allowing outside air to ventilate the cockpit. The windshield defrost switch is marked "INCREASE," "DECREASE" and "HOLD." The "INCREASE" position increases the proportional air flow to the windshield; the "DECREASE" position decreases the flow of air to the windshield and increases airflow to the footwarmers and "eyeball" diffuser (see figure 4-1). The "HOLD" position allows the proportional flow to the windshield and the footwarmers to remain as is. To prevent windshield frosting, the switch should be moved to "INCREASE" prior to a dive.

DEFROSTING SYSTEM

Defrosting of the windshield side panels is accomplished by utilizing hot air from the air conditioning system and is in operation whenever the CABIN PRESS switch on the air conditioning control panel is in the "NORMAL" position. To provide the pilot with additional control of the cockpit temperature and the air flow distribution, the WINDSHIELD DEFROST switch is provided. This three-position switch operates a motor-controlled proportioning valve to divert air from the windshield to the footwarmers and "eyeball" diffusers. The diffusers may be turned on or off at the discretion of the pilot and may be directed to provide air flow in the most comfortable direction.

COCKPIT FOG AND SNOW SUPPRESSION

The windshield de-fogging system normally requires no control. Small quantities of fog, however, or even finely

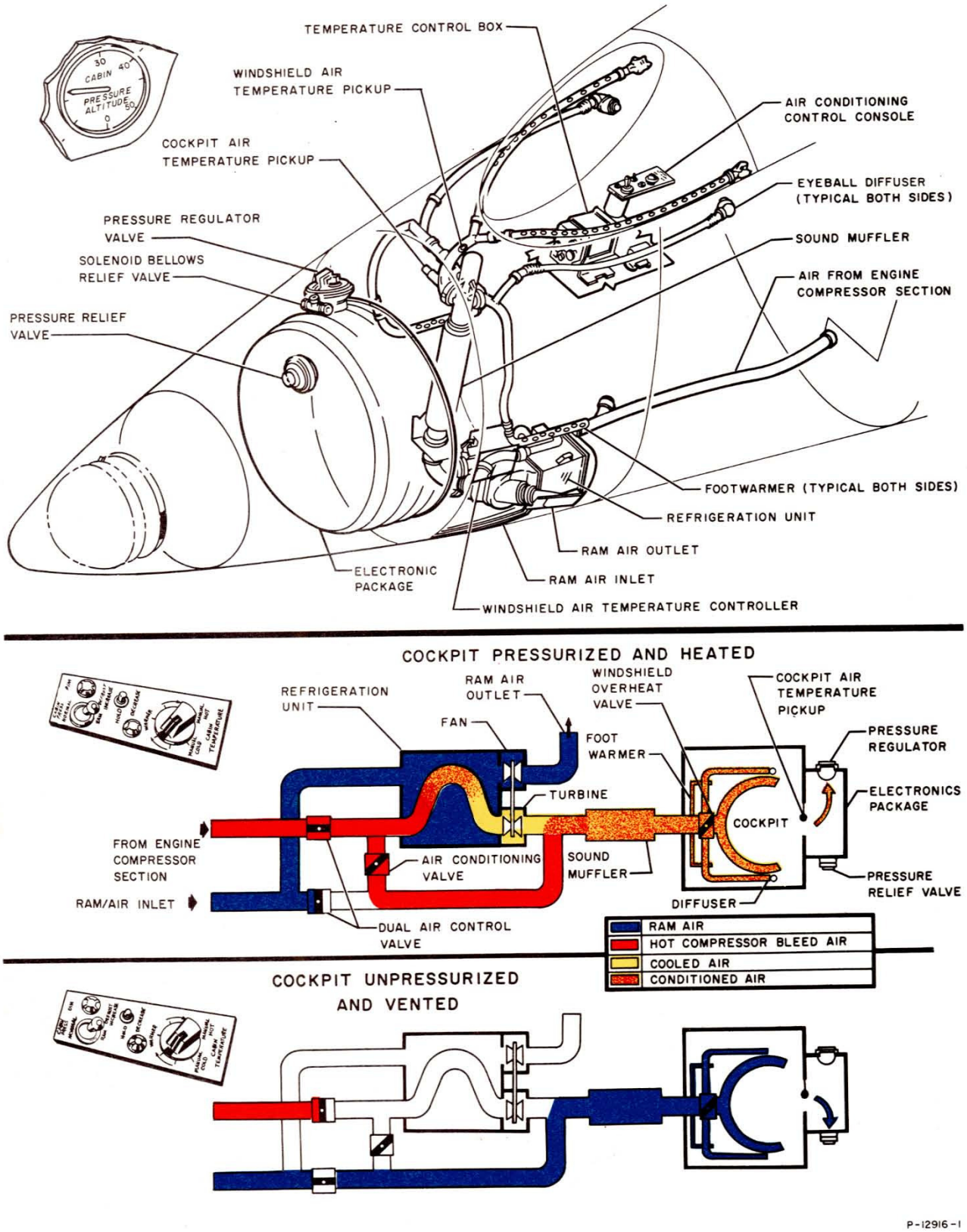


Figure 4-1. Air Conditioning and Pressurization System

divided snow, will frequently appear at the air conditioning outlets. While this is a normal condition resulting from rapid cooling of air by the air conditioning unit, an excessively large volume of fog which obstructs vision can occur under extreme conditions of high humidity and high ambient air temperatures at very low altitude. This fog may be eliminated by (a) adjusting the cockpit temperature control knob for higher cockpit temperature, or (b) by adjusting the windshield defrost switch to decrease the flow of air to the windshield defrost ducts and to close the "eyeball" diffusers, thereby dumping the fog and snow to the footwarmers. In some cases the ducting may have cooled to a point where fog will persist for a short time after the cockpit temperature has been increased. After the fog has been suppressed, a temperature setting should be selected that will provide the most comfortable temperature above the fogging point.

NORMAL OPERATION

BEFORE TAKE-OFF. Before take-off, place the cockpit temperature control switch in the middle of the "WARMER" range or as desired, and divert all of the air to the footwarmers with the position of the "eyeball" diffusers as desired.

DURING FLIGHT. Rotate the cockpit temperature control knobs to a temperature which provides the most comfort, and adjust the windshield defrost switch and "eyeball" diffusers to the position required.

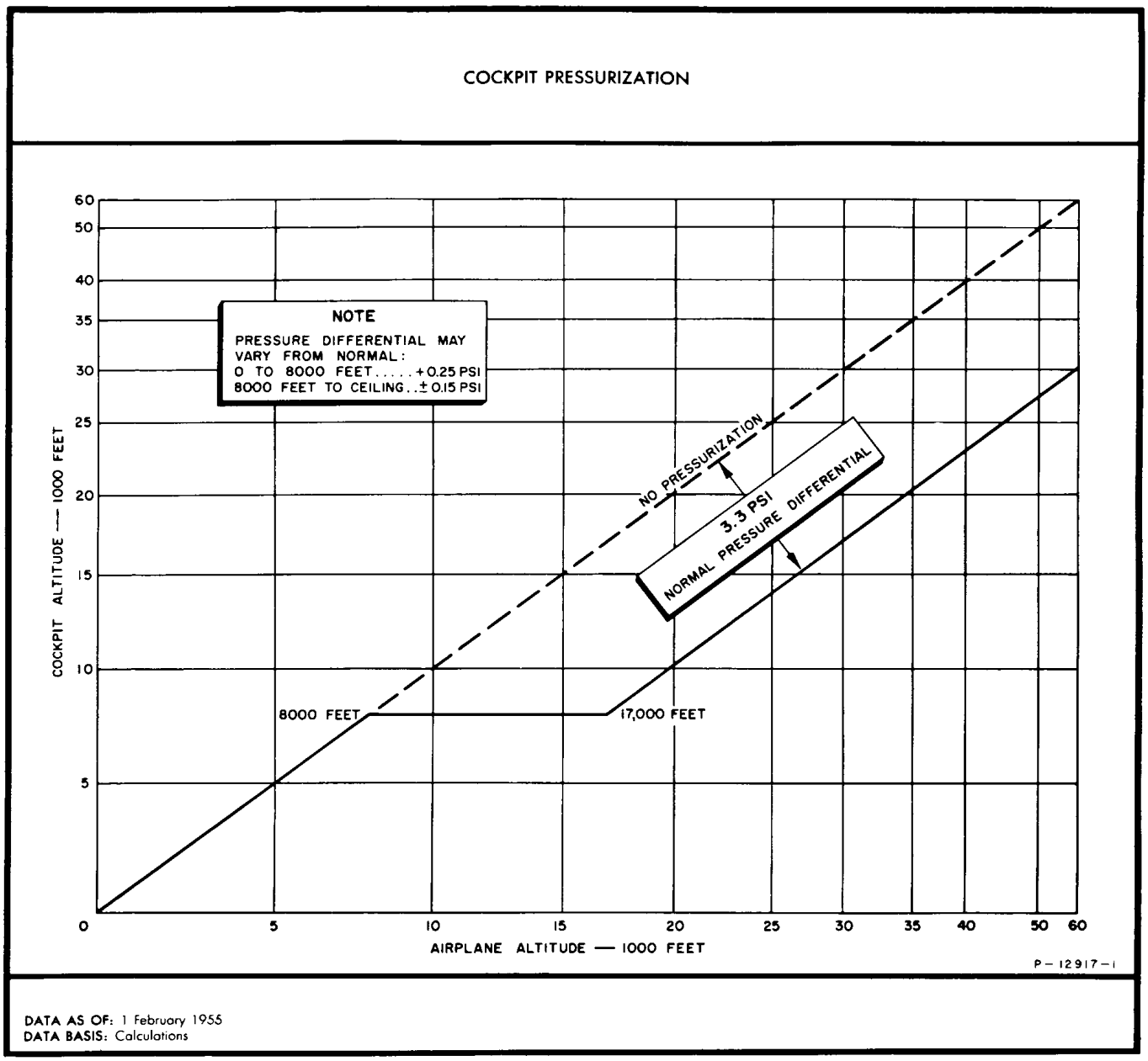


Figure 4-2. Cockpit Pressurization Chart

AFTER FLIGHT. No repositioning of the air conditioning controls is required.

EMERGENCY OPERATION

If the air conditioning unit fails or loses electrical power, the cockpit air temperature will remain the same and the cockpit pressure will remain as is. If the unit itself has failed, positioning of the cockpit pressure toggle switch to the "RAM" position will provide a more comfortable temperature, but pressurization will be lost. If failure is due to loss of electrical power, temperature control will be restored when the emergency generator is put into operation.

DE-FOGGING SYSTEM

Fogging or frosting of the bullet resistant glass center panel of the windshield is prevented by electrical means. This system is energized whenever the main generator is operating or when external power is supplied to the a-c system. A transparent layer within the glass panel provides resistance for electrical heating, and a sensing element contained in the panel causes a heating controller to regulate automatically the temperature of the surface to maintain it between two predetermined limits.

Windshield de-fogging is possible when the emergency generator is extended. Electrical power for the heating element is supplied by the emergency generator through the monitored primary bus. With the emergency generator extended, a switch in the system automatically shuts off the heating element when the landing gear handle is moved to the "DOWN" position. To minimize fogging of the center panel when the emergency generator is extended, delay lowering the landing gear as long as possible in the landing sequence.

ANTI-ICING SYSTEM

Anti-icing is provided for the pitot system and for the angle of attack vane. An electrical heating element in the pitot head is controlled by the PITOT HEAT switch (9, figure 1-5) on the right hand console. Two positions, "ON" and "OFF," are provided for the operation of the pitot heat. The "ON" position should normally be used only in flight, as prolonged ground operation without cooling air flow can damage the heating element. Power to the angle of attack vane is continually supplied and regulated by a thermostat.

COMMUNICATIONS AND ASSOCIATED ELECTRONIC EQUIPMENT

All communications and associated electronic equipment are listed in the Table of Electronic Equipment, figure 4-3. Major units of the AN/ARC-27A UHF radio, the AN/ARA-25 direction finder, and the AN/APX-6B IFF equipment are mounted in an integrated electronics central, which is designated AN/ASQ-17 and located in the nose section of the airplane, along with the AN/APA-89 coder group. Also installed in the nose section is the AN/ARN-21 omni bearing-distance radio. Auxiliary navigation equipment, the AN/ARN-12 marker beacon receiver and the AN/ARN-14E VOR radio, can be carried as an external store in a navigation package (NAVPAC). Until the master radio switch (refer to MASTER RADIO SWITCH) is provided to energize the radio circuits, each piece of equipment must be turned on at its associated control panel, with the exception of the AN/ARN-12 marker beacon receiver and the AN/ARC-27 UHF radio, which are energized whenever the main generator is operating or external power is connected to the aircraft.

MASTER RADIO SWITCH. The function selector switch of the AN/ARC-27A UHF radio is used as a master radio switch, and controls the power to the electronic central through a relay. When this switch (marked "OFF," "T/R," "T/R & G," "ADF") is positioned at "OFF," all units of the electronic central are de-energized. When the aircraft electrical system is energized and the function switch is positioned at "T/R," "T/R & G" or "ADF," the AN/ARC-27A UHF is energized, and electrical power is available for other units of the electronic central.

Note

During maintenance operations or extended ground operation with the canopy open, air is not available for cooling the AN/ASQ-17 electronic central. Under these conditions the master radio switch should be "OFF."

CAUTION

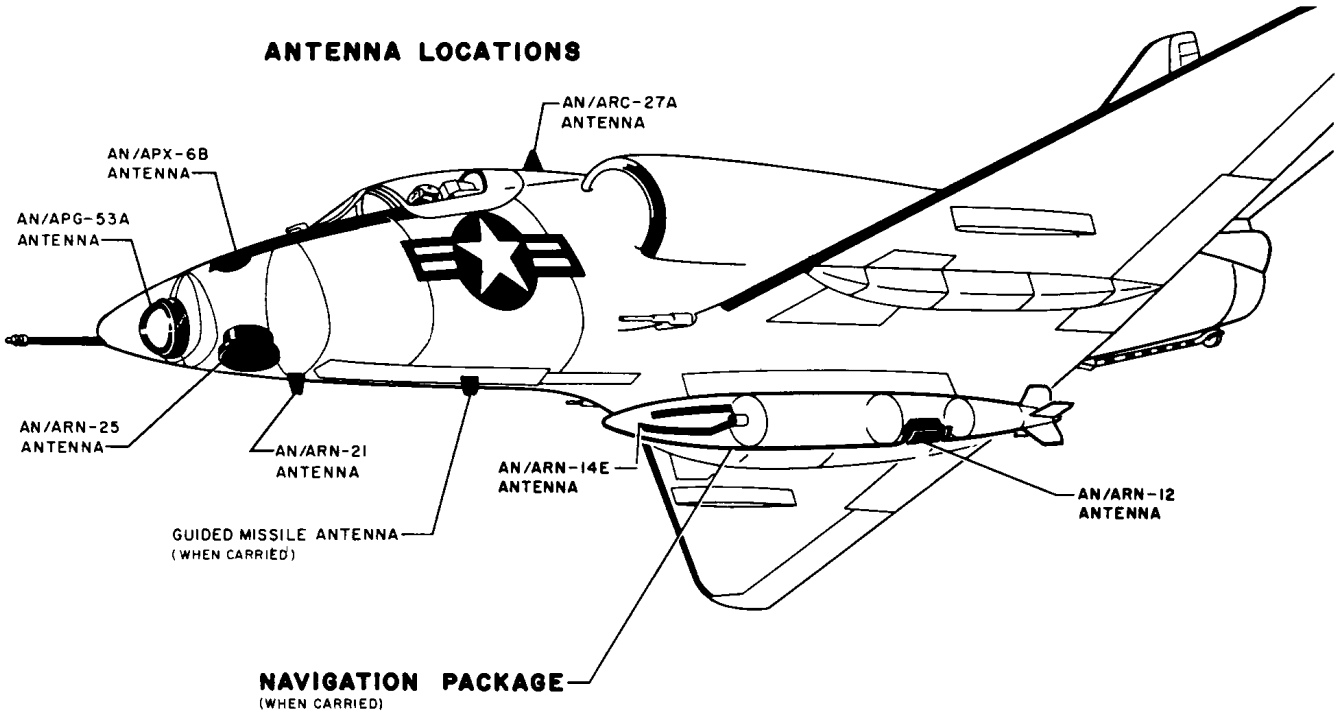
After losing cabin pressure, avoid UHF transmission above 27,500 feet cockpit altitude. Under these conditions, keying the ARC-27A at higher altitudes causes arcing within the ASQ-17, and eventual failure.

UHF RADIO

The AN/ARC-27A UHF radio equipment provides two-way voice communications with other aircraft and with surface stations. The equipment can transmit or receive through the same antenna on any one of the 1750 channels within a frequency range of 225.0 through 399.9 megacycles.

UHF RADIO CONTROL PANEL. The C-1015/ARC-27A control panel (12, figure 1-5) is located on the right console. The panel contains a VOL control, SENS control, function selector switch, CHAN selector switch, and a manual tuning control. The VOL control regulates the volume of incoming signals, and the SENS control provides a vernier adjustment of the sensitivity. The CHAN selector switch has twenty channel positions, numbered 1 through 20, a "G" (guard) position, and an "M" (manual) position.

The manual tuning control consists of three concentric dials. The outer dial is used to select the first two digits of the desired frequency, the center dial selects the third



AIRCRAFT INSTALLATIONS

TYPE	DESIGNATION	FUNCTION	RANGE	LOCATION OF CONTROLS
COMMUNICATION				
UHF RADIO	AN/ARC-27A	SHORT RANGE—TWO WAY VOICE COMMUNICATION	LINE-OF-SIGHT	RIGHT CONSOLE
NAVIGATION				
UHF—ADF	AN/ARA-25	DIRECTIONAL HOMING	LINE-OF-SIGHT	RIGHT CONSOLE
TACAN	AN/ARN-21	PROVIDES BEARING AND DISTANCE TO A SELECTED STATION	LINE-OF-SIGHT TO 200 MILES	RIGHT CONSOLE
IDENTIFICATION				
IFF RADAR	AN/APX-68	IDENTIFIES AS FRIENDLY	LINE-OF-SIGHT	RIGHT CONSOLE
SIF RADAR	AN/APA-89	IDENTIFICATION CODER	LINE-OF-SIGHT	RIGHT CONSOLE
TERRAIN CLEARANCE RADAR				
AIR-TO-GROUND RECEIVE AND TRANSMIT	AN/APG-53A	RADAR	LINE-OF-SIGHT	LEFT CONSOLE AND INSTRUMENT PANEL
WEAPONS DELIVERY (WHEN CARRIED)				
AIR-TO-GROUND MISSILE	(SEE SUPPLEMENT)	GUIDED MISSILE	LINE-OF-SIGHT	LEFT CONSOLE AND CONTROL STICK
NAVIGATION (WHEN CARRIED)				
OMNI RANGE RECEIVER	AN/ARN-14E	DIRECTIONAL HOMING	LINE-OF-SIGHT	LEFT CONSOLE
MARKER BEACON RECEIVER	AN/ARN-12	INDICATES MARKER BEACON POSITION	WITHIN MARKER BEACON SIGNAL PATTERN	LEFT CONSOLE

P-12918-1

Figure 4-3. Table of Electronic Equipment

digit, and the inner dial selects the digit to the right of the decimal point. The CHAN selector switch must be placed at "M" before channels can be selected manually. The function selector switch is used to place the set in operation, and has four positions marked as follows:

Position	*Function*
"OFF"	Inoperative (the transmitter-receiver is energized when the electrical system is energized.)
"T/R"	Transmitter on standby and receiver in operation.
"T/R + G"	Same as "T/R" plus reception on the guard.
"ADF"	Transmitter on standby and AN/ARA-25 direction finding equipment in operation through receiver.

OPERATION OF THE UHF RADIO

a. Function selector switch . . "T/R"

b. CHAN selector switch . . . . Desired channel

c. Depress throttle MIC switch to transmit.

d. For operation on "ADF" refer to AUTOMATIC DIRECTION FINDING EQUIPMENT.

AUTOMATIC DIRECTION FINDING EQUIPMENT

The AN/ARA-25 automatic direction finding equipment operates in conjunction with the AN/ARC-27A UHF radio to provide a continuous directional indication of the source of signals received in the 225 to 400 megacycles. Source indication in degrees of magnetic bearing for homing or navigational purposes is provided by the number 1 needle of the ID-250/ARN course indicator.

OPERATION OF THE AN/ARA-25. The AN/ARA-25 ADF equipment is energized when the aircraft electrical system is energized, and is placed in operation by moving the function selector switch on the UHF radio control panel to the "ADF" position.

Note

When the emergency generator is extended, APX-6B, ARA-25, ARC-27A, and the compass system are the only navigational aids available to the pilot.

RADAR IDENTIFICATION EQUIPMENT

The aircraft radar identification equipment consists of the AN/APX-6B IFF transponder and AN/APA-89 selective identification equipment. The AN/APX-6B IFF transponder provides the aircraft with automatic identification when properly challenged by surface or airborne radar equipment. The identification system also permits surface tracking of the aircraft in which it is installed. Functionally, the AN/APX-6B equipment receives challenges and transmits coded replies for display upon the challenger's radar indicator.

IFF CONTROL PANEL. A C-1159/APX-6B control panel (16, figure 1-5) is installed on the right console and is identified as IFF. The panel contains a rotary selector switch labeled MASTER with five designated positions: "OFF," "STBY," "LOW," "NORM," and "EMERGENCY." Two MODE switches are located adjacent to the MASTER switch; a third toggle switch provides selection of "I/P" and "MIC." The equipment is placed in operation when the MASTER switch is rotated out of the "OFF" position, provided the main generator is operating or external power is available.

SIF CONTROL PANEL. A C-1272/APA-89 control panel (17, figure 1-5), labeled SIF, (Selective Identification Feature), is located on the right console adjacent to the IFF control panel.

BEARING-DISTANCE EQUIPMENT (TACAN)

The AN/ARN-21 airborne equipment operates in conjunction with surface navigation beacons to provide continuous directional and distance information to the pilot. Visual indication of bearing to a selected station is provided by the number 2 pointer of the ID-250/ARN course indicator (20, figure 1-4), and distance information is indicated on the ID-310/ARN range indicator (19, figure 1-4). Beacon identification tone signals are received through the regular headset.

ARN/21 CONTROL PANEL. The C-1763/ARN/21 control panel (13, figure 1-5), is identified as NAV and is located on the right-hand console. Operating controls include the power switch with "OFF-REC-T/R" positions, two CHAN (channel selector) knobs, and a VOL (volume) control.

ARN-21 TRANSFER RELAY. Because the ID-250/ARN course indicator is common to both the AN/ARN-14 radio and the AN/ARN-21 radio, a switching means is provided for the selection of proper receiver-indicator combinations to meet specific navigational requirements. The ARN-21 transfer relay will automatically connect the ID-250/ARN course indicator to either the AN/ARN-14 or the AN/ARN-21 radio when their respective console control panel is turned on. The AN/ARN-21 transfer relay is energized by either the "REC" or "T/R" position of the power switch on the ARN-21 control panel, disconnecting the AN/ARN-14 radio and connecting the AN/ARN-21 radio to the ID-250/course indicator. Thus if both radio sets are inadvertently turned on at the same time, only the AN/ARN-21 equipment will be operative.

OPERATION OF AN/ARN-21. To operate the AN/ARN-21 radio, proceed as follows:

a. Power switch . . . . . "REC"

Note

A warm-up period of 90 seconds is required after the power switch is moved from "OFF."

b. CHAN selector switch . . . . Set channel number in indicator dial

c. Identify beacon by tone signals in headset and read bearing to station at the number 2 pointer of the ID-250 indicator.

d. For distance information, the power switch must be turned to "T/R." Read distance to the beacon in nautical miles on the ID-310 range indicator.

MARKER BEACON EQUIPMENT

The AN/ARN-12 marker beacon equipment, which is placed in operation when the aircraft electrical system is energized, is located in the external navigation package. Functionally, the system receives a 75 megacycle signal, modulated at 400, 1300, or 3000 cycles, from marker beacon transmitters. From these signals, the relative position of the aircraft can be checked in respect to specific marker beacon stations. An aural indication of marker beacon interception is provided by the aircraft audio system. In addition, a marker beacon indicating light, located beneath the glareshield, (9, figure 1-3) glows an amber color to give visual indication of marker beacon interception.

Note

The marker beacon indicating light is also used in conjunction with certain special weapon installations when the NAVPAC is not carried. In this event a red lens cover should be placed over the light by the ground crew.

MARKER BEACON CONTROL PANEL. A MARKER BEACON control panel (when carried), on the left console forward of the throttle, contains two toggle switches: an AUDIO switch with "ON" and "OFF" positions; and a sensitivity switch with positions marked "BELOW 20,000 FT" and "ABOVE 20,000 FT." Since no volume control is provided, the AUDIO switch is used to continue or discontinue the reception of aural signals when their volume level interferes with other radio receptions. Regardless of the position of the AUDIO switch, visual indication of marker beacon interception will be provided by the indicator light. The sensitivity switch should be placed in the position corresponding to the general altitude level at which the aircraft is flying to achieve the best reception.

OMNI-RANGE RADIO

The AN/ARN-14E omni-range radio includes an R-540/ARN-14C VHF receiver, an ID-251/ARN indicator control, and an antenna; all are contained in the NAVPAC external stores. The omni-range radio provides for the reception of VOR, VAR and localizer signals in a frequency spectrum of 108.0 to 136.0 megacycles. Use of the equipment in this aircraft is described as follows:

a. Indication of the magnetic bearing of the VHF omni-range station from the aircraft by the number 2 needle of the ID-250/ARN course indicator.

b. Reception of voice facilities on communications channels or superimposed on navigation signals in the localizer or omni-range channels.

OMNI-RANGE RADIO CONTROL PANEL. The omni-range receiver is remotely tuned by means of a C-760 R/A ARN-14 control panel (when carried) labeled VHF NAV. The panel contains a POWER switch with "ON TONE" and "OFF" positions, a VOLUME control, and a FREQUENCY selector which consists of two concentric dials. A window is provided to show the selected frequency.

OPERATION OF THE OMNI-RANGE RADIO.

a. POWER switch . . . . . "ON TONE"

b. FREQUENCY selector . . . . Desired frequency

c. Read the magnetic bearing to the station on the number 2 needle of the ID-250/ARN course indicator.

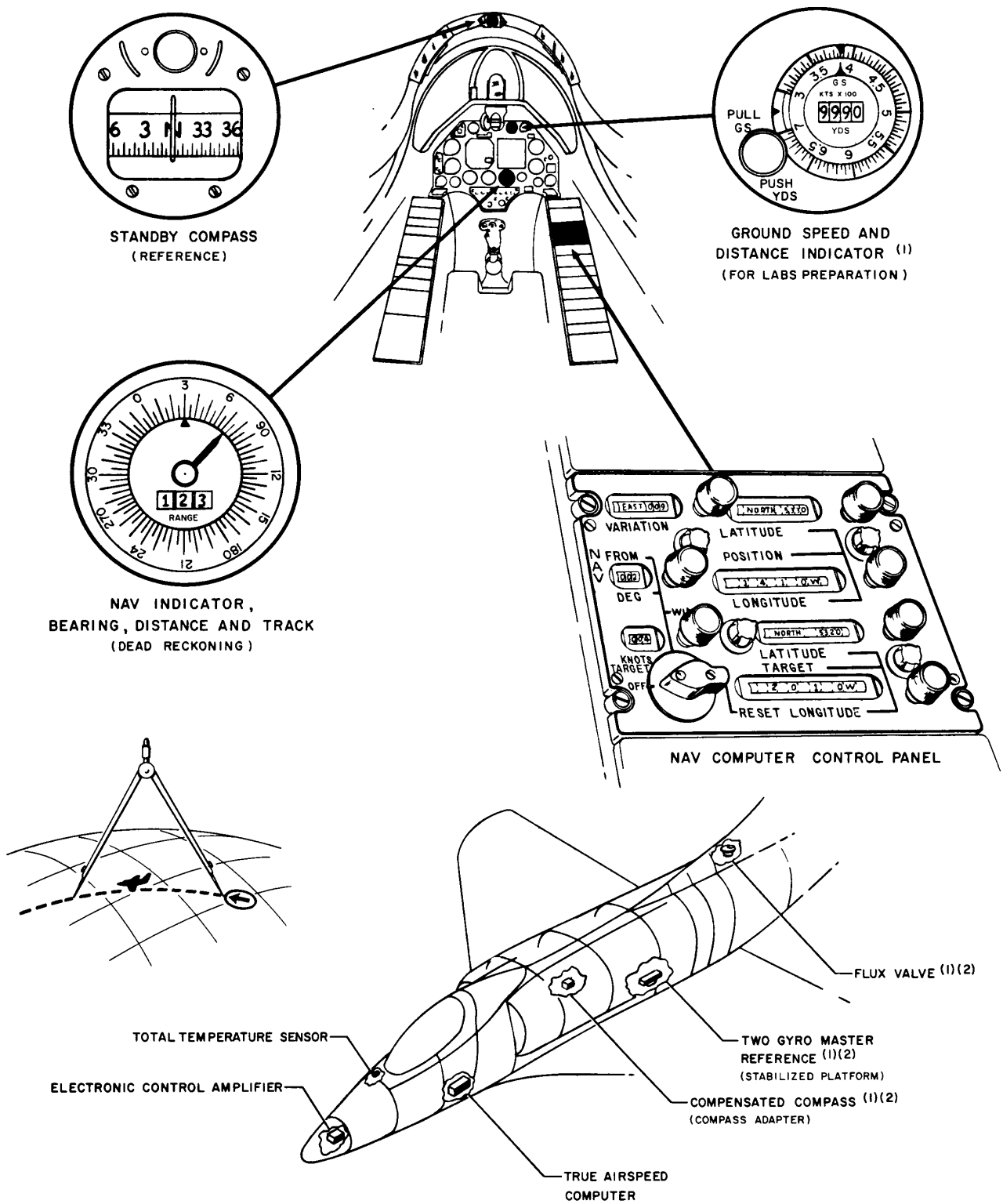
Note

The "OFF-REC'T/R" switch on the ARN-21 control panel must be positioned at "OFF" in order for the AN/ARN-14E radio to be connected to the ID-250/ARN course indicator.

NAVIGATION EQUIPMENT

COMPASS CONTROLLER

Controls for the operation of the compass system are located on the COMPASS CONTROLLER panel (15, figure 1-5) of the right console. The switch marked "SLAVED" and "FREE" permits selection of either function. A SET HEADING control, with "FAST," "SLOW," "INCREASE," and "DECREASE" positions, is used to rotate the ID-250/ARN compass card and All Attitude Indicator to any desired heading or to synchronize the compass system with the magnetic flux valve. The "PUSH TO SYNC" button will do this synchronizing automatically. The compass synchronization needle is energized only when the system is operated as a slaved directional gyro. If the needle is across the center line of the synchronization dial when the system is operated in the "SLAVED" mode, the compass card is synchronized with the magnetic flux valve. Any small deviation from the null position will be slaved out in a period of time from one to three minutes after the initial heading is set. During flight the sync needle will oscillate about the null position because of the motion of the flux valve. The oscillation of the sync needle should not be interpreted as a need for null adjustment or as a compass malfunction. The directional gyro will integrate or smooth out these variations to the ID-250/ARN compass card. To adjust the needle and synchronize the compass proceed as follows: if the needle is left of center, clockwise rotation of the SET HEADING control should move the needle from left to right and rotate the compass card clockwise; if the needle is right of center, counterclockwise rotation of the SET HEADING control should



(1) ALSO SEE LABS SYSTEM
(2) ALSO SEE AUTOPILOT SYSTEM

P-12919-1

Figure 4-4. Navigational Computer Set (Automatic Dead Reckoning System)

move the needle from right to left and rotate the compass card counterclockwise. For fast centering of the needle push "PUSH TO SYNC" button and hold it until the needle is centered. To move the needle slowly hold the knob half way over in the desired direction. A small knob marked "N" "S" LAT should be set to "N" when operating in northern latitudes and "S" when operating in southern latitudes. The latitude setting dial marked LAT is used to control the apparent drift of the gyro when operating as a free gyro. This dial is marked for each two degrees from "0" to "90". The dial should be set to the approximate latitude of the aircraft. If the latitude changes as the flight progresses the dial should be reset to the new latitude.

SLAVED OPERATION. When initially turning on the system to operate as a slaved gyro compass, allow 100 seconds for warm-up; then:

a. Place the SLAVED-FREE switch to "SLAVED".

b. Rotate the compass card of the ID-250/ARN to the desired heading by use of the SET HEADING control. The compass system will now maintain its magnetic heading reference on the ID-250 indicator compass card *and* All Attitude Indicator.

Note

- The synchronization dial is used as a null indicator only. Heading information should be obtained from the ID-250/ARN, or the All Attitude Indicator.
- A compass card error of $\pm 2°$ may peg the needle. If the sync needle stays pegged after prolonged straight and level flight (more than 5 minutes) a possible malfunction of the system is indicated.
- The heading indicator should show the correct magnetic heading when the annunciator pointer stabilizes.

FREE GYRO OPERATION. To operate the system as a free gyro allow 90 seconds for the system to warm up; then:

a. Place the SLAVED-FREE switch to "FREE".

b. Set the N.S. LAT knob to "N" for northern hemisphere or to "S" for southern hemisphere operation.

c. Rotate the compass card of the ID-250/ARN to the desired heading by use of the SET HEADING control.

Note

The compass synchronization needle is inoperative when the system is used as a free gyro.

d. Rotate the latitude setting dial to the latitude of the aircraft.

AN/ASN-19A NAVIGATIONAL COMPUTER SET

The AN/ASN-19A (automatic dead-reckoning) set (figure 4-4) continuously computes and indicates throughout a flight the great circle bearing and range to a target or home base, present latitude and longitude, and the ground track angle. This system consists of a CP-434/ASN-19A Computer-Control (data setting box), on the right hand console (13, figure 1-5), an Electronic Control Amplifier, in the nose section, and an ID-732/ASN-19A Bearing-Distance-Track Indicator on the pilot's instrument panel (21, figure 1-4). The set is energized by the forward monitored bus, and may be operated only when the main generator is running or when external power is applied to the aircraft. The TAS transducer, through rotation of a synchro control transformer rotor (which is varied by the outside air temperature and pitot/static pressure values), computes TAS information and transmits it to the Computer-Control which accepts manual inputs of base position, target position, wind and variation, as well as the automatic input from the TAS transducer and the compass system. These inputs are resolved and integrated to provide great circle bearing, range, and ground track information. Present latitude and longitude may be read in windows on the computer. True great circle bearing and distance to target or base are presented on the Indicator by means of a pointer and counter, respectively, and ground track is presented by a moving card.

The compass card in free gyro operation of the Radio Magnetic Indicator (2, figure 1-4) as well as the standby compass are used for reference only with the Navigational Computer Set.

NAVIGATIONAL COMPUTER SET CONTROLS.

FUNCTION SWITCH. The function selector switch is used to place the set in operation, and has five positions marked as follows:

Position	*Function*
"OFF"	The set is completely de-energized.
"TARGET"	Computations are continuously performed so that distance to the target and target bearing appear on the Indicator.
"BASE"	Distance to base and base bearing appear on the Indicator in place of target data.
"STBY"	System computes present position to base, but does not integrate.
"RESET"	Former base position may be erased, and a new base position may be established.

LATITUDE AND LONGITUDE INPUT. Four knobs are provided to set POSITION LATITUDE, POSITION

LONGITUDE, TARGET LATITUDE, and TARGET LONGITUDE. Each of these settings is read on an adjacent counter on the computer-control box.

Note

The operational range of the Computer Set is 72°N to 72°S. System accuracy decreases moderately at latitudes greater than 50°; rapidly, at those greater than 70°.

WIND INPUT. Two knobs are used to set WIND on two counters in the Computer.

Note

- The Computer accepts wind speed from 0-200 KNOTS.
- True wind direction must be set into the Computer.

VARIATION INPUT. Magnetic variation up to 180° E or W may be introduced into the computer by means of a single knob adjacent to the VARIATION counter.

OPERATIONAL PROCEDURE.

PRE-FLIGHT. Steps a. through g., which do not require electrical power, can be accomplished before the engine is started.

a. Switch function selector to "RESET." (Knob must be pulled out approximately 1/16-inch.)

b. Set in magnetic VARIATION corresponding to present position. For short flights, use average variation.

c. Set WIND-FROM and WIND-KNOTS counters. Use true—not magnetic—north as reference.

d. Set TARGET LATITUDE and LONGITUDE counters. (Knobs must be pushed in.)

e. Set in point of return (base) LATITUDE and LONGITUDE on POSITION counters. If point of return and starting point are the same, omit step f.

f. If point of return and starting point are different, switch selector to "STBY" and set in LATITUDE and LONGITUDE of starting point on POSITION counters.

g. Switch selector to "OFF." (Knob must be pulled out.)

h. After engine is started, switch selector to "STBY."

AFTER TAKE-OFF.

Note

Leave selector in "STBY" until 150 knots TAS is attained. The Computer "assumes" an input of 150 knots minimum, even at lower airspeeds.

a. Switch selector to "TARGET" (or "BASE").

b. To fly great circle (shortest) route to target, head airplane to align bearing needle of indicator with fixed ground track index mark.

IN-FLIGHT.

a. On long flights, correct VARIATION periodically to minimize heading errors.

b. Correct WIND whenever reliable information is available. Incorrect wind settings are a *major source* of Computer error.

Note

- A new base position which lies in the flight path can be established without affecting present position computation by switching the selector to "RESET" momentarily, then returning it to "TARGET" or "BASE" when POSITION coordinates coincide with the new base coordinates. Pushing in the counter knobs automatically stops the present position computation—which resumes when the knobs are released.
- Course deviations to avoid enemy action, adverse weather conditions, and the like, may be made at any time without affecting the accuracy of computations; however, frequent or large changes of altitude cause the system to indicate arrival at the target slightly ahead of the airplane.

c. After completing the mission, switch the selector to "BASE." Read the base RANGE and bearing on the indicator.

Note

- At any time during the flight, the TARGET, POSITION, WIND and VARIATION settings may be changed, regardless of the position of the selector switch. Location is continuously shown by the LATITUDE and LONGITUDE POSITION windows.
- The base reference is erased whenever the function switch is moved to "RESET", and the location seen at that time in the POSITION windows is the new base reference.
- If the airplane is to be abandoned where its equipment is likely to fall into the hands of an unfriendly nation, the function switch must be placed in the "RESET" position in order to erase base reference.
- The system will not operate on the emergency generator.

FLIGHTS GREATER THAN 1000 MILES.

a. Set into the TARGET counters an intermediate destination which lies on the desired flight path and which is less than 1000 miles from the starting position. The intermediate destination may be an arbitrary point along the flight path. If possible, however, employ a recognizable location which may be used to check the present POSITION readings.

b. When the intermediate destination is approached, set into the TARGET counters another intermediate destination which is less than 1000 miles away.

c. When within 1000 miles of the target, set the target coordinates in on the TARGET counters.

d. When returning to the base position, use the same procedure as above except turn the selector switch to "BASE" when within 1000 miles of the base position.

Note

The use of intermediate destinations does not affect the accuracy of the dead reckoning set but is merely a convenient method for performing long range flights.

FLIGHTS USING DOG-LEGS. The most convenient method of flying dog-legs follows:

a. Set the target coordinates on the TARGET counters.

b. Before the flight, determine the ground track angle and time required for each leg.

c. Fly each leg using the ground track angle presented by the dead reckoning set indicator and the predetermined time of flight. Since the dead reckoning set continuously computes present position, intermediate legs need not be flown accurately.

d. After entering the last leg, align the bearing pointer with the fiducial mark to obtain the correct path to the target.

If it is necessary for the legs to be flown accurately, set in the end point of each leg in turn into the TARGET counters. This procedure will not result in any increase in accuracy over that obtainable from the first method unless the end points are recognizable locations and are used as check points.

STANDBY COMPASS

A direct-reading magnetic compass is mounted on the forward edge of the canopy. The reading obtained from the standby compass must be compensated for deviation by applying the corrections given on the compass correction card (6, figure 1-5) located on the right side of the cockpit adjacent to the arresting hook control.

LIGHTING EQUIPMENT

INTERIOR LIGHTS

The interior lighting system includes all instrument and console lights, and two cockpit floodlights. The instrument faces are concave and each has an individual light mounted in the center to provide even illumination over the entire instrument face. The two floodlights are mounted on each side of the gunsight beneath the glareshield to provide auxiliary or emergency red lighting of the instrument panel. The console lights are standard. The instrument and console lights receive power from the primary bus and the floodlights are powered from the 26-volt a-c bus.

INTERIOR LIGHTS CONTROL PANEL. An INT LTS control panel (18, figure 1-5), mounted on the right console, contains switches for the operation of all interior lights. Two rotary switches, marked INST and CONSOLES, are rotated clockwise from "OFF" to turn on the instrument lights and console lights, respectively. Further rotation in a clockwise direction toward the "BRIGHT" position increases the intensity of the illumination. A toggle-type FLOOD switch with three positions, "BRIGHT", "MEDIUM" and "DIM," controls the operation of the floodlights after the CONSOLES switch is rotated from the "OFF" position. The "DIM" position provides further intensity adjustment to accomodate individual pilot preference.

Note

The dimming of the radar scope is completely independent of the interior lights controls.

EXTERIOR LIGHTS

The exterior lights system includes position, formation, and fuselage-wing lights, an approach light, and provisions for a removable taxi light. Standard semi-flush wing tip position lights and a single white tail light are installed on the aircraft. Formation lights are rectangular windows on the top and bottom of each wing tip and have colors corresponding to the position lights. A semi-flush white fuselage-wing light is located under the leading edge of each wing and one is mounted on top of the fuselage. The angle of attack approach lights

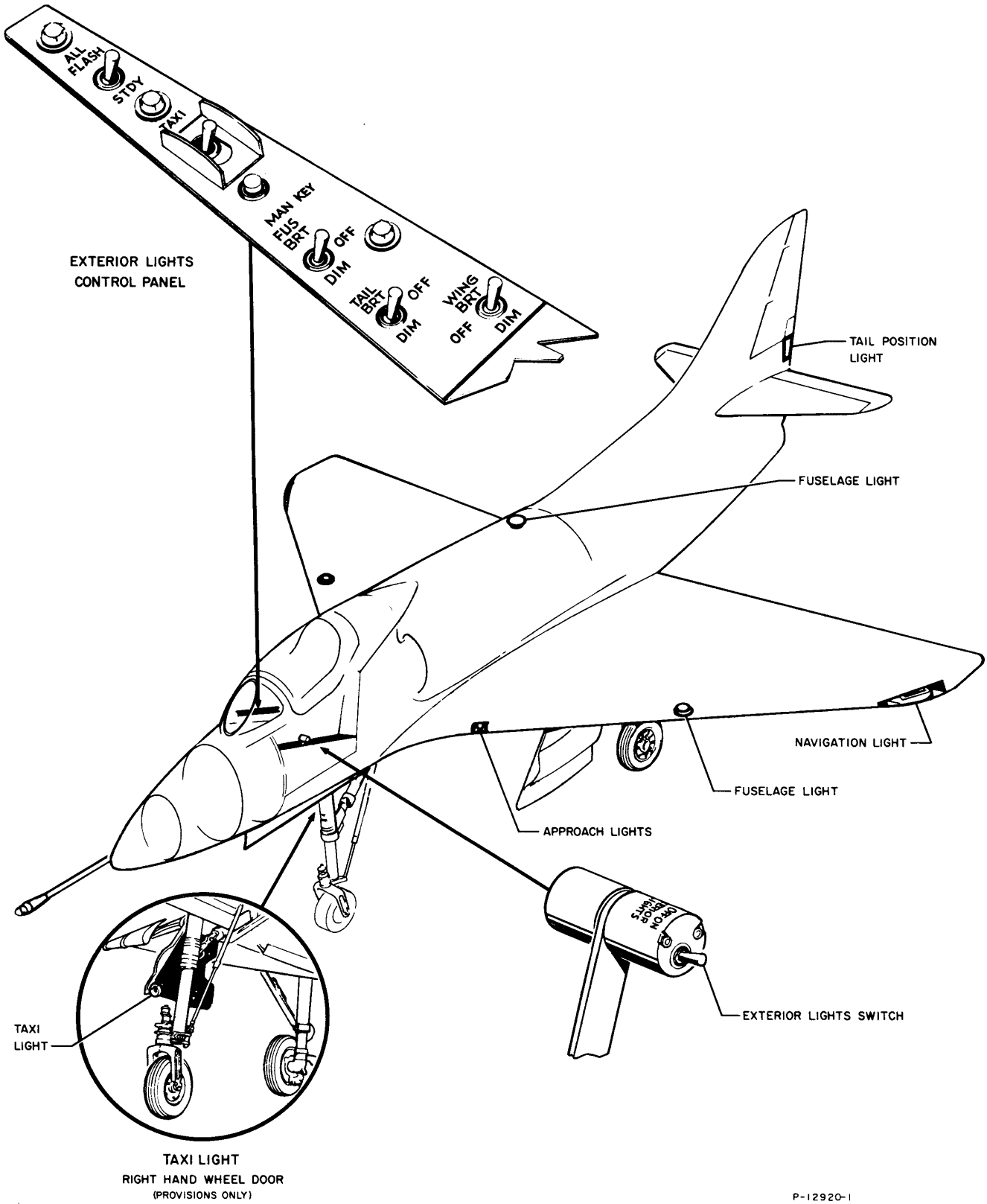


Figure 4-5. Exterior Lights

are mounted on the leading edge of the left wing (see figure 4-6); the taxi light can be installed on the right hand main landing gear door. The exterior lights receive power from the forward monitored bus.

Wing tip, tail and fuselage lights are actually double lights, as both filament and gas-discharge types are provided. The "BRT" (bright) position directs power to the gas discharge lights; the "DIM" position directs power to the filament lights.

EXTERIOR LIGHTS CONTROLS

MASTER EXTERIOR LIGHTS SWITCH. A master exterior lights switch (15, figure 1-3), on the outboard side of the throttle grip, controls power to the exterior lights. The switch has a forward "on" position, a center "off" position, and an aft, or "momentary" position. The master exterior lights switch is spring-loaded from the aft to the center position, thus providing a means of signaling with the exterior lights.

EXTERIOR LIGHTS CONTROL PANEL. An EXT LTS control panel (5, figure 1-5) on the right console contains switches for functional control of the exterior lights. Two FUSELAGE switches control operation of the fuselage-wing lights; one switch has "FLASH" and "STEADY" positions, and the other has "BRIGHT," "MAN," and "DIM." The "MAN" position is used in conjunction with an adjacent MAN KEY switch and associated IND (indicator) light for sending code with the fuselage-wing lights. The WING & TAIL switch and the FORM (formation lights) switch have "BRIGHT," "OFF", and "DIM" positions. A guarded TAXI switch with "ON" and "OFF" positions controls the operation of the taxi light, when the latter is installed.

OPERATION OF THE EXTERIOR LIGHTS.

a. Master exterior lights switch ..... "On"

b. FUSELAGE switches ..... "FLASH" and "BRIGHT"

c. WING & TAIL switch .... "BRIGHT"

d. FORM switch ..... "BRIGHT"

e. To send code signals manually, leave the FUSELAGE switches on "STEADY" and "MAN," and depress the MAN KEY switch to signal, using the IND light to monitor the signals.

APPROACH LIGHT OPERATION. The approach light circuit is energized by the a-c primary bus and is controlled by a tail hook switch, a landing gear microswitch, and by a manually operated tail hook bypass switch. The approach light functions when the master exterior lights switch is turned on and provides the landing signal officer with information as to flight attitude on approach, as well as indicating the positions of the landing gear and arresting hook.

ANGLE OF ATTACK-APPROACH LIGHTS SYSTEM

The angle of attack-approach light system consists of an ANGLE OF ATTACK VANE transducer unit, an ANGLE OF ATTACK INDICATOR, an ANGLE OF ATTACK INDEX LIGHT with a dimming wheel and a three colored external approach lights unit. (See figure 4-6). The angle of attack vane, extending outboard on the left side of the fuselage, senses the attitude of the aircraft in relation to the *relative wind* and sends the angle of attack readings to the ANGLE OF ATTACK INDICATOR located at the top of the instrument panel (3, figure 1-4). The ANGLE OF ATTACK INDICATOR has a pointer on the dial graduated from "0" through "30," and an "OFF" window. This dial is adjustable with respect to the fixed reference index at the 3 o'clock position on the case. Relative wind angle of attack information is relayed by means of cams and wiring from the ANGLE OF ATTACK INDICATOR up to the ANGLE OF ATTACK INDEX LIGHT located just left of the gunsight for the pilot, and also out to the three colored external approach lights unit for the landing signal officer. The outside sensing vane is internally heated (thermostatically controlled) to prevent freezing.

ANGLE OF ATTACK INDEX LIGHT. The pilot's ANGLE OF ATTACK INDEX LIGHT (1, figure 1-4) has a "V" showing "too high angle of attack" (down arrow) at the top, and "O" showing "proper angle of attack" ("bulls eye") in the center, and a "Λ" showing "too low angle of attack" (up arrow) at the bottom. Two intermediate conditions are also indicated by showing the "O" with the "V" or the "Λ". (See figure 4-6 for "INDEX CONDITIONS" with the corresponding color of the external light visible to the L.S.O.) The ANGLE OF ATTACK INDEX LIGHT shows all readings in a red glow, compatible with night flying accomodation, and intensity is adjustable by a dimming control wheel. A press-to-test button is provided to check lighting integrity of the three bulbs of the INDEX light.

ANGLE OF ATTACK INDICATOR. The INDICATOR registers units of angle of attack to the relative airstream, from "0" to "30" on the face of the dial. (These increments are *not* absolute angles of attack but are arbitrary units grouped around the optimum.) An "OFF" flag becomes visible when d-c power is lost. The dial is adjustable by means of an Allen wrench at the lower left hand corner of the indicator to set the optimum unit setting at the 3 o'clock position. All switching is referenced to the 3 o'clock position regardless of dial setting.

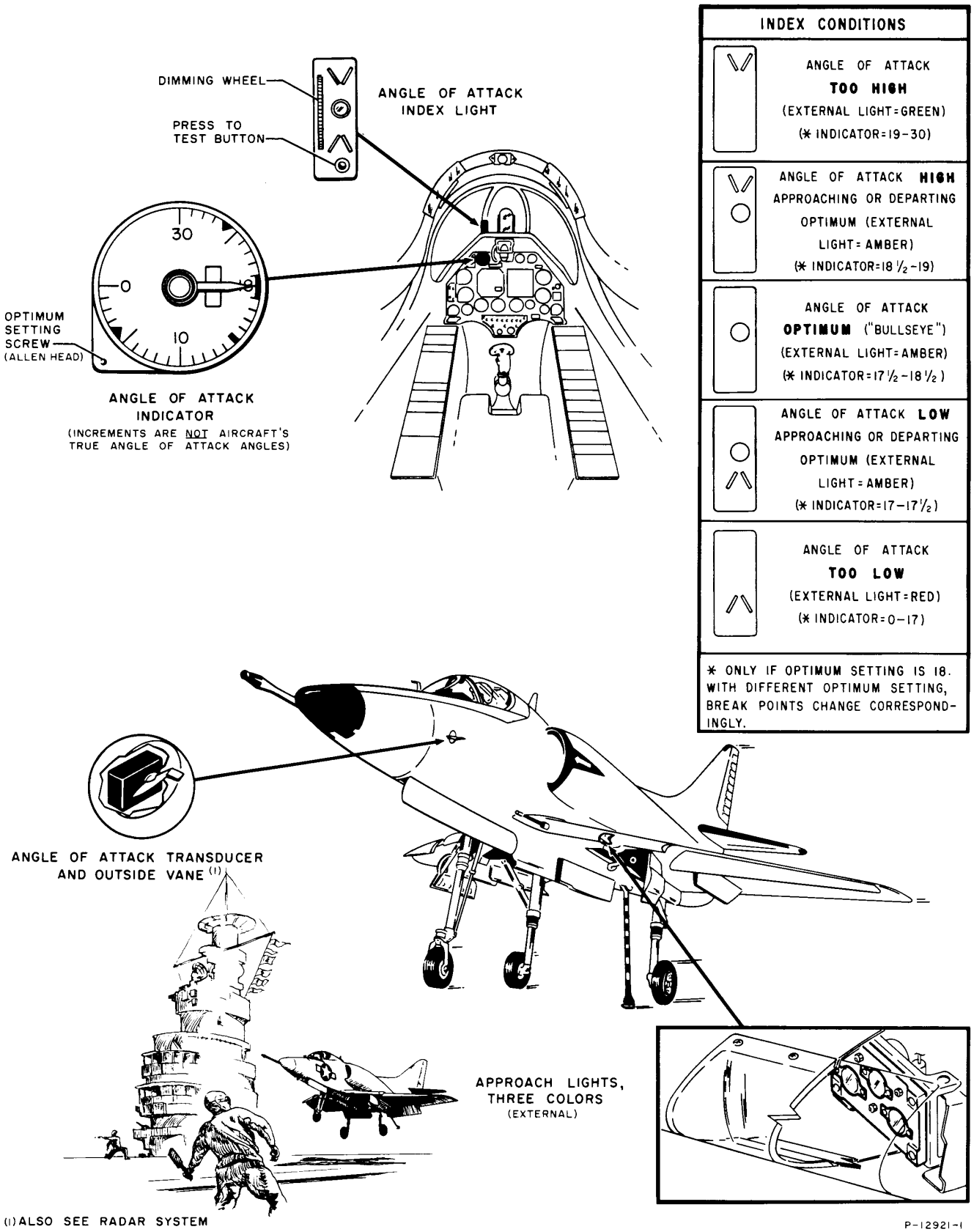


Figure 4-6. Angle of Attack—Approach Lights System

EXTERNAL APPROACH LIGHT. The external approach lights unit located in the leading edge of the left wing behind a transparent section has three separate lamps covered by a red, amber and green lens. The corresponding angle of attack conditions are shown to the LSO, as green for angle of attack too high; as amber for angle of attack proper or approaching or departing optimum; and as red for angle of attack too low.

Note

The two intermediary index conditions (see figure 4-6) will show amber to the LSO.

The external approach lights unit glows bright in the daytime and dim automatically at night when the master EXT LTS switch is activated for night flying.

The INDICATOR in the cockpit will be in operation during the entire flight to present angle of attack information for approach or for optimum cruise. The transducer is also connected to the AN/APG-53A radar system. The pilot's INDEX LIGHT and the external approach lights, powered by the d-c primary bus, operate automatically when the landing gear is down and locked, the tail arresting hook is extended and the aircraft is in flight or up on jacks. All approach lights go out, upon landing, by means of a landing gear strut compress switch ("squat switch"). An APPROACH LIGHT TAIL HOOK BYPASS SWITCH for field carrier landing practice with tail arresting hook retracted is provided. (See APPROACH LIGHT TAIL HOOK BYPASS.)

APPROACH LIGHT TAIL HOOK BYPASS. A momentary contact toggle-type switch with a red safety guard, located in the nose-wheel well, is provided for by-passing the tail hook circuit of the approach light for night field carrier landing practice. This switch is labeled "HOOK BYPASS" and must necessarily be operated by a ground crewman. When the switch is operated momentarily with the electrical system energized, the approach lights will illuminate with the landing gear down and locked even though the arresting hook is in the retracted position. Normal operation of the approach light circuit may be re-established by operating the arresting hook through one cycle, or interrupting electrical power to the approach light circuit.

WARNING

If "bounce drill" on the carrier at night is conducted using the APPROACH LIGHT TAIL HOOK BYPASS, extra precaution must be taken to insure that the tail hook is extended before the final complete landing.

OXYGEN SYSTEM

WARNING

During periods of engine malfunction, it is possible for highly toxic fumes to enter the cockpit via the air conditioning system. It is recommended that oxygen be used at all times, regardless of altitude.

LIQUID SUPPLY SYSTEM. A liquid oxygen supply has an insulated tank mounted in the aft fuselage section. The tank filler valve is reached through an access door on the left side of the fuselage for servicing. The tank contains 5[1] liters of liquid oxygen when serviced to capacity. Evaporation loss is constant when the system is not in use, and this loss is used to pressurize the system. By venting any excess pressure overboard through relief valves, pressure is maintained at 70 ± 5 psi. Venting pressure may increase to 90 psi when the LOX system is not being used. A LIQUID OXYGEN quantity gage (24, figure 1-4) is located on the right side of the instrument panel, and is marked "5" (full), "4", "3," "2," "1" and "0" (empty) to show the number of liters remaining. The quantity gage is electrically operated, and has a small "OFF" window to indicate that the gage is not showing an accurate reading of the quantity when electrical power is lost. Also to be found on the indicator is a red "LOW LEVEL" warning light, which comes on when the quantity falls below ½ liter. Pressure is maintained in the system by the constant evaporation and is limited to 70 ± 5 psi by venting any excess pressure overboard through relief valves.

Later airplanes[2] have an increased liquid oxygen capacity of 10 liters. The gage is graduated with markings of "10", "8", "6", "4", "2", and "0." The operation of the red "LOW LEVEL" warning light is the same as above. However, the light illuminates when the quantity falls below 1 liter rather than ½ liter.

The WARN-TEST switch (23, figure 1-14) when pressed tests the operation of the LIQUID OXYGEN quantity gage causing the needle to move counter-clockwise. The "LOW LEVEL" warning light will go on when the needle passes the 1 liter mark. When the WARN-TEST switch is released, the needle should return to its previous position.

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[1] Airplanes BuNo. 145062 through 145079.

[2] Airplanes BuNo. 145080 and subsequent; others after ASC 125.

WARNING

Should liquid oxygen contamination be indicated by disagreeable odors in the oxygen supply, descend immediately to below oxygen altitude. If necessary, use the bail-out bottle for a limited period.

CONTROLS AND EQUIPMENT. The oxygen supply gage (24, figure 1-14) is located on the right side of the instrument panel. A toggle type OXYGEN control (19, figure 1-3), installed at the rear of the left console on the ANTI-G & OXYGEN panel (19, figure 1-3) places the system in operation when moved from "OFF" to "ON".

When the OXYGEN control is turned on, oxygen is delivered from the supply system at a pressure of 70 psi to the OXYGEN receptacle (19, figure 1-3) on the left console. The pilot's supply tube is plugged into the receptacle to allow the oxygen to flow to the system regulator, installed just below the pilot's face mask, which meters oxygen to the pilot under positive pressure at all altitudes.

WARNING

- The Type A-13A face mask used with this oxygen system should be properly fitted to the pilot's face for best results. Relatively small leaks around a mask are cumulative in effect and result in considerable oxygen loss over long periods of operation.
- Always check the oxygen supply tubes for tight connections before moving the OXYGEN control to "ON." Escaping oxygen creates a fire hazard in the presence of oil or grease.

BAIL-OUT BOTTLE. Emergency oxygen is contained in a cylindrical "U" shaped bail-out bottle (6, figure 1-12) installed in the seat cushion. A pressure gage (9, figure 1-12), which extends through the lower forward right hand corner of the seat cushion, should register 1800 psi when the bottle is filled. The duration of the emergency oxygen supply is approximately 4 to 20 minutes, depending on the altitude (the higher the altitude, the longer the duration) since the oxygen is delivered by the mask regulator only upon demand. Oxygen is supplied from the bail-out bottle when a green ball[1] (7, figure 1-10) hanging from the left front side of the seat, or a green release ring[2] on the seat bucket, is pulled and releases a plunger on the pressure reducer of the bail-out bottle, allowing oxygen to flow at a reduced pressure of 70 psi. The emergency oxygen then flows through the pilot's supply tube to the oxygen regulator for delivery to the face mask. A check valve in the segment of supply tube which plugs into the OXYGEN receptacle on the left console prevents loss of oxygen when the bail-out bottle is actuated. During ejection of the seat in case of emergency bailout, the ball release will be actuated automatically when the pilot is separated from the ejection seat.

OXYGEN DURATION

Figure 4-7 (sheets 1 and 2) is a tabulation of hours remaining for various altitude-tank supply combinations for the liquid oxygen supply system. It will be noted that although 100% oxygen is used at all times, duration is greater at high altitudes. This is explained by the physical property of gases as affected by pressure. The volume of oxygen increases in direct proportion to the decrease in atmospheric pressure as altitude increases. Thus, while the volume of oxygen required by the pilot's lungs is approximately the same at any altitude, the 100% oxygen delivered in reduced cockpit pressure is lower in density and less of the supply is required to satisfy the demand.

NORMAL OPERATION

BEFORE FLIGHT. Before each flight the oxygen system and mask may be checked as follows:

a. Check general condition of fittings, hose, regulator, and mask.

b. Inspect the inhalation valve for foreign matter (sand, grit, lint, etc.).

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

d. Inspect the inhalation valves for foreign matter and proper mounting of the plastic covers. The arrow scribed in the cover must point down.

e. Insert the end of the oxygen hose into the mouth and draw lightly. The inhalation valves should collapse against the valve bodies.

f. Place the mask on the face without connecting the oxygen hose to the ship's system and exhale. Exhalation should be possible without difficulty or resistance if the exhalation valve is unseating properly.

g. Under the same conditions, inhale. Inhalation should be difficult and will confirm that the exhalation valve is seating properly. Some air will enter the mask

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[1] Airplanes BuNo. 145062–145072 prior to service change.

[2] Airplanes BuNo. 145071 and subsequent. BuNo's 145062–145070 after service change.

through the inhalation valves by way of the oxygen regulator and the restrictor in the supply tube.

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

i. Check oxygen supply and security of both the seat cushion and console oxygen and radio connections.

DURING FLIGHT. The following should be checked frequently during flight:

a. Oxygen supply.

b. Oxygen mask for secure fit.

c. Security of oxygen disconnect couplings.

WARNING

- Loss of radio communication may indicate separation of the oxygen tube couplings. Check

LIQUID OXYGEN DURATION

5 LITER SYSTEM

MAN HOURS REMAINING

CABIN PRESSURE ALTITUDE —FEET—	GAGE READING (LITERS) "5"	"4"	"3"	"2"	"1"	"0.5"
40,000 UP ▶	30.3	24.2	18.2	12.1	6.0	3.0
35,000 ▶	18.5	14.8	11.1	7.4	3.7	1.8
30,000 ▶	13.6	10.9	8.2	5.4	2.7	1.4
25,000 ▶	10.2	8.2	6.2	4.1	2.0	1.0
20,000 ▶	8.0	6.4	4.8	3.2	1.6	0.8
15,000 ▶	6.4	5.1	3.8	2.6	1.3	0.6
10,000 ▶	5.0	4.0	3.0	2.0	1.0	0.5
5000 ▶	4.2	3.3	2.5	1.6	0.8	0.4
SEA LEVEL ▶	3.5	2.8	2.1	1.4	0.7	0.3

P-12922-1

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

DATA AS OF: 15 October 1957

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

Figure 4-7. Oxygen Duration (Sheet 1)

these connections for security before making any other check of communications equipment.

- During flight, if there is any indication of oxygen contamination such as disagreeable odors in the oxygen supply, descend immediately to below oxygen altitude. If necessary use the bail-out bottle for a limited period.

AFTER FLIGHT. Following each flight during which oxygen has been used:

a. OXYGEN control ..... "OFF"

b. Disconnect the mask-to-seat cushion oxygen connection and ascertain that the dust cover on the supply hose coming out of the seat cushion snaps in place.

c. Report any oxygen system discrepancies and see that they are corrected.

WARNING

If the oxygen has become nearly depleted and the aircraft remains for over two hours without

LIQUID OXYGEN DURATION

10 LITER SYSTEM

CABIN PRESSURE ALTITUDE —FEET—	MAN HOURS REMAINING — GAGE READING (LITERS)					
	10	8	6	4	2	1
40,000 UP ▶	60.6	48.5	36.4	24.2	12.0	4.8
35,000 ▶	37.0	29.6	22.2	14.8	7.4	3.6
30,000 ▶	27.2	21.8	16.4	10.8	5.4	2.8
25,000 ▶	20.4	16.4	12.4	8.2	4.0	2.0
20,000 ▶	16.0	12.8	9.6	6.4	3.2	1.6
15,000 ▶	12.8	10.2	7.6	5.2	2.6	1.2
10,000 ▶	10.0	8.0	6.0	4.0	2.0	1.0
5,000 ▶	8.4	6.6	5.0	3.2	1.6	0.8
SEA LEVEL ▶	7.0	5.6	4.2	2.8	1.4	0.6

9 P-12922-2

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

DATA AS OF: 15 October 1957

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

Figure 4-7. Oxygen Duration (Sheet 2)

oxygen refilling, there is a danger of contamination. In this event, the pilot should report the condition to the maintenance crew and the oxygen system must be purged.

d. The following instructions are to be followed to prevent malfunction of aircraft liquid oxygen converter systems or to prevent odors in the aircraft oxygen supply through the introduction of water vapor or other gases into the system:

(1) Aircraft liquid oxygen converter systems must not be permitted to go dry and be exposed to the surrounding atmosphere. If the converter system is exposed, water vapors or other gases may condense in the converter bottle causing malfunction of the system valves or odors to be present in the oxygen supply;

(2) Aircraft oxygen converter systems should be left in the build-up condition with the supply valve in the "OFF" position, except while filling the system;

(3) If an aircraft liquid oxygen converter system is exposed to the surrounding atmosphere for any extended period, it should be purged with gaseous oxygen only, prior to further use.

AUTOMATIC FLIGHT CONTROL SYSTEM (AFCS) (AUTOPILOT)

The Model A4D-2N is equipped with an Eclipse-Pioneer Automatic Flight Control System (AFCS) designed specifically for the airplane. (See figure 4-8). Use of the system allows the pilot to direct his attention mainly to tactical problems. Automatic flight control is made possible by such features as automatic pitch trim, yaw-damping ("stability augmentation") in controlled or manual flight and automatically coordinated turns at any airspeed. The system can be used to maintain level flight, constant barometric altitude, an established compass heading, a selected bank angle, climbs and dives and logical combinations of the foregoing maneuvers. An additional feature is a heading-select allowing for an automatic turn onto a pre-selected heading. Control-stick steering by pilot's application of force at the stick, over the autopilot, is a favorable feature. The system also has an emergency disconnect, as well as capability (provisions only) for ground controlled bombing. (Refer to Section V, Autopilot Flight Restrictions and Section VI, Flight Characteristics on AFCS for additional information.)

The AFCS is electro-hydraulic in operation. It requires all three phases of 115/200-volt, 400-cycle a-c power and 28-volt d-c power.

Note

The AFCS will not operate on the emergency generator.

Operation of the hydraulic servos requires utility hydraulic power.

Accordingly, in the event any of these power supplies are not available, the autopilot cannot be engaged, and should any of them fail while it is engaged, it will be automatically disengaged.

Normal hydraulic system pressure (3000 psi) is reduced to 1500 (±50 psi) for the aileron and elevator servos and to 1150 (±50 psi) for the dual input rudder valve. (See figure 1-10.)

The autopilot receives its primary command signals from the stabilized platform (two-gyro master reference) located internally, aft, for "attitude-hold" mode and for "heading-hold" mode (including the heading set on the HDG SET knob), from the air data sensor for "altitude-hold" mode, from the control stick and aileron trim button for "control-stick-steering-mode." Secondary command signals for stabilization of the aircraft are received from the 3-axis rate sensor and the normal accelerometer.

AFCS CONTROLS

Figure 4-8 illustrates the components of the AFCS. The pilot-actuated controls are shown at the top of the figure. Internal components ("black boxes" etc.) are shown in the lower portion.

AUTOMATIC FLIGHT CONTROL CONSOLE PANEL. Located on the left-hand console is the AFCS control panel, labeled AFCS. A STANDBY-OFF switch warms up the system; a STAB-AUG-OFF switch provides electrical pilot's pedal control yaw damping. A partially guarded ENGAGE-OFF switch engages the system; a HDG SEL-OFF switch starts the aircraft turning and settling down on a selected heading into the HDG SEL INDICATOR ("box") a SET knob is used to set in the desired azimuth heading for the HDG SEL box or for turn control; an ALT-OFF switch holds the aircraft at the barometric altitude of the aircraft at the time of actuating; and an AIL TRIM-NORM-EMRG switch is provided for a possible emergency situation should the trim button fail to provide normal aileron trim after disengaging the system.

PRE-FLIGHT TEST PANEL. Located on the right-hand console is the pre-flight test panel labeled AFCS TEST. Three index windows labeled R, Y and P measure control current going to the autopilot servos for roll, yaw and pitch. A guarded switch labeled 1-N-2 bypasses various interlocks allowing the pilot to check out the above roll, yaw and pitch servo circuits along with important protection circuits.

CONTROL STICK. On the stick grip is found the trim switch. Also, an autopilot override button labeled AP provides for an AFCS emergency disconnect. The control stick itself contains a stick force sensor which picks

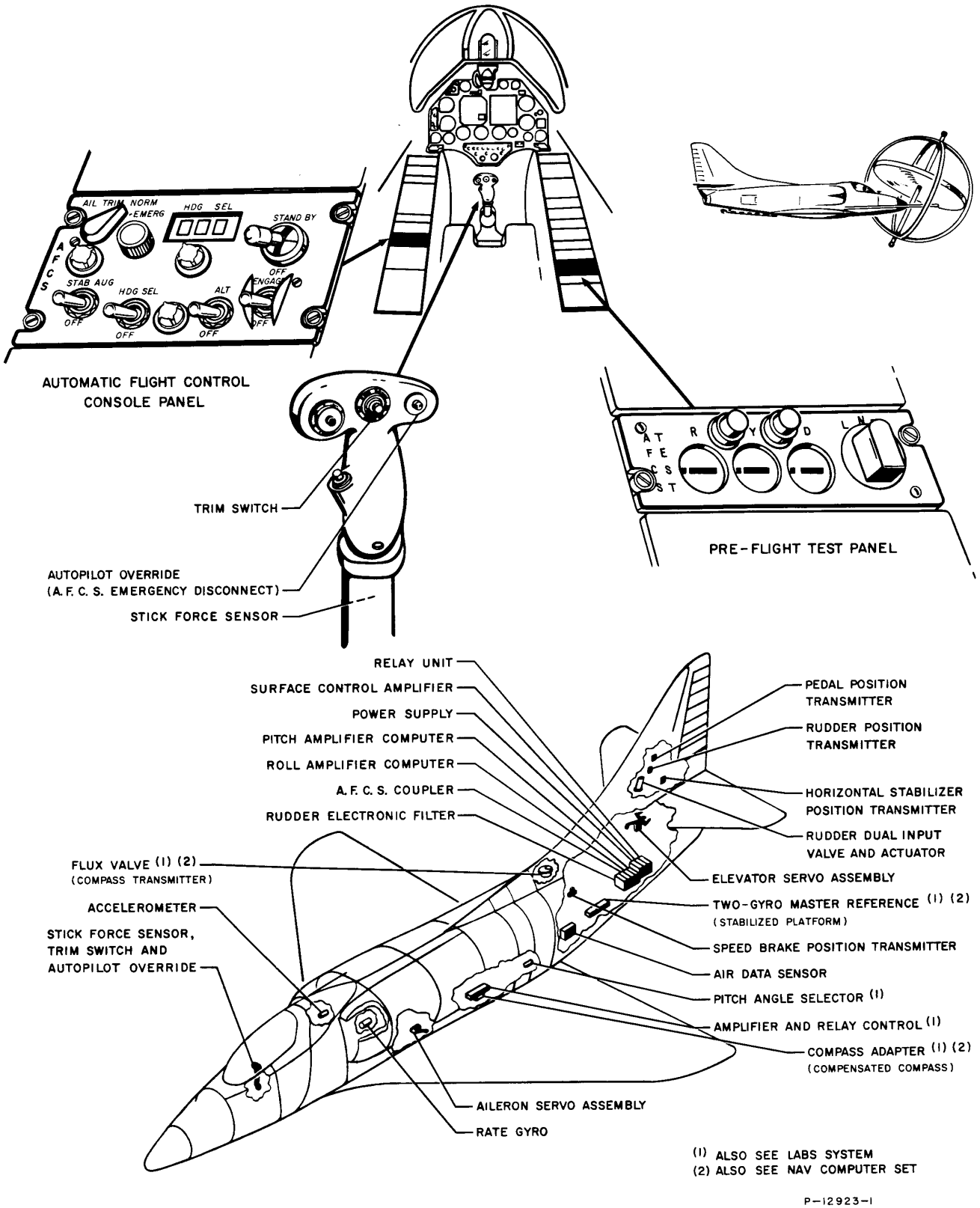


Figure 4-8. Automatic Flight Control System

up pilot-applied forces and transmits them to the control stick steering function of the system.

STANDBY SWITCH AND STANDBY MODE. The STANDBY-OFF switch has two position, "STANDBY" and "OFF". Placing this switch in the "STANDBY" position starts the AFCS warming up and supplies power to the system. This is known as the STANDBY MODE which is a pre-engage mode in which all gyros, amplifiers and other components involving time delay are maintained in an operating state to permit immediate engagement of the automatic flight control system without delay. This should be done at least 30 seconds prior to either engaging the stability augmentation (STAB AUG) feature or engaging the entire AFCS. This switch, then, is the first one to be actuated in using this system. The pilot, of course, will take off on manual control, but may wish to have the STANDBY-OFF switch in the "STANDBY" position at that time. (Refer also to SYNCHRONIZING MODE).

STABILITY AUGMENTATION SWITCH AND STABILITY AUGMENTATION MODE.

Note

The pilot should understand that "stability augmentation" in this autopilot covers only heading and yaw. The terminology must not be confused with the traditional flying concept of pitch and roll stability.

The STAB AUG switch has two positions, "STAB AUG" and "OFF". Placing this switch into the "STAB AUG" position provides flight control functions of electrical pilot's pedal control and yaw damping. Because STAB AUG provides these features during manually controlled flight without engagement of other AFCS modes of operation, it may be considered an independent sub-system.

ELECTRICAL PILOT'S PEDAL CONTROL. The pilot controls the rudder position electrically by means of his pedals when the AFCS is engaged on STAB AUG. A yaw rate signal from the 3-axis rate sensor may drive the rudder up to 8 degrees away from the position indicated by the pilot's pedal control, but the pilot will not feel this, as there is no mechanical feedback to the pedals with STAB AUG (or AFCS) engaged.

YAW DAMPING. With STAB AUG engaged but without the AFCS engaged, only the rudder channel of the autopilot system is energized, automatically damping yaw by decreasing the amplitude of directional oscillation while the airplane is under pilot control in normal flight. Damping is affected by rudder servo movement when a rate of change of airplane heading is sensed by the yaw axis of the three-axis rate sensor.

ENGAGE-OFF SWITCH. The partially guarded ENGAGE-OFF switch engages the AFCS when it is actuated to the "ENGAGE" position. When engaged, the aircraft's control surfaces are actuated by the automatic flight control system servos.

Note

- *The three functions of stability augmentation are always working when the AFCS is engaged whether the STAB AUG switch is actuated or not.* Should the pilot go directly from manual flight to AFCS controlled flight, the STAB AUG switch will *not* flip from "OFF" to "STAB AUG", but the pilot should know that the three functions are working, nevertheless. In the event the pilot first actuates the STAB AUG switch to obtain the three features of that sub-system and later engages the AFCS, and then later disengages it, the STAB AUG sub-system will still remain in effect, and the STAB AUG switch will *not* flip back to "OFF" position. This allows for approach to landing with stability augmentation, without autopilot.
- It is recommended that the pilot engage both the ENGAGE and the STAB AUG switches when engaging the AFCS so that he will still have the stability augmentation functions when he disengages the AFCS.

When engaged, the AFCS will go into one of the two following modes:

(a) pitch/attitude and roll/attitude holding.

(b) pitch/attitude and heading holding.

The choice is determined by the bank angle existing at the time of engagement; if greater than 10°, the AFCS will hold the pitch and roll angles existing. If the bank angle is less than 10°, the AFCS will hold the pitch angle and heading existing.

Note

While flying with AFCS flight control, the pilot may notice indications on the pitch trim indicator and on the R, Y and P indicators. He should disregard these indications, which are meaningless during automatic flight control.

ALT-OFF SWITCH. The ALT-OFF switch provides an altitude hold function, which modifies the automatic flight control functions in the elevator channel to hold the airplane at the constant pressure altitude existing at the time of engagement. The system must be engaged before the altitude-hold function can be used.

Note

If the system is disengaged or if control stick steering is used while using the altitude-hold mode, the ALT-OFF switch will flip to the "OFF" position by means of an interlock.

If the altitude-hold mode is attempted while the aircraft is changing altitude (either diving or climbing) at a rate greater than 3500 feet per minute, a safety interlock prevents altitude engagement. Thus, if the pilot actuates the ALT-OFF altitude switch under this condition, he will find that it will not hold in the "ALT" position. If the climb or dive rate is less than 3500 feet per minute with the altitude-hold mode used, the airplane will level out at the altitude of engagement of the ALT switch within a small tolerance.

HDG SEL-OFF SWITCH. A heading select switch, when actuated to the "HDG SEL" position, starts the controls for automatically steering the airplane to any heading set into the counter of the HDG SEL box.

HDG SEL INDICATOR BOX AND SET KNOB. A SET knob is turned to set in the desired azimuth heading of the counter for the HDG SEL indicator box. The AFCS must be engaged for the HDG SEL switch to be effective. However, the HDG SEL counter can be set any time, either in flight or on the ground. The pilot should be certain of his HDG SEL reading in the counter box before actuating the HDG SEL switch.

When the HDG SEL switch is actuated, the airplane will bank and level out on whatever heading is in the HDG SEL counter. If the HDG SEL switch is actuated while the airplane is in a banked attitude, the AFCS will cause a roll toward wings-level before beginning the programmed turn. The system programs the rate of turning to preclude unsafe maneuvers and limits the maximum bank angle. However, HDG SEL should not be engaged below 160 knots (plus 5 knots for each 1000 pounds above 12,504). Heading-select mode engagement can be made from either level flight or steep bank angles. The airplane will turn through the smaller angle (less than 180 degrees) to the new heading. If the system is disengaged or control stick steering is used while in the heading-select mode, the HDG SEL switch will flip to "OFF" position by means of an interlock.

CAUTION

After actuating the HDG SEL-OFF switch to "OFF," wait at least 5 seconds before setting a new heading into the HDG SEL counter. This delay is necessary to prevent an abrupt roll transient.

TURN CONTROL. The heading select SET knob can be used as a turn control with HDG SEL engaged. Wherever the HDG SEL counter is stopped will be the heading the AFCS will maintain.

CAUTION

Rapid movement of the SET knob will result in abrupt roll-off or bank angle change.

AIL TRIM-NORM-EMRG SWITCH. An aileron trim emergency switch is provided for a possible emergency situation in the event of a malfunction of the switch-over circuit from automatic trim to manual trim. Should an out of trim condition exist either upon disengaging the system or in manual flight, and the trim button does not trim, actuation to the "EMRG" position will restore the trim button to normal operation. During normal autopilot or manual flight control, this switch is left in the "NORM" position.

Note

- Use of the "EMRG" position disengages and prevents re-engagement of all of the AFCS system except the STAB AUG sub-system if the latter is engaged.
- When the AIL TRIM-NORM-EMRG switch is rotated to the "EMRG" position a red area will be visible from under its former position.

TRIM SWITCH. The trim switch or button on the stick grip is used to trim for aileron roll and elevator pitch when flying on manual control. However, when the AFCS is controlling the aircraft, the trim switch is operative only during the control-stick-steering mode. During the control-stick-steering mode, aileron trim feeds an electrical signal to the aileron servo (not to the aileron trim tab as in manual control), and pitch trim operates the horizontal stabilizer. (Pitch trim on control-stick-steering operates the same as pitch trim on manual control).

AP BUTTON (AUTOPILOT OVERRIDE). An override button on the stick grip labeled AP acts as an AFCS emergency disconnect when it is depressed. Use of the AP button disengages the entire AFCS, including the stability augmentation (STAB AUG) feature by disengaging power to all of the system interlock circuits.

DISENGAGING THE SYSTEM

Disengaging the system is accomplished by actuating the ENGAGE-OFF switch to the "OFF" position. This by-passes the aileron and elevator servos allowing for the "mechanical mode" of normal flight control. Again, if the pilot was using the stability augmentation (STAB AUG) feature, he would still have two aspects of the mode by use of the rudder input valve, giving him pilot's electrical pedal control and yaw damping, even though the AFCS is disengaged.

CAUTION

The pilot should have one hand on the control stick when he disengages and should be ready to trim the aileron if he has released a wing station store while on AFCS.

CONTROL STICK STEERING

The AFCS will operate in a "control stick steering" mode whenever the force on the stick exerted by the pilot is greater than 2 pounds. This enables the pilot to control the attitude of the airplane in pitch and roll through the elevator and aileron channels of the AFCS. While on control stick steering, the aileron trim button may be used to reduce necessary stick force.

Note

If altitude-hold (ALT) mode or heading select (HDG SEL) mode are engaged when control stick steering force is applied, they become disengaged and the solenoid held switches of these two features will flip to their "OFF" positions, requiring reactuation of either or both of them, if desired after going off control stick steering.

A stick force sensor is part of the control stick column. It has sensing transducers which pick up forces in the stick, sending electrical signals to the aileron and elevator servos through the amplifiers of the system. The attitude signals from the stable platform are synchronized to prevent transients ("jumping") when the system is returned to "attitude-hold" or "heading-hold."

Note

When system is returned to altitude-hold (ALT) care should be taken to allow at least 5 seconds for auto follow-up trim to complete trimming cycle, otherwise airplane may be badly out of trim and a substantial upset may result if control stick steering is re-engaged.

The pilot may over-power the AFCS aileron and elevator servos. Application of abrupt and fast (high velocity) force to the control-stick will activate a bypass valve causing hydraulic fluid to by-pass the aileron servo cylinder, and will cause mechanical over-ride of the elevator servo. The aileron servo can then put no force on the controls and the pilot can fly using the normal flight control system. The result is disengagement of aileron AFCS control and mechanical over-ride of elevator AFCS control; but the ENGAGE-OFF switch does not flip to its "OFF" position. Reengagement is accomplished by momentarily moving the ENGAGE-OFF switch to the "OFF" position, then reengaging by moving to the "ENGAGE" position. AFCS servo control will result from this cycling.

Note

The force required to overpower the AFCS laterally with control stick steering operative is approximately 35 to 40 pounds at ½ stick throw or 10 degrees.

If control stick steering is rendered inoperative, the force required to move the stick laterally to ½ throw to disconnect will be in excess of 60 pounds.

To get out of the control stick steering mode, the pilot merely needs to let go of the stick or reduce the forces to under 2 pounds. The airplane will hold the attitude or heading existing at the time the stick force becomes less than 1¼ pounds and the AFCS system resumes control. (Refer to ENGAGE-OFF SWITCH paragraph for discussion of whether "attitude-hold" or "heading-hold" will be affected.

AUTOMATIC PITCH TRIM. Whenever the AFCS is engaged and working, pitch trim takes place automatically. The operation of the horizontal stabilizer is monitored for proper operation. If it operates improperly, the AFCS disengages. In this event, the pilot should use either his trim button (for pitch) or the emergency UP-NOSE-DOWN override lever on the left-hand console.

Note

The automatic pitch trim feature does not function during control stick steering mode, during stability augmentation (STAB AUG) mode working alone (without AFCS), or during the synchronizing (STANDBY) mode.

SYNCHRONIZING MODE

Power applied to the AFCS by actuating the STAND-BY-OFF switch to "STANDBY" gives a synchronizing mode. Here, the AFCS follows the pilot's controls, while the pilot flies manually, in such a way that upon engagement, the AFCS starts from the correct position without any "transient" ("jumping").

Note

It is recommended that the airplane be trimmed for "hands off" flight by the pilot through his normal trim controls prior to engaging the autopilot.

STRUCTURAL PROTECTION

The AFCS also has features to preclude excessive pitch and roll, to prevent damaging the structural integrity of the airplane. This is called the structural protection system.

a. If the safe structural load factors (g's) are exceeded in pitch while the AFCS is engaged, the system is automatically disengaged. This feature uses the normal accelerometer as a primary initiating signal. If the normal

load factor exceeds 4g's or −2g's while the AFCS is engaged, signals generated by the pitch rate gyro and the normal accelerometer disengage the AFCS. The disengage circuit is tested as part of the pre-flight test. A secondary protection feature is the limitation of the AFCS authority to the elevator surface by limiting the elevator servo force output.

b. The AFCS also limits roll rates by limiting the authority of the aileron channel. Whenever the aileron servo displacement from the neutral position becomes greater than a total aileron surface displacement of 20 degrees (i.e.: half-travel), the aileron servo is by-passed and the AFCS is automatically disengaged.

CAUTION

Extreme caution should be exercised when airplane is flown on AFCS below 250 KIAS, as a hard-over will not result in AFCS disconnect due to the airplane's inability to obtain the "g" forces at low airspeeds. Large pitch angle changes with heavy buffet and asymmetric wing slat opening can result in abrupt roll-offs or snap-rolls.

PRE-FLIGHT TEST PANEL

While the aircraft is on the ground, the pilot can preflight check the AFCS system by means of the preflight test panel labelled AFCS TEST which is located on the right-hand console. The three indicators measure the d-c control current to the autopilot servos for roll, yaw and pitch. These are labelled R, Y and P. A switch labeled 1-N-2 is provided to obtain two test conditions. This switch is spring-loaded in the N or normal position and must be held in either Test Position #1 or Test Position #2. The "STANDBY-OFF" switch should be in "STANDBY" for 30 seconds for warmup, and the black flag should cover the "OFF" window of the all attitude indicator before performing the pre-flight test.

a. Test Position #1: (Refer to PREFLIGHT PROCEDURE for four checks using this test position.) Actuating the 1-N-2 switch to the "1" position accomplishes the following: The rudder, aileron and elevator servo loops are opened; test signals are put into these circuits; and the landing gear shock strut compress switch ("squat switch") is by-passed.

b. Test Position #2: (Refer to PREFLIGHT PROCEDURE for thirteen checks using this test position.) Actuating the 1-N-2 switch to the "2" position accomplishes the following: Test signals are put into the rudder, aileron and elevator servo loops; The "squat" switch" is by-passed; The synchronizing monitors are by-passed; The aileron Trim Button is connected to feed signals to the structural protection circuit; and the AFCS is allowed to engage in the "attitude mode" only (not heading-hold nor heading-select modes). After using the pre-flight test panel, the 1-N-2 switch should be checked to insure its return to the "N" position for normal flight operation for takeoff. The pilot will probably wish to leave the STANDBY-OFF switch in the "STANDBY" position, on takeoff, for synchronizing mode and autopilot warmup.

GROUND CONTROL BOMBING MODE. While control boxes for ground control bombing are not as yet installed in the airplane, the AFCS has incorporated circuitry for tie-in with the AN/TPQ-10 bombing system.

PREFLIGHT PROCEDURE

The following pre-flight test procedure is recommended:

a. WHEELS control ..... "DOWN"

b. Engine RPM ..... "IDLE"

c. Perform the following:

(1) Observe ship's a-c power from all attitude indicator power warning flag after 90 seconds . . . not visible

(2) Observe ship's d-c power from FUEL BOOST window of Engine Performance Indicator . . . "NORM"

(3) Observe hydraulic power from movement of control surfaces

(4) STANDBY-OFF switch..... "STANDBY"

(5) Warmup period for LABS gyros, etc. . . . 30-90 seconds

(6) AIL TRIM-NORM-EMRG switch.. "NORM"

(7) STAB AUG-OFF switch..... "OFF"

(8) HDG SEL-OFF switch..... "OFF"

(9) ALT-OFF switch..... "OFF"

(10) ENGAGE-OFF switch..... "OFF"

(11) 1-N-2 switch..... "N"

(12) HDG SEL counter and SET knob . . . any preselected heading, or position if desired.

(13) Perform the following PERFORMANCE CHECKS as outlined:

Note

Two sets of preflight performance checks are provided here. The pilot should make the three

MANDATORY CHECKS daily or before each flight when time is limited. If there is plenty of time or after any reworking or overhauling of the autopilot system, the COMPLETE PERFORMANCE CHECKS consisting of seventeen items should be made.

MANDATORY CHECKS. These three checks are all made in "TEST POSITION #2." They should be made daily or before each flight.

a. 1-N-2 switch ..... "2"

b. ENGAGE-OFF switch ..... "ENGAGE"

(1) Move the stick right. At about half stroke, the autopilot should disengage and the ENGAGE-OFF switch will be seen to flip to its "OFF" position. Re-cycle the ENGAGE-OFF switch to its "ENGAGE" position after centering the stick. Repeat the same check to the left. The results should be the same. (This is the Aileron Limit Switch Check).

(2) Move the trim button right. The autopilot should disengage and the ENGAGE-OFF switch will be seen to flip to its "OFF" position. Re-cycle the ENGAGE-OFF switch to its "ENGAGE" position after centering the trim button. Repeat the same check to the left. The results should be the same. (This is the Load Factor Monitor Limit Switch Check).

(3) Move the stick aft (nose up) and move the horizontal stabilizer trim full "NOSE UP". The autopilot should disengage and the ENGAGE-OFF switch will be seen to flip to its "OFF" position. Re-cycle the ENGAGE-OFF switch to its "ENGAGE" position after centering both the stick and the trim. Repeat the same check in the opposite direction. The results should be the same. (This is the Trim Monitor Switch Check).

The pilot will know from the above tests that he has electrical power to the autopilot's servos as well as that the safety circuits are operating.

COMPLETE PERFORMANCE CHECKS. It is recommended that these checks be made in the sequence given. There are four checks in "TEST POSITION #1" and thirteen checks in "TEST POSITION #2". These seventeen checks should be made if there is plenty of time or after reworking or overhauling the autopilot system:

a. TEST POSITION #1 CHECKS: Hold the spring-loaded 1-N-2 switch in the "1" position until the following four tests have been completed: (The AFCS is unsynchronized.)

(1) All three pointers (R, Y, and P) should deflect upward and remain positioned upward. This shows d-c control current to the autopilot servos and indicates proper direction for surface movement.

(2) Push on the right rudder pedal. The indicator needle in the "Y" (yaw) window should move from the upward position to a full down position.

(3) Actuate the ENGAGE-OFF switch to the "ENGAGE" position: it should *not* engage, because the AFCS should never engage while in an unsynchronized condition. If the switch does not flip back to the "OFF" position, report the trouble.

(4) Actuate the STAB AUG-OFF switch to the "STAB AUG" position: it should remain engaged rather than flipping back to "OFF". Return switch to "OFF" position when test is completed.

b. TEST POSITION #2 CHECKS: Hold the spring-loaded 1-N-2 switch in the "2" position until the following thirteen tests have been completed: (The AFCS is still unsynchronized.)

(1) All three pointers (R, Y and P) should again deflect upward and remain positioned upward.

(2) Actuate the STAB AUG-OFF switch to the "STAB AUG" position: it should engage, but the "Y" indicator for rudder should "null" (go to the center) because Test Position #2 closes the rudder loop. Leave the switch in the "STAB AUG" position for later checks.

(3) Actuate the ENGAGE-OFF switch to the "ENGAGE" position: it should engage and the switch should remain there because Test Position #2 allows engagement in the unsynchronized condition by bypassing the synchronizing monitors that normally protect the airplane from engage transients ("jumping"). A small stick jump or movement normally accompanies engagement in position #2.

(4) With the ENGAGE-OFF switch in the "ENGAGE" position (per paragraph 3. above) the "P" and "R" indicators for pitch (elevator) and roll (aileron) should "null" (go to the center) because the pitch and roll loops have been closed in Test Position #2.

(5) Move the control stick for roll and pitch: it should "feel" normal.

(6) Move the control stick hard-over to the right. The ENGAGE-OFF switch should flip to the "OFF" position but the STAB AUG-OFF switch should remain engaged because the aileron has reached a position greater than half-travel-from-faired and the protection circuit has caused the AFCS system to disengage when an excessive roll rate is created.

(7) Move the ENGAGE-OFF switch back to "ENGAGE" position. Move the control stick hard-over to the left. The results should be the same as in paragraph (6).

(8) Move the ENGAGE-OFF switch back to "ENGAGE" position. Move the trim button to the right for right aileron. The results should be the same as in paragraphs (6) and (7) because Test Position #2 feeds a test signal into the structural protection circuit.

(9) Move the ENGAGE-OFF switch back to "ENGAGE" position. Move the trim button to the left for left aileron. The results should be the same as in paragraph (8).

(10) Move the ENGAGE-OFF switch back to the "ENGAGE" position. Actuate the AIL TRIM-NORM-EMRG switch to the "EMRG" position. The ENGAGE-OFF switch should flip to the "OFF" position, but the STAB AUG-OFF switch should remain in the "STAB AUG" (engaged) position. The emergency trim switch is to be used only with the AFCS disengaged, and this switch interlocks the AFCS ENGAGE-OFF switch as a protective measure.

(11) Return the AIL TRIM-NORM-EMRG switch to the "NORM" position, but do *not reengage the ENGAGE-OFF switch* to its "ENGAGE" position at this time. With the AFCS system so disengaged, use the trim button on the stick grip to drive the horizontal stabilizer to its "0" or faired position (±1°). (Watch the NOSE UP-NOSE DOWN position indicator on the right hand console.)

Engage the AFCS by actuating the ENGAGE-OFF switch to the "ENGAGE" position. Then move the stick forward and, while holding a forward force on the stick, operate the trim button to trim the airplane "NOSE UP." The result should be that the autopilot disengages, the ENGAGE-OFF switch should flip to its "OFF" position and the STAB AUG-OFF switch should remain (engaged) in its "STAB AUG" position. The test simulates the automatic trim circuit working improperly (making an out-of-trim condition worse).

(12) With the switches left in the positions resulting from the check of paragraph (11), refair the horizontal stabilizer, engage the AFCS and make a similar test as in paragraph (11), but pull the stick back and trim for a "NOSE DOWN" condition. The results should be the same as in paragraph (11).

(13) Re-engage the "ENGAGE-OFF" switch, then depress the "AP" button on the stick-grip. The ENGAGE-OFF switch and the STAB AUG switch should flip to their "OFF" positions. *This emergency switch removes all AFCS authority from the airplane control system.*

c. Retrim for desired take-off trim. The configurations for the various switch positions should be the same, now, as in (1) through (12) of paragraph c of PREFLIGHT PROCEDURE. Takeoff with the STANDBY-OFF switch in the "STANDBY" position for synchronization mode and for AFCS system warmup.

NORMAL OPERATION (INFLIGHT PROCEDURE)

TO ENGAGE STABILITY AUGMENTATION (YAW DAMPER, ETC) ONLY.

a. STANDBY-OFF switch.....“STANDBY”

b. Warmup period.....30 to 90 seconds

c. AIL TRIM-NORM-EMRG switch.....“NORM”

d. HDG SEL-OFF switch.....“OFF”

e. ALT-OFF switch.....“OFF”

f. ENGAGE-OFF switch.....“OFF”

g. 1-N-2 switch.....“N”

h. STAB AUG-OFF switch.....“STAB AUG”

TO ENGAGE AFCS (AUTOPILOT, ETC.). Perform the above steps, then actuate the ENGAGE-OFF switch to the "ENGAGE" position.

Note

Engagement by use of the ENGAGE-OFF switch can be made without first using stability augmentation (STAB AUG). However, STAB AUG actuation is recommended first so that the pilot will have the stability augmentation mode after he disengages the AFCS but prior to and during his landing approach.

TO DISENGAGE AUTOPILOT. Merely moving the ENGAGE-OFF switch to the "OFF" position disengages the system. This may be done either with or without the stability augmentation feature operating as a separate sub-system.

Note

If a severe trim condition exists upon disengagement, trim immediately, manually. If after the switch-over from the AFCS control to manual flight control the aileron trim appears to be malfunctioning, immediately move the AIL TRIM-NORM-EMRG switch to the "EMRG" position and trim normally.

TO DISENGAGE STABILITY AUGMENTATION (STAB AUG). Actuating the STAB AUG-OFF switch to the "OFF" position disengages stability augmentation, *if* the AFCS is not engaged. If the AFCS is engaged, the stability augmentation sub-system is also automatically engaged, whether the STAB AUG-OFF switch is in the "STAB AUG" position or not.

BEFORE LANDING

The AFCS should be disengaged prior to landing. The approach to landing may be made with the stability augmentation (STAB AUG) sub-system either engaged or disengaged.

EMERGENCY PROCEDURE

The following are emergency measures which may be used with the AFCS:

a. AP BUTTON: An emergency override disengages the entire system. (Stability augmentation is disengaged whether or not the STAB AUG-OFF switch has been actuated to the "STAB AUG" position.)

b. CONTROL STICK STEERING: This mode will override the autopilot when a stick force greater than 2 pounds is applied. This override is momentary: only so long as the force is applied. However, altitude-hold ("ALT") and heading select ("HDG SEL") switches will disengage by flipping to their "OFF" positions if they have been actuated.

c. OVERPOWERING: The overpowering of control stick steering mode is effected by application of sufficient and fast (high velocity) force to aileron and elevator, causing disengagement and overpowering *without* the ENGAGE-OFF switch flipping to the "OFF" position. (See Control Stick Steering).

d. DISENGAGEMENT: Complete disengagement is accomplished by moving both the ENGAGE-OFF and the STAB AUG-OFF switches to their "OFF" positions.

e. STANDBY-OFF SWITCH: Moving the STANDBY-OFF switch to its "OFF" position cuts off all power to the system and effects a disengagement. (All four solenoid-held switches, STAB AUG, HDG SEL, ALT and ENGAGE will flip to their "OFF" positions).

f. UP-NOSE-DOWN override lever on the left-hand console: "UP" or "DOWN" actuation of this emergency pitch trim lever will manually overcome malfunction of the automatic pitch trimmer during either AFCS control or manual flight control.

g. AIL TRIM-NORM-EMRG SWITCH: In the event the switch-over from automatic trim to manual trim malfunctions, ie: upon disengagement, the "EMRG" position gives an additional switchover.

h. The AFCS and/or the stability augmentation (STAB AUG) feature are automatically disengaged upon failure of either the electrical power supply or of the utility hydraulic power supply.

ARMAMENT EQUIPMENT

All droppable stores are carried externally on three racks. Weapons which can be carried are bombs, rockets, chemical tanks, mines, torpedoes and special stores. A four-hook ejector type bomb rack is installed on the centerline (fuselage) station and two-hook ejector racks are provided on the wing stations. The centerline rack, which is limited to a load of 3575 pounds, can be used to carry stores which require either 30-inch or 14-inch suspension. Wing racks are provided with 14-inch suspension only, and have a load limit of 1200 pounds each, except when carrying the 300-gallon external fuel tanks. (See Table V-II, Confidential Supplement.)

Control of all armament is effected through an armament panel and, when various special stores are loaded, through additional panels installed on the left-hand console. Electrical release of stores is controlled directly by the pilot.

MASTER ARMAMENT SWITCH

All armament equipment is controlled by the MASTER ARMAMENT switch (11, switch 4-9) except during emergency jettisoning of stores. The armament circuits can be energized only when this switch is "ON." An armament safety circuit prevents operation of the armament system when the landing gear is extended.

STATIONS SELECTOR SWITCHES

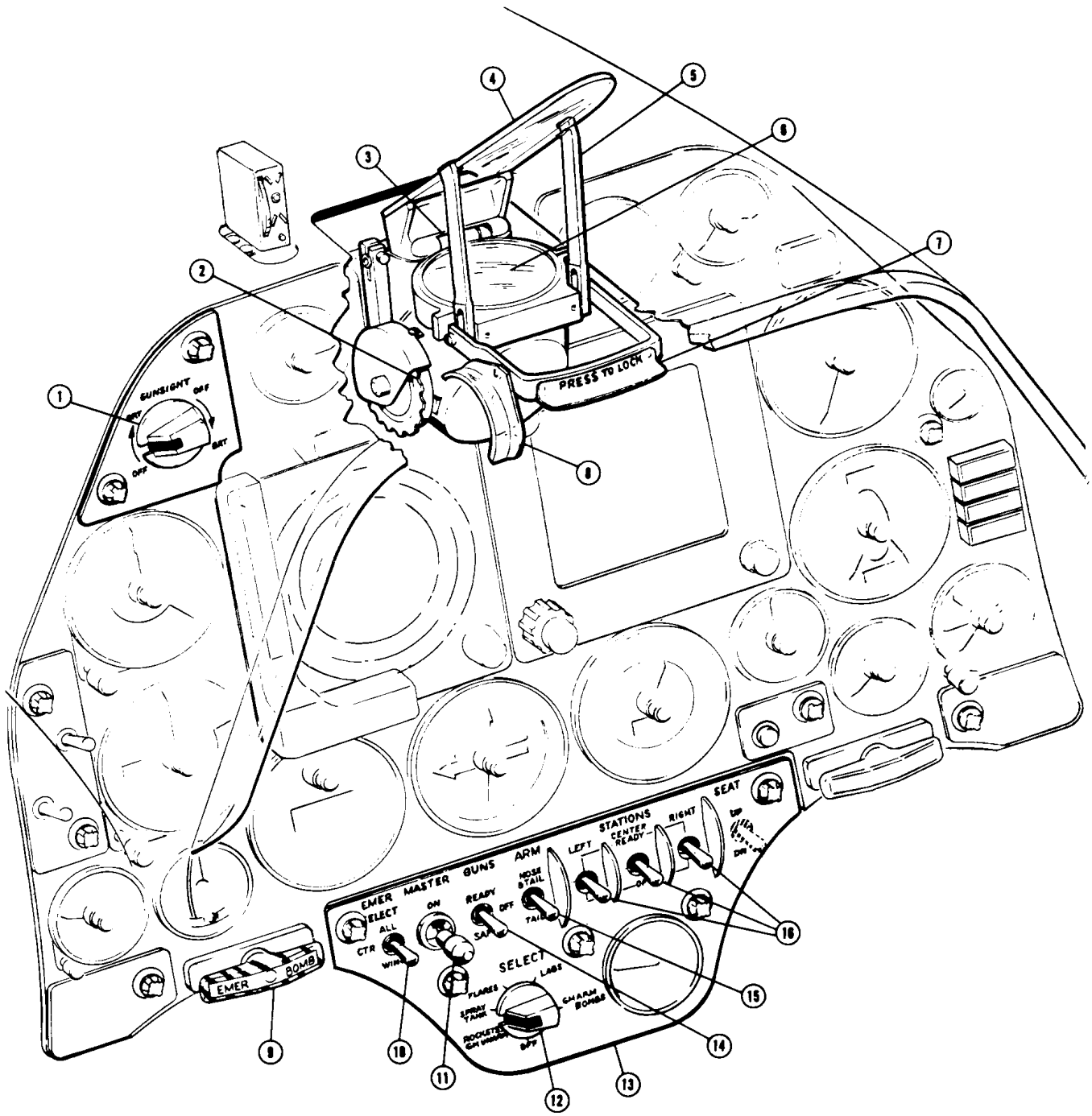
Three STATIONS switches (16, figure 4-9) are provided for LEFT, CENTER AND RIGHT armament release. Each switch has "READY" and "OFF" positions providing single or multiple release of stores with the armament firing switches.

FUNCTION SELECTOR SWITCH

A rotary SELECT switch (12, figure 4-9) is provided for selecting the type of armament to be released. The switch may be set on any one of six separate detents which are labeled "LABS", "BOMBS & GM ARM", "ROCKET & GM UNARM", "OFF", "SPRAY TANK", and "FLARES".

KEY

1. GUNSIGHT DIMMING SWITCH
2. GUNSIGHT ELEVATION CONTROL
3. SKID INDICATOR
4. GUNSIGHT REFLECTOR PLATE
5. REFLECTOR PLATE STABILIZING STRUT
6. GUNSIGHT
7. LOCKING YOKE HANDLE
8. ELEVATION CONTROL GUARD
9. EMERGENCY BOMB MANUAL RELEASE HANDLE
10. EMERGENCY STATIONS SELECT SWITCH
11. MASTER ARMAMENT SWITCH
12. FUNCTION SELECTOR SWITCH
13. ARMAMENT PANEL (EXCEPT CABIN ALTIMETER AND SEAT SWITCH)
14. GUNS SWITCH
15. BOMB ARMING SWITCH
16. STATIONS SELECTOR SWITCHES



P-12924-1

Figure 4-9. Gunsight and Armament Panel

ARMAMENT SAFETY CIRCUIT DISABLING SWITCH

When the airplane is on the ground, an alternate circuit may be energized for the purpose of checking the armament system. This circuit is engaged by momentarily closing the ARM SAFETY DISABLE switch, located on the outboard side of the right-hand wheel well. Raising the landing gear or moving the MASTER ARMAMENT switch to "OFF" will restore the armament safety circuit to normal operation.

GUNSIGHT

An illuminated gunsight (6, figure 4-9) is provided for gunnery and for rocket and bomb aiming. The gunsight, mounted on the top center of the glareshield, contains one ladder type reticle and a glass reflector to superimpose the reticle image upon the target.

The mil setting knob rotates the reflector plate, thus changing the effective boresight line of the gunsight in a vertical plane and permitting the relatively narrow-field optics to have a large effective field in a vertical plane. In dive bombing, the amount of down-lead required is obtained from ballistics charts which take into account airspeed, dive angle, weapon release altitude, and the ballistics of the particular weapon being used. This down-lead is set into the gunsight, and while the proper dive angle and airspeed are held, the airplane is flown so that the center of the reticle just crosses the center of the target when the airplane is at the predetermined altitude, at which time the weapon is released and evasive action initiated. If any wind is present, its effect must be estimated and the weapon released when the reticle center is at some point upwind of the target.

When using the gunsight with guns or rockets, the proper ballistic drop of the projectile is set into the gunsight as down-lead. The center of the reticle is then kept on the center of the target, provided it is a fixed target. If the target is moving, any required lead angle must be estimated, using the graduations on the reticle.

In LABS maneuvers, the gunsight may be used to align the flight path of the airplane with the IP (identification point). If any cross wind is present, the airplane is crabbed until some point on the azimuth center line of the reticle appears not to drift off the IP. When this condition is obtained, the airplane's true flight path will be a straight line passing directly over the IP. Also, the no-drift point of the reticle gives a measure of the crab angle, from which the wind effect on the weapon may be estimated.

GUNSIGHT ELEVATION CONTROL. A sight elevation knob (2, figure 4-9) on the left-hand side of the gunsight controls the glass reflector angle for increasing or decreasing the down-lead of the reticle. The locking yoke must be lifted before setting the sight elevation knob. After setting the knob to the desired down lead, press the locking yoke firmly against the sight body to lock the reflector plate struts.

CAUTION

Press on the yoke proper; do not press on the transparent plastic guard which is attached to the locking yoke.

GUNSIGHT SWITCH. A single rotary knob (1, figure 4-9) on the armament panel, identified as GUNSIGHT serves as the gunsight light control. By rotating the knob, either of two filaments may be selected for lighting. Light intensity can be adjusted between the "OFF" and "BRIGHT" positions for either the primary (PRI) filament or for the alternate (ALT) filament.

Note

Initially, turn the knob approximately 30 degrees toward "BRIGHT". Wait 3 seconds before changing this setting.

For maximum safety factor, the primary filament should always be used first on all missions, until it burns out. This allows for the unused alternate filament to be switched on, to complete the mission. The lamp should then be replaced before the next mission.

GUNNERY EQUIPMENT

Two forward firing Mark 12 Mod 0 20-millimeter guns can be installed in the airplane as alternate armament. Ammunition boxes, located in the main access area between the guns, can be loaded with one hundred rounds of ammunition for each gun.

The Mark 12 Mod 0 gun is a combination blowback and gas-operated weapon which fires ammunition electrically. The weapon, which is air-cooled, has a rate of fire of 1000 rounds per minute in short bursts. A pneumatic charger mechanism operates the breechblock for first round loading. Although firing is simultaneous from both guns, individual compressed air tanks, filled to 3200 $\pm$200 psi, permit each gun to be remotely charged as a separate unit. The gun electro-pneumatic packages are located in the right-hand wheel well, and in the forward engine compartment and accessory section.

GUN CHARGING SWITCH. The gun charging switch (14, figure 4-9) on the armament panel is identified as GUNS and has two positions, "SAFE" and "READY". With the switch on "READY", the charged gun is ready to fire. To recharge or cycle the guns, the switch is moved to "SAFE" position for at least two seconds and then returned to "READY". In this operation, the breechblock is retracted by pneumatic pressure in the

charger cylinder and held aft as long as the switch remains on "SAFE". When the switch is moved to "READY" the breechblock and a round of ammunition are brought forward to charge the gun.

WARNING

If stoppage occurs while the trigger is squeezed, do not cycle the gun charger. Movement of the gun selector switch from "READY" to "SAFE" and back to "READY" can cause an explosion by ramming a new round against a jammed one. Movement of the master armament switch from "ON" to "OFF" and back to "ON" while the gun charging switch is at "READY" creates the same hazard.

Always keep the charging switch in the "SAFE" position until guns must be readied; and return it to that position after using guns.

The armament safety circuit functions when the landing gear is lowered, de-energizing the guncharging circuits and causing the breechblock to be retracted to the safe position.

GUNS-ROCKETS FIRING SWITCH. The gun-rocket trigger switch on the control stick grip is used to fire both guns and rockets. This trigger switch is on the front of the stick grip. (See figure 4-10.) The guns will fire

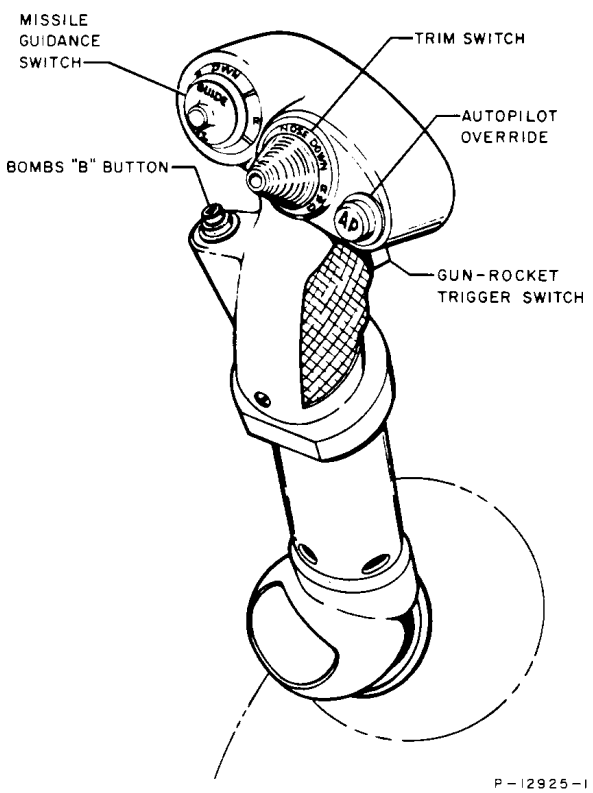


Figure 4-10. Control Stick Switches

when the switch is depressed, providing the MASTER ARMAMENT switch is turned "ON" and the GUNS charging switch is at "READY".

Note

To prevent rockets from firing when operating the guns, the function SELECT switch should be set on the "OFF" position or the STATIONS selector switches turned "OFF".

FIRING GUNS.

a. MASTER ARMAMENT switch......"ON"

b. Function SELECT switch or STATIONS selector switch....."OFF"

c. GUNS switch....."READY"

d. Gun-rocket trigger.....Squeeze

ROCKET EQUIPMENT

Forward firing air-to-ground rockets of two sizes can be carried in rocket launchers suspended from the bomb racks. The rockets are carried in the package launchers in any combination of the following configurations:

EACH WING STATION	CENTERLINE STATION
7....2.75" rockets	7....2.75" rockets
19....2.75" rockets	19....2.75" rockets
4....5.00" rockets	4....5.00" rockets

FIRING ROCKETS

Release of rockets from packages is accomplished by ripple fire. To fire the rockets, observe the following procedure:

a. MASTER ARMAMENT switch....."ON"

b. Function SELECT switch....."ROCKET"

c. STATIONS selector switches (LEFT, CENTER AND RIGHT stations)....."READY" on each station as required.

d. GUNS switch....."SAFE"

e. Gun-rocket trigger.....Squeeze

Note

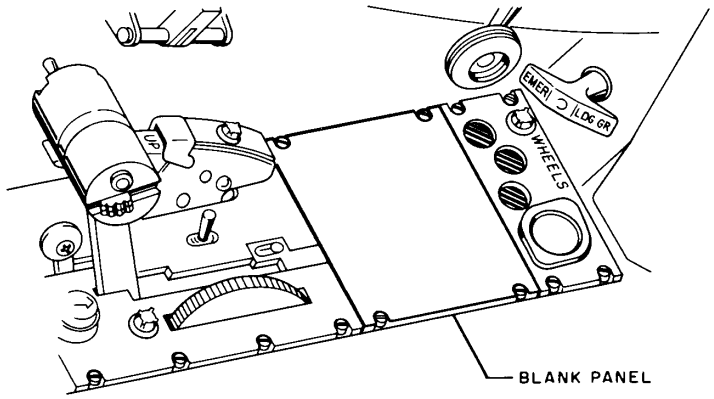
Make certain that the GUN charging switch is on "SAFE", to prevent the guns from firing simultaneously with the rockets.

JETTISONING ROCKETS

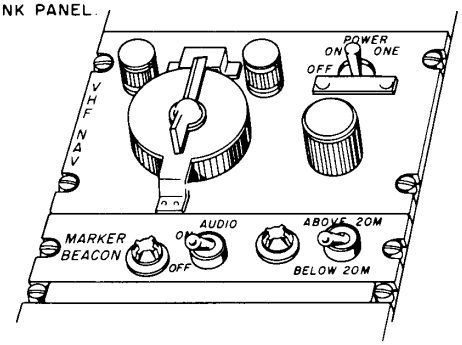
Rockets are carried only in packages hung directly on the bomb racks. The packages may be jettisoned in the same manner as other external stores, using either the normal bomb releasing methods or the emergency releasing controls. (Refer to RELEASING BOMBS.)

NO STORES CARRIED

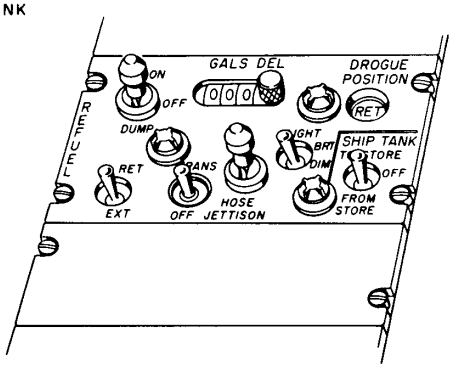
EIGHT ALTERNATIVE CONFIGURATIONS FIT BLANK PANEL DEPENDING ON WHICH STORES CARRIED.



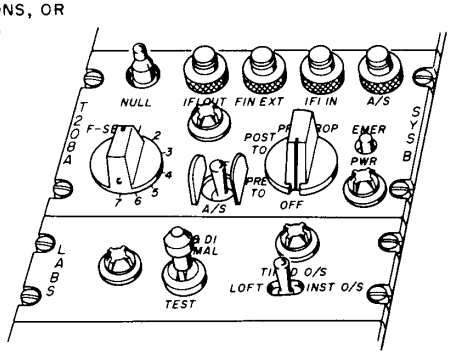
OMNI RANGE (AN/ARN-14E), MARKER BEACON (AN/ARN-12) (NAVPAC) AND BLANK PANEL.



INFLIGHT FUELING (TANKER) CONTROL AND BLANK PANEL.

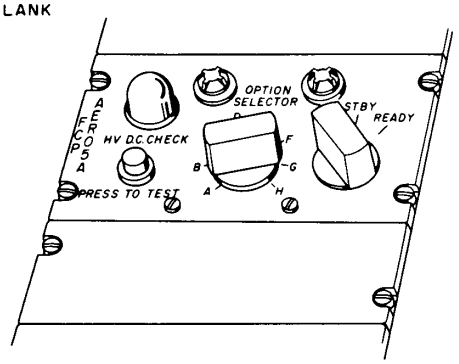


BOMB CONTROL AND MONITOR (T-208A, 2 VERSIONS, OR T-249) WITH LABS CONTROL PANEL.

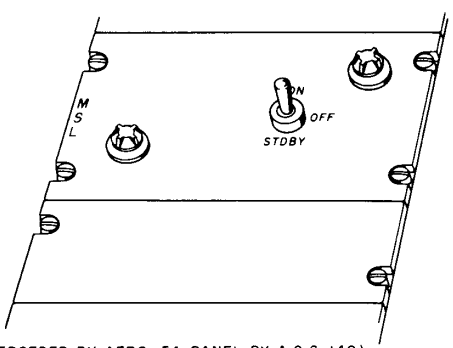


(T-208A, SYS B VERSION, SHOWN)

ARMAMENT FUZE CONTROL (AERO 5A) AND BLANK PANEL.

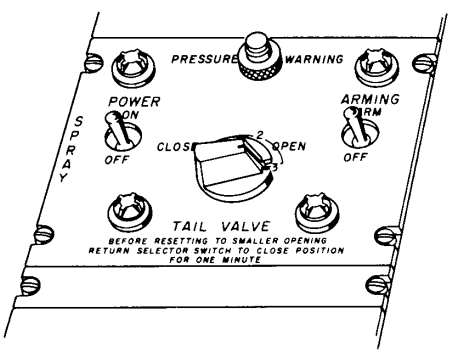


GUIDED MISSILE CONTROL AND BLANK PANEL.



(THIS PANEL IS SUPERSEDED BY AERO-5A PANEL BY A.S.C. 149).

SPRAY TANK (AERO 1-B) CONTROL AND BLANK PANEL.



P-14087-1

Figure 4-11. Alternate Control Panels For External Stores

BOMBING EQUIPMENT

Release of bombs and other stores from the ejector-type racks is accomplished by electrical detonation of cartridges. When cartridges are fired by pressing the bomb release switch, the initial force is an upward thrust which opens the hooks, followed by a downward ejector thrust of several inches which forces the bomb clear of the aircraft. The ejector foot is located aft of center on the bomb rack in order to counteract the twisting moment on the bomb caused by drag forces in high speed flight. Each rack contains two cartridges. One firing circuit is for normal release and the second is for emergency release. Either circuit fires both cartridges.

BOMB ARMING SWITCH. The bomb arming switch (15, figure 4-9), identified as ARM, is located adjacent to the function SELECT switch. The ARM switch can be set at "NOSE & TAIL" or "TAIL" depending on arming requirements, or can be placed in the "SAFE" position for releasing stores in an unarmed condition.

BOMB RELEASE SWITCH. The "pickle" switch (figure 4-10), used for releasing bombs and other external stores, is located on the left side of the control stick grip and is identified by the letter "B". This switch is also used with alternate installations, such as the chemical spray tank, the practice bomb container, and the missile.

EMERGENCY SELECTOR SWITCH. The EMER SELECT switch (10, figure 4-9), located adjacent to the EMER BOMB release handle, provides selection of "WINGS," "CENTER," or "ALL" stations when jettisoning stores with the EMER BOMB release handle.

EMERGENCY BOMB RELEASE HANDLE. An EMER BOMB REL handle (9, figure 4-9) on the lower left-hand side of the instrument panel is used to jettison external stores. Pulling the handle closes a switch in the emergency release circuit, bypassing the normal release controls. Power to the emergency circuit is supplied by the primary bus, which is energized by either the main or the emergency generator. Stores may be released irrespective of the position of the landing gear control or MASTER ARMAMENT switch. (Refer to EMERGENCY SELECTOR SWITCH.)

RELEASING BOMBS

SINGLE RELEASE

a. MASTER ARMAMENT switch......"ON"

b. Function SELECT switch....."BOMBS"

c. STATIONS selector switches (LEFT, CENTER OR RIGHT)....."READY" as required for single release

d. Bomb release switch.....Depress

SALVO RELEASE

a. MASTER ARMAMENT switch....."ON"

b. Function SELECT switch....."BOMBS"

c. STATIONS selector switches (LEFT, CENTER and RIGHT....."READY"

d. Bomb release switch.....Depress

JETTISON

a. EMER SELECT switch....."WING" or "ALL" (as required)

b. EMER BOMB REL handle.....Pull

CAUTION

When the EMER BOMB REL handle is used to release wing stores only (EMER SELECT switch set on "WING"), make sure the center STATIONS selector switch is in "OFF" position to prevent an electrical feedback through the normal bomb release circuit and inadvertent release of the center store.

PRACTICE BOMB CONTAINER, AERO 5A

Information will be supplied when available.

FLARE DISPENSER

Information will be supplied when available.

ARMOR PLATE (Refer to Section IV, Confidential Supplement).

RADAR SET—AN/APG-53 (Refer to Section IV, Confidential Supplement).

ALL ATTITUDE FLIGHT REFERENCE AND LOFT BOMBING SYSTEM (IMPROVED LABS) (MODIFIED AN/AJB-3) (Refer to Section IV, Confidential Supplement).

MISSILE, AIR-TO-GROUND (Refer to Section IV, Confidential Supplement).

FUZE FUNCTION CONTROL SYSTEM (AN/AWW-1) (Refer to Section IV, Confidential Supplement).

SPRAY TANK

A chemical spray tank, designated Aero 14B, can be installed on the fuselage station only. (See figure 4-17.)

INFLIGHT FUELING (TANKER SYSTEM)

The inflight fueling system enables the airplane to serve as a tanker for other airplanes. Fuel from the wing tank and the drop tanks may be directed to the inflight fueling store. Any percentage of total fuel in the two drop tanks, the wing tank, and the fueling store

may be transferred to the receiver airplane. However, because of the slower transfer rate from drop tanks to wing and from wing to fueling store, not all of this total is instantly available.

INFLIGHT FUELING STORE

The fueling store carried on the center line rack contains a 300-gallon fuel cell, a constant speed ram air turbine driven hydraulic pump, a hydraulically driven fuel pump, a hydraulically operated hose reel, and 50 feet of refueling hose with a drogue. Fuel is transferred to the receiver aircraft at approximately 200 gallons per minute. Provisions are made for dumping fuel overboard if necessary.

FUELING STORE LIGHTS. At the aft end of the fueling store are two lights, amber (left side) and green (right side). These lights are of use only to the receiver airplane. The amber light illuminates when the hose is extended, indicating that the receiver airplane may now engage the drogue. After engagement is made the receiver must move forward (3 to 6 feet) until the amber light extinguishes before the green light will illuminate and fuel will transfer. Illumination of the green light indicates that fuel is flowing from the tanker to the receiver. The green light will not illuminate and fuel will not transfer unless the TRANS-OFF switch in the tanker aircraft is positioned at "TRANS".

FUELING CONTROL CONSOLE PANEL

The fueling control panel located forward on the left console contains all the indicators and switches used to operate the system (except drop tank pressurization switches). The DROGUE POSITION indicator will read RET (retracted) EXT (extended) or TRANS (transfer) at particular times during system operation. The indicator marker GALS DEL registers the gallons of fuel transferred. The fueling master switch has three positions: "ON," "OFF" and "DUMP." When the fueling master switch is placed "ON," it unlocks and unfeathers the air driven propeller at the forward end of the fueling store. When placed to "OFF" it feathers and locks the propeller. When the switch is placed at "DUMP," an electrically operated fuel dump valve in the bottom of the fueling store opens to dump fuel. To place it in "DUMP," first lift the switch from its spring loaded safety position. The two position RET-EXT switch positions the hose and drogue.

When the fueling master switch is "ON," the RET-EXT switch controls the position of the hose and drogue. If the switch is positioned at "RET," the hose will retract. If the switch is positioned at "EXT," the hose will extend to trail position. The TRANS-OFF switch controls the flow of fuel after proper hookup is made. The switch must be at "TRANS" before fuel will transfer. Fuel flow will stop any time this switch is positioned at "OFF." The LIGHT switch determines the brightness of the amber and green lights at the aft end of the fueling store. The switch has two positions: "BRT" for daylight fueling, and "DIM" to be used as conditions require. The SHIP TANK switch has three positions: "TO STORE," "OFF," and "FROM STORE." The "TO STORE" position permits fuel to flow from the wing tank to the fueling store. When the switch is placed at "FROM STORE" (and the drop tank pressurization switch is "PRESS"), fuel will flow under engine air pressurization from the store to the wing tank.

The HOSE JETTISON switch must be kept in the forward (off) position at all times unless jettisoning of the hose and drogue is required during an inflight emergency. Be sure that this switch is in its forward (off) position *before* electrical power is applied.

WARNING

Once the HOSE JETTISON switch is actuated to its "HOSE JETTISON" position for emergency jettisoning in flight, it *must not be moved* back to its forward (off) position. Inadvertent cycling of this switch can cause a dangerous condition in the store.

NORMAL OPERATION (TANKER)

CAUTION

- Do not actuate the dive brakes during any part of the fueling operation.
- Be prepared for small trim changes as the drogue is extended.
- As fueling takes place, anticipate small variations in stick and rudder pressure.
- Be sure that the SHIP TANK switch is "OFF" during catapults and arrested landings. The integral wing tank pressure increases to 6 psi above ambient when the SHIP TANK switch is in the "TO STORE" position. The addition of the 6 psi static pressure to the accelerations induced by catapulting and arresting would impose severe loads on the tank surfaces.

BEFORE TAKE-OFF.

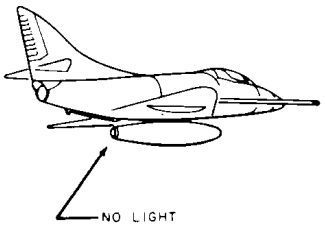
a. SHIP TANK switch.....“OFF”

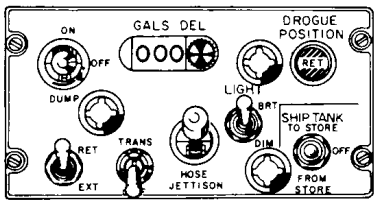
b. RET-EXT switch.....“RET”

c. ON-OFF-DUMP switch.....“OFF”

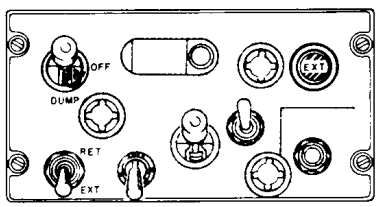
d. TRANS-OFF switch.....“OFF”

TANKER PANEL CONFIGURATION PRIOR TO INFLIGHT FUELING



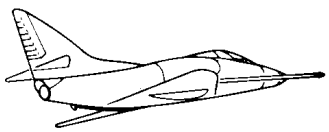


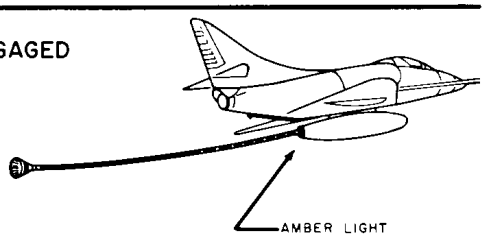
ON-OFF-DUMP......"OFF"
GALS DEL....."000"
DROGUE POSITION....."RET"
RET-EXT....."RET"
TRANS-OFF....."OFF"
HOSE JETTISON.....(OFF=FORWARD)
LIGHT.....(DAYTIME)"BRT"
SHIP TANK....."OFF"



ON-OFF-DUMP....."ON"
RET-EXT....."EXT"
DROGUE POSITION....."EXT"

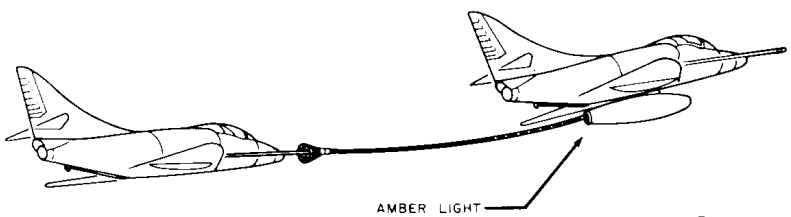
DROGUE EXTENDED-NOT ENGAGED

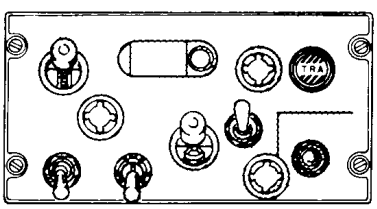




NOTE
"ON" POSITION OF ON-OFF-DUMP SWITCH UNFEATHERS RAM AIR TURBINE FOR STORE'S HYDRAULIC PRESSURE.

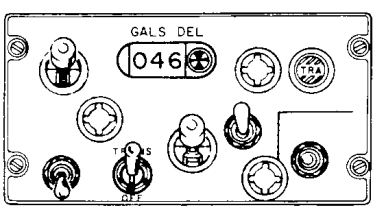
ENGAGED - BEFORE FUEL TRANSFER





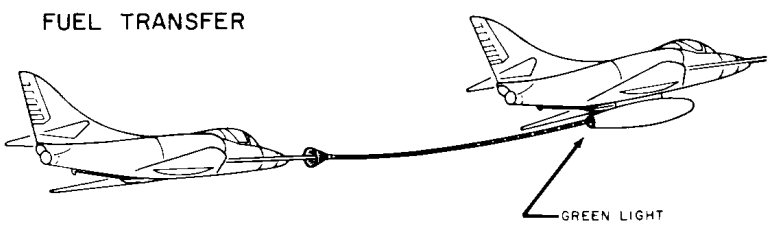
DROGUE POSITION....."TRA"

NOTE
COUPLING OF PROBE WITH DROGUE WHILE TRANS-OFF SWITCH IS "OFF" CAUSES DROGUE POSITION INDICATOR TO SHOW "TRA" MEANING READY TO TRANSFER.



TRANS-OFF....."TRANS"
GALS DEL.....(COUNTS GALLONS)

FUEL TRANSFER

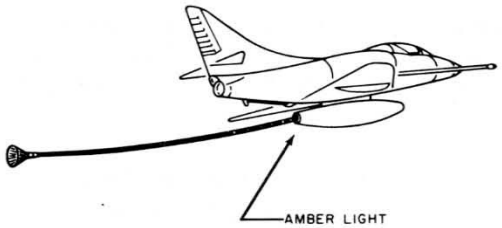


NOTE
GALLONS COUNTER CONFIRMS FUEL TRANSFER.

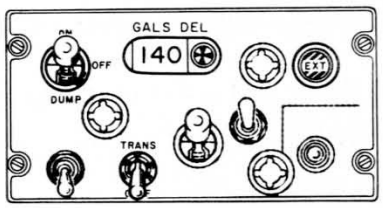
AVB-1-4 P-12926-1

Figure 4-12. Tanker Operation—Inflight Fueling (Sheet 1)

DISENGAGEMENT



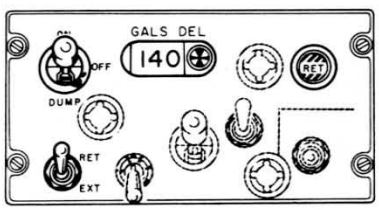




ON-OFF-DUMP....."ON"
TRANS-OFF....."OFF"
DROGUE POSITION....."EXT"

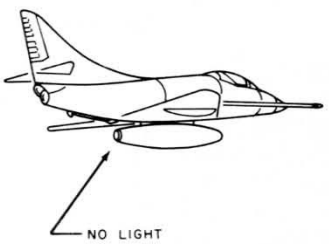
NOTE
"ON" POSITION OF ON-OFF-DUMP SWITCH IS STILL REQUIRED FOR HYDRAULIC PRESSURE TO REEL IN HOSE.

DROGUE RETRACT



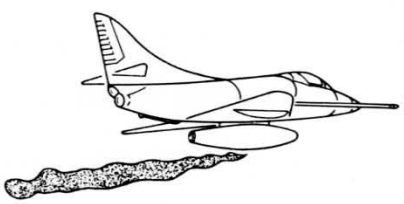
ON-OFF-DUMP....."ON"
RET-EXT....."RET"
DROGUE POSITION....."RET"

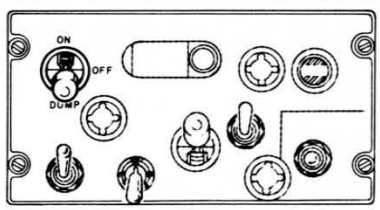
AFTER DROGUE RETRACT
ON-OFF-DUMP....."OFF"



NOTE
DROGUE MUST BE RETRACTED PRIOR TO ON-OFF-DUMP SWITCH BEING ACTUATED TO "OFF" POSITION.

FUEL DUMP

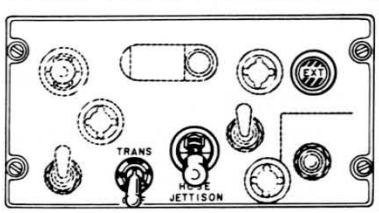




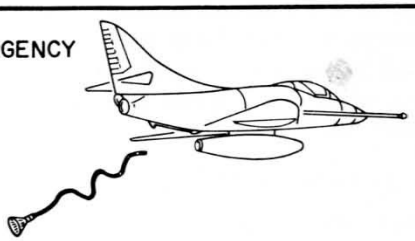
ON-OFF-DUMP....."DUMP"
(ALL OTHER SWITCHES SAME AS NORMAL PANEL CONFIGURATION)

NOTE
FUEL DUMPING SHOULD ALWAYS BE DONE PRIOR TO ANY ARRESTED LANDING EITHER AFLOAT OR ASHORE.

HOSE AND DROGUE JETTISON - EMERGENCY



HOSE JETTISON....."HOSE JETTISON"
TRANS-OFF....."OFF"
ON-OFF-DUMP.....(CONDITION)
RET-EXT.....(CONDITION)
DROGUE POSITION....."EXT"



NOTE
5 TO 20 SECOND TIME DELAY IS A SAFETY FEATURE.

NOTE
JETTISONING CUTS OFF ALL STORE POWER EXCEPT POWER TO DUMP FUEL. THEREFORE, FUEL DUMP IS POSSIBLE AFTER JETTISONING.

WARNING

DO NOT MOVE HOSE JETTISON SWITCH FROM "HOSE JETTISON" POSITION AFTER JETTISONING.

AV8-1-4 P-12926-2

Figure 4-12. Tanker Operation—Inflight Fueling (Sheet 2)

e. LIGHT switch.....“BRT” (day); may be dimmed at night

f. GALS DEL indicator set to.....000

g. HOSE JETTISON switch.....Off (forward)

AFTER TAKE-OFF

DROGUE EXTENSION.

a. ON-OFF-DUMP switch.....“ON”

b. RET-EXT switch.....“EXT”

c. DROGUE POSITION will read....“EXT” when drogue reaches full trail position

d. SHIP TANK switch.....“TO STORE” for over 300 gallon transfer

RECEIVER HOOK-UP AND FUELING

After the receiving pilot engages and moves forward in relation to the tanker enough to extinguish the amber light on the store, the DROGUE POSITION indicator will read TRANS. The tanker pilot then places the TRANS-OFF switch at “TRANS” to start the flow of fuel.

DROP TANK TRANSFER IN INFLIGHT FUELING

To use the fuel in the drop tanks for inflight fueling, place the drop tank pressurizing switch at “PRESS.”

STOPPING FUEL TRANSFER. To halt fuel transfer at any time:

a. TRANS-OFF switch.....“OFF”

b. SHIP TANK switch.....“OFF”

CAUTION

Fueling cannot be stopped by placing the ON-OFF-DUMP switch in the “OFF” position. Fueling will stop if the receiver aircraft backs off enough for the amber light to illuminate or if he disengages. In either case, the drogue position indicator window will change from “TRANS” to “EXT.”

DROGUE RETRACTION

a. TRANS-OFF switch.....“OFF”

b. RET-EXT switch.....“RET”

c. When DROGUE POSITION indicator reads “RET”

d. Place the ON-OFF-DUMP switch to “OFF”

Note

Any sequence of switch positioning is possible without causing damage or malfunction to the tanker store. The fueling master switch may be moved to “OFF” position at any time after the drogue has extended. The tanker store propeller will feather automatically only after the drogue has returned to the retracted position.

TRANSFER FROM STORE TO WING. If it is desired to transfer fuel from the fueling store to the wing tank, first place the drop tank pressurization switch to “ON.” Then place the SHIP TANK switch to “FROM STORE.” This will cause both drop tank air shut-off valves and the fueling store shut-off valve to open, allowing all external tanks to be air pressurized by the engine. Fuel will then flow from the drop tanks and the fueling store to the wing tank.

DUMPING FUEL. An electrically operated fuel dump valve is located on the bottom of the fueling store. To dump fuel, raise the master switch from the spring loaded safety position and position at “DUMP”.

BEFORE LANDING.

a. SHIP TANK switch.....“OFF”

b. RET-EXT switch.....“RET”

c. DROGUE POSITION indicator.....“RET”

d. ON-OFF-DUMP switch.....“OFF”

e. TRANS-OFF switch.....“OFF”

f. DROP TANKS switch.....“OFF”

JETTISONING THE FUELING STORE

The inflight fueling store may be jettisoned electrically in the same manner as other droppable external stores. (Refer to RELEASE BOMBS, Section IV.)

FUEL DUMP. To dump fuel from the store, switch ON-OFF-DUMP to “DUMP.”

EMERGENCY OPERATION

HOSE JETTISONING. To jettison hose (and drogue) from store, operate HOSE JETTISON switch. (If possible, reduce speed to 250 knots or less before actuating the cutter.)

Note

- Firing of the hose cutter is delayed 5 to 20 seconds after the HOSE JETTISON switch is operated—to permit engagement of the hose reel lockpin.
- Operation of the HOSE JETTISON switch shuts off all power to the store except power to dump fuel.
- Hose jettisoning is possible on emergency generator operation.

WARNING

Do not change position of HOSE JETTISON switch after jettisoning hose and drogue.

DROGUE AND COUPLING LOST AND/OR HOSE SEVERED (other than hose cutter severance). If the drogue and coupling are lost and/or the hose is severed, the remaining hose will immediately retract, the reel will over-travel, and the level-wind will jam—all without pilot action. The RET-EXT switch should be moved to "RET." The pilot may dump the remaining fuel or return it to the airplane tanks. He can feather the ram air turbine blades by momentarily pulling the proper circuit breakers, with the ON-OFF-DUMP switch "OFF."

STORE HYDRAULIC SYSTEM FAILURE. In case of hydraulic failure which precludes hose and drogue retraction:

a. For a field landing.

(1) Dump fuel, retain fuel in store, or return fuel to airplane tanks.

(2) Jettison hose and drogue.

Note

If fuel dumping is elected, it is desirable, but not mandatory, first to jettison the hose and drogue.

b. For a carrier landing,

(1) Jettison hose and drogue.

(2) Dump fuel or (only if the fuel remaining in the store is required to complete the flight) return the fuel to the airplane tanks.

ELECTRICAL FAILURE. In case of electrical failure which precludes hose and drogue *retraction only:*

a. For a field landing,

(1) Dump fuel, retain fuel in store, or return fuel to airplane tanks.

(2) Jettison hose and drogue.

Note

The ram air turbine blades feather when electrical power (to the store) fails.

b. For a carrier landing,

(1) Dump fuel or (only if the fuel remaining in the store is required to complete the flight) return the fuel to the airplane tanks.

(2) Jettison hose and drogue.

(3) If hose and drogue cannot be jettisoned, return (required) fuel to airplane tanks and jettison store.

Note

If the hose drogue cannot be fully retracted at above 260 knots IAS, reducing airspeed below 250 knots normally will permit full retraction.

INFLIGHT FUELING (RECEIVER SYSTEM)

During inflight fueling, fuel flows through the receiver airplane's probe nozzle under pressure and is distributed to each tank in the same manner as it is through the pressure fueling receptacle.

NORMAL OPERATION

When the amber light on the tanker fueling store is illuminated, the airplane to be fueled maneuvers into position for probe-drogue engagement. After the probe is engaged in the drogue the receiving airplane must move forward (3 to 6 feet in relation to the tanker) until the store amber light extinguishes. As long as the two airplanes maintain this relationship fuel transfer may be made. Actual fueling will be indicated by the illumination of a green light on the store. Fuel flow through the probe to the wing tank is automatic. If the drop tanks are to be fueled the DROP TANKS switch must be positioned at "FLIGHT REFUEL." Fuel flow will then be through the probe direct to the drop tanks.

PILOT TECHNIQUE

Inflight fueling engagements can be accomplished at any altitude within a wide range of airspeed. Successful engagements have been made between sea-level and 32,000 feet at airspeed between 190 and 300 knots. Thermal turbulence from the deck may be annoying for hook-ups at very low altitudes. Lower airspeeds will assist the receiver in escaping heavy buffeting caused by the tanker's slipstream and jet exhaust. Under these conditions, the tanker will maintain rpm settings from 90% to 96%, while the receiver will maintain rpm settings from 93% to 100%.

CAUTION

The receiver should not be in the engagement approach starting position until the tanker hose is fully extended; else the drogue is likely to strike the receiver.

The receiver should start the engagement approach from behind and below the tanker. The receiver's flight path prior to engagement should follow the angle of the trailing drogue hose, using the drogue only as a target reference during the final three or four feet prior to

contact. The receiver pilot will notice pitch sensitivity at this point. A slight increase in closing rate during the final three feet is applied by the receiver pilot to give a positive forward relative motion to force the probe into the drogue.

After engaging, the receiver airplane must move forward so that approximately four feet of hose take-up occurs, starting the fuel transfer. The receiver should be flown so that the hose is centered directionally and maintained just above the lower centerline lip of the store's trailing edge, but not riding on or touching the lower lip. This optimum position is approximately two feet below the drogue's normal trailing position. This position is the most comfortable position for the receiver to avoid severe buffeting. Once the engagement has been accomplished, it is not difficult to fly the receiver dead astern with a two foot lateral tolerance, even in rough air or in turns up to 30 degrees bank angle.

Mild buffeting will be felt by the receiver, but it should not be uncomfortable. Occasional mild fuel sprays of short duration may hit the receiver, but the only adverse result is possibly a greasy film on the windshield.

CAUTION

Transfer of fuel from the wing tank to the fueling store imposes a static pressure of 6 psi in the wing tank. During transfer, do not exceed 45° bank angles and load factors of positive 2 g or negative 1 g.

Disconnecting is accomplished by the tanker holding constant power while the receiver retards throttle. The hose reel will unwind the take-up until it reaches the end of the hose travel and the receiver will break free.

MISCELLANEOUS EQUIPMENT

ANTI-BLACKOUT SYSTEM

The anti-blackout system utilizes high pressure air bled from the air conditioning refrigeration unit air supply. Air is filtered and directed through a line to the valve located on the ANTI-G & OXYGEN panel on the left-hand console (19, figure 1-3). The valve control knob can be turned to "HI" or "LO" to regulate the amount of air pressure increase in the suit and should be set according to the ability of the pilot to withstand "g" forces. As level flight is attained, and "g" forces are reduced, the valve will automatically reduce the pressure in the suit. A push button on the top of the valve control knob may be manually operated to test the system on the ground or in level flight. Prior to each flight, with the engine running and anti-blackout suit connected, depress this button several times to check the operation of the anti-blackout system. If the valve has any tendency to stick or fails to return to the closed position, it should be replaced. On long flights this system makes it possible for the pilot to inflate the suit occasionally for body massage to lessen fatigue. The pilot's anti-blackout suit connection plugs into a receptacle adjacent to the control knob.

MAP CASE

A map case (10, figure 1-5) is installed at the aft end of the right console.

SPARE LAMPS RECEPTACLE

Replacement lamps for the instrument lamps and for fire warning lamps are contained in the SPARE LAMPS receptacle (20, figure 1-5) on the right-hand console.

PILOT'S RELIEF CONTAINER. The pilot's relief tube has been removed and replaced with disposable plastic bags. The storage compartment for the bags is located on the left-hand side of the canted bulkhead (1, figure 1-3).

BARRICADE STRAP DETENTS

Three barricade strap detents are installed on each leading edge to insure proper barricade engagement. Two of the detents are spaced evenly on the wing slat; the third is on the leading edge of the wing, inboard of the slat (31, figure 1-2).

REAR VIEW MIRRORS

A rear view mirror is installed on each side of the canopy bow to provide rearward vision during flight and taxiing.

SECTION V
OPERATING LIMITATIONS

See NAVAER 01-40AVB-1A, Confidential Supplement to Flight Handbook

SECTION VI
FLIGHT CHARACTERISTICS

See NAVAER 01-40AVB-1A, Confidential Supplement to Flight Handbook

SECTION VII
SYSTEMS OPERATION

INTRODUCTION

A pilot's proficiency is not measured solely by the finesse with which he performs maneuvers designed to impress the uninitiated, but by the manner in which he gains the utmost from his aircraft through intelligent employment of the many systems and components which have been placed in the aircraft for just that purpose. This can be attained only by diligent study of the airplane as an entity . . . learning the theory and operation of the systems, determining the relationship of one system to another, knowing the maximum capabilities of each, and then correlating his ability to fly with his understanding of the aircraft. Then, and only then, can a pilot be considered proficient. To help him attain this proficiency, the following section is included.

ENGINE FUEL CONTROL SYSTEM

MANUAL FUEL CONTROL SYSTEM OPERATION GROUND CHECK. Because the manual fuel control system lacks the automatic compensating devices found in the primary system, its use requires cautious manipulation of the throttle. Slow, steady power changes must be made to prevent overspeeding and excessive exhaust gas temperatures. High temperatures have a tendency to break down the structure of the metals in the engine, causing distortion and subsequent failure. (For manual fuel control system ground check procedure, refer to MANUAL FUEL CONTROL CHECK in Section II.)

IN-FLIGHT SWITCH-OVER. The engine fuel control operation may be changed from the primary to the manual system during flight at all altitudes by retarding the throttle to "IDLE" and moving the FUEL CONTROL switch to the "MANUAL" position. The switch-over to the manual system may be accompanied by a surge in engine speed and tailpipe temperature, the severity of which depends on the difference between ambient atmospheric conditions and those of a standard day. As the primary system incorporates devices which compensate for these differences and the manual system does not, when the switch-over is made, the sudden lack of compensation results in a change in fuel flow, thus causing the temporary aberration in operating characteristics.

During flight testing, it has been demonstrated that the manual control position can be selected safely, while at military power, up to 6,000 feet.

After a switch-over, and when tailpipe temperature permits an acceleration, the throttle may be advanced slowly and smoothly to the desired power setting, provided that the engine operating limitations given in Section V are not exceeded. It must be remembered that when operating on the manual fuel control system, all fuel metering to the engine is accomplished by direct movement of the throttle; therefore, all subsequent power changes must be made with the same care, not only to prevent overspeeding and extreme temperatures, but also to avoid a flame-out from the possible inability of the engine to parallel in speed the rapidly changing fuel flow during quick accelerations and decelerations. Switch-overs should be practiced regularly. During take-off, if it becomes expedient to switch to the manual fuel control system, it is inadvisable to retard the throttle to "IDLE" prior to the switch-over. Because of the rapidity with which the engine decelerates upon failure of the primary fuel control system—the deceleration from 100% to 80% RPM requires approximately ½ second—the change must be made very quickly to prevent a complete loss of power. The throttle should be retarded only enough to keep the tailpipe temperature within limits after the switch-over, then advanced slowly to the necessary power setting.

HYDRAULIC POWER SUPPLY SYSTEMS

Since both of the engine-driven hydraulic pumps in the tandem hydraulic system and the one pump in the single hydraulic system are all of the constant pressure, variable displacement type, the flow of fluid through each system will vary in rate (gallons per minute) with the operating speed of the associated pump. Each pump is geared to the engine in such a manner that for each revolution of the engine, the hydraulic pump will complete approximately one-half revolution. At military power, fluid flows through the system at the approximate rate of six gallons per minute, while at sea level idle approach power the flow is reduced to slightly over two gallons per minute. As rate of fluid flow determines the speed at which the various hydraulically operated units respond to actuation of their individual controls, this variation in rate of flow with power changes during normal operation might ordinarily produce objectionable characteristics in operation of the hydraulic power supply system. Therefore, flow restrictors have been installed in the sub-systems to regulate the maximum rate of flow. The flow restrictors prevent the wing flaps, speed brakes, and arresting hook from operating too fast when fluid flow is at its peak, yet do not affect the time of operation when flow is reduced, as low engine speeds.

Each hydraulic actuating cylinder within the systems requires a certain quantity of fluid to be delivered through its inlet port to completely extend the cylinder piston. The rate of flow determines how quickly the piston extends, and the pressure at which the fluid is delivered dictates the maximum load against which the piston will extend. As long as the engine is turning at "IDLE" RPM or greater, even windmilling under flame-out conditions, the hydraulically operated units will operate slowly against the usual loads. As rate of fluid flow diminishes with decreasing engine speed, the full extension of the hydraulically actuated pistons will require a greater period of time.

TANDEM HYDRAULIC SYSTEM

In the tandem hydraulic system the flight controls are powered by two completely separate hydraulic systems; however, when units other than the flight controls are being operated by the utility hydraulic system, the effectiveness of the flight controls will be reduced, especially at high air speeds. Within the utility system, when two controls are operated at the same time at very low engine speeds, one will respond more quickly than the other, depending on which offers the least resistance. When operating on the utility system alone, actuations of various units normally operated by the utility pressure will cause a temporary decrease in the effectiveness of the flight controls.

WARNING

Do not attempt maneuvers requiring high control forces (such as high-speed pull-outs) when it is known beforehand that one or both of the systems are inoperative.

HYDRAULIC POWER DISCONNECT. The use of the power disconnect is an invaluable air in the event of complete hydraulic system failure or in the execution of a flame-out approach. The pilot should be aware that the basic forces will be much higher when on manual, at higher Mach numbers, particularly on the aileron controls. Accordingly, for intentional disconnects, it is recommended that the aircraft be slowed, and, once disconnected, not flown at high Mach numbers (above 300 knots IAS).

Normally, the rudder trim system is a force-trim system; that is, it does not trim the airplane directionally through aerodynamic loads provided by tab displacement. Actuation of the rudder trim switch (when on hydraulic power), as far as the pilot is concerned, merely relocates the zero-force position in the rudder-feel system. On manual control, the pilot has no rudder trim available.

The aileron trim system is also a force-trim system. The aileron tab, however, moves as a follow-up, in order that the airplane will be reasonably close to trim when the power system is disconnected; and the aerodynamic forces will then be felt by the pilot through the manual control system. On the manual control system, trimming by tab action imparts a hinge moment to the aileron. (Refer to AILERON TRIM SYSTEM, Section I.)

The "in-trim" angular position of this tab will vary between individual airplanes due to manufacturing tolerances, and is established in flight by company test pilots, prior to fleet delivery of each aircraft. Theoretically, this setting should not change during the service life of the aircraft unless some change is made to its aerodynamic configuration. For safety of flight, it is mandatory that an "in-trim" position be re-established, since this establishes the range of action of the tab, and may result in uncontrollable, rolling tendencies when the power system is next disconnected. However, flight tests of the aileron tab setting are required only after an aileron or wing change.

The flight procedure for checking the aileron tab rigging setting may be found in the applicable handbook of maintenance instructions. The pilot technique for power disconnect in re-rigging tests is also found in the maintenance instructions.

Note

As long as primary (normal) electrical power is available, the airplane can be trimmed. Therefore, in the event of an actual hydraulic system failure, when the MAN FLT CONTROL handle is pulled, if the airplane starts to roll, it should be trimmed immediately. (This is to be distinguished from the rerigging test procedure where no trimming is to be done, unless absolutely necessary.)

WARNING

Do not fly over 300 knots IAS after disconnecting.

HYDRAULIC POWER DISCONNECT WITH ASSYMMETRIC LOADINGS. Disconnect tests should not be performed with asymmetric loadings. However, in the event that an actual hydraulic power disconnect must be made with asymmetric wing or store loadings, the following recommendations are made:

a. Speed must be reduced to less than 200 knots IAS prior to disconnecting;

b. After disconnect, excessive longitudinal stick motions must be avoided;

c. Cross-wind landings must be made upwind or downwind, whichever is required to put the cross-wind component under the heavy or loaded wing;

d. A final approach speed of 115 knots IAS must be considered an absolute minimum, as it represents the minimum control speed with a power failure and a 1200 pound asymmetric load. The initial approach airspeed should be a minimum of 140 knots IAS, with a minimum final approach and touchdown airspeed of 125 knots IAS.

(Refer to Section VI, FLIGHT WITH EXTERNAL STORES, for further information.)

SECTION VIII
CREW DUTIES

NOT APPLICABLE

SECTION IX
ALL WEATHER OPERATION

INTRODUCTION

Discussion of special techniques and procedures for operation in adverse weather necessarily includes some instructions found in other sections of this handbook. Normal operating instructions covered in Section II will be repeated here only to establish the correct sequence of operations or to emphasize the importance of certain procedures. Any discussion concerning systems operation will be found in Section VII.

NIGHT FLYING

For pre-flight preparations and take-off at night, refer to procedure described under INSTRUMENT FLIGHT PROCEDURES. In addition, include these items:

a. Prior to take-off, avoid use of bright light in the cockpit to prevent loss of night vision.

b. To prevent loss of night vision, avoid taking off behind planes using afterburner.

c. After take-off, if bright light inadvertently appears, close or cover up one eye during the exposure so that night vision will be retained in at least one eye for use after the light exposure.

d. All exterior lights "BRIGHT" and "FLASH."

Note

If a single instrument or fire warning lamp goes out, replace it with one from the SPARE LAMP receptacle (20, figure 1-5) on the right-hand console. If all lights go out, pulling the EMER GEN release handle should restore the power and the interior lights (but not the exterior lights).

INSTRUMENT FLIGHT PROCEDURES

This section presents certain characteristics and limitations of the airplane during instrument flight conditions as a supplement to previous training and experience. Successful fulfillment of a mission under instrument flight conditions, especially in jets, requires careful preflight planning, current instrument proficiency on the part of the pilot, and adequate instrumentation for blind take-off, orientation, approach and landing.

The UHF receiver-transmitter (AN/ARC-27) provides static-free communication and works in conjunction with the UHF homing adapter (AN/ARA-25) receiver (automatic direction finding equipment). The TACAN (AN/ARN-21) airborne equipment operates in conjunction with surface navigation beacons to provide continuous directional and distance information to the pilot. Marker beacon equipment (AN/ARN-12) indicates position relative to specific marker beacon stations. Omni-range (AN/ARN-14E) receivers, available with airplanes carrying NAVPAC as an external store, include an R-540/ARN-14C VOR receiver and an ID-251/ARN indicator control for navigation, orientation and let-down. The automatic flight control system (autopilot) facilitates instrument flying.

INSTRUMENT TAKE-OFF

PRIOR TO TAKE-OFF. To reduce fuel consumption, complete as much as possible of the pre-take-off check before starting the engine.

a. Connect external source of electrical power.

b. Check all communications and navigation equipment for correct operation.

c. Switch IFF to "NORMAL."

d. Set navigation equipment on local channel so that an immediate heading indication is available if an emergency develops after take-off.

e. Check cockpit lighting and set as low as possible in order to retain night vision. Adjust the forward flood-lights for use in reading instrument flight guides, maps, etc.

f. Check oxygen supply and oxygen mask fit.

g. Set the altimeter and record the altimeter error (if any) to insert at destination.

h. Adjust the all-attitude indicator.

i. Set clock.

j. Make short autopilot preflight check.

k. Check for proper operation of all directional instruments while taxiing.

l. Check canopy by pushing up on it to make certain that it has been securely latched and locked.

m. Complete normal check list.

n. Review the procedure used to jettison stores during a take-off emergency.

TAKE-OFF. When in take-off position and lined up with the runway:

a. Hold and synchronize the gyro compass.

b. Check all-attitude indicator for correct operation.

c. Turn on PITOT HEAT switch. Do not prolong use on the ground.

d. Advance throttle, maintaining directional control with brakes until rudder control is effective (approximately 50 knots).

e. When take-off speed is reached, lift the nose gently from the ground to prevent an excessively high angle of attack.

f. When airplane is well clear of the ground, raise the gear.

INSTRUMENT CLIMB.

a. If possible, climb straight ahead to 1000 feet above terrain before commencing turns.

b. Climb out at a predetermined airspeed (approximately 200 knots) until well clear of all terrain obstacles before leveling-off to pick up climbing speed.

c. Use standard rate climbing turns. Use autopilot if desired.

d. Retard throttle as required to prevent excessive EGT.

e. Avoid icing levels.

CAUTION

If lightning should hit the airplane, navigation instruments may be thrown off temporarily, or even permanently, and require resetting on the ground. Electronic navigation instruments should all be checked against each other and the standby compass after such occurrence.

INSTRUMENT LANDING CHECK. In addition to the normal landing check:

a. Set the altimeter (including the error obtained at take-off).

b. Exterior lights "BRIGHT" and "FLASH."

c. Synchronize compass.

d. Air conditioning either full hot or "OFF."

Note

Wave-off characteristics are excellent; however, 100% rpm may cause pressurization 'fog' in the cockpit.

JET PENETRATIONS

Jet penetrations have been set up to provide a high-speed and high rate-of-descent letdown from cruising altitude to a point where VFR approach or an instrument approach (such as GCA or low-frequency range) can be made. Penetration procedures for specific fields are given on JAL (jet approach and landing) charts. The Pilot's Handbook—Jet, in two parts for the eastern and western United States, has the JAL charts for all fields where jet penetration procedures have been established. Figure 9-1 presents a suggested jet penetration with instrument approach, which is accomplished by beginning a letdown at the penetration cone (cruising altitude) on the heading specified in the JAL chart. The initial phase of the penetration is set up to avoid interference with altitudes occupied by other airplanes. After the high cone is crossed, a conventional instrument approach is begun. The conditions set up in the JAL charts should be given careful consideration during flight planning. Availability of GCA, alternates, and operational problems in high-density traffic areas should be analyzed.

GROUND-CONTROLLED APPROACHES

Ground-controlled approaches can be successfully carried out. However, the small reflecting surfaces of the clean design may make it difficult, when precipitation is heavy, for the GCA controller to pick up the airplane with radar for an initial entry. The pilot can assist the pick-up by extending speedbrakes and landing gear higher in the pattern, until he is identified. Then he should go back to the normal GCA procedure. A typical GCA approach for the airplane is shown in figure 9-2. Should a wave-off be necessary, squadron procedure should be followed, with 100% rpm, landing gear and flaps "UP," until another GCA entry is made.

ICE, SNOW AND RAIN

Precipitation can create flight hazards when the temperature borders on freezing. A thorough pre-flight inspection just prior to take-off is essential. Frost can form on the wing surface in a very short time, making take-off hazardous. Wet snow, if allowed to accumulate while the airplane is on the ground, may freeze while it is gaining altitude and seriously reduce airspeed and range for an indefinite period. Take-offs should never be attempted when frost, ice or patches of wet snow adhere to the surfaces.

Note

The white and grey color of the aircraft finish may make it difficult to detect glaze ice formation on the wings. Because of the rapidity with which icing conditions may occur, the importance of making last minute checks of the exterior of the airplane cannot be over-stressed.

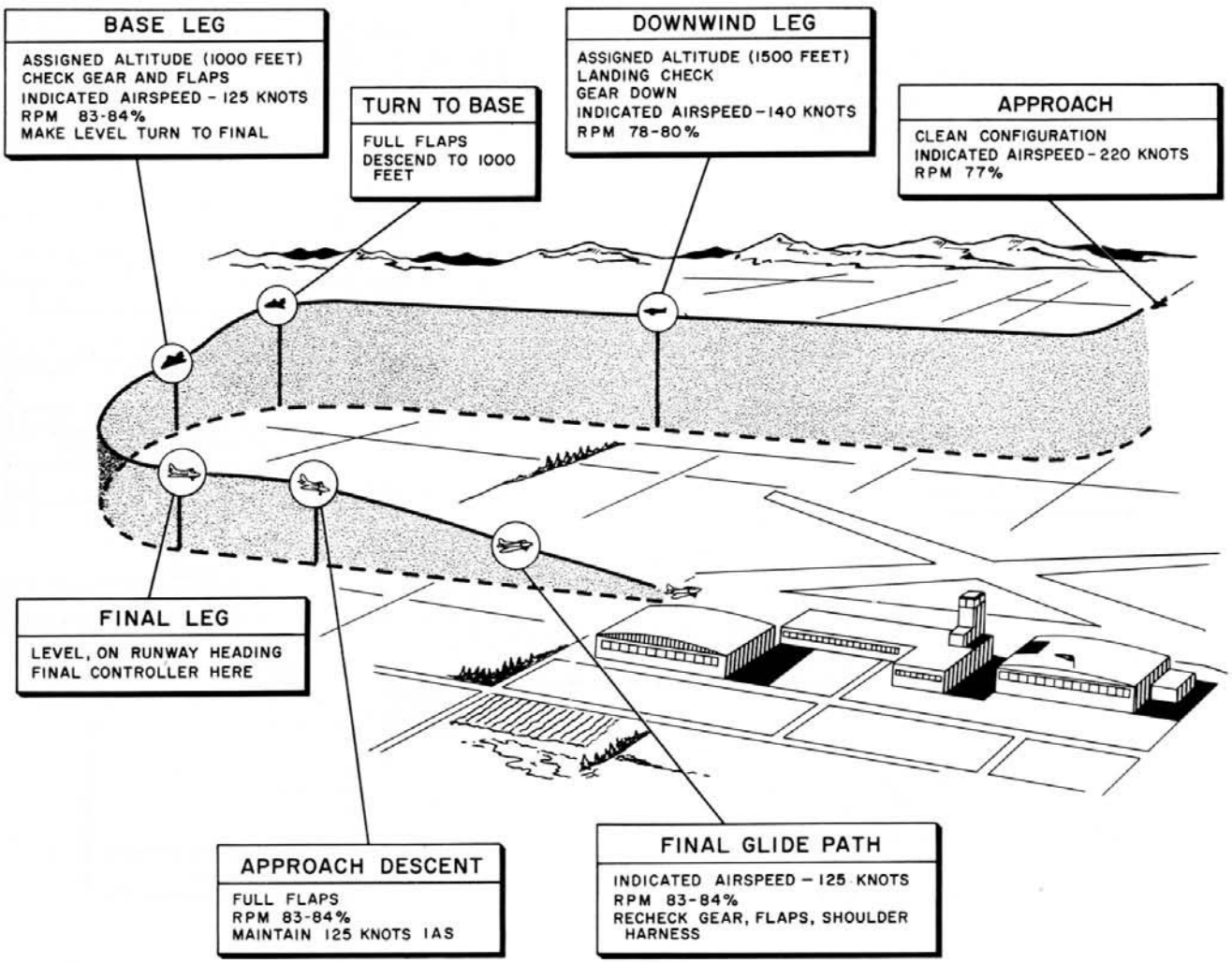
Taxiing on ice may present problems, particularly in a wind. Icing occurs in flight when freezing conditions

exist and one or more of the following weather types are encountered: rain, fog, sleet, wet snow, supersaturated vapor and high humidity.

WARNING

The airplane is not equipped to prevent ice formation on the wings or fuselage and should not be flown in areas where heavy icing is likely to be encountered.

Two kinds of icing may be encountered in flight: aircraft icing and/or engine icing. A loss of airspeed is an indication of both types of icing. Engine icing is recognized by a decrease of engine rpm and an increase in tail-pipe temperature. Icing may form in the air intake ducts forward of the engine, and is indicated by an increase in tailpipe temperature and a loss of airspeed, with rpm remaining constant. Icing of the inlet pressure sensing probe of the fuel control may be corrected by switching to "MANUAL." However, this shift to manual fuel control may cause "rich blow-out" if the throttle is not first returned to "IDLE." Returning the throttle

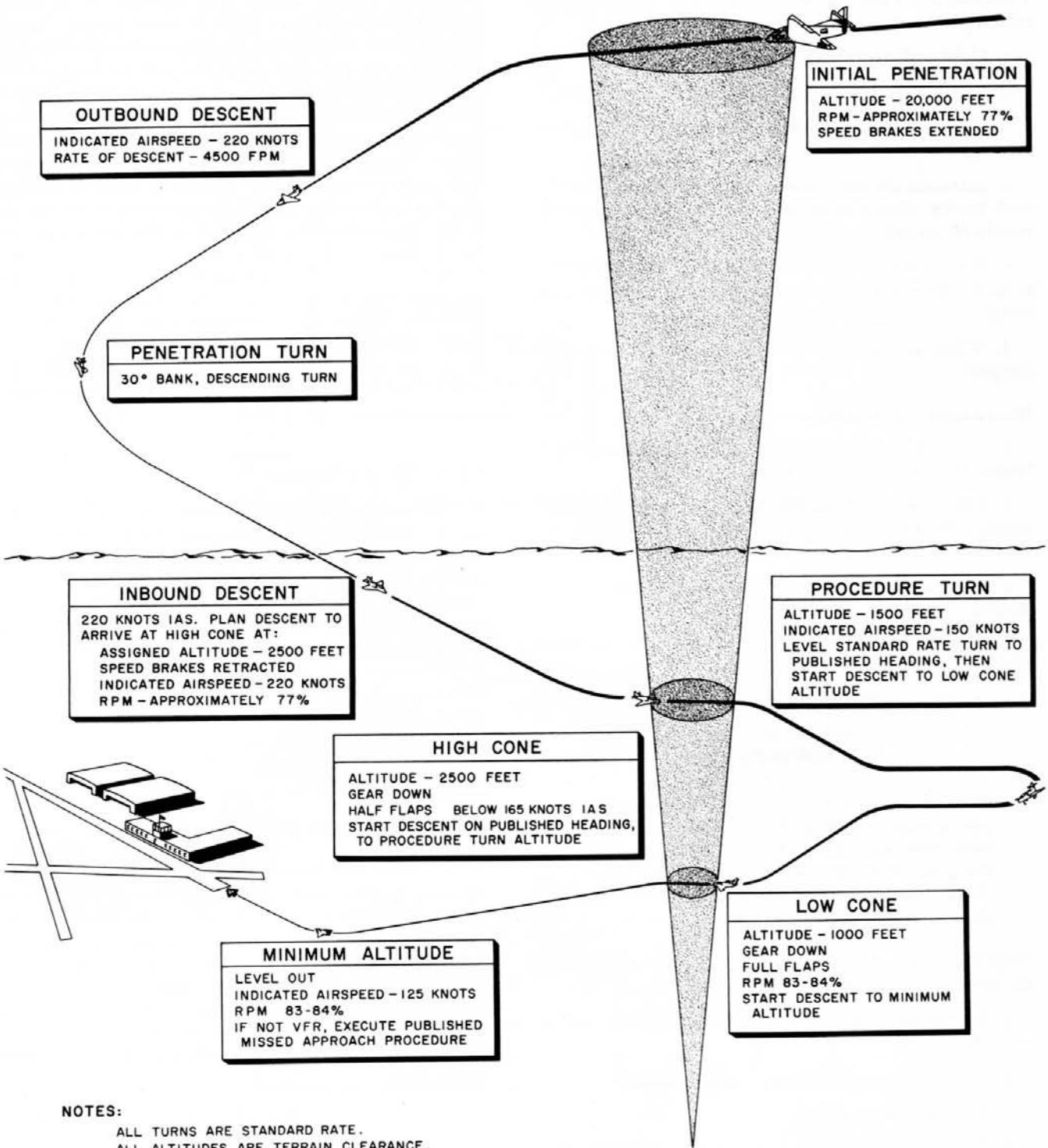


NOTES:

ALL TURNS STANDARD RATE.
ALL ALTITUDES ARE TERRAIN CLEARANCE.
VARY POWER SETTINGS WITH EXTERNAL STORES CARRIED.
INCREASE AIRSPEED FOR GROSS WEIGHT INCREASE.
AVOID STEADY STATE OPERATION IN THE RESTRICTED 60-82% RPM RANGE.
AVERAGE FUEL CONSUMPTION: 400 POUNDS (INCLUDING PENETRATION).
AVERAGE TIME: 8 MINUTES (INCLUDING PENETRATION).

P-12928-1

Figure 9-2. Typical Ground Controlled Approach



NOTES:

ALL TURNS ARE STANDARD RATE.
ALL ALTITUDES ARE TERRAIN CLEARANCE.
INCREASE POWER SETTINGS AND AIRSPEEDS FOR GROSS WEIGHT INCREASE.
AVOID STEADY STATE OPERATION IN THE RESTRICTED 60-82% RPM RANGE.
AVERAGE FUEL CONSUMPTION: 450 POUNDS (INCLUDING PENETRATION).
AVERAGE TIME: 12 MINUTES (INCLUDING PENETRATION).
OBSERVE ALL PUBLISHED HEADINGS AND ALTITUDES (JAL) UNLESS ADVISED OTHERWISE BY AIR TRAFFIC CONTROL.

P-12927-1

Figure 9-1. Suggested Jet Penetration

to "IDLE" is necessary even though engine rpm is already at altitude idle.

CAUTION

The engine is not equipped with anti-icing equipment.

Snow or fog may occur in the cockpit on certain days when humid air reaches a low (air conditioning) temperature. This usually occurs during take-offs and landings; within a few seconds visible moisture in front of the pilot may be so thick as to obscure the entire instrument panel. In the event of this phenomenon, windshield air must be switched from the windshield to the floor, and the AIR COND control knob adjusted to full hot, to be readjusted later to a more comfortable temperature. Should this fail to correct the situation, the air conditioning system should be turned "OFF." If high humidity exists on take-off so that cockpit fogging or snow is anticipated, squadron doctrine may recommend that take-offs be accomplished with the air conditioning in the "OFF" position, and then turned "ON" at 5,000 feet.

In extremely cold weather, some moving parts may freeze. The two most likely to freeze are the slats and the landing gear switch. Because of the great force used to actuate the landing gear and gear doors, the gear doors themselves are not likely to freeze open or closed. Prior to take-off, the pilot should check both slats for freedom of movement. In flight, there is the possibility that one or both slats may freeze closed in freezing rain. This is dangerous at speeds blow the stalling speed for closed slats, if the pilot does not realize that slats are not extended. After flying in freezing rain, the pilot should check both slats during the approach and, if the slats are frozen in, should approach at an airspeed higher than the recommended approach speed. In order to get the proper rate of descent and flare-out, the pilot must consider buffet onset as a minimum speed factor if the condition of wing slats is not known. Should the landing gear switch become frozen, an incorrect gear position indication would result.

Should canopy frosting occur from ice crystals on the *inside,* some side vision may be temporarily obtained by scraping off the ice.

On fields which have arresting gear, the arresting hook may be used for landing on wet or icy runways.

There is no water separator in the air conditioning system.

RAIN REPELLENT. A rain repellent kit, stock number R83K710075, is available for coating the external surface of the windshield and canopy and will permit normal visibility upon encountering rain. The rain repellent is applied as follows:

a. Wash surface if it is excessively soiled.

b. Clean surface with the cleaner that is provided, using a soft cloth; then polish.

c. Apply the bonding paste with a clean soft cloth. Use the bonding paste sparingly, since only a thin flim is required.

Note

Applying the bonding paste to a wet surface will not provide a satisfactory bond.

d. Polish the surface with a clean soft cloth until all the black color disappears.

e. Apply the stick rain repellent by rubbing the side of the stick lightly over the surface. Do not apply rain repellent stick endwise, since too heavy a film will be deposited.

f. Polish with a soft cloth until the flim is clear.

g. To recoat, repeat the foregoing procedure.

The treated windshield may be cleaned and polished several times without adversely affecting the rain repellent qualities. Use the following procedure as a guide:

a. If the film is cloudy or moderately soiled, clean and polish with a clean soft cloth.

b. If the soiled area is heavier and of a nature that responds to water, clean with cloth and water only, and after drying, polish with a soft cloth. Should this procedure remove the film, restore it by applying the rain stick repellent only and polishing.

c. If the soiled area required the use of a cleaner or detergent, follow the procedure for recoating the surface.

Note

The rain repellent coating can be removed with windshield de-icing fluid.

CAUTION

Do not permit the rain repellent compound to remain on the sealant around the edges of the windshield and canopy.

ANTI-FOGGING COMPOUND. An anti-fogging compound, stock number R51-XAE101-1-8, for coating the interior surface of the windshield and canopy, prevents fogging of these transparent surfaces.

The anti-fogging compound is applied as follows:

a. Wash interior surface if it is excessively soiled.

b. Apply the anti-fogging compound, using the application unit.

c. Wipe the surface with a clean, lintless cloth until it is clear.

CAUTION

- The anti-fogging compound has a detrimental softening effect on cellulose nitrate instrument lacquer when in contact over one hour. Care should be taken to prevent contact of the compound with the instrument panel finish.
- The anti-fogging compound has a severe swelling effect on rubber. Care should be taken to minimize contact of the compound with the rubber and sealant surrounding the windshield and canopy.

One application of the anti-fogging compound is effective for a minimum of ten fogging and drying cycles. When there is doubt as to the condition of the film, a new film should be applied.

FLIGHT IN TURBULENCE AND THUNDERSTORMS

The key to flying in turbulent air is to "fly attitude." The best way to fly through a storm is to reduce airspeed to approximately 250 knots, fly the all-attitude indicator and pay less attention to altitude changes.

Whenever possible, thunderstorms should be by-passed. If a storm area covers a wide front, it is usually advisable to fly above the weather to avoid heavy icing and hail-damage to the plastic nose. Should operations require some thunderstorm flying, an airspeed of about 250 knots IAS will aid in reducing excessive gust loads in the structure. Vertical air currents in well-developed thunderstorms will sometimes alter the airplane altitude several thousand feet, and airspeed will fluctuate considerably. Rather than attempt to fly at a constant altitude, the pilot should maintain the initial flight attitude commensurate with a safe airspeed, keep a constant throttle setting and use light stick forces to fly the attitude indicator. Abrupt pitch corrections should be avoided. Chasing the airspeed indicator should be avoided because the readings are unreliable during pressure changes within the storm-cell and have been known to go to zero during thunderstorm penetration. Flying by pitch attitude reference should keep the airspeed and altitude relatively constant regardless of instrument indications.

BEFORE TAKEOFF. A flight plan avoiding known thunderstorms must be made. A check should be made of all flight instruments, navigation equipment, interior lighting and pitot heat. Pitot heat should not be left "ON," as prolonged ground operation without cooling airflow can damage the heating element.

APPROACHING THE STORM. Preparation before entering the storm is as follows:

a. Reduce airspeed to 200-250 knots IAS and lock throttle friction lock.

b. Adjust all-attitude reference airplane.

c. Pitot heater switch.....“ON.”

d. Lower the seat to prevent striking the head against the canopy and to reduce the blinding effect o lightning.

e. Turn all cockpit lights on and bright.

f. Safety belt tight.

g. Shoulder harness.....“LOCKED.”

h. Turn radio volume down during severe crash static conditions.

i. Fly level on a heading calculated to provide the quickest passage through the storm at an altitude affording the least turbulence and icing while clearing all ground obstacles by a wide margin. Use autopilot, if desired.

j. Go on instruments *prior* to penetrating the storm.

IN THE STORM. While flying through the storm:

a. Maintain power setting and pitch attitude established before entering storm. Do not chase airspeed indicator, since this will result in extreme attitudes. If a sudden gust should be encountered while in a nose-high attitude, a minimum flight speed might result. Use as little horizontal stabilizer control as possible to minimize the possibility of overstressing the airplane.

b. Maintain the initial heading through the storm, correcting for any deviation from flight plan after emerging from the weather.

c. Devote all attention to flying the airplane.

d. Expect turbulence, precipitation and lightning. Do not allow these conditions to cause undue concern.

e. *Maintain attitude.* Fly the attitude indicator to maintain a level attiude.

f. Avoid looking at lightning flashes. Concentrate on instruments.

COLD WEATHER OPERATIONS

Low temperatures will be encountered in all regions at high flight altitudes. However, most cold weather difficulties exist on the deck or airfield. Safety of flight depends on thorough preparation and careful observation of weather by the pilot. Equally important are pre-flight inspections which must eliminate the added hazards of cold weather whenever the grounded airplane is exposed to ice, snow and frost.

WARNING

The collection of ice, snow and frost on the airplane surfaces constitutes one of the major flight hazards in low-temperature operation and can result in loss of lift and treacherous stalling characteristics.

BEFORE ENTERING THE AIRPLANE. A thorough check of the following items should be made by the pilot before entering the cockpit:

a. Visually check engine intakes for evidence of ice.

b. Check fuel drains (defueling valves), fuel lines and shut-off valves for frozen condensation.

c. Remove all ice from fuel tank vents, static air sources and pitot tube.

d. Remove dirt and ice from shock struts. Inspect limit switches, door hinges, actuating cylinders and wheels.

e. Check control surfaces and hinges.

f. Check wing slats for smooth roller and track movement and that they can be closed manually.

g. With airplanes *not* equipped with the rocket ejection seat, check the ejection catapult cartridge to see that the flight will not be made with a "cold cartridge." (See Section III, Ejection, Cold Cartridge Operation, and see figure 3-4, Ejection Seat Cold Cartridge Performance.) During extreme cold weather operation, safety precautions should include some means of warming the catapult cartridge to insure that a successful ejection could be made at high speed immediately after take-off. The use of cartridges kept overnight at room temperature, inserted just prior to take-off, should insure tail clearance.

h. Check the entire airplane for freedom from ice, snow and frost. Remove ice carefully by approved methods and remove snow or frost by light brushing.

CAUTION

- Do not permit ground crew to scrape or chip ice from aircraft surfaces, as damage to the skin will result.
- Check that water from ice removal does not refreeze, particularly on the control hinges.

i. Make sure that wheels are chocked securely to prevent slippage.

ON ENTERING THE AIRPLANE. The canopy seal must be inspected to make sure that no ice has accumulated to prevent proper seating.

BEFORE STARTING THE ENGINE.

a. Check to see that compressor rotates freely by momentary starter application. Engine heat on shutdown melts ice accumulated during the previous flight, and the moisture may refreeze on the lower sections of the low pressure compressor blades. Heat may be applied to melt ice, and engine should be started as quickly as possible after the compressor is free.

b. Before starting, and with external power engaged, the pitot heater should be checked, but should *not* be left "ON," as prolonged ground operation without cooling airflow can damage the heating element.

STARTING AND WARM-UP GROUND CHECK.

a. Use normal procedure for starting engine. If temperature is less than −35°C, run at "IDLE" for two minutes before take-off.

b. Make sure all instruments have been sufficiently warmed up to insure normal operation. Also, check for sluggish instrument indicator movement during taxiing.

c. Check all flight controls, both visually and by feel, for unrestricted movement.

d. Run through a complete cycle with rudder trim, stabilizer trim, aileron trim (observing the tab), stick, speed brakes and flaps, several times, to assure correct operation.

e. Cabin heat "ON."

f. Use caution while running engine up on a slippery surface, as the chocks may slide. A normal full-power check can be made during the initial part of the take-off roll.

TAXIING

a. If it is necessary to taxi on ice or snow, allow greater distance for braking action. Skidding may occur with temporary loss of control when sharp turns are made or when a cross wind exists. Taxiing in deep snow is difficult and may also cause freezing of brakes and gear after take-off.

b. Avoid taxiing through melted snow or slush caused by the jet blast of other airplanes, to prevent accumulation of ice on the airplane surfaces.

c. Use caution when taxiing in the vicinity of other airplanes. Increase the space between airplanes, to insure safe stopping distance. Jet blast can impair visibility by blowing clouds of dry snow over a large area.

d. Minimize taxi time to conserve fuel and reduce amount of ice-fog generated by jet engines.

BEFORE TAKE-OFF

a. Turn air conditioning to approximately 85°, temporarily, to insure against fogging and frosting.

WARNING

- Do not take off with frosted windshield, or with frost, snow or ice on wings or control surfaces.
- Should fog or snow in the cockpit obscure the instruments, the air conditioning should either be turned "OFF" or full hot.

b. Pitot heat "ON" just prior to take-off.

c. If surface of runway is too slippery for engine run-up, the power check must be made during early part of take-off.

TAKE-OFF

a. When starting the take-off run, advance the throttle rapidly and check engine instruments.

b. After take-off from snow or slush-covered runways, operate the landing gear and wing flaps through several cycles to prevent possible freezing in the up position. (Expect considerably slower operation of the landing gear in cold weather.

CAUTION

- Do not exceed the wheels-and flaps-down airspeed limits during the cycling operation.
- Do not apply brakes to stop rotation of retracted wheels.

c. Check instruments. At extremely low outside air temperatures, instruments should be sufficiently warmed up to insure reliable operation.

DURING FLIGHT

a. Flight characteristics of the airplane are not affected by cold weather, although colder than normal temperature increases air density and produces greater ram pressure. Engine thrust, therefore, may be reduced to establish the desired airspeed-altitude combination for maximum range.

b. Use cockpit air conditioning system as desired.

DESCENT.

a. Should canopy frosting or fog or snow in the cockpit occur, increase the temperature. The heated windshield (nesa glass) should give forward vision and, in an emergency, some side vision can be obtained by scraping off the ice with a glove. (Use a knee-board or sharp object only in an extreme emergency.)

b. If flight has been through freezing rain, check that slats open in the landing approach. (See ICE, SNOW AND RAIN.)

c. A carrier-type approach is recommended for landing on wet and icy runways to lessen the possibility of skidding. This gives the maximum runway available, requires a minimum of braking, and allows landing at the lowest airspeed.

LANDING.

When landing on snow, wet or ice-covered runways, be careful to avoid drift which will cause skidding and consequent loss of control. Maintain a straight course down the runway, applying brakes evenly and lightly. The best approach to land on wet and icy runways is a carrier-type approach, with touchdown as close to the end of the runway as possible. After touch-down, retract flaps and open speed brakes for drag and increased braking effectiveness. The proper braking technique is light tapping of the pedals. If the aircraft starts to skid, the pilot *must* release the brakes and resume the tapping when the tracking becomes straightened out in the landing roll.

Note

Hard braking on icy or wet runways may result in dangerous skidding or fishtailing.

Be certain to turn the pitot heater switch "OFF" after landing.

SHUTDOWN AND POSTFLIGHT.

a. Use normal shutdown procedures.

b. See that wheels are chocked securely.

c. Have airplane serviced, and fuel lines (defueling valves) drained. Every effort should be made during servicing to prevent moisture from entering the fuel system.

d. Have covers and plugs installed if mooring outside. Make certain airplane is tied down securely.

e. If it is not snowing or raining, leave canopy open to allow circulation until the cockpit has cooled off, to prevent canopy cracking from differential contraction.

HOT WEATHER AND DESERT OPERATION

When high altitude flight requires the wearing of a close-fitting pressure suit, make a pre-flight check before getting into the suit. When wearing tight clothing, take as little time as possible in getting the engine started if ground-connected air conditioning is not provided for the cockpit. Metal exposed to the sun can inflict severe burns.

BEFORE STARTING ENGINE.

a. Make visual inspection of the airplane exterior, checking for system leakages, sand or dust accumulation, tire over-inflation, blistering, fungus or corrosion, and loose inspection plates.

b. See that all lock pins, protective covers and plugs (including pitot head cover) are removed.

c. Make any other necessary ground checks prior to starting engine, such as oxygen and fuel servicing.

d. Make sure air conditioning system is turned on.

AFTER STARTING ENGINE.

a. Make engine ground run-up as short as possible.

b. Acceleration to "IDLE" rpm will take longer than on a normal or cold day.

TAXIING AND TAKE-OFF.

a. Avoid excessive use of brakes.

CAUTION

When aggravated by hot weather, excessive use of brakes is likely to increase tire pressure and decrease both tire and wheel strength sufficiently to cause explosive failure. Such a failure, if it occurs after a wheel is retracted, can rupture a door fairing or integral fuel tank.

b. Watch exhaust temperatures closely.

c. Because of the lower density of air in hot weather, be prepared for slower acceleration, longer take-off distance, and reduced thrust at all throttle settings. The increased requirement for take-off distances commonly associated with hot-weather operation of any airplane is even greater for jets. (See figure A-7 for take-off distances at various temperatures.) TAS will be greater for the normal IAS and strict adherence to recommended IAS is essential to safe flight.

CAUTION

Do not attempt to take off in a sandstorm or dust storm. Park the airplane cross-wind and shut down the engine to prevent sand or dirt from damaging the engine.

BEFORE LEAVING AIRPLANE.

a. If sand or dust is not blowing, leave canopy open to permit air circulation within the cockpit.

b. Check that protective covers are installed on pitot head, canopy, and intake and exhaust ducts.

INDEX

A

Abnormal starts 38
  Chugs and stalls 38
  Clear engine procedure 38
  False start 38
  Hot start 38
A-c power distribution 15
Automatic direction finding 68
After landing 45
After starting the engine 38
After take-off 42
Ailerons 18
Aileron trim system 18
  Trim runaway 61
Air Conditioning and Pressurization System 63
Air conditioning and pressurization system 63
  Air conditioning 63
  Cockpit fog and snow suppression 63, 113
  Normal operation 65
    After flight 66
    Before take-off 65
    During flight 65
  Emergency operation 66
  De-frosting system 63
  Pressurization 63
    Air conditioning control panel 63
Aircraft systems failure 59
  Electrical system 60
    Main generator 60
    Transformer-rectifier 60
  Flight control systems 17, 60
    Trim switch 61
  Fuel System 59
    Engine-driven fuel pump 59
    Fuel boost pump 59
    Fuel control unit 59
    Transfer pump 59
  Hydraulic system 60
  Landing gear system 61
  Oil system 59
  Speedbrakes 61
Airfield landing 44
Airfield take-off 41
Airspeed indicator 25
Air start 48
Air-start switch 7, 48
All Attitude Flight Reference and Loft Bombing System 94
All Attitude Indicator 25
All-weather operation 109
Altitude Control Panels for External Stores 93
Altimeter 24
Ammunition boxes 91
AN/AJB-3 LABS System 94
AN/APA-89 (SIF) 66
AN/APG-53A Radar Set 94
AN/APX-6B (IFF) 66, 68
AN/ARA-25 (UHF-ADF) 66, 68
AN/ARC-27A (UHF) 66
AN/ARN-12 (marker beacon) 66, 69
AN/ARN-14E (omni-range) 66
AN/ARN-21 (omni-bearing-distance) 66, 68
AN/ASN-19A 71
AN/ASQ-17 66
Angle of Attack-Approach Lights System 75
Angle of Attack-Approach Lights System 76
Antenna locations 67
Anti-blackout system 100
Anti-fogging compound 113
Anti-icing system 66
Approach lights 75
Approach light tail bypass 77
Armament bus 15
Armament Panel 90
Armament operation 89
    Armament safety circuit disabling switch 15, 91
    Function selector switch 89
    Master armament switch 89
    Stations selector switches 89
  Automatic Flight Control System 62
  Autopilot 62
  Bombing equipment 94
    Bomb arming switch 94
    Bomb release switch 94
    Emergency bomb release handle 94
    Emergency selector switch 94
    Jettison 94
    Practice Bomb Container, Aero 5A 94
    Releasing bombs 94
    Salvo release 94
    Single release 94
    Spray tank 94
  Flare dispenser 94
  Gunnery equipment 91
    Firing guns 92
    Gun charging switch 91
    Gun-rocket firing switch 92
  Gunsight 91
    Gunsight elevation control 91
    Gunsight switch 91
  Rocket equipment 92
    Firing rockets 92
    Jettisoning rockets 92
  Spray tank 94
Armament safety disabling switch 15, 91
Armor plate 94
Arresting hook system 24
  Arresting hook control 24
Attitude gyro indicator 25
Automatic dead reckoning (AN/ASN-19 Navigational Computer) set 70
Automatic direction finding equipment 68
  Operation of the AN/ARA-25 68
Automatic flight control system (AFCS) (Autopilot) 62, 81
Autopilot 81
Auxiliary equipment 32, 63

B

Bail-out bottle 78
Barricade strap detents 100
Barometric parachute opener 25
Before entering the aircraft 33
  Check list 33
  Cruise control 33
  Exterior inspection 33
  Weight and balance 33
Before leaving the aircraft 46
Before starting the engine 36
Before take-off 39
  Deceleration check 40
  Preflight aircraft check 39
  Pre-flight engine check 39

Manual fuel control check 40
Primary fuel control check 40
Bombing equipment 94
Bomb arming switch 94
Bomb release switch 94
Emergency bomb release handle 94
Emergency selector switch 94
Releasing bombs 94
Jettison 94
Salvo release 94
Single release 94
Brake system 24

C

C-8 compass system 69
Canopy 27
Canopy bungee safety lock 27
Canopy controls 27
Canopy emergency escape through 54
Canopy jettison handle 27
Canopy jettisoning 27, 55
Carrier landing 44
Carrier take-off 41
Check-off Lists 40
Chusg and stalls 38
Clear engine procedure 38
Climb 42
Cockpit enclosure 27
Canopy 27
Canopy controls 27
Canopy bungee safety lock 27
Exterior canopy jettisoning 28
Interior canopy jettisoning 27, 55
Cockpit under-water pressure equalization valve 28, 55
Cockpit fog and snow suppression 63, 113
Cockpit—Instrument Panel 6
Cockpit—Left Console 4
Cockpit Pressurization Chart 65
Cockpit—Right Console 8
Cold cartridge operation 59, 115
Cold weather operation 114
Communications and associated electronic equipment 66
Automatic direction finding equipment 68
Operation of the AN/ARA-25 68
Master radio switch 66
Marker beacon equipment 69
Omni-bearing distance equipment 68
AN/ARN-21 control panel 68
ARN-21 transfer relay 68
Operation of AN/ARN-21 68
Omni-range radio 69
Omni-range radio control panel 69
Operation of the omni-range radio 69
Radar identification equipment 68
IFF control panel 68
SIF control panel 68
UHF radio 66
Operation of the UHF radio 68
UHF radio control panel 66
Compass controller 69
Compass, standby 73
Compass systems 69
Control Stick Switches 92
Cruise control 33

D

Danger Areas 36
Dead-reckoning set 70
Deceleration check 40
D-c power distribution 15
Armament bus 15
D-c bus 15
De-fogging system 66
Defrosting system 63
Defueling 14
Descent 42
Description of the airplane 1
Desert operation 116
Differences (A4D-2) 1
Dimensions 1
Disconnect (see Hydraulic power disconnect)
Ditching 54
Drop tanks 9
Drop tanks jettisoning 9
Drop tank transfer 9

E

Ejection 56
Ejection procedure 56
Ejection seat 28
Seat attachments 29
Seat controls 29
Pilot-release handle 29
Face curtain 29
Parachute release ring 29
Shoulder harness control 29
Seat switch 29
Ejection Seat 30
Ejection seat cold cartridge operation 50, 115
Ejection Seat Cold Cartridge Performance Graph 58
Electrical fire 53
Electrical power supply system 14
A-c power distribution 15
Emergency a-c power 15
D-c power distribution 15
Armament bus 15
Armament safety disabling switch 15
D-c bus 15
Emergency generator 14
Emergency generator release handle 15
Fuse panels 15
Main generator 14
External power switch 14
Generator field flash switch 14
Electrical System 14
Electrical System 16, 17
Electrical system failure 60
Main generator 60
Transformer-rectifier 60
Electronic Equipment 67
Elevators 18
Emergency a-c power 15
Emergency bomb release handle 94
Emergency entrance 54
Emergency equipment 25
Barometric parachute opener 25
Fire detection system 25
Emergency exit 54
Emergency generator 14
Emergency generator release handle 15
Emergency generator operation chart 17
Emergency landing gear system 24, 61
Emergency release handle 24, 61
Emergency release selector switch 94
Emergency speedbrake control 23, 61
Engine 1
Engine controls 5
Engine control panel 5
Engine performance indicator 5
Throttle 5
Engine fuel control system 1, 103
Flow dividers, 2
Fuel control switch 2
Fuel control unit 1
Fuel primers 2

Fuel pump 1, 59
Manual fuel control system operation 40, 103
Engine-driven fuel pump failure 59
Engine failure 47
Air start 47
Procedure on encountering engine failure 47
Engine fuel control failure 47
Flame-out 47
Engine failure under specific conditions 49
Aborting take-off 49
During flight 50
During take-off 49
During catapult 49
After airborne 49
Landing with no power 50
Maximum glide 50
Engine fire 53
In the air 53
On the ground 53
Engine flame-out landings 50
Engine fuel control failure 47
Engine ground operation 38
Engine oil pressure (see Engine performance indicator) 5
Engine performance indicator (E.P.I.) 5
Engine speed (see Engine performance indicator) 5
Engine, starting 37
Engine, stopping 45
Entering the aircraft 35
Entrance, emergency 54
EPI 5
Exhaust temperature (see E.P.I.) 5
Exterior canopy jettisoning 28, 54
Exterior inspection 33
Exterior Inspection 33
Exterior Lights 74
Exterior lights 73
Approach light operation 75
Exterior lights control panel 75
Master exterior lights switch 75
Operation of the exterior lights 75
Tail hook by-pass switch 77
External power switch 14

F

Face curtain 29, 55
Fail-Safe fuel control positioner 2
False start 38
Fire 53
Electrical fire 53
Engine fire 53
In the air 53
On the ground 53
Fuselage fire 53
Wing fire 53
Fire detection system 25, 53
Firing guns 92
Firing rockets 92
Flame-out 47, 51
Flame-out Landing Pattern Diagram 51
Flaps 19
Flare dispenser 94
Flight characteristics 42, 101
Flight control system 17
Flight control power system 17
Tandem hydraulic system 15
Ailerons control 18
Aileron trim system 18
Elevator control 18
Horizontal stabilizer 18
Manual override switch 18
Rudder control 19
Power boost release 19, 61
Trim position indicator 19
Flight control systems failure 60
Flight restrictions 33
Flow dividers 2
Fog (anti-fogging) compound 113
Fog (cockpit) and snow suppression 63, 113
Fuel/attitude Calibration Chart 13
Fuel boost pressure indicator 5, 10
Fuel boost pump 9, 59
Fuel boost pump failure 59
Fuel control failure 47
Fuel control switch 2
Fuel control console panel 97
Fuel control unit 1, 59
Fuel control unit failure 59
Fuel flowmeter 12
Fuel gaging 10
Fuel primers 2
Fuel pump 1
Fuel Quantity Data 10
Fuel quantity indicating system 10, 12
Fuel System 11
Fuel system 7
Fuel boost pump 9
Fuel boost pressure indicator 10
Manual fuel valve control 10
Fuel tanks 9
Drop tanks 9
Internal tanks 9
Fuel transfer 9
Drop tank transfer 9
Wing tank transfer 9
Fuel quantity indicating system 10
Fuel flowmeter 12
Fuel quantity indicator 12
Test switch 12
Inflight fueling system 97
Dumping fuel 98
Fueling store lights 97
Fueling control panel 97
In-flight fueling store 97
In-flight fueling (receiver system) 99
Jettisoning the fueling store 98
Normal operation (tanker) 97
Pressure fueling and defueling system 12
Pressure fuel and defueling system 12
Defueling 14
Fueling 12
Pressure fueling switch panel 14
Fuel system failure 59
Engine driven fuel pump 59
Fuel boost pump 9, 59
Fuel control unit 59
Transfer pump 9, 59
Fuel tank 9
Fuel transfer 9, 59
Fuel transfer pump failure 59
Fueling, wing and fuselage tanks 12
Function selector switch (armament) 89
Fuselage fire 53
Fuse panels 15

G

General Arrangement 3
Generator, emergency 14
Generator field flash switch 14
Generator, main 14
Ground-controlled approach 110
Typical GCA Approach 112
Ground tests 38
Gunnery equipment 91
Firing guns 92
Gun charging switch 91
Gun-rocket firing switch 92

Gunsight 91
Gunsight elevation control 91
Gunsight switch 91
Gunsight and Armament Panel 90
Gyro horizon attitude indicator 25
Gyrosyn (C-8) compass system 69

H

Horizontal stabilizer 18, 39, 42
Manual override switch 18
Hose Jettisoning 97
Hot start 38
Hot weather and desert operation 116
Hydraulic power disconnect 104
(See also 19, 50, 60)
Hydraulic power supply system 15, 103
Tandem hydraulic system 15, 103
Hydraulic System 15, 17, 20, 21, 22
Hydraulic system failure 60

I

Ice, snow and rain 110
ID-250/ARN course indicator 68, 69
ID-732/ASN bearing, distance track indicator 71
IFF control panel 68
Ignition 7
Inflight Fueling Store 88
In-flight fueling system 97
Control panel (tanker) 97
Emergency operation (tanker) 98
Drogue and coupling lost and/or hose broken off 99
Hydraulic failure precluding drogue retraction 99
Carrier landings 99
Field landings 99
Fueling store lights 97
Normal operation (tanker) 97
Before landing 98
Drop tank transfer in in-flight fueling 98
Drogue retract 98
Dumping fuel 98
Jettisoning the refueling store 98
Receiver hook-up and refueling 98
Stopping fuel transfer 98
Transfer from store to wing 98
Receiver aircraft, in-flight fueling 99
Normal operation 99
Pilot technique 99
Inspection, exterior 33
Inspection, interior 35
Instrument flight procedures 109
Instruments 24
Airspeed indicator 25
Altimeter 24
All Attitude indicator 25
Instrument take-off 109
Integrated Flight Suit 26
Interior canopy jettisoning 27
Interior inspection 35
Interior lights 73
Interior lights control panel 73
Internal tanks 9

J

Jet penetrations 110
Suggested Jet Penetration 111
Jettisoning fueling store 98
Jettisoning rockets 92

L

LABS (Refer to All Attitude Flight Reference and Loft Bombing System)
Landing 44
Airfield 44
Carrier 44
Cross-wind 44
Minimum run 44
Landing emergencies (except ditching) 53
Landing gear system 23, 61
Landing gear control 23
Emergency landing gear system 24
Wheel and flaps position indicator 23
Landing gear system failure 61
Landing Pattern Diagram 43
Landing with no power 50
Landing with throttle linkage broken 54
Lighting equipment 73
Exterior lights 73
Exterior lights control panel 75
Master exterior lights switch 75
Operation of the exterior lights 75
Approach light operation 75
Tail-hook by-pass switch 77
Interior lights 73
Interior lights control panel 73
Loft bombing 94

M

Main generator 14
Manual fuel control check 40
Manual fuel control system operation 2, 103
Ground check 40
In-flight switch-over 103
Manual fuel valve control 10
Manual fuel warning light 2
Manual override switch 18
Map case 100
Marker beacon equipment 69
AN/ARN-12 66
Marker beacon control panel 69
Master armament switch 89
Maximum glide 50
Maximum Glide 48
Minimum run, landing 44
Minimum run, take-off 41
Mirrors, rear view 100
Miscellaneous equipment 100
Anti-blackout system 100
Barricade strap detent 100
Pilots relief container 100
Spare lamps receptacle 100
Mooring 46
Mooring 45

N

Navigational Computer Set 73
Navigational computer set 71
Automatic dead reckoning 71
Dead reckoning set controls 71
Function switch 71
Longitude and latitude input 71
Variation input 72
Wind input 72
Operation of the dead reckoning set 70
C-8 Compass system 69
Compass controller 69
Free gyro operation 71
Slaved operation 71
Standby compass 73
NAVPAC 66, 74
Nesa glass (de-fogging) 63, 113
Night flights, interior inspection 109
Night flying 109
Normal procedures (Section II) 33

O

Oil pressure gage 5, 59
Oil pressure indicator (E.P.I.) 5, 7, 59
Oil system 7, 59
Omni bearing-distance equipment 68
  ARN-21 control panel 68
  ARN-21 transfer relay 68
  Operation of AN/ARN-21 68
Omni-range radio 69
  Omni-range radio control panel 69
  Operation of the omni-range radio 69
On entering the aircraft 35
  Interior inspection 35
  Interior inspection (night flights) 73
Operating limitations 101
Oxygen Duration 79, 80
Oxygen system 77
  Bail-out bottle 78
  Controls and equipment 78
  Liquid supply system 77
  Normal operation 78
  After flight 80
  Before flight 78
  During flight 79
  Oxygen duration 79, 80

P

Parachute (barometric) opener 25
Parachute release ring 29
Pilot's relief container 100
Pitot heat 66
Power boost release 19, 60, 104
Pre-flight aircraft check 39
Pre-flight engine check 39
Pre-traffic pattern check list 42
Pressure fueling and de-fueling 12, 14
Pressurization 63
Primary fuel control check 40
Procedure on encountering engine failure 47

R

Radar identification equipment 68
  IFF control panel 68
  SIF control panel 68
Radio, UHF, voice 66, 68
Radio, VOR, omni-range 69
Rain, ice and snow 110
Rain repellant 113
Rear view mirror 100
Releasing bombs 94
  Jettison 94
  Salvo release 94
  Single release 94
Relief container 100
Rocket catapult ground level escape system 31
Rocket equipment 92
  Firing rockets 92
  Jettisoning rockets 92
RPM indicator (E.P.I.) 5
Rudder 19
  Trim runaway 61

S

Seat attachments 29
Seat Controls 29
Servicing Diagram 31
Shoulder harness control 29
SIF, coder, control panel 68
Simulated flameout landings 52
Slats 19
Smoke elimination 53
Snow (cockpit) suppression 63, 113
Snow, ice and rain 110
Spare lamps receptacle 100
Speedbrakes 23
  Emergency speedbrake control 23, 61
Spray tank 94
Standby compass 73
Starter 5
  Start-abort switch 7
Starting the engine 37
  Abnormal starts 38
  Chugs and stalls 38
  Clear engine procedure 38
  False start 38
  Hot start 38
Suitable starter units 37
Stations selector switches 89
Stopping the engine 45
Systems failure 59
Systems operation 42, 103

T

Tacan 68
Table of Electronic Equipment 67
Tail hook by-pass switch 77
Take-off 41
  Airfield 41
  Carrier 41
  Minimum run 41
Tandem hydraulic power system 15
Tanker operation 94
Tanker operation 95, 96
Taxiing instructions 39
Temperature indicator (E.P.I.) 5
Test switch 12, 77
The airplane 1
  Dimensions 1
Throttle 5
Throttle linkage failure 47
Thunderstorms, flight in 114
Tie down (mooring) 45, 46
Traffic pattern check list 42
Transformer rectifier 14, 60
Trim position indicator 19
Trim switch 18, 61
Turbulence, flight in 114

U

UHF radio 66
  Operation of the UHF radio 68
  UHF radio control panel 66
Underwater escape 55

V

VOR 66, 109
Vortex generators 23

W

Warn-Test switch 12, 77
Wave-off 45
Weight and balance 33
Wheels and flaps position indicator 23
Wing fire 53
Wing flaps 19
Wing slats 19
Wing tank transfer 9

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