FLIGHT MANUAL

USAF SERIES B/RB-58A AIRCRAFT

THIS CHANGE INCORPORATES SAFETY OF FLIGHT SUPPLEMENTS -1F, -1G, -1H, AND -1J. SEE WEEKLY SUPPLEMENTAL INDEX T.O. 0-1-1A FOR CURRENT STATUS OF SAFETY OF FLIGHT SUPPLEMENTS.

This publication is incomplete without Confidential Supplements T.O. 1B-58A-1A and T.O. 1B-58A-1B.

Commanders are responsible for bringing this publication to the attention of all Air Force personnel cleared for operation of subject aircraft.

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SAFETY OF FLIGHT SUPPLEMENT

SUMMARY

NOTE: This is a test page being included for your use and comments. If found desirable, it will become a standard item to be included in all USAF Flight Manuals.

Safety of Flight Supplements are numbered with suffix letters after the -1. They start with -1C because the letters A and B are reserved for use with classified Supplements to the basic Flight Manual. The letters A, B, O and I will never appear in the numbering sequence. The Supplements you receive should follow in sequence and if you find you are missing one, check the Safety of Flight Supplement index (T.O. 0-1-1A) to see if it was issued and if it is still in effect. It may have been replaced or rescinded before you received your copy. If it is still active, see your Publication Distribution Officer and get your copy. An example of the numbering sequence is as follows:

-1C, -1D, — -1F, -1G, -1H, -1J — -1Z, -1CC, -1CD, — -1CN, -1CP — -1CZ, -1DC, -1DD etc.

It should be noted that a Supplement number will never be used more than once.

SAFETY OF FLIGHT SUPPLEMENTS INCORPORATED IN THIS (CHANGE OR REVISION) OF FLIGHT MANUAL

T.O. 1B-58A-1F, -1G, -1H, and -1J.

SAFETY OF FLIGHT SUPPLEMENTS OUTSTANDING

(This portion to be filled in by you when you receive your Flight Manual and to be added to as you receive additional Supplements. Refer to the Safety of Flight Supplement index (T.O. 0-1-1A) for latest information if any questions arise.)

Number	*Date*	*Short Title*	*Disposition*

TABLE OF CONTENTS

HOW!

......to get the most out of this manual

SCOPE.

This manual contains all the information necessary for safe and efficient operation of the B/RB-58A. The instructions do not attempt the teaching of basic flight principles, but are designed to provide you with a general knowledge of the airplane, its flight characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and elementary instructions have been avoided.

SOUND JUDGMENT.

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

PERMISSIBLE OPERATIONS.

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

STANDARDIZATION.

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

ARRANGEMENT.

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

YOUR RESPONSIBILITY.

These Flight Manuals are constantly maintained current through an extremely active revision program. Frequent conferences with operating personnel and constant review of UR's, accident reports, flight test reports, etc., assure inclusion of the latest data in these manuals. In this regard, it is essential that you do your part! If you find anything you don't like about the manual, let us know right away. We cannot correct an error whose existence is unknown to us.

PERSONAL COPIES, TABS AND BINDERS.

In accordance with the provisions of AFR 5-13, flight crew members are entitled to have personal copies of the Flight Manuals. Flexible, loose leaf tabs and binders have been provided to hold your personal copy of the Flight Manual. These good-looking, simulated-leather binders will make it much easier for you to revise your manual as well as to keep it in good shape. These tabs and binders are secured through your local materiel staff and contracting officers.

HOW TO GET COPIES.

If you want to be sure of getting your manuals on time, order them before you need them. Early ordering will assure that enough copies are printed to cover your requirements. Technical Order 00-5-2 explains how to order Flight Manuals, classified supplements thereto, and Safety of Flight Supplements so that you automatically will get all original issues, changes and revisions. Basically, all you have to do is order the required quantities in the Publication Requirements Table (T.O. 0-3-1). Talk to your Senior Materiel Staff Officer—it is his job to fulfill your Technical Order requests. Make sure to establish some system that will rapidly get the manuals and Safety of Flight Supplements to the flight crews once they are received on the base.

SAFETY OF FLIGHT SUPPLEMENTS.

Safety of Flight Supplements are used to get information to you in a hurry. Safety of Flight Supplements use the same number as your Flight Manual, except for the addition of a suffix letter. Supplements covering loss of life will get to you in 48 hours; those concerning serious damage to equipment will make it in 10 days. You can determine the status of Safety of Flight Supplements by referring to the Index of Technical Publications (T.O. 0-1-1) and the Weekly Supplemental Index (T.O. 0-1-1A). This is the only way you can determine whether a supplement has been rescinded. The title page of the Flight Manual and title block of each Safety of Flight Supplement should also be checked to determine the effect that these publications may have on existing Safety of Flight Supplements. It is critically important that you remain constantly aware of the status of all supplements—you must comply with all existing supplements but there is no point in restricting the operation of your aircraft by complying with a supplement that has been replaced or rescinded. Technical Order 0-5-1 covers some additional information regarding these supplements.

WARNINGS, CAUTIONS, AND NOTES.

For your information, the following definitions apply to the "Warnings," "Cautions," and "Notes" found throughout the manual:

WARNING

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

CAUTION

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

Note

An operating procedure, condition, etc., which is essential to emphasize.

COMMENTS AND QUESTIONS.

Comments and questions regarding any phase of the Flight Manual program are invited and should be forwarded through your Command Headquarters to Commander, Detachment #1, Air Research and Development Command, Wright-Patterson Air Force Base, Ohio, ATTN: RDZSPH.

AIRPLANE DESIGNATION CODES.

Major differences between airplanes covered in this Manual are designated by number symbols which appear on illustrations and within the text. Symbol designations for individual aircraft, and groups of aircraft are as follows:

31	59-2428	36	59-2433
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33	59-2430	38	59-2435
34	59-2431	➧	"through" or "and on"
35	59-2432		

the B/RB-58A airplane

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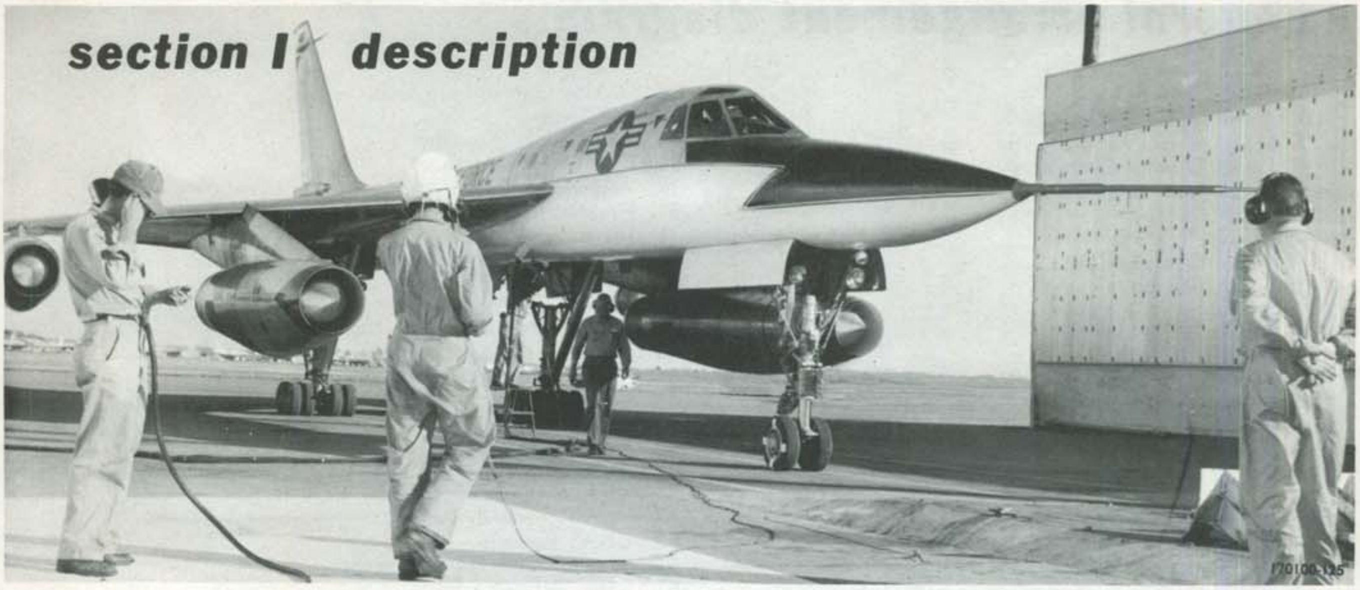
section I description



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THE AIRPLANE.

The B/RB-58A is a high-altitude, supersonic bomber manufactured by Convair, A Division of General Dynamics Corporation, Fort Worth, Texas. The airplane is designed to carry an externally attached weapon. The tactical mission is the destruction of surface objectives by bombs.

AIRPLANE DIMENSIONS.

- Length (overall) — 96 feet 9 inches
- Height (to top of fin) — 29 feet 11 inches
- Wing Span — 56 feet 10 inches
- Wing Area — 1542 square feet
- Tread — 13 feet 4 inches
- Wing Leading Edge Sweepback — 60 degrees

Refer to Section II for turning radius and ground clearances.

GROSS WEIGHT.

- Weight Empty (approximately) 52,500 pounds.
- For the maximum taxi and takeoff gross weight and the maximum inflight gross weight, refer to "Weight Limitations," Section V.

FLIGHT CREW.

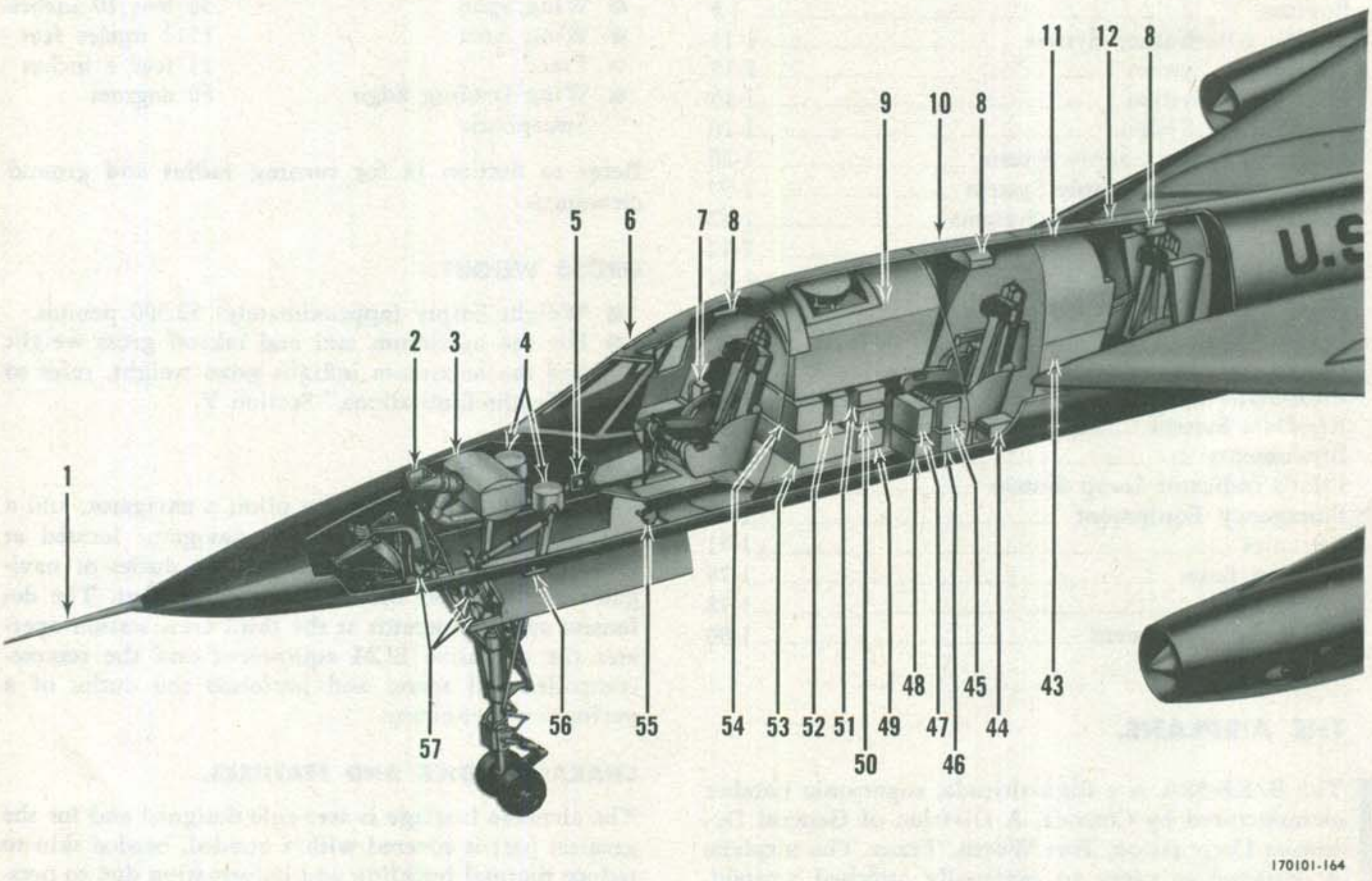
The flight crew consists of a pilot, a navigator, and a defensive system operator. The navigator located at the second crew station performs the duties of navigator and operates the bombing equipment. The defensive system operator at the third crew station operates the defensive ECM equipment and the remote-controlled tail turret and performs the duties of a performance engineer.

CHARACTERISTICS AND FEATURES.

The airplane fuselage is area-rule designed and for the greatest part is covered with a bonded, beaded skin to reduce thermal buckling and deformation due to pressurization. The wing is a full cantilever, midwing, modified delta design with a cambered leading edge

general arrangement diagram

1. Nose Boom
2. Air Refueling Receptacle
3. Search Radar RT Modulator Unit
4. Liquid Oxygen Containers
5. Single-Point Refueling Adapter
6. Pilot's Canopy
7. CG Calibrator
8. Liquid Container (3)
9. Navigation Unit
10. Navigator's Canopy
11. DECM Equipment
12. DSO's Canopy
13. Primary Navigation Stabilization Computer
14. Primary Navigation Stabilization Unit
15. Astrotracker Amplifier Unit
16. Primary Navigation Computer Amplifier
17. Astrotracker Unit
18. Primary Navigation Stabilization Amplifier Unit
19. Primary Navigation Auxiliary Reference Unit
20. Engine Starter Cart Receptacle
21. Ground Air Conditioning Receptacle
22. External Power and Ground Interphone Receptacles
23. Power Control Linkage Assembly
24. Radio Altimeter RT Amplifier Unit
25. Doppler Electronics Unit
26. Fuel Dump Probe Assembly
27. Air-to-Air Transponder
28. Remote Compass Transmitter
29. Fire Control System Frequency Control
30. Fire Control RF and Modulator Package
31. Fire Control System Controlled Line Platform
32. 20-MM Gatling-Type Gun
33. Tail Turret
34. Gun Feeder Assembly
35. Gun Control Package
36. Ammunition Box
37. Fire Control System Tracking Control Package
38. Drag Chute
39. Fire Control Computer Package
40. IBDA Camera Package
41. Nacelle Cooling and Fire Access Door (Inboard and Outboard Side of Each Nacelle)
42. Hydraulic Oil Cooler Door
43. Multiple Voltage Power Supply Unit
44. Battery
45. Inflight Printer
46. Printer Control Unit
47. IBDA Data Package
48. Air-to-Ground IFF Decoder Unit
49. UHF Command Radio
50. CNAS Package
51. Search Radar Photo Recorder
52. Radio Altimeter Unit
53. Autopilot Amplifier-Computer Assembly
54. Air Data Computer
55. Nose Wheel Well Canopy Control Valve
56. Temperature Probe
57. Landing and Taxi Lights
58. PI Beacon Receiver-Transmitter
59. RV Beacon Receiver-Transmitter



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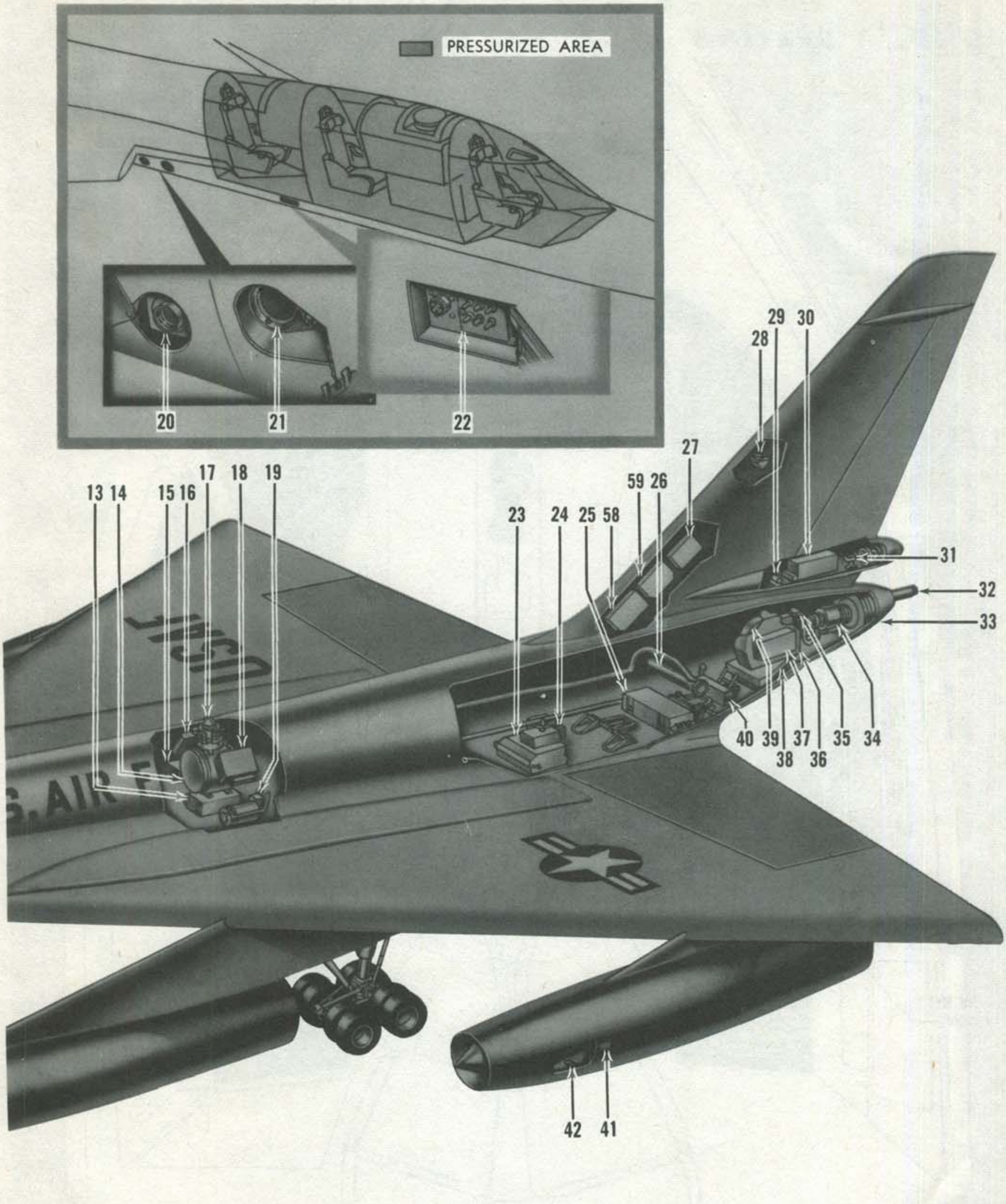

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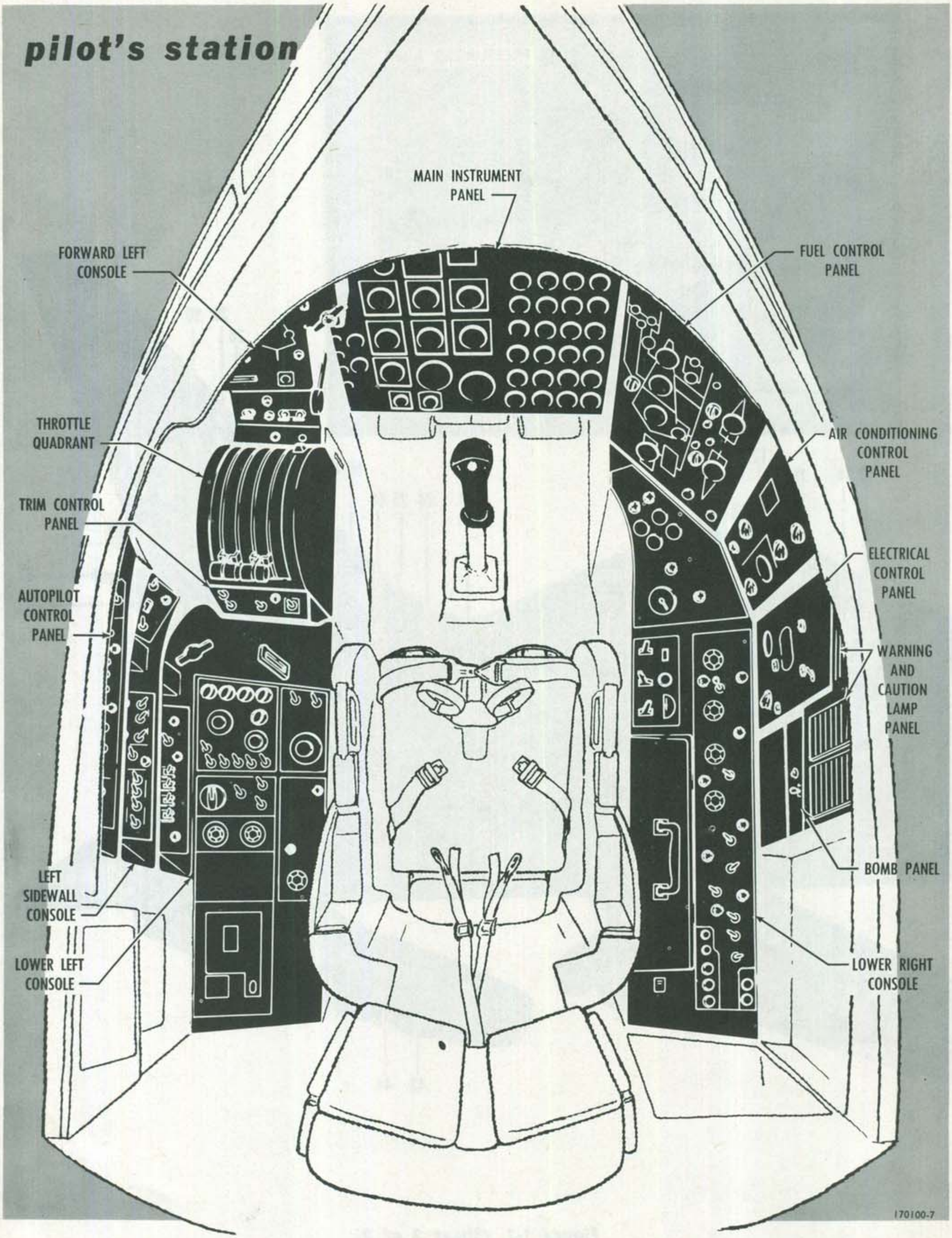
pilot's station
MAIN INSTRUMENT PANEL
FORWARD LEFT CONSOLE
FUEL CONTROL PANEL
THROTTLE QUADRANT
AIR CONDITIONING CONTROL PANEL
TRIM CONTROL PANEL
ELECTRICAL CONTROL PANEL
AUTOPILOT CONTROL PANEL
WARNING AND CAUTION LAMP PANEL
BOMB PANEL
LEFT SIDEWALL CONSOLE
LOWER LEFT CONSOLE
LOWER RIGHT CONSOLE
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Figure 1-2.

and a bonded honeycomb skin. The three-man crew sits in tandem in separate compartments. Entrance to their positions is made through individual power-actuated canopies. An air conditioning system maintains proper temperature, ventilation, and pressurization at all speeds and altitudes for crew compartments and temperature-limited equipment. The crew is also provided with a liquid oxygen system. Electrical power for the airplane is supplied through a two-bus a-c distribution system by three a-c generators which are driven by engines 1, 2, and 3 through constant-speed drive units. A portion of the a-c power is rectified to provide multiple voltages for d-c operated equipment; a 28-volt battery provides a limited source of d-c power for operation during extreme emergencies. The tricycle landing gear, brakes, nose wheel steering, tail turret, autopilot servos, search radar, and flight control system are actuated by a dual hydraulic system. The flight control surfaces consist of two elevons and a rudder. The airplane is not equipped with flaps. The flight control system has provisions for automatic flight control throughout the flight mission (except takeoff and landing). A pneumatic system provides for emergency operation of the landing gear and brakes. Normal actuation of the canopies and the deployment of the drag chute are accomplished by separate pneumatic systems. Offensive armament consists of bombing equipment. Defensive armament consists of defensive ECM equipment and a remote-controlled tail turret equipped with a multi-barrel 20-mm cannon.

ENGINES.

Power is developed for the airplane by four General Electric J79-5 engines. The approximate thrust rating of each engine at standard sea level static conditions is 15,600 pounds with maximum afterburner and 10,000 pounds at Military power. The engines are mounted in individual nacelles suspended beneath the wing and are numbered from left to right with the left outboard engine being No. 1. Each nacelle is equipped with a variable positioning spike which is used to maintain an efficient airflow to the engine throughout the speed range of the airplane. For further information on the spike refer to "Inlet Spike System" of this section. The engine is an axial-flow, reheat, turbojet engine consisting of a 17-stage compressor, 10 can-type combustion chambers, a three-stage turbine, an afterburner, and a variable exhaust nozzle. The amount of air entering the compressor is automatically controlled by variable positioning inlet guide vanes which act as an inlet air metering device. The first six stages of the compressor are equipped with variable positioning stator vanes which are positioned so that at a particular engine speed and compressor inlet temperature the inlet air strikes the vanes at the most effective angle of attack. The inlet guide vanes and variable stator vanes are connected externally and rotate in unison to control compressor pressure ratio and maintain an adequate stall margin under all operating conditions. The compressor and turbine, which are splined together, are supported by three bearings and rotate as a single unit; the moment of inertia of this assembly is extremely low, permitting rapid engine acceleration. The exhaust nozzle functions as a variable restriction through which gases leaving the engine are accelerated to convert as much as possible of their pressure and temperature to velocity for thrust. Each engine is provided with a fuel control system, a main ignition system, and a starter system. Engine lubricating oil is provided by the oil supply system. Frontal areas of the engines are anti-iced by air from the anti-icing system. (Refer to "Anti-Icing and Defogging Systems," Section IV.) Engines 2 and 3 drive the compressors for the airplane air conditioning system and engines 1, 2, and 3 drive the electrical system a-c generators.

ENGINE FUEL CONTROL SYSTEM.

The engine fuel control system consists of two separate systems—one for engine fuel control and one for afterburner fuel control. For information on the afterburner fuel control system, refer to "Engine Afterburner System" of this section. The primary function of the engine fuel control system (figure 1-3) is regulating engine speed by supplying and controlling fuel flow. The system also positions the inlet guide and variable stator vanes of the compressor section and initiates afterburner operation. Principal components of the system include a fuel strainer; a two-element, engine-driven fuel pump; a fuel control unit; and a pressurizing and drain valve. Fuel flow is primarily controlled by the movement of the throttles. Movement of a throttle out of the OFF position opens the cutoff valve in the fuel control unit. Fuel is then supplied from the airplane fuel system through the strainer to the engine-driven fuel pump, which delivers the fuel under pressure to the main fuel control unit. The basic control elements of this unit consist of an inlet guide and stator vane control unit, a bypass valve, an afterburner signal valve, and a metering valve. The inlet guide and stator vane control unit ports high pressure fuel to the inlet guide and stator vane actuators which position the vanes in proportion to engine speed and compressor inlet temperature. The bypass valve maintains a constant pressure to the metering valve by bypassing excess fuel back to the fuel pump inlet and controls actuating fuel pressure to open the afterburner ignition switch. The afterburner signal valve controls actuating fuel pressure to open the afterburner on-off valve. The metering valve automatically meters the optimum fuel flow for the particular flight condition (accelerating, decelerating, high altitude operation, etc.) in response to control signals received in terms of throttle position, engine speed, inlet air temperature, engine acceleration, and compressor discharge pressure. From the control unit the metered fuel flows first through an oil cooler, where it is used as the cooling medium, and then to the pressurizing and drain valve. This valve maintains pressure in the fuel control unit outlet line.

engine fuel control and variable exhaust nozzle system.. j79-5 engine

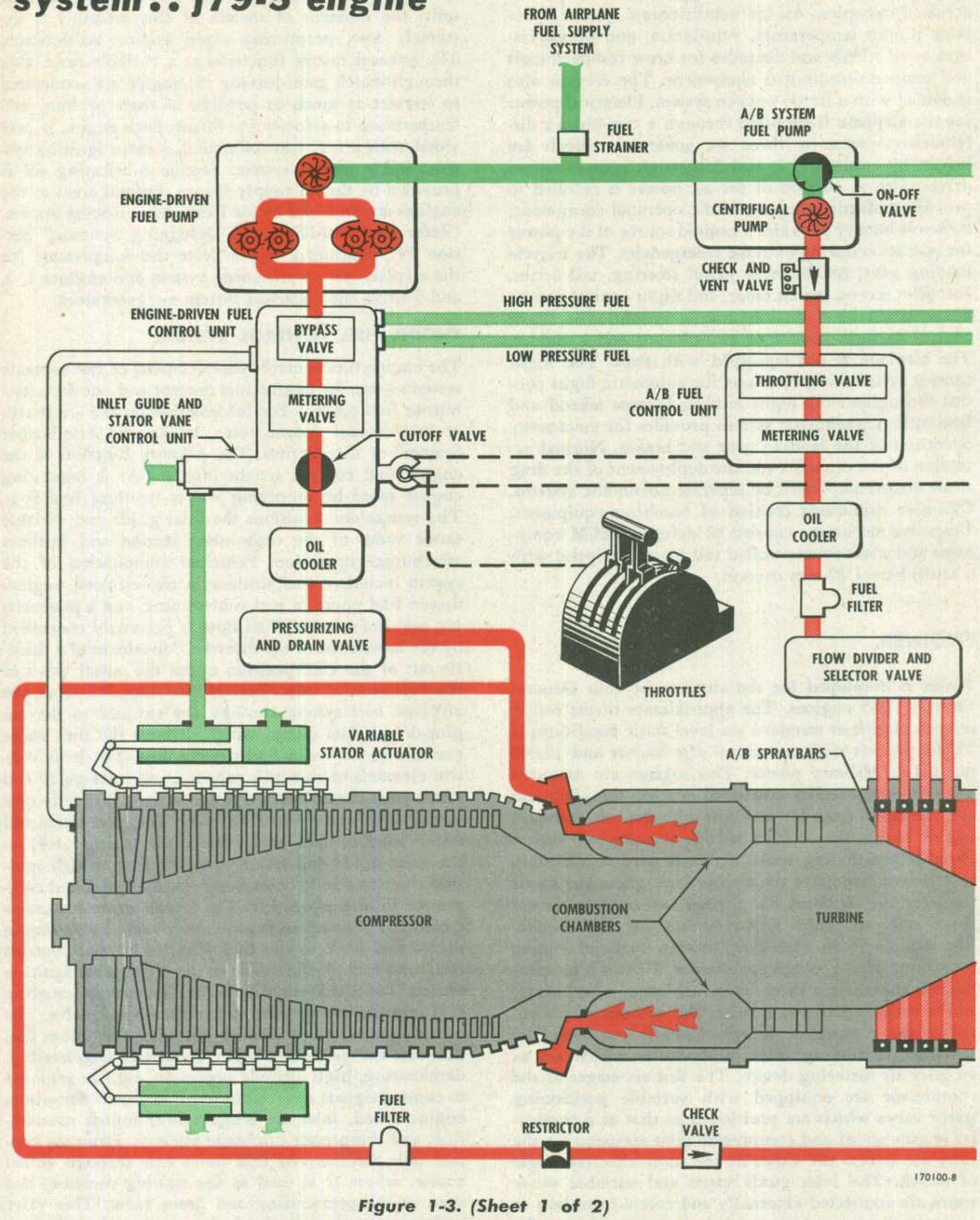

Figure 1-3. (Sheet 1 of 2)

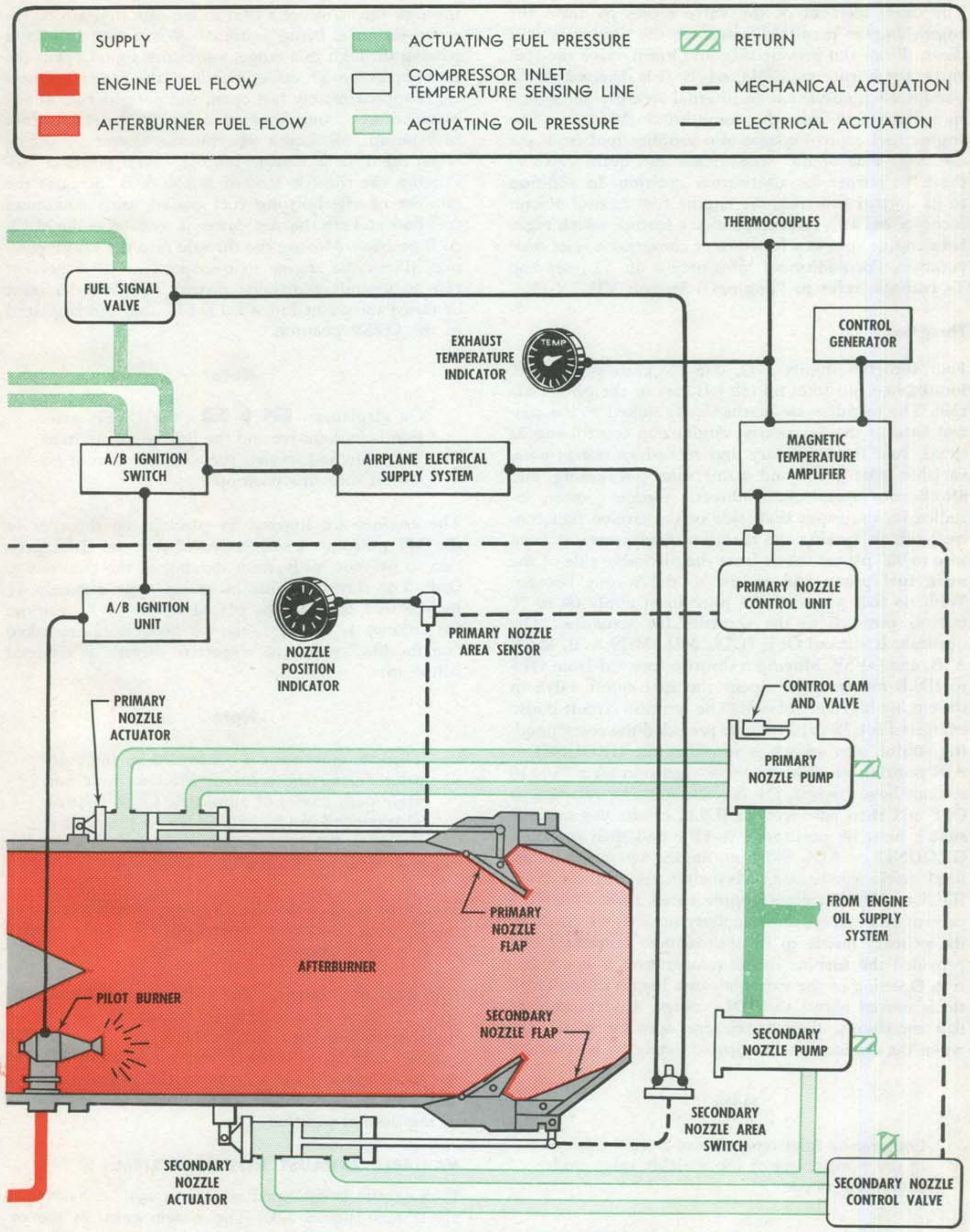

Figure 1-3. (Sheet 2 of 2)

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The drain element of the valve serves to drain the engine burner manifold whenever the engine is shut down. From the pressurizing and drain valve the fuel enters the burner manifold, where it is directed to the nozzles. Each nozzle has an internal flow divider which sprays the fuel into the combustion chambers. The engine fuel control system also supplies fuel from the discharge side of the pressurizing and drain valve to the pilot burner for afterburner ignition. In addition to its normal function, the engine fuel control system incorporates a T_2 reset and cutback feature which regulates engine rpm as a function of compressor inlet temperature. For additional information on T_2 reset and T_2 cutback, refer to "Engines", Section VII.

Throttles.

Four throttles (figure 1-4), one for each engine, are located in a quadrant on the left side of the pilot's station. The throttles are mechanically linked to the control units of their respective engine and control engine speed, fuel flow, primary and secondary nozzle area, variable inlet guide and stator vane positioning, and afterburner operation. A throttle torque booster, installed on the input shaft side of the engine fuel control, aids in moving the throttles. Fuel pressures from zero to 900 psi are taken from the discharge side of the main fuel pump and routed to the torque booster. With no fuel pressure, the pilot must apply 60 to 70 pounds pressure to the throttles for actuation. The quadrant is marked OFF, IDLE, MIL, MIN A/B, MAX A/B, and OVSP. Moving a throttle forward from OFF to IDLE mechanically opens the fuel cutoff valve in the engine fuel control unit. The ignition circuit is also energized for 75 $\pm$10 seconds provided the corresponding engine start switch is in either the GROUND or AIR position. In order to restore ignition after 75 $\pm$10 seconds have elapsed, the throttle must be retarded to OFF and then advanced to IDLE, or the engine start switch must be positioned to OFF and then to either GROUND or AIR. With an engine operating at sea level static conditions, advancing its throttle from IDLE to MIL increases engine speed from 67 to 100 percent rpm, closes the secondary nozzle and positions the primary nozzle to its approximate minimum area provided the turbine outlet temperature is not excessive. Opening of the variable vanes begins as the throttle is moved above the IDLE range. Under standard day conditions, their maximum opening is reached when the engine rpm is approximately 90 percent.

Note

Compressor inlet temperature is also a factor in the positioning of the variable inlet guide and stator vanes.

As the throttle is moved from the MIL position through the afterburner transition range, it is raised through the action of a cam to indicate that afterburner operation is being initiated. When the throttle is passing through this range, a pressure signal opens the afterburner on-off valve, provided the secondary nozzle is approximately full open, and permits fuel at airplane booster pump pressure to flow to the afterburner fuel pump. Minimum afterburner operation occurs when the throttle reaches the MIN A/B position. Advancing the throttle toward MAX A/B increases the number of afterburning fuel outlets until maximum fuel flow and afterburner power is reached at the MAX A/B position. Moving the throttle into the OVSP position allows the engine to overspeed to 103.6 percent rpm to provide additional thrust. The throttles must be raised and pushed forward before they can be placed in the OVSP position.

Note

On airplanes 31 ➧ 37 the OVSP position is inoperative and the linkage is mechanically blocked so that the throttles cannot be moved into this position.

The engines are stopped by placing the throttles in the OFF position. A stop is provided at the IDLE position to prevent inadvertent moving of the throttles to OFF. The throttles must be raised approximately ½ inch before they can be placed in the OFF position. On engines 1, 2, and 3, the a-c generators are taken "off the line" when the respective throttle is retarded below idle.

Note

Throttle movement is controlled by the autopilot during the constant Mach-altitude and glide path modes of automatic flight control. This control can be overridden by the pilot if required. For information on automatic control, refer to "Autopilot," Section IV.

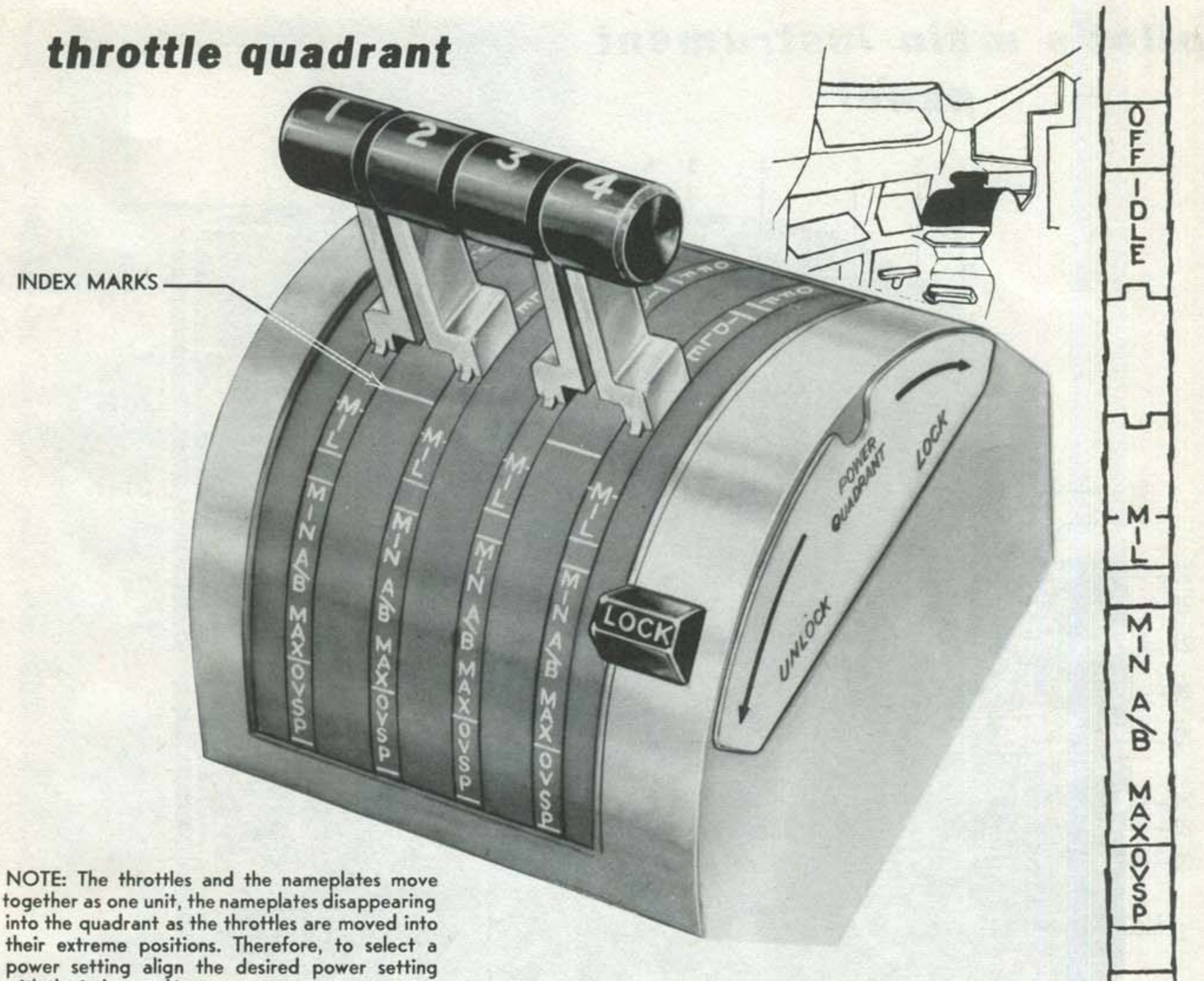
The throttle schedules the secondary nozzle open during idle and afterburner operation and close for operation in the cruise and military range.

Throttle Lock Lever. The throttles are prevented from creeping by a lock lever (figure 1-4) located on the throttle quadrant. When the lever is in the UNLOCK position, the throttles are free to move. Moving the lever forward toward the LOCK position applies an increasing amount of friction to hold the throttles in the desired position.

VARIABLE EXHAUST NOZZLE SYSTEM.

Each engine is equipped with a variable exhaust nozzle system (figure 1-3). The system controls the exhaust area to provide optimum thrust and specific fuel consumption for varying engine operating conditions.

throttle quadrant



NOTE: The throttles and the nameplates move together as one unit, the nameplates disappearing into the quadrant as the throttles are moved into their extreme positions. Therefore, to select a power setting align the desired power setting with the index markings.

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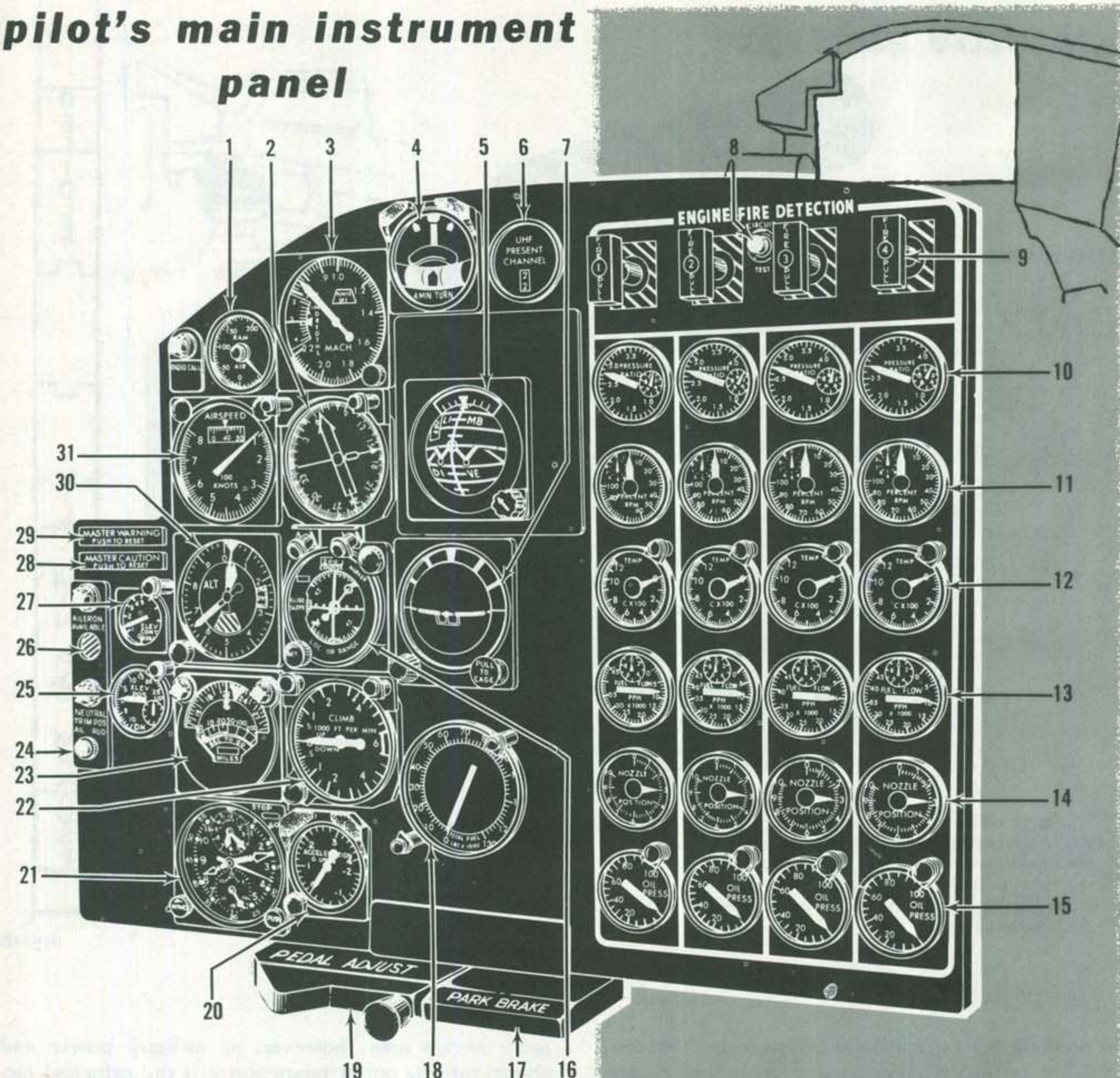
Figure 1-4.

It also protects the engine from overheating. The system consists mainly of primary and secondary nozzle flaps, a primary nozzle control unit, primary and secondary nozzle pumps and actuators, thermocouples, a magnetic temperature amplifier, a control a-c generator, and a secondary nozzle control valve. The primary and secondary nozzle pumps, using oil from the oil supply system, supply hydraulic pressure for nozzle actuation. Each primary nozzle control unit and respective engine throttle is mechanically interconnected and synchronized so that throttle movement will automatically result in proper actuation of the primary nozzle. However, an electrical control is superimposed upon the mechanical linkage to prevent engine overheating. The magnetic temperature amplifier, acting through the primary nozzle control unit, automatically increases the nozzle area as necessary, regardless of throttle setting, to prevent turbine outlet overtemperature. Normally, at powers below military, the turbine outlet temperature has little effect on the primary nozzle area; however, at military power and above, turbine outlet temperature is the principal factor in determining the area. In the afterburner range, primary nozzle area is used to set power; however, fuel flow should also be monitored. An engine driven a-c generator, independent of the airplane electrical power supply system, supplies a-c power to the magnetic temperature amplifier. The secondary nozzle flaps are used to provide maximum thrust and reduce drag during the cruise and military operating ranges. They are opened during idle and afterburner engine operation, and are closed for operation in the cruise and military ranges. This is accomplished automatically by throttle movement. A secondary nozzle area switch in each nozzle system prevents afterburner operation until the secondary nozzle flaps are approximately full open.

Nozzle Position Indicators.

Four nozzle position indicators (14, figure 1-5) are located on the right side of the pilot's main instrument

pilot's main instrument panel



1. Ram Air Temperature Indicator
2. Radio Magnetic Indicator
3. Machmeter
4. Turn-and-Slip Indicator
5. MM-3 Attitude Indicator
6. UHF Channel Indicator
7. J-8 Attitude Indicator
8. Fire Detector Circuit Test Button
9. Engine Fire Pull Switches (4)
10. Pressure Ratio Indicators (4)
11. Tachometers (4)
12. Exhaust Temperature Indicators (4)
13. Fuel Flow Indicators (4)
14. Nozzle Position Indicators (4)
15. Oil Pressure Indicators (4)
16. Course Indicator
17. Parking Brake Control Handle
18. Fuel Quantity Totalizer Indicator
19. Rudder Pedal Adjustment Crank
20. Accelerometer
21. Clock
22. Vertical Velocity Indicator
23. Pilot's Data Indicator
24. Aileron-Rudder Neutral Trim Indicator Lamp
25. Elevator Position Indicator
26. Aileron Control Available Indicator
27. Elevator Control Available Indicator
28. Master Caution Lamp
29. Master Warning Lamp
30. Altimeter
31. Airspeed Indicator

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Figure 1-5.

panel. These instruments indicate the primary nozzle position in percent of travel of a teleflex cable which is used to transmit a feedback signal from the nozzle actuating pistons to a synchro transmitter. The nozzle position indicator is actuated by electrical signals from the synchro transmitter. The transmitter measures nozzle position over a range from 39 to 100 percent open only, since the nozzle is 39 percent open at its maximum closed position. The indicator dial is marked in ten equal major graduations from zero to 10. The nozzle position indicators are used to set power when operating with afterburner. The indicators operate on 115-volt a-c power.

VARIABLE INLET GUIDE AND STATOR VANE SYSTEM.

The inlet guide vanes and the stator vanes of the compressor's first six stages are variable positioning to provide optimum engine performance throughout the engine speed range. The inlet guide vanes act as an inlet air metering device which controls the amount of air entering the compressor. The variable stator vanes are positioned so that at a particular engine speed and compressor inlet temperature the inlet air strikes the vanes at the most efficient angle of attack. At low engine speeds, the variable positioning of the stator vanes prevents the inlet stages of the compressor from stalling. The inlet guide vanes and the stator vanes are mechanically linked together and operate in unison. The vanes are in the closed position during start and idle. At standard day conditions, they begin to open at approximately 65 percent rpm, and continue to open until they are at the maximum open position at approximately 90 percent rpm. These opening and closing points change as the compressor inlet temperature varies from standard conditions. The vanes are automatically modulated by the engine fuel control unit as a function of engine speed and compressor inlet temperature. In response to these factors, the inlet guide and stator vane control unit directs high pressure fuel to the actuators which drive the vanes to their scheduled position. The high pressure fuel is supplied to the inlet guide and stator vane control unit by the engine fuel control unit.

MAIN IGNITION SYSTEM.

Each engine is equipped with two separate ignition systems—one main and one afterburner. (For information on afterburner ignition, refer to "Engine Afterburner System" of this section.) The main ignition system is a single-type, low-tension, capacitor discharge system. It consists of an ignition-relay, an ignition unit, a spark plug, a time delay relay, and an ignition switch actuated by the throttle. Power for ignition is obtained from the 28-volt d-c essential ring bus. Moving a throttle to the IDLE position completes a 28-volt d-c circuit from the ignition switch to the ignition relay, provided the corresponding engine start switch is actuated. The ignition relay supplies 28-volt direct current from the essential d-c bus to the ignition unit. This unit delivers high-voltage direct current to the spark plug in the No. 4 combustion chamber. The time delay relay, located in the circuit between the ignition switch and the ignition relay, automatically de-energizes the ignition relay after 75 ±10 seconds of continuous operation. This feature prevents the overheating of the ignition coils in the ignition unit if the start switch is inadvertently left energized. The ignition circuit is energized only during starting as combustion is continuous once the engine starts.

Ignition Switches.

Four ignition switches, one for each engine, are located in the throttle quadrant and are actuated by throttle movement. Electrical power to the switches is controlled by the engine start switches. With an engine start switch positioned to GROUND or AIR, advancing the corresponding throttle to the IDLE position or beyond completes the ignition circuit and supplies high-voltage direct current to the spark plug in the No. 4 combustion chamber.

Note

To prevent damage to the ignition unit, a time delay relay automatically de-energizes the ignition circuit after 75 ±10 seconds of continuous operation.

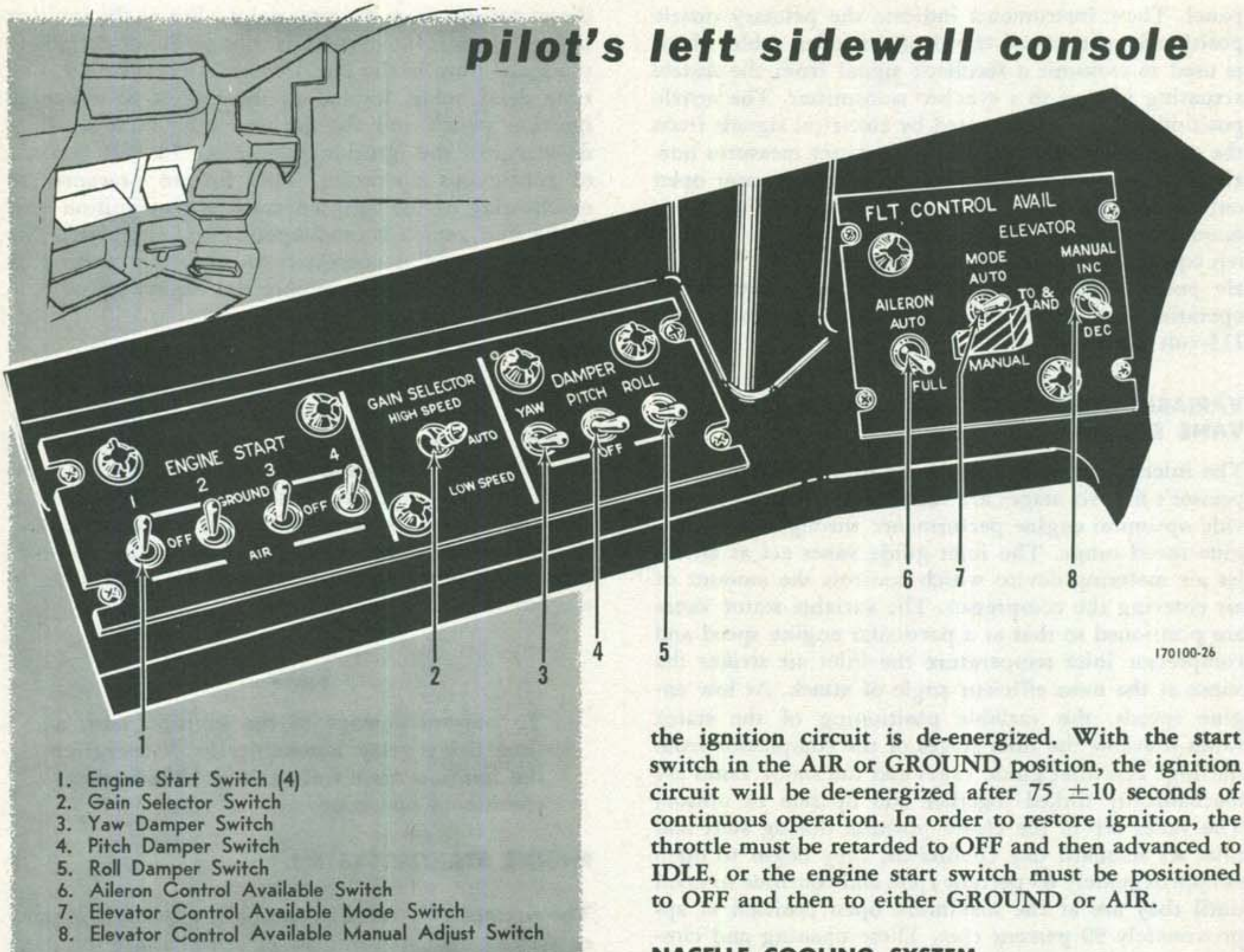
ENGINE STARTER SYSTEM.

The engines are started by means of a pneumatic starter system that requires an external source of compressed air for operation. The system is designed so that the compressed air can be supplied from a ground cart to start any one or all of the engines. The system also provides for compressor bleed air from an operating inboard engine to be used in starting the remaining three engines. The system consists of four engine-mounted pneumatic starters, four engine starter valves, a receptacle located on the right side of fuselage below the wing leading edge for connecting the ground cart, and four engine start switches located at the pilot's station. The warm air manifold of the air conditioning system is used for directing the compressed air to the engine starters. Two centrifugal switches, one on each side of the starter clutch, control the starter valve to automatically disengage the starter at approximately 47 percent engine rpm. Refer to "Engine Limitations," Section V, for limitations on the starter. Engine starting in flight can be accomplished by windmilling the engine.

Note

Before an engine start is attempted, the air conditioning system must be set up in its engine-start configuration.

pilot's left sidewall console



1. Engine Start Switch (4)
2. Gain Selector Switch
3. Yaw Damper Switch
4. Pitch Damper Switch
5. Roll Damper Switch
6. Aileron Control Available Switch
7. Elevator Control Available Mode Switch
8. Elevator Control Available Manual Adjust Switch

Figure 1-6.

Engine Start Switches.

Four engine start switches (1, figure 1-6), one for each engine, are located on the pilot's left sidewall console. Each switch has three positions, marked AIR, GROUND, and OFF. When a switch is positioned to GROUND, 28-volt direct current is supplied to the starter relay. The energized relay directs 28-volt direct current to open the starter valve and the warm air manifold valves, permitting high energy compressed air from either the ground source or the compressor of an operating inboard engine to drive the starter. With the switch in this position, the ignition circuit is energized to the throttle ignition switch with 28-volt direct current. The AIR position is used in flight to make a windmilling start and provides ignition only. When the switch is in this position, the ignition circuit is energized to the throttle ignition switches. When the switch is placed to OFF, the starter and warm air manifold valves close, stopping starter operation; also, the ignition circuit is de-energized. With the start switch in the AIR or GROUND position, the ignition circuit will be de-energized after 75 ±10 seconds of continuous operation. In order to restore ignition, the throttle must be retarded to OFF and then advanced to IDLE, or the engine start switch must be positioned to OFF and then to either GROUND or AIR.

NACELLE COOLING SYSTEM.

Secondary air for inflight nacelle cooling is provided by using part of the engine ram air. Ram air enters two scoops, located in the air inlet of each nacelle, and flows through bypass flaps and the hydraulic oil cooler and aft between the engine and nacelle to be expelled into the engine exhaust gases. During ground and low speed operation, secondary air for nacelle cooling is drawn in through two inward opening nacelle cooling and fire access doors by the pumping action of the ejector nozzle. At the same time, the lowered inlet pressure closes the flap valve at the rear of the hydraulic oil cooler and the bypass flap valves and opens the hydraulic oil cooler external door. This provides for hydraulic oil cooling under all nacelle pressure conditions and prevents reverse flow of air from the nacelle compartments into the engine air inlet. The hydraulic oil cooler door and the two nacelle cooling and fire access doors are closed during flight by the differential air pressure across the doors. In addition, the nacelle heat during ground and inflight operations is reduced by routing seventeenth-stage seal leakage air overboard through two overboard dump doors, located on each side of the nacelle. The operation of the system is entirely automatic and no controls are provided.

ENGINE INSTRUMENTS.

Pressure Ratio Indicators.

Four pressure ratio indicators (10, figure 1-5) are located on the right side of the pilot's main instrument panel. These instruments give an indication of engine operation by showing the ratio of turbine outlet pressure to compressor inlet pressure. The indicators are used to set power when the afterburners are not being used. Inlet and outlet pressures are routed to a transmitter, located on the aft compressor case of each engine, where they are translated into an electrical signal. The signal is then transmitted to the indicator where it appears as a pressure ratio. The indicators operate on 115-volt a-c power.

Tachometers.

Four tachometers (11, figure 1-5), located on the pilot's main instrument panel, indicate engine speed in percent of military rpm (7460). The instruments receive power from tachometer generators which are mounted on the aft side of the rear gearcase; they are independent of the airplane electrical system.

Fuel Flow Indicators.

The airplane is equipped with four individual fuel flow indicators (13, figure 1-5). The instruments are located on the pilot's main instrument panel and show fuel flow in pounds per hour. The indicators operate on 115-volt a-c power.

Oil Pressure Indicators.

Four oil pressure indicators (15, figure 1-5) are located on the pilot's main instrument panel. They indicate oil pressure in pounds per square inch and operate on 28-volt a-c power.

Ram Air Temperature Indicator.

A ram air temperature indicator (1, figure 1-5), located on the pilot's main instrument panel, indicates engine ram air temperature in degrees centigrade. This information is used when regulating airspeed so that excessive engine operating temperatures can be avoided. A resistance bulb-type probe located in the No. 2 engine ram air duct supplies control signals to the indicator. The indicator operates on 28-volt d-c power.

Exhaust Temperature Indicators.

Four exhaust temperature indicators (12, figure 1-5), which are located on the pilot's main instrument panel, indicate temperatures taken from the turbine outlet of each engine by thermocouples. Indications are in degrees centigrade. The indicating system is of the self-generating type and does not require power from the airplane electrical system.

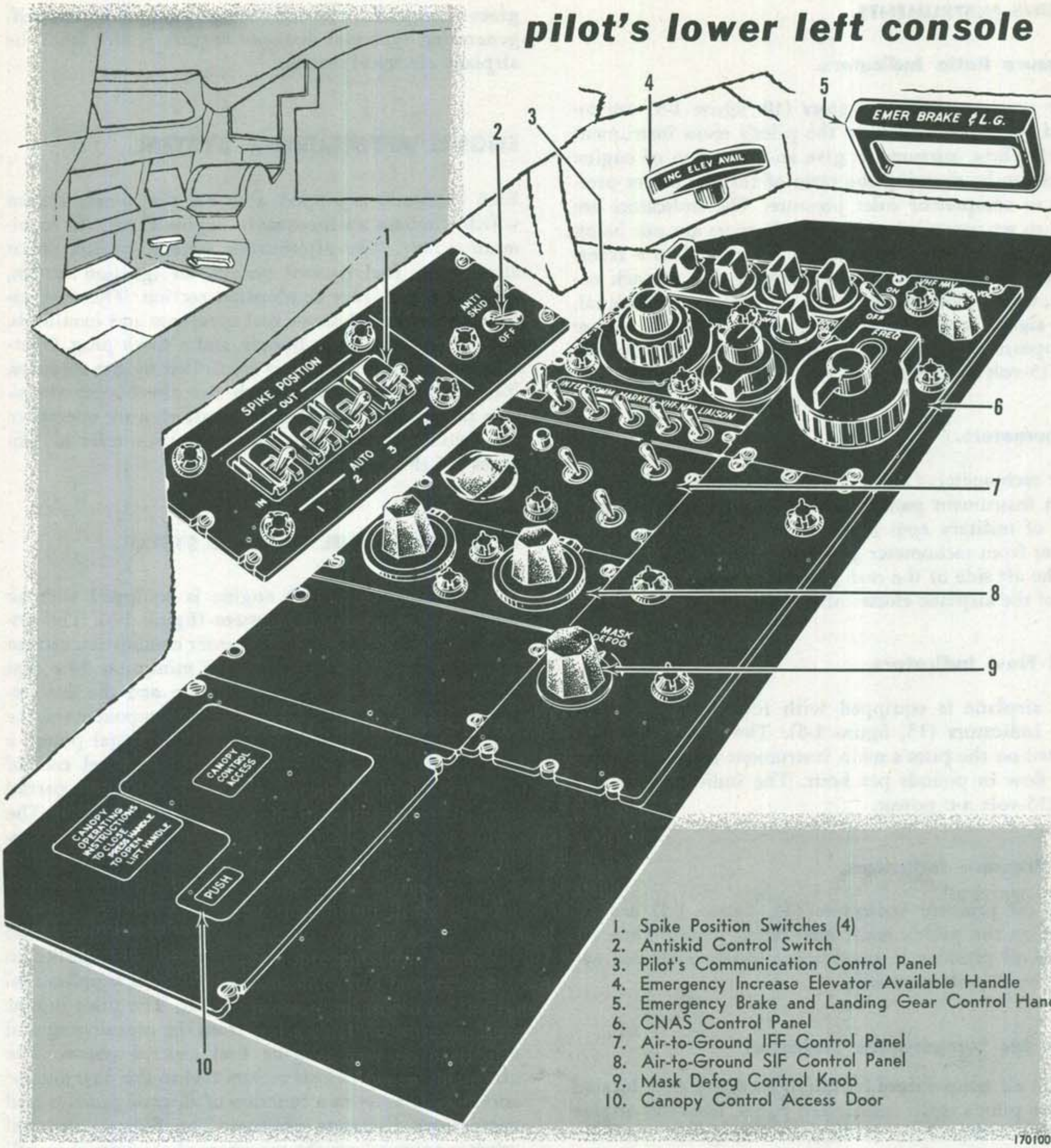
ENGINE AFTERBURNER SYSTEM.

Each engine is equipped with an afterburner system which provides an increase in engine thrust for maximum power. The afterburner system consists of an afterburner fuel control system, an ignition system, and the afterburner combustion section. The combustion section incorporates fuel spraybars and manifolds, a flame holder, a pilot burner, and a spark plug. Operation of the afterburners is controlled by the throttles. Moving the throttles through the afterburner transition range to MIN A/B initiates afterburner operation. For detailed information on the throttles, refer to "Engines" of this section.

AFTERBURNER FUEL CONTROL SYSTEM.

The afterburner of each engine is equipped with an independent fuel control system (figure 1-3). The system supplies fuel to the afterburner combustion section at a rate that varies between the minimum flow that will support afterburner combustion and the flow required to develop maximum thrust. Components of the system include an on-off valve, a centrifugal pump, a pilot burner, a check and vent valve, a fuel control unit, a flow divider and selector valve, and a partial burning and a full burning distribution system. The on-off valve is opened by fuel pressure from the engine fuel control unit as the throttle is advanced to the afterburner range. The on-off valve is also controlled by a secondary nozzle area switch to prevent afterburner operation until the secondary nozzle flaps are full open. When the on-off valve opens, fuel is supplied to the afterburner fuel pump which in turn, supplies fuel to the afterburner fuel control unit. The pilot burner is supplied fuel continuously from the pressurizing and drain valve in the engine fuel control system. The afterburner control unit meters fuel to the flow divider and selector valve as a function of throttle position and compressor discharge pressure. The flow divider and selector valve selects the spraybars of the partial or full burning distribution system according to the throttle position. The spraybars inject the fuel into the afterburner combustion section where it is ignited by the pilot burner. If the throttle is left at the point of switchover from the partial to the full burning distribution system, unstable afterburner operation may occur; therefore, the throttle should be moved through this range with a continuous motion. The check and vent valve aids in keeping the system primed when not in operation. It also allows fuel that seeps into the pumps to be vented overboard when the afterburner is not being used.

pilot's lower left console



1. Spike Position Switches (4)
2. Antiskid Control Switch
3. Pilot's Communication Control Panel
4. Emergency Increase Elevator Available Handle
5. Emergency Brake and Landing Gear Control Handle
6. CNAS Control Panel
7. Air-to-Ground IFF Control Panel
8. Air-to-Ground SIF Control Panel
9. Mask Defog Control Knob
10. Canopy Control Access Door

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Figure 1-7.

AFTERBURNER IGNITION SYSTEM.

The afterburner ignition system provides continuous ignition during afterburner operation. The system consists of an afterburner ignition switch, ignition unit, and a spark plug. When the throttle is advanced to the MIN A/B position and engine rpm is 100 percent, the afterburner ignition switch is controlled by the fuel pressure differential between the on-off valve actuating line and the ignition switch actuating line. Both of these lines are connected to the ignition switch so that when afterburner operation is initiated, the pressure increase in the on-off valve actuating line will close the switch allowing 115-volt alternating current to flow to the ignition unit. This unit supplies continuous high-voltage direct current to the spark plug located in the pilot burner. The ignition system maintains a continuous flame in the pilot burner during afterburner operation.

OIL SUPPLY SYSTEM.

Each engine is equipped with an independent priority oil system which is contained within the engine nacelle. The operation of the system is entirely automatic and no controls are provided. The oil is used not only for engine lubrication and cooling, but it also serves as the actuating fluid in the variable exhaust nozzle system. In addition, on engines 1, 2, and 3 the oil lubricates and cools the constant-speed drive and a-c generator; it also serves as the working fluid in the constant-speed drive. The oil supply tank of each engine is installed around the upper outside quadrant of the engine in the region of the front compressor case. The tank has a capacity of 4.5 gallons and adequate expansion space. (For the oil specification, refer to figure 1-41). The oil tank supplies oil to the engine, variable exhaust nozzle system and constant-speed drive unit on a priority basis so that any oil leakage in the constant-speed drive will not result in complete oil tank drainage. This is accomplished with an internal standpipe arrangement connected to the constant-speed drive oil supply line. Should a leak occur, the oil level in the tank will descend only to the level of the standpipe inlet allowing the remaining oil to circulate to the engine and variable exhaust nozzle system. From the oil tank, oil flows to the constant-speed drive and to the two pressure elements of the gear-type oil pump. One element of the pump supplies oil to the variable exhaust nozzle system; the other element supplies pressurized oil for lubrication and cooling to the three main engine bearings, the transfer gear case and the rear gear case. During periods of peak demand, a crossover valve which connects the lines from the two pump elements will open and allow engine lubrication oil pressure to supplement the variable exhaust nozzle system. After the oil has passed through the engine bearings and gear cases and the exhaust nozzle system, it is scavenged by three pumps and returned to the oil tank through the main scavenge filter and two oil coolers. The oil supplied to the constant-speed drive is scavenged by the constant-speed drive scavenge pump, filtered and returned to the tank through the main scavenge filter and the two oil coolers. Under certain oil temperature conditions, the oil will bypass one or more of the coolers. In addition, a pressure relief valve, located in the bypass line connecting the constant-speed drive oil inlet and outlet lines, will open to allow oil to recirculate through the constant-speed drive in the event of excessive back pressure from the engine scavenge pumps. This produces a closed circulation that continues until the excessive back pressure is relieved and normal oil flow resumes. Deaeration of the scavenged oil takes place as the oil enters through the top and spills down the side of the tank. Each oil tank is pressurized by the scavenge pumps to reduce oil foaming and to insure a more positive flow to the oil pump and to the constant-speed drive. The pressure is maintained at approximately 2 to 4 psi above the ambient pressure at altitudes below 28,000 feet and at 4 to 6 psi above ambient pressure at altitudes above 28,000 feet. Up to 20,000 feet the pressurization is maintained by a tank pressurizing valve; above this altitude the tank valve is aided by a sump pressurizing valve. The tank pressurizing valve is mounted on the sump pressurizing valve which is located on the rear compressor casing. The sump pressurizing valve begins regulation at 20,000 feet and attains full regulation at 28,000 feet. The tank pressurizing valve also provides for venting ambient air into the tank during rapid descent. The oil system provides a continuous oil supply without flow interruption in any aircraft attitudes, including negative "G" conditions; however, only a maximum of 30 seconds negative "G" capability is provided. For information on the oil pressure indicators, refer to "Engine Instruments" of this section.

INLET SPIKE SYSTEM.

A variable position inlet spike is located in each nacelle to maintain an efficient inlet airflow to the engine throughout the speed range of the airplane. At supersonic speeds, shock waves form at the engine air inlets. If the shock waves are not kept outside of the diffuser so that the air in the diffuser is subsonic, airflow to the engine will be greatly reduced. The inlet spike system prevents this from occurring by maintaining a constant ratio between two control pressures—a static pressure measured on the inner surface of the inlet lip and a total pressure measured on the spike tip. These pressures have no particular physical significance, but the ratio between them provides a sensitive means of controlling the inlet efficiency. The control system of each nacelle includes a transducer, an actuator, a control switch located at the pilot's station, and a control unit containing the amplifier and controlling relays of each of the four systems. Movement of the spike is forward and aft. During normal operation, control of this movement is completely automatic. The spike remains in the aft or retracted position until an airspeed of Mach No. 1.42 is reached. At this speed, a switch in the air data computer closes and supplies a 28-volt direct current signal to the control unit, activating the system. The transducer receives the control pressures, computes their ratio, and produces an electrical error signal when the computed ratio is incorrect. The amplifier receives the error signal from the transducer, amplifies it, and closes a relay which supplies 200-volt a-c power to the actuator. The actuator drives the spike in the proper direction. In event of malfunction in the automatic control system or engine during supersonic flight, the spike may be fully retracted by placing the spike position switch to IN. The positioning of the switch to OUT will be performed during ground maintenance only. No spike position indicators are provided.

SPIKE POSITION SWITCHES.

Four spike position switches (1, figure 1-7) are located on the pilot's lower left console. The switches have three positions marked AUTO, IN, and OUT. When a switch is in the AUTO position, the system is set up for automatic operation. In this condition, the system will become activated when an airspeed of Mach No. 1.42 is reached. At speeds below Mach No. 1.42, the spike will remain in its retracted position. Placing a switch in the IN position moves its spike to the fully retracted position. The OUT position is a spring-loaded guarded position and is provided for ground checking purposes only. Holding a switch in this position extends its spike.

CAUTION

> The spike position switch should be retained at the IN position during engine ground operations and during all subsonic flight conditions. Holding the switch to the OUT position will extend the spike and place an excessive structural load on the nacelles.

FUEL SUPPLY SYSTEM.

The airplane is equipped with a fuel system (figure 1-8) which delivers fuel at booster pump pressure plus tank pressure to the fuel control system of the engines. The fuel system also transfers fuel as required for cg control. Fuel is contained in four airplane tanks and two pod tanks. Refer to Confidential Supplement, T.O. 1B-58A-1A for fuel tank capacities. The fuel tanks of the airplane consist of a forward tank, an aft tank, a reservoir tank, and a balance tank. The forward and aft tanks each comprise a section of the wing and fuselage; the reservoir tank is located in the fuselage above the forward tank, and the balance tank is located in the aft portion of the fuselage. No provisions have been made to bullet-seal the tanks. Two types of booster pumps are used in the airplane and pod tanks. The forward tank has centrifugal-type pumps which have a single inlet while the aft, balance and reservoir tanks and both pod tanks have impeller-type pumps which have inlets at both the top and bottom. Fuel can be supplied directly to the engines from the aft, forward, and/or reservoir tank. The fuel supply in the reservoir tank is held on standby for direct engine supply if the pressure in either the right or left engine supply manifold drops too low to support the engines. Fuel in the balance tank and pod tanks cannot be supplied directly to the engine supply manifolds, but must be transferred to the aft, forward, and/or reservoir tanks for engine supply. Refer to Section VII for fuel management information. The fuel system is divided functionally into the following subsystems: engine supply, fuel transfer, vent and pressurization, fuel dump, fuel quantity measuring, single-point refueling, and air refueling. (Refer to Section IV for information on single-point and air refueling systems.) The system is operated from the fuel control panel (figure 1-10) at the pilot's station. Six fuel system maintenance test buttons, located on the upper exterior surface of the fuselage, provide a means of defueling the reservoir tank and for checking the operation of individual tank high level shutoff valves during refueling. For the specification of the fuel, refer to figure 1-41.

ENGINE SUPPLY SYSTEM.

The engine supply system delivers fuel at booster pump pressure plus tank pressure to the engines from the airplane forward, aft, and/or reservoir tank supply systems. Fuel is delivered to engines No. 1 and No. 2 through the left engine supply manifold and to engines No. 3 and No. 4 through the right engine supply manifold. For identification, the fuel booster pumps are numbered 1 through 11. The forward tank supply system consists of booster pumps No. 1 and 2, and two booster pump low pressure caution lamps. The pumps are arranged so that booster pump No. 2 supplies the right manifold and booster pump No. 1 supplies the left manifold. In addition to supplying the engines, the forward tank pumps are used to transfer fuel to the balance and aft tanks for cg control. The aft tank supply system consists of booster pumps No. 6, 7, 8, and 9, and four booster pump low pressure caution lamps. The pumps are arranged so that booster pumps No. 8 and 9 supply the right manifold and booster pumps No. 6 and 7 supply the left manifold. In addition to supplying the engines, the aft tank pumps are used to transfer fuel to the forward tank for cg control. When the engines are being supplied from both the forward and aft tanks, booster pumps No. 6 and 7 supply the left engine manifold and booster pump No. 2 supplies the right engine manifold. The reservoir tank supply system consists of booster pumps No. 3, 4, and 5; right and left manifolds; and three booster pump low pressure caution lamps. Booster pumps No. 3 and 4 operate continuously, while booster pump No. 5 operates only when the right or left engine manifold pressure decreases to 19 (±1) psig. The reservoir tank pumps insure a positive fuel supply to the engines during deceleration, descent, negative gravity conditions, or at any time engine supply manifold pressure drops too low to fulfill the engine requirements. Each reservoir manifold incorporates a pressure relief valve, a shutoff valve, a check valve, and a suction check valve. The arrangement of the pumps and reservoir manifolds is such that the upper outlet of each pump supplies one manifold and the lower outlet of each pump supplies the other manifold. If the reservoir tank is not supplying the engines, fuel in the reservoir manifolds is recirculated back to the tank through the pressure relief valves. A shutoff valve in each reservoir tank manifold prevents loss of fuel from the reservoir tank if a break in an engine supply manifold should occur. The reservoir tank is automatically maintained full, and is the last fuel source to be depleted. In the event of total loss of electrical power, fuel is introduced by tank pressure into the reservoir tank manifolds through the suction check valves in sufficient quantities for the engine-driven fuel pumps to sustain afterburner operation of the engines at altitudes up to 6000 feet. Antisuction valves incorporated in the engine supply manifolds prevent the suction of fuel or air from the forward and aft tanks in the event of electrical power failure.

FUEL TRANSFER SYSTEM.

The fuel transfer system is used for pod to airplane fuel transfer, reservoir tank automatic filling, center of gravity control, and fuel scavenging.

Pod-To-Airplane Fuel Transfer System.

The pod-to-airplane fuel transfer system is used to replenish fuel in the airplane forward, aft, and/or balance tanks. The system consists primarily of two pod tank transfer-refuel knobs, two transfer pumps, a pod tank interconnect valve switch, and two pod tank inter-connect valves. When either pod tank transfer-refuel knob is placed in the TRANS position, fuel in the pod is transferred to the airplane tanks preselected by the pilot. In the event of a pod transfer pump failure, the interconnect valves between the two tanks may be actuated by placing the pod interconnect valve switch to INTERCONNECT. Pod pressurization air will open the two interconnect valves and allow fuel in the two tanks to seek a common level. Under these conditions, the remaining active transfer pump in the pod may be used to transfer fuel to the airplane tanks.

Note

Fuel cannot be transferred from the airplane tanks to the pod tanks.

Reservoir Tank Automatic Filling System.

The reservoir tank automatic filling system, which consists of an automatic transfer valve and a float control valve, maintains the reservoir tank full. Reservoir tank fuel level and left engine supply manifold pressure controls the operation of the system. If the left engine supply manifold pressure is greater than 18 (±1) psi above tank pressure and the reservoir tank supply drops below the full level, two float controlled valves in the reservoir tank will open the automatic transfer valve and the reservoir tank refuel valve. This allows fuel in the left engine supply manifold to flow through the transfer line and into the reservoir tank. The transfer valve will remain open until the reservoir tank supply reaches a full level or until the engine supply left manifold pressure drops below 18 (±1) psi above tank pressure.

Center of Gravity Control System.

The airplane center of gravity is controlled by transferring fuel either forward or aft. The system consists of a cg calibrator, a cg indicator, a cg repeater indicator, a cg control switch, a manual cg shift switch and various relays. These units operate in conjunction with various components of the fuel system for transferring fuel forward or aft. The cg calibrator computes the cg position in percent of the airplane mean aerodynamic chord (MAC) which appears in percent MAC on the cg indicator. The calibrator receives input signals from the airplane and pod tank fuel quantity indicators and totalizer so that it can correctly compute changes in the cg due to fuel use or transfer. Controlling the cg may be accomplished automatically or manually.

Note

The cg control system is designed to accurately indicate and control the aircraft cg when the aircraft is at a deck angle of plus 2.5 degrees during stable flight. However, under transient conditions such as acceleration and deceleration the system accuracy is degraded.

Automatic CG Control. The airplane cg is automatically controlled by the cg control switch and the cg indicator located on the fuel control panel. With the cg control switch positioned to AUTO, the cg indicator maintains the indicated cg within 0.5 ±0.1 percent MAC of the selected cg setting. A selector set knob, located on the cg indicator provides a means of selecting the desired cg for a particular flight condition. If a cg is selected that is forward of the airplane cg, fuel will be transferred forward until the desired cg position is reached. Conversely, if a cg is selected that is aft of the airplane cg, fuel will be transferred aft. Fuel flows forward or aft in the same manner as during manual cg control except that the fuel transfer is automatically stopped.

Note

The cg repeater indicator located at the navigator's station is for indication only. Automatic control of cg location is available only through the pilot's cg indicator.

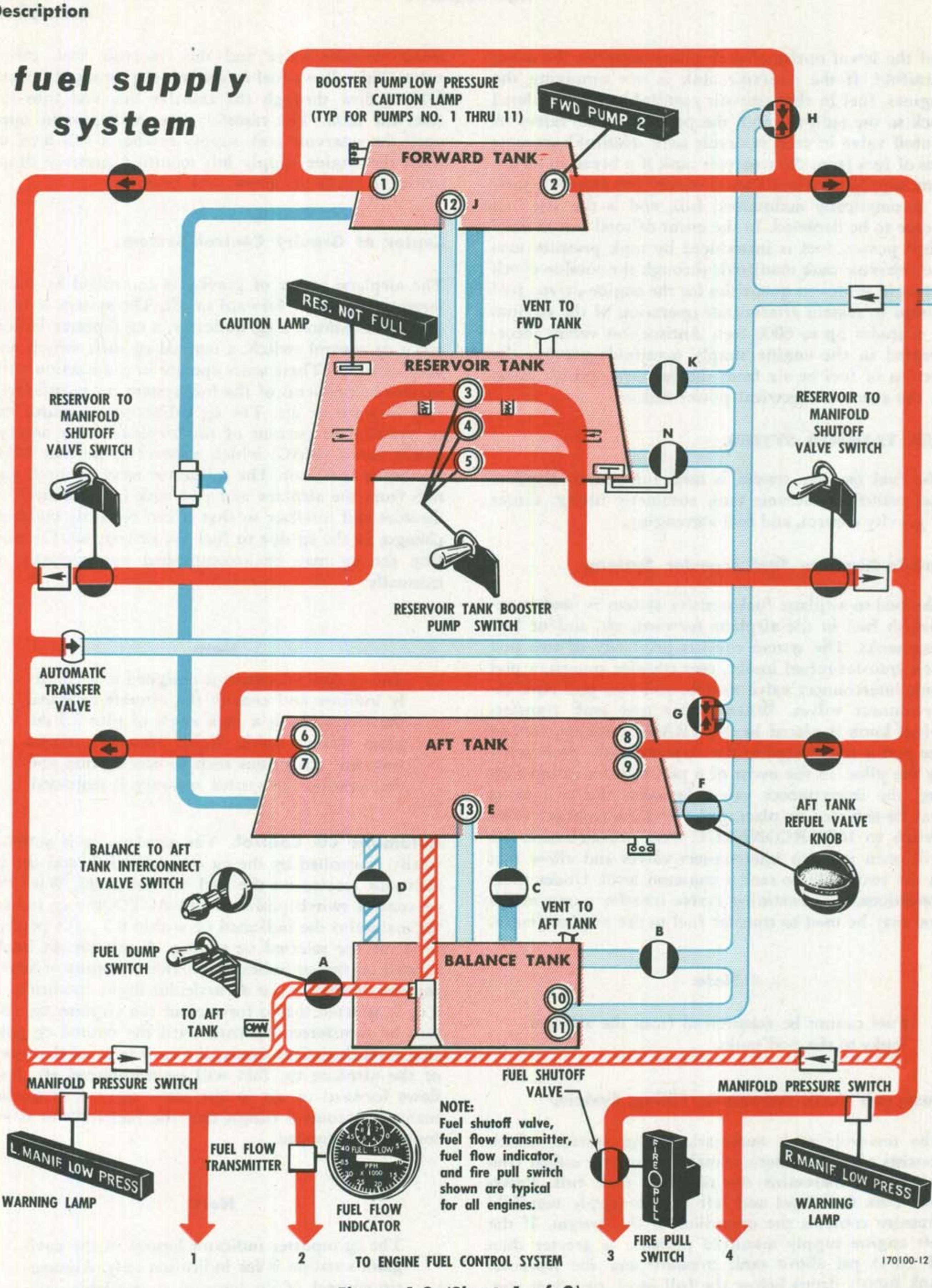


Figure 1-8. (Sheet 1 of 2)

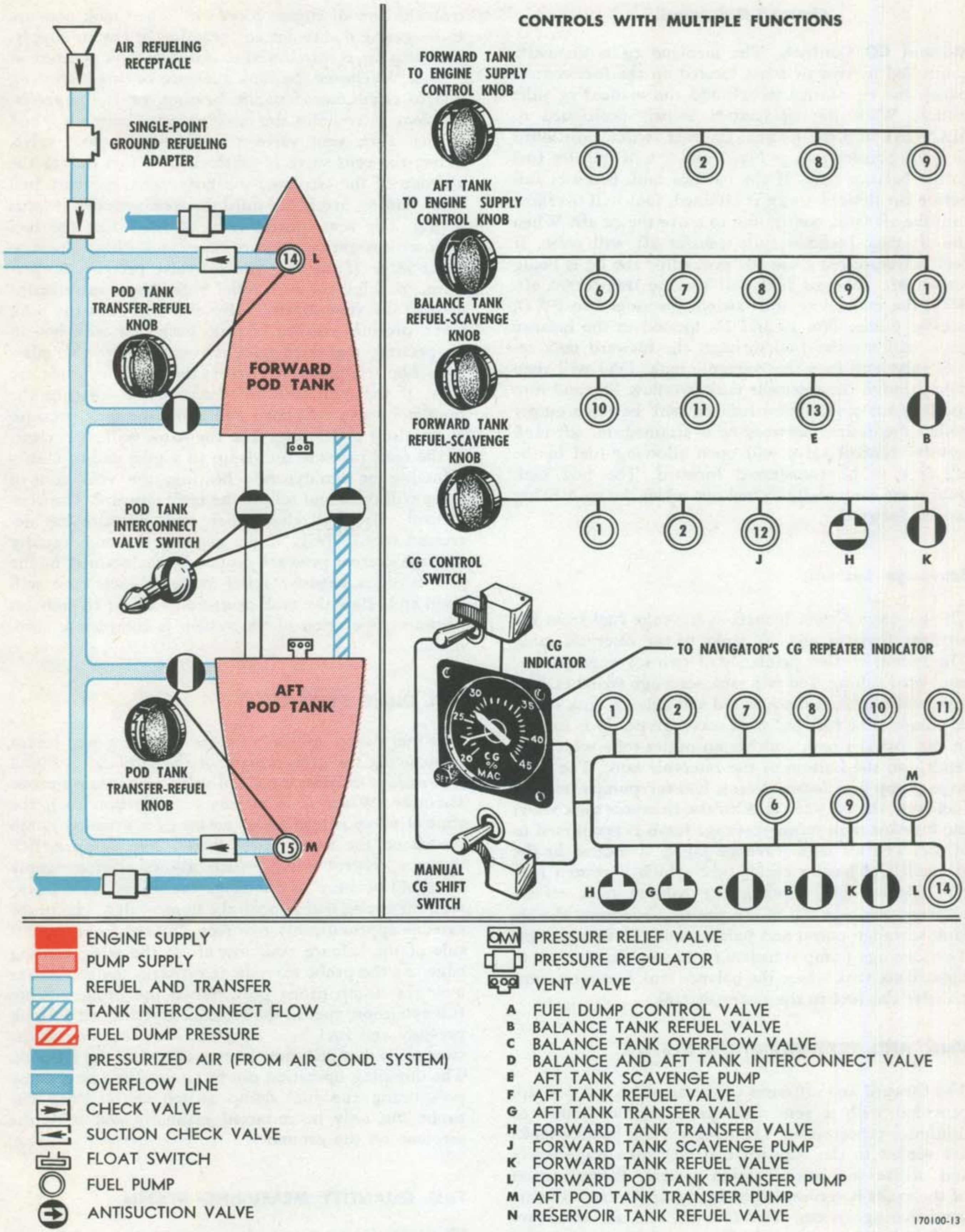


Figure 1-8. (Sheet 2 of 2)

Figure 1-9 deleted.

Manual CG Control. The airplane cg is manually controlled by two switches located on the fuel control panel: the cg control switch and the manual cg shift switch. With the cg control switch positioned to MANUAL and the manual cg shift switch positioned to AFT, booster pumps No. 1 and 2 will transfer fuel to the balance tank. If the balance tank becomes full before the desired aft cg is attained, fuel will overflow into the aft tank, continuing to move the cg aft. When the aft tank becomes full, transfer aft will cease. If fuel is transferred from the pod while the cg is being moved aft, the pod fuel will also be transferred aft. With the manual cg shift switch positioned to FWD, booster pumps No. 10 and 11, located in the balance tank, will transfer fuel through the forward tank refuel valve and into the reservoir tank. Fuel will then flow through the reservoir tank overflow line and into the forward tank. If the balance tank becomes empty before the desired forward cg is attained, the aft tank transfer control valve will open allowing fuel in the aft tank to be transferred forward. The pod tank pumps are electrically locked out when the cg is being moved forward.

Scavenge System.

The scavenge system is used to scavenge fuel from the airplane forward and aft tanks to the reservoir tank. The system consists primarily of two scavenge pumps, associated tubing, and two tank scavenge switches. The system also utilizes the forward and balance tank booster pumps. The forward tank scavenge pump is located in the forward tank and has an outlet tube which extends into the bottom of the reservoir tank. The scavenge pump and forward tank booster pumps transfer fuel from the forward tank to the reservoir tank when the forward tank refuel-scavenge knob is positioned to SCAV. The aft tank scavenge pump is located in the aft tank and has an outlet tube which is routed into the balance tank. Placing the balance tank refuel-scavenge knob in the SCAV position energizes the aft tank scavenge pump and balance tank booster pumps. The scavenge pump transfers fuel from the aft tank to the balance tank where the balance tank booster pumps transfer the fuel to the reservoir tank.

VENT AND PRESSURIZATION SYSTEM.

The forward and aft tanks of the airplane and pod are provided with a vent and pressurization system to minimize vaporization. The reservoir and balance tanks are vented to the forward and aft tanks respectively and utilize the pressurization system. Pressurization of the tanks is accomplished by using air from the air conditioning system. The forward and aft tanks are equipped with a vent control valve which incorporates a pressure regulating valve. The regulating valve controls the flow of engine bleed air. When tank pressure is decreasing due to descent, transfer, or engine supply, sufficient air is introduced to hold the tank pressure at 5 psig. Whenever the tank pressure begins increasing due to climb, aerodynamic heating, or fuel transfer, the vent valve holds the tank pressure between 5 and 6 psig. Each vent valve also contains a float valve. When the vent valve is submerged in fuel due to the attitude of the airplane, the float valve prevents fuel from venting overboard until the tank pressure exceeds 8 psig. The vent control valve also provides the fuel tank with negative pressure relief and a high pressure relief valve. If the vent control valve becomes inoperative, the high pressure relief valve becomes independent to the vent control valve and will vent the tank when pressure reaches 12 psig. Each pod tank has an air pressure regulator valve that controls the air pressure. The regulator valve senses the pressure inside the tank. If the tank pressure drops below 4.4 psig the regulator valve will open and allow the tank pressure to build up to 4.7 psig. The regulator will then close. If the tank pressure builds up to 5 psig due to climb, refueling or aerodynamic heating, the vent control valve will open and relieve the tank pressure. The vent control valve will close when tank pressure has decreased to 4.75 psig. If the airplane descends rapidly and the correct pressure cannot be maintained in the pod tanks, a negative relief valve in each tank will open and allow the tank pressure to adjust to ambient pressure. Operation of the system is completely automatic.

FUEL DUMP SYSTEM.

The fuel dump system provides an emergency means of reducing the gross weight of the airplane in flight. The system includes a control valve and a dump probe assembly. When it is necessary to jettison fuel, the control valve is opened by means of a guarded dump switch on the fuel control panel. The dump switch opens a control valve which allows engine supply manifold pressure to disengage the probe latch, to extend the probe, and to open the dump valve. The probe extends approximately two feet outward from the left side of the balance tank just aft of the wing trailing edge. As the probe extends, it ruptures the thin cover over the dump probe port. When the probe reaches full extension, fuel in the aft tank is jettisoned by tank pressure and fuel head pressure. Any fuel that is desired to be dumped must be transferred to the aft tank. The dumping operation can be stopped at any time by positioning the fuel dump switch to NORM. The probe can only be retracted manually and with the airplane on the ground.

FUEL QUANTITY MEASURING SYSTEM.

The fuel quantity measuring system is a capacitor-type indicating system which measures and indicates in pounds the quantity of fuel contained in the tanks of the airplane and pod. The system consists of capacitor-type tank units, six fuel quantity indicators, a fuel quantity totalizer indicator, and a transfer relay. In addition to indicating the individual tank fuel quantities, the system also totals and indicates, on the totalizer indicator, the number of pounds of fuel remaining in the airplane and pod tanks. The transfer relay consists of two relay units and two equivalent capacitors. When a pod is not attached to the airplane, the relays connect the capacitors into the pod indicator circuits to simulate empty tanks.

FUEL SYSTEM CONTROLS AND INDICATORS.

Tank to Engine Supply Control Knobs.

Two tank to engine supply control knobs (17 and 19, figure 1-10), one for the forward tank and one for the aft tank, are located on the fuel control panel. The knobs have two positions marked ON and OFF. Placing either knob in the ON position supplies power to the respective tank booster pumps allowing one tank to supply both engine supply manifolds. Placing both knobs in the ON position supplies power to booster pumps No. 2, 6, and 7 so that the forward tank will supply the right manifold and the aft tank will supply the left manifold.

Reservoir Tank Booster Pump Switch.

A reservoir tank booster pump switch (18, figure 1-10) is located on the fuel control panel. The switch has two positions marked NORM and OFF. Placing the switch in the NORM position energizes booster pumps No. 3 and 4 and supplies power to the left and right engine manifold pressure switches in the starting circuit of booster pump No. 5. Booster pump No. 5 will not become energized until the right or left engine supply manifold pressure decreases to 19 (± 1) psig. The switch is guarded in the NORM position.

Reservoir to Manifold Shutoff Valve Switches.

Two reservoir to manifold shutoff valve switches (13, figure 1-10), one for the right manifold and one for the left manifold, are located on the fuel control panel. The switches control 28-volt direct current to the manifold shutoff valves and have two positions marked NORMAL and CLOSE. Placing the switches in the NORMAL position opens the reservoir manifold shutoff valves allowing fuel in the reservoir tank to become available to the engine supply manifolds. Placing either switch in the CLOSE position isolates the reservoir tank from the respective engine supply manifold, The switches are guarded in the NORMAL position.

CG Control Switch.

A cg control switch (2, figure 1-10), located on the fuel control panel, has two positions marked MANUAL and AUTO. In the MANUAL position, the switch directs 28-volt direct current to the manual cg shift switch contacts which control operation of the forward tank transfer control valve, aft tank transfer control valve, balance tank overflow valve, balance tank refuel valve, and the forward tank refuel valve. This enables fuel to be transferred forward or aft with the manual cg shift switch. In the AUTO position, the switch directs 28-volt direct current to the automatic cg control circuits which control operation of the components used to automatically transfer fuel either forward or aft. The switch is guarded in the MANUAL position.

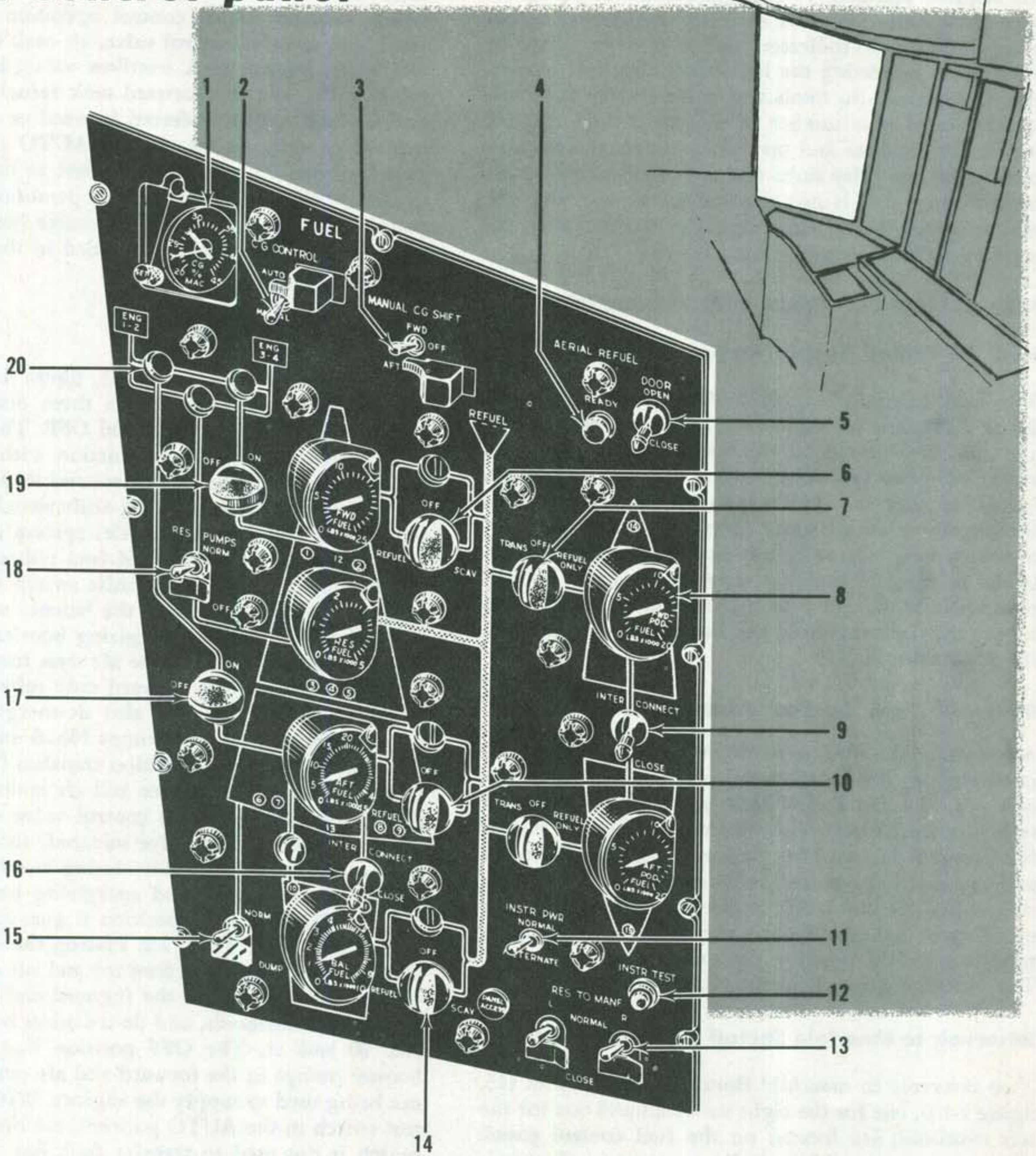
Manual CG Shift Switch.

The manual cg shift switch (3, figure 1-10), located on the fuel control panel, is a three position toggle switch marked FWD, AFT, and OFF. The manual cg shift switch operates in conjunction with the cg control switch. With the cg control switch in the MANUAL position, the manual cg shift switch directs 28-volt direct current to the fuel system components which control the transfer of fuel either forward or aft. Placing the manual cg shift switch in the FWD position transfers fuel from the balance and aft tanks to the forward tank by energizing booster pumps No. 7, 8, 10, and 11; opening the aft tank transfer control valve solenoid and the forward tank refuel valve solenoid. The FWD position also de-energizes the pod tank pumps and booster pumps No. 6 and 9. Placing the switch in the AFT position transfers fuel from the forward tank to the balance and aft tanks by opening the forward tank transfer control valve solenoid, the balance tank overflow valve solenoid, and the balance tank refuel valve solenoid; closing the forward tank refuel valve solenoid; and energizing booster pumps No. 1 and 2. The AFT position is guarded to prevent inadvertent shift of fuel aft. Placing the switch in the OFF position closes the forward and aft tank transfer control valve solenoids, the forward and balance tank refuel valve solenoids, and de-energizes booster pumps No. 10 and 11. The OFF position also de-energizes booster pumps in the forward and aft tanks which are not being used to supply the engines. With the cg control switch in the AUTO position, the manual cg shift switch is not used to transfer fuel, but will energize the booster pumps as follows: positioning the switch to FWD energizes booster pumps No. 7, 8, 10, and 11; positioning the switch to AFT energizes booster pumps No. 1 and 2.

Balance To Aft Tank Interconnect Valve Switch.

The balance to aft tank interconnect valve switch (16, figure 1-10), with positions marked INTERCONNECT and CLOSE, controls a 28-volt d-c solenoid valve located on the balance tank. When the switch is in the INTERCONNECT position, the solenoid valve allows engine manifold pressure to open the interconnect

fuel control panel



1. CG Indicator
2. CG Control Switch
3. Manual CG Shift Switch
4. Air Refueling Ready Indicator Lamp
5. Air Refueling Door Switch
6. Forward Tank Refuel-Scavenge Knob
7. Pod Tank Transfer-Refuel Knob (2)
8. Fuel Quantity Indicator (6)
9. Pod Tank Interconnect Valve Switch
10. Aft Tank Refuel Valve Knob
11. Instrument Power Switch
12. Instrument Test Button
13. Reservoir to Manifold Shutoff Valve Switch (2)
14. Balance Tank Refuel-Scavenge Knob
15. Fuel Dump Switch
16. Balance to Aft Tank Interconnect Valve Switch
17. Aft Tank to Engine Supply Control Knob
18. Reservoir Tank Booster Pump Switch
19. Forward Tank to Engine Supply Control Knob
20. Fuel Flow Direction Indicator (7)

170101-168

Figure 1-10.

valve which is located on the bulkhead separating the aft and balance tanks. This valve, when open, allows the fuel level in the aft and balance tanks to equalize.

Forward Tank Refuel-Scavenge Knob.

The forward tank refuel-scavenge knob (6, figure 1-10), located on the fuel control panel, has three positions marked REFUEL, SCAV and OFF. Placing the knob in the REFUEL position opens the forward tank refuel valve. Placing the knob in the SCAV position energizes booster pumps No. 1 and 2, and scavenge pump No. 12; opens the forward tank transfer control valve and closes the forward tank refuel valve. Fuel is then scavenged from the forward tank to the reservoir tank.

Balance Tank Refuel-Scavenge Knob.

The balance tank refuel-scavenge knob (14, figure 1-10), located on the fuel control panel, has three positions marked REFUEL, SCAV, and OFF. Placing the knob in the REFUEL position opens the balance tank refuel valve. Placing the knob in the SCAV position energizes booster pumps No. 10, and 11, and scavenge pump No. 13; and closes the balance tank refuel valve. Fuel is then scavenged from the aft tank to the balance tank. From the balance tank, the fuel is then transferred to the reservoir tank by booster pumps No. 10 and 11.

Aft Tank Refuel Valve Knob.

The aft tank refuel valve knob (10, figure 1-10), located on the fuel control panel, has two positions marked REFUEL and OFF. Placing the knob in the REFUEL position opens the aft tank refuel valve. When the knob is positioned to OFF, the refuel valve closes and fuel flow into the tank is stopped.

Fuel Dump Switch.

The fuel dump switch (15, figure 1-10) is a two position switch marked DUMP and NORM. The switch is guarded in the NORM position. Placing the switch in the DUMP position opens the dump control valve which allows engine manifold pressure to actuate the dump probe assembly. Fuel is then dumped from the aft tank. The NORM position closes the dump control valve and stops the dumping operation.

Pod Tank Transfer-Refuel Knobs.

Two pod tank transfer-refuel knobs (7, figure 1-10), one for the forward tank of the pod and one for the aft tank of the pod, are located on the fuel control panel. The knobs have three positions marked TRANS, OFF and REFUEL-ONLY. When either knob is placed in the TRANS position, 28-volt direct current closes the respective pod refuel valve and the respective pod transfer pump is energized. This allows fuel in the pod tanks to be transferred to the airplane tanks. Placing either knob in the REFUEL ONLY position, opens the respective pod refuel valve allowing the tank to be refilled through the airplane refuel manifold.

Note

Fuel cannot be transferred from the airplane tanks to the pod tanks.

Pod Tank Interconnect Valve Switch.

The pod tank interconnect valve switch (9, figure 1-10), with positions marked INTERCONNECT and CLOSE, controls the 28-volt d-c solenoid valve located in the pod pylon. When open, this valve allows pod tank pressure to open the two interconnect valves located on the bulkhead separating the forward and aft pod tanks. These valves, when open, allow fuel in the two tanks to seek a common level.

Instrument Power Switch.

An instrument power switch (11, figure 1-10), located on the fuel control panel, controls electrical power to the fuel quantity and cg indicators. The switch is a two-position switch marked NORMAL and ALTERNATE. Placing the switch in either position supplies 115-volt a-c power to the indicators from the respective power bus. Placing the switch to the ALTERNATE position during single-point refueling operations directs 115-volt a-c and 28-volt d-c power from the refueling buses to the fuel system components necessary to refuel the airplane.

Instrument Test Button.

An instrument test button (12, figure 1-10) is provided for the fuel quantity indicators. The instrument test circuit is operative only when the cg control switch is positioned to MANUAL. When the button is depressed and fuel is in the tanks, movement of the indicator pointers toward zero indicates that the gages are functioning properly. Proper functioning of the totalizer indicator is indicated when the totalizer pointer follows the movement of the tank indicator pointers.

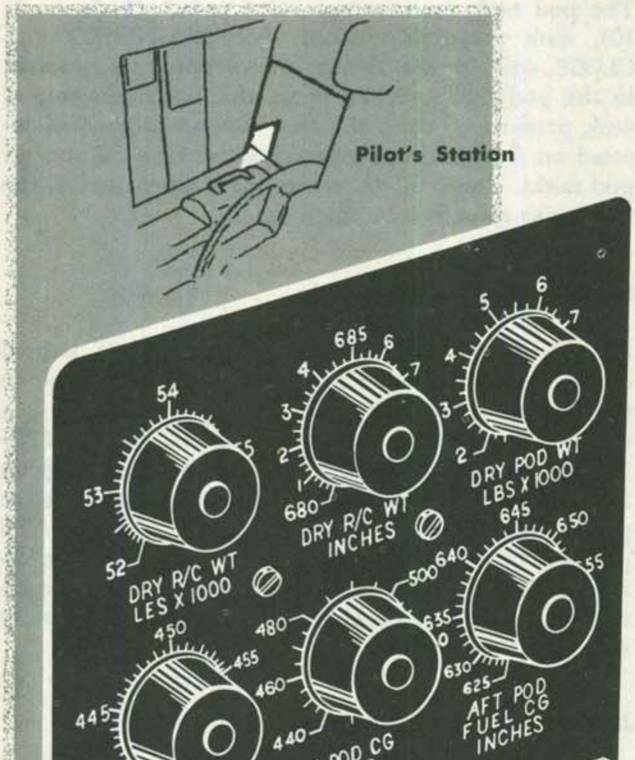
Fuel Quantity Indicators.

Six fuel quantity indicators (8, figure 1-10), one for each tank of the airplane and the pod, are located on the fuel control panel and indicate the fuel quantity in pounds. An instrument test button is provided to test the operation of the indicators. All of the indicators require 115-volt a-c power only.

Note

- When a pod is released, capacitors are automatically connected to the affected indicator circuits to simulate empty tanks. These empty tank readings on the individual tank quantity indicators prevent the totalizer from giving erroneous indications.

cg calibrator panel



170100-87

Figure 1-11.

- When electrical power to an indicator is interrupted for any reason, the pointer will remain in the position it was in before the power was interrupted. Since the totalizer gets its signals from the tank quantity indicators, power failure to an indicator will cause the totalizer to give an erroneous indication.

Fuel Quantity Totalizer Indicator.

A fuel quantity totalizer indicator (18, figure 1-5), located on the pilot's main instrument panel, indicates in pounds the total quantity of fuel remaining in the pod and airplane tanks. The system requires 115-volt a-c power only.

Note

When the indicator's electrical power is interrupted for any reason, the pointer remains in the position it was in before the power was interrupted.

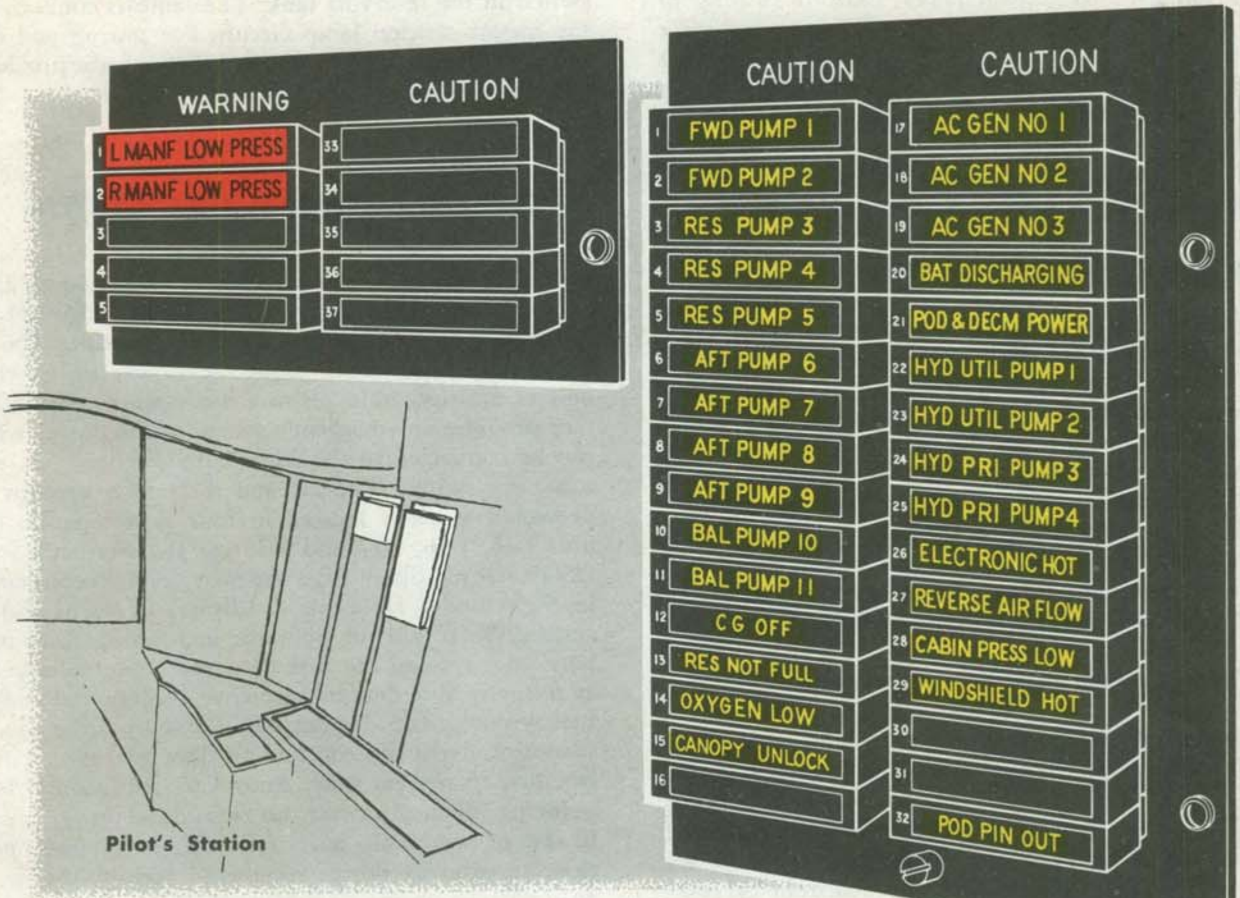
CG Indicator.

A cg indicator (1, figure 1-10), located on the fuel control panel, indicates (in percent of the mean aerodynamic chord) the airplane center of gravity; and provides selection of the desired cg. The indicator has two pointers, a switching unit, and a selector set knob. One of the indicator pointers shows the actual cg location. The other pointer is manually controlled with the selector set knob, located on the face of the instrument. During automatic cg control, the desired cg is selected by adjusting this indicator pointer with the selector set knob. The switching unit transmits signals to the fuel system for transferring fuel forward or aft as required to move and maintain the airplane cg at the selected position. When the preselected cg is obtained, the fuel transfer is stopped automatically. The airplane cg is maintained within 0.5 ± 0.1 percent MAC of the selected cg setting. The cg indicator requires 115-volt a-c power and the switching unit requires 28-volt d-c power.

CG Repeater Indicator.

A cg repeater indicator (6, figure 4-26), located on the auxiliary flight instrument panel at the navigator's station, provides the navigator with an indication of the airplane cg location (in percent of the mean aerodynamic chord). The indicator has two pointers and a set knob. One of the pointers shows the actual cg location and is slaved directly to the cg indicator on the fuel control panel. The other pointer is manually

warning and caution lamp panels



NOTE:
All lamps are shown as they will appear when lighted for identification purposes. Unlighted warning and caution indicators are inactive.

170100-47

Figure 1-12.

controlled with the set knob and may be set to reference a desired cg; however, the pointer has no effect on automatic cg control. The indicator requires 115-volt a-c power.

Note

The repeater indicator is identical to the cg indicator on the fuel control panel except that it does not permit selection or control of the cg location.

CG Calibrator Adjustment Knobs.

Six cg calibrator adjustment knobs (figure 1-11) are located on the cg calibrator panel. These knobs permit adjusting the cg control system to compensate for variations in airplane (return component) and pod dry weights, airplane and pod dry cg locations and cg location of fuel in the forward and aft tanks of the pod. The pod values are automatically disconnected anytime the pod is removed from the airplane. A clear plastic cover on the cg calibrator panel enables the flight crew to verify the adjustments without removal of the cover. The proper values for the adjustments are obtained from the supplement to Form 365F and should be verified before each flight.

Note

The pod calibration switch and other adjustments under a safetied cover on the cg calibrator panel are used only during calibration and adjustment of the entire fuel system.

Fuel Flow Direction Indicators.

Seven fuel flow direction indicators (20, figure 1-10), located on the fuel control panel, indicate routing of fuel for engine supply and transfer. When an indicator is energized it does not necessarily mean that fuel is flowing through the line as indicated, but only that the system is electrically set up for flow in that direction. To determine if fuel is flowing as indicated it is necessary to monitor the respective fuel quantity indicator. The indicators operate on 28-volt d-c power.

Automatic CG Off Caution Lamp.

An automatic cg off caution lamp (figure 1-12), located on the caution panel, lights and displays "CG OFF" when the cg of the airplane is not within one percent of the desired location during automatic cg control. The lamp will light when the cg is originally shifting to, but has not reached, the desired position, or when the cg is not maintained within one percent of the selected setting. The lamp is connected to the master caution lamp circuit and operates on 28-volt d-c power. For testing and dimming of the lamp, refer to the "Pilot's Indicator Lamp System" of this section.

Manifold Low Pressure Warning Lamps.

Two manifold low pressure warning lamps (figure 1-12), located on the warning lamp panel, light and display "L MANF LOW PRESS" or "R MANF LOW PRESS" if the left or right engine supply manifold pressure drops below 11 (±.5) psi. The appropriate lamp will remain lighted until the manifold pressure increases to 13.5 psi. The warning lamps are connected to the master warning lamp circuit and operate on 28-volt d-c power. For testing and dimming of the lamps, refer to the "Pilot's Indicator Lamp System" of this section.

Booster Pump Low Pressure Caution Lamps.

Eleven booster pump low pressure caution lamps (figure 1-12), one each for pumps No. 1 through 11, are located on the caution lamp panel. Each lamp is operated by a fuel pressure switch which receives pressure from the discharge side of its respective fuel pump. The appropriate lamp will light when the discharge pressure of a booster pump falls below 10.5 (±.5) psig. The appropriate lamp will remain lighted until the pump discharge pressure increases to 12 psig. The caution lamps are connected to the master caution lamp circuit and operate on 28-volt d-c power. For testing and dimming of the lamps, refer to the "Pilot's Indicator Lamp System" of this section.

Reservoir Tank Not Full Caution Lamp.

A reservoir tank not full caution lamp (figure 1-12), located on the caution lamp panel, lights and displays "RES NOT FULL" when the reservoir tank fuel quantity has dropped below the full level. The lamp operates on 28-volt d-c power and is controlled by a float switch in the reservoir tank. The lamp is connected to the master caution lamp circuit. For testing and dimming of the lamps, refer to the "Pilot's Indicator Lamp System" of this section.

ELECTRICAL POWER SUPPLY SYSTEM.

Electrical power for the airplane is generated by three engine-driven generators which supply 115/200-volt alternating current to an a-c bus network. The a-c buses supply power to eight d-c power units which deliver multiple voltages to a d-c bus network. A battery provides an emergency source of d-c power which can be connected to the 28-volt d-c essential bus with a battery switch. The a-c and d-c power systems are protected by fuses located in four power panels (figures 1-15, 1-16, 1-17 and 1-18) at the navigator's and DSO's station. Spare fuses are provided for replacement in flight under favorable conditions of flight and accessibility. To aid the operator in locating fuses for a particular system, the fuse nameplates are color coded as follows: blue denotes electrical feeders, red denotes fuel system, green denotes engines and orange denotes autopilot, flight controls and air data system. All other fuse nameplates are gray. Automatic and manual load-reducing features protect the a-c and d-c power sources in case of partial electrical failures. For ground operation, an external power receptacle permits the use of an auxiliary power unit. Operation of the electrical power supply system is automatic when the electrical control panel is set up in the normal configuration. For information on pod electrical systems, refer to "Pods," Section IV.

A-C POWER SYSTEM.

Alternating current is distributed by the left and right main a-c buses. (Refer to figure 1-13.) Each bus receives three-phase, 200-volt alternating current from a generator power source. The airplane is equipped with three oil-cooled, 40-KVA, 111-ampere generators driven by engines 1, 2, and 3. Each generator has a constant-speed drive which is connected to the engine by a drive shaft. The constant-speed drive maintains generator speed at 8000 rpm when engine speed is at idle or above. In normal operation, the No. 1 generator energizes the left main a-c bus, the No. 3 generator energizes the right main a-c bus, and the No. 2 generator serves as a standby source on the bus crossfeed circuit. If a primary generator (No. 1 or No. 3) fails, the standby generator (No. 2) is immediately connected to the applicable bus by automatic switching circuits, provided all generator control switches are in the GEN

1 (2, 3) positions. A single generator can energize both a-c buses, but lockout circuits prevent two generators from energizing the same bus. The a-c power system is equipped with an automatic load-reducing safety feature. If a situation arises in which two generators fail or are taken out of operation, relays automatically cut off electrical power from the pod and DECM equipment. This prevents the a-c load from exceeding the capabilities of the remaining good generator. When necessary, power can be restored to the pod and DECM through the use of a pod and DECM power switch. All controls and indicators for the a-c power supply system are located on the electrical control panel (figure 1-14) at the pilot's station. Using the frequency meter and voltmeter on the electrical control panel to monitor the generators and the left and right a-c buses, the following values should be read: 115 ±5 volts and 400 ±6 cycles per second. These values include meter tolerances.

Generator Control Switches.

Three control switches (6, figure 1-14), one for each generator, are located on the electrical control panel. Each switch has three positions: RESET, OFF, and GEN 1 (2, 3). The switch is spring-loaded from RESET to OFF. While the switch is held momentarily in the RESET position, the respective field flashing circuits are closed and the voltage regulation circuits are connected to the generator. These actions excite the generator and place it in operation. When the switch is placed in the GEN position, the associated power transfer contactor is electrically actuated, connecting the generator to its bus or crossfeed circuit. When the switch is placed in the OFF position, the power transfer contactor is electrically tripped, isolating the generator from its bus or crossfeed circuit. The generator control switches control 28-volt direct current to the actuation and trip coils of the power transfer contactors.

Note

When an abnormal voltage condition exists, protection circuits automatically override the switch circuits to isolate the malfunctioning generator. When an excessive current condition exists, a protection circuit automatically overrides the switch circuits to isolate both generator and bus.

A-C Meter Selector Knob.

An a-c system meter selector knob (8, figure 1-14), located on the electrical control panel, enables the pilot to monitor the generator and bus systems with the three instruments mounted on the panel. The rotary-type knob has positions marked GEN 1, L BUS, GEN 2, R BUS, and GEN 3. Placing the knob in a generator position connects the voltmeter, frequency meter, and ammeter to the respective generator. Placing the knob in a bus position connects the voltmeter and frequency meter to the respective a-c bus system.

Note

The ammeter is not operational when the meter selector knob is in a bus position.

Pod & DECM Power Switch.

This two-position switch (3, figure 1-14), located on the electrical control panel, provides a means of restoring electrical power to the pod and DECM equipment after it has been interrupted by the automatic load-reducing circuit. The switch has positions marked NORMAL and RESET, and is mechanically latched in the NORMAL position. With the switch in the NORMAL position, electrical power is available to the pod and DECM equipment until two generators fail, at which time the automatic load-reducing circuits remove power from the pod and DECM equipment. When the switch is placed in the RESET position during single generator operation, the automatic load-reducing circuits are overridden and electrical power is again restored to pod and DECM equipment. To move the switch out of the NORMAL position, it is necessary to pull out on the handle.

CAUTION

Before placing the pod & DECM power switch to the RESET position, check that the restoration of pod and DECM power does not cause the total current load to exceed single generator capabilities. It may be necessary to de-energize other equipment using a-c power in order to safely restore pod and DECM power.

A-C Voltmeter.

A voltmeter (7, figure 1-14), located on the electrical control panel, is provided to enable the pilot to monitor the voltages delivered by the three generators and the two a-c bus systems. The meter scale is calibrated from 0 to 150 volts. With the meter selector knob in any one of the generator or bus positions, the normal indication should be 115 ±5 volts.

a-c power distribution

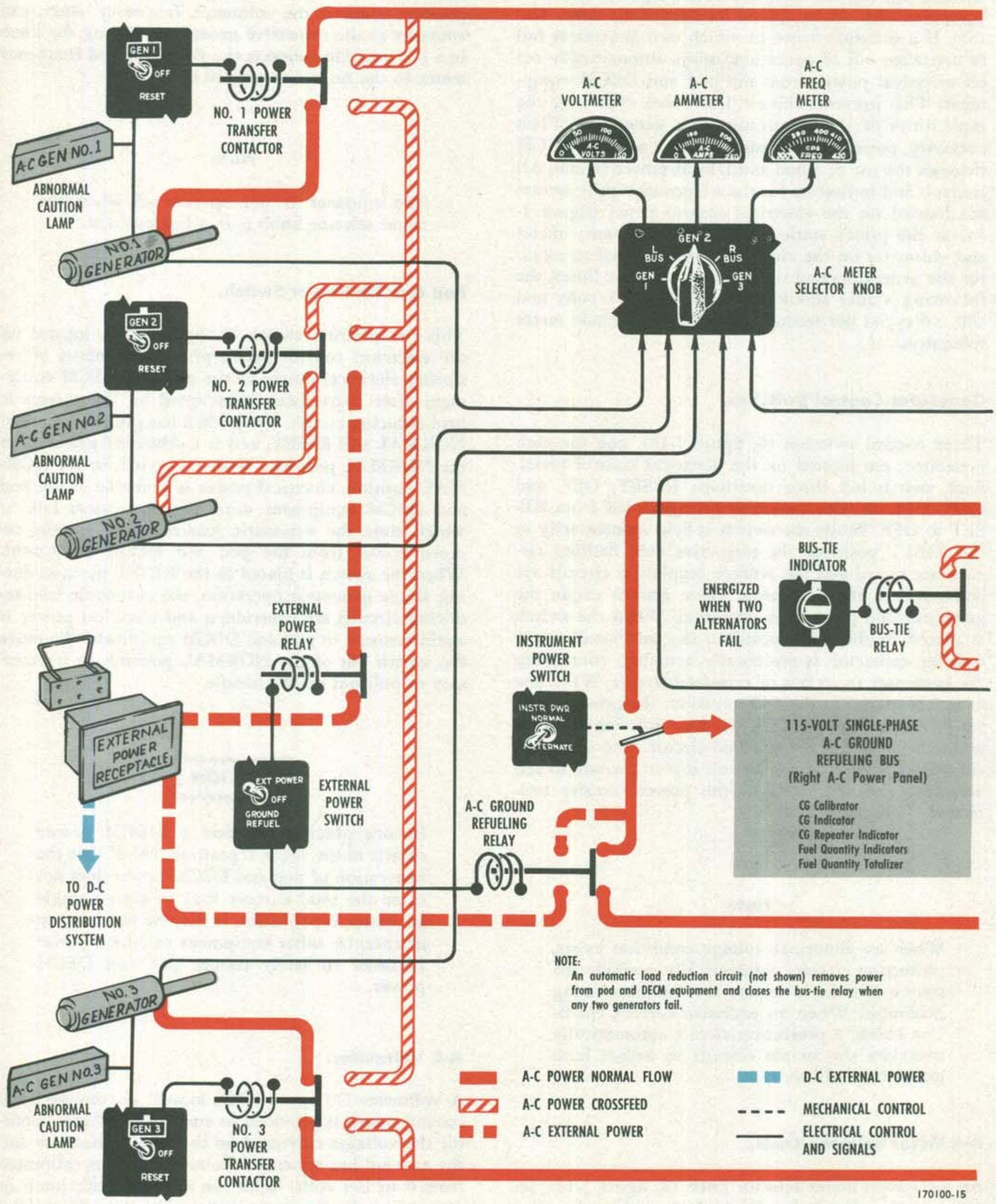


Figure 1-13. (Sheet 1 of 2)

TO D-C-POWER UNITS

115/200-VOLT LEFT A-C BUS
(Left A-C Power Panel)

200-VOLT THREE-PHASE

Autopilot (Amplifier-Computer Assembly)
Doppler Radar
Fuel Booster Pumps (No. 2, 4, 6, 8, and 10)
Forward Tank Scavenge Pump No. 12
Inflight Printer
Long Range Communication (Provisions)
Navigation Unit
Pod Feeders
Power Control Linkage Assembly
Rendezvous Beacon (Provisions)
Search Radar
Spike Position Actuators (Engines 1 and 2)
Stabilization Unit

115-VOLT SINGLE PHASE

Air Data Computer
Air Data Computer Heater
Astrotracker
Attitude Indicators (Pilot's and Navigator's)
CNAS Control Panel (AN/ARN-50)
CNAS Receiver Package (AN/ARN-50)
Engine Afterburner Ignition Units (Engines 1 and 2)
Engine Anti-Icing Valves (Engines 1 and 2)
Engine Fuel Flow Indicators
Engine Fuel Flow Totalizer
Engine Pressure Ratio Indicators (Engines 1 and 2)
Exhaust Nozzle Position Indicators (Engines 1 and 2)
IBDA Camera Heater
IBDA Data Package
Landing Light (Left)
Machmeter
Navigation Unit Heater
Oxygen Quantity Indicator
Radio Altimeter System
Stabilization Unit Heater
Time Clock (Elapsed Time Indicators)
Upper Anticollision Lights
VGH Recorder

115/200-VOLT LEFT A-C BUS
(Right A-C Power Panel)

200-VOLT THREE-PHASE

Aft Tank Scavenge Pump (No. 13)
ALQ-15
ALQ-16
Fire Control Computer Package
Fuel Booster Pumps (No. 1, 3, 5, 7, 9, and 11)
Pod Feeders
Spike Position Actuators (Engines 3 and 4)

115-VOLT SINGLE-PHASE

ALR-12
Cabin Temperature Controller
Chaff Dispenser Control Unit (Provisions)
Command Radio Receiver Transmitter (AN/ARC-57)
Critical Temperature Indicator
Electronic Equipment Air Conditioning Control Units (Aft Fuselage)
Engine Afterburner Ignition Units (Engines 3 and 4)
Engine Anti-Icing Valves (Engines 3 and 4)
Engine Pressure Ratio Indicators (Engines 3 and 4)
Exhaust Nozzle Position Indicators (Engines 3 and 4)
Fire Control System Control Indicator
IFF Air-to-Air
IFF Air-to-Ground
Landing Light (Right)
Lower Anticollision Lights
Nose Gear Steering
Pilot's Instrument Panel Vibrator
Pitot Tube Heater
Pod Fire Detector System
Ram Air Scoop
Seat Positioning Actuators (Pilot's, Navigator's, and DSO'S)
Time Clock (Elapsed Time Indicators)

TO D-C POWER UNITS

170100-140

Figure 1-13. (Sheet 2 of 2)

Frequency Meter.

The frequency meter (9, figure 1-14), located on the electrical control panel, enables the pilot to monitor frequencies of the generator and bus currents. The scale of this meter is calibrated from 380 to 420 cycles per second. With the meter selector knob in a generator or bus position, the normal meter indication should be 400 ±6 cycles per second.

A-C Ammeter.

The a-c ammeter (10, figure 1-14), located on the electrical control panel, enables the pilot to monitor the current loads being placed on the generators. The meter scale is calibrated from 0 to 250 amperes. With the meter selector knob in a generator position, the meter will indicate the current flow from the generator to the bus.

Note

The ammeter is not operational when the meter selector knob is in a bus position.

Power Flow Indicators.

Two power flow indicators (5, figure 1-14), located on the electrical control panel, indicate the flow of power from source to bus. Each indicator, one for each bus, is a three-position, dual-solenoid instrument. Right-angled white lines appear in the indicator window to show that the bus is being supplied by either a primary or the standby generator. If a bus is not energized or if power is being supplied through the bus-tie relay, diagonal stripes appear in the window.

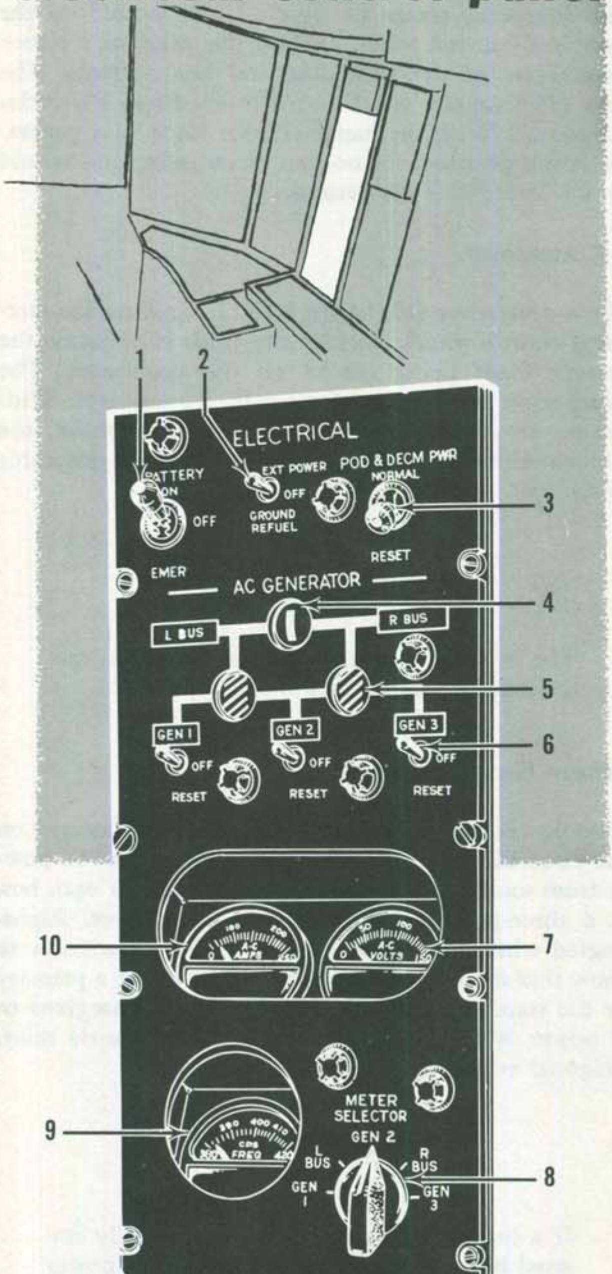
Note

If a bus and generator are automatically isolated by an overcurrent condition, the power flow indicator will continue to show a right-angled white line.

A-C Generator Abnormal Caution Lamps.

Three a-c generator abnormal lamps (figure 1-12), one for each generator, are located on the warning and caution lamp panel and warn of abnormal conditions existing in the generator systems. The appropriate lamp will light and display "AC GEN NO. 1 (2, 3)" to indicate de-excitation, off-frequency, or overtemperature conditions in the respective generator. When starting the engines, each lamp will remain lighted until its generator is excited. The lamps are connected

electrical control panel



1. Battery Switch
2. External Power Switch
3. Pod and DECM Power Switch
4. Bus-Tie Indicator
5. Power Flow Indicator (2)
6. Generator Control Switch (3)
7. A-C Voltmeter
8. A-C Meter Selector Knob
9. Frequency Meter
10. A-C Ammeter

170100-16

Figure 1-14.

to the master caution lamp circuit and operate on 28-volt d-c power. For dimming and testing of the lamps, refer to the "Pilot's Indicator Lamp System," of this section.

Bus-Tie Indicator.

A two-position bus-tie indicator (4, figure 1-14), located on the electrical control panel, indicates when the bus-tie relay has closed. A horizontal white line appears in the indicator window to show that the bus-tie relay has closed. A horizontal white line indication also serves as a warning device, since the bus-tie relay closes automatically whenever any two generators are inoperative. When the bus-tie relay is open or the indicator is de-energized, a vertical white line appears in the indicator window.

Pod and DECM Power Caution Lamp.

A pod and DECM power caution lamp (figure 1-12), located on the warning and caution lamp panel, lights and displays "POD & DECM POWER" when the automatic load-reducing function has removed electrical power from the pod and DECM equipment. The lamp is connected to the master caution lamp and operates on 28-volt d-c power. For dimming and testing of the lamp, refer to the "Pilot's Indicator Lamp System," of this section.

D-C POWER SYSTEM.

Direct current is distributed by a network of d-c buses which receive power from eight multiple-voltage d-c power units and a battery. (Refer to figure 1-19.) The power units, which produce direct current by rectifying a-c power from the main a-c buses, are installed in a rack forward of the left console at the DSO's station. The eight units are equally divided into a forward and aft bank, and the individual units of the two banks are paired and wired in parallel. A pair of units produces one of the following voltages: 250-volt dc, 150-volt dc, negative 150-volt dc, and 28-volt dc. The 28-volt d-c power units also produce 28-volt a-c power for miscellaneous low-voltage a-c requirements. The forward bank receives power from the right main a-c bus and the aft bank receives power from the left main a-c bus. If a power unit in either bank fails, the corresponding unit in the other bank assumes the full load for that voltage. During normal inflight operation, the power units are cooled by cabin air conditioning. During abnormal flight conditions, a cooling fan in each unit automatically limits operating temperatures. During ground operations, the cooling fans operate continuously whenever power is being supplied from an external source. The battery, located at the navigator's station, is provided for emergency d-c power and is connected directly to the battery bus. Under

left a-c power panel (typical)

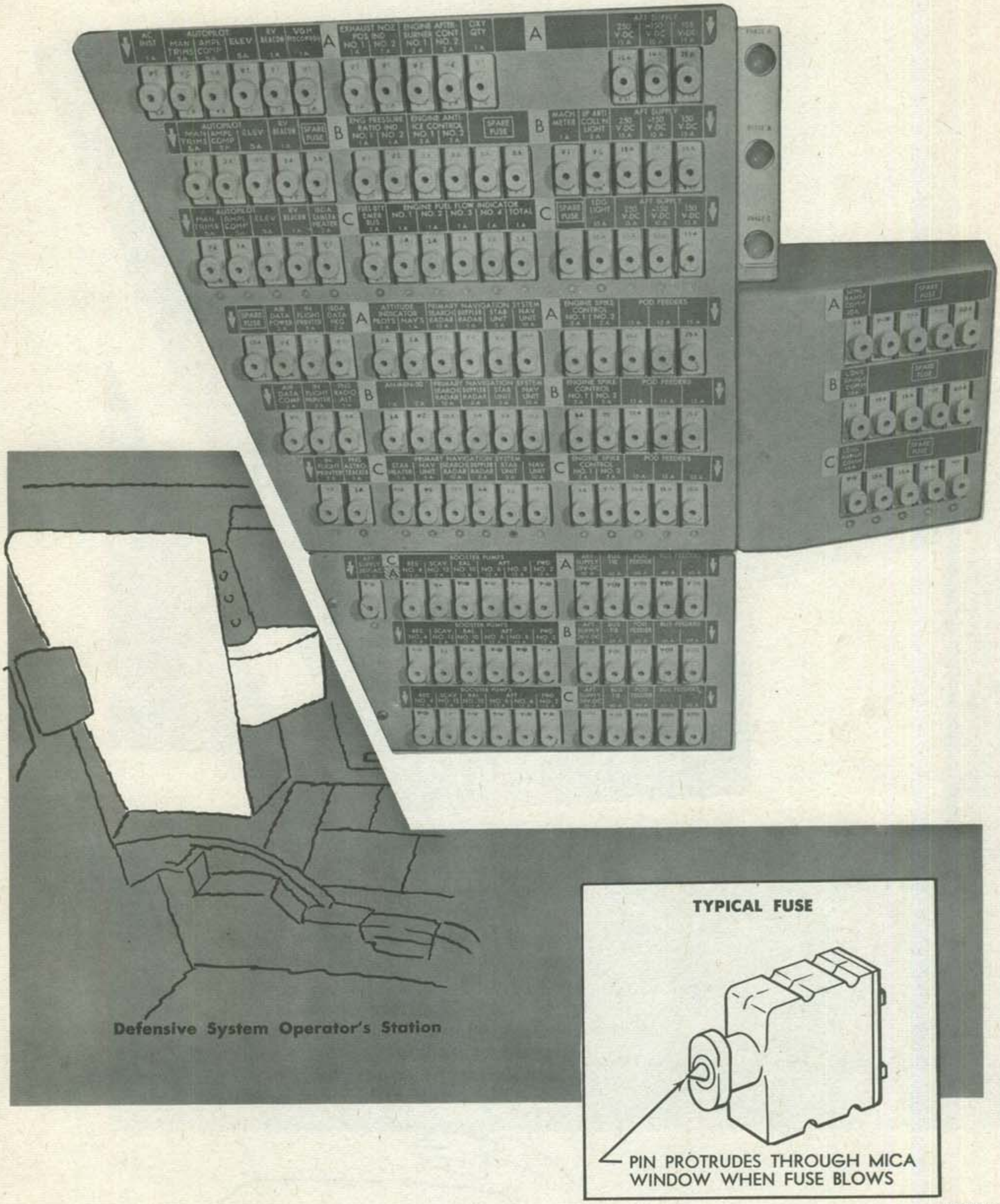


Figure 1-15.

right a-c power panel (typical)

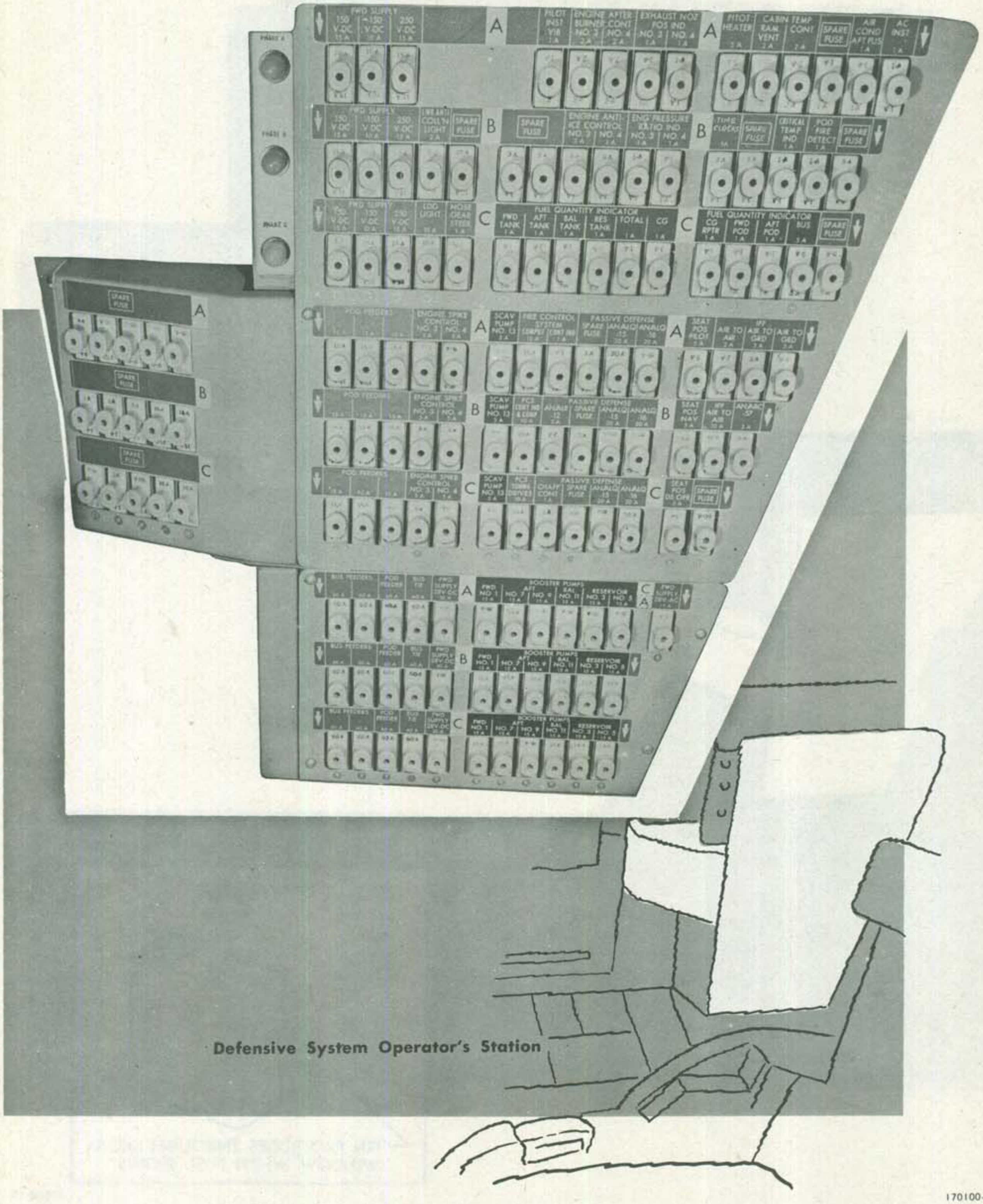


Figure 1-16.

normal conditions, the two 28-volt d-c power units supply power to the non-essential bus which in turn supplies power to the essential bus, the ground refueling bus and the interphone bus. In the event that power from the non-essential bus is disrupted, the battery bus is automatically connected to the essential bus provided the battery switch is in the ON position. The battery bus can also be manually connected to the essential bus in the event of a failure of the automatic transfer system by placing the battery switch in the EMER position. Blocking diodes prevent the battery from supplying power to the non-essential bus. The discharge time of the battery is monitored by a timer which also functions as a charge time limiter. The timer places the battery on charge for a period approximately twice the discharge interval up to a maximum charge time of 150 minutes. Following the termination of a discharge and the reinstatement of power on the non-essential bus, the timer will place the battery on charge. Blocking diodes are included in the charging circuit to insure the correct current flow. The charging and discharging circuits are two separate and distinct circuits. The battery is contained in a box which is connected to the air conditioning system and to an overboard vent line to provide force ventilation. Operation of the d-c power supply system is entirely automatic. An ammeter, a voltmeter, and a rotary-type selector knob, mounted on the d-c system check panel (figure 1-20) at the upper aft end of the power unit rack, enable the DSO to monitor each d-c power unit. Using the voltmeter to monitor the power supplies, the following range of voltages from no load to full load should be indicated.

28-volt units (d-c section)	24.5 to 30 (full scale acceptable)
150-volt units	141 to 159
—150-volt units	—141 to —159
250-volt units	226 to 277

Note

- The voltmeter cannot be used to monitor the 28-volt a-c power.
- The above voltage values include meter tolerances.

Battery Switch.

The three-position battery switch (1, figure 1-14), located on the electrical control panel, has three positions marked ON, OFF and EMER and is mechanically latched in each position. When the switch is in the ON position, the automatic transfer function is set up to automatically connect the battery to the essential bus in the event of a power failure of the non-essential bus. Placing the switch in the EMER position bypasses the automatic transfer circuits and connects the battery bus to the essential bus. With the battery switch in the OFF position, the battery cannot be connected to the essential bus by the automatic transfer circuit. To move the switch out of any position, it is necessary to pull out on the switch handle.

Battery Discharging Caution Lamp.

A battery discharging caution lamp (figure 1-12), located on the warning and caution panel, lights and displays "BAT DISCHARGING" when the battery is supplying power to the essential bus. The lamp is connected to the master caution lamp circuit and operates on battery power. For dimming and testing of the caution lamp, refer to the "Pilot's Indicator Lamp System," of this section.

D-C Meter Selector Knob.

The d-c meter selector knob (figure 1-20), located on the d-c system check panel at the DSO's station, permits the crew member to monitor each of the d-c power units. The rotary type knob has ten positions. The positions on the left and right side of the knob are marked 28VDC, 150VDC, 250VDC, and —150VDC. When the meter selector knob is placed in any one of the voltage positions on the left side, the d-c voltmeter and ammeter are connected to the respective power unit in the aft bank of the rack. With the knob in a voltage position on the right side, the voltmeter and ammeter are connected to the respective power unit in the forward bank.

D-C Voltmeter.

A voltmeter (figure 1-20) is located on the d-c system check panel at the DSO's station. The meter, which is connected to any one of the d-c buses through the d-c meter selector knob, is a direct-reading instrument. A single pointer moves over two scales. Voltages of the 28-volt d-c bus are read on the lower scale, which is marked from 0 to 30. Voltages of the other d-c buses are read on the upper scale, which is marked from 0 to 300.

Note

The d-c voltmeter cannot be used to monitor the 28-volt a-c power supply; nor can it be used as a reference to adjust the output voltage of the d-c power units.

D-C Ammeter.

An ammeter (figure 1-20) is located on the d-c system check panel at the DSO's station. This instrument is connected to any one of the power units through the d-c meter selector knob. When measuring a power unit

28-volt d-c power panel (typical)

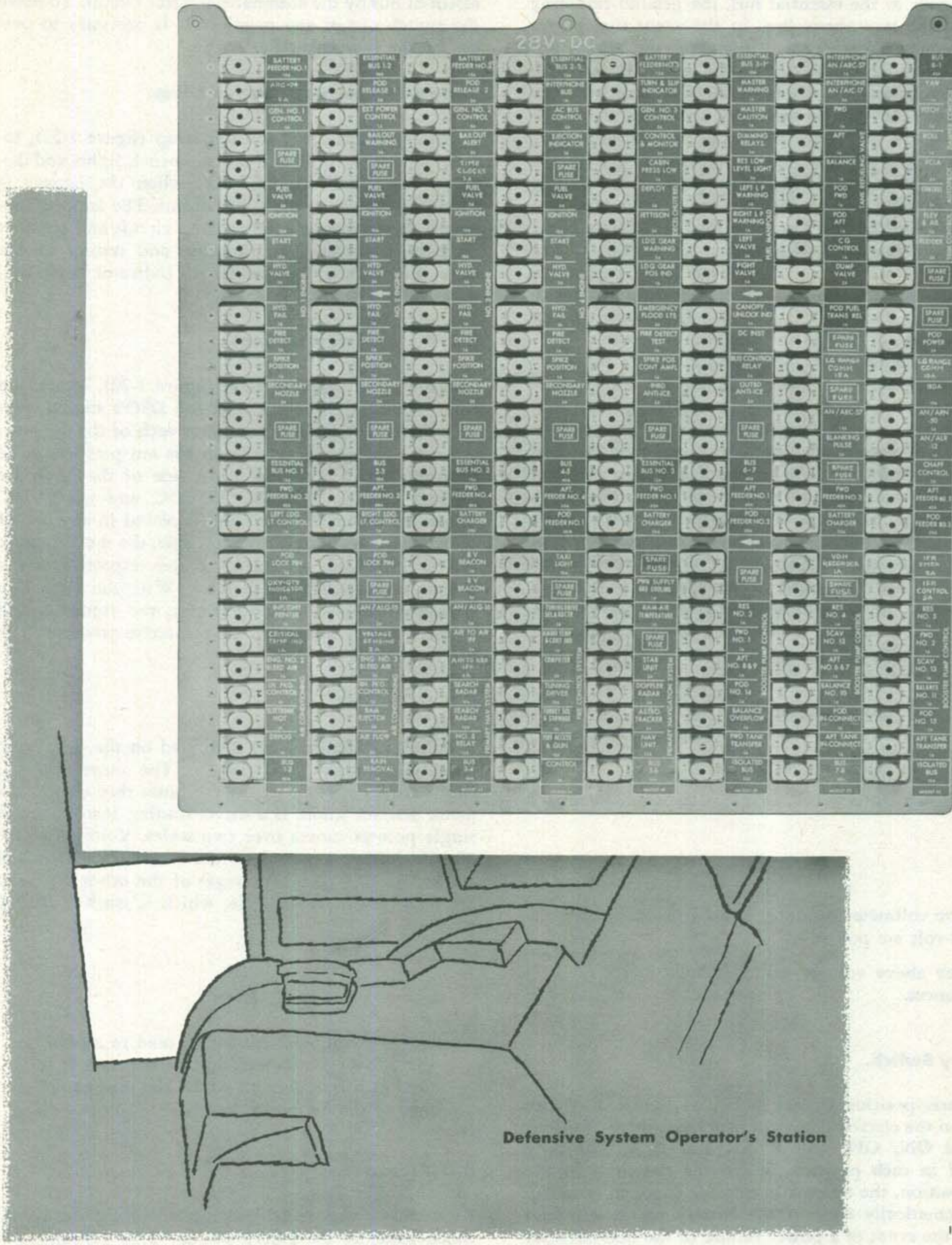


Figure 1-17.

multiple voltage power panels (typical)

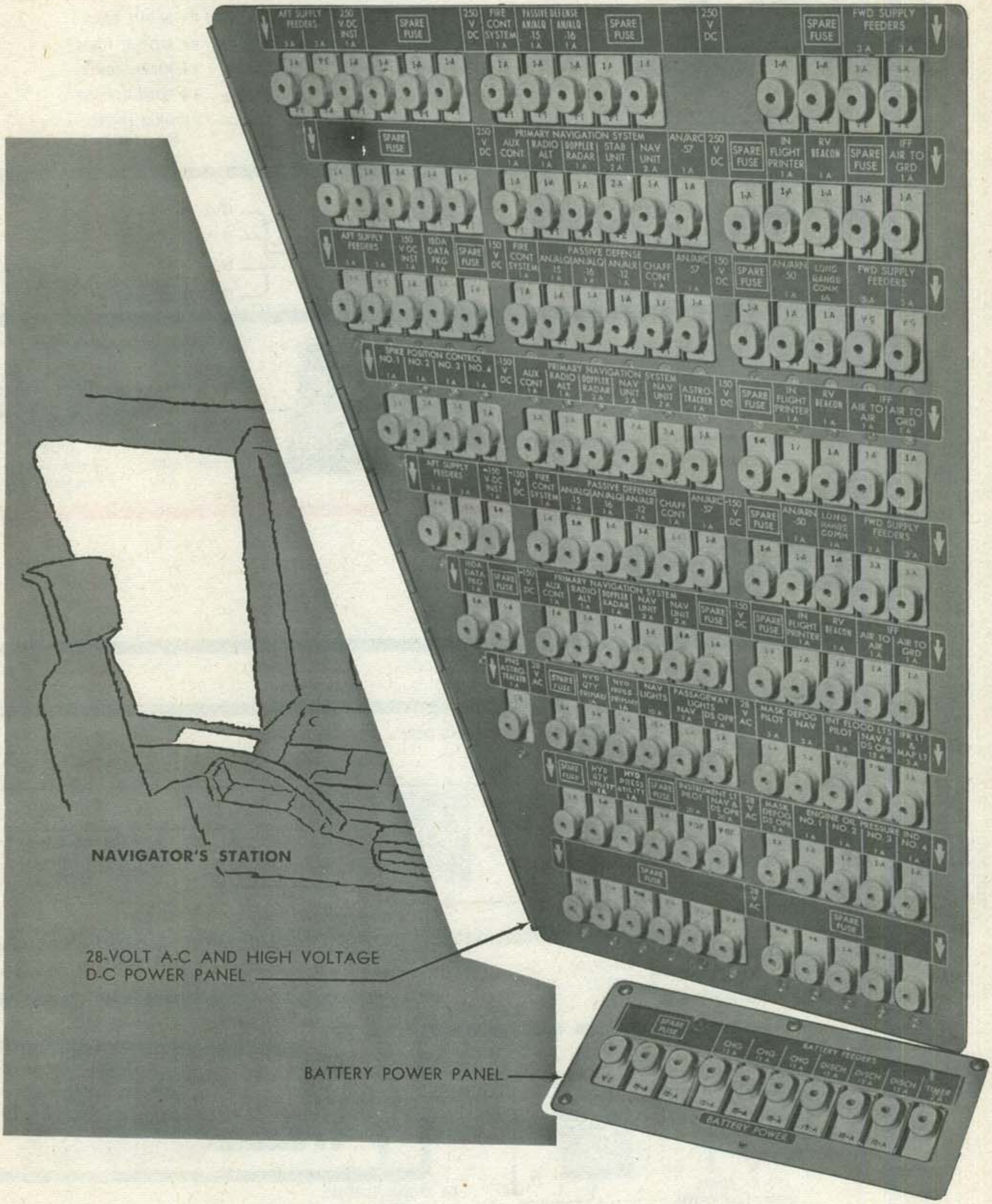


Figure 1-18.

d-c power distribution

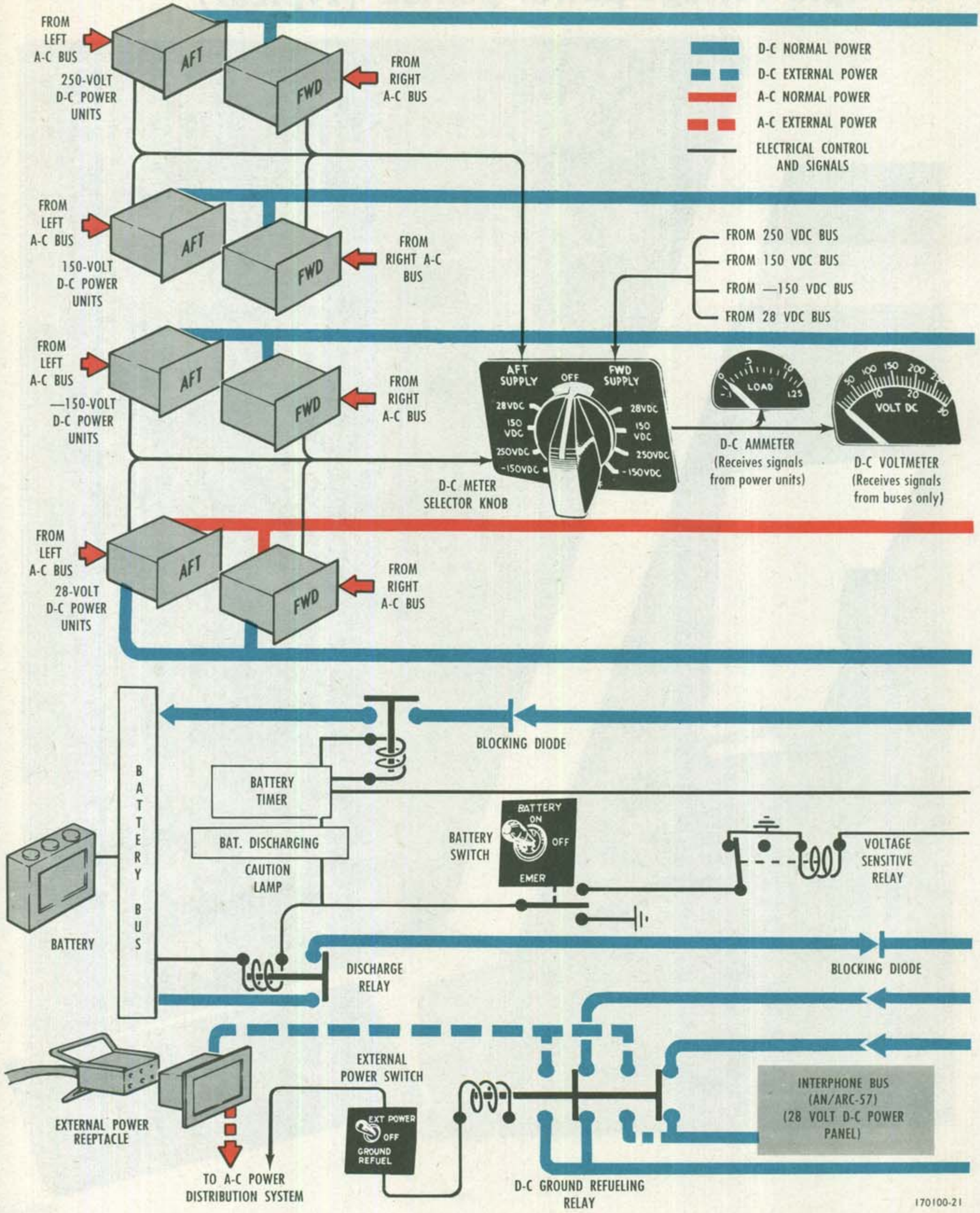


Figure 1-19. (Sheet 1 of 2)

250-VOLT D-C BUS (28-Volt A-C and High Voltage D-C Power Panel)

- ALQ-15
- ALQ-16
- Command Radio Receiver-Transmitter (AN/ARC-57)
- Doppler Radar
- Fire Control Computer Package
- IFF Air-To-Ground
- Inflight Printer
- Navigation Unit
- Primary Navigation Auxiliary Control
- Radio Altimeter System
- Rendezvous Beacon (Provisions)
- Stabilization Unit

150-VOLT D-C BUS (28-Volt A-C and High Voltage D-C Power Panel)

- ALQ-15
- ALQ-16
- ALA-12
- Astrotracker
- Chaff Control (Provisions)
- CNAS Receiver Package (AN/ARN-50)
- Command Radio Receiver-Transmitter (AN/ARC-57)
- Doppler Radar
- Fire Control Computer Package
- Fire Control Radar Package
- IBDA Data Package
- IFF Air-To-Air
- IFF Air-To-Ground
- Inflight Printer
- Long Range Communications (Provisions)
- Navigation Unit
- Primary Navigation Auxiliary Control
- Radio Altimeter System
- Rendezvous Beacon (Provisions)
- Spike Position Amplifier Package

–150-VOLT D-C BUS (28-Volt A-C and High Voltage D-C Power Panel)

- ALQ-15
- ALQ-16
- ALR-12
- Astrotracker
- Chaff Control (Provisions)
- CNAS Receiver Package (AN/ARN-50)
- Command Radio Receiver-Transmitter (AN/ARC-57)
- Doppler Radar
- Fire Control Computer Package
- Fire Control Radar Package
- IBDA Data Package
- IFF Air-To-Air
- IFF Air-To-Ground
- Inflight Printer
- Long Range Communications (Provisions)
- Navigation Unit
- Primary Navigation Auxiliary Control
- Radio Altimeter System
- Rendezvous Beacon (Provisions)

28-VOLT A-C BUS (28-Volt A-C and High Voltage D-C Power Panel)

- Astro Tracker
- Engine Oil Pressure Indicators
- Face Mask Defog
- Hydraulic Pressure Indicators
- Hydraulic Quantity Indicators
- Inflight Refueling Light Dim Control
- Instrument Panel Lights
- Interior Flood Lights
- Map Light Control
- Navigation Lights
- Passageway Lights

NON-ESSENTIAL BUS (28-Volt D-C Power Panel)

- Air Conditioning System Controls (Refrigeration Unit—L and R Package, Air Source—Engine 2 and 3 Bleed Air and Airflow)
- Air Refueling (IFR) Controls
- AN/ALQ-15
- AN/ALQ-16
- AN/ALR-12
- Astrotracker
- Autopilot Controls and Power Control Linkage Assembly
- Blanking Pulse Junction Box
- Chaff Control (Provisions)
- CNAS Receiver Package (AN/ARN-50)
- Damper Controls (Pitch, Yaw and Roll)
- Doppler Radar
- Electronic Equipment Critical Temperature Indicator
- Electronic Hot Caution Lamp
- Engine Anti-Ice Controls
- Fire Control Ammunition Temperature Control and Indicator
- Fire Control Computer Package
- Fire Control Gun Circuits
- Fire Control Manual Control Package
- Fire Control Radar Anti-Jam
- Fire Control Tracking Control Package
- Fuel Booster Pump Controls (Includes Scavenge and Pod Pumps)
- Fuel System Valve Controls (Except Refuel Valves and Dump Valves)
- IBDA System
- IFF Air-To-Air
- IFF Air-To-Ground
- Inflight Printer
- Landing Gear Light Controls
- Long Range Communication (Provisions)
- Navigation Unit
- Oxygen Low Quantity Indicator
- Pod Power Feeders
- Pod Pin Lock Indicator
- Radio Receiver-Transmitter Package (AN/ARC-57)
- Ram Air Ejector Valve
- Ram Air Temperature Indicator
- Rendezvous Beacon (Provisions)
- Search Radar
- Secondary Nozzle Control
- Spike Position Controls
- Spike Position Control Amplifier
- Stabilization Unit
- Taxi Light
- Trim Controls (Elevator, Aileron and Rudder)
- VGH Recorder
- Windshield Defog Control
- Windshield Rain Removal Control

BLOCKING DIODE

ESSENTIAL BUS (28-Volt D-C Power Panel)

- A-C Bus Tie Control
- AN/ARC-74 Emergency UHF Command Radio (Provisions)
- Bailout Warning System
- Cabin Low Pressure Caution Lamp
- Canopy Unlock Caution Lamps
- Deceleration Chute Control
- Emergency Lighting Controls
- Engine Fire Detector System
- Engine Fuel Shutoff Valve Controls
- Engine Ignition and Starting Controls
- External Power Control
- Fuel Manifold Low Pressure Warning Lamps
- Generator Controls
- Hydraulic Firewall Shutoff Valve Controls
- Hydraulic Pump Caution Lamps
- Landing Gear Warning Lamp (In Handle)
- Landing Gear Position Indicators
- Master Warning and Caution Indication and Dimming Relays
- Pod Release Controls
- Pod Warhead Control and Monitoring
- Reservoir Manifold Shutoff Valve Controls
- Reservoir Not Full Caution Lamp
- Time Clock (Elapse Time Indicator)
- Turn and Slip Indicator

GROUND REFUEL BUS (28-Volt D-C Power Panel)

- CG Control System
- Fuel Dump Valve Controls
- Ground Interphone (AN/AIC-17)
- Pod Fuel Transfer Relay
- Refuel Valve Controls

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Figure 1-19. (Sheet 2 of 2)

d-c system check panel

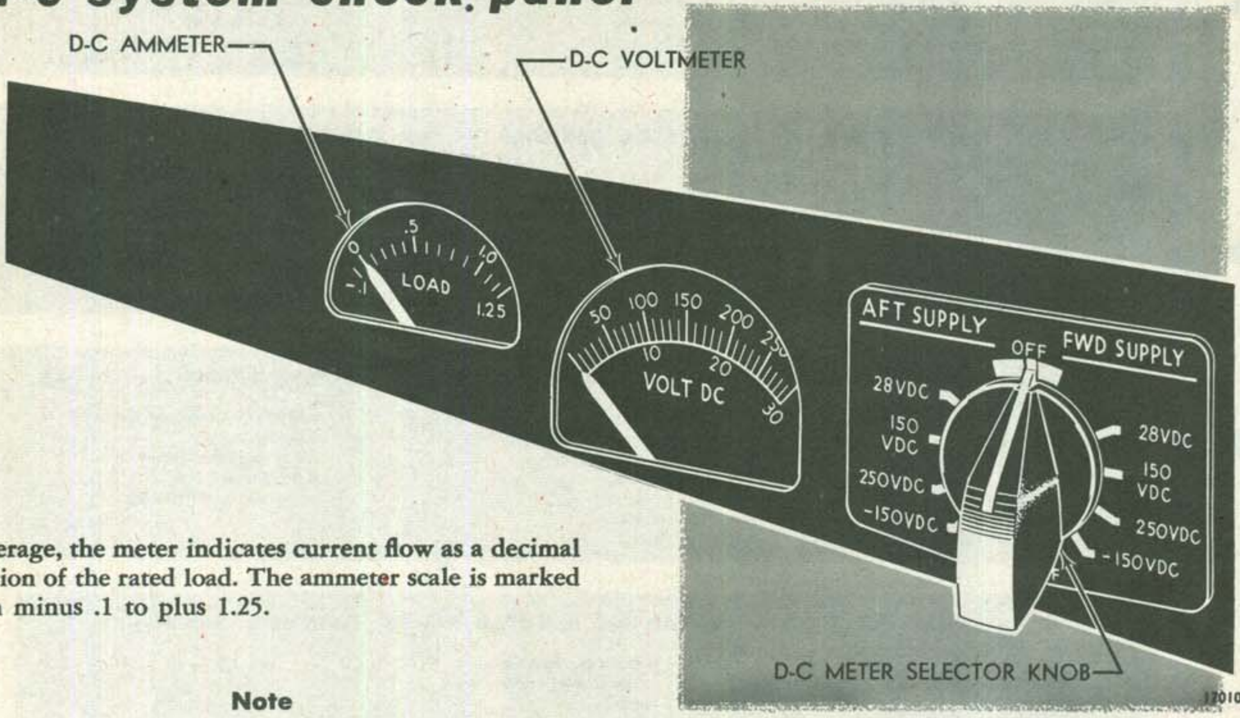

Figure 1-20.

amperage, the meter indicates current flow as a decimal fraction of the rated load. The ammeter scale is marked from minus .1 to plus 1.25.

Note

The d-c ammeter cannot be used to monitor the 28-volt a-c power supply.

ELECTRICALLY OPERATED EQUIPMENT.

For listings of electrically operated equipment, refer to figures 1-13 and 1-19.

EXTERNAL POWER SOURCE.

Electrical power for ground operations is supplied by an auxiliary power unit. The unit is connected to the external power receptacle located on the right side of the fuselage below the wing leading edge. When the auxiliary power unit is in use, 200-volt alternating current is routed to the bus crossfeed circuit to energize the main a-c buses.

CAUTION

The electrical power should not be connected to the airplane unless air conditioning is available for equipment cooling.

Direct current for ground operations is provided, as in normal flight operation, through the multiple voltage d-c power supply system, provided a main a-c bus is energized. A switch in the pilot's compartment enables servicing personnel to isolate the refueling buses for use with the external power source in single-point ground refueling operations. For such operations, the external source supplies 115-volt, single-phase a-c power and 28-volt d-c power to the isolated buses only.

External Power Switch.

The external power switch (2, figure 1-14), located on the electrical control panel provides control of electrical power during operation with an external power unit. The switch positions are marked EXT POWER, OFF, and GROUND REFUEL. Placing the switch to EXT POWER connects the external power supply to the electrical system provided the generator control switches are positioned to OFF. Placing the switch to GROUND REFUEL supplies a-c and d-c power to the ground refueling equipment and isolates the other parts of the electrical system from the power supply. On airplane 35 ▶, the switch has four positions marked GRD MAINT, OFF, GRD REFUEL, and ALERT. Placing the switch to GRD MAINT connects the external power supply to the electrical system provided the generator control switches are positioned to OFF and the air conditioning system is activated. The latter feature prevents possible damage to electrical equipment from operation without proper cooling. The OFF and GRD REFUEL positions remain unchanged. Placing the switch to ALERT accomplishes the same thing as GRD MAINT except that the air conditioning requirement is bypassed.

HYDRAULIC POWER SUPPLY SYSTEM.

Two separate, constant-pressure-type hydraulic systems, a utility system (figure 1-21) and a primary system (figure 1-22), supply power for operation of the hydraulic equipment. The two systems are completely independent with no interchange of fluid pressure. The hydraulic power required for operation of the elevon and rudder control surfaces is equally divided between the utility and primary systems, each system being connected to separate actuators. With either system inoperative, the remaining system will assume the entire load of flight control operation. Under such a condition, maximum control surface force output is limited to half that of normal dual system operation. Also, the flow rate is reduced which results in slower response of the control surfaces; however, this will not be appreciably noticeable except when high loads are imposed on the control surfaces. In addition to providing power for the elevon and rudder control surfaces, the utility hydraulic system also supplies power for operating the landing gear, nose wheel steering, wheel brakes, tail turret, search radar, air refueling system, aileron-rudder interconnect, aileron damper servo, elevator damper servo and autopilot servos. The only additional equipment receiving hydraulic power from the primary system is the rudder damper servo. Each system consists mainly of a pressurized reservoir, two engine-driven pumps, two ram air fluid coolers, two accumulators, two pressure switches, a pressure indicator, a quantity indicator, a spring-loaded surge damper, and two hydraulic shutoff valves. In addition, the utility system includes a brake accumulator and a brake hand pump. Refer to figure 1-41 for hydraulic fluid specification. Each of the two hydraulic systems is independently supplied with fluid from a pressurized reservoir. The reservoirs are located in the main landing gear wheel wells—the utility reservoir in the left wheel well and the primary reservoir in the right wheel well. Each reservoir is pressurized by hydraulic pressure from its respective system. With the systems operating at a normal pressure of 3000 psi, a pressure of approximately 60 psi will be maintained in the pump suction side of each reservoir. Pressurization of the reservoirs is necessary to prevent pump cavitation. Fluid level in the reservoirs is determined by a sliding rod arrangement located on the reservoirs. The rod is etched to show the quantity of fluid in the reservoir and is visible from the ground. Fluid level in the reservoir varies with temperature and is serviced according to a placard on the sliding rod arrangement. The system must be pressurized in order to check the fluid level in the reservoir. Refer to figure 1-41 for servicing data. Hydraulic fluid pressure is supplied to the two systems by four engine-driven pumps, one per engine. Each of the hydraulic systems utilizes two pumps, manifolded together—two left wing pumps for the utility system and the right wing pumps for the primary system. In the event of a pump failure in either the utility or the primary hydraulic system, the affected system will continue to function with fluid pressure from the remaining pump. The variable delivery-type pumps are rated to deliver 25 gpm at 3000 psi. They are mounted on the aft side of the rear gear case in the lower part of the engine section. A ram air fluid cooler located in the ram air inlet duct of each nacelle provides automatic cooling of the hydraulic fluid during normal operation of the hydraulic system. The coolers are located in the pump suction supply lines. Each cooler is equipped with an integral thermal bypass arrangement which provides rapid warmup of the fluid during cold starts. A pump scavenge and bleeder bypass arrangement insures a small circulation of fluid through the cooler even when little or no hydraulic pressure is being used to operate the various hydraulic equipment. This prevents the static fluid in the pump suction and pump pressure lines from becoming overheated by engine heat. A pump scavenge valve allows the pump scavenge flow to bypass the cooler when a flame out has occurred in the engine. This improves the flow of fluid into the pump by reducing pressure differential between the cooler and the pump inlet, thus enabling the windmilling engine to maintain sufficient hydraulic pressure for flight control in case of four-engine flame out. Four piston-type accumulators, two for the primary and two for the utility hydraulic system, help maintain constant pressure in the elevon hydraulic lines. This assures rapid elevon surface response. The utility hydraulic system also includes a piston-type brake accumulator which supplies pressure for parking brakes. These accumulators are precharged with nitrogen according to the ambient temperature. Placards near the filler gages are used to determine the correct precharge pressure. Refer to figure 1-41 for servicing data. A pressure switch located in the hydraulic pressure line downstream from each pump energizes a pump failure caution lamp and the master caution lamp when pump pressure drops below 750 (±250) psi. The pressure switches, in conjunction with the caution lamps, furnish the only means of determining which hydraulic pump is not functioning in case of pump failure. An electrically actuated hydraulic shutoff valve is incorporated in the fluid suction line of each hydraulic pump and is located above the firewall in the nacelle center section. This valve is utilized to shut off the flow of hydraulic fluid to the nacelle in case of fire in the nacelle area. The hydraulic shutoff valves are controlled with the engine fire pull switches on the pilot's main instrument panel. Refer to "Engine Fire Detector System" of this section.

INDICATORS.

Hydraulic Pressure Indicator.

Two hydraulic pressure indicators (2, figure 1-26), one for each hydraulic system, are located on the

hydraulic power supply system (utility)

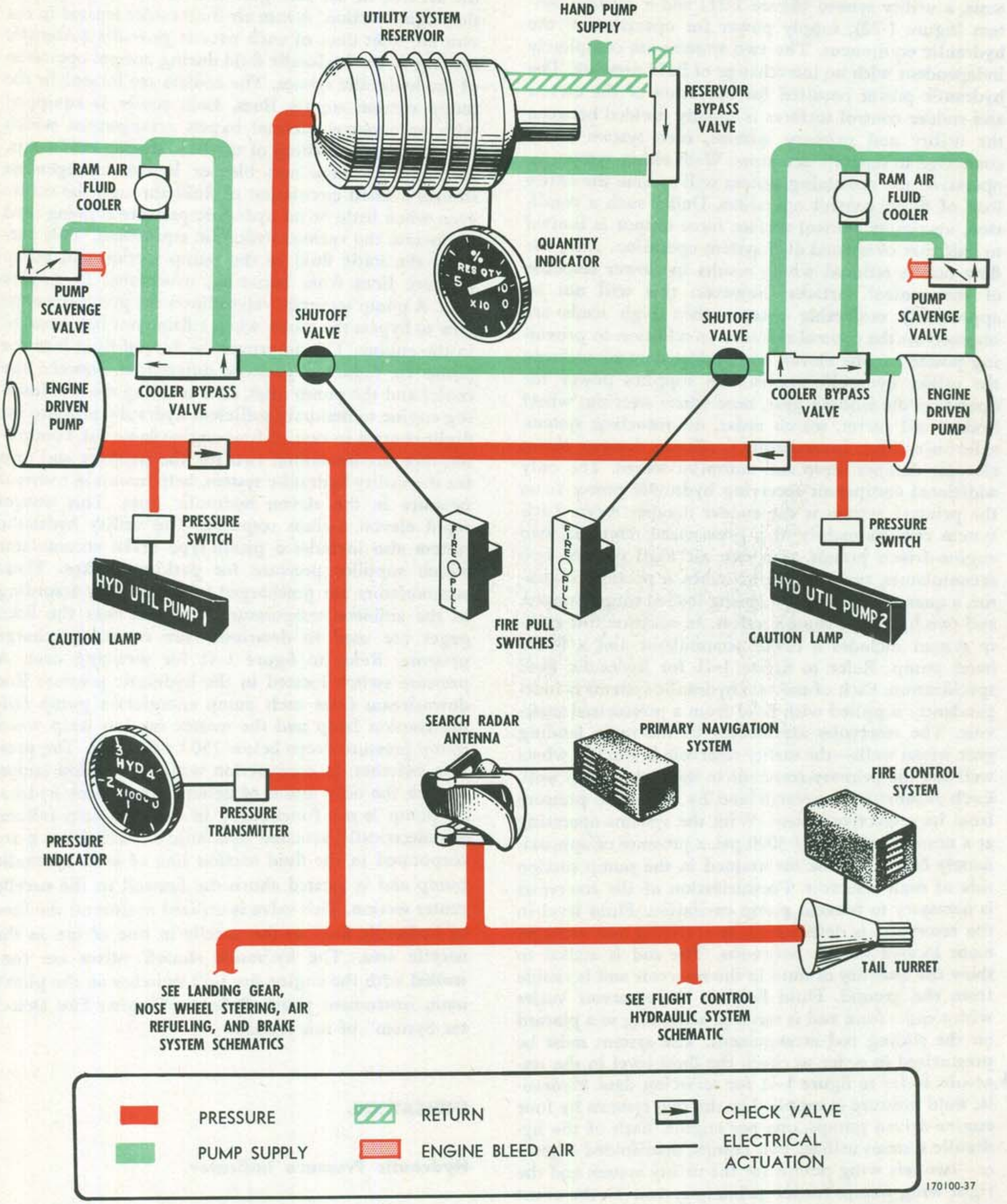

Figure 1-21.

hydraulic power supply system (primary)

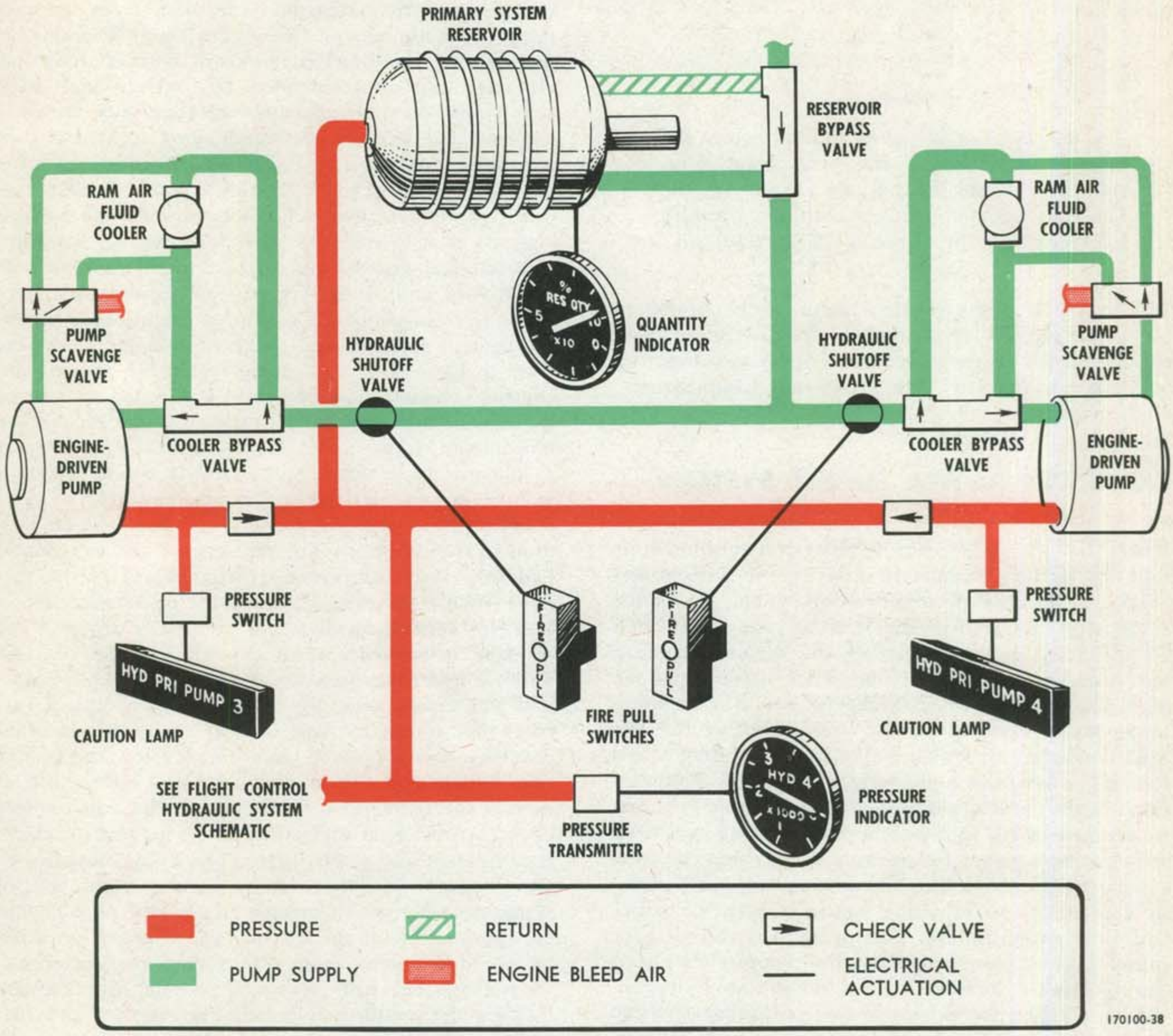

Figure 1-22.

pilot's lower right console. The indicators are controlled by pressure transmitters and indicate the respective system operating pressure in pounds per square inch. The indicators operate on 28-volt a-c power.

Hydraulic Reservoir Quantity Indicator.

Two hydraulic reservoir quantity indicators (9, figure 1-26), one for each hydraulic system reservoir, are located on the pilot's lower right console. The indicators are actuated by transmitters utilizing 28-volt a-c power and indicate reservoir quantity in percent from 0 to 100.

Hydraulic Pump Caution Lamps.

Four caution lamps (figure 1-12), one for each hydraulic pump, are located on the pilot's caution lamp panel. When the pressure output of any pump drops to 750 (±250) psi, a pressure switch downstream from the pump causes the corresponding pump caution lamp to light. When lighted, yellow letters appear on the face of the caution lamp to identify the affected hydraulic system and pump number that is malfunctioning. Since the two pumps in each hydraulic system are manifolded together, these lamps provide the only means of determining the failure of any individual hydraulic pump.

Note

The caution lamps will be lighted before the engines are started if electrical power is on the airplane. As the engines are started, the lamps will go out when the hydraulic pressure builds up to approximately 750 ($\pm$250) psi.

The hydraulic pump caution lamps are connected to the master caution lamp circuit and receive power from the 28-volt d-c power panel. For testing and dimming of the lamps, refer to "Pilot's Indicator Lamp System" of this section.

PNEUMATIC POWER SUPPLY SYSTEMS.

Power for the pneumatically operated equipment is supplied by four independent pneumatic systems and bleed air from the air conditioning system. Power for emergency extension of the landing gear is provided by pneumatic pressure stored in the left main landing gear drag strut. Power for emergency operation of the main landing gear wheel brakes is provided by pneumatic pressure stored in two truss tubes of the left main landing gear linkage assembly. The drag chute receives power from a pressurized pneumatic bottle located in the parachute stowage compartment. Pneumatic pressure stored in the right main landing gear drag strut provides power for opening and closing the crew compartment canopies, and for pressurizing the hydraulic fluid in the air refueling system in event of utility hydraulic system failure. This pressure is also used for inflating the canopy seals when the canopies are closed during ground operations. Each of the four independent pneumatic systems uses pressurized nitrogen as the source of pneumatic power. With one or both inboard engines operating, pneumatic power for inflating the canopy seals is supplied by air pressure from the warm air lines of the air conditioning system. For detailed information on these pneumatic systems refer to "Landing Gear System," "Brake System," "Drag Chute," and "Canopies" of this section.

FLIGHT CONTROL SYSTEM.

The flight control system (figure 1-24) provides control of the airplane by means of three control surfaces—two elevons and a rudder. The control surfaces are controlled both by the pilot and the autopilot, and utilize hydraulic power for actuation. Hydraulic actuation is essential since the control surface loads become quite high during some flight conditions. Each control surface has two independent sets of hydraulic actuators. One set receives hydraulic power from the utility hydraulic system and the other from the primary hydraulic system. (See figure 1-23.) The elevons perform the combined functions of both ailerons and elevators and are controlled by conventional stick commands. A mixer assembly mechanically converts elevator and aileron commands into right and left elevon commands. The rudder is controlled by conventional rudder pedals. The elevon and rudder surface hydraulic actuators do not transmit the surface airloads back to the stick or rudder pedals; therefore, artificial feel systems are utilized to provide conventional stick and rudder forces. (For the maximum deflections, rates of operation, etc., of the pilot's controls, the control surfaces, and the trim and damper units, refer to figure 1-25.) A control valve for each of the control surfaces is mechanically positioned to control the flow of hydraulic fluid to the actuators for surface movement. Mechanical feedback signals, proportional to the surface position, automatically return the control valves to neutral when the surfaces reach the command position, thereby stopping the flow of hydraulic fluid to the actuators. The irreversible surface control hydraulic systems prevent free movement of the surfaces when the hydraulic systems are pressurized. However, the control surfaces will eventually droop if the airplane is parked for an extended period of time without hydraulic pressure on the system. This is normal and should cause no concern, as the control surfaces will return to their normal positions when hydraulic power is applied. Aileron, elevator, and rudder trim switches provide manual control of electrical trim motors for reducing control forces. The trim motors operate directly on the artificial feel systems to relieve control stick and pedal forces. The flying qualities of the airplane are improved by various flight control system features which include an elevator ratio changer, automatic trim, an aileron ratio changer, an aileron-to-rudder interconnect, a rate gyro and accelerometer package, and roll, pitch, and yaw stability augmentation. The stability augmentation system provides continuous automatic damping about all three flight axes. Damping signals are derived from the rate gyro and accelerometer package and are automatically gain adjusted as a function of Mach number and altitude by the air data system. In event of failure of the automatic gain adjustment, a switch at the pilot's station provides selection of fixed gains for stability augmentation and portions of autopilot system operation. This feature is to be used only in event of failure of the automatic gain adjustment. (Refer to "Mach-Altitude Gain Adjustment Failure" Section III.) The ratio changers, the elevator and aileron autopilot and damper servos, the elevon mixer, the trim motors, the artificial feel systems, and the aileron-to-rudder mechanical interconnect are grouped together in a power control linkage assembly (PCLA), which is located in the fuselage

flight control hydraulic system

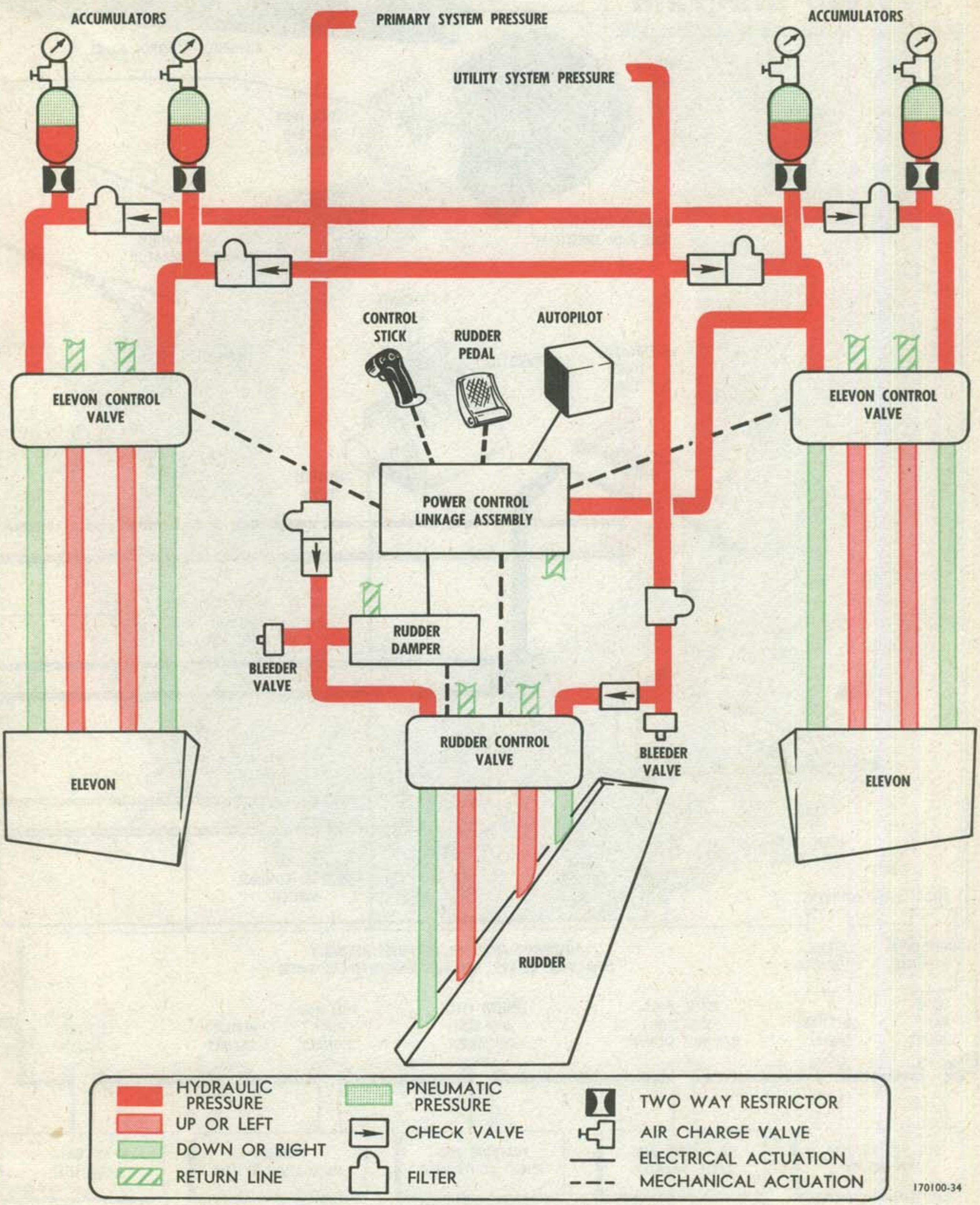

Figure 1-23.

flight control system diagram

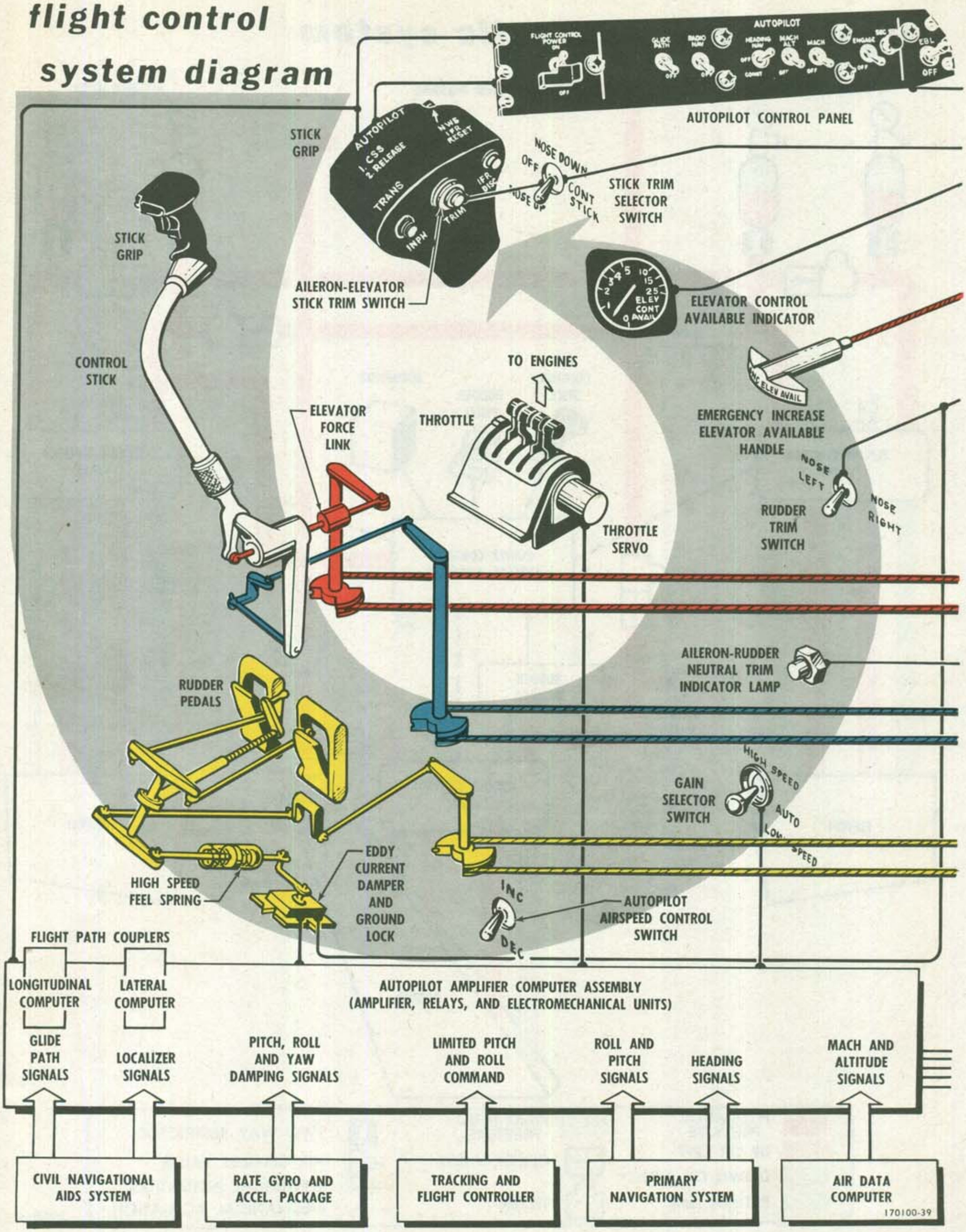

Figure 1-24. (Sheet 1 of 2)

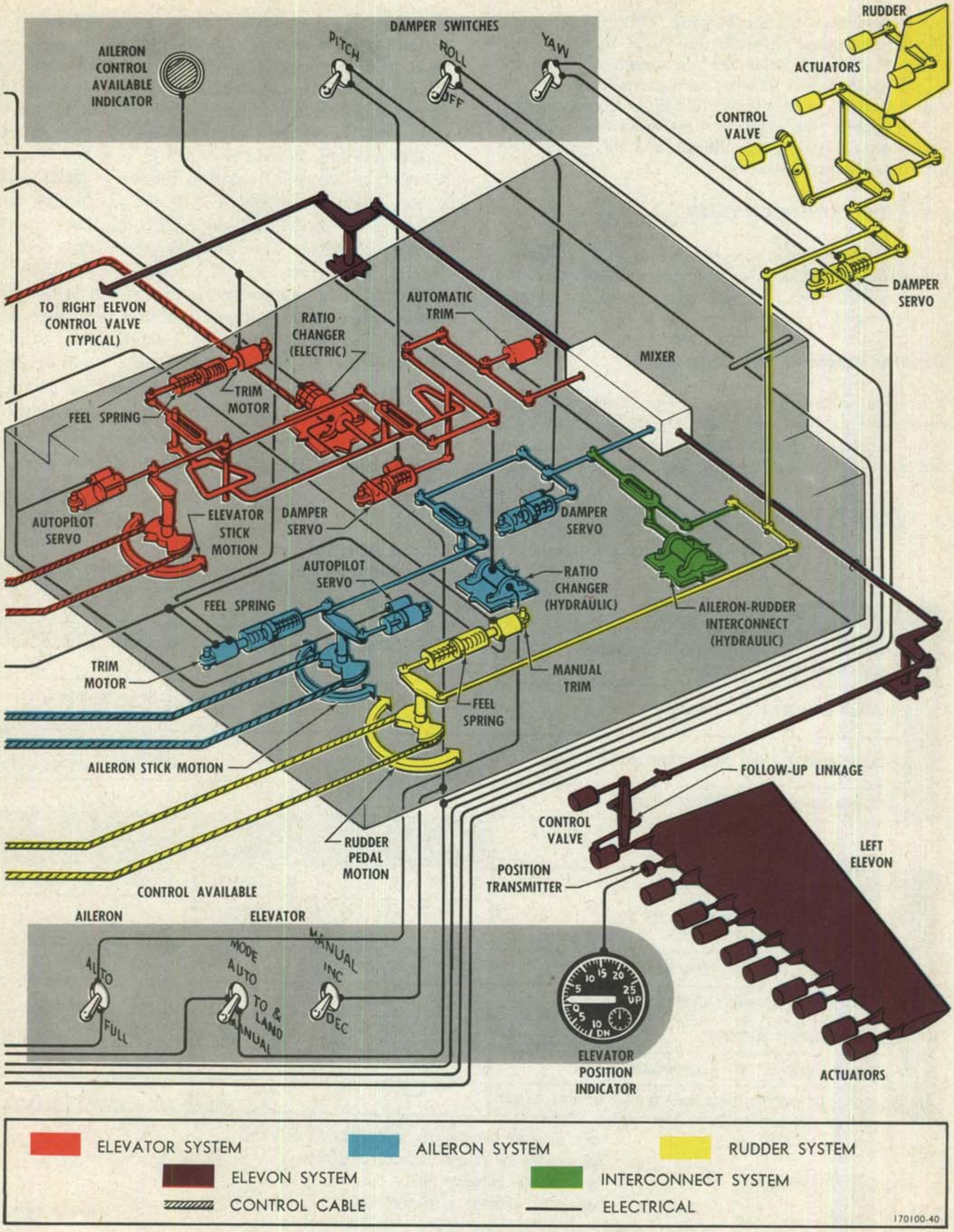

Figure 1-24. (Sheet 2 of 2)

tail section between the elevons. All pilot command signals are routed through the PCLA to the surface control valves. All other surface commands, with the exception of rudder damper servo commands, are iniated by PCLA components. The flight control system is functionally divided into three subsystems; the elevator control system, the aileron control system, and the rudder control system.

ELEVATOR CONTROL SYSTEM.

The elevator control system consists of the elevator automatic trim system, an elevator ratio changer, the elevator stick trim and feel system, and an elevator damper servo.

Elevator Automatic Trim System.

The elevator automatic trim system contains an electromechanical servo which automatically provides elevator command signals to position the elevator for constant "one-g" flight when the pilot's control stick is in the neutral position. "One-g" flight can occur in a climb or dive as well as level flight. This servo, in addition to the elevator ratio changer, is energized by the elevator control available mode selector switch (7, figure 1-6). Automatic operation of the elevator automatic trim is provided only when the switch is in the AUTO position. When the switch is in either the TO & LAND or MANUAL position, the servo will drive to a position corresponding to 3 degrees up-elevator and lock in that position until the AUTO position is again selected. However, if elevator available is less than 7 degrees when either TO & LAND or MANUAL is selected, the elevator automatic trim will hold the position it had at the time of selection until elevator available becomes greater than 7 degrees. The output motion of the elevator automatic trim grounds against both the elevator feel spring and the elevator damper servo and therefore does not move the pilot's control stick. The automatic trim authority in terms of elevator deflection is 10 degrees up and 0.5 degrees down.

flight control system data

WITH MAXIMUM ELEVATOR AND AILERON CONTROL AVAILABLE

	ITEM	ELEVATOR		AILERON		RUDDER	
		STICK		STICK		PEDALS	
		AFT	FWD	RIGHT	LEFT	FWD	AFT
PILOT'S CONTROLS	MAXIMUM DISPLACEMENT (INCHES)	6.0 ▼★	3.9 ▼★	4.5	4.5	3.64	3.64
	MAXIMUM BREAKOUT FORCE (POUNDS)	5		4		7 (Below Mach No. 0.6) 14 (Above Mach No. 0.6)	
	NOMINAL FORCE FOR FULL DISPLACEMENT (POUNDS) ◆	25	19	15		80 (Below Mach No. 0.6) 170 (Above Mach No. 0.6)	
	STICK AND PEDAL TRIM RATE (POUNDS/SECOND)	2.1		0.66		2.0	
		SURFACE		SURFACE		SURFACE	
		UP	DOWN	UP	DOWN	RIGHT	LEFT
CONTROL SURFACE	TOTAL DEFLECTION (DEGREES)	23 ▼	10 ▼	15 ●	15 ●	30	30
	FOR ELEVATORS FROM 20° UP TO 23° UP			12 Min	12 Min		
	FOR ELEVATORS FROM 5° DOWN TO 10° DOWN			10 Min	10 Min		
	STICK AND PEDAL TRIM AUTHORITY (DEGREES)	10 ▼	10 ▼	5	5	10	10
	AUTOMATIC TRIM AUTHORITY (DEGREES)	10	0.5				
	DAMPER AUTHORITY (DEGREES)	2 ▼	2 ▼	5	5	7.5	7.5
	MAXIMUM AUTOMATIC TRIM RATE (DEGREES/SECOND)	0.2					
	RATE OF DEFLECTION AT 1/2 MAX HINGE MOMENT (DEGREES/SECOND)	20		20		35	

▼ MAXIMUM VALUE (VARIES WITH ELEVATOR AVAILABLE)
● EXCEPT FOR EXTREME ELEVATOR DEFLECTIONS
◆ INCLUDES BREAKOUT FORCE
★ WITH 3 DEGREES AUTOMATIC TRIM

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Figure 1-25.

Elevator Ratio Changer.

The elevator ratio changer is an electro-mechanical servo mounted in the PCLA which improves the airplane flying qualities by varying the elevator control stick sensitivity, and which protects the airplane against excessive "g" loading by controlling both elevator available and elevator damper servo authority. The elevator ratio changer mode is controlled by the three-position elevator control available mode selector switch located on the pilot's left sidewall console. The switch positions are marked AUTO, TO & LAND and MANUAL. When AUTO is selected, the elevator ratio changer is automatically controlled. Elevator available is limited to that value required to develop approximate limit load factor. Elevator available is controlled by varying the stick to surface mechanical advantage and by limiting the stick displacement authority. At maximum elevator available (20 degrees), the stick authority is 6 inches aft and 3.9 inches forward. As elevator available decreases, the stick to surface mechanical advantage and the stick displacement authority decreases. At minimum elevator available (2.0 degrees) for pilot control of the airplane, the stick displacement authority is 1.9 inches fore or aft.

Note

Minimum elevator available when AUTO is selected is 2.0 degrees for pilot control of the airplane. During autopilot operation in the automatic mode, or during operation with the elevator control available selector switch positioned to MANUAL, the minimum elevator available is 0.8 degrees.

The control stick feel sensitivity is also varied by the elevator ratio changer. The feel force at maximum stick displacement is 25 pounds for all values of elevator available. When the elevator control available mode selector switch is placed in the TO & LAND position, the elevator ratio changer drives to the maximum elevator available position and remains in this position until another mode is selected. When the elevator control available mode selector switch is placed in the MANUAL position, control of the elevator ratio changer is transferred to the elevator control available manual adjust switch located on the pilot's left sidewall console. When the MANUAL position is selected, elevator available remains fixed until the pilot increases or decreases elevator available with the elevator control available manual adjust switch. The manual mode is used only in case of failure of the automatic mode. The TO & LAND position is used for all take-offs and landings except during autopilot controlled approaches. In the event of failure in the automatic mode, several means are provided to override the elevator ratio changer. First, the elevator control available mode selector switch can be positioned to either TO & LAND or MANUAL. Second, application of approximately 105-120 pounds of force at the top of the stick will trip a force switch in the elevator force link that will automatically return the elevator control available mode selector switch to the TO & LAND position, causing the elevator ratio changer to drive to the maximum elevator available position. In case of extreme emergency and when the preceding provisions fail to provide enough elevator available for control of the airplane, an emergency increase elevator available handle (4, figure 1-7), located on the pilot's lower left console, can be used to manually position the elevator ratio changer for an *increase* in elevator control available. The handle provides increased control available in distinct steps: the first pull repositions the elevator available mode selector switch to TO & LAND and disconnects the ratio changer electrical circuit; each subsequent pull on the handle provides an increase in control available until the maximum is reached. The handle must be pushed back in each time it is pulled. For the amount of increase with each pull of the handle, refer to "Flight Control Emergency Procedures" Section III.

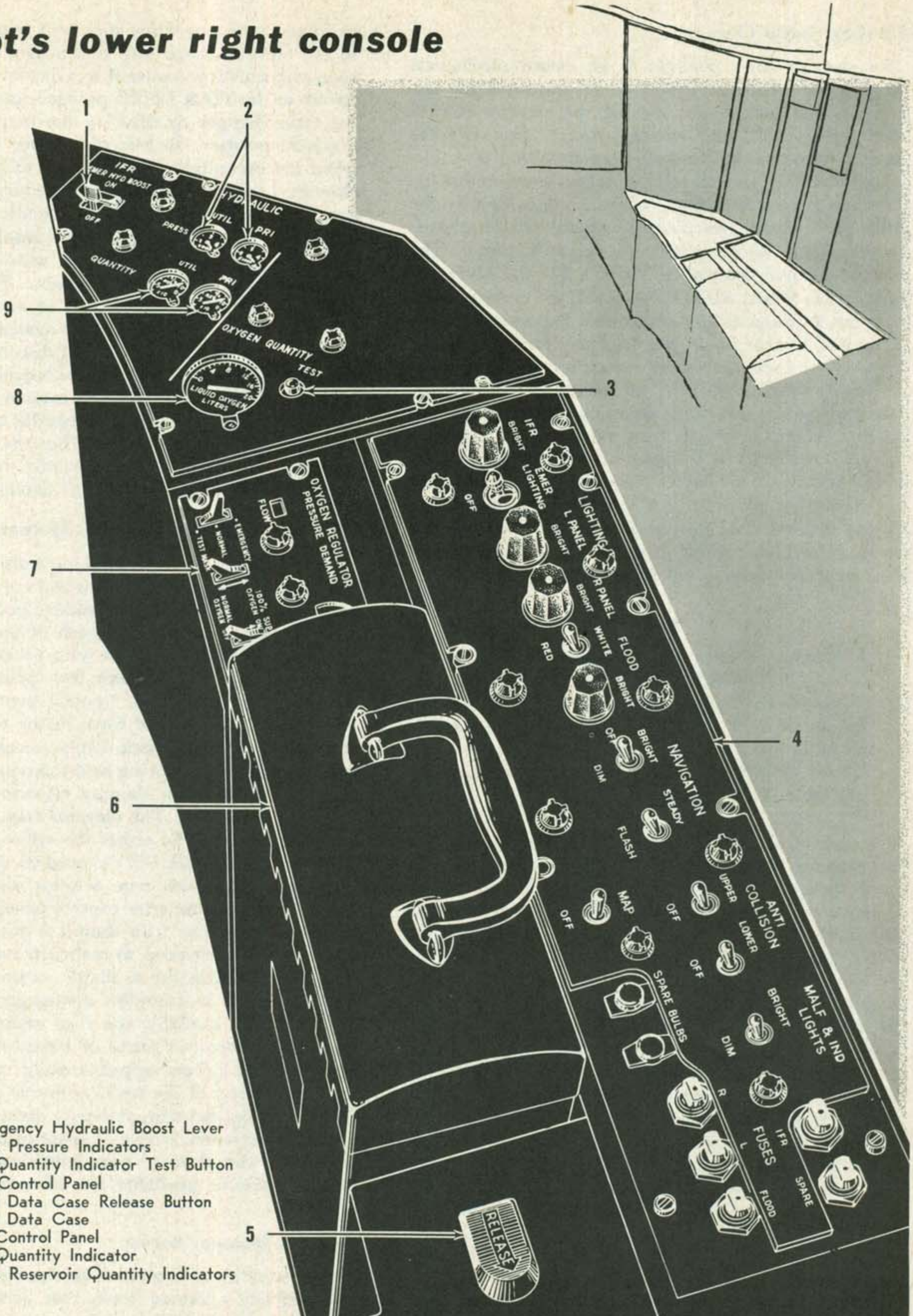
Elevator Stick Trim and Feel System.

Airloads on the flight control surfaces are reacted by the hydraulic actuating systems and are not transferred back to the control stick or rudder pedals. Therefore, artificial feel is supplied in each of the three control systems to provide the pilot with synthetic indication of the airloads. The elevator feel spring is located in the PCLA and provides a 3-pound breakout force and feeds back 25 pounds of force to the top of the stick at maximum elevator stick displacements. The elevator stick trim aligns the spring zero-force position with the pilot's stick position, thereby relieving the force at the top of the stick. The elevator trim motor may be manually operated by either the aileron-elevator stick trim switch (2, figure 1-27) located on the control stick grip or by the stick trim selector switch (3, figure 1-28) located on the trim control panel. During autopilot operation the trim motor is automatically and continuously positioned to maintain zero force on the feel spring within the available authority to prevent stick transients at autopilot disengagement. At maximum elevator available the trim motor has ±10 degrees of authority in terms of elevator surface deflection and can relieve approximately ±14 pounds of force at the top of the stick. In terms of elevator surface deflection, the trim authority decreases as elevator available decreases. However, discounting system nonlinearities, the elevator trim motor authority is one-half of elevator available for all values of elevator available.

Elevator Damper Servo.

The elevator damper servo is an electrically controlled, hydraulically operated servo that automatically provides elevator commands to damp the rate of pitch of the airplane. This servo is located in the PCLA and is activated by the pitch damper switch located on the pilot's left sidewall console. The output of the eleva-

pilot's lower right console



1. IFR Emergency Hydraulic Boost Lever
2. Hydraulic Pressure Indicators
3. Oxygen Quantity Indicator Test Button
4. Lighting Control Panel
5. Map and Data Case Release Button
6. Map and Data Case
7. Oxygen Control Panel
8. Oxygen Quantity Indicator
9. Hydraulic Reservoir Quantity Indicators

Figure 1-26.

tor damper servo grounds against the elevator feel spring and does not move the pilot's control stick. The authority of the elevator damper servo is controlled by the elevator ratio changer. For values of elevator available greater than 3.33 degrees, the authority limit of the elevator damper servo is ±2 degrees of elevator. For values of elevator available less than 3.33 degrees, the authority limit of the elevator damper servo is ±0.6 times the value of elevator available. Hydraulic power for this servo is supplied by the utility hydraulic system. A pitch rate gyro located in the rate gyro and accelerometer package transmits to the servo transfer valve a gain-adjusted electrical signal proportional to the airplane pitch rate. The transfer valve controls, according to the electrical signal, the flow of hydraulic fluid that positions the servo actuator. The output of the actuator, and hence the commanded elevator, is always in a direction to decrease the pitch rate. The elevator damper servo should be energized during all normal flight operations.

Elevator Autopilot Servo.

The elevator autopilot servo is an electrically controlled, hydraulically operated servo mounted in the PCLA. Hydraulic power to the elevator autopilot servo is supplied by the utility hydraulic system. Actuation of this servo causes the stick to follow the servo motion, and mechanical commands from the servo to the PCLA linkage are very similar to stick commands. For operation of the autopilot, refer to "Autopilot" Section IV.

AILERON CONTROL SYSTEM.

The aileron control system consists of an aileron ratio changer, the aileron manual trim and feel system, and aileron damper servo.

Aileron Ratio Changer.

The aileron ratio changer is a two-position electrically controlled, hydraulically operated servo unit. The servo is controlled by a switch at the pilot's station and operates to provide either automatic control of aileron available or full aileron control available. In the automatic mode, the servo provides either full aileron or one half aileron control available as a function of Mach number. The servo is automatically controlled to provide 15 degrees of available aileron control below Mach No. 0.6 and 7-1/2 degrees of available control above Mach No. 0.6. In the event of a malfunction in the automatic mode or at the pilot's discretion, the servo can be positioned to provide 15 degrees of available aileron control. In the event of loss of either electrical or hydraulic power, the servo will provide 15 degrees of available aileron control. The aileron ratio changer is supplied hydraulic power from the utility hydraulic system. During the automatic mode of operation, electrical signals proportional to Mach number are supplied by the air data system.

Aileron Stick Trim and Feel System.

Artificial feel is also provided in the aileron control system. The feel is supplied by a feel spring located in the PCLA. Due to a non-linear mechanism located between the control stick and the PCLA in the aileron control system, the force gradient at the stick is a function of stick position. With the stick at neutral, the nominal breakout force is 4 pounds at the top of the stick. Also, the force gradient and the stick to surface mechanical advantage is low. As the stick is moved away from neutral, both the force gradient and the stick to surface mechanical advantage increases. The maximum aileron stick movement in either direction from neutral is 4.5 inches and the maximum feel force at hardover stick positions is 15 pounds. A stick trim motor is provided to align the feel spring zero force position with the stick position; thereby, relieving the forces at the pilot's control stick. The pilot may command force changes with a trim button located on the control stick. Maximum trim authority is ±5 degrees of aileron surface displacement when the aileron ratio changer is in the full position and ±2.5 degrees in the half position.

Aileron Damper Servo.

The aileron damper servo is electrically controlled and hydraulically operated. This servo is activated by a switch at the pilot's station. The output motion of the aileron damper servo grounds against the aileron feel spring and does not move the pilot's control stick. Also, the authority of the servo is not changed by the aileron ratio changer; the authority is always ±5 degrees in terms of aileron surface displacement. The primary function of the aileron damper servo is to damp the airplane roll rate. The airplane roll rate is sensed by the roll rate gyro located in the rate gyro and accelerometer package. Electrical signals proportional to the roll rate are transmitted to the aileron damper servo and cause the servo to command aileron in a direction to decrease the roll rate. The servo receives hydraulic power from the utility system. A secondary function of the servo is to provide yaw damping in case of rudder damper servo failure. Control loops to provide this secondary function are closed only if the yaw damper switch (5, figure 1-6) is OFF or if the autopilot is engaged. The yaw rate is sensed by the yaw rate gyro also located in the rate gyro and accelerometer package. Electrical signals proportional to the airplane yaw rate are transmitted to the servo and cause the servo to command aileron in a direction to decrease the yaw rate. The aileron damper servo should be operative during all normal flight operations.

Aileron Autopilot Servo.

The aileron autopilot servo is electrically controlled and hydraulically operated. Hydraulic power is supplied by the utility hydraulic system. The output signals from the aileron autopilot servo cause the control stick to move with the servo. The authority of this servo is controlled by the aileron ratio changer and is either 15 degrees (full) or 7.5 degrees (half). For operation of the autopilot, refer to "Autopilot" Section IV.

RUDDER CONTROL SYSTEM.

The rudder control system consists of an aileron-to-rudder interconnect system, a rudder pedal trim and feel system, and a rudder damper servo.

Aileron-to-Rudder Interconnect System.

The aileron-to-rudder interconnect system automatically transmits electrical and mechanical commands from the aileron to the rudder control system to provide turn coordination. Mechanical signals proportional to aileron command are transmitted by a system of linkages in the PCLA and provide either one or two degrees of rudder per degree of aileron. The aileron-to-rudder interconnect actuator automatically shifts the mechanical interconnect from one degree of rudder per degree of aileron to two degrees of rudder per degree of aileron as a function of Mach number. The actuator is a two-position electrically controlled, hydraulically operated unit which automatically returns to two degrees of rudder per degree of aileron position in the event of electrical or hydraulic failure. Hydraulic power is supplied by the utility hydraulic system. Electrical signals proportional to Mach number are received from the air data system and cause the actuator to be hydraulically changed from the one degree of rudder per degree of aileron to the two-degree position when the airspeed is increased to Mach No. 0.72. The actuator returns to the one-to-one ratio when the airspeed is decreased to Mach No. 0.67. The total interconnect gain is a function of both Mach number and altitude. Electrical signals proportional to the difference between the total and the mechanical gains are converted into rudder command signals by the rudder damper servo. Therefore, with the rudder damper servo in operation, during normal flight (except at low airspeeds), turn maneuvers can be accomplished without the use of the rudder pedals. In case of failure of the rudder damper servo, pedal corrections will be necessary at some flight conditions in order to achieve turn coordination.

Rudder Pedal Trim and Feel System.

The rudder pedal trim and feel system consists of a feel spring and trim motor combination located in the PCLA and a high-speed feel spring assembly located just forward of the pilot's left rudder pedal. This system features a low breakout force and a low force gradient at speeds below Mach No. 0.6, a high breakout force and a high force gradient at speeds above Mach No. 0.6 for pedal deflections less than 6 degrees of rudder, and a low force gradient for speeds above Mach No. 0.6 for pedal deflections greater than 6 degrees of rudder. The first feature is provided by the feel spring in the PCLA and the second and third features are provided by the feel spring in the PCLA in combination with the high-speed feel spring assembly. For speeds below Mach No. 0.6 the nominal breakout force is 7 pounds and the maximum force at maximum pedal deflection (30 degrees) is 80 pounds at the pedals. This level of force is for ground (nose wheel steering) and take-off and landing operations. At high speeds the airplane becomes more sensitive to rudder pedal commands. Thus it is desirable to have a high force gradient about the neutral pedal position to control rudder sensitivity during high-speed flight conditions. If the same high spring gradient were maintained throughout the entire rudder authority (30 degrees) it would take 375 pounds of force to command maximum rudder. It is therefore desirable to reduce the spring gradient when rudder commands in excess of a nominal value (6 degrees) are required. For the high-speed conditions the breakout force is approximately 14 pounds. Approximately 75 pounds of force at the pedal is required to command 6 degrees and 170 pounds is required to command maximum authority. The high-speed feel spring assembly is caged by a magnetic brake which is controlled by an electrical signal, proportional to Mach number, which is supplied by the air data system. The brake releases and allows the spring ground to float whenever the speed is reduced below Mach No. 0.6 or whenever the rudder pedal trim motor is energized. The spring return to the zero force position is restricted by an eddy current damper. The damper acts to slow the rate of return and reduces disengage transients. It will normally take several seconds for the force across the high-speed feel spring assembly to be completely relieved by trim commands. The rudder pedal trim motor is controlled by a switch at the pilot's station. The rudder pedal trim authority is ±10 degrees of rudder. It should be noted that the motor itself only acts directly on the feel spring in the PCLA.

Rudder Damper Servo.

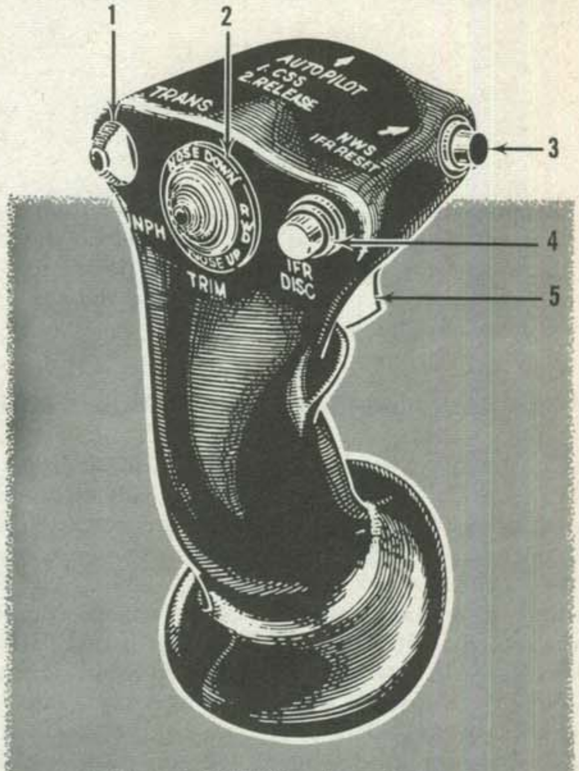
The rudder damper servo is an electrically controlled, hydraulically operated servo located in the vertical tail section. The servo provides rudder command signals proportional to yaw rate, lateral acceleration (in operation only when the pod is installed), and the electrical portion of the aileron rudder interconnect signal. The rudder damper servo grounds against the rudder and aileron feel springs in the PCLA and therefore does not move the rudder pedals. This servo is activated by the yaw damper power switch located at the pilot's station. The servo should remain activated during all normal flight operations. Hydraulic power for the rudder damper servo is supplied by the primary hydraulic system.

FLIGHT CONTROLS AND INDICATORS.

Control Stick.

The control stick provides a mechanical means of lateral and longitudinal control of the airplane. Forward and aft movement of the control stick causes the elevons to move up and down together for elevator control. Left or right movement of the stick causes the elevons to move in opposite directions for aileron control. A mixer assembly mechanically converts elevator and aileron control inputs into elevon commands. Conventional control cables are connected to the control stick and extend aft to the power control linkage assembly (PCLA). Movement of the stick transmits a mechanical signal (motion) to elevator or aileron system linkages located in the PCLA. These linkages act as connections between equipment such as feel springs, trim actuators, ratio changers, damper servos, etc.; therefore, the signal may be altered before reaching the mixer assembly. The mixer assembly converts the elevator or aileron signal into elevon motion and mechanically positions the elevon hydraulic control valves for either aileron or elevator action. A followup linkage automatically closes off the flow of hydraulic fluid to the control valves when the desired control surface deflection is obtained. The control stick grip (figure 1-27) incorporates a microphone switch, aileron-elevator stick trim switch, autopilot trigger switch, inflight refueling disconnect button, and a nose wheel steering and inflight refueling reset button.

stick grip



1. Control Stick Microphone Switch
2. Aileron-Elevator Stick Trim Switch
3. NWS-IFR Reset Button
4. Inflight Refueling Disconnect Button
5. Autopilot Trigger Switch

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Figure 1-27.

Rudder Pedals.

Conventional rudder pedals provide a mechanical means of directional control of the airplane. Conventional control cables are connected to the rudder pedals and extend aft to the power control linkage assembly (PCLA). Movement of the pedals transmits a mechanical signal (motion) to rudder system linkages located in the PCLA. The resultant movement of the linkages positions the rudder hydraulic control valve for rudder surface action. When the desired rudder deflection is obtained, a followup linkage automatically closes off the flow of hydraulic fluid to the control valve. An artificial feel system, a trim actuator, a damper servo, and a mechanical aileron-rudder interconnect are incorporated into the rudder linkages. The rudder pedals are collectively adjusted fore and aft by the crank on the lower center edge of the pilot's main instrument panel. Toe action on the rudder pedals applies wheel brakes. Refer to "Brake System" of this section. With the nose wheel steering system energized, movement of the rudder pedals provides directional control during ground operation. Refer to "Nose Wheel Steering System" of this section.

Flight Control Power Switch.

The flight control power switch (1, figure 4-20) is located on the autopilot control panel and is marked ON and OFF. The OFF position is guarded to prevent moving the switch to OFF inadvertently. The switch controls a-c and d-c power for operation of all automatic features of the flight control system, autopilot, and stability augmentation system. When the switch is positioned to ON, power is supplied to the roll, pitch and yaw damper power switches, and to the amplifier-computer assembly. The amplifier-computer assembly in turn supplies power to the autopilot mode switches, controls operation of the aileron and elevator ratio changers in the automatic mode, automatic trim, and, in conjunction with the damper power switches, controls operation of the roll, pitch, and yaw damper servos.

Note

The flight control equipment and modes of operation which are not affected by the power switch include manual trims (aileron, elevator and rudder), TO & LAND and MANUAL positions of the elevator available mode selector switch, FULL position of the aileron control available mode switch, aileron control available indicator, elevator position indicator, elevator control available indicator, aileron-rudder interconnect switching, high-speed rudder feel spring switching, and the elevator force link switch.

The automatic features of the flight control system are normally ready for operation approximately three minutes after the power switch is placed in the ON position.

CAUTION

During ground operations, the air conditioning system must be in operation before the flight control power switch is positioned to ON in order to prevent overheating the amplifier-computer assembly.

Elevator Control Available Mode Selector Switch.

A three-position switch (7, figure 1-6), located on the pilot's left sidewall panel, supplies 28-volt direct current to relays which direct 115-volt a-c power to the ratio changer actuator. The three positions are marked AUTO, TO & LAND, and MANUAL. The MANUAL position is guarded to prevent inadvertent positioning of the switch to MANUAL. The switch is cam-held in either MANUAL or AUTO, and is solenoid-returned to the TO & LAND position. When the switch is placed in the AUTO position, the required computed signals drive the ratio changer and automatic trim actuators. This position is normally selected after takeoff and transition to stabilized climb. When the switch is placed in the TO & LAND position, the ratio changer is positioned to provide full elevator control available. The automatic trim actuator will position the elevons to 3-degrees up-elevator when the control available increases to 7 degrees. This switch position is utilized for takeoff and landing. When the switch is placed in the MANUAL position, control of the ratio changer is transferred to the elevator available manual adjust switch. The automatic trim actuator will position the elevons to 3-degrees up-elevator when the control available is increased to 7 degrees.

WARNING

The elevator control available mode selector switch must be placed to TO & LAND before attempting a takeoff or landing to assure full elevator control available.

Elevator Control Available Manual Adjust Switch.

The amount of elevator control available is manually controlled by a three-position switch (8, figure 1-6) located on the pilot's left sidewall console. This switch is utilized only when the elevator control available mode selector switch is placed in the MANUAL position. The manual adjust switch has two momentary positions, marked INC and DEC, which are spring-loaded to an unmarked center (OFF) position. Positioning the switch to either INC or DEC energizes the ratio changer motor which will drive the ratio changer until the desired amount of control available is reached. The ratio changer can be driven through its full range using this switch.

Aileron Control Available Switch.

This two-position switch (6, figure 1-6), located on the pilot's left sidewall console, provides automatic control of aileron available or provides full aileron control available. The two positions are marked AUTO and FULL. When the switch is positioned to AUTO, aileron control available is automatically controlled to provide either 7.5 degrees or 15 degrees control available. The amount of control available is determined by electrical signals proportional to Mach number which are supplied by the air data system. Placing the switch to FULL provides 15 degrees control available so that full control stick displacement will result in 15 degrees of aileron deflection. The switch is normally left in the AUTO position unless there is a malfunction in the automatic mode. In event of a malfunction in the automatic mode, the switch may be positioned to FULL to provide full aileron control available. The aileron control available switch requires 28-volt d-c power for operation.

Rudder Trim Switch.

This three-position momentary-type switch (1, figure 1-28) is located on the trim control panel and is used to reposition the rudder feel springs for directional trim. The two switch positions, marked NOSE LEFT and NOSE RIGHT, provide rudder pedal trim action as indicated. When the trim switch is held in the desired position, the electrical trim motor repositions the feel spring in the PCLA and, at airspeeds above Mach No. 0.6, the high speed feel spring magnetic brake is released allowing the spring to return to a neutral position. Repositioning of the feel spring in the PCLA deflects the rudder control surface and relieves pedal force.

Note

When the high speed feel spring returns to a neutral position, some of the force is relieved from the pedals. Therefore, due to changes in the feel force on the pedals, care should be exercised when trimming with the pedals deflected in order to avoid inadvertent pedal deflection.

The switch is spring-loaded to the center (OFF) position and controls 28-volt direct current to the trim motor relay.

Aileron-Elevator Stick Trim Switch.

The combination aileron-elevator stick trim switch (2, figure 1-27) is located on the control stick and is used to reposition the aileron or elevator feel spring for lateral and longitudinal trim. This five-position switch has positions marked NOSE UP, NOSE DOWN, LWD (left wing down) RWD (right wing down), and is spring-loaded to an unmarked center (OFF) position. Holding the switch to any one of its positions induces trim as indicated. The switch controls 28-volt d-c electrical power to the aileron and elevator trim motor relay.

Note

> The aileron-elevator stick trim switch is inoperative unless the stick trim selector switch, located on the trim control panel, is placed in the CONT STICK position.

Stick Trim Selector Switch.

This four-position switch (3, figure 1-28), located on the trim control panel, is used to control 28-volt d-c electrical power to the aileron-elevator stick trim switch located on the control stick; in event the aileron-elevator stick trim switch malfunctions, it is used as an alternate method of controlling longitudinal trim. The switch positions are marked CONT STICK, NOSE UP, NOSE DOWN, and OFF. Placing the switch to CONT STICK completes the 28-volt d-c circuit to the aileron-elevator stick trim switch on the control stick so that lateral and longitudinal trim may be controlled from that point. Moving the switch to the center OFF position breaks the electrical circuit to the aileron-elevator stick trim switch and renders that circuit inoperative. The NOSE UP and NOSE DOWN positions are spring-loaded to OFF; therefore, the switch must be held in these positions for the longitudinal trim as indicated.

Note

> The stick trim selector switch provides an alternate method for controlling longitudinal trim only. No provision is made for alternate control of lateral trim.

Damper Switches.

Three two-position switches (3, 4, 5, figure 1-6), located on the pilot's left sidewall console, are used to control 28-volt d-c electrical power to the roll, pitch, and yaw damper systems. The switches are normally left in the ON position except in event of a malfunction in one of the damper systems. In this event, the respective switch may be positioned to OFF. Refer to "Flight Control System Limitations", Section V for limitations with the dampers inoperative.

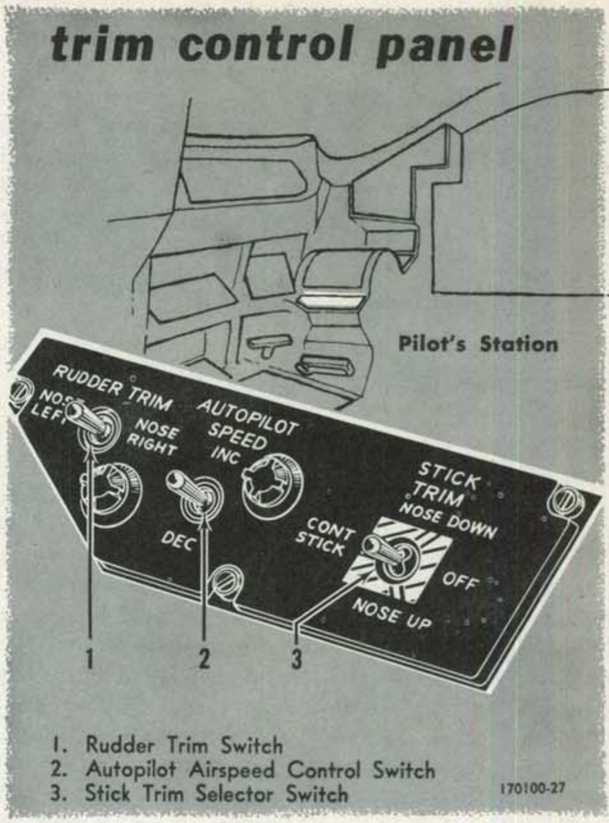

Figure 1-28.

Gain Selector Switch.

The gain selector switch (2, figure 1-6), located on the pilot's left sidewall console, provides a means of selecting the mode of gain adjustment for the autopilot and stability augmentation systems. The switch is marked HIGH SPEED, AUTO, and LOW SPEED, and is internally latched in all three positions. It is necessary to pull out on the handle in order to move the switch from one position to another. The switch is normally left in the AUTO position which provides the autopilot and stability augmentation systems with the correct gain adjustments according to altitude and Mach number signals from the air data system. The HIGH SPEED and LOW SPEED positions are used as a means of providing emergency fixed gains to the autopilot heading and attitude stabilization modes, and the stability augmentation system and should be used only in the event of malfunction of the normal gain adjustment signals. The HIGH SPEED position provides gain adjustment for regions bounded by Mach No. 1.8

to 2.0 and altitudes of 40,000 to 50,000 feet. The LOW SPEED position provides gain adjustment for regions bounded by Mach No. 0.9 to 0.95 and altitude of 30,000 to 50,000 feet. The LOW SPEED position also provides the stability augmentation gain adjustment for landing conditions at airspeeds below 195 knots IAS and altitudes up to 5000 feet. For operation in the operating regions and transition from one region to another using emergency fixed gains, refer to "Mach-Altitude Gain Adjustment Failure" Section III.

Emergency Increase Elevator Available Handle.

The emergency increase elevator available handle (4, figure 1-7), located on the pilot's lower left console, is used to manually position the elevator ratio changer to increase control available in the event of a failure in the normal system. The ratio changer can be positioned to provide increased control available in distinct steps by pulling the handle: the first pull repositions the elevator available mode selector switch to TO & LAND and disconnects the ratio changer actuator electrical circuit; each subsequent pull on the handle moves the ratio changer to provide greater control available until the maximum is reached. The handle must be pushed back in each time it is pulled. The handle must be pulled (full strokes) eight to ten times in order to return the ratio changer from the minimum control available position (2.0 degree) to the maximum control available position (20 degrees).

Note

- The first two pulls of the handle will increase the control available only a small amount; however, as maximum control available is approached, larger increments of change will be noted with each additional pull of the handle. For the amount of increase in control available with each pull of the handle, refer to figure 3-10.
- When the control available is increased to 7 degrees, the automatic trim actuator will position the elevons to 3 degrees up-elevator.

There is no provision for manually decreasing the control available. If the ratio changer is positioned to the maximum control available position by manual control, it will remain in that position until reset on the ground.

Elevator Position Indicator.

The elevator position indicator (25, figure 1-5), located on the pilot's main instrument panel, indicates the elevator position of the elevons in degrees. A small vernier scale on the indicator face indicates deflection in tenths of a degree. Aileron action of the elevons has no effect on the indicator since the indicator pointer changes only when the elevons move up or down together. The indicator may be used to determine the amount of longitudinal trim induced on the elevator. The elevator position indicator operates on 26-volt a-c power.

Elevator Control Available Indicator.

This indicator (27, figure 1-5) is located on the pilot's main instrument panel and is provided to indicate the amount of elevator control available with full control stick movement. For example, if the indicator pointer indicates 5 degrees, a full forward or aft motion of the stick will result in a 5-degree deflection of the control surface. The indicator operates on 26-volt a-c power.

Aileron Control Available Indicator.

A three-position indicator (26, figure 1-5) located on the pilot's main instrument panel, indicates the amount of aileron control available with full stick movement. The word FULL or HALF appears in the window of the indicator to correspond with the amount of aileron control available. Parallel white and black diagonal stripes are displayed when there is no electrical power or when the aileron ratio changer is in transit. The indicator operates on 28-volt d-c power.

Aileron-Rudder Neutral Trim Indicator Lamp.

The green aileron-rudder neutral trim indicator lamp (24, figure 1-5) is located on the pilot's main instrument panel. The lamp is used during trimming operations to indicate the neutral position of aileron and/or rudder. The lamp circuit is energized by actuating and holding the rudder trim switch or the aileron-elevator stick trim switch to its respective position for lateral or directional trim; then when the control surface reaches the neutral position it mechanically actuates a limit switch and the lamp will light to indicate that the affected control surface is in neutral position. The lamp will go out as the surface passes through the neutral position. The lamp operates on 28-volt d-c power.

LANDING GEAR SYSTEM.

The airplane is equipped with hydraulically operated tricycle landing gear consisting of a two-wheel nose gear and two four-wheel main gear. The eight split-type wheels of the main gear are each equipped with two tubeless tires. Each of the two split-type wheels on the nose gear has a single tubeless tire. The gear retracts into wheel wells that are enclosed by doors. The doors close, latch, and open mechanically by movement of the gear, but are unlatched and

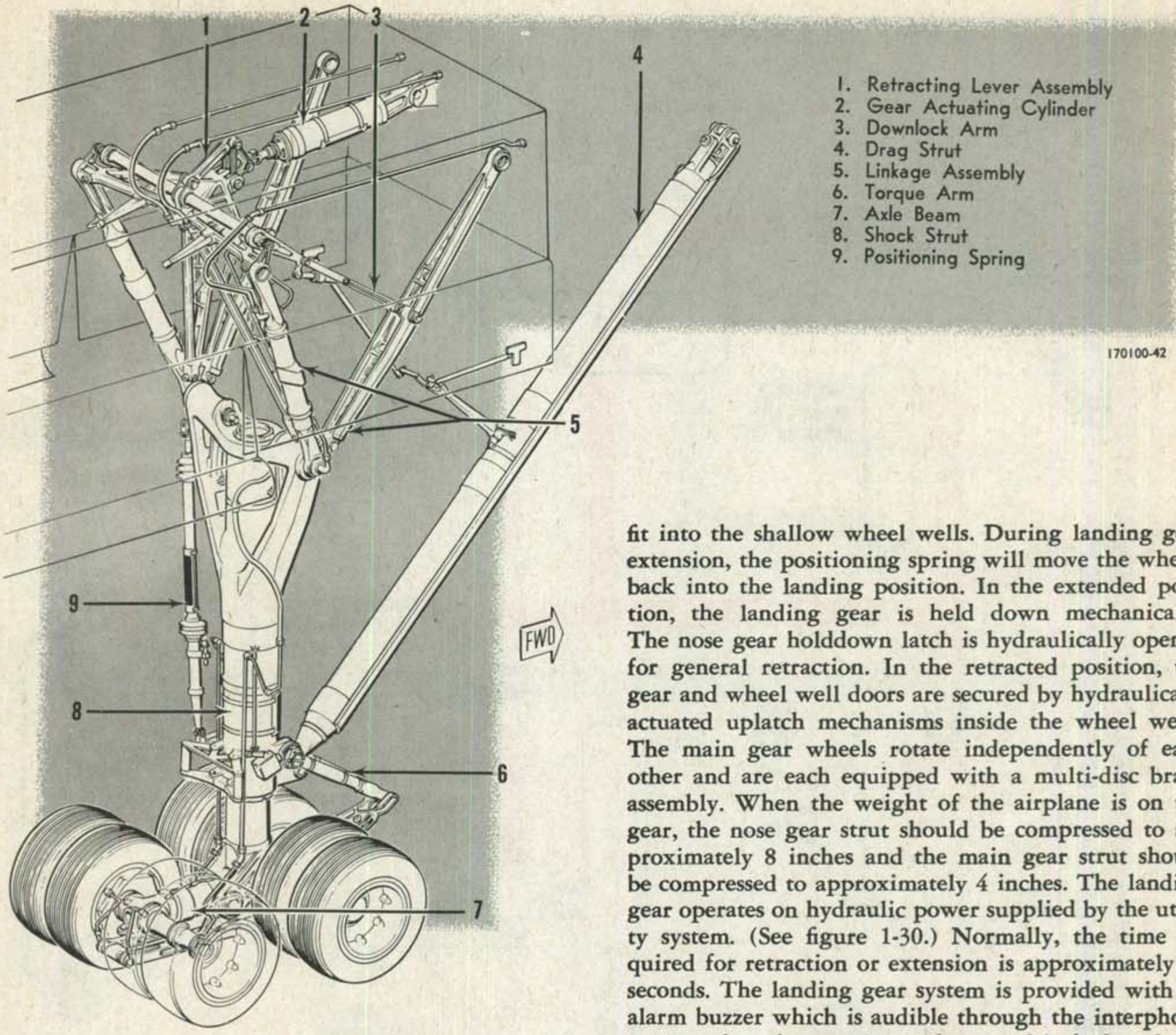

Figure 1-29.

cinched in the latched position hydraulically. The four wheels of each main gear are divided into two sets with a separate axle for each set. The two axles are attached to the forward and aft ends of a horizontal axle beam (7, figure 1-29). The axle beam is attached, at its center, to the bottom of the shock strut (8, figure 1-29) with a trunnion pin. This arrangement permits one set of wheels to pass over an obstacle while the other set remains in contact with the runway. The pivoting feature also permits the wheels and axle beam to be positioned for retraction and extension. As the gear retracts, a pneumatic positioning spring (9, figure 1-29) forces the forward set of wheels down to rotate the axle beam about the center pivot to a position parallel to the shock strut. This permits the wheels to fit into the shallow wheel wells. During landing gear extension, the positioning spring will move the wheels back into the landing position. In the extended position, the landing gear is held down mechanically. The nose gear holddown latch is hydraulically opened for general retraction. In the retracted position, the gear and wheel well doors are secured by hydraulically actuated uplatch mechanisms inside the wheel wells. The main gear wheels rotate independently of each other and are each equipped with a multi-disc brake assembly. When the weight of the airplane is on the gear, the nose gear strut should be compressed to approximately 8 inches and the main gear strut should be compressed to approximately 4 inches. The landing gear operates on hydraulic power supplied by the utility system. (See figure 1-30.) Normally, the time required for retraction or extension is approximately 10 seconds. The landing gear system is provided with an alarm buzzer which is audible through the interphone system when the gear is not down and locked, and certain conditions of airspeed, altitude, and throttle position exist. A pneumatic system is provided for emergency extension of the landing gear in the event the normal hydraulic system fails. Ground safety locks (figure 1-31) are provided; when installed, they prevent unlocking of the gear.

LANDING GEAR CONTROLS AND INDICATORS.

Landing Gear Handle.

The landing gear handle (6, figure 1-32) is located on the pilot's forward left console and has three positions, marked UP, PRES REL, and DOWN. The handle has a wheel-shaped knob which contains a red warning lamp. Placing the handle in either the UP or DOWN position mechanically positions the landing gear selector valve to port hydraulic fluid to the gear-up or gear-down side of the landing gear hydraulic actuators to operate the gear. The landing gear handle is locked in the DOWN position by a spring-loaded electrical solenoid when the weight of the airplane is on the

landing gear system

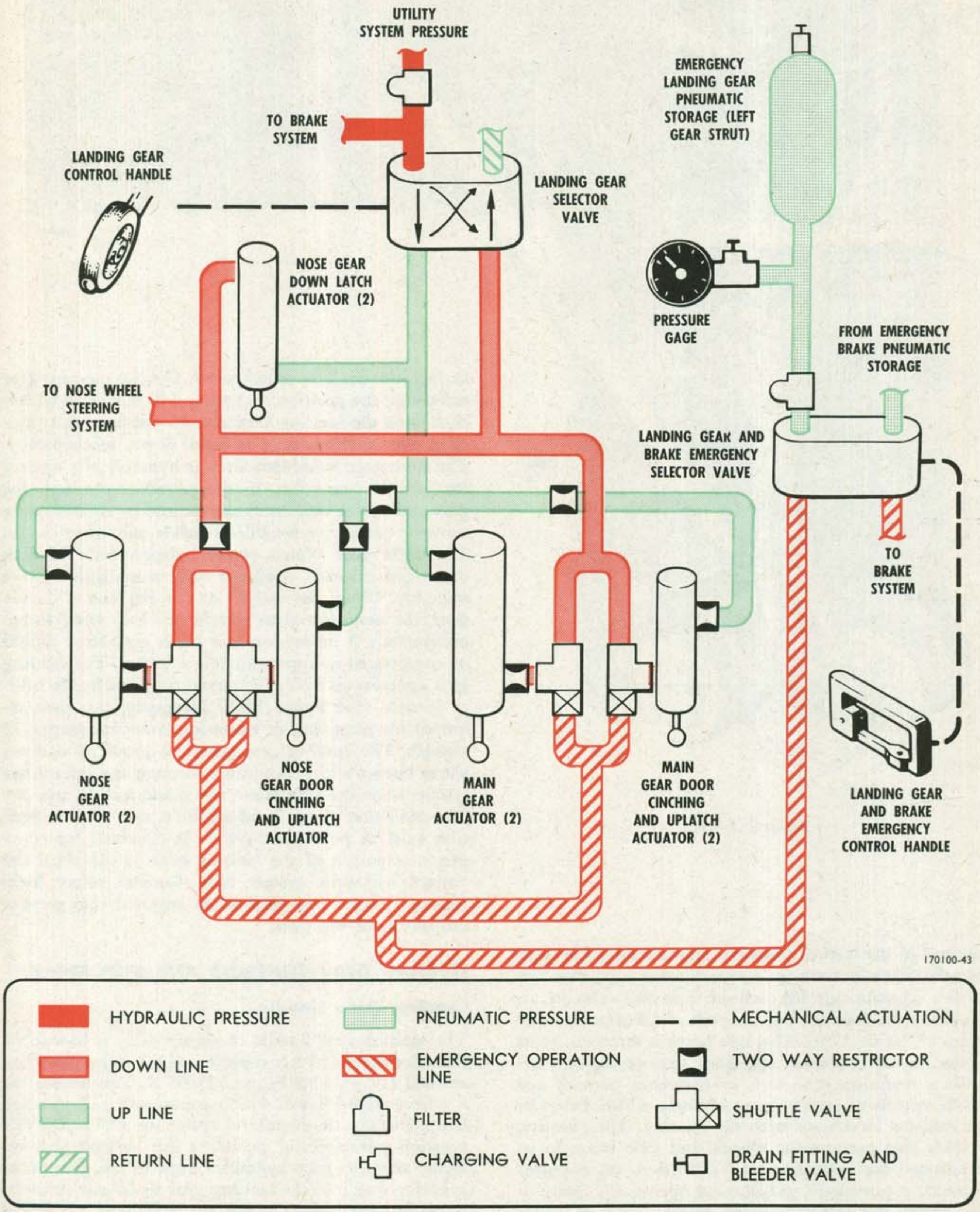

Figure 1-30.

gear. A limit switch on the torque arm assembly of the left main gear controls 28-volt d-c power to the solenoid. The weight of the airplane compresses the shock strut and opens the limit switch which breaks the electrical circuit to the solenoid. When the solenoid is de-energized, the spring tension extends a mechanical lock which holds the landing gear control handle in the DOWN position. Removing the weight from the landing gear, with electrical power on the airplane, will close the limit switch on the gear and energize the solenoid. The energized solenoid retracts the lock and frees the landing gear control handle. The mechanical lock may be manually released from the handle by depressing the landing gear downlock override button located on the pilot's forward left console. When the landing gear is retracted after takeoff, the landing gear handle will remain in the UP position. In this condition, hydraulic pressure is maintained on the actuators. Placing the handle in the PRES REL position will mechanically position the landing gear selector valve, closing the pressure ports to the actuators and opening a return port to the utility hydraulic reservoir. This action prevents the airplane structure from being subjected to unnecessary stress throughout the flight. The handle must then be pulled out approximately one-half inch to clear a stop before it can be moved to the DOWN position.

Landing Gear Downlock Override Button.

This button (11, figure 1-32), located on the pilot's forward left console is connected to the spring-loaded electrical solenoid which mechanically locks the landing gear control handle in the DOWN position. In event of a malfunction in the electrical circuit of the solenoid, this button may be used to free the landing gear control handle. When the button is depressed, the mechanical lock is released and the handle is free to be moved to the UP position.

Landing Gear Alarm Cutoff Button.

A pushbutton switch (8, figure 1-32), located on the pilot's forward left console provides a means of silencing the alarm buzzer. Depressing the button energizes a relay in the buzzer circuit which cuts off power to the alarm buzzer.

Landing Gear Position Indicator Lamps.

Three green landing gear position indicator lamps (2, figure 1-32) are located on the pilot's forward left console. The lamps are arranged in a triangular relationship corresponding to the landing gear and will light when the corresponding gear is down and locked. The lamps will go out when the gear is in any position other than down and locked. The lamps operate on 28-volt d-c power. For testing and dimming of the lamps refer to "Pilot's Indicator Lamp System" of this section.

landing gear ground locks

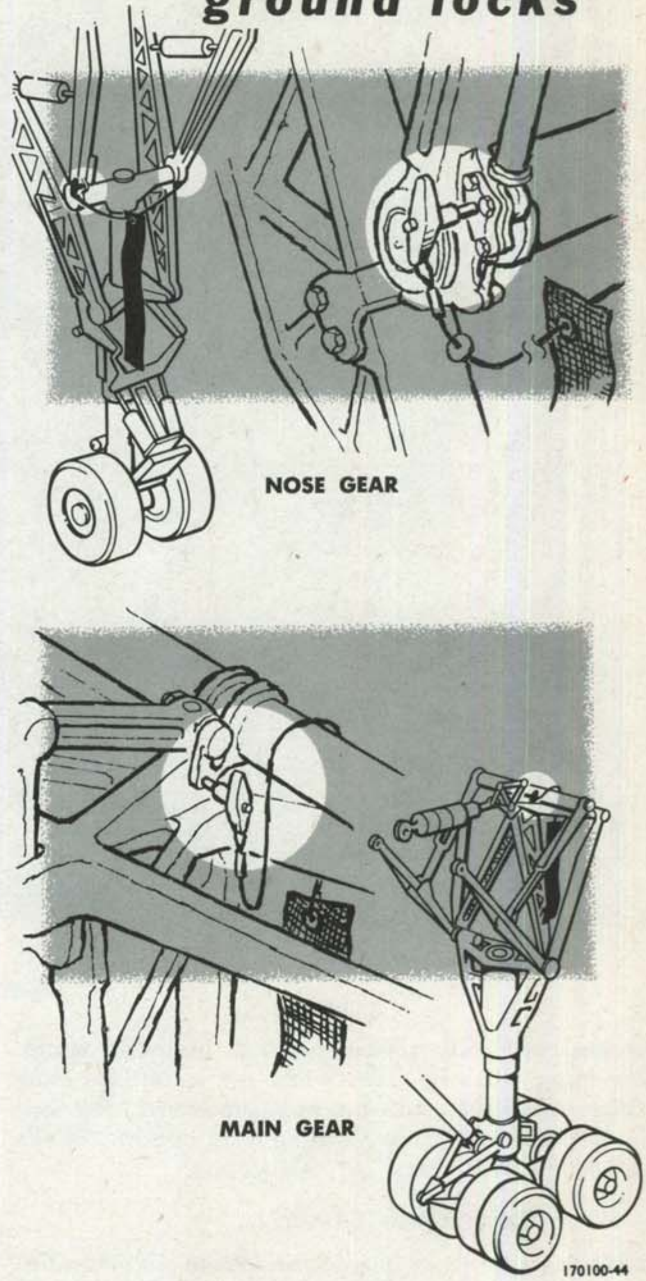

Figure 1-31.

Landing Gear Warning Lamp.

The red landing gear warning lamp (5, figure 1-32) is located in the wheel-shaped knob of the landing gear control handle. When the landing gear handle is moved to either the UP or DOWN position, the warning lamp will light and will remain lighted until the last gear is locked in the selected position. If the landing gear control handle is positioned to DOWN and the warning lamp remains lighted, it can be determined which gear is not down and locked by ob-

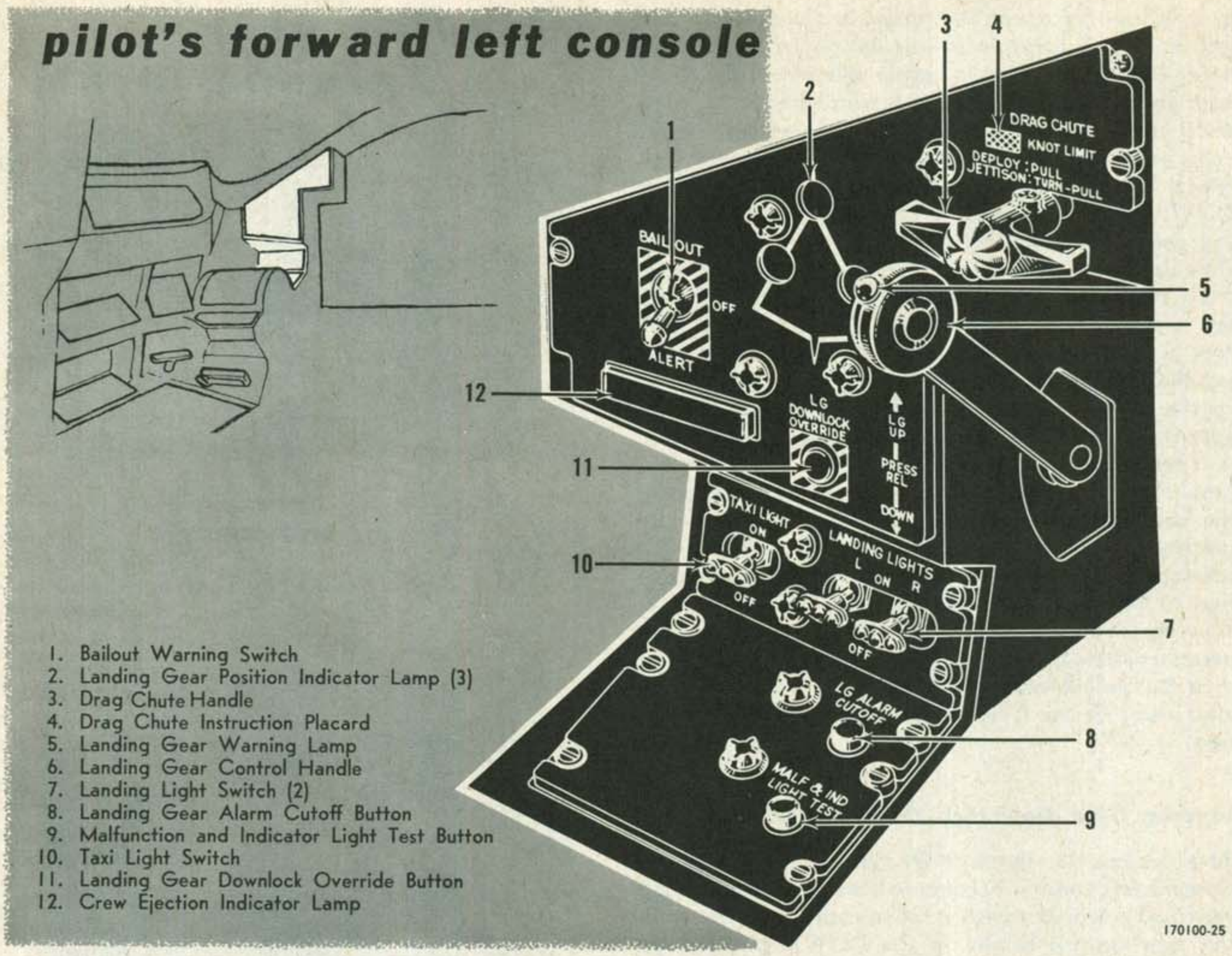

Figure 1-32.

serving the landing gear position indicator lamps. The lamp will also light when the conditions exist which sound the landing gear alarm buzzer. For testing and dimming of the warning lamp refer to "Pilot's Indicator Lamp System" of this section.

Landing Gear Alarm Buzzer.

A landing gear alarm buzzer provides an audible warning, through the interphone system, when certain flight conditions exist and the landing gear is not down and locked. The buzzer will be audible in the headsets when *all* the following conditions exist *simultaneously:*

During takeoff and climb —

1. The airspeed is below Mach No. 0.43 (±0.015).
2. The airplane is below an altitude of 11,000 (±450) feet.
3. Any one or all four engine throttles retarded below military power setting.
4. Landing gear in any position except down and locked.

During descent from altitude —

1. The airspeed is below Mach No. 0.38 (±0.15).
2. The airplane is below an altitude of 10,000 (±450) feet.
3. Any one or all four engine throttles retarded below military power setting.
4. Landing gear in any position except down and locked.

The landing gear alarm buzzer operates on 28-volt d-c power.

LANDING GEAR EMERGENCY PNEUMATIC SYSTEM.

The landing gear emergency pneumatic system (figure 1-30) provides a means of emergency extension of the landing gear in the event the utility hydraulic system fails. The drag strut on the left main gear is charged with nitrogen according to the ambient temperature.

A placard near the filler gage is used to determine the correct precharge pressure. Refer to figure 1-41 for servicing data. The pneumatic system pressure is controlled by the emergency brake and landing gear control handle.

Emergency Brake and Landing Gear Control Handle.

This handle (5, figure 1-7), located on the pilot's lower left console, is mechanically connected to the landing gear and brake emergency selector valve. When the handle is pulled to its full travel, pneumatic pressure (nitrogen) is ported to the landing gear uplatches and the extend side of the actuators to extend the gears. Also, the brake emergency pneumatic system is activated. (Refer to "Brake Emergency Pneumatic System," this section.) The handle will remain in its extended position until reset on the ground.

Note

- When the emergency brake and landing gear control handle is pulled, the landing gear control handle must either be in the PRESS REL position or the DOWN position (preferably DOWN).

NOSE WHEEL STEERING SYSTEM.

A steerable nose gear system is provided which allows directional control of the airplane during taxiing. The system is electrically controlled and hydraulically operated. (See figure 1-33). The main components of the system are a nose wheel steering button, a control transmitter, a position transmitter, a safety switch, two steering actuators, and an electrically operated hydraulic steering valve. Hydraulic pressure for steering operation is supplied by the utility hydraulic system through the landing gear down line. When the nose wheel steering button is depressed and held to energize the system, movement of the rudder pedals will electrically position the steering valve to port hydraulic pressure to the actuators which turn the nose wheel. Nose wheel shimmy is prevented by one-way restrictors which allow a free flow of pressurized fluid into the steering actuators but restrict the flow of return fluid from the actuators. With maximum movement of the rudder pedals, the nose wheel may be steered approximately 50 degrees in either direction from center. When the airplane is being taxied with the steering system de-energized, the nose wheel is free to caster. When castering, if the nose wheel strut turns to right or left beyond the 50-degree position, a limit switch in the position transmitter will energize the steering valve to port hydraulic pressure to the steering actuators and force the wheel back to the 50-degree position. The nose wheel is kept centered during retraction and extention by centering cams which are en-

nose wheel steering hydraulic system

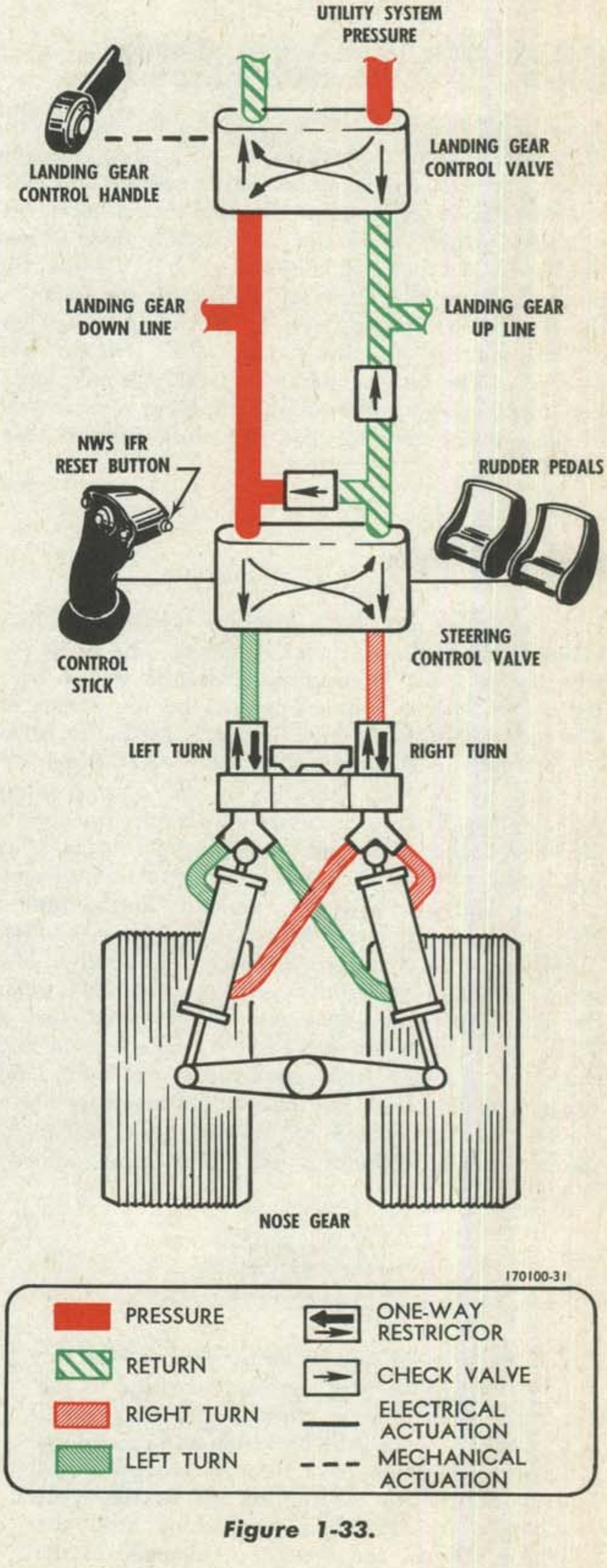

Figure 1-33.

gaged by removing the weight from the nose gear. A safety switch in the nose steering electrical control system is also actuated simultaneously with the centering cams to prevent energizing the steering system while the centering cams are engaged.

NWS-IFR RESET (NOSE WHEEL STEERING – INFLIGHT REFUELING RESET) BUTTON.

A pushbutton switch (3, figure 1-27) on the control stick grip is used to energize the nose wheel steering system and to reset the air refueling system. The button operates in conjunction with the air refueling system door switch. With the air refueling door switch in the CLOSE position, depressing and holding the button will provide electrical power for operation of the nose wheel steering system. With the system energized, movement of the rudder pedals will turn the nose gear. The system operates on 115-volt a-c power. For information on the inflight refueling reset feature of the button, refer to "Air Refueling System", Section IV.

BRAKE SYSTEM.

Each main landing gear wheel is equipped with a hydraulically operated multidisc brake. The brake system (figure 1-34) is supplied hydraulic power from the utility system and is operated by toe action on the rudder pedals. A metering-type hydraulic brake control valve is equipped with two levers which are actuated by cables connected to the corresponding brake pedals. Each lever controls hydraulic pressure to all wheel brakes of the corresponding main gear. With full application of the brakes, the control valve meters 1000 to 1260 psi hydraulic pressure to the brakes. Hydraulic pressure to the brake control valve is routed through a brake hydraulic pressure shutoff valve. This valve shuts off hydraulic pressure to the brake when the brake emergency pneumatic system is actuated. A brake sequence shutoff valve in the brake line on each main gear prevents brake application when the landing gear is not down and locked. The sequence valves are mechanically closed and opened by movement of the gear during retraction and extension respectively.

CAUTION

Retraction of the landing gear while the wheels are rotating can cause damage to the main landing gear wheel well. To prevent possible damage, the brakes should be applied for a minimum of 2 seconds to stop wheel rotation before positioning the landing gear handle to UP. Brake application after the gear unlocks could result in damage to the retraction mechanism if a brake sequence shutoff valve failed.

The brake system is also equipped with an accumulator which stores pressure for parking brakes and acts as a surge damper during normal operation. The utility system engine-driven hydraulic pumps maintain normal system pressure on the accumulator. The accumulator is precharged with nitrogen according to the ambient temperature. A placard near the filler gage in the left wheel well is used to determine the correct precharge pressure. Refer to figure 1-41 for servicing data. During prolonged periods with no pressure on the utility hydraulic system, the brake accumulator pressure can be maintained with a hand pump which is located in the left wheel well. The accumulator gage should indicate at least 1500 psi to assure adequate pressure for parking brakes. A pneumatic system is provided for emergency brake operation in the event of utility hydraulic system failure. On airplane 35 ➧ the brake system incorporates an anti-skid system which momentarily releases brake pressure each time the wheels approach a skid condition. Although artificial feel is built into the brake system, on airplanes 31 ➧ 34 the pilot must use caution when applying braking pressure in order to prevent locking the wheels and skidding the tires. For additional information pertaining to the brakes, refer to "Brake System", Section VII.

ANTI-SKID SYSTEM. 35 ➧

The anti-skid system prevents tire skids from occurring by releasing brake pressure before a skidding condition exists. The system consists of a detector unit driven by each main gear wheel, a control unit and an anti-skid valve for each main gear, and an anti-skid control switch located in the pilot's station. The anti-skid system detects an incipient skid condition by sensing the rapid wheel deceleration rate which exists when the brake torque being applied exceeds the frictional force available between the tires and runway. When the anti-skid control switch is positioned to ON and brakes are applied, the detector units supply the control units with electrical voltage signals proportional to the speed of each wheel on the main gear. The control units monitor these signals and sense a skid condition when rotation of the wheels decreases too rapidly. When the wheels approach a skid condition, the control unit energizes the anti-skid valve and brake pressure is released allowing the wheels to accelerate. When the wheels have regained speed, the control unit de-energizes the anti-skid valve and brake pressure is re-applied. The system will cycle in this manner as long as the brake pressure applied is in excess of that which is necessary to achieve maximum braking. The anti-skid system operates independently on each main gear. If a wheel on either gear approaches a skid condition, brake pressure will be released from all wheels on that gear. Pressure will

brake system

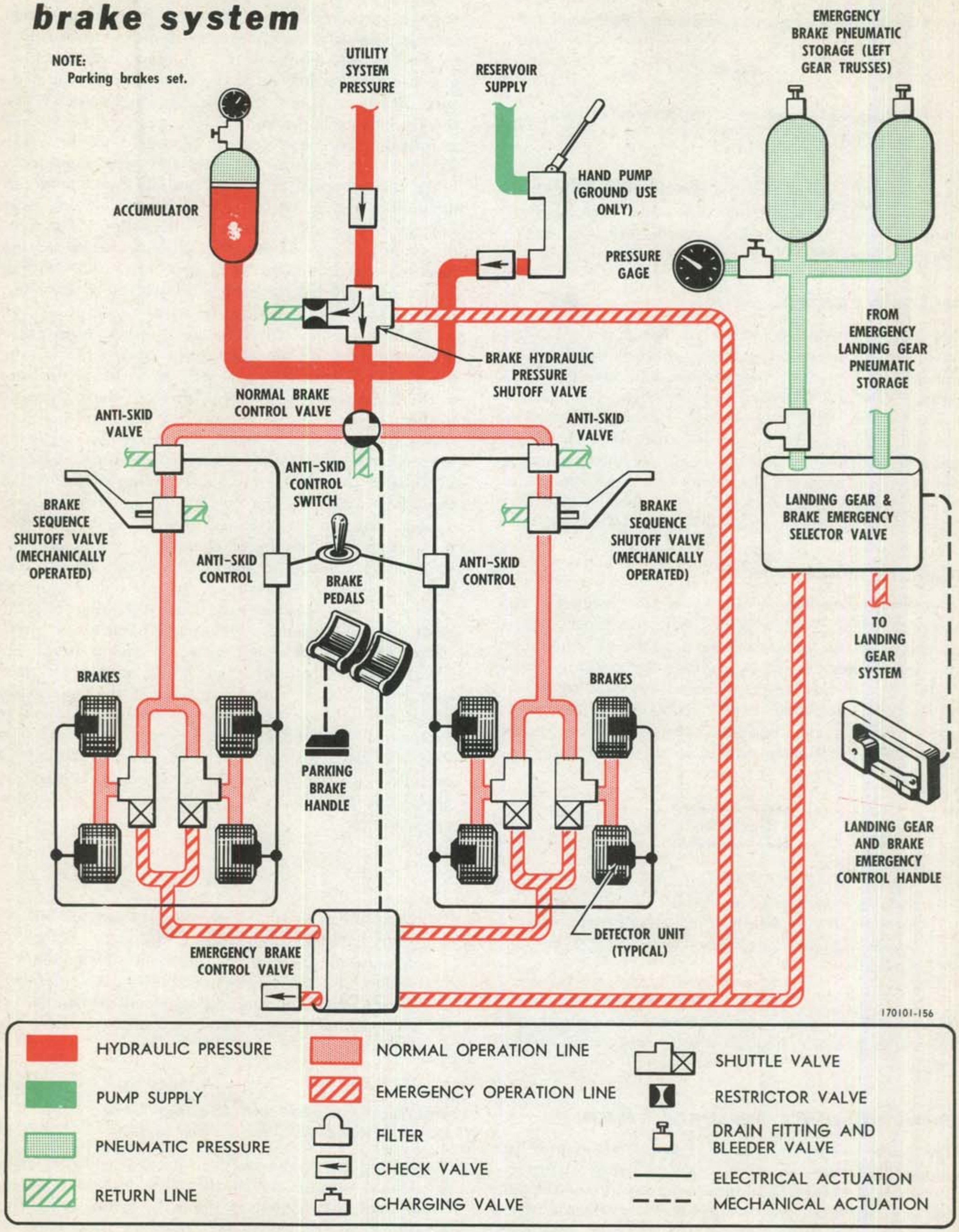

Figure 1-34.

not be released from the wheels of the other gear unless a wheel on that gear approaches a skid condition.

Note

> The anti-skid system is inoperative during emergency brake operation.

The anti-skid system receives power from the 28-volt d-c power distribution panel. For additional information pertaining to anti-skid system, refer to "Brake System", Section VII.

ANTI-SKID CONTROL SWITCH. 35

The anti-skid control switch (2, figure 1-7), located on the pilot's lower left console, controls operation of the anti-skid system. The switch has two positions marked ON and OFF and requires 28-volt d-c power for operation. When the switch is positioned to ON, the anti-skid control valves are energized. However, the anti-skid feature will not begin to function unless the wheels approach a skid condition. Positioning the switch to OFF de-energizes the control valves, removing the anti-skid feature from the brake system.

PARKING BRAKE HANDLE.

A parking brake handle (17, figure 1-5), located at the lower center edge of the pilot's main instrument panel, is used to set the brakes for parking the airplane. The parking brakes are set by pulling the parking brake handle out its full length of travel and holding it out while depressing both brake pedals until they catch and remain in the depressed position. The parking brake handle will then remain in the out position.

CAUTION

> When setting the parking brakes, make sure that the parking brake handle is pulled out through its full length of travel and that both pedals remain depressed when force is removed.

The brakes are released by depressing the pedals; then the parking brake handle will return to its normal position.

BRAKE EMERGENCY PNEUMATIC SYSTEM.

The brake pneumatic system (figure 1-34) is used for emergency brake operation in the event the utility hydraulic system fails. The main components of the system are two nitrogen storage bottles, a selector valve, an emergency brake control valve, brake hydraulic pressure shutoff valve, pneumatic tubing, and the emergency brake and landing gear control handle. The storage bottles (two truss tubes of the left main gear linkage assembly) are charged with nitrogen according to the ambient temperature. A placard near the filler gages is used to determine the correct precharge pressure. Refer to figure 1-41 for servicing data. When the emergency brake and landing gear control handle is pulled, pneumatic pressure is routed to the brake shutoff valve and to the metering-type emergency brake control valve. Also, the landing gear emergency pneumatic system is activated. (Refer to "Landing Gear Emergency Pneumatic System," this section.) The shutoff valve is closed to prevent hydraulic pressure from reaching the normal brake control valve. The normal brake control valve is mechanically linked to the emergency control valve so that one set of brake pedal control cables may be utilized for both valves. With pneumatic pressure to the emergency control valve, the action on either brake pedal will direct brake pressure to the respective sets of wheels through the pneumatic tubing. Brakes should be applied with gradual but steady pressure on the pedals. Each time the pedals are released, the pneumatic pressure in the lines is vented overboard; therefore, excessive releasing of the pedals should be avoided. The number of full brake applications that can be obtained depends upon the temperature of the system. If the system temperature is 70°F (21°C), seven to eight full brake applications can be obtained; however, at system temperature of —65°F (—54°C), as little as three full brake applications may be available. After the last full brake application has been released, each subsequent brake application will result in a decreasing amount of pressure being applied to the brakes. If the emergency brake and landing gear control handle is pulled to extend the gear the brake emergency pneumatic system will be activated; therefore, caution should be exercised to prevent inadvertent brake application before the airplane is on the ground and the brakes are required.

Note

> If sufficient hydraulic pressure is available for gear extension but questionable for brake operation, or in event of hydraulic system failure after gear extension, pulling the emergency brake and landing gear control handle will still provide pneumatic pressure for brake operation.

Emergency Brake and Landing Gear Control Handle.

The emergency brake and landing gear control handle is used to extend the landing gear and activate the brake pneumatic system in the event of utility hydraulic system failure. Pulling the handle will activate the brake pneumatic system whether the landing gear was extended pneumatically or hydraulically. For further information on this handle refer to "Landing Gear Emergency Pneumatic System", this section.

DRAG CHUTE.

The airplane is equipped with a drag chute to supplement the airplane brakes by reducing ground roll during landings and aborted takeoffs. The chute is installed in a compartment located in the bottom of the tail section forward of the tail turret. The compartment is covered by dual clamshell-type doors which are hinged at the outboard edges. The chute installation consists essentially of a main canopy, which is equipped with a pilot chute, and the drag chute doors. The main canopy riser is attached to the aft end of the stowage compartment by a pneumatically actuated hook which engages the chute D-ring. To protect the airplane from excessive drag forces in the event the stowage compartment door should open accidentally and deploy the parachute during flight, the hook normally remains in a half-open configuration so that the chute assembly will pull free of the airplane. As a further precaution, the D-ring is designed so that it will fail and the chute will be released from the airplane if it is deployed by the control handle at airspeeds above 230 knots IAS. The drag chute system is actuated pneumatically and is controlled electrically. The pneumatic system consists of a filler valve, a pressure gage, a sequence valve and hook actuator assembly, and a door actuator, all located in the parachute stowage compartment, and a nitrogen bottle located in the adjoining compartment. The system is charged with nitrogen according to the ambient temperature. A placard near the filler gage is used to determine the correct precharge pressure. Refer to figure 1-41 for servicing data. The system is controlled from the pilot's station. A drag chute instruction placard (4, figure 1-32) is used to inform the pilot of the maximum deployment speed for the particular chute installed on that airplane. The deployment speed is marked on the instruction placard in white numerals each time a drag chute is installed. The deployment speed marking must be erased after the drag chute has been deployed.

DRAG CHUTE CONTROL HANDLE.

The drag chute system is controlled by a T-handle (3, figure 1-32) located on the pilot's forward left console. The handle is in its normal position when it is pushed in and the crossbar is horizontal. Pulling the handle out to the first stop deploys the chute. Then turning the handle 90 degrees counterclockwise and pulling it out to its full travel will jettison the parachute. The handle operates the system by supplying 28-volt d-c power to the pneumatic sequence valve through two circuits. Pulling the handle out closes the first circuit, actuating the valve. Actuating the valve closes the hook on the chute D-ring, unlatches the compartment doors, and forces them into the airstream. As the clamshell doors are opened by the airstream, the chute pack is pulled from the stowage compartment. As the pack is forced into the airstream, a ripcord attached to the airplane opens the pilot chute compartment located in the main canopy pack. The pilot chute is then projected into the airstream by a spring which is an integral part of the pilot chute. The opened pilot chute pulls the main canopy from the pack to complete the operation. Turning the handle 90 degrees counterclockwise and pulling the handle out will open the first circuit and close the second, causing the valves to open the D-ring hook, jettisoning the parachute. Returning the handle to its normal position (crossbar horizontal) opens the second circuit and allows the D-ring hook to return to its normal half-open position.

PRESSURE GAGE.

A pressure gage, located in a small compartment adjacent to the forward end of the parachute stowage compartment, indicates drag chute pneumatic pressure in pounds per square inch. The gage is visible through a window in the small compartment door.

PITOT-STATIC SYSTEM.

The pitot-static system supplies the pitot and static pressure necessary to operate various flight instruments and system components. The system consists of a pitot-static probe, impact and static pressure lines, and flex hoses which connect the pressure lines to the components. The pitot-static probe is attached to a boom which is mounted on the nose of the fuselage. Anti-icing of the probe is accomplished by electrical elements located within the probe. (Refer to "Anti-Icing and Defogging Systems," Section IV.) The pitot-static system supplies impact and static pressure to the air data computer, the VGH recorder, the airspeed indicator, and static pressure only to the vertical velocity indicator and altimeter.

AIR DATA SYSTEM.

The airplane is equipped with an air data system which provides aerodynamic intelligence to various control systems. The air data system consists basically of an electromechanical air data computer which processes raw data from the pitot-static probe and a temperature sensor probe located on the left side of the fuselage above the nose wheel well. The computer utilizes the following raw data: static pressure, pitot pressure, and total temperature. When this data reaches the computer, it is transformed into electrical signal outputs through an arrangement of transducers, mechanical linkage, and servo repeaters. These outputs, when delivered to the various control systems on the airplane, correspond to values of Mach number, static pressure, pressure altitude, density ratio, true airspeed, and free stream temperature. The mechanism of the computer operates on 115-volt a-c power.

OUTPUT DISTRIBUTION AND BASIC DIFFERENCES.

Listed below are the various airplane systems served by the air data system, followed in parentheses by the computer outputs which go to the systems:

1. Flight control (Mach number, static pressure).
2. Autopilot (Mach number, static pressure).
3. Spike positioning (Mach number).
4. Air conditioning (Mach number).
5. Civil navigational aids (static pressure to marker beacon signal amplifier).
6. Pilot's Mach indicator (Mach number).
7. Primary navigation (pressure altitude, true airspeed).
8. Bombing (density ratio, pressure altitude, altitude rate of change).
9. Inflight printer (pressure altitude).
10. Fire control (Mach number, density ratio).
11. Landing gear warning (Mach number, static pressure).

INSTRUMENTS.

The instruments covered here are only those which are not considered to be a part of a complete system. For information on instruments which are an integral part of a particular system, refer to applicable paragraphs in this section and Section IV.

AIRSPEED INDICATOR.

The airspeed indicator (31, figure 1-5), which is on the pilot's main instrument panel, shows indicated airspeed in knots. The indicator is operated by impact and static pressures from the pitot-static system.

MACHMETER.

A machmeter (3, figure 1-5), installed on the pilot's main instrument panel, indicates the Mach number at which the airplane is being flown. A set knob, located at the lower right corner of the machmeter, provides a means of setting the desired Mach No. reference point. Rotating the knob adjusts the reference point on the main dial, and depressing and rotating the knob adjusts the reference point on the subdial. In event of a power failure, POWER OFF appears in a window on the face of the main dial.

ALTIMETER.

An altimeter (30, figure 1-5), located on the pilot's main instrument panel, indicates altitude in feet. A safety display in the form of a crosshatched area appears when the airplane is below 16,666 feet. When at zero feet, the area is fully exposed. The altimeter is a barometric-type instrument which operates on static pressure from the pitot-static system.

VERTICAL VELOCITY INDICATOR.

A vertical velocity indicator (22, figure 1-5), located on the pilot's main instrument panel, measures in feet per minute the rate of climb or descent of the airplane. The indicator operates on static pressure from the pitot-static system.

ACCELEROMETER.

The accelerometer (20, figure 1-5) is located on the pilot's main instrument panel. It indicates the vertical load imposed on the airplane in terms of "g" units and enables the pilot to maneuver the airplane within its operational limits. A main pointer gives continuous indication of gravitational load; two auxiliary pointers indicate maximum acceleration—positive and negative—during any maneuver. The two auxiliary pointers maintain their extreme positions until they are reset by depressing the knob on the lower left side of the instrument. The accelerometer is operated by gravitational forces and has no external power source.

MM-3 ATTITUDE INDICATORS.

A visual indication of the flight attitude of the airplane in pitch and roll is provided by two MM-3 attitude indicators (5, figure 1-5, and 4, figure 4-26), one at the pilot's station and one at the navigator's station. The indicator at the navigator's station is used to determine if the stable table unit in the primary navigation system is erect and is also used when flying the airplane with the tracking and flight control stick. Both are remote indicating instruments which are controlled by pitch and roll signals from the stabilization unit in the primary navigation system. These signals establish the vertical reference line from which pitch and roll deviation is measured. Changes in aircraft attitude are electrically relayed from the stabilization unit to the indicator causing displacement of the indicator sphere in relation to a fixed miniature airplane on the indicator. The amount of displacement is directly proportional to actual airplane attitude deviation from level flight. The indicator displays pitch information by movement of the spherical surface used as a reference background for the fixed miniature airplane. A line on the sphere represents the horizon and divides the grey portion which represents the sky from the black portion which represents the ground. Roll information is presented by movement of an index at the top of the instrument in relation to a scale along the circumference of the instrument face. The indicator does not contain gyros; therefore, a caging handle is not provided. The indicator is unlimited in roll and is operative through 90 degrees of climb or dive; however, mechanical stops in the stabilization unit prevent signals beyond 90 degrees of roll and 70 degrees of climb or dive from being relayed to the indicator. The indicator is powered by 115-volt alternating current. A power failure flag, marked OFF and visible in a window at the lower left side of the indicator, appears in the event of complete power failure. However, a slight reduction in power or a deviation of the stable table unit will not cause the flag to appear even though the system is not operating properly.

WARNING

It is possible that a malfunction of the attitude indicator can be determined only by checking it with the turn and slip indicator.

A pitch trim knob, located at the lower right corner of the indicator, is provided for centering the horizon line after the airplane has been trimmed for level flight.

J-8 ATTITUDE INDICATOR.

A J-8 attitude indicator (7, figure 1-5), located on the pilot's main instrument panel, is a standby indicator which gives a visual indication of the flight attitude of the arplane in pitch and roll. The instrument is self-contained and operates on 115-volt a-c power. An "OFF" flag appears in the upper right arc of the dial whenever power is not being supplied or when the gyro is not up to speed. Within a range of approximately 25 degrees in climb or dive, the pitch attitude of the airplane is indicated by displacement of the horizon bar in relation to a miniature airplane on the indicator. When the pitch attitude of the airplane exceeds approximately 25 degrees, the horizon bar remains in the extreme position, and the sphere then serves as the reference. If the climb or dive angle is further increased, the attitude is indicated by graduations on the sphere. In a roll, the attitude of the airplane is shown by the angular setting of the horizon bar with respects to the miniature airplane and by the relation of the bank index to the degree markings. The gyro may be manually caged by use of the "Pull to Cage" knob on the lower right side of the instrument.

CAUTION

The "Pull to Cage" knob should be pulled out smoothly and released quickly when caging the gyro. A violent or hard pull may damage the instrument.

The manual caging feature permits fast gyro erection for takeoff or for erecting the gyro to correct inflight errors caused by turns. After power is applied to the airplane, one and one-half minutes should be allowed to bring the gyro up to speed, and then the gyro should be caged immediately. When the gyro is caged to correct inflight errors, caging should be used only when the airplane is in straight and level flight as determined by visual reference to a true horizon, since the

indicator cages to the attitude of the airplane. A knob on the lower left side of the instrument permits the miniature airplane to be adjusted to compensate for longitudinal trim changes.

WARNING

A slight amount of pitch error in the indication of the J-8 attitude indicator will result from acceleration or deceleration. It will appear as a slight climb indication after a forward acceleration and as a slight dive indication after deceleration when the airplane is flying straight and level. This error will be most noticeable at the time the airplane breaks ground during the takeoff run. At this time, a climb indication error of about 1-1/2 bar widths will normally be noticed; however, the exact amount of error will depend upon the acceleration and elapsed time of each individual takeoff. The erection system will automatically remove the error after the acceleration ceases.

TURN AND SLIP INDICATOR.

A turn and slip indicator (4, figure 1-5) is installed at the top of the pilot's main instrument panel. It is driven by 28-volt d-c power.

MAGNETIC COMPASS.

A magnetic compass is installed on the center post of the pilot's windshield.

CLOCK.

A mechanical time-of-day, elapsed-time clock (21, figure 1-5) is located on the pilot's main instrument panel. The clock contains a main dial, two subdials, two control knobs, and a control lever. The clock has an eight-day movement and is stem wound. The main dial indicates the time of day and consists of minute, hour, and sweep second hands which are controlled by a winding-set knob located on the lower left corner of the clock. Rotating the knob counterclockwise winds the clock mainspring. Pulling out on the knob stops the clock and zeros the sweep second hand and allows it to be reset as desired. Pushing the knob back in restarts the clock. The upper subdial indicates elapsed time and consists of minute and hour hands which are controlled by a lever located on the upper right corner of the clock. The lever has three positions marked GO, STOP, and 0 (zero). Placing the lever in the corresponding position will start, stop, or zero the minute and hour hands. The lower subdial indicates elapsed time in increments of minutes, and consists of a minute hand which is controlled by a knob located on the lower right corner of the clock. Depressing the knob once starts the minute hand and displays a small white dot on the face of the subdial. A second depression of the knob stops the minute hand and displays a red and white dot. A third depression of the knob zeros the minute hand and displays a red dot.

PILOT'S INDICATOR LAMP SYSTEM.

The pilot's indicator lamp system consists of all the lamps on the warning and caution lamp panels (figure 1-12), the individual lamps located on the pilot's consoles and control panels, and a light test button and a dimming switch for these lamps. All of these lamps, except the master warning and caution lamps, are described under their respective systems. The master warning and caution lamps provide visual indications in the event of a system malfunction or unsafe condition requiring immediate attention by the pilot.

MALFUNCTION AND INDICATOR LIGHT TEST BUTTON.

The malfunction and indicator light test button (9, figure 1-32) is located on the pilot's forward left console. This button provides a means of simultaneously testing the operation of the master and the individual warning and caution lamps, the landing gear warning and position indicator lamps, and the crew ejection, inflight refueling ready, autopilot second station, and neutral trim indicator lamps. Each of these lamps should light when the test button is depressed. Also, the landing gear warning buzzer should sound when the test button is depressed if the landing gear control handle is in the DOWN position. The button controls 28-volt direct current for lighting the lamps.

MALFUNCTION AND INDICATOR LIGHT DIMMING SWITCH.

The malfunction and indicator light dimming switch (11, figure 4-15) is located on the pilot's lighting control panel. The switch has positions marked BRIGHT and DIM and is spring loaded to a neutral position. This switch controls the dimming of the master and the individual warning and caution lamps, the landing gear warning and position indicator lamps, and the inflight refueling ready, autopilot second station, and neutral trim indicator lamps. When this switch is momentarily positioned to DIM, the intensity of these lamps wll be dimmed provided both panel light control knobs on the pilot's lighting panel are rotated approximately 25 degrees from OFF. If either of the knobs are below this setting the warning, caution, and indicator lamps will stay dim only as long as the dimming switch is held in the DIM position. Once these lamps are dimmed they can be brightened by momentarily positioning the switch to BRIGHT. The dimming switch controls 28-volt direct current to the warning, caution, and indicator lamps.

MASTER WARNING LAMP.

The red master warning lamp (29, figure 1-5) is located at the left side of the pilot's main instrument panel. When the lamp is lighted, MASTER WARNING appears in black letters on the face of the lamp. The lamp lights when any individual *warning* lamp on the warning and caution lamp panels becomes lighted as a result of a malfunction or unsafe condition in some system of the airplane. The master lamp remains lighted as long as an individual lamp is lighted. The master lamp can be reset, however, by depressing the face of the lamp. This should be accomplished as soon as possible after the individual warning lamps have been checked to determine the source of trouble. The individual warning lamp will remain lighted as long as the trouble exists and the master warning lamp will remain off until some other source of trouble causes another individual lamp to light. Dimming of the lamp can be accomplished with the malfunction and indicator lights dimming switch on the pilot's lighting control panel and the lamp can be tested by depressing the malfunction and indicator light test button on the pilot's forward left console. The lamp operates on 28-volt direct current.

MASTER CAUTION LAMP.

The master caution lamp (28, figure 1-5) is located at the left side of the pilot's main instrument panel. When the lamp is lighted, MASTER CAUTION appears in yellow letters on the face of the lamp. The master lamp lights when any individual *caution* lamp on the warning and caution lamps panels becomes lighted as a result of a malfunction or unsafe condition in some system of the airplane. The master caution lamp remains lighted as long as an individual lamp is lighted or until reset by depressing the face of the lamp. The control unit for the master caution lamp contains a delay circuit which delays the lighting of the master caution lamp from one to one and one-half seconds after an individual caution lamp has lighted. The master lamp should always be reset as soon as possible after the caution panel has been checked to determine the source of trouble or type of malfunction.

EMERGENCY EQUIPMENT.

BAILOUT WARNING SYSTEM.

The bailout warning system provides a means for the pilot to alert the crew to a possible inflight emergency and notify them when to eject in case of an emergency requiring inflight escape from the airplane. The system also provides the pilot an indication when both crew members have ejected. The system consists primarily of a bailout switch and a crew ejection indicator lamp in the pilot's station, and alert lamps and warning lamps in the navigator's and defensive system operator's (DSO) crew stations.

CONTROLS AND INDICATORS.

Bailout Warning Switch.

The bailout warning switch (1, figure 1-32) is located on the pilot's forward left console and is marked BAILOUT, OFF, and ALERT. The switch is held in the selected position by an internal locking device which requires that the switch lever be pulled out before it can be repositioned. When the switch is positioned to ALERT, the alert lamps at the navigator's and DSO's station will light and flash on and off. If ejection is anticipated and if time permits, the switch should be positioned to ALERT soon enough to allow the crew members to accomplish all necessary ejection preparations. When the switch is positioned to BAILOUT the navigator's and DSO's bailout warning lamps will light. This serves as a signal for these crew members to eject.

Bailout Warning Lamps.

The red bailout warning lamps (2, figure 4-26, 2, figure 4-38, and figure 4-43), when lighted, provide a visual signal from pilot to crew members to eject from the airplane using the proper ejection sequence. A bailout warning lamp is located on the navigator's auxiliary flight instrument panel and pod release panel, and on the defensive system operator's bailout warning panel. The bailout warning lamps are controlled by the pilot's bailout warning switch and are powered by 28-volt direct current.

Note

In case the pilot ejects without placing the bailout switch to BAILOUT, the upward movement of the pilot's seat will automatically cause all the bailout warning lamps to light.

Bailout Alert Lamps.

The amber bailout alert lamps (1, figure 4-26, 1, figure 4-38, and figure 4-43), when flashing on and off, provide a visual signal from pilot to crew members that an emergency exists which may require ejection from the airplane. The crew members should immediately begin to prepare for seat ejection when this lamp begins to flash. A bailout alert lamp is located on the navigator's pod release panel and auxiliary flight instrument panel, and on the defensive system operator's bailout warning panel. The lamps are powered by 28-volt direct current and controlled by the pilot's bailout warning switch and by a flasher mechanism in the lamp circuitry.

Crew Ejection Indicator Lamp.

A crew ejection indicator lamp (12, figure 1-32) is located on the pilot's forward left console.. This lamp is automatically lighted when the navigator and defensive systems operator have ejected from the airplane. When lighted, the words CREW HAS EJECTED appear in black letters on the red face of the lamp. The lamp is controlled by two switches in series arrangement located adjacent to the back of the navigator's and DSO's ejection seats. Each switch closes when its respective seat ejects. When both switches have closed, a 28-volt d-c circuit is completed causing the lamp to light. For information on testing this lamp, refer to "Pilot's Indicator Lamp System" of this section.

ENGINE FIRE DETECTOR SYSTEM.

A detector system is provided in the airplane to give the pilot warning of engine overheat or a nacelle fire. The system consists essentially of a fire pull switch and warning lamp for each engine, electrical control boxes, cable-type sensing elements, and a button for testing the sensing circuits. When fire or excessive heat increases the temperature of the sensing elements, the warning lamps will light. The sensing elements of each nacelle are installed in a continuous series with a sensing signal applied at both ends. A single break in an element will not make the system inoperative; in case of a double break, only the portion between the breaks will be inoperative.

Fire Pull Switches and Warning Lamps.

Four fire pull switches and warning lamps (9, figure 1-5) marked FIRE PULL are located on the top right corner of the pilot's main instrument panel. The warning lamps, which are recessed in the center portion of the pull switches and identified by engine number, light when a fire or overheat condition exists in the nacelles. They can be checked for operation by depressing the pull switches. The pull switches control the engine fuel shutoff valves and the hydraulic system firewall shutoff valves. Pulling the switches out closes the valves, stopping fuel and hydraulic fluid flow to the applicable nacelles. The valves can be opened again by pushing the switches in. The switches operate on 28-volt direct current.

CAUTION

Pulling a fire pull switch when an engine is operating will cause the hydraulic pump to cavitate, resulting in possible contamination of the hydraulic system with metal particles. For this reason, engines should not be shut down by pulling the fire pull switches, except in an emergency.

Engine Fire Detector Circuit Test Button.

A push-to-test button (8, figure 1-5) is located above the fire pull switches to provide a means of checking the fire detection circuits in the nacelles. When the button is depressed, the indicator lamps in the fire pull switches will light, indicating operative detector circuits. The switch operates on 28-volt direct current.

POD FIRE DETECTOR SYSTEM.

A detector system is provided in the pod nose section to warn the navigator in case of a fire in the pod. The system consists essentially of a warning lamp, a circuit test button, an electrical control unit, and continuous sectional sensing elements. The warning lamp and test button are at the navigator's station; the control unit and sensing element are in the pod. When an overheat condition exists in the pod, the sensing element in the overheated area signals the control unit which, in turn, lights the warning lamp. A single break in the sensing element will not render the system inoperative; a double break in the element will cause only that portion located between the breaks to become inoperative. The detector circuit is powered by 115-volt alternating current.

Pod Fire Detector Warning Lamp.

A red push-to-test warning lamp (3, figure 4-38) is located on the navigator's pod release panel. When lighted, the lamp indicates a fire or overheat condition in the nose section of the pod. The lamp operates on 115-volt alternating current.

Pod Fire Detector Circuit Test Button.

A push-to-test circuit test button (9, figure 4-38) is located on the navigator's pod release panel for checking the continuity of the pod fire detector circuit in

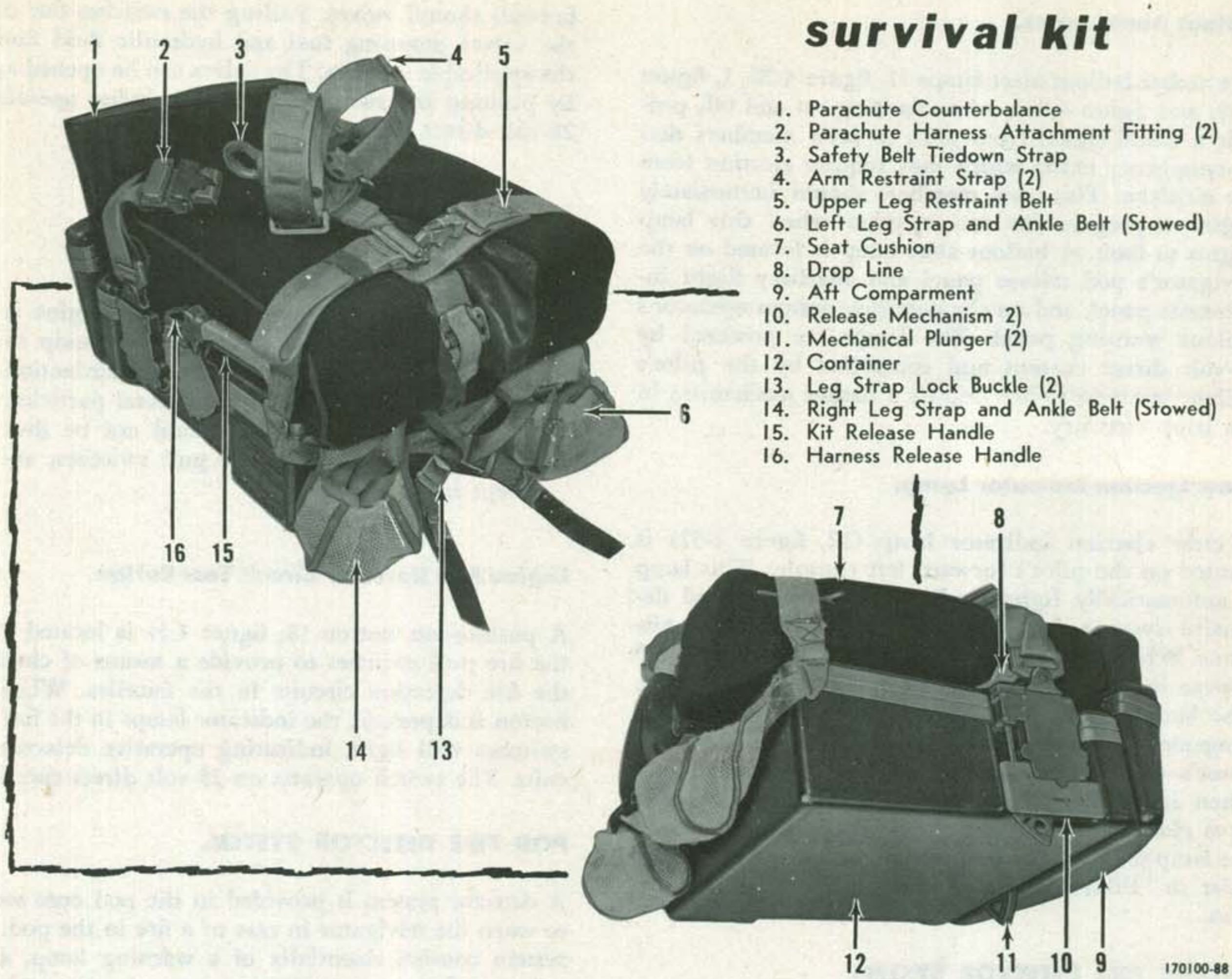

Figure 1-35.

the pod nose section. When the button is depressed, the pod fire detector warning lamp will light if the detector circuitry is operative. The button controls 115-volt alternating current for testing the circuitry.

SURVIVAL KIT.

A global survival kit (figure 1-35) is provided for installation in the ejection seat at each crew station. Each kit consists of a Fiberglas container, a container lid with attached seat cushion, a parachute counterbalance, a safety belt tie-down strap, arm and leg restraint harnesses, a left and right parachute harness attachment strap, and manual controls for effecting harness and kit release. The large forward compartment of the container is equipped with items necessary for crew survival in the particular area over which flight is to be made. The aft compartment of the container supports the parachute counterbalance. The safety belt tie-down strap prevents the seat safety belt from being pulled out of position by the shoulder harness; also, the tie-down strap serves as an attachment point for the arm restraint straps. Two adjustable attachment straps on the sides of the kit are for attaching the kit to the parachute harness. These straps are equipped with special fittings which insert into the release mechanisms on the sides of the container. The fittings separate from the release mechanisms when either the harness release handle or the kit release handle is pulled. The function performed by the kit release handle is determined by the position of two spring-loaded mechanical plungers which protrude from the bottom of the container. Normally, the weight of the kit maintains these plungers retracted into the kit bottom. With the plungers retracted, pulling the kit release handle will result only in separation of the harness attachment strap fittings from the release mechanisms. However, when the weight of the kit is not supported by the bottom of the container, these plungers extend down from the container bottom. If the kit release handle is pulled while these plungers are extended, the fittings will separate from the release mechanisms, the kit will drop free of the crew member, the kit lid and the leg restraint harnesses will separate from the kit container, and, if the kit is equipped with a life raft, the raft will begin to inflate; also, a 25-foot drop line remains attached to the left attachment fitting and to both the lid and the container. The lid of the kit can be manually unlatched without operating the kit release handle by means of a lid latch located on the aft end of the lid beneath the edge of the seat cushion.

WARNING

The kit release handle must not be pulled while the plungers are extended *except* during seat ejection *after* separation from the seat. During parachute descent, the handle should be pulled at an approximate altitude of 1000 feet. Landing with the survival kit closely attached to the body could result in personal injury.

When the kit release handle is pulled during parachute descent, the kit will drop free but will remain suspended by the drop line approximately 25 feet below the crew member. The life raft (if installed) will be inflated and ready for use upon landing.

Leg Restraint Harness.

The leg restraint harness consists of upper and lower leg straps and belts which prevent flailing and excessive movement of the crew member's legs during an ejection from the airplane. The upper leg restraint belt (5, figure 1-35) consists of two halves, each of which is attached, at opposite sides, to fittings on the forward corners of the kit container. The loose ends of each half of the belt fit over the crew member's legs above the knees and can be adjusted to the desired tightness. The lower leg restraint harness (6 and 14, figure 1-35) consists of a suspension harness and two ankle belts which are each attached to a lengthy leg strap. The ends of the suspension harness are secured to the kit container at the same fittings which secure the upper leg restraint belt. Two small stowage bags are provided on the suspension harness for stowing the leg straps and ankle belts when not in use. The two adjustable ankle belts fit around the crew member's flight boots and are equipped with an ejector snap fastener. The leg straps are of sufficient length to allow complete freedom of leg movement when the ankle belts are fastened during flight and the end of each leg harness strap is attached to the airplane floor structure. From the floor, each strap is routed through a lock buckle mounted on the suspension harness. During ejection the upward movement of the seat away from the floor causes the floor attached leg straps to be pulled through the lock buckle. This action results in pulling the crew member's legs back against the seat leg guards. When the leg straps are extended to their upward limit, a shear fitting fails in each strap, thus disconnecting the upper portion of the straps from the airplane. The lock buckles prevent significant forward or lateral movement of the ankle belts which, in turn, secure the crew member's legs. When the crew member separates from the seat, the leg restraint harnesses remain attached to the crew member and to the survival kit. However, when the crew member pulls the kit release handle and the kit lid separates from the container, the suspension strap and the upper leg restraint belt come loose from the corners of the container. When this happens, only the ankle belts remain fastened to the crew member; the upper leg belt, suspension harness, and leg straps hang suspended from the ankle belts. The crew member can then free himself of all these harnesses, if desired, by unfastening the ankle belt ejector snaps.

Arm Restraint Straps.

Two arm restraint straps (4, figure 1-35) are provided on the survival kit to prevent arm flailing during seat ejection. One end of each strap is equipped with a buckle and is snapped to the top side of a leather pad on the safety belt tie-down strap. The other end of each arm strap is inserted through the buckle, fitted around the end of the tie-down strap, and snapped to the under side of the pad. With the crew member sitting in his ejection seat and all personal gear connected, the arm straps form two large loops in his lap. When a crew member inserts his hands into the loops and vigorously extends each arm outward toward the adjacent side of the seat, the buckles will unsnap from the pad and the loops will tighten around the crew member's wrists. When the loops become tight the buckles will catch on a tab in the armstraps and will maintain the crew member's wrists secure within the loop. In this position, the crew member has ample freedom of arms and hands to grasp and pull the ejection handgrips. When the seat safety belt opens during the ejection sequence, the arm straps will slip off the end of the tie-down strap. The crew member's wrists will remain in the arm straps but the relatively short straps will allow complete freedom of hands and arms during the parachute descent.

Kit Release Handle.

A kit release handle (15, figure 1-35) is located on the right side of the survival kit. The handle is equipped with a hand-hold type trigger which locks the handle down and prevents inadvertent actuation. The trigger is located along the under side of the handle so that it will be actuated during the normal motion of raising the handle. Normally, when the weight of the kit is supported by the bottom of the container, pulling the release handle results in separating the parachute harness attachment fittings from the release mechanism. If the handle is pulled while the bottom of the kit is unsupported, the lid will unfasten from the container, the life raft (if installed in the kit) will begin to inflate, and the fittings will separate from the release mechanisms.

CAUTION

The release handle must not be pulled while the plungers on the bottom of the container are extended *except* after the crew member has separated from the seat during an ejection escape.

The release handle is designed to separate from the survival kit when it is pulled. The handle must be reinstalled and locked down before the parachute harness attachment fittings will lock into the release mechanism.

Harness Release Handle.

A small harness release handle (16, figure 1-35) is located on the right side of the kit aft of the kit release handle. When this handle is pulled, both parachute harness attachment strap fittings separate from the release mechanisms on the sides of the kit. Once the handle has been pulled, it must be pushed back in before the fittings can be locked into the release mechanisms.

Note

Normally, when the weight of the kit is supported by the bottom of the kit container, the kit release handle is used to accomplish the functions of the harness release handle.

ESCAPE ROPES.

An emergency escape rope (1, figure 3-3) is located at each crew station for use during emergency exit from the airplane. Each rope is rolled up on a reel and stowed inside the side fairing of its respective crew station with the end loop extending through the fairing. The pilot's escape rope is located on the left side of the crew station aft of the window panes. Both the navigator's and defensive system operator's ropes are located forward of the right window in their respective crew stations. To accomplish emergency exit from the airplane on the ground, the loop may be held in the hands or placed around the body in the form of a sling. When the crew member drops over the side of the fuselage (or off the wing), the rope will unroll allowing a controlled descent to help reduce the possibility of injury.

HAND FIRE EXTINGUISHER.

A type A-20 hand fire extinguisher (3, figure 3-3) is located on the floor at the right side of the second crew station. The extinguisher is charged with bromochloromethane and can be used on any type of fire.

WARNING

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

FIRST AID KIT.

A first aid kit (5, figure 3-3) is located in the right aft side of the second crew station.

BATTLE DRESSING KIT.

A battle dressing kit (5, figure 3-3) is installed at the second crew station in the right aft side.

BLOOD PLASMA KIT.

A blood plasma kit (4, figure 3-3) is installed on the aft right side of the second crew compartment.

KNIFE.

A knife (5, figure 3-3) is installed in the right aft side of the second crew station.

canopy pneumatic system

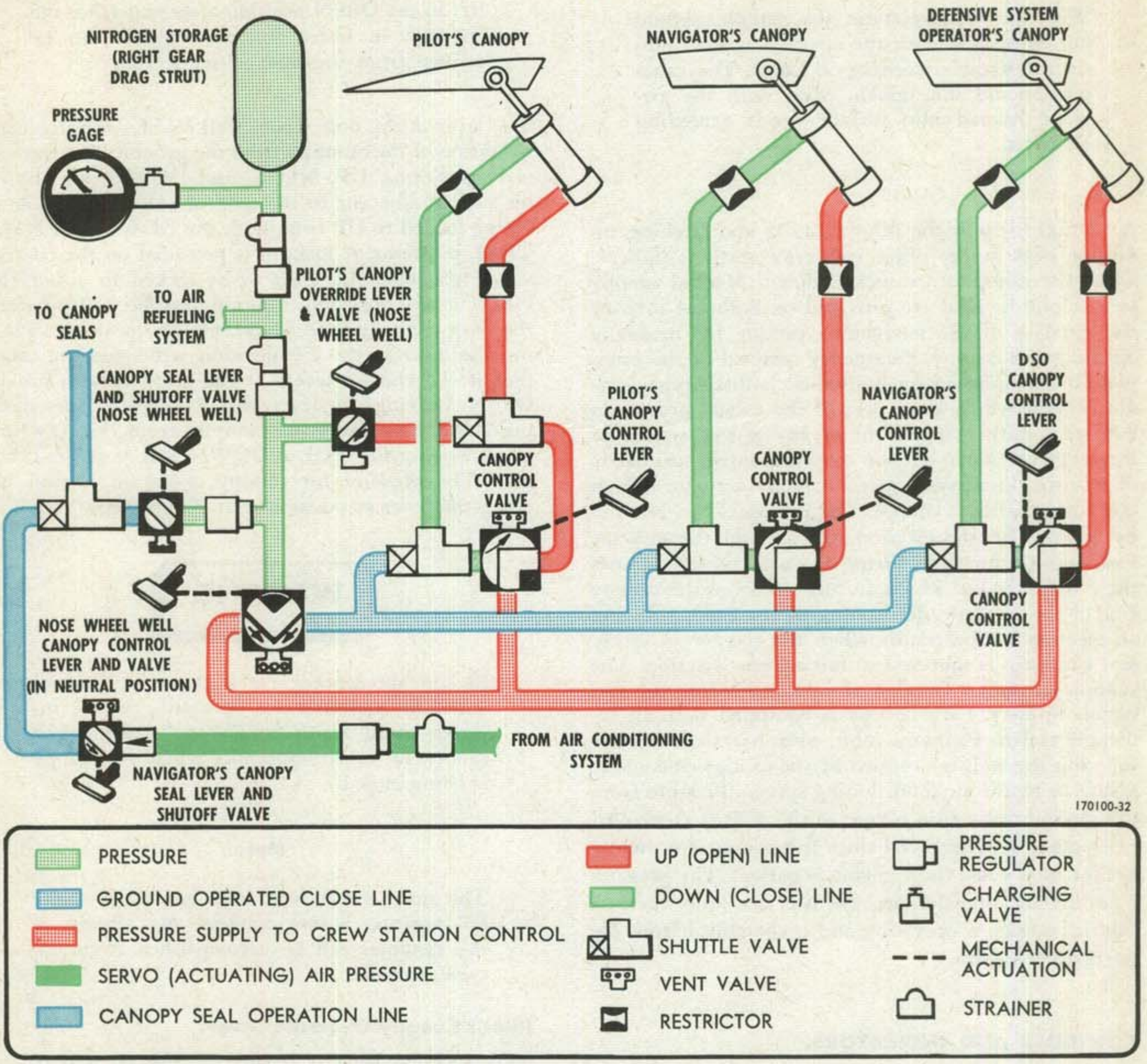

Figure 1-36.

CANOPIES.

Each crew station is equipped with a jettisonable clam-shell-type canopy which is hinged at the aft end. Each canopy actuator is mechanically connected to a push-rod-bellcrank arrangement which provides automatic latching and unlatching of the canopy in the closed position. The canopies are normally operated by a pneumatic system (figure 1-36) and are controlled from the crew stations and from the nose wheel well. The pneumatic system pressure supply is stored in the right landing gear drag strut. A filler valve and pressure gage are located in the right wheel well. The system is charged with nitrogen according to the ambient temperature and a placard located near the filler valve is used to determine the correct precharge pressure. Refer to figure 1-41 for servicing data. When the system is fully charged, approximately 22 complete cycles (opened and closed) are available. An override control in the nose wheel well provides an alternate method of opening the pilot's canopy in event of system malfunction.

CAUTION

With the airplane static, the canopies should not be opened with the airplane headed into surface winds exceeding 30 knots. The canopies should not remain open with the airplane headed into surface winds exceeding 40 knots.

A caution lamp at the pilot's station and latching indicator flags at the other two crew stations indicate when the canopies are locked down. Manual canopy lock release handles are provided on both the interior and exterior of the navigator's canopy for manually opening that canopy. Emergency removal of the canopies is accomplished by individual ballistic-type jettison systems which are a part of the escape provisions but are totally independent of any power system of the airplane. Each jettison system consists primarily of ballistic initiators and the canopy actuator which contains a ballistic charge. The initiators can be fired by controls on the ejection seat and on the exterior surface of the airplane. Firing a canopy initiator causes the actuator to fire which, in turn, jettisons the canopy free of the airplane. Jettisoning of the canopy during an ejection escape results when the trigger in either seat handgrip is squeezed to initiate seat ejection. The canopy jettisons a fraction of a second before the seat begins to eject. Each canopy is equipped with an inflatable seal to maintain cabin pressurization. Air for inflating the seals is supplied by the canopy pneumatic system or by the air conditioning system. Pressure from the canopy pneumatic system to the seals is controlled from the nose wheel well since this source is normally needed only when the airplane is parked. The pressure from the air conditioning system is available when an inboard engine is operating and is controlled from the navigator's station.

CONTROLS AND INDICATORS.

Canopy Control Levers.

The canopies are controlled by four control levers—one located in the left console of each crew station and one in the left side of the nose wheel well. The lever in each crew station controls operation of the canopy at that station. These levers are accessible through the hinged canopy control access door in the left console of each station. The levers each have three unmarked positions—OPEN (up), CLOSE (down), and NEUTRAL (center). These levers are mechanically latched in the OPEN position and are spring loaded to NEUTRAL from the CLOSE position.

Note

The control levers at crew stations must be left in the OPEN position after exit from the airplane in order for the canopies to be opened from the nose wheel well.

The lever in the nose wheel well enables simultaneous operation of the canopies from the ground. The marked lever positions, UP, NEUT, and DOWN, are shown on a decal adjacent to the control valve. The lever is spring loaded to UP from both the DOWN and NEUTRAL positions. A lockpin is provided on the control valve to enable the lever to be locked in either the NEUT or UP positions. The pin must be pulled before the lever can be moved from these two positions. Placing the lever in the UP position will open the canopies if the control levers at the crew stations are in OPEN. Leaving the lever in UP supplies pneumatic pressure for operation of canopies from the crew stations. Placing the lever to DOWN will close the canopies. The pressure for canopy operation is shut off when the lever is positioned at NEUTRAL.

WARNING

Be sure the canopy area is clear of personnel when the canopies are operated. Serious injuries could result to anyone struck by a canopy in transit, especially when the canopy is being closed.

Note

The nose wheel well lever must be in the UP position before opening and closing of the canopies can be accomplished from the crew stations.

Pilot's Canopy Override Lever.

This override lever is located in the aft end of the nose wheel well and has unmarked ON and OFF positions. Placing the lever to ON bypasses pneumatic pressure around the pilot's canopy controls and opens the pilot's canopy. This lever is used in event the pilot's canopy has been inadvertently closed from the nose wheel well while the canopy control lever at pilot's station is in NEUTRAL. The canopy override lever should normally be safetied OFF.

Canopy Seal Control Levers.

Inflation and deflation of the canopy seals are controlled by two levers—one located slightly forward of and beneath the navigator's left window and one in the left side of the nose wheel well. The navigator's seal control lever has positions marked SEALED and ALL CANOPIES UNSEALED. When the lever is positioned to SEALED, with one or both inboard engines operating, air from the air conditioning system inflates all three canopy seals simultaneously; the seals will remain inflated even if the inboard engines are shut down. The seals deflate when the lever is positioned to ALL CANOPIES UNSEALED. The seal control lever in the nose wheel well functions in the same manner except that this lever controls pressure from the canopy pneumatic system and is for ground use only. This lever has positions marked ON and OFF.

CAUTION

The canopies must never be opened while the canopy seals are inflated; damage to the seals and canopy mechanism will result.

Canopy Jettison Handles.

A handle (7, figure 1-37) for jettisoning the canopy is provided on the left leg brace of each crew member's seat. The handle is for use when subsequent jettisoning of the seat is not anticipated. Unlatching the handle and pulling it up fires a ballistic canopy initiator in the seat which, in turn, fires the ballistic charge in the canopy actuator, jettisoning the canopy in the same manner as it is jettisoned by the handgrip. The handle is latched in position by a spring latch. It is released by pressing up on the latch and pulling the handle up.

Canopy External Jettison Handles.

Three canopy external jettison handles provide a means of jettisoning the canopies from the ground during an emergency. A handle is located below each canopy on the left side of the airplane, in a small compartment which is equipped with an access door. Each handle is attached to a long cable so that the user may stand clear of the airplane to jettison the canopies. The cable unwinds from its stowage when the handle is pulled; when the cable is extended a further pull will fire a ballistic initiator, supplying gas pressure which fires the ballistic charge in the canopy actuator to jettison the canopy.

Navigator's Canopy Release Handles.

Two release handles at the second station provide a means of opening the canopy from inside or outside the compartment when pneumatic power is not available. The inside handle is located on the right side of the canopy. Pushing up on the handle unlatches the canopy so that it can be opened and latched open by a special tool furnished by the ground crew. The exterior handle is located on the left side of the canopy. It is mounted in a vertical position flush with the canopy skin. The top of the handle pivots out so that it can be grasped and pulled down to unlatch the canopy.

Note

The second station canopy release handles are provided for emergency exit only. The position of these handles should not be used for determining whether or not the canopy is latched.

Canopy Safety Pins.

Canopy safety pins are provided to prevent accidental firing of the ballistic charge in the canopy actuator. A pin is installed in each seat handgrip (12, figure 1-37), in the canopy jettison handle (7, figure 1-37), and in the canopy jettison initiators.

WARNING

Prior to flight, crew members must remove and stow the handgrip safety pins and the pins installed in the canopy jettison handles. They must also check that the ground crew have removed the pins from the seat and canopy initiators located in the ejection seats and the canopy initiators below the seats.

Canopy Actuator Warning Pin.

A warning pin is incorporated in the back portion of the canopy actuator (1, figure 1-37) to show whether the ballistic charge in the actuator has been fired. The pin is a red plunger-type which is normally recessed in the actuator so that it is not visible. When the actuator charge is fired, the pin automatically protrudes so that it can be seen when viewed from the right side of the seat.

WARNING

A check must be made before each flight to see that the ballistic charges have not been fired, since a fired charge renders the associated canopy opening and jettisoning systems inoperative.

Pneumatic System Pressure Gage.

A pressure gage for the canopy pneumatic system is installed in the forward left corner of the right wheel well. It indicates pneumatic system supply pressure in pounds per square inch.

Canopy Unlock Caution Lamp.

A canopy unlock caution lamp (figure 1-12) is located on the warning and caution lamp panels in the pilot's station. When lighted, CANOPY UNLOCK appears in yellow letters on the face of the lamp. The caution lamp is actuated by limit switches attached to the canopy mechanism in the canopy. The lamp will light when any one of the canopies unlatches and will remain lighted until the latching mechanism of all canopies is in the overcenter locked position.

Note

An unlighted canopy unlock caution lamp is a positive indication that the pilot's canopy is down and locked. Due to the difference in canopy design, however, an unlighted caution lamp does not constitute a positive indication that the other two canopies are down and locked; the unlighted lamp assures only that the canopies are down and that the latching mechanism of these two canopies are in the overcenter locked position. The latching mechanism indicators for these two canopies must be checked individually to assure that the canopy latching bars are locked in place.

The caution lamp is tied into the master caution lamp circuit and receives 28-volt direct current from the d-c power panel. (For testing and dimming the canopy caution lamp and for information on the master caution lamp, refer to "Pilot's Indicator Lamp System" of this section.

Canopy Latching Mechanism Indicators.

Red indicator flags incorporated in the forward portion of the right and left latching bar at the second and third crew stations indicate latching hook position. These flags are mechanically actuated by the latching hooks of their respective canopy and disappear behind shields as the canopy closes.

CAUTION

The flags must be hidden from view before the canopies can be assumed to be locked even when the canopy unlock caution lamp is out.

EJECTION SEATS.

Each crew station is equipped with an ejection seat (figure 1-37) which permits high-speed escape from the airplane. Each seat is equipped with a ballistic-type ejection system which is totally independent of any other power system of the airplane.

Note

All crew station ejection seats are basically the same except that the pilot's seat ejection rails are canted to the right to assure adequate clearance between the seat and the overhead structure during ejection.

Each seat is mounted on ejection rails and is supported by a combination ballistic-rocket-type catapult. Slide blocks on the back of the seat engage the ejection rails and maintain the seat in a position such that its path of travel is parallel to the rails. The seat catapult, being mounted on bulkhead attached brackets behind the seat, supports a seat adjustment actuator which, in turn, supports the seat and the canopy actuator. The seat can be adjusted vertically to the desired height by means of the seat adjustment actuator. Adjustment of the seat results in automatic positioning of the catapult, while the canopy actuator remains stationary; this is to assure that the catapult is maintained in the same relative position in regard to the seat center of gravity and that the canopy actautor is maintained in the the same relative position with respect to the canopy. An M3A1 initiator and an XM26 delay initiator is provided inside each seat armrest for initiating automatcally sequenced canopy jettison and seat ejection. An additional M3A1 initiator is provided in the left seat armrest for initiating canopy jettison without subsequent seat ejection. The ejection sequence begins when either of the M3A1 canopy-seat initiators are mechanically tripped by squeezing an ejection trigger. This initiator produces gas pressure which fires a ballistic charge in the canopy actuator causing the canopy to jettison. Also, the gas pressure from this initiator simultaneously actuates the corresponding XM26 catapult delay initiator in that side of the seat. The catapult initiator delays 0.3 of a second, then produces gas pressure which fires the ballistic charge in the seat catapult. The ballistic charge in the catapult provides the initial thrust for propelling the seat from the airplane and subsequently ignites the catapult rocket motor. All electrical, oxygen, ballistic, and pneumatic lines from the airplane to the seat separate at automatic quick disconnect fittings as the seat travels up the seat rails during the ejection sequence. Also, as the seat travels up the rails, a tripper mechanism fires an M-12 delay initiator, which after a one-second delay, produces gas pressure to open the safety belt. After the seat clears the airplane, the thrust of the rocket motor reacts through the seatman center of gravity propelling the seat in an upward and forward trajectory to clear the tail structure of the airplane. The rocket thrust also minimizes seat tumbling. The seat is constructed so that the crew member is well protected during ejection, rough airplane landings,

ejection seats

1. Canopy Actuator
2. Seat Vertical Adjustment Actuator
3. Automatic Safety Belt
4. Arm Restraint (2)
5. Seat Ejection Trigger (2)
6. Inertia Reel Lock Handle
7. Canopy Jettison Handle
8. Seat Vertical Adjustment Switch
9. Lower Leg Restraints (2, Stowed)
10. Upper Leg Restraint
11. Ground Safety Pins (3)
12. Seat Handgrip (2)
13. Safety Belt Tiedown Strap
14. Personal Leads
15. Shoulder Harness
16. Headrest
17. Head Restraint (2, Stowed)
18. Seat Catapult (Rocket-Type)
19. Safety Belt Initiator
20. Automatic Tripper Mechanism
21. Slide Block

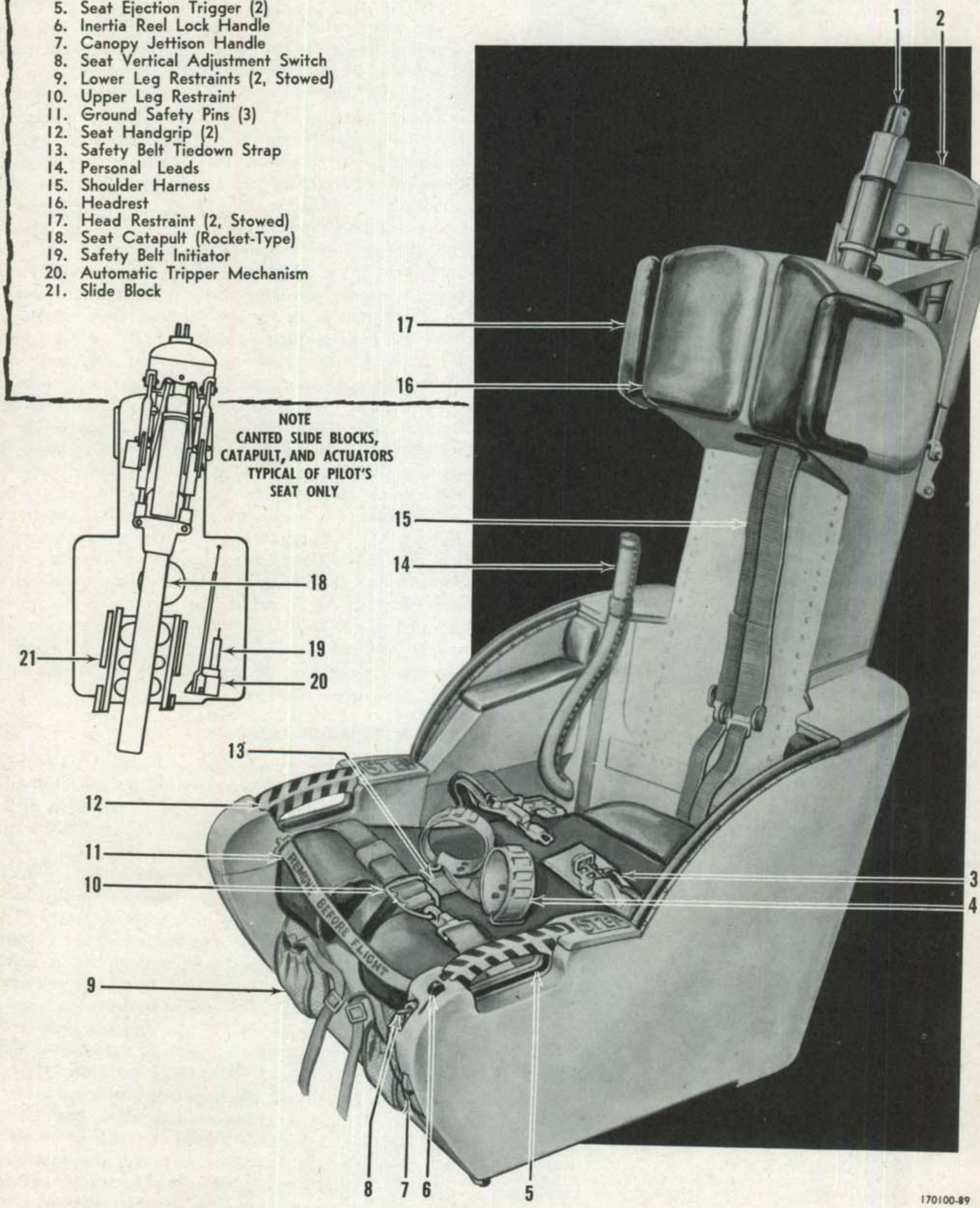

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Figure 1-37.

seat ejection controls

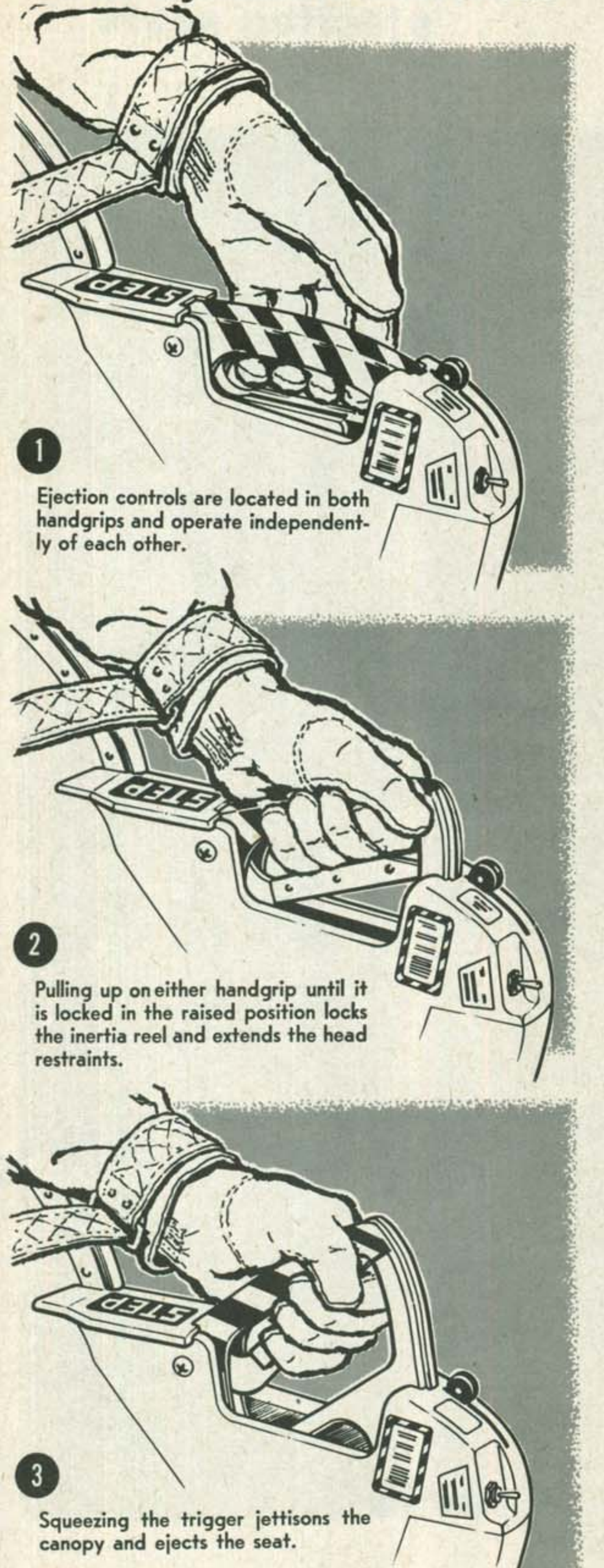


Figure 1-38.

and adverse flying conditions. The seat is provided with padded armrests and a padded cradle type headrest. The headrest is equipped with a lateral head restraint on each side. These head restraints are extended and locked in this position prior to ejection by raising either ejection handle. (This action also locks the shoulder harness.) The head restraints prevent excessive lateral movement of the crew members' head during ejection and are padded on their inner surface to minimize head injury in the event the crew member loses his helmet during the ejection sequence. The crew member is held secure in the seat during normal flight by means of shoulder harness straps (15, figure 1-37), an automatic safety belt (13, figure 1-37), and the safety belt tie-down strap (3, figure 1-35) which is attached to the front side of the global survival kit. The tie-down strap prevents the safety belt from being pulled out of position by the shoulder harness and further serves as an attachment point for the arm restraints which prevent arm flailing during ejection. A full width padded leg guard extends downward automatically, and locks in the down position as the seat ejects, to prevent the crew member's legs from being blown beneath the seat. At the same time, the survival kit attached leg restraints hold the crew member's legs against the forward side of the seat and leg guard to prevent leg flailing during ejection. The backrest portion of the seat accommodates a back-type parachute and the bucket portion of the seat accommodates the seat-type survival kit. (Refer to "Emergency Equipment" of this section for information on the arm and leg restraints and the survival kit.) All controls affecting the seat are incorporated on the seat itself. Inspection holes are provided on the inboard panel of each seat armrest for checking the canopy and seat initiators to assure that the safety pins have been removed.

SHOULDER HARNESS.

Each ejection seat is equipped with an inertia reel-type shoulder harness which is secured by the safety belt and locks automatically under an inertia load of 2 to 3 G's in any direction. A handle (6, figure 1-37) located on the left leg brace provides manual control of the lock. The handle positions are marked AUTOMATIC LOCK and MANUAL LOCK. The inertia reel is locked manually by moving the handle forward to the MANUAL LOCK position. If it is locked either manually or automatically while the crew member is leaning forward, the harness retracts with him as he straightens up, moving into successive locked positions as he moves back against the seat. When the reel has been locked manually, it is unlocked by moving the control handle aft to the AUTOMATIC LOCK position. If it has locked automatically, the handle must be moved to the MANUAL LOCK position and then back to the AUTOMATIC position before it is unlocked. In the event of ejection from the airplane, the inertia reel is locked automatically when either seat handgrip is raised prior to ejection. The shoulder harness is then released when the safety belt opens after the seat ejects.

automatic safety belts

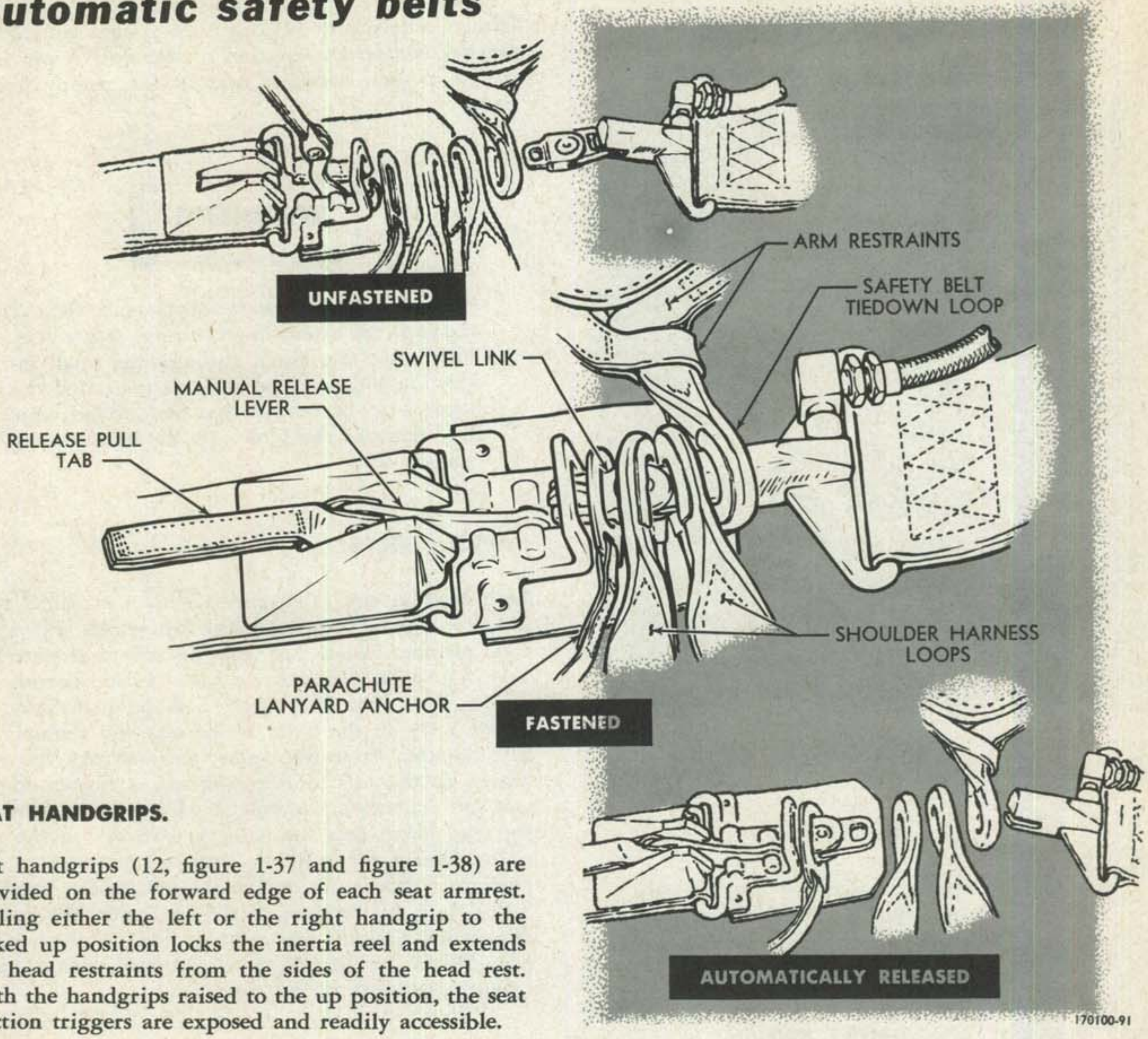


Figure 1-39.

SEAT HANDGRIPS.

Seat handgrips (12, figure 1-37 and figure 1-38) are provided on the forward edge of each seat armrest. Pulling either the left or the right handgrip to the locked up position locks the inertia reel and extends the head restraints from the sides of the head rest. With the handgrips raised to the up position, the seat ejection triggers are exposed and readily accessible.

WARNING

The seat handgrips must never be raised except during flight after a positive decision to eject has been made and the crew member has inserted both of his hands through the arm restraint loops. Once the handgrips are raised and locked up, a special ground tool is required to lower the handgrips back down into the seat armrest.

Seat handgrip safety pins (11, figure 1-37) are provided for installation in the handgrips (and the canopy jettison lever) which should be installed at all times except immediately before and during flight.

SEAT EJECTION TRIGGERS.

A seat ejection trigger (5, figure 1-37) is located in each handgrip and is accessible only after the handgrip has been pulled up to lock the inertia reel and extend the head restraints. (See figure 1-38.) Squeezing either or both triggers mechanically fires an M3A1 initiator to produce gas pressure which is routed through a hose system to fire the ballistic charges in both the canopy actuator and the seat catapult XM-26 delay initiator. The canopy is jettisoned and 0.3 second later, the delay initiator produces gas pressure which is routed through another hose system to fire the cartridge in the catapult and ignite the rocket motor.

low altitude escape system attaching points

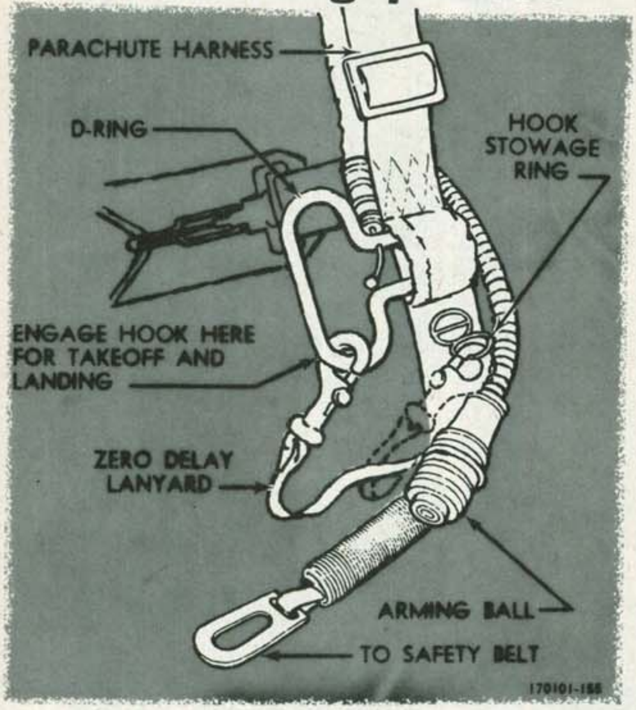


Figure 1-40.

Note

The canopy actuator is fixed to the top portion of the seat. Therefore, if the canopy is not jettisoned when the trigger is squeezed, it will be removed as the seat ejects.

SEAT VERTICAL ADJUSTMENT SWITCH.

Vertical adjustment of the seat is accomplished electrically and is controlled by a three-position switch (2, figure 1-37) located forward of the left seat handgrip. The switch is marked UP and DOWN and is spring loaded to an unmarked OFF position. The switch lever is locked in the OFF position and must be pulled out (forward) before it can be moved up or down. Holding the switch in either of the operative positions energizes the double screw jack seat actuator which positions the seat at the desired height and, at the same time, repositions the catapult to the same relative position with respect to seat-man center of gravity while maintaining the canopy actuator in a stationary position. Each seat may be adjusted through a vertical travel range of approximately 5 inches. The adjustment switch controls 115-volt alternating current for operating the seat actuator.

GROUND SAFETY PINS.

Ground safety pins (11, figure 1-37) are provided to prevent inadvertent ejection of the seat. A pin is installed in each handgrip and in the canopy jettison lever.

WARNING

Prior to flight, crew members must remove and stow the handgrip and canopy safety pins. They must also check through the small inspection holes in the inboard panels of the armrests to be certain that the ground crew have removed the pins from the initiators inside the seat.

SAFETY BELTS.

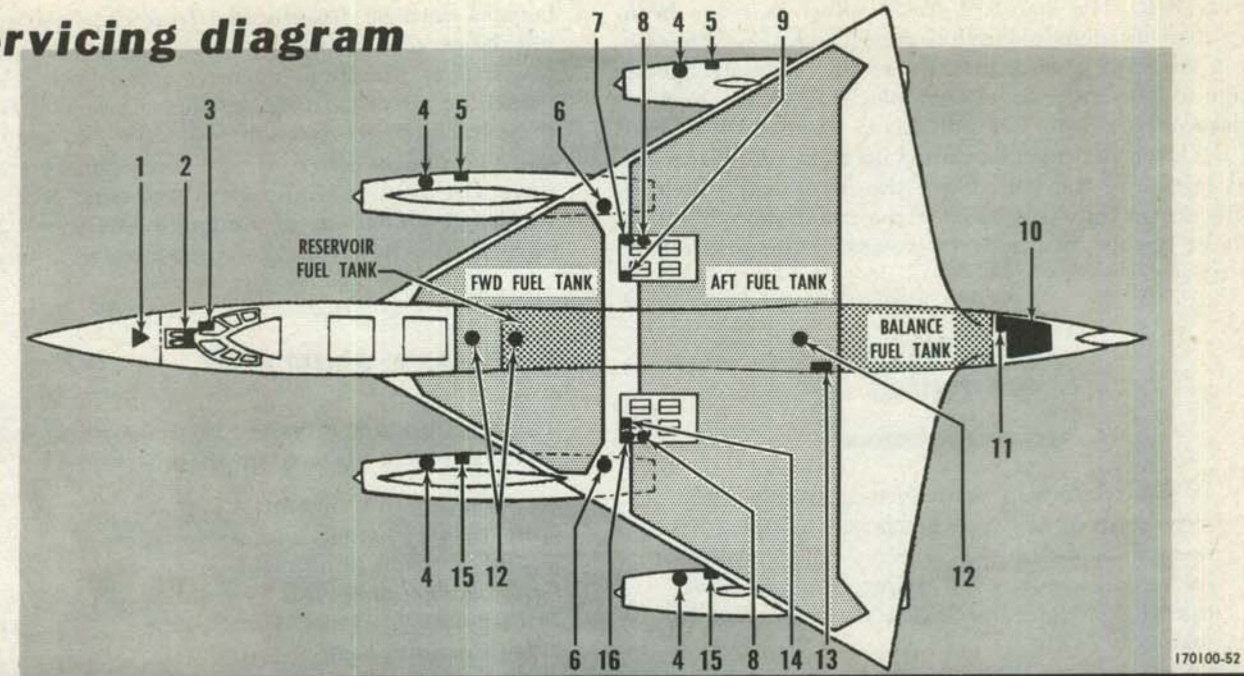
Each ejection seat is equipped with a modified type MA-6 automatic opening safety belt which allows the crew member to fall free from his seat after seat ejection. The belt is opened as part of the ejection sequence by a type M12 safety belt delay initiator (3, figure 1-37) on the back of the seat and requires no manipulation from the crew member. As the seat moves up the rails during ejection, a striker on the seat rail actuates an automatic tripper mechanism on the seat which fires the ballistic cartridge in the initiator. Firing the initiator cartridge produces a gas pressure which is directed to the belt buckle through a flexible hose. Pressure of the gas opens the buckle one second after the seat catapult fires. A safety pin is provided for installation in the initiator during maintenance operation of the airplane.

WARNING

The safety pin must be removed before flight.

The shoulder harness and the safety belt tie-down strap are attached to the belt release mechanism during normal flight, but automatically comes loose when the belt opens. When the crew member is using an automatic-opening aneroid-type parachute with a lanyard from the chute automatic ball-handle control, the lanyard must also be attached to the safety belt. As the crew member falls free of the seat, the parachute lanyard serves as a static line to arm the automatic opening device of the parachute. Refer to figure 1-39 for the correct attachment of the parachute lanyard to the

servicing diagram



SERVICING POINTS	UNITS TO BE SERVICED	SERVICING AGENT OR UNIT	SPECIFICATION	SERVICING LOCATION
1	AIR REFUELING RECEPTICLE	FUEL JP-4	MIL-J-5624D	UPPER PORTION OF RADOME FORWARD OF PILOT'S STATION
2	LIQUID OXYGEN CONTAINERS	LIQUID OXYGEN	BB-0-925, TYPE II LIQUID	FORWARD UPPER NOSE WHEEL WELL
3	FUEL TANKS (SINGLE-POINT GROUND REFUELING)	FUEL JP-4	MIL-J-5624D	NOSE WHEEL WELL AFT RIGHT SIDE
4	ENGINE OIL TANKS (4)	SYNTHETIC OIL	MIL-L-7808C	FORWARD UPPER RIGHT SIDE NACELLE (EACH ENGINE)
5	PRIMARY HYDRAULIC SYSTEM AND RESERVOIR	HYDRAULIC FLUID	MIL-H-8446A	FORWARD RIGHT SIDE NACELLE NO. 3 OR NO. 4 ENGINE
6	AIR CONDITIONING TURBINE SUMP (2)	SYNTHETIC OIL	MIL-L-7808 FILTERED TO 10 MICRONS OR LESS	LOWER WING SURFACE INBOARD OF EACH INBOARD PYLON
7	PRIMARY HYDRAULIC RESERVOIR	HYDRAULIC FLUID	MIL-H-8446A	RIGHT MAIN WHEEL WELL FORWARD OUTBOARD SIDE
8	WATER BOILER RESERVOIR (2)	DEMINERALIZED WATER	MIL-D-4024	MAIN WHEEL WELLS FORWARD OUTBOARD SIDE
9	CANOPY PNEUMATIC RESERVOIR	DRY NITROGEN	MIL-N-6011, GRADE A, TYPE 1 OR II	RIGHT MAIN WHEEL WELL FORWARD BULKHEAD INBOARD
10	DRAG CHUTE COMPARTMENT	DRAG CHUTE PACK	CONVAIR SPEC FZC-4-355	BOTTOM AFT FUSELAGE
11	DRAG CHUTE PNEUMATIC RESERVOIR	DRY NITROGEN	MIL-N-6011, GRADE A, TYPE I OR II	FORWARD OF DRAG CHUTE COMPARTMENT
12	FUEL TANKS (INDIVIDUAL TANK GRAVITY REFUELING (3))	FUEL JP-4	MIL-J-5624D	TOP FUSELAGE
13	FLIGHT CONTROL ACCUMULATOR (4)	DRY NITROGEN	MIL-N-6011, GRADE A, TYPE I OR II	LOWER AFT FUSELAGE LEFT SIDE
14	BRAKE ACCUMULATOR EMERGENCY BRAKE AND GEAR PNEUMATIC RESERVOIRS	DRY NITROGEN	MIL-N-6011, GRADE A, TYPE I OR II	LEFT MAIN WHEEL WELL FORWARD BULKHEAD OUTBOARD
15	UTILITY HYDRAULIC SYSTEM AND RESERVOIR	HYDRAULIC FLUID	MIL-H-8446A	FORWARD RIGHT SIDE NACELLE NO. 1 OR NO. 2 ENGINE
16	UTILITY HYDRAULIC RESERVOIR	HYDRAULIC FLUID	MIL-H-8446A	LEFT MAIN WHEEL WELL FORWARD OUTBOARD SIDE

Figure 1-41.

safety belt. The standard MA-6 safety belt has been modified to include a nylon guard and a lock release pull tab. The guard fits around the manual release lever to prevent inadvertent unlocking of the manual release mechanism. The pull tab is attached to the end of the lever and must be pulled up to accomplish manual release of the belt. Since the MA-6 safety belt is unlocked in the same manner as a conventional belt, it can be opened manually by means of the pull tab if automatic opening fails.

WARNING

If the safety belt is opened manually after seat ejection, any type of chute used must be opened by pulling the ripcord grip or automatic ball-handle control since the parachute opening lanyard is released when the belt is manually opened.

ONE-AND-ZERO ESCAPE SYSTEM.

A system incorporating a one-second safety belt delay and a zero-second parachute delay (one-and-zero system) is provided to improve low altitude ejection seat escape capability. This system makes use of a detachable zero delay lanyard that connects the parachute timer knob to the parachute D-ring by means of a hook. (Refer to figure 1-40.) At very low altitudes and airspeeds, this lanyard must be connected to provide parachute actuation immediately after separation from the ejection seat. At other altitudes and airspeeds, the lanyard must be disconnected from the D-ring, allowing the parachute timer to actuate the parachute below the critical parachute opening speed and below the parachute timer altitude setting. A ring attached to the parachute harness is provided for stowage of the lanyard hook when it is not connected to the parachute D-ring. For minimum safe ejection altitudes for various combinations of automatic safety belt and automatic parachute timing sequence, refer to figure 3-5.

AUXILIARY EQUIPMENT.

The description and operation of the following auxiliary equipment are contained in Section IV:

Air Conditioning System.
Anti-Icing and Defogging Systems.
Communication Equipment.
Civil Navigational Aids System.
Military Navigational Aids System.
Lighting Equipment.
Oxygen System.
Autopilot.
Weapons Control System (AN/ASQ-42).
Primary Navigation System.
Bombing System.
Recording System.
Indirect Bomb Damage Assessment System.
Pods.
Defensive Electronic Countermeasure System.
Active Defense System.
Air Refueling System.
Single-Point Refueling System.
Miscellaneous Equipment.

section II normal procedures

TABLE OF CONTENTS.

PREPARATION FOR FLIGHT.

FLIGHT RESTRICTIONS.

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

FLIGHT PLANNING.

Jet aircraft require special emphasis on flight planning and cruise control because of the inherently high fuel consumption of jet engines and the wide range of attainable speeds and altitudes. Prior to each mission, prepare takeoff and landing data cards and a fuel plan. (Refer to the Condensed Check List of this section.) Determine takeoff and landing data, required fuel, speeds, and power settings, using chart data from Appendix I. Fuel management schedules are outlined in "Fuel Supply System," Section VII.

TAKEOFF AND LANDING DATA CARDS.

Compute all takeoff and landing data from the Appendix and complete the Takeoff and Landing Data Cards in the Condensed Check List.

WEIGHT AND BALANCE.

Refer to Section V for weight and balance limitations. For loading information, refer to Handbook of Weight and Balance Data, T.O. 1-1B-40. The use of a B-58 balance computer will aid in determining loading and cg data. Before each flight, check the following:

1. Takeoff and anticipated landing gross weights.
2. Weight and balance clearance (Form 365F).
3. Sufficient fuel, oil, oxygen, and special equipment to complete proposed mission.

ENTRANCE TO THE AIRCRAFT.

Entrance to the crew compartment is gained from the right side of the airplane by use of a stand as shown in figure 2-1. The canopy control valve in the nose

entrance to the aircraft

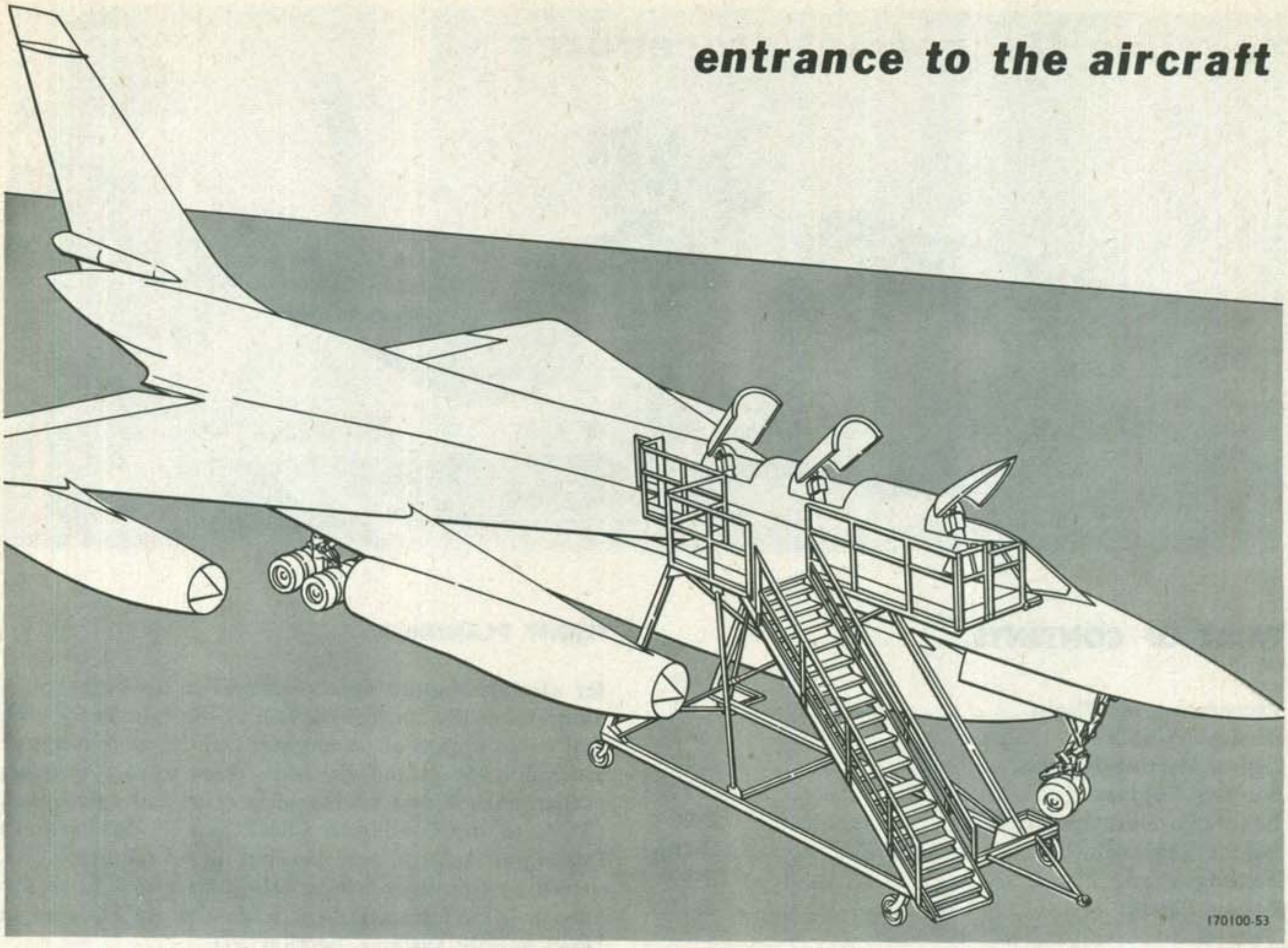


Figure 2-1.

wheel well is used to open the canopies for initial entry. Prior to opening canopies, check that canopy seal selector is in the off position. To open the canopies, move the control lever to UP.

CAUTION

If the canopies are opened with the seals inflated, the seals and canopy actuators can be damaged. When the canopy control valve handle is moved to UP, a mechanical latch should engage the handle in that position.

PREFLIGHT CHECK.

The following preflight check lists are based on the assumption that maintenance personnel have completed the maintenance preflight contained in the Handbook of Inspection Requirements (T.O. 1B-58A-6). It is also assumed that the external power, engine starter carts, and air conditioning ground carts are connected but not supplying service when the flight crew arrives to begin the preflight check. Discrepancies noted during the preflight check will be recorded in Form 781 and cleared by authorized maintenance personnel prior to takeoff. The performance of the exterior and interior inspections is the responsibility of the pilot; however, he may designate other crew members to assist with the inspections as desired.

BEFORE STATIONS INSPECTION.

Before performing the interior inspections, accomplish the following procedures.

Note

The crew chief will have the Form 781 available to the pilot and the inspection stands will be in place when the flight crew arrives at the airplane (station time).

1. Form 781—Check.

   Pilot checks Form 781 for engineering status discrepancies and aircraft loading. He also notes fuel loading and distribution for comparison with Form 365F and aircraft gages later during preflight. Checks that all other required servicing has been accomplished.
2. Landing gear ground safety locks, wheel chocks, static ground wires and fire extinguisher—In place.
3. Electrical, air conditioning, and starter carts and interphone—Connected.

   Check that this equipment is connected but not operating. The ground carts will be started as directed by the pilot.

Note

Check that none of the cables or hoses are in direct contact with the fuselage or pod.

STATIONS INSPECTION.

Station time (normally 2 hours prior to scheduled takeoff) is established at the operations briefing. At station time, all crew members and the crew chief will assemble at the airplane and display equipment. During inclement weather the crew and equipment check may be performed prior to station time.

1. Equipment check:

   Pilot checks that the crew members have necessary equipment and that it is arranged in the following manner (figure 2-2).

Note

Parachutes and survival kits will be installed in the airplane and not displayed.

   a. Professional kits—Check.

      Placed at rear of display.

   b. Helmet and oxygen mask—Check.

      In storage bag forward of professional kits.

CONTINUED

crew inspection

1. Explosion Proof Flashlight
2. Life Vest
3. Helmet
4. Professional Kit

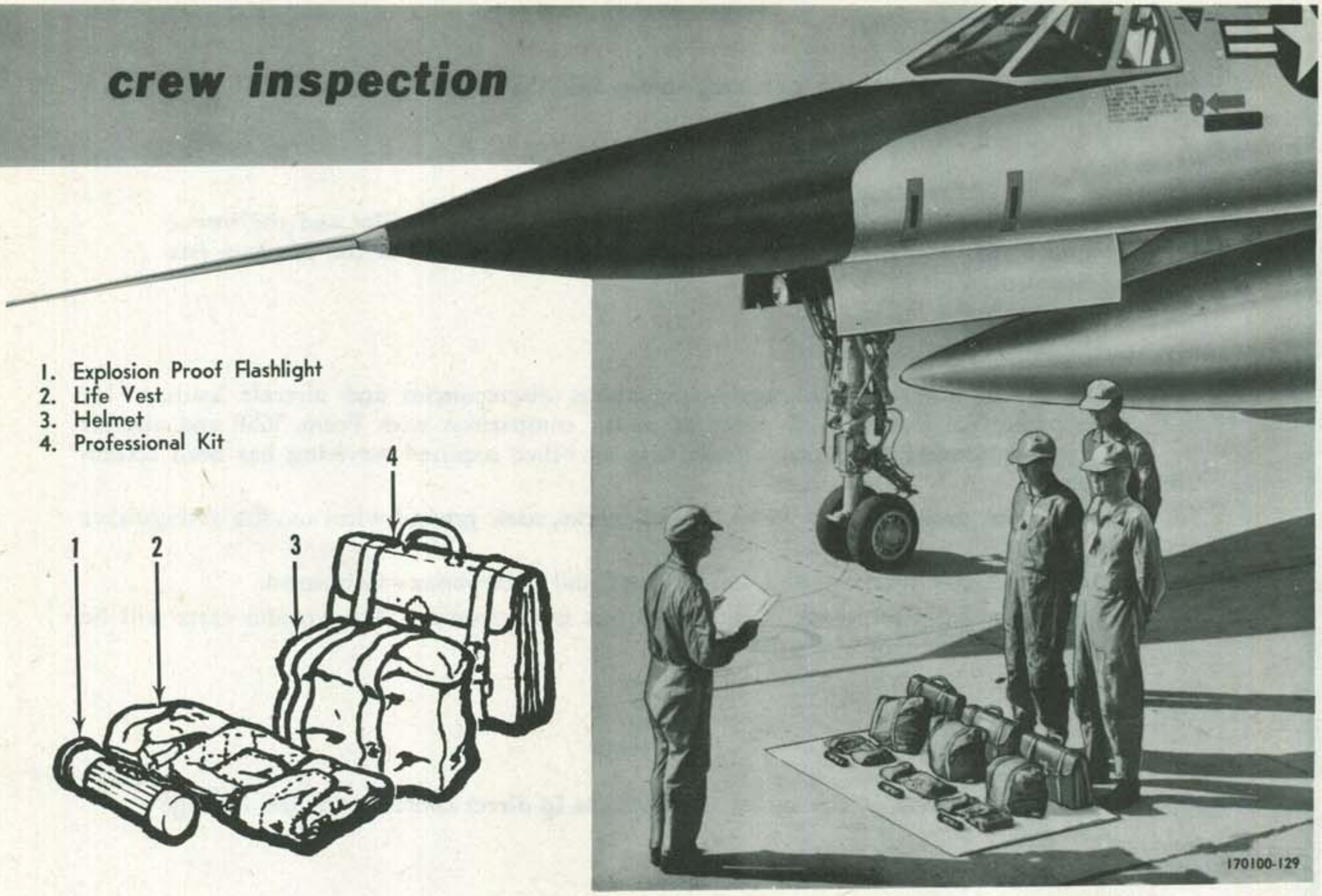


Figure 2-2.

STATIONS INSPECTION (CONTINUED)

c. Life vest (when carried)—Check.

Placed forward of helmet.

d. Flashlight (explosion proof)—Check.

Placed forward of life vest.

e. Proper clothing—Check.

Pilot checks that each crew member has proper clothing for the type mission to be flown.

f. Identification tags and dosimeter—Check.

Pilot checks that each crew member is wearing his identification tags and dosimeter.

2. Time hack—Completed.

Navigator gives time hack.

3. Form 781—Review.

Pilot notifies crew of discrepancies that are being carried on the Form 781. In event the inspection is not made at the airplane, the pilot will review the Form 781 upon arrival at the airplane.

4. Emergency procedures briefing:

a. Fire and smoke in pressurized compartment—Brief.

Pilot reviews the immediate action steps each crew member will accomplish should fire and smoke be discovered in the pressurized compartment.

CONTINUED

STATIONS INSPECTION (CONTINUED)

b. Crash landing—Brief.

Pilot reviews the immediate action steps each crew member will accomplish in event of crash landing.

c. Bailout—Brief.

Pilot reviews the immediate action steps each crew member will accomplish in event of bailout.

d. Substitute crew member—Brief.

Pilot briefs any other information for these crew members and insures that emergency procedures and any other duties during flight are thoroughly understood.

5. Oxygen discipline—Brief.

   Pilot briefs crew on oxygen discipline to be observed during flight.

6. Preflight instructions—Brief.

   Pilot briefs each crew member and crew chief on preflight duties.

7. Time to board airplane—Brief.

POWER-OFF INTERIOR INSPECTION.

1. Canopy lock—Installed.

   Check that the canopy lock is installed and that canopy actuator warning pin is not visible.

WARNING

The red pin, when visible, indicates that the canopy actuator ballistics charge has been fired, thus making ballistic canopy jettisoning impossible.

2. Ejection seat safety pins (3)—Installed.

   Before entering the airplane, check that safety pins are installed in both seat handgrips and in the canopy jettison handle.

3. Canopy actuator and seal—Check.

   Check actuator condition, and check the canopy seal properly seated and the inflation tube connected.

4. Liquid container—Check.

   Check liquid container for servicing and operation of flow valve.

5. Exterior emergency canopy jettison access door—Secure.
6. Cg calibrator—Check.

   Check that proper values and weights are set in according to Form 365F and supplementary data. Six required inputs are: return component dry cg, return component dry weight, pod dry cg, pod dry weight, forward pod fuel cg and aft pod fuel cg.

7. Relief container—Empty.
8. Ejection seat, survival kit and parachute—Check.

   a. Ejection seat:

      (1) Check that pins are removed from 5 initiators (2 lower left arm rest, 1 lower right arm rest, 1 lower left side fuselage behind seat, and 1 middle right rear of seat).

      (2) Check that oxygen and radio personal leads are connected and secure.

CONTINUED

POWER-OFF INTERIOR INSPECTION (CONTINUED)

(3) Check operation of the shoulder harness in automatic and manual locked positions.

(4) Check general condition of safety belt, shoulder harness, safety belt tie-down strap, arm restraints, and leg restraint harness.

(5) Check quick disconnect fittings connected underneath seat.

b. Survival kit:

(1) Check parachute attachment straps securely attached in kit release fittings and attached to parachute.

Note

The attachment straps should not be connected to the parachute over the safety belt or routed between the safety belt and the safety belt release hose. Improper connection could result in not separating from the seat or in the lap belt initiator not firing.

(2) Check that the harness and kit release handles are down.

9. Map and data case—Check.

   Check that current sets of the following FLIPS's are in the aircraft: FLIP, Terminal High Altitude; FLIP, Enroute High Altitude; and FLIP, Enroute Low Altitude.

10. External power switch—OFF.
11. Battery switch—OFF.
12. Escape rope—Check.

    Check that rope is fully stowed and the exposed end is snapped to retainers.

13. Flight control power switch—OFF.
14. Boom latch control switch—OFF.
15. Engine start switches—OFF.
16. Gain selector switch—AUTO.
17. Aileron control available switch—AUTO.
18. Elevator control available mode switch—TO & LAND.
19. Canopy control lever—OPEN.
20. SIF—Set.
21. IFF master control knob—OFF.
22. UHF command radio—OFF.
23. Mask defog—OFF.
24. VHF-NAV power switch—OFF.
25. Emergency increase elevator available handle—In.
26. Emergency brake and landing gear handle—In.
27. Throttles—OFF.
28. Taxi and landing lights—OFF.
29. Landing gear handle—DOWN.
30. Drag chute handle—In and horizontal.
31. Fire pull switches—In.

CONTINUED

POWER-OFF INTERIOR INSPECTION (CONTINUED)

32. CG selector—Set.
    Check that cg selector is positioned properly.
33. Cg control switch—Guarded MANUAL.
34. Manual cg shift switch—Guarded OFF.
35. Air refueling door switch—CLOSE.
36. Reservoir booster pumps—OFF.
37. Fuel dump switch—NORMAL.
38. Reservoir to manifold shutoff valve switches—CLOSE.
39. All other fuel switches—OFF, CLOSE or NORMAL.
40. IFR emergency hydraulic boost lever—OFF.
41. Pitot heat switch—OFF.
42. Engine anti-ice switch—OFF.
43. Rain removal switch—OFF.
44. Air source selector—BOTH.
45. Refrigeration unit selector—GRD CART.
46. Air conditioning control mode selector—OFF.
47. Cabin temperature control—3 o'clock.
48. Cabin pressure selector—NORMAL.
49. Pod & DECM power switch—NORMAL.
50. Generator control switches—OFF.
51. Pod release switch—OFF.

POWER-ON INTERIOR INSPECTION.

1. Essential DC power:
   a. Battery switch—EMERGENCY.
   b. Battery discharging lamp—On.
   c. Interphone—Check.
      Check interphone operation with flight crew and ground crew.
   d. Alert and bailout warning system—Check.
      (1) Place bailout warning switch to ALERT.
      (2) Check all alert signal lamps on.
      (3) Place bailout warning switch to BAILOUT.
      (4) Check all bailout signal lamps on.
      (5) Return bailout warning switch to OFF.
2. Ground air conditioning—Operating.
   Instruct the ground crew to apply cooling and servo air to the airplane before activating the electrical system.

CAUTION

Air conditioning must be used whenever any electrical power is applied.

CONTINUED

POWER-ON INTERIOR INSPECTION (CONTINUED)

e. Air ignition—Check.

(1) Place each engine start switch to AIR.

(2) Individually move throttles momentarily to IDLE and return to OFF.

(3) Ground crew reports on ignition sounds at each engine as it occurs.

(4) Return engine start switches to OFF.

f. Battery switch—ON.

g. Battery discharging lamp—On.

3. AC power—EXT POWER or GROUND MAINT, and check.

a. External power switch—EXTERNAL POWER (31 ▶ 34) or GROUND MAINTENANCE (35 ▶).

b. Left and right bus voltage and frequency readings 115 ±5 volts and 400 ±6 cycles.

4. Emergency ram air scoop—Check.
Place air conditioning mode selector to RAM and instruct ground crew to report operation of the scoop, then return switch to OFF.

5. UHF command radio—BOTH.

6. Oxygen and interphone—On call, on normal, oxygen check complete. (P-N-DSO)

a. Pilot checks oxygen quantity for 18 liters minimum. Press test button and check for decreasing indication, then release button and check for return to former reading.

b. Each crew member checks his oxygen as follows:

(1) Oxygen pressure 70 to 110 psi.

(2) Diluter lever NORMAL OXYGEN and check regulator.

Place diluter lever to normal oxygen and check regulator breathing valve by blowing gently into end of seat hose. There should be resistance to blowing. Little or no resistance indicates leakage or faulty operation.

(3) Place diluter lever to 100% OXYGEN and perform check as in preceding step.

(4) Connect oxygen mask and seat hoses to manifold block.

(5) Oxygen supply lever ON.

(6) Check system flow and mask leakage.

With the mask fitted snugly to the face, breathe normally and conduct the following check:

(a) Observe flow indicator and note that shutter moves with each breathing cycle.

(b) Place emergency lever to EMERGENCY and notice a continuous flow with noticeable pressure increase in the mask.

(c) Place emergency lever to TEST MASK and hold. A continuous flow and positive pressure increase should be felt in the mask. Hold breath to determine that there is no leakage around the mask. Release the emergency lever and note that positive pressure ceases.

(d) Check that oxygen pressure reads 70 to 110 psi after the check.

(7) Diluter lever NORMAL OXYGEN.

(8) Supply lever OFF.

(9) Check seat hose quick-disconnect fitting at the manifold block for approximately 10 to 15 pounds pull.

CONTINUED

POWER-ON INTERIOR INSPECTION (CONTINUED)

7. High voltage DC power—Checked. (DSO)
   DSO will perform the following check and report completion to the pilot:
   a. Positions meter selector knob to each position and notes proper voltage and if the ammeter is indicating a load to determine that all units are functioning. Tolerance includes meter tolerance.

Unit	*Tolerance*
28 volt	24.5 to 30.0 volts (full scale acceptable)
150 volt	141 to 159 volts
—150 volt	141 to 159 volts
250 volt	226 to 277 volts

8. Notify navigator and DSO that normal power is available.
9. Seats and pedals—Adjust.
   Adjust seat position by use of vertical adjustment switch and the pedals by use of the crank.
10. Spikes—Check.
    Instruct the ground crew to report spike positions and check as follows:
    a. Hold No. 1 and No. 2 spike switches to OUT until spikes are fully extended.
    b. Place No. 1 and No. 2 spike switches to AUTO and check spikes retracting.
    c. Return No. 1 and No. 2 spike switches to IN and check that spikes retract fully.
    d. Repeat same check for spikes No. 3 and No. 4.
11. UHF command radio and VHF-NAV equipment—ON and checked.
    a. Set interphone function selector to COMM and place the INTER, COMM, and VHF NAV mixing switches up.
    b. Perform command radio check:
       (1) Select tower frequency.
       (2) Call tower for radio check and altimeter setting.
       (3) Instruct the navigator and DSO to make a radio check call.
    c. Perform VHF-NAV radio check:
       (1) Place VHF-NAV power switch ON.
       (2) Select and identify VOR station.
       (3) Check the OFF flag disappears from course deviation indicator (glide slope indicator will remain OFF).
       (4) Check that No. 2 indicator of RMI points to appropriate bearing.
       (5) Rotate the course selector until the CDI is centered and TO or FROM tab appears in the ambiguity indicator window. Cross check indication with the No. 2 indicator bearing.
       (6) Rotate the course selector ten degrees either direction from the bearing that centered the CDI and check for a full scale deflection with the ten degree change.
       (7) Select and identify ILS station (if available).
       (8) Check the OFF flag dissappears from course indicator in both the CDI and glide slope indicators and check for correct indicator deflection in relation to the ILS transmitters.
12. Malfunction and indicator lights—Check.
    Press malfunction and indicator light test button and check that all warning and caution lamps on the warning and caution lamp panels are on, plus the following:
    a. Autopilot second station indicator lamp

CONTINUED

POWER-ON INTERIOR INSPECTION (CONTINUED)

b. Crew ejected indicator lamp
c. Landing gear handle warning lamp
d. Landing gear warning buzzer (should sound)
e. Trim neutral indicator lamp
f. Master warning lamp
g. Master caution lamp
h. Air refueling ready indicator lamp

13. Landing gear position indicator lamps—On.
14. Ram air temperature indicator—Climatic.
Check for correct ambient temperature.
15. Flight instruments—Checked.
Perform the following checks:
a. Standby compass on proper heading.
b. Turn and slip indicator, machmeter, airspeed indicator and vertical velocity indicator indicate proper static condition.
c. Altimeter set and checked against local altimeter setting received from the tower.

WARNING

When checking the altimeter barometric setting, check also that the 10,000 foot pointer is reading correctly. If the set knob is rotated until the baro scale goes out of view and reappears, the altimeter will be approximately 10,000 feet in error even though the correct barometric setting appears in the Kollsman window.

d. Clock set and running.

16. Fuel quantity totalizer and total fuel flow indicators—Check.
Check fuel quantity totalizer indication against the fuel loading schedule and that the flow indicator reads zero.
17. Accelerometer—Reset.
18. Engine fire detection circuit—Check.
Press circuit test button and check that all fire warning lamps are on.
19. Fuel system:
a. Fuel quantity indicators—Check.
Press the fuel quantity indicator test button and check all tank indicators and fuel system totalizer for decreasing indications. Check cg indicator for change in indication. Release button and check all indicators return to former readings.
b. Reservoir tank booster pump switch—NORM.
Check No. 3, 4 and 5 pump caution lamps light momentarily.
c. Reservoir to manifold shutoff valve switches—NORMAL.
Check left and right manifold low pressure warning lamps go out and for reservoir to all engines feed indication.

Note

If the manifold is pressurized, the lamps may not be lighted and the check cannot be accomplished.

CONTINUED

POWER-ON INTERIOR INSPECTION (CONTINUED)

d. Forward tank to engine supply control knob—ON.

Check No. 1 and 2 pump caution lamps light momentarily, for a forward to all engines feed indications, and reservoir indicator showing no feed.

e. CG control switch—AUTO.

f. CG selector set knob—Forward transfer.

Check No. 10 and 11 pump caution lamps light momentarily, and for a balance to forward tank flow indication. Check cg off caution lamp comes on when selector is 1% from indicated value.

Note

When the balance tank quantity is less than 1500 to 2000 pounds, No. 7 and No. 8 pump caution lamps will also light momentarily and indicator will show flow out of aft tank.

g. CG selector set knob—Aft transfer.

Check for a forward to balance tank flow indication.

h. CG selector set knob—Reset, lamp out.

Reset selector to coincide with indicated value. Check cg off caution lamp goes out when selector is within 1% of indicated value, and indicator shows no flow when selected value is within .5% of indicated value.

i. CG control switch—MANUAL.

j. Aft tank to engine supply control knob—ON.

Check No. 6 and 7 pump caution lamps light momentarily, for a split feed indication, and reservoir indicator showing no feed.

k. Manual cg shift switch—FWD.

Check No. 8, 10 and 11 pump caution lamps light momentarily, and for a balance to forward tank flow indication.

Note

When the balance tank quantity is less than 1500 to 2000 pounds, the aft tank transfer valve will open and indicators will show flow from the aft to balance tank.

l. Manual cg shift switch—OFF.

Check No. 6 pump caution lamp lights momentarily.

m. Manual cg shift switch—AFT.

Check No. 1 pump caution lamp lights momentarily, and for a forward to balance tank flow indication.

n. Manual cg shift switch—OFF.

Check No. 6 pump caution lamp lights momentarily.

o. Forward tank to engine supply control knob—OFF.

Check No. 8 and 9 pump caution lamps light momentarily, for an aft tank to all engines feed indication, and reservoir indicator showing no feed.

p. Forward tank refuel-scavenge knob—SCAV, then OFF.

Check No. 1 and 2 pump caution lamps light momentarily, then turn switch OFF. Check No. 6 and 9 pump caution lamps light momentarily.

q. Balance tank refuel-scavenge knob—SCAV, then OFF.

Check No. 10 and 11 pump caution lamps light momentarily, then turn switch OFF. Check No. 6 and 9 pump caution lamps light momentarily.

r. Aft tank to engine supply control knob—OFF.

CONTINUED

POWER-ON INTERIOR INSPECTION (CONTINUED)

Note

The reservoir tank booster pump switch is left on during the "Exterior Inspection."

20. Pitot heat—Check, then OFF.

    Place switch to ON and instruct ground crew to check pitot tube for heat, then return switch to OFF.

21. Hydraulic pressure and quantity—Check.

    a. Motor No. 4 engine (maximum of one minute). Elevons will streamline prior to the primary system pressure building up. Check that No. 4 hydraulic pump low pressure lamp goes out at 750 ±250 psi. When primary system pressure indicates 3000 psi, instruct ground crew to check hydraulic quantity gage in right wheel well and to report indicated temperature and hydraulic oil temperature.

    b. Motor No. 1 engine and repeat check for the utility system.

    c. Recheck hydraulic quantity indications two minutes after engines have ceased rotating.

    Note

    The initial hydraulic quantity levels (read in degrees Fahrenheit) should not be more than 50°F below nor 40°F above the hydraulic oil temperature. Two minutes after engines have stopped, reservoir quantity should not have increased more than 55°F above initial quantity. Greater increases are indication of excess air in the system and will be bled prior to flight. Oil temperature is obtained from the thermometer installed near reservoir.

    d. Actuate brakes to bleed down hydraulic pressure in brake accumulator.

22. Interior and exterior lights—Check.

    a. Turn ON the navigation, anti-collision, taxi and landing lights and instruct the ground crew to check them for operation.

    b. Turn ON and check all cockpit and instrument lights, then return them to OFF.

    c. Return exterior light switches OFF when check completed.

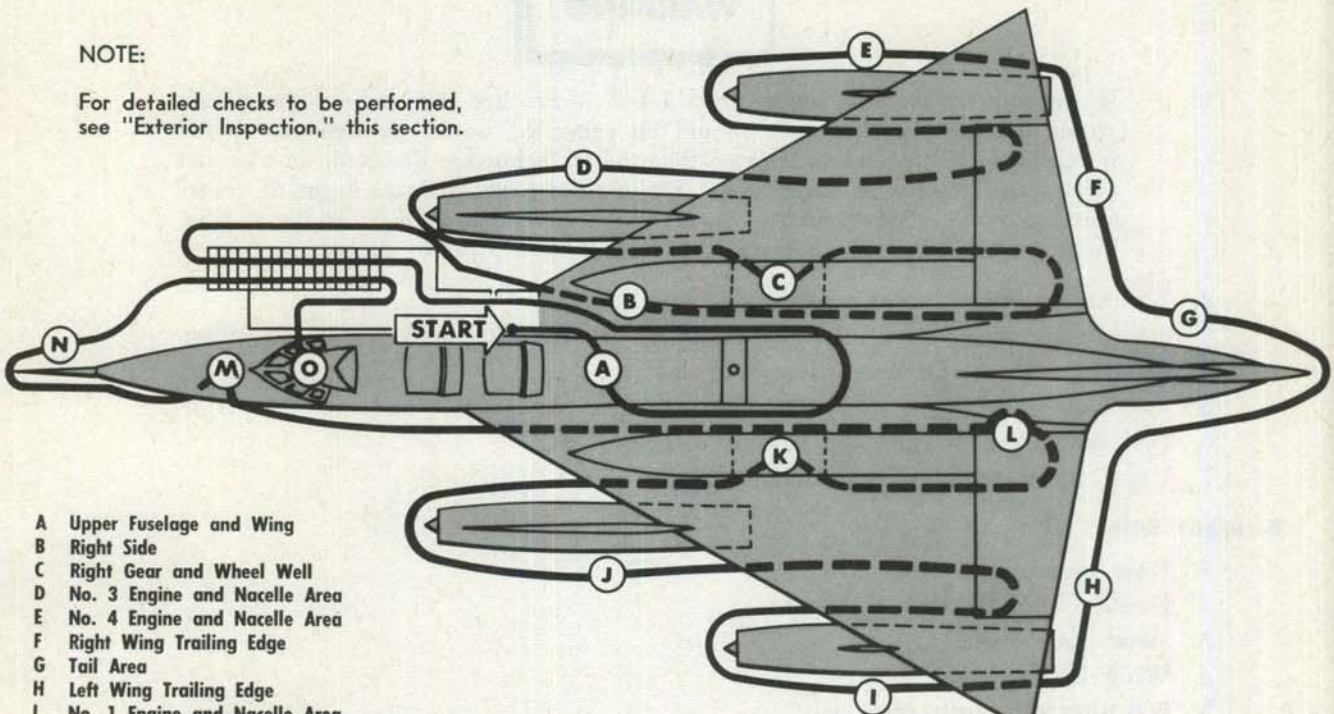
EXTERIOR INSPECTION.

Check the airplane as shown in figure 2-3. The flight crew should keep in mind that the exterior inspection performed by them is only a flight crew inspection of readily accessible items. Should the pilot wish information on non-accessible items, he should examine the "Preflight Inspection Record" before signing Form 781. Ground personnel will be at the airplane to discuss the status of the airplane and its systems. The following inspection is based on the assumption that the flight crew is merely accepting the airplane for flight with emphasis on the items that affect safety of flight. The access panels to the stable table area and the PCLA will have been removed by the ground crew prior to the arrival of the flight crew at the airplane.

exterior inspection

NOTE:

For detailed checks to be performed, see "Exterior Inspection," this section.



A Upper Fuselage and Wing
B Right Side
C Right Gear and Wheel Well
D No. 3 Engine and Nacelle Area
E No. 4 Engine and Nacelle Area
F Right Wing Trailing Edge
G Tail Area
H Left Wing Trailing Edge
I No. 1 Engine and Nacelle Area
J No. 2 Engine and Nacelle Area
K Left Gear and Wheel Well
L Left Side
M Nose Gear and Wheel Well
N Nose
O Pilot's Station

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Figure 2-3.

EXTERIOR INSPECTION (CONTINUED)

Note

While performing the exterior inspection:

- Check the overall exterior for cuts, scratches, loose rivets, and fluid leaks.
- Check all drain plugs for leakage.
- Check that all vents and ports are clear.
- Check that all access doors and panels are secure.
- Check ground area around aircraft for cleanliness.

A. Upper Fuselage and Wing Area.

1. Windshield and windows for condition (cleanliness, cracks, etc.).

EXTERIOR INSPECTION (CONTINUED)

WARNING

If any interlayer cracks longer than 1-1/2 inches are detected in the pilot's windshield panels, the flight should be cancelled until the defective panel is replaced. If any cracks shorter than 1-1/2 inches are detected, an external glass retainer must be installed on the affected panel prior to flight. If cracks are discovered in the window panels in the pilot's canopy or at the navigator's or DSO's stations, they need not be replaced prior to flight.

2. Windshield rain removal nozzle clear.
3. Stable table area for fuel leaks, security of cooling ducts, and general condition.
4. Astrodome for cleanliness, cracks, and scratches.
5. Fuel tank caps (3) for security and leakage.
6. Fuel system maintenance test buttons (6) flush.
7. Upper fuselage and wing surface panels.

B. Right Side.

1. Nose wheel well door.
2. Fuselage skin panels.
3. Static ports clear.
4. Wing leading edge.
5. Pod pitot tube fully retracted.
6. Pod pylon for fit and condition.
7. Warhead drag pin flush.
8. Pod exterior for fuel leaks and condition.
9. PCLA area:
    a. Accumulator pressures (1500 psi at 70°F).
    b. Fuses secure.
    c. Reset the T-handles.
    d. General condition.
10. Radomes for security and fluid seepage.
11. Drag chute compartment doors secure and overcenter pin flush.
12. Drag chute pneumatic pressure gage (2550 psi at 70°F).
13. Inboard elevon actuator area for leakage.
14. Wing lower surface.

C. Right Gear and Wheel Well.

1. Wheels, tires, and brakes for general condition.
2. Strut for condition and proper extension (as placarded).
3. Gear scissors and uplock roller assembly for condition.
4. Landing gear positioning spring pressure gage (1500 psi at 70°F).
5. Fuel system static port clear.
6. Canopy pneumatic system pressure gage (2555 psi at 70°F).
7. Gear hydraulic actuators for condition.
8. Air conditioning water tank filler cap secure.
9. Fuel and hydraulic lines for condition and leakage.
10. Electrical harness for condition.
11. Landing gear and door mechanism; door lock latch for condition.

CONTINUED

EXTERIOR INSPECTION (CONTINUED)

D. No. 3 Engine and Nacelle Area.

1. Afterburner nozzle for condition.
2. Inside tailpipe for fuel accumulation.
3. Pilot burner for condition.
4. Flame holders for cracks.
5. Turbine wheel for condition.
6. Inboard and lower nacelle panels.
7. Fire access and nacelle cooler door open.
8. Engine nose cowling and spike for damage.
9. Spike secure and retracted, and anti-ice cone closed.
10. Air inlet opening for foreign materials.
11. Static ports (4) clear.
12. Inlet guide vanes for condition.
13. Fire access and nacelle cooler door open.
14. Oil tank filler cap access door secure.
15. Outboard nacelle panels.
16. Wing leading edge and lower surface.
17. Outboard elevon actuator area for leakage.

E. No. 4 Engine and Nacelle Area.

1. Repeat the same check as for No. 3 Engine and Nacelle Area.

F. Right Wing Trailing Edge.

1. Wing tip condition.
2. Wing and elevon trailing edge.

G. Tail Area.

1. Turret and radome checked, safety pin removed, and safety switch flush.
   Check radome and turret for condition and security; check for hydraulic leaks; check safety pin removed from barrel housing and turret safety switch closed.
2. Empennage exterior surfaces.
3. Fuel dump cap flush with fuselage.

H. Left Wing Trailing Edge.

1. Wing and elevon trailing edge.
2. Wing tip condition.

I. No. 1 Engine and Nacelle Area.

1. Afterburner nozzle for condition.
2. Inside tailpipe for fuel accumulation.
3. Pilot burner for condition.
4. Flame holders for cracks.
5. Turbine wheel for condition.
6. Outboard and lower nacelle panels.

CONTINUED

EXTERIOR INSPECTION (CONTINUED)

7. Fire access and nacelle cooler door open.
8. Engine nose cowling and spike for damage.
9. Spike secure and retracted, and anti-ice cone closed.
10. Air inlet opening for foreign materials.
11. Static ports (4) clear.
12. Inlet guide vanes for condition.
13. Fire access and nacelle cooler door open.
14. Oil tank filler cap access door secure.
15. Inboard nacelle panels.
16. Wing leading edge and lower surface.
17. Outboard elevon actuators area for leakage.

J. No. 2 Engine and Nacelle Area.

1. Repeat the same check as for No. 1 Engine and Nacelle Area.

K. Left Gear and Wheel Well.

1. Wheels, tires, and brakes for general condition.
2. Strut for condition and proper extension (as placarded).
3. Gear scissors and uplock roller assembly for condition.
4. Landing gear positioning spring pressure gage (1500 psi at 70°F).
5. Air conditioning water tank filler cap secure.
6. Landing gear emergency pneumatic system pressure gage (2555 psi at 70°F).
7. Brake hydraulic accumulator pressure gage (preload 500 psi at 70°F).
8. Brake emergency pneumatic system pressure gage (2555 psi at 70°F).
9. Reservoir isolation valve cap secure.
10. Gear hydraulic actuators for condition.
11. Parking brake pump handle secure.
12. Fuel and hydraulic lines for condition and leakage.
13. Electrical harness for condition.
14. Landing gear and door mechanism; doorlock latch for condition.

L. Left Side.

1. Inboard elevon actuators area for leakage.
2. Wing lower surface.
3. PCLA access panel installed.
4. Pod exterior for fuel leaks and condition.
5. Pod safety lock pin flush.
6. Pod pneumatic bottle pressure (2) (2550 ±200 psi).
7. Pod arm-safe selector as required.
8. Warhead drag pin flush.
9. Pod pylon for fit condition.
10. Wing leading edge.
11. Fuselage skin panels.
12. Exterior emergency canopy jettison access doors (3) secure.
13. Nose wheel well door.

CONTINUED

EXTERIOR INSPECTION (CONTINUED)

M. Nose Gear and Wheel Well.

1. Tires and wheels for general condition.
2. Nose strut for proper extension (as placarded).
3. Gear scissors quick disconnect lock pin installed and safetied.
4. Steering safety switch actuator retainer in place.
5. Landing and taxi lights.
6. Gear actuators and lock cylinders for leakage.
7. Oxygen filler valve covers (2) secure.
8. Oxygen drain valves (2) closed.
9. Oxygen containers (2) and plumbing for security and leakage.
10. Search radar flexible waveguide for condition and security.

CAUTION

Do not handle the waveguide as it can be damaged internally by excessive handling.

11. Single-point refueling adapter cover secure.
12. Pitot-static system water drain caps secure.
13. Pilot's canopy override lever safety-wired OFF.
14. Canopy control lever latched in UP position.
15. Canopy seal control lever OFF.
16. Electrical harness for condition.

N. Nose.

1. Outside air temperature pickup guard removed.
2. Radome condition, and drain hole clear.
3. Pitot mast tube and static ports.

O. Upper Fuselage and Pilot's Station.

1. Stable table access panels installed.
2. Fuel booster pumps off.

Note

If no delay is anticipated in starting engines, the above step may be omitted.

BEFORE STARTING ENGINES. (DSO READS)

The DSO will read the Before Starting and all subsequent check lists to the pilot at the pilot's request.

1. UHF command radio—BOTH.
2. Personal gear—Survival kit attached, safety belt, shoulder harness, safety belt tie-down strap, arm restraints, and both parachute lanyards connected. (P-N-DSO)
   a. Each crew member connects personal gear and harness as shown in figure 2-4.

WARNING

Operational usage of the leg restraint harness (upper and lower) has not been fully determined. Until such information is available, crew members will utilize these devices as specified in the operations briefing prior to each mission.

CONTINUED

personal gear connections

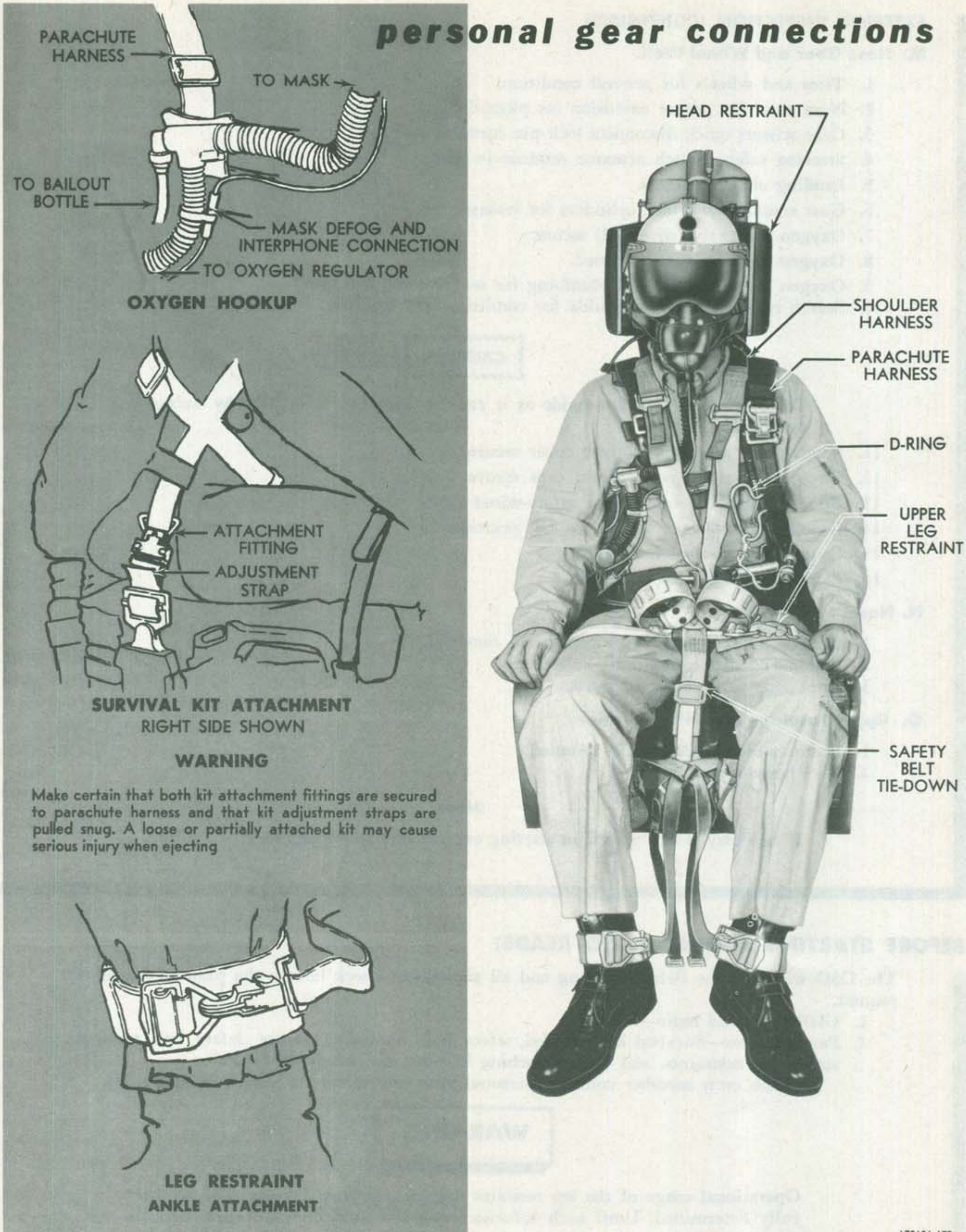
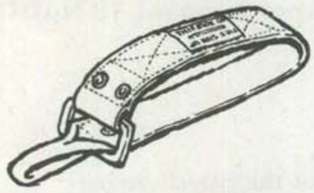
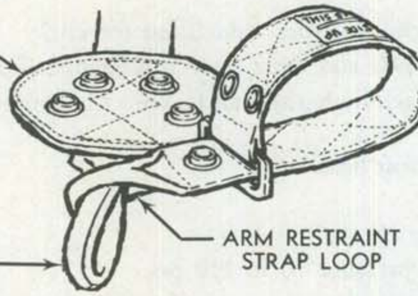


Figure 2-4. (Sheet 1 of 2)

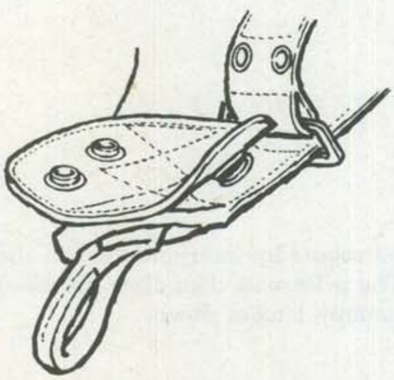
ARM RESTRAINT STRAP HOOKUP (Typical)



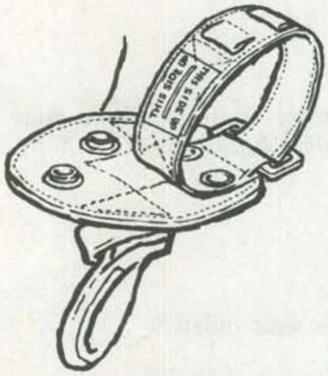
1 Insert fabric loop of arm restraint strap through metal link. The two female snaps should be on the outside of the strap.



2 Place loop of arm restraint strap over end of safety belt tiedown strap.



3 Snap arm restraint strap to lower side of stowage pad.

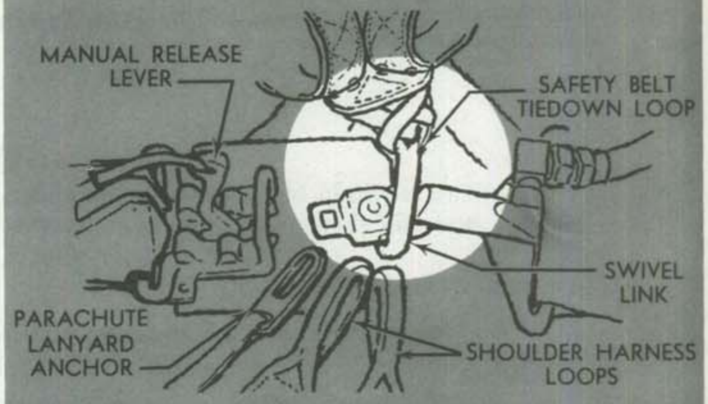


4 Rotate arm restraint strap inboard and snap to upper side of stowage pad.

5 Repeat procedure to install remaining arm restraint strap.

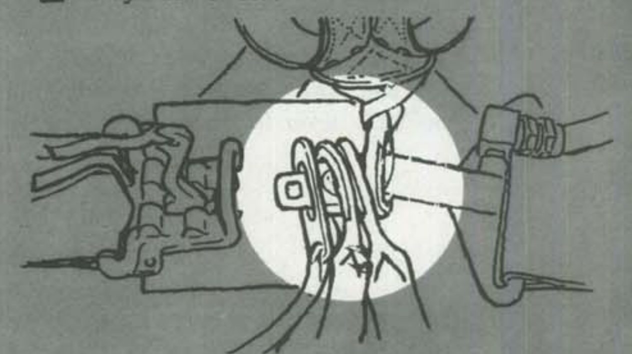
NOTE: Hookup shown is for right side; straps are identical and may be used on either side.

MODIFIED MA-6 SAFETY BELT HOOKUP

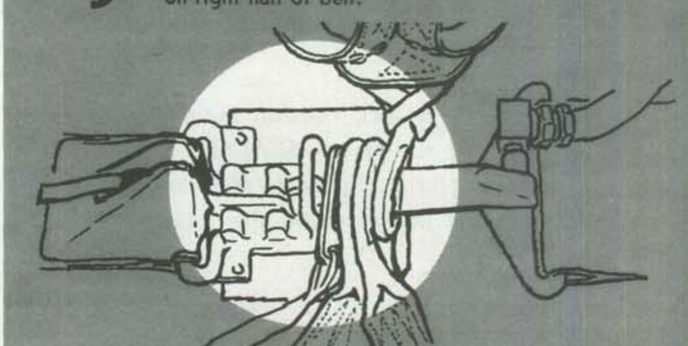


1 Place safety belt tiedown loop over swivel link on right half of belt.

2 Place shoulder harness loops over swivel link on right half of belt.



3 Place parachute lanyard anchor over swivel link on right half of belt.



4 Join left and right halves of belt and fasten by locking manual release lever.

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Figure 2-4. (Sheet 2 of 2)

BEFORE STARTING ENGINES (CONTINUED)

3. Mask, bailout bottle, and mike cord—Oxygen hoses and mike cord connected. (P-N-DSO)
   Each crew member connects oxygen mask as follows:

Note

The manifold block is normally attached to the right side of the parachute harness and should be checked for security prior to connecting hoses.

   a. Plug seat hose into manifold block on parachute harness and listen for click.
   b. Plug mask hose connector into manifold block and twist to secure bayonet fitting.
   c. Route bailout bottle tubing underneath parachute harness and connect bayonet fitting to manifold block.
   d. Plug mike cord into receptacle attached to seat hose.
4. Oxygen—Oxygen check complete. (P-N-DSO)
   Each crew member accomplishes the following check:
   a. Oxygen supply lever ON and check system pressure 70 to 110 psi.
   b. Check oxygen flow blinker and hose connection.
5. Ejection seat and initiator safety pins—Removed and stowed. (P-N-DSO)
6. Flight control power switch—ON.
7. Damper switches—ON.
8. IFF master control knob—STDBY.
9. Air conditioning mode selector knob—AUTO.
10. Radio call—Completed.
11. Altimeter—Set.
12. Canopies—Closed and latched. (P-N-DSO)
    The navigator and DSO close their canopies and report by interphone when the latching mechanism indicator flags are out of sight. The pilot will then close his canopy and hold the lever in the CLOSE position until the canopy latches down.

WARNING

The navigator's and DSO's canopy latching mechanism indicator flags must be out of sight behind their shields to indicate positive locking of the canopy.

13. Canopy unlock caution lamp—Out.
14. Canopy seal lever—SEALED. (N)
    Instruct navigator to seal canopies. Pilot visually checks seals inflated.
15. Ground observer and fire guards—Posted. (GO)

CONTINUED

BEFORE STARTING ENGINES (CONTINUED)

16. Ground area—Clear to start engines. (GO)

    Receive acknowledgement from ground observer that all ground support equipment is cleared at a safe distance from the airplane, and that danger areas (figure 2-5) are clear of all personnel.

WARNING

Suction at air inlets is sufficient to kill or seriously injure personnel pulled against or drawn into the inlets. The danger area aft of the airplane is created by high exhaust velocity, temperature, and noise level.

STARTING ENGINES. (DSO READS)

During engine starting, a qualified ground observer will be in constant communication with the pilot. The pilot will announce his actions at all times during engine starting operations. Action which require ground personnel to approach an operating engine, such as disconnecting ground service carts, must be performed with caution. Ground fire equipment should be properly manned and standing by. See "Engine Fire on the Ground," Section III, for instructions in combating engine fires. The engine starting sequence is 2, 1, 3, 4. An outside source of air is necessary to start the first engine and is normally used for starting all the engines. However, as an alternate method, after one inboard engine is started, compressor bleed air from that engine may then be used to start the remaining engines. Whenever possible, start the engines with the airplane headed into or at right angles to the wind. Starting with the tail pointed into a strong wind may cause erratic exhaust gas temperature readings.

1. Parking brakes—Set.

   Check that both pedals remain depressed.
2. Throttles—OFF.
3. Reservoir booster pump switch—NORM.
4. Aft tank to engine supply control knob—ON.

   Start engines on the aft tank.
5. External starter air—Supplied. (GO)

   Instruct ground observer to supply external starter air.
6. No. 2 throttle—IDLE.

   Move throttle beyond IDLE, then back to IDLE.
7. No. 2 engine start switch—GROUND.

   Place engine start switch to GROUND position. Light-off should occur within 15 seconds after fuel flow is indicated, or by the time fuel flow reaches 800 pph.

CAUTION

If the engine fails to light-off within 15 seconds after fuel flow is indicated, or by the time fuel flow reaches 800 pph, abort the start by returning the throt-

CONTINUED

STARTING ENGINES (CONTINUED)

tle and starter switch to OFF. Light-off failure is indicated by no rise in EGT, no increase in rpm, or abnormally high or low fuel flow. Clear the engine prior to another start attempt.

8. Engine starter switch—OFF at 47 percent rpm.
9. Engine instruments—Within limits.

   After light-off and during acceleration to idle rpm, check that engine instrument readings do not exceed limitations as set forth in Section V. When engine has stabilized at idle, check that rpm is approximately 67 percent.

WARNING

It is considered a hot start when EGT exceeds starting limits. Refer to "Overtemperature Operations," Section V. The seriousness of a hot start depends on the degree of overtemperature and the elapsed time during which engine was subjected to such temperature. Operation that exceeds the time or temperature limits requires replacement of turbine. All hot starts will be logged in Form 781.

CAUTION

After light-off, if engine rpm does not increase to the idle range but remains at some intermediate speed, and the EGT remains below the maximum, the engine has made a false start. Shut down the engine, allow one minute for fuel drainage, then clear the engine prior to another start attempt.

10. Utility hydraulic system—Pressure checked; No. 2 pump lamp out.

    Check that No. 2 hydraulic pump low pressure caution lamp goes out at 750 ±250 psi during acceleration. Check that utility hydraulic pressure gage indicates 3000 (+50-100) psi.
11. Generator No. 2—Excited and checked.
    a. Momentarily place the No. 2 generator control switch to RESET.
    b. Check that abnormal lamp goes out.
    c. Place meter selector knob to GEN 2 and check for approximately 115V and 400 cycles.
12. Air refueling system:

Note

- This check will be accomplished with the assistance of a ground observer on a stand located on the right side of the nose. The stand will be removed immediately after this check is completed and before starting No. 3 engine.
- Items marked with an asterisk (*) may be omitted on flights where air refueling is not scheduled.

CONTINUED

STARTING ENGINES (CONTINUED)

a. Air refueling door—OPEN.
b. Air refueling ready lamp—On.
*c. Test probe—Inserted. (GO)
*d. Air refueling ready lamp—Out.
*e. Toggles—Engaged. (GO)
*f. IFR disconnect button—Depressed.
*g. Toggles—Released. (GO)
*h. Test probe—Removed. (GO)
i. EBL switch—EBL.
   Check that air refueling ready lamp goes out.
*j. Toggles—Engaged. (GO)
*k. IFR disconnect button—Depressed.
*l. Toggles—Released. (GO)
m. Boom latch control switch—OFF.
   Check that air refueling ready lamp comes on.
*n. Slipway lights and condition—Checked. (GO)
o. Air refueling door—CLOSE.

13. No. 1 engine—Start.
    Repeat the same start procedure as for No. 2 engine.
14. No. 1 hydraulic pump low pressure caution lamp—Out.
15. Generator No. 1—Excited and checked.
    Repeat same procedure as for No. 2 generator.
16. No. 3 engine—Start.
    Repeat the same start procedure as for No. 2 engine.
17. Primary hydraulic system—Pressure checked; No. 3 pump lamp out.
    Check that No. 3 hydraulic pump low pressure caution light goes out at 750 ±250 psi during acceleration. Check that primary hydraulic pressure gage indicates 3000 (+50, —100) psi.
18. Generator No. 3—Excited and checked.
    Repeat same procedure as for No. 2 generator.
19. No. 4 engine—Start.
    Repeat the same procedure as for No. 2 engine.
20. No. 4 hydraulic pump low pressure caution lamp—Out.

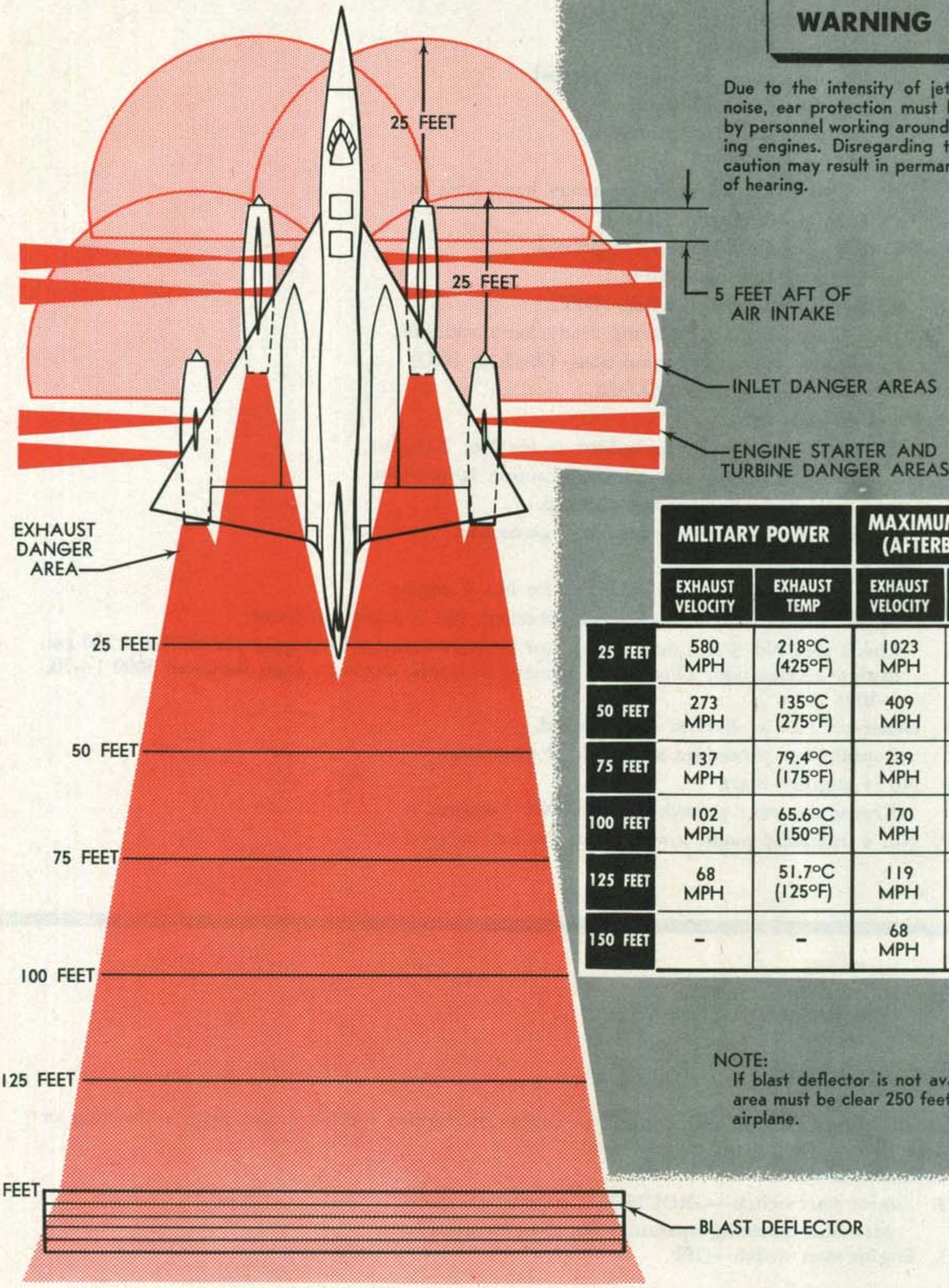
CLEARING AN ENGINE.

If for any reason it is desired to clear an engine of trapped fuel or vapors prior to starting or after an aborted start, proceed as follows:

1. Throttle—OFF.
2. Engine start switch—GROUND.
   Maintain motoring operation for 10 to 20 seconds.
3. Engine start switch—OFF.

danger areas

— engines —



WARNING

Due to the intensity of jet engine noise, ear protection must be worn by personnel working around operating engines. Disregarding this precaution may result in permanent loss of hearing.

	MILITARY POWER		MAXIMUM POWER (AFTERBURNER)	
	EXHAUST VELOCITY	EXHAUST TEMP	EXHAUST VELOCITY	EXHAUST TEMP
25 FEET	580 MPH	218°C (425°F)	1023 MPH	815°C (1500°F)
50 FEET	273 MPH	135°C (275°F)	409 MPH	371.1°C (700°F)
75 FEET	137 MPH	79.4°C (175°F)	239 MPH	232.2°C (450°F)
100 FEET	102 MPH	65.6°C (150°F)	170 MPH	176.7°C (350°F)
125 FEET	68 MPH	51.7°C (125°F)	119 MPH	135°C (275°F)
150 FEET	-	-	68 MPH	93.3°C (200°F)

NOTE:
If blast deflector is not available, area must be clear 250 feet aft of airplane.

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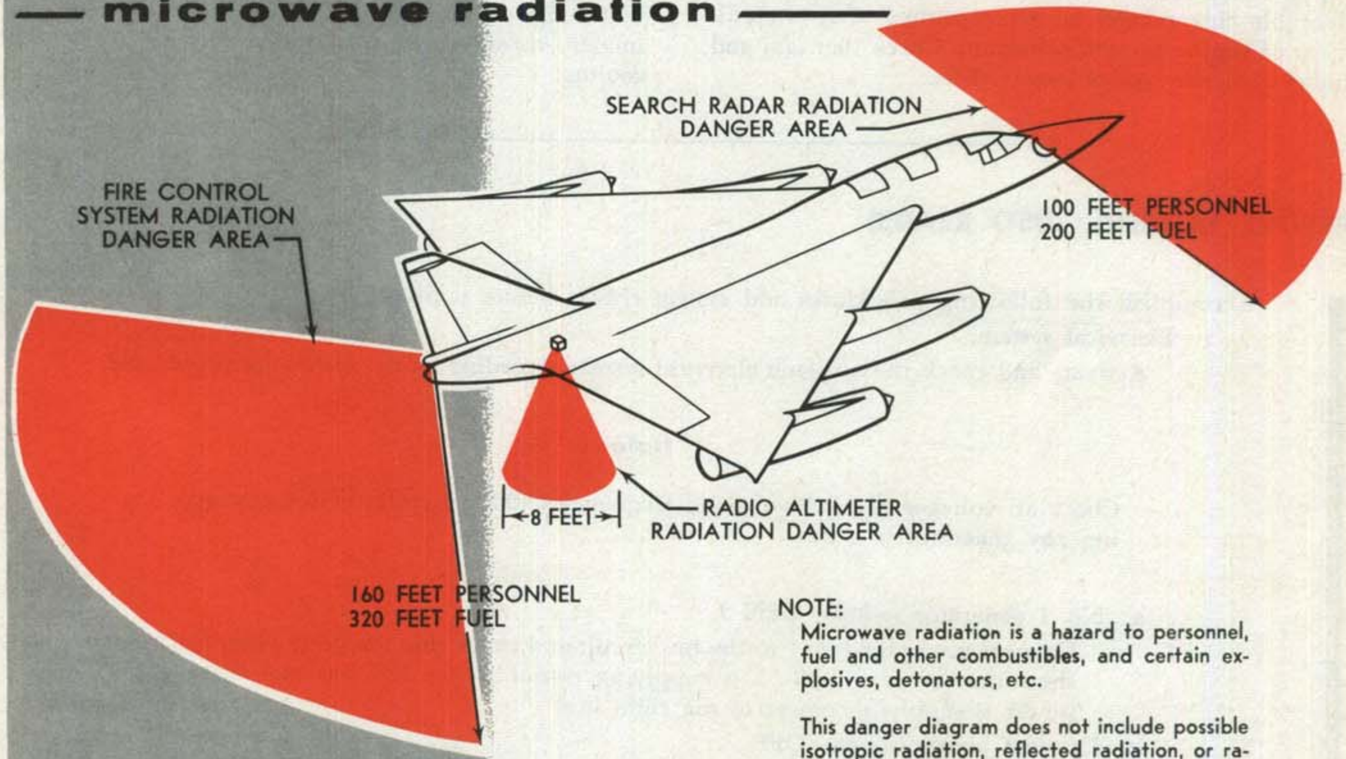
Figure 2-5. (Sheet 1 of 2)

— microwave radiation —



NOTE:
Microwave radiation is a hazard to personnel, fuel and other combustibles, and certain explosives, detonators, etc.

This danger diagram does not include possible isotropic radiation, reflected radiation, or radiation by other aircraft or ground equipment.

— wheels —

NOTE:
Applicable for 30 minutes after brake action following a landing or taxi run and providing the tire safety shields are not installed.

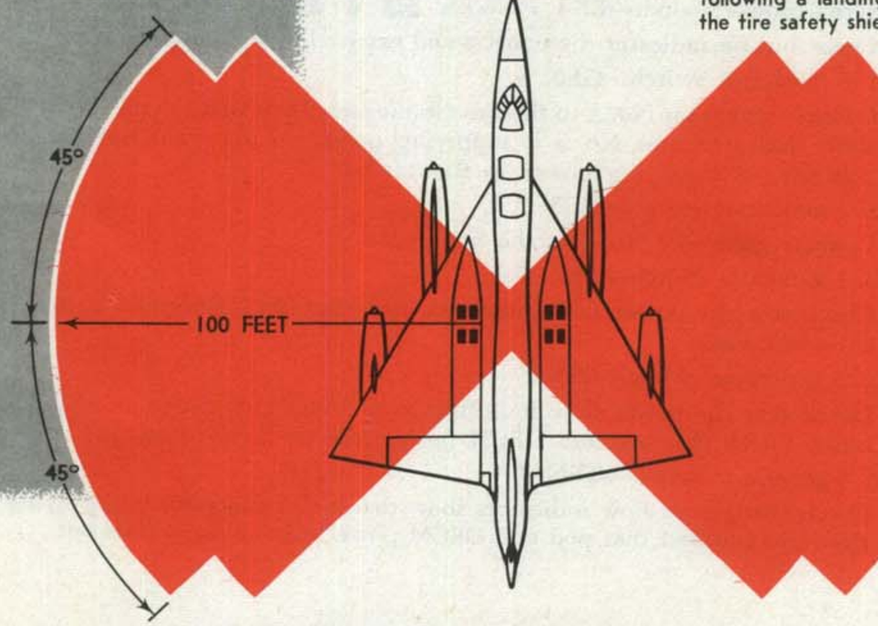


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Figure 2-5. (Sheet 2 of 2)

ENGINE GROUND OPERATION.

No warmup period is required for jet engines, except for the oil system when operating under extreme cold weather conditions. Under normal conditions it is desirable that takeoff be accomplished after a minimum of engine ground operation. Check that taxi and runup areas are free of loose debris.

The air conditioning system will usually be in normal flow during ground operations and idle rpm on the inboard engines should be sufficient for electronic equipment cooling. However, the system may go to reverse flow and the electronic overheat caution lamp will come on, indicating an overheat condition. The inboard throttles may be advanced slightly to increase cooling.

BEFORE TAXIING. (DSO READS)

Accomplish the following procedures and system checks before taxiing:

1. Electrical system:

   Activate and check the airplane electrical system according to the following procedures:

   Note

   Check all voltages 115 ±5 volts and frequencies 400 ±6 cycles before connecting any generator to a bus.

   a. No. 1 generator switch—GEN 1.
      Connect generator No. 1 to the bus circuit and check that the power flow indicators show that generator No. 1 is supplying power to the left bus and that external power is supplying power to the right bus.
   b. External power switch—OFF.
      Check that bus-tie indicator shows that generator No. 1 is supplying power to both buses and that pod and DECM power is off (pod and DECM power caution lamp should be on).
   c. Pod and DECM power switch—RESET, then NORMAL.
      Check that pod and DECM power caution lamp goes out. Return switch to NORMAL and check caution lamp on.
   d. External power switch—EXT POWER 31 ➧ 34 or GRD MAINT 35 ➧.
      Check bus-tie indicator disconnects and external power supplies right bus.
   e. No. 3 generator switch—GEN 3.
      Connect generator No. 3 to the bus circuit and check that the power flow indicators show that generator No. 3 is supplying power to the right bus and that No. 1 generator is supplying power to the left bus.
   f. No. 2 generator switch—GEN 2.
      Connect generator No. 2 to the bus circuit.
   g. No. 1 generator switch—OFF.
      Check that the power flow indicators show that No. 2 generator is supplying power to left bus.
   h. No. 3 generator switch—OFF.
      Check that the power flow indicators show that No. 2 generator is supplying both buses. Check that pod and DECM power caution lamp comes on.
   i. No. 3 generator switch—GEN 3.
      Check that power flow indicators show that No. 3 generator is supplying power to the right bus and that pod and DECM power caution lamp goes out.

CONTINUED

BEFORE TAXIING (CONTINUED)

j. No. 1 generator switch—GEN 1.

Check that power flow indicators show that No. 1 generator is supplying power to the left bus.

k. External power switch—OFF.

l. Voltage and frequencies—Checked.

Check all generators and both buses for correct voltages and frequencies.

m. D-C voltages—Checked. (DSO)

2. Air conditioning system:

a. Ground air conditioning cart—Off. (GO)

Instruct ground observer to stop airflow from air conditioning cart.

b. Refrigeration unit selector knob—BOTH.

Place this knob in the BOTH position to select airplane air conditioning.

c. Flow switch—RESET TO NORMAL then release.

Move the flow switch to RESET TO NORMAL momentarily, then release. Check that the reverse air flow caution lamp goes out and that the air conditioning system goes into normal flow.

d. Cabin altimeter—Checked.

Check that the cabin altitude does not drop more than 2000 feet below the field altitude.

e. Refrigeration unit selector—BOTH, L, R, then BOTH.

Check that cool air is flowing from the cabin air inlet ducts when the knob is in BOTH, then L and R positions. Check the temperature gages for left and right units show approximately equal discharge temperatures. Return the knob to BOTH.

f. Rain removal switch—REMOVE, then OFF.

Place the rain removal switch in the REMOVE position momentarily, then return to OFF.

Note

The rain removal switch should be placed in the REMOVE position momentarily before testing the defog switch in order to blow out any water that may have backed up into the warm air manifold.

g. Windshield defog switch—INC, DEC, then HOLD.

Momentarily hold switch to INC and check for airflow from defog nozzle (maximum airflow in 9 seconds), then place switch to DEC. When switch is placed to DEC, airflow will stop in approximately 9 seconds.

3. Air conditioning, starter air, and electrical power carts—Disconnected. (GO)

WARNING

Engine rpm must not exceed idle while ground personnel are around airplane.

CONTINUED

BEFORE TAXIING (CONTINUED)

4. Flight control system:

CAUTION

All flight control movements should be made slowly so as to avoid hydraulic pump cavitation.

a. Flight controls—Checked freedom.

Move control stick and rudders through full limits to check for freedom.

b. Rudder trim—Checked.

Hold the rudder trim switch to NOSE LEFT and check for left rudder movement. Hold the switch to NOSE RIGHT and check for right rudder movement. Hold switch to NOSE LEFT until the aileron-rudder neutral trim indicator lamp comes on. Release the switch simultaneously with the lamp coming on. Check that lamp goes out.

c. Elevator trim—Checked.

Hold the trim selector switch alternately to NOSE UP and NOSE DOWN and check for correct control stick movement. Place the trim selector switch to OFF; check the aileron-elevator stick trim switch inoperative in all positions. Then place trim selector switch to CONT STICK; now hold the aileron-elevator stick trim switch alternately to NOSE UP and NOSE DOWN and check for correct control stick movement. When check is completed, trim elevators to 3 degrees up.

d. Aileron trim—Checked.

Hold the aileron-elevator stick trim switch alternately to LWD and RWD and check for correct control stick movement. Then hold the switch to LWD until the aileron-rudder neutral trim indicator lamp comes on. Release the switch simultaneously with the lamp lighting. Check that lamp goes out.

e. Elevator control available check:

Determine that rudder and ailerons are in neutral position and elevators are trimmed to 3 degrees up.

(1) Elevator available mode switch—AUTO.

The elevator available should start driving smoothly to a decreased value. Check the elevator position remaining constant until the elevator available stops decreasing. If elevator position moves, stop movement by adjusting control stick position. After the system stabilizes, pull back on the stick and note the elevator available beginning to increase. Release the stick to neutral momentarily and note elevator available stops driving. Hold forward force on the stick and check that the available does not drive below 2°. Release the stick to neutral momentarily and note the elevator available remains at the previous position.

Note

- At gross weights below 100,000 pounds, elevator available should read between 5 and 10 degrees, depending on field elevation and autotrim tolerance.
- At gross weights above 135,000 pounds, elevator available should read between 2 and 6 degrees, depending on field elevation and autotrim tolerance.

CONTINUED

BEFORE TAXIING (CONTINUED)

- At gross weights between 100,000 and 135,000 pounds, elevator available is a function of gross weight and will decrease linearly between the above limits as gross weight increases.

(2) Force link—Override.

Push forward on the stick and apply sufficient force to actuate the force link. Check that elevator mode selector switch returns to TO & LAND, elevator available begins to increase, and elevator position does not change.

(3) Elevator available mode switch—MANUAL.

Select manual before the elevator available increases above 5°.

(4) Elevator manual adjust switch—DECREASE.

Decrease the elevator available to minimum of 8/10°. Check manual increase available momentarily. Deflect the control stick to full forward and aft positions and check that the elevator positions obtained are proper for the available. This will provide a partial check of the indicator as well as a functional check of correct elevator available.

(5) Force link—Override.

Pull back on the stick and apply sufficient force to actuate the force link. Check that elevator mode switch returns to TO & LAND. Release the control stick and check that the elevator position does not begin to drive up toward 3° until the elevator available has increased to 7 ±1°.

(6) Elevator available—Full (20°).

Check the increase of elevator available as the control increases smoothly to full.

(7) Elevator position—3° up.

Check that elevator position drives to approximately 3° up and remains there with the control stick in neutral.

f. Control System:

Ground observer will report flight control positions.

WARNING

Engine rpm must not exceed idle while ground personnel are assisting with the flight control check.

(1) Elevators—Checked.

Deflect the elevators full up and note the position indicator as reading approximately 23° up. Deflect the elevators full down and note the position as approximately 10° down. Ground observer will report all control positions.

(2) Ailerons—Checked.

Deflect the ailerons full throw first in one direction, then in the other direction, and the Ground Observer will report the position of the ailerons and rudder.

CONTINUED

BEFORE TAXIING (CONTINUED)

(3) Yaw damper—Checked.

While the ailerons and rudder are deflected to full available, turn the yaw damper off and observe the rudder moving to a larger deflection. Turn the yaw damper on again and the rudder deflection should decrease. Neutralize aileron and rudder, then turn yaw damper OFF and ON. Check for no large engage transient vibrations.

(4) Pitch damper—Checked.

Turn the pitch damper off and on to determine there are no large engage transient vibrations. There is no specific indication of pitch damper operation other than determining the amount of engage transient vibration.

(5) Roll damper—Checked.

Turn the roll damper off and on to determine there are no large engage transient vibrations. There is no specific indication of roll damper operation other than determining the amount of engage transient vibration.

(6) Rudder—Checked.

Deflect the rudder full throw to the left and right with the ground observer reporting the control positions.

(7) Elevator—Trimmed zero.

Trim the control stick until the elevator position indicator reads zero.

5. Ground safety locks—Removed. (GO)

   Instruct ground observer to remove ground safety lock pins (4).

6. Primary and utility hydraulic reservoir indicators—Checked. (GO)

   Instruct ground observer to report hydraulic reservoir indicators readings. Also note each system quantity indication.

7. Antiskid switch—ON. 35
8. Ground safety locks—Removed and in sight.
9. Remove ground static wire, chocks, and interphone—Removed. (GO)

   Instruct ground observer to prepare the exterior of the airplane for taxi.

10. Anti-collision and navigation lights—As required.
11. Navigator and DSO—Ready for taxi. (N-DSO)

    Check that navigator and DSO have completed station checks and are ready to taxi.

TAXIING. (DSO READS)

Release the brakes and use throttles as necessary. Depress the NWS-IFR reset button and utilize the steerable nose wheel to maintain directional control. Refer to figure 2-6 for minimum turning radius and ground clearances. While taxiing, check the following:

1. Brakes—Checked.

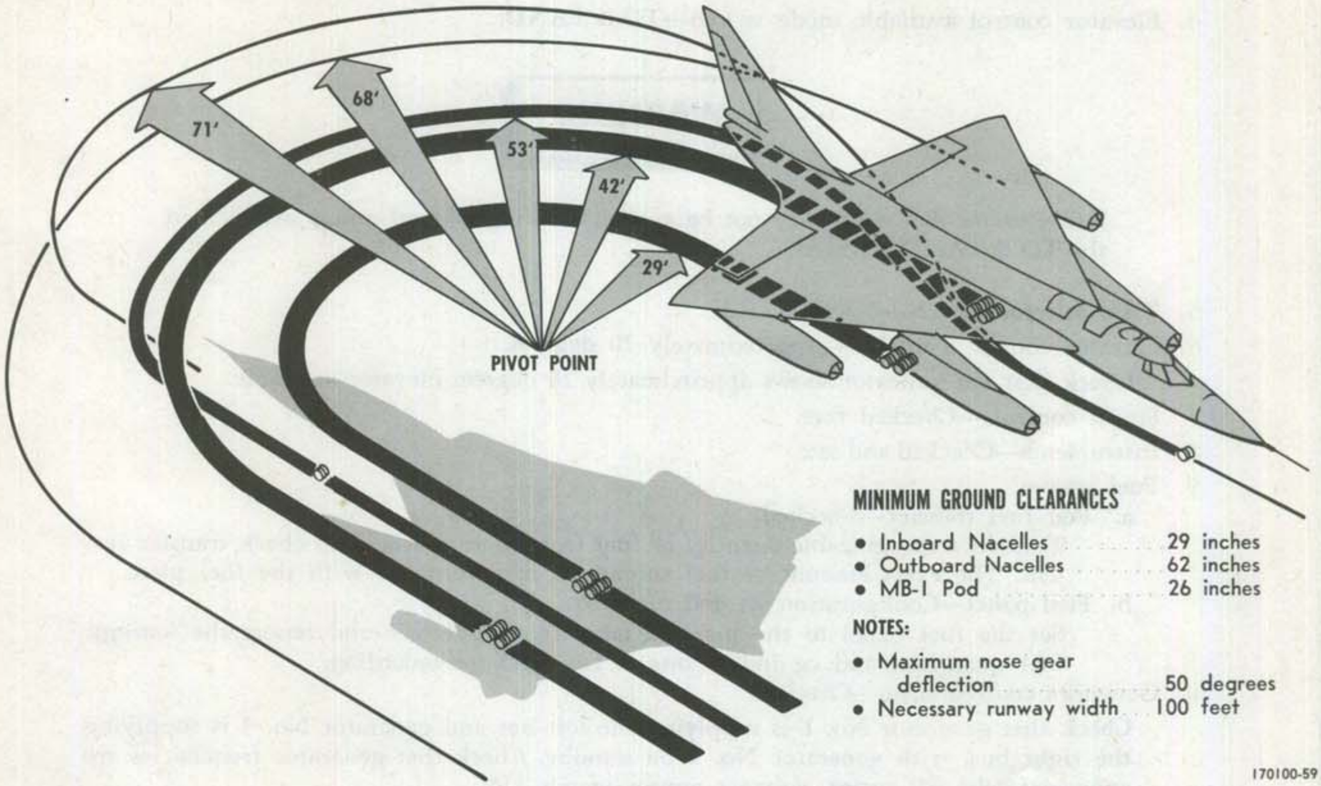
   After initial roll, apply brakes and check operation.

2. Nose wheel steering—Checked.

   Operate rudder pedals to check that nose wheel steering is engaged and operating properly. Straighten path with nose wheel steering, then disengage briefly to check for dragging brakes.

CONTINUED

minimum turning radius and ground clearance



MINIMUM GROUND CLEARANCES

- Inboard Nacelles 29 inches
- Outboard Nacelles 62 inches
- MB-1 Pod 26 inches

NOTES:

- Maximum nose gear deflection 50 degrees
- Necessary runway width 100 feet

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Figure 2-6.

TAXIING (CONTINUED)

3. Turn-and-slip, RMI, and attitude indicator—Checked.
   Check the turn-and-slip indicator for proper turn indications while taxiing. Check that the RMI checks closely with the standby compass heading and that the attitude indicator has erected.
4. Hydraulic pressure and quantity—Checked.
   Check utility and primary system hydraulic pressure indicators for normal pressure and quantity at regular intervals while taxiing.
5. Navigator and DSO fuse panels—Checked. (N-DSO)
   Check with navigator and DSO to make sure that no power panel fuses are blown.
6. D-C voltages—Checked. (DSO)
   DSO checks and monitors d-c voltages.

BEFORE LINEUP. (DSO READS)

1. Parking brakes—Set.
2. IFF master control knob—NORM.
3. Aileron control available—AUTO.
   Check that aileron control available switch is in AUTO position and that aileron control available indicator reads full.

CONTINUED

BEFORE LINEUP (CONTINUED)

4. Elevator control available mode switch—TO & LAND.

WARNING

Full elevator deflection may not be available during take off unless switch is in the TO & LAND position.

5. Trim selector switch—CONT STICK.
6. Elevator control available—Approximately 20 degrees.
   Check that the indicator shows approximately 20 degrees elevator available.
7. Flight controls—Checked free.
8. Instruments—Checked and set.
9. Fuel system:
   a. Pod fuel transfer—Checked.
      Transfer a recognizable quantity of fuel from each pod tank to check transfer system. The exact amount of fuel should be in accordance with the fuel plan.
   b. Fuel panel—Configuration set and reported.
      Set the fuel panel to the planned takeoff configuration and report the settings, fuel quantities and cg indications to the DSO for recording.
10. Generator configuration—Checked.
    Check that generator No. 1 is supplying the left bus and generator No. 3 is supplying the right bus, with generator No. 2 on standby. Check that generator frequencies are approximately 400 cycles, voltages approximately 115.
11. Anti-ice, defog, rain removal, and pitot heat—Climatic.
12. Warning and caution lamps—Out.
13. Takeoff data—Reviewed.
    Pilot and DSO review the Takeoff and Landing Data Card for wind-corrected decision speed and for take-off data.
14. Navigator and DSO—Ready for takeoff. (N-DSO)
    Check that navigator and DSO station checks are completed and that crew members are ready for takeoff.

TAKEOFF. (DSO READS)

While advancing the throttles to the MIL power setting, monitor the engine instruments to check that rpm, EGT, and oil pressure do not exceed limits and that pressure ratio readings correspond with data on the Takeoff Data Card. Check these instruments again as the brakes are released for the takeoff roll. Before releasing brakes, advance throttles to Min A/B and check for light off of the afterburners. After brakes are released, advance throttles to MAX A/B and check that fuel flows and nozzle positions are correct. It is recommended that the nosewheel be kept in contact with the runway until 10 KTS below takeoff-speed. This configuration allows maximum acceleration. Acceleration will be checked at decision point and a decision made to either abort or continue the takeoff. When unstick speed is reached, rotate the airplane into the takeoff attitude. The main landing gear will unstick as the wing angle of attack reaches approximately 14 degrees. A typical normal takeoff pattern is shown in figure 2-7.

WARNING

Do not attempt to unstick before unstick speed is attained. A high angle of attack

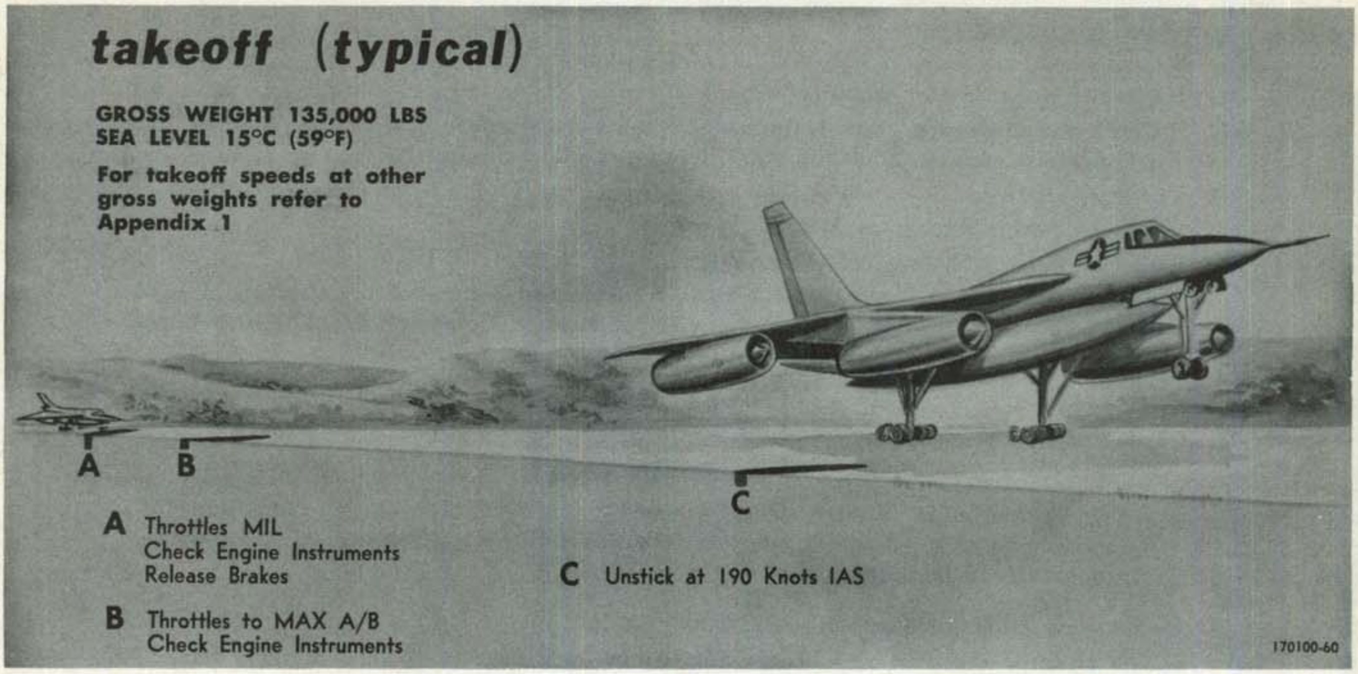

Figure 2-7.

prior to unstick speed will increase the takeoff roll distance.

Because of the effective rudder area, considerable directional control is available for crosswind control. During climbout, the longitudinal trim change due to gear retraction is negligible.

CAUTION

During heavy gross weight takeoffs, the nose landing gear door may not lock up. A slight nose down control maneuver will reduce the air load and allow the gear to latch up.

To perform the takeoff, accomplish the following steps:

1. Landing lights—As required.
2. Throttles—MIL.
3. Instruments—Checked.
4. Throttles—MIN A/B.
5. Nose gear steering button—Depressed.
6. Brakes—Released.
7. Throttles—MAX A/B.
8. Decision speed—Checked.

AFTER TAKEOFF. (DSO READS)

After the airplane is definitely airborne and during transition to climb, accomplish the following:

1. Wheels—Braked.
   Depress the pedals to brake the wheels before retracting the landing gear.
2. Landing gear handle—UP.
   Place the landing gear handle in the UP position; check that the gear position indicator and warning lamps go out.
3. Engine instruments—Checked.
   Check that the following engine instrument indications are within operational limits: rpm, EGT, fuel flow, nozzle position, pressure ratio and oil pressure.
4. Warning and caution lamps—Checked.
   Make a check of the panels to make certain that no warning or caution lamps are on.
5. Landing gear handle—PRESS REL.
   Move the landing gear handle to the PRESS REL. position prior to reaching 300 knots.

CONTINUED

AFTER TAKEOFF (CONTINUED)

6. Hydraulic pressure and quantity—Checked.

   Check that hydraulic pressure indicators show normal pressure, and that hydraulic pump low pressure caution lamps are out. Check hydraulic quantity.

7. Throttles—MIL.

   Reduce power setting to MIL after takeoff.

8. Parachute zero delay lanyard—Disconnected and stowed. (P-N-DSO)

   Disconnect parachute zero delay lanyard from ripcord D-ring before exceeding 300 knots IAS, or upon reaching minimum safe ejection altitude. Connect lanyard hook to stowage ring on parachute harness.

WARNING

The lanyard must be disconnected whenever operating at high altitudes and airspeeds in order that the safety delay provided by the parachute aneroid timer will not be overridden.

9. Elevator available mode switch—AUTO.

   The elevator available should not decrease below 2 degrees.

CAUTION

Automatic G-limiting is not available prior to selecting the AUTO position.

Note

When Mach No. 0.6 is attained, check that aileron control available changes to HALF.

10. Oxygen and station check—Completed. (P-N-DSO)

    During the climb, at approximately 12,000 feet and at Level-off, the crew will accomplish an oxygen and station check. During cruise, the crew will accomplish these checks at hourly intervals. Sequence for report will be pilot, navigator, and DSO.

11. Altimeter—Reset at 23,500 feet.

    Reset altimeter at 29.92" Hg while climbing through 23,500 feet.

CLIMB.

After takeoff, accelerate to a climb airspeed of 400 knots IAS. Maintain this speed until cruise Mach number is reached. Refer to climb charts in Appendix I for climb performance. Adjust the fuel system configuration according to the fuel management schedule. After the climb is established, make a detailed check of the a-c and d-c electrical power supply systems to make certain that the proper voltages, frequencies, and amperages are being delivered.

CRUISE.

After transition to cruise, check cg indicator for correct setting, place cg control switch to AUTO, and follow the mission cruise schedule, paying particular attention to power settings, Mach-altitude schedule, and fuel management schedule. Refer to "Fuel Supply System," Section VII, for fuel management procedures. Throughout the flight, particularly at supersonic speeds, monitor the turn-and-slip indicator and keep the ball centered with rudder trim. If sideslip is allowed for extended periods of time, fuel in the wings will shift in the direction of the slip. This will cause one wing to become heavy. Sideslip may develop as a result of slight thrust variations in the engines during stabilized cruise. Other causes may induce random sideslipping. Reduce all such sideslip as soon as possible using rudder trim. If some fuel shifting does occur due to unnoticed sideslip, maintain wings level using aileron trim.

Note

During autopilot flight, the stick trim switch (for aileron trim) is operative only during control stick steering. The rudder trim switch, however, is operative at all times, since the rudder is not controlled by the autopilot.

WARNING

Caution must be exercised during turns at supersonic speeds when appreciable aileron trim is required for wings level flight (indicating a heavy wing). During such turns, the increased "g" force acting on the unbalanced fuel load creates a rolling moment on the airplane. This may require large aileron deflections in order to remain in the turn or to roll out. Therefore, use shallow bank angles if it is necessary to turn into a heavy wing at supersonic speeds.

FLIGHT CHARACTERISTICS.

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

BEFORE ACCELERATION. (DSO READS)

Before accelerating to supersonic speed, accomplish the following checks.

1. Fuel system configuration—Checked.
   Position the knobs and switches on the fuel control panel according to the fuel management schedule for acceleration.
2. CG indicator—Checked.
   Check that cg position is at desired location.
3. Hydraulic pressure and quantity—Checked.
4. Throttles—MAX A/B.
   Set A/B power and check for correct fuel flow and nozzle position.
5. Spike switches—AUTO.

DURING ACCELERATION. (DSO READS)

During the acceleration to supersonic speed, make the following checks:

1. Warning and caution lamps—Out.
2. Monitor elevator control available.
   Monitor the elevator available indicator during the acceleration. Refer to "Longitudinal Flight Characteristics," Section VI, for typical variation of elevator control available with change in Mach number.
3. Monitor turn-and-slip indicator.
   Keep the ball centered with the rudder trim switch to prevent asymmetrical fuel shifting during acceleration.
4. Fuel configuration—Checked.
5. Monitor ram air temperature.
   Monitor ram air temperature within limits. Monitor engine rpm T2 reset for proper operation versus ram air temperature. Engine rpm will increase to approximately 103.5%.

CONTINUED

DURING ACCELERATION (CONTINUED)

CAUTION

If T2 rpm reset does not occur at appropriate ram air temperature, the compressor stall margin is reduced and severe compressor stall and possible flameout of the engine may occur.

6. Power setting—Stabilized.

   Stabilize power setting when desired Mach number is reached.
7. CG selector knob—Set.

   Select desired cg location for supersonic flight.
8. CG indicator—Checked.

   If automatic cg control is used, monitor indicator to insure that cg location shifts to approximate selected value. If manual cg control is used, return manual cg shift switch to OFF when desired cg location is obtained.

DECELERATION. (DSO READS)

For deceleration to subsonic speed, accomplish the following checks.

1. Throttles—Set.

CAUTION

Do not reduce power to idle at Mach 1.8 or above if ram air temperature is not high enough to have caused T2 reset, as the low rpm will cause inlet buzz.

2. CG selector knob—Set.

   Select desired cg for deceleration. Subsonic cg location normally should be obtained before decelerating below M1.2.
3. CG indicator—Checked.

   If automatic cg control is used, monitor indicator to insure that cg location shifts to approximate selected value. If manual cg control is used, return manual cg shift switch to OFF when desired cg location is obtained.
4. Fuel system configuration—Checked.

   Position the knobs and switches on the fuel control panel according to the fuel management schedule for deceleration.
5. Warning and caution lamps—Out.
6. Monitor elevator control available.

   Monitor the elevator control available indicator during the deceleration. Refer to "Longitudinal Flight Characteristics," Section VI, for typical variation of elevator control available with change in Mach number.

AIR REFUELING.

For the amplified check list of the air refueling procedures refer to "Air Refueling System," Section IV. The condensed portion of these procedures are covered in the "Pilot's Condensed Check List."

DESCENT. (DSO READS)

The following procedure is recommended as the best method for accomplishing jet penetrations at most gross weight possibilities. In determining the procedure, consideration was given to stability, fuel availability, environmental control, and range capabilities. Refer to Appendix I for descent time and fuel consumption. Accomplish the following procedure prior to penetration:

1. Altimeter—Reset at flight level 240
   Reset altimeter to correct barometric setting while descending through flight level 240.
2. Autopilot switches—OFF.
3. Spike switches—IN.
4. Antiskid switch—ON. 35 ➧
5. Fuel system configuration—Checked.
   Position the knobs and switches on the fuel control panel according to the fuel management schedule.
6. Anti-ice, rain removal, defog, and pitot heat switches—Climatic.
   Position these switches as required for existing weather conditions.
7. Warning and caution lamps—Checked.
8. Landing Data Card—Computed; flare speed ...... knots, stopping distance ...... feet. (DSO)
   Check gross weight and cg and complete the Landing Data Card. Advise fuel transfer as necessary for landing.
9. Aileron available switch—AUTO.
   Check that aileron control available switch is in the AUTO position and that aileron control available indicator reads FULL when airplane speed is below Mach 0.6.
10. Elevator available mode switch—TO & LAND.
    Check that the elevator control available mode selector switch is in the TO & LAND position. Check that the elevator control available indicator shows approximately 20 degrees.

WARNING

Unless the elevator control available mode selector switch is in the TO & LAND position, maximum elevator control may not be available for landing.

11. Landing gear handle—DOWN.
    Lower gear below 300 knots. Check that landing gear warning lamp goes out and that indicators show the gear down and locked.
12. Hydraulic pressure and quantities—Checked.
13. Brake pedals—Depressed.
    Depress pedals one at a time and check for proper brake feel. With each pedal depression, observe utility hydraulic pressure gage for momentary drop in pressure of approximately 100 psi.

BEFORE LANDING (SHORT). (DSO READS)

This check will be used when accomplishing a GCA, ILS or landing following a jet penetration.

1. Parachute zero delay lanyard—Connected. (P-N-DSO)
   Connect parachute zero delay lanyard to ripcord D-ring prior to reaching minimum safe ejection altitude. This provides "one-and-zero" escape capability during approach and landing.
2. Navigator and DSO—Ready for landing. (N-DSO)

BEFORE LANDING. (DSO READS)

The following procedures should be accomplished prior to entering the traffic pattern:

1. Altimeter—Reset at flight level 240.

   Reset altimeter to correct barometric setting while descending through flight level 240.
2. Landing data card—Computed; flare speed ...... knots, stopping distance ...... feet. (DSO)

   Check gross weight and cg and the Landing Data Card. Advise fuel transfer as necessary for landing.
3. Spike switches—IN.
4. Antiskid switch—ON. 35
5. Fuel system configuration—Checked.

   Position controls according to fuel management schedule.
6. Warning and caution lamps—Checked.
7. Aileron available switch—AUTO.

   Check that aileron control available switch is in the AUTO position and that aileron control available indicator reads FULL when airplane speed is below Mach No. 0.6.
8. Elevator available mode switch—TO & LAND.

   Check that the elevator control available mode selector switch is in the TO & LAND position. Check that the elevator control available indicator shows approximately 20 degrees.

WARNING

Unless the elevator control available mode selector switch is in the TO & LAND position, maximum elevator control may not be available for landing.

9. Landing gear handle—DOWN.

   Lower gear below 300 knots. Check that warning lamp goes out and that indicators show gear down and locked.
10. Hydraulic pressure and quantities—Checked.
11. Brake pedals—Depressed.

    Depress pedals, one at a time, and check for proper brake feel. With each pedal depression, observe utility hydraulic pressure gage for momentary drop in pressure of approximately 100 psi.
12. Parachute zero delay lanyard—Connected. (P-N-DSO)

    Connect parachute zero delay lanyard to ripcord D-ring prior to reaching minimum safe ejection altitude. This provides "one-and-zero" escape capability during approach and landing.
13. Navigator and DSO—Ready for landing. (N-DSO)

    When approaching the traffic pattern, decelerate to pattern entry airspeed and altitude and set pattern entry power. A typical normal traffic pattern is shown in figure 2-8. Maintain listed airspeed and power settings throughout the pattern. Airspeed-power combinations for various gross weights are computed to maintain altitude and provide maximum pilot visibility.

LANDING.

The flight characteristics of this airplane during landing are conventional for tricycle gear aircraft. Generally, airplane touchdowns will be performed at 14 degrees wing angle of attack. Excessively high angles of attack must be avoided prior to flare. The delta wing does not stall at angles of attack normally attainable in flight.

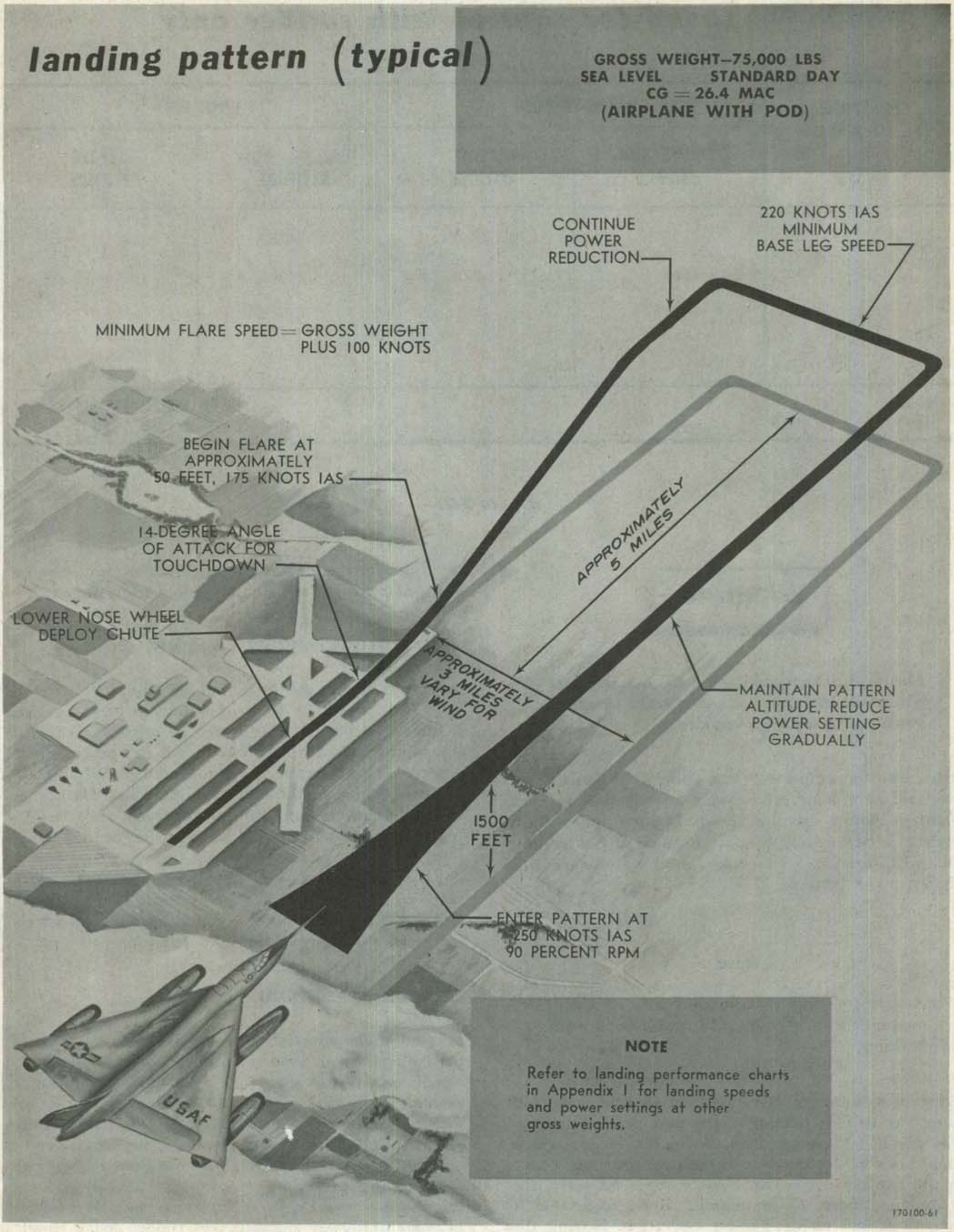
landing pattern (typical)
GROSS WEIGHT–75,000 LBS
SEA LEVEL STANDARD DAY
CG = 26.4 MAC
(AIRPLANE WITH POD)
CONTINUE POWER REDUCTION
220 KNOTS IAS MINIMUM BASE LEG SPEED
MINIMUM FLARE SPEED = GROSS WEIGHT PLUS 100 KNOTS
BEGIN FLARE AT APPROXIMATELY 50 FEET, 175 KNOTS IAS
14-DEGREE ANGLE OF ATTACK FOR TOUCHDOWN
LOWER NOSE WHEEL DEPLOY CHUTE
APPROXIMATELY 5 MILES
APPROXIMATELY 3 MILES VARY FOR WIND
MAINTAIN PATTERN ALTITUDE, REDUCE POWER SETTING GRADUALLY
1500 FEET
ENTER PATTERN AT 250 KNOTS IAS 90 PERCENT RPM
USAF
NOTE
Refer to landing performance charts in Appendix I for landing speeds and power settings at other gross weights.
170100-61

Figure 2-8.

minimum airspeed for control with rudder only

CROSSWIND 90° TO RUNWAY KNOTS	WITHOUT POD		WITH POD	
	GROUND RUN ATTITUDE	TAKEOFF ATTITUDE	GROUND RUN ATTITUDE	TAKEOFF ATTITUDE
10	32 KNOTS	60 KNOTS	15 KNOTS	47 KNOTS
20	68 KNOTS	112 KNOTS	43 KNOTS	92 KNOTS
30	98 KNOTS	152 KNOTS	64 KNOTS	135 KNOTS
40	135 KNOTS	195 KNOTS	86 KNOTS	182 KNOTS

NOTE:
Zero Nose Gear Side load.

DATA BASIS: ESTIMATES
DATE: 3 JUNE 1958

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Figure 2-9.

WARNING

Abrupt throttle chop during the landing flare will result in a rapid rate of descent at touchdown and should be avoided.

After landing, ample elevator control is available to maintain nose-high ground-run attitudes to at least 40 knots below landing speed. Maintaining a high angle of attack during the initial phase of the landing roll will provide aerodynamic braking during this phase of the landing.

Note

At airspeeds slightly below the landing speed, nose-up attitudes cannot be maintained with braking.

Prior to slowing to the speed where the nose will drop, a controlled settling of the nose gear to the runway should be accomplished. Normally the drag chute should not be deployed until the nose gear has settled to the runway. However, if it is deployed early, the attitude can be easily maintained. Refer to Section V for restrictions on drag chute operation. During the landing roll, after the nose wheel is in contact with the runway, the nose wheel steering system may be engaged provided the rudder pedals are centered.

HEAVY GROSS WEIGHT LANDING.

In the event that the gross weight cannot be reduced to 95,000 pounds or below, landings at gross weights in excess of 95,000 pounds are permissible provided the sinking speed limitations shown in Section V are observed. Power reduction should be carefully accomplished because of the increased inertia at the higher weights. The landing pattern, approach, and the airplane attitude will be the same as for normal landings. With the increased weight, the flare and touchdown speeds will be higher and and the landing distance will be longer. Refer to Appendix I for approach and landing performance. For braking precautions refer to "Brake Energy Limits," Section V.

CROSSWIND LANDING.

Because of the effective rudder area which is provided for control of asymmetric thrust, considerable directional control is available for crosswind landings. For extreme crosswind conditions and with aft center of gravity positions, where nose wheel steering is ineffectual, asymmetric thrust must be utilized. In making a crosswind landing, use the normal approach and landing procedures. However, after touchdown put the nosewheel on the runway as soon as possible in order to prevent sideskip. The rudder pedals should be centered prior to engaging nose wheel steering as the nose wheel will immediately position itself with the rudder pedals.

TOUCH-AND-GO LANDING.

Touch-and-go landings may be easily accomplished using normal techniques. Execute a normal touchdown, lower the nose, and add power. Except for heavy gross weights, military power will be adequate for the subsequent takeoff. The landing gear will normally be left down after a touch-and-go landing to insure adequate tire cooling.

LANDING ON SLIPPERY RUNWAYS.

Complete flight testing for landing on wet or icy runways has not yet been completed. Until further information is available, the following basic procedures are recommended.

Wet Runways.

When approaching to land on a wet runway, fly a rectangular traffic pattern and maintain normal pattern and approach speeds. For the same airplane gross weight, a landing on a wet runway will require approximately 30 percent more stopping distance than a landing on dry concrete. During the final approach, check anti-skid switch on (if installed). Touch down at the normal touchdown speed and keep the nose up in order to utilize aerodynamic braking. Deploy the drag chute and maintain directional control with rudder. Use brakes after the nosewheel is in contact with the runway. If anti-skid is not installed, use brakes intermittently to avoid skidding yawing. Employ nose gear steering when rudder becomes ineffective.

Icy Runways.

Operation of the aircraft on ice is hazardous and should be attempted only when the mission is of a nature that such operation is necessary. Under no condition should landings on icy runways be attempted unless the wind is within 10 degrees of runway heading. For the same airplane gross weight, a landing on an icy runway will require three times more stopping distance than a landing on dry concrete. Techniques for landing on icy runways are generally similar to those used for landing on wet runways. Even though the airplane is equipped with nose gear steering, caution must be exercised during a landing roll or during taxiing operations on ice. It is important that taxi speeds are kept to a minimum, since skidding may develop rapidly during taxi turns. The airplane should be fitted with ice grip tires prior to operation on ice.

Use of Brakes on Slippery Runways.

When landing on a wet or icy runway, the first 2000 feet of roll are the most critical in that the airplane has a "skimming" tendency until the lift of the wing has dissipated. If brakes are used during this period, they will tend to aggravate this condition, resulting in a severe yaw. It is virtualy impossible to determine

when one wheel has stopped rotating on a slippery runway. When brakes are used, they should be applied very lightly at first, and with equal pressure on each pedal. If the airplane starts to yaw, do not try to correct with asymmetric braking, but release both brakes, then use rudder and light braking after the airplane stabilizes. If an anti-skid system is installed, much more efficient braking may be accomplished, and the yawing tendency is reduced to a minimum. However, some shimmy may be evident during anti-skid operation on slippery runways, since the anti-skid cycles independently on each main gear.

GO-AROUND.

A go-around may be initiated at any point in the approach by advancing the throttles to military power and regaining pattern altitude and airspeed. Afterburners will ordinarily not be needed for a go-around unless the airplane is at a heavy gross weight. The landing gear should normally be left extended for the go-around unless fuel and thrust are critical. Regardless of engine rpm at the time go-around is initiated, power is available almost instantaneously because of the rapid acceleration time of the engines.

AFTER LANDING. (DSO READS)

While taxiing to the ramp, perform the following:

1. Drag chute—Jettisoned.

   After turning off the active runway, jettison the drag chute by turning the drag chute handle counterclockwise 90 degrees and pulling it further aft.
2. Hydraulic pressure—Checked.
3. Anti-ice, defog, rain removal, and pitot heat switches—Climatic.
4. Unnecessary electrical and electronic equipment—Off.

   De-energize all electrical and electronic equipment not required for taxiing and engine shutdown, in order to reduce air conditioning requirements.

ENGINE SHUTDOWN. (DSO READS)

After parking the airplane, perform the following:

Note

During engine shutdown the ground observer will be on interphone.

1. Parking brakes—Set.
2. Generator switches—OFF.
3. Throttles 1, 3, and 4—OFF.

   After operating engines 1, 3, and 4 at idle for 3-5 minutes (part or all of this time may occur while taxiing) shut each engine down in sequence by retarding throttle to OFF. Monitor engine temperatures and fire detector systems for possible residual fires during shutdown. Listen for abnormal noises during coastdowns.
4. Refrigeration unit selector—GRD CART.
5. No. 2 throttle—OFF.

Note

As a safety precaution, engine No. 2 is kept operating while the other engines are shut down. If a fire occurs during shutdown, compressed air from engine No. 2 may be required to motorize the burning engine in order to blow out the flame.

CONTINUED

ENGINE SHUTDOWN (CONTINUED)

6. Nose wheel chock and main landing gear tire safety shields—In place. (GO)

WARNING

If tire safety shields are not available, personnel must not approach the main gear wheels for at least 30 minutes after the airplane is parked. (Refer to figure 2-5.) A serious explosion hazard exists when the brakes, wheels, and tires are hot as a result of braking action during the landing roll.

7. Canopy seal lever—UNSEALED. (N)
8. Canopies—OPEN. (P-N-DSO)
   Place lever to OPEN and check that it latches up, then instruct navigator and DSO to open canopies.
9. Fuel system configuration:
   a. CG control switch—Guarded MANUAL.
   b. Fuel dump switch—NORM.
   c. All other fuel switches and controls—OFF or CLOSE.

BEFORE LEAVING AIRPLANE.

1. Ejection seat safety pins installed.
   Install safety pins at each handgrip and canopy jettison handle.
2. Canopy locks installed.
3. Oxygen system 100% and OFF.
4. All switches OFF.
   Check that all switches are OFF or positioned properly for leaving the airplane.

POSTFLIGHT.

1. Ground safety locks installed.
   Check for installation of landing gear ground safety locks.
2. Exterior inspection completed.
   The pilot will make a visual walkaround inspection of the airplane, checking for general condition and evidence of fuel, oil, or hydraulic leaks, structural damage, etc.
3. Form 781 completed.

CAUTION

In addition to the established requirements for reporting any system defects or unusual and excessive operations, the flight crew will also make entries in Form 781 to indicate when any limits in the Flight Manual have been exceeded.

CUT ON BLACK LINE

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PILOT'S CONDENSED CHECK LIST

AIRPLANE DESIGNATION CODES

31	59-2428	34	59-2431	37	59-2434
32	59-2429	35	59-2432	38	59-2435
33	59-2430	36	59-2433	➧	"through" or "and on"

Example: Information applicable to airplanes AF 59-2428 through AF 59-2430 would be coded 31 ➧ 33 . Information applicable to airplanes AF 59-2433 and on would be coded 36 ➧ .

PREFLIGHT CHECK.

BEFORE STATIONS INSPECTION.

1. Form 781—Check.
2. Landing gear ground safety locks, wheel chocks, static ground wires and fire extinguisher—In place.
3. Electrical, air conditioning, and starter carts and interphone—Connected.

STATIONS INSPECTION.

1. Equipment check:
   a. Professional kits—Check.
   b. Helmet and oxygen mask—Check.
   c. Life vest (when carried)—Check.

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d. Flashlight (explosion-proof)—Check.
e. Proper clothing—Check.
f. Identification tags and dosimeter—Check.

2. Time hack—Completed.
3. Form 781—Review.
4. Emergency procedures briefing:
   a. Fire and smoke in pressurized compartment—Brief.
   b. Crash landing—Brief.
   c. Bailout—Brief.
   d. Substitute crew member—Brief.
5. Oxygen discipline—Brief.
6. Preflight instructions—Brief.
7. Time to board airplane—Brief.

POWER-OFF INTERIOR INSPECTION.

1. Canopy lock—Installed.
2. Ejection seat safety pins (3)—Installed.
3. Canopy actuator and seal—Check.
4. Liquid container—Check.
5. Exterior emergency canopy jettison access door—Secure.
6. CG calibrator—Check.
7. Relief container—Empty.
8. Ejection seat, survival kit and parachute—Check.
9. Map and data case—Check.
10. External power switch—OFF.
11. Battery switch—OFF.
12. Escape rope—Check.
13. Flight control power switch—OFF.

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14. Boom latch switch—OFF.
15. Engine start switches—OFF.
16. Gain selector switch—AUTO.
17. Aileron available switch—AUTO.
18. Elevator available mode switch—TO & LAND.
19. Canopy control lever—OPEN.
20. SIF—Set.
21. IFF master control—OFF.
22. UHF command radio—OFF.
23. Mask defog—OFF.
24. VHF-NAV power switch—OFF.
25. Emergency elevator available handle—In.
26. Emergency brake and landing gear handle—In.
27. Throttles—OFF.
28. Taxi and landing lights—OFF.
29. Landing gear handle—DOWN.
30. Drag chute handle—In and horizontal.
31. Fire pull switches—In.
32. CG selector—Set.
33. CG control switch—Guarded MANUAL.
34. Manual cg shift switch—Guarded OFF.
35. Air refueling door switch—CLOSE.
36. Reservoir booster pumps—OFF.
37. Fuel dump—NORMAL.
38. Reservoir to manifold switches—CLOSE.
39. All other fuel switches—OFF, CLOSE or NORMAL.
40. IFR emergency hydraulic boost—OFF.
41. Pitot heat switch—OFF.
42. Engine anti-ice switch—OFF.

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43. Rain removal switch—OFF.
44. Air source selector—BOTH.
45. Refrigeration unit selector—GRD CART.
46. Air conditioning control mode selector—OFF.
47. Cabin temperature control—3 o'clock.
48. Cabin pressure selector—NORMAL.
49. Pod & DECM power switches—OFF.
50. Generator control switches—OFF.
51. Pod release switch—OFF.

POWER-ON INTERIOR INSPECTION.

1. Essential d-c power:
   a. Battery switch—EMERGENCY.
   b. Battery discharging lamp—On.
   c. Interphone—Check.
   d. Alert and bailout warning system—Check.
   e. Air ignition—Check.
   f. Battery switch—ON.
   g. Battery discharging lamp—On.
2. Ground air conditioning—Operating.
3. A-C power—EXT POWER or GROUND MAINT, and check.
4. Emergency ram air scoop—Check.
5. UHF command radio—BOTH.
6. Oxygen and interphone—On call, on normal, oxygen check complete. (P-N-DSO)
7. High voltage d-c power—Checked. (DSO)
8. Notify navigator and DSO that normal power is available.
9. Seats and pedals—Adjust.
10. Spikes—Check.
11. UHF command radio and VHF-NAV equipment—Check, and OFF.
12. Malfunction and indicator lights—Check.

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13. Landing gear position indicator lamps—On.
14. Ram air temperature indicator—Climatic.
15. Flight instruments—Checked.
16. Fuel quantity totalizer and total fuel flow indicators—Check.
17. Accelerometer—Reset.
18. Engine fire detection circuit—Check.
19. Fuel system:
    a. Fuel quantity indicators—Check.
    b. Reservoir booster pump—NORM.
    c. Reservoir to manifold switches—NORMAL.
    d. Forward tank to engine supply—ON.
    e. CG control switch—AUTO.
    f. CG selector set knob—Forward transfer.
    g. CG selector set knob—Aft transfer.
    h. CG selector set knob—Reset, lamp out.
    i. CG control switch—MANUAL.
    j. Aft tank to Engine supply—ON.
    k. Manual cg shift switch—FWD.
    l. Manual cg shift switch—OFF.
    m. Manual cg shift switch—AFT.
    n. Manual cg shift switch—OFF.
    o. Forward tank to engine supply—OFF.
    p. Forward tank refuel-scavenge knob—SCAV, then OFF.
    q. Balance tank refuel-scavenge knob—SCAV, then OFF.
    r. Aft tank to engine supply—OFF.

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20. Pitot heat—Check, then OFF.
21. Hydraulic pressure and quantity—Check.
22. Interior and exterior lights—Check.

EXTERIOR INSPECTION.

A. Upper Fuselage and Wing Area.

1. Windshield and windows for condition (cleanliness, cracks, etc.).
2. Windshield rain removal nozzle clear.
3. Stable table area for fuel leaks, security of cooling ducts, and general condition.
4. Astrodome for cleanliness, cracks, and scratches.
5. Fuel tank caps (3) for security and leakage.

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6. Fuel system maintenance test buttons (6) flush.
7. Upper fuselage and wing surface panels.

B. Right Side.

1. Nose wheel well door.
2. Fuselage skin panels.
3. Static ports clear.
4. Wing leading edge.
5. Pod pitot tube fully retracted.
6. Pod pylon for fit and condition.
7. Warhead drag pin flush.
8. Pod exterior for fuel leaks and condition.
9. PCLA area:
   a. Accumulator pressures (1500 psi at 70°F).
   b. Fuses secure.
   c. Reset the T-handles.
   d. General condition.
10. Radomes for security and fluid seepage.
11. Drag chute compartment doors secure and overcenter pin flush.
12. Drag chute pneumatic pressure gage (2550 psi at 70°F).
13. Inboard elevon actuator area for leakage.
14. Wing lower surface.

C. Right Gear and Wheel Well.

1. Wheels, tires, and brakes for general condition.
2. Strut for condition and proper extension (as placarded).
3. Gear scissors and uplock roller assembly for condition.
4. Landing gear positioning spring pressure gage (1500 psi at 70°F).
5. Fuel system static ports clear.

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CUT ON BLACK LINE

6. Canopy pneumatic system pressure gage (2555 psi at 70°F).
7. Gear hydraulic actuators for condition.
8. Air conditioning water tank filler cap secure.
9. Fuel and hydraulic lines for condition and leakage.
10. Electrical harness for condition.
11. Landing gear and door mechanism; door lock latch for condition.

D. No. 3 Engine and Nacelle Area.

1. Afterburner nozzle for condition.
2. Inside tailpipe for fuel accumulation.
3. Pilot burner for condition.
4. Flame holders for cracks.
5. Turbine wheel for condition.
6. Inboard and lower nacelle panels.
7. Fire access and nacelle cooler door open.
8. Engine nose cowling and spike for damage.
9. Spike secure and retracted, and anti-ice cone closed.
10. Air inlet opening for foreign materials.
11. Static ports (4) clear.
12. Inlet guide vanes for condition.
13. Fire access and nacelle cooler door open.
14. Oil tank filler cap access door secure.
15. Outboard nacelle panels.
16. Wing leading edge and lower surface.
17. Outboard elevon actuator area for leakage.

E. No. 4 Engine and Nacelle Area.

1. Repeat the same check as for No. 3 engine and nacelle area.

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CUT ON BLACK LINE

F. Right Wing Trailing Edge.

1. Wing tip condition.
2. Wing and elevon trailing edge.

G. Tail Area.

1. Turret and radome checked, safety pin removed, and safety switch flush.
2. Empennage exterior surfaces.
3. Fuel dump cap flush with fuselage.

H. Left Wing Trailing Edge.

1. Wing and elevon trailing edge.
2. Wing tip condition.

I. No. 1 Engine and Nacelle Area.

1. Afterburner nozzle for condition.
2. Inside tailpipe for fuel accumulation.
3. Pilot burner for condition.
4. Flame holders for cracks.
5. Turbine wheel for condition.
6. Outboard and lower nacelle panels.
7. Fire access and nacelle cooler door open.
8. Engine nose cowling and spike for damage.
9. Spike secure and retracted, and anti-ice cone closed.
10. Air inlet opening for foreign materials.
11. Static ports (4) clear.
12. Inlet guide vanes for condition.
13. Fire access and nacelle cooler door open.
14. Oil tank filler cap access door secure.

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CUT ON BLACK LINE

15. Inboard nacelle panels.
16. Wing leading edge and lower surface.
17. Outboard elevon actuator area for leakage.

J. No. 2 Engine and Nacelle Area.

1. Repeat the same check as for No. 1 engine and nacelle area.

K. Left Gear and Wheel Well.

1. Wheels, tires, and brakes for general condition.
2. Strut for condition and proper extension (as placarded).
3. Gear scissors and uplock roller assembly for condition.
4. Landing gear positioning spring pressure gage (1500 psi at 70°F).
5. Air conditioning water tank filler cap secure.
6. Landing gear emergency pneumatic system pressure gage (2555 psi at 70°F).
7. Brake hydraulic accumulator pressure gage (preload 500 psi at 70°F).
8. Brake emergency pneumatic system pressure gage (2555 psi at 70°F).
9. Reservoir isolation valve cap secure.
10. Gear hydraulic actuators for condition.
11. Parking brake pump handle secure.
12. Fuel and hydraulic lines for condition and leakage.
13. Electrical harness for condition.
14. Landing gear and door mechanism; door lock latch for condition.

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L. Left Side.

1. Inboard elevon actuators for leakage.
2. Wing lower surface.
3. PCLA access panel installed.
4. Pod exterior for fuel leaks and condition.
5. Pod safety lockpin flush.
6. Pod pneumatic bottle pressure (2) (2550 ±200 psi).
7. Pod arm-safe selector as required.
8. Warhead drag pin flush.
9. Pod pylon for fit and condition.
10. Wing leading edge.
11. Fuselage skin panels.
12. Exterior emergency canopy jettison access doors (3) secure.
13. Nose wheel well door.

M. Nose Gear and Wheel Well.

1. Tires and wheels for general condition.
2. Nose strut for proper extension (as placarded).
3. Gear scissors quick-disconnect lockpin installed and safetied.
4. Steering safety switch actuator retainer in place.
5. Landing and taxi lights.
6. Gear actuators and lock cylinders for leakage.
7. Oxygen filler valve covers (2) secure.
8. Oxygen drain valves (2) closed.
9. Oxygen containers (2) and plumbing for security and leakage.
10. Search radar flexible waveguide for condition and security.
11. Single-point refueling adapter cover secure.
12. Pitot-static system water drain caps secure.

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13. Pilot's canopy override lever safety-wired OFF.
14. Canopy control lever latched in UP position.
15. Canopy seal control lever OFF.
16. Electrical harness for condition.

N. Nose.

1. Outside air temperature pickup guard removed.
2. Radome condition, and drain hole clear.
3. Pitot mast tube and static ports.

O. Upper Fuselage and Pilot's Station.

1. Stable table access panels installed.
2. Fuel booster pumps OFF.

BEFORE STARTING ENGINES. (DSO READS)

1. UHF command radio—BOTH.
2. Personal gear—Survival kit attached; safety belt, shoulder harness, safety belt tie-down strap, arm restraints, and both parachute lanyards connected. (P-N-DSO)
3. Mask, bailout bottle, and mike cord—Oxygen hose and mike cord connected. (P-N-DSO)
4. Oxygen—Oxygen check complete. (P-N-DSO)
5. Ejection seat and initiator safety pins—Removed and stowed. (P-N-DSO)
6. Flight control power switch—ON.
7. Damper switches—ON.
8. IFF master control—STDBY.
9. Air conditioning mode selector knob—AUTO.
10. Radio call—Completed.
11. Altimeter—Set.
12. Canopies—Closed and latching indicator flags checked. (N-DSO)

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13. Canopy unlock caution lamp—Out.
14. Canopy seal lever—SEALED. (N)
15. Ground observer and fire guards—Posted. (GO)
16. Ground area—Clear to start engines. (GO)

STARTING ENGINES. (DSO READS)

1. Parking brakes—Set.
2. Throttles—OFF.
3. Reservoir booster pumps—NORM.
4. Aft tank booster pumps—ON.
5. External starter air—Supplied. (GO)
6. No. 2 throttle—IDLE.
7. No. 2 engine start switch—GROUND.
8. Engine start switch—OFF at 47 percent rpm.
9. Engine instruments—Within limits.
10. Utility hydraulic system—Pressure checked; No. 2 pump lamp out.
11. Generator No. 2—Excited and checked.
12. Air refueling system:

Note

Items marked with an asterisk (*) may be omitted on flights where air refueling is not scheduled.

a. Air refueling door—OPEN.
b. Air refueling ready lamp—On.
*c. Test probe—Inserted. (GO)

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*d. Air refueling ready lamp—Out.
*e. Toggles—Engaged. (GO)
*f. IFR disconnect button—Depressed.
*g. Toggles—Released. (GO)
*h. Test probe—Removed. (GO)
i. EBL switch—EBL.
*j. Toggles—Engaged. (GO)
*k. IFR disconnect button—Depressed.
*l. Toggles—Released. (GO)
m. Boom latch switch—OFF.
*n. Slipway lights and condition—Checked. (GO)
o. Air refueling door—CLOSE.

13. No. 1 engine—Start.
14. No. 1 hydraulic pump low pressure caution lamp—Out.
15. Generator No. 1—Excited and checked.
16. No. 3 engine—Start.
17. Primary hydraulic system—Pressure checked; No. 3 pump lamp out.
18. Generator No. 3—Excited and checked.
19. No. 4 engine—Start.
20. No. 4 hydraulic pump low pressure caution lamp—Out.

CLEARING AN ENGINE.

1. Throttle—OFF.
2. Engine start switch—GROUND.
3. Engine start switch—OFF.

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CUT ON BLACK LINE

BEFORE TAXIING. (DSO READS)

1. Electrical system:
   a. No. 1 generator switch—GEN 1.
   b. External power switch—OFF.
   c. Pod and DECM switch—RESET, then NORMAL.
   d. External power switch—EXT POWER 31 ▶ 34 or GRD MAINT 35 ▶.
   e. No. 3 generator switch—GEN 3.
   f. No. 2 generator switch—GEN 2.
   g. No. 1 generator switch—OFF.
   h. No. 3 generator switch—OFF.
   i. No. 3 generator switch—GEN 3.
   j. No. 1 generator switch—GEN 1.
   k. External power switch—OFF.
   l. Voltage and frequencies—Checked.
   m. D-C voltages—Checked. (DSO)
2. Air conditioning system:
   a. Ground air conditioning cart—Off. (Go)
   b. Refrigeration unit selector—BOTH.
   c. Flow switch—RESET TO NORMAL then release.
   d. Cabin altimeter—Checked.
   e. Refrigeration unit selector—BOTH, L, R, then BOTH.
   f. Rain removal switch—REMOVE, then OFF.
   g. Windshield defog switch—INC, DEC, then HOLD.
3. Air conditioning, starter air, and electrical power carts—Disconnected. (GO)

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4. Flight control system:
   a. Flight controls—Checked freedom.
   b. Rudder trim—Checked.
   c. Elevator trim—Checked.
   d. Aileron trim—Checked.
   e. Elevator control available check:
      (1) Elevator available mode switch—AUTO.
      (2) Force link—Override.
      (3) Elevator available mode switch—MANUAL.
      (4) Elevator manual adjust switch—DECREASE.
      (5) Force link—Override.
      (6) Elevator available—Full (20 degrees).
      (7) Elevator position—3 degrees up.
   f. Control system:
      (1) Elevators—Checked.
      (2) Ailerons—Checked.
      (3) Yaw damper—Checked.
      (4) Pitch damper—Checked.
      (5) Roll damper—Checked.
      (6) Rudder—Checked.
      (7) Elevator—Trimmed zero.
5. Ground safety locks—Removed. (GO)
6. Primary and utility hydraulic reservoir indicators—Checked. (GO)
7. Antiskid switch—ON. 35
8. Ground safety locks—Removed and in sight.
9. Remove ground static wire, chocks, and interphone—Removed. (GO)
10. Anti-collision and navigation lights—As required.
11. Navigator and DSO—Ready for taxi. (N-DSO)

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CUT ON BLACK LINE

TAXIING. (DSO READS)

1. Brakes—Checked.
2. Nose wheel steering—Checked.
3. Turn-and-slip, RMI, and attitude indicator—Checked.
4. Hydraulic pressure and quantity—Checked.
5. Navigator and DSO fuse panels—Checked. (N-DSO)
6. D-C voltages—Checked. (DSO)

BEFORE LINEUP. (DSO READS)

1. Parking brakes—Set.
2. IFF master control—NORM.
3. Aileron available switch—AUTO.
4. Elevator available mode switch—TO & LAND.
5. Trim selector switch—CONT STICK.
6. Elevator control available—Approximately 20 degrees.
7. Flight controls—Checked free.
8. Instruments—Checked and set.
9. Fuel system:
   a. Pod fuel transfer—Checked.
   b. Fuel panel—Configuration set and reported.
10. Generator configuration—Checked.
11. Anti-ice, defog, rain removal, and pitot heat—Climatic.
12. Warning and caution lamps—Out.
13. Takeoff data—Reviewed.
14. Navigator and DSO—Ready for takeoff. (N-DSO)

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CUT ON BLACK LINE

TAKEOFF. (DSO READS)

1. Landing lights—As required.
2. Throttles—MIL.
3. Instruments—Checked.
4. Throttles—MIN A/B.
5. Nose gear steering button—Depressed.
6. Brakes—Released.
7. Throttles—MAX A/B.
8. Decision speed—Checked.

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TAKEOFF DATA CARD

Runway Length__________ Field PA__________

Wind__________ Gross Weight__________

OAT__________ CG__________

Critical Field Length__________

PLANNING DATA

EPR at Mil. Pwr__________ Nozzle Position__________

Takeoff Pwr Setting__________ Fuel Flow__________

TAKEOFF

Go-No-Go Marker__________ Takeoff Distance__________

Go-No-Go Speed__________ Takeoff Speed__________

4-Eng Climb Speed__________ 3-Eng Climb Speed__________

LANDING IMMEDIATELY AFTER TAKEOFF

Amount of Fuel to Dump__________ CG__________

Flare Speed__________ Touchdown Speed__________

Maximum Brake Speed__________ Ground Roll__________
(Wheel brakes only—no chute)

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AFTER TAKEOFF. (DSO READS)

1. Wheels—Braked.
2. Landing gear handle—UP.
3. Engine instruments—Checked.
4. Warning and caution lamps—Checked.
5. Landing gear handle—PRESS REL.
6. Hydraulic pressure and quantity—Checked.
7. Throttles—MIL.
8. Parachute zero-delay lanyard—Disconnected and stowed. (P-N-DSO)
9. Elevator available mode switch—AUTO.
10. Oxygen and station check—Completed. (P-N-DSO)
11. Altimeter—Reset at 23,500 feet.

BEFORE ACCELERATION. (DSO READS)

1. Fuel system configuration—Checked.
2. CG indicator—Checked.
3. Hydraulic pressure and quantity—Checked.
4. Throttle—MAX A/B.
5. Spike switches—AUTO.

DURING ACCELERATION. (DSO READS)

1. Warning and caution lamps—Out.
2. Monitor elevator control available.
3. Monitor turn-and-slip indicator.
4. Fuel configuration—Checked.
5. Monitor ram air temperature.
6. Power setting—Stabilized.

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7. CG selector knob—Set.
8. CG indicator—Checked.

DECELERATION. (DSO READS)

1. Throttles—Set.
2. CG selector knob—Set.
3. CG indicator—Checked.
4. Fuel system configuration—Checked.
5. Warning and caution lamps—Out.
6. Monitor elevator control available.

AIR REFUELING.

PREPARATION FOR CONTACT.

1. Fuel panel configuration—Check.
2. Boom latch control switch—OFF.
3. Air refueling door switch—OPEN.
4. Air refueling ready lamp—Lighted.
5. Elevator available mode switch—MANUAL.

CONTACT.

1. Ready lamp—Out.

AFTER AIR REFUELING.

1. Air refueling door switch—CLOSE.
2. Fuel panel configuration—Check.
3. Elevator available mode switch—AUTO.
4. CG—Check as required.

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DESCENT.

1. Altimeter—Reset at flight level 240.
2. Autopilot switches—OFF.
3. Spike switches—IN.
4. Antiskid switch—ON. 35 ➧
5. Fuel system configuration—Checked.
6. Anti-ice, rain removal, defog, and pitot heat switches—Climatic.
7. Warning and caution lamps—Checked.
8. Landing data card—Computed; flare speed............knots, stopping distance...........feet. (DSO)
9. Aileron available switch—AUTO.
10. Elevator available mode switch—TO & LAND.
11. Landing gear handle—DOWN.
12. Hydraulic pressure and quantities—Checked.
13. Brake pedals—Depressed.

BEFORE LANDING (SHORT). (DSO READS)

1. Parachute zero-delay lanyard—Connected. (P-N-DSO)
2. Navigator and DSO—Ready for landing. (N-DSO)

BEFORE LANDING. (DSO READS)

1. Altimeter—Reset at flight level 240.
2. Landing data card—Computed; flare speed............knots, stopping distance...........feet. (DSO)
3. Spike switches—IN.
4. Antiskid switch—ON. 35 ➧

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5. Fuel system configuration—Checked.
6. Warning and caution lamps—Checked.
7. Aileron available switch—AUTO.
8. Elevator available mode switch—TO & LAND.
9. Landing gear handle—DOWN.
10. Hydraulic pressure and quantities—Checked.
11. Brake pedals—Depressed.
12. Parachute zero-delay lanyard—Connected. (P-N-DSO)
13. Navigator and DSO—Ready for landing. (N-DSO)

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CUT ON BLACK LINE

B/RB-58A

LANDING DATA CARD

CONDITIONS

Runway Length__________ Field PA__________

Wind__________ Gross Weight__________

OAT__________ Static Margin__________

LANDING

Pattern Speed__________

Flare Speed__________
(50 ft. altitude)

Flare Distance__________
(From 50 ft. altitude to T.D.)

Touchdown Speed__________

Ground Roll__________
(Wheel brakes only—no chute)

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AFTER LANDING. (DSO READS)

1. Drag chute—Jettisoned.
2. Hydraulic pressure—Checked.
3. Anti-ice, defog, rain removal, and pitot heat switches—Climatic.
4. Unnecessary electrical and electronic equipment—Off.

ENGINE SHUTDOWN. (DSO READS)

1. Parking brakes—Set.
2. Generator switches—OFF.
3. Throttles 1, 3, and 4—OFF.
4. Refrigeration unit selector—GRD CART.
5. No. 2 throttle—OFF.
6. Nose-wheel chock and main landing gear tire safety shields—In place. (GO)
7. Canopy seal lever—UNSEALED. (N)
8. Canopies—OPEN. (P-N-DSO)
9. Fuel system configuration:
   a. CG control switch—Guarded MANUAL.
   b. Fuel dump switch—NORM.
   c. All other fuel switches and controls—OFF or CLOSE.

BEFORE LEAVING AIRPLANE.

1. Ejection seat safety pins installed.
2. Canopy locks installed.
3. Oxygen system 100 percent and OFF.
4. All switches OFF.

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POSTFLIGHT.

1. Ground safety locks installed.
2. Exterior inspection completed.
3. Form 781 completed.

section III emergency procedures

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ENGINE FAILURE.

An engine failure can usually be determined by observing the engine instruments for a radical change in exhaust gas temperature and a loss in rpm. In case of a malfunction due to material failure (bearing failure, turbine bucket and compressor vane failure, rotor imbalance, stator and rotor friction, etc.) the above indication may be accompanied by noticeable vibration. The yawing maneuver resulting from engine failure may be gradual, moderate, or abrupt depending upon the rate of thrust loss and the number of engines malfunctioning and their location.

FLIGHT CHARACTERISTICS WITH PARTIAL POWER.

Engine Failure During Takeoff.

Engine failure during the takeoff run can be critical and should be considered and planned for prior to the time the takeoff run is started. For many gross weight and takeoff conditions, refusal speed is greater than the takeoff speed. If any speed above the refusal speed is obtained, the airplane is committed to takeoff. Refer to Appendix I for charts covering data on refusal speed and reduced thrust takeoff performance. Minimum airspeeds for control of asymmetric thrust with rudder only are indicated in figure 3-1. In the most critical condition, when the minimum speed for control with rudder only is greater than refusal speed, additional directional control is best obtained through a slight reduction of power on the outboard engine opposite the failed engine.

Engine Failure During Cruise.

Adequate rudder and aileron control are available to maintain straight and level flight throughout the cruise range with one or two engines inoperative on one side.

directional control of asymmetric thrust for takeoff

ASYMMETRIC THRUST CONDITIONS				MINIMUM AIRSPEED FOR CONTROL USING RUDDER ONLY – ZERO SIDESLIP	
ENGINE NO. 1	ENGINE NO. 2	ENGINE NO. 3	ENGINE NO. 4	GROUND RUN ATTITUDE	TAKEOFF ATTITUDE
INOPERATIVE	MAX A/B	MAX A/B	MAX A/B	169 KNOTS	154 KNOTS
INOPERATIVE	MILITARY	MILITARY	MILITARY	132 KNOTS	121 KNOTS
MILITARY	MAX A/B	MAX A/B	MAX A/B	103 KNOTS	95 KNOTS
MAX A/B	INOPERATIVE	MAX A/B	MAX A/B	129 KNOTS	116 KNOTS
MILITARY	INOPERATIVE	MILITARY	MILITARY	99 KNOTS	90 KNOTS
MAX A/B	MILITARY	MAX A/B	MAX A/B	78 KNOTS	70 KNOTS
INOPERATIVE	INOPERATIVE	MAX A/B	MAX A/B	211 KNOTS	192 KNOTS
INOPERATIVE	INOPERATIVE	MILITARY	MILITARY	166 KNOTS	149 KNOTS
MILITARY	MILITARY	MAX A/B	MAX A/B	130 KNOTS	119 KNOTS

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Figure 3-1.

WARNING

If two engines on the same side are inoperative, one of the independent hydraulic control systems will not function. If the left engines are inoperative, the utility hydraulic system will be out with consequent loss of roll and pitch dampers.

Engine Failure at Supersonic Speed.

Instantaneous loss of thrust from an outboard engine at the lower altitudes and highest speed flight conditions will result in large excursions in yaw and roll. The recommended pilot technique in this event is to keep the wings level with aileron, to retard throttles to military power, and to apply rudder after the initial yaw oscillation.

WARNING

In the event of sudden engine failure, the airplane cg must be closely monitored with regard to operational limits. Refer to "Center of Gravity Limitations," Section V.

The aft center of gravity limits are established to provide protection without pilot rudder response or with rudder response expected by inadvertent pilot reaction.

Large rudder deflections to reduce initial yaw peaks should not be attempted since they are not required and may increase the tail load developed if applied at the wrong time.

WARNING

In the event of sudden engine failure, airplane control and structural integrity are dependent upon roll and yaw damper operation. Observe flight limitations with roll and yaw damper malfunctions. Refer to "Miscellaneous Operational Limitations," Section V.

Reduction in power on one or two engines at the dash speed will result in loss of airspeed or altitude. Except at the highest speed, a straight ground track can be maintained with wings level. Under high speed conditions, utilize a shallow bank angle to hold a straight ground track during deceleration.

ENGINE FAILURE DURING TAKEOFF, TAKEOFF REFUSED.

If engine failure occurs at or before refusal speed, accomplish the following procedures and alert the crew:

1. Accomplish abort procedure.

Refer to "Takeoff and Landing Emergencies" of this section for the abort procedure.

2. Affected engine throttle—OFF.

3. Fire pull switch of affected engine—Pull, if required.

ENGINE FAILURE DURING TAKEOFF, TAKEOFF CONTINUED.

If engine failure occurs above refusal speed, hold all landing gear on the runway and utilize all possible runway length for obtaining maximum speed and for maintaining nose steering capabilities. Under some conditions it may be necessary to maintain directional control with nose steering at slightly above refusal speeds due to the effects of asymmetric thrust. However, directional control with rudder will be adequate before reaching unstick speed and will be enhanced when the airplane assumes the takeoff attitude. The loss of one generator-equipped engine will not reduce the airplane electrical power supply.

1. Landing gear handle—UP.

Retract the gear as soon as airborne.

2. Affected engine throttle—OFF.

After a safe operating altitude and/or airspeed is attained, retard the throttle of the inoperative engine to OFF.

3. Fire pull switch of affected engine—Pull, if required.

ENGINE SHUTDOWN DURING FLIGHT.

If it becomes necessary to shut down an engine during flight, proceed as follows:

1. Throttle of affected engine—OFF.

Note

In an emergency shutdown, the throttles on the malfunctioning engines may be retarded immediately to OFF from any quadrant position.

2. Affected generator control switch—OFF (if applicable).

If the affected engine drives a generator, place the generator control switch OFF to assure a steady power supply to the stable table.

Note

By monitoring the EGT, rpm, and fuel flow indicators at time of shutdown, the pilot may be able to determine whether engine malfunction was due to improper fuel scheduling or to material failure. If malfunction was due to material failure, a restart should not be attempted. Shutting off air conditioning bleed air from a malfunctioning inboard engine need not be accomplished unless the engine is contaminating the supply of conditioned air.

ENGINE RESTART DURING FLIGHT.

A windmilling airstart can be accomplished successfully with the J79 engine over a wide range of speed and altitudes below 60,000 feet. (See figure 3-2.) If two asymmetrical engines have failed, and it is determined that it is safe to restart both, attempt a restart on the outboard dead engine first. To accomplish restart on a dead engine, use the following procedure:

CAUTION

An engine restart must not be attempted if the engine was shut down by pulling the fire pull switch.

1. Fire pull switch—IN.

2. Throttle—OFF.

CAUTION

The throttle should remain OFF for one minute prior to restart in order that all fuel will be drained from the combustion cans.

3. Spike position switch—IN.

CAUTION

Before attempting an air start make sure that spike on dead engine is fully retracted and remains there until 100 percent rpm is attained. Do not place switch in AUTO position until engine speed is up to 100 percent rpm.

4. Generator control switch—OFF (as applicable).

If the engine drives a generator, check that the affected generator control switch is OFF. The switch should remain OFF until the engine is started to prevent generator drag.

5. Airspeed—Within air start envelope.

Refer to figure 3-2.

6. Engine start switch—AIR.

7. Throttle—Move beyond IDLE, then back to IDLE.

Advance throttle of affected engine beyond IDLE stop. Then, retard throttle to IDLE to restart engine.

Note

If light-off does not occur within 45 seconds after moving the throttle to IDLE,

windmilling airstart speeds

DATA BASIS: ESTIMATED
DATE: 10 JUNE 1959

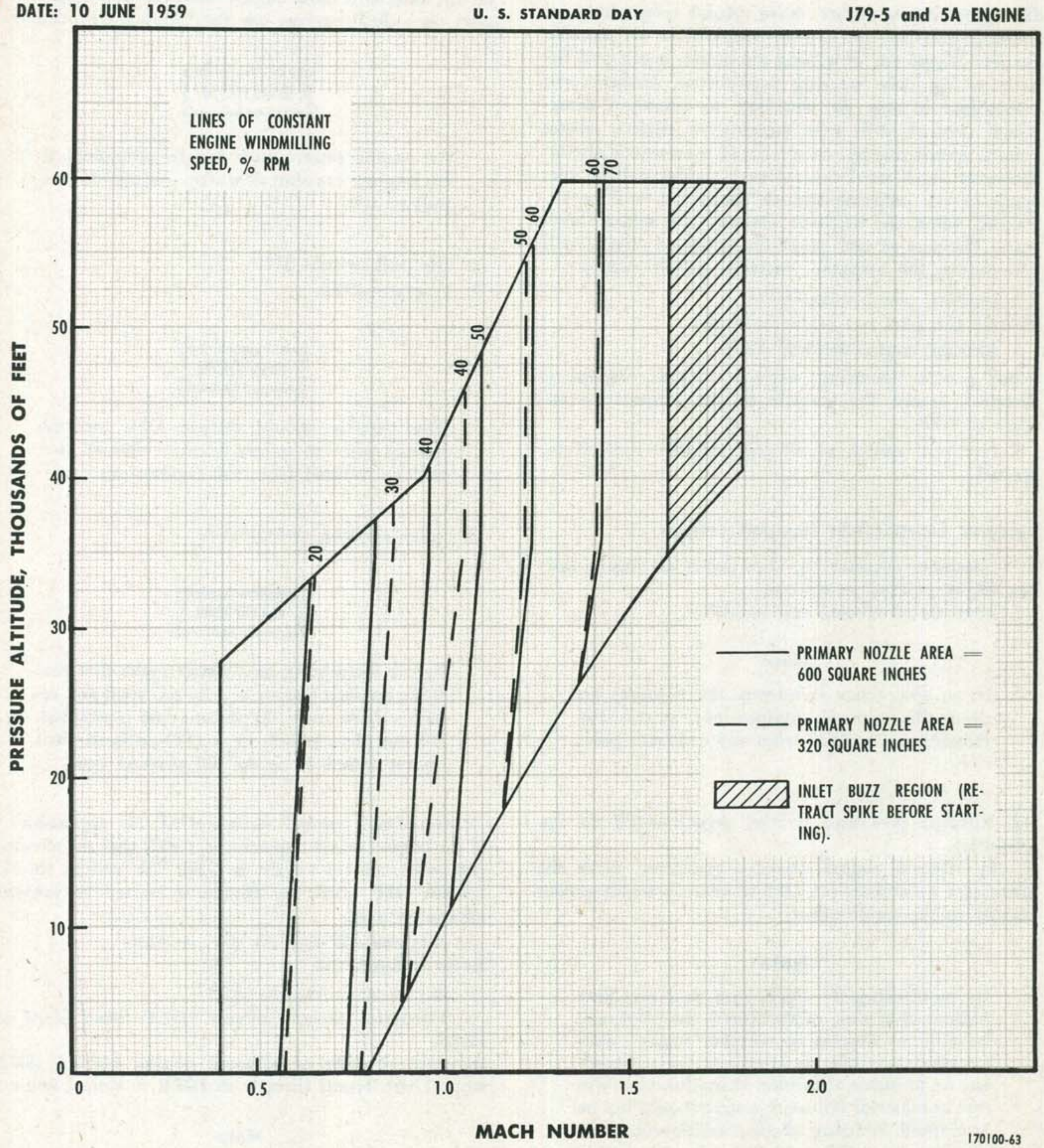

Figure 3-2.

abort the start by pulling the throttle to OFF and moving the start switch to OFF. Allow one minute for fuel drainage; then repeat steps 6 and 7 for another start attempt.

8. Engine start switch—OFF after light-off.

9. Generator control switch—RESET.
Momentarily hold the switch to RESET.

10. A-C meter selector knob—As required.
Position the selector knob to the affected generator position and check the frequency and voltmeter for proper output.

11. Throttle—Advance to desired power.

Engine Restart After Four-Engine Flameout.

If a four-engine flameout occurs, the best chance for recovery is in getting the engines restarted immediately, before engine rpm drops to the point where the generators de-excite and hydraulic pressure drops to a point below which the primary controls can not be actuated. De-excitation of all generators results in the loss of a-c power and the subsequent loss of fuel booster pumps. During the restart attempt, it is recommended that the pilot monitor the electrical control panel and hydraulic pressure indicators periodically in order to check the status of the generators and hydraulic pumps. If the restart attempt is not successful, retract spikes, limit maneuver to those required for control of the aircraft for another airstart attempt, and monitor hydraulic pressure.

Note

Should pressure on either hydraulic system drop below 1500 psi, increase glide angle to increase hydraulic pressure.

If all airstart attempts are not successful, maintain descent control of the aircraft until safe ejection altitude is reached. Under no circumstances will a flameout landing be attempted. The following procedures should be accomplished in rapid sequence immediately after flameout.

1. Engine start switches—AIR.
Place all engine start switches in the AIR position and watch for light-off of all or any engines. If an immediate light-off does not occur, proceed to next step.

2. Throttles—IDLE.
Retard all throttles to the idle stop.

3. Reservoir tank booster pump switch—NORM.
Check that the reservoir tank booster pump switch is in NORM to assure that engine fuel supply is available.

4. Throttles—Adjust as required.
Adjust throttles as required to accomplish light-off and to resume powered flight.

Note

If a light-off does not occur within approximately 20 seconds, it is recommended that throttles 1 and 4 be retarded to the OFF position. Allow the outboard engines to drain while still attempting a light-off on engines 2 and 3. Then if the inboard engines do not light-off, reverse the procedure, placing the outboard throttles in the IDLE position and retarding throttles 2 and 3 to OFF to allow drainage.

5. Fuel control panel—Check.
Reposition the switches on the fuel control panel according to the desired fuel system configuration.

6. Electrical control panel—Check.
Monitor the electrical control panel for normal power flow configuration and normal voltages, amperages, and frequencies.

Note

If the generators de-excite during restart, place the generator control switches to RESET (momentarily) for re-excitation.

Unsatisfactory Air Start.

An air start is considered unsatisfactory if any one of the following conditions exist: light-off does not occur within 45 seconds after throttle is advanced to IDLE; engine does not accelerate to idle rpm; EGT exceeds starting limits; oil pressure fails to reach minimum idle rpm pressure. Abort an unsatisfactory start by accomplishing the following:

1. Throttle—OFF.
2. Engine start switch—OFF.

CAUTION

The throttle should remain OFF for one minute prior to another restart in order that all fuel will be drained from the combustion cans.

LANDING WITH ONE OR MORE ENGINES INOPERATIVE.

Landing with one or two engines inoperative may be accomplished without undue difficulty up to maximum landing gross weights. Landing with three engines inoperative is not recommended. Procedures and techniques for a partial-engine landing are essentially the same as for a normal landing. If minimum drag is desired in the pattern, do not extend the landing gear until completing the turn on final approach. Do not allow the airspeed to drop below the normal pattern, approach, and touchdown speeds. Pattern power settings for partial-engine operation are found in Appendix I. When landing with two engines inoperative on the same side, plan carefully in order to avoid a go-around.

WARNING

If both left engines are inoperative, hydraulic brakes and nose steering will be inoperative. Lower gear pneumatically when this condition exists, (or when any two engines are inoperative) reducing demand on remaining hydraulic pumps and activating pneumatic brake system.

Full thrust with such an asymmetric power configuration may cause excessive yawing. Refer to figure 3-1 for minimum rudder control speeds at various asymmetric power configurations.

WARNING

Do not attempt a dead-stick landing. With all engines flamed out, the windmilling rpm of the engines at any safe landing speed is not sufficient to support the engine-driven hydraulic pumps. Since the flight controls are hydraulically actuated, the loss of hydraulic pressure from all pumps would render these controls inoperative.

GO-AROUND WITH ONE OR MORE ENGINES INOPERATIVE.

The decision to go around with one or more engines inoperative should be made as early as possible and without hesitation. If the airspeed is too low for the gross weight, an excessive sink rate may develop which can be difficult to detect and correct with partial thrust. Retract the landing gear as soon as it becomes evident that the airplane will not sink onto the runway.

Note

If gear has been extended pneumatically, it can not be retracted.

TAKEOFF WITH ONE OR MORE ENGINES INOPERATIVE.

In cases where emergency evacuation of aircraft becomes necessary, a takeoff with one engine inoperative can be safely accomplished. After computing normal takeoff speed and distance, use the three-engine takeoff performance data in Appendix I to determine three-engine takeoff distance. Refer to figure 3-1 for minimum airspeeds for rudder control during partial-engine takeoff. It is necessary to use nose wheel steering below these minimum airspeeds. Takeoff with two engines inoperative is not recommended.

FIRE.

ENGINE FIRE ON THE GROUND.

In the event of a visible engine fire or if the fire warning lamp lights while the airplane is on the ground, alert the crew, signal to ground crew fire-fighting personnel, and notify the control tower. If taxiing, stop the airplane and set the parking brake.

CAUTION

If raw fuel is running from the affected engine, move the airplane, if possible, to avoid accumulation of fuel under the wing.

If the fire diminishes, let it burn itself out. If it does not diminish, advise ground personnel to use fire extinguisher through the fire access door. If it can be determined that the fire is confined to the tailpipe, do not use the fire extinguisher, but motorize the engine to blow out the flame and excess fuel. (Refer to "Starting Engines," Section II, for information on clearing the engine.) Shut down or maintain operation of the other engines, as required, to allow ground crew approach or to provide bleed air for clearing the engine. Accomplish the following procedures immediately upon discovery of engine fire:

1. Applicable fire pull switch—Pull.
2. Throttles—IDLE.

Retard all throttles to the idle stop.

3. Air source selector knob—L or R (if applicable).

If an inboard engine is being shut down, position the air source selector knob as necessary to select the operating inboard engine.

ENGINE FIRE DURING TAKEOFF, TAKEOFF REFUSED.

If a fire warning lamp lights or an engine fire occurs during takeoff at or below refusal speed, alert the crew, notify the control tower, and at the same time accomplish the following procedures:

1. Accomplish abort procedure.

Refer to "Takeoff and Landing Emergencies" of this section for the abort procedure.

2. Affected engine fire pull switch—Pull.
3. Affected engine throttle—OFF.

Note

If a stop cannot be made before reaching an obstacle, perform these additional steps.

4. Remaining fire pull switches—Pull.
5. Remaining throttles—OFF.
6. Landing gear and brake emergency handle—Pull.

WARNING

If all fire pull switches are pulled, flight controls, nose steering, and hydraulic brakes are inoperative.

7. Canopy jettison handle—UP, if necessary.

Unlatch canopy jettison handle and pull up. Instruct navigator and DSO to jettison canopies.

ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED.

If a fire warning lamp lights or an engine fire occurs during takeoff above refusal speed, continue the takeoff and alert the crew. Hold the airplane on the runway as long as it is practical, to gain maximum speed. Accomplish the following procedures:

1. Landing gear handle—UP.

Retract the gear when definitely airborne.

2. Affected engine throttle—IDLE.

Note

If the fire warning lamp goes out and indications are normal after retarding throttle, advance the throttle to climb power setting. However, if EGT is high, warning lamp remains lighted or lights again after throttle is advanced, or if evidence of fire is visible, proceed with the next two steps.

3. Affected fire pull switch—Pull (if fire continues).
4. Affected engine throttle—OFF (if fire continues).

CAUTION

Do not attempt to restart the engine.

ENGINE FIRE DURING FLIGHT.

If an engine fire occurs during flight, alert the crew and at the same time accomplish the following procedures:

1. Applicable fire pull switch—Pull.
2. Affected engine throttle—OFF.

CAUTION

Do not attempt to restart the engine.

FUSELAGE FIRE.

In the event that fire is discovered or suspected in any of the accessible fuselage compartments, immediately alert other crew members.

CAUTION

All crew members must go on 100 percent oxygen.

Locate the fire and, using the extinguisher from the second crew compartment, apply a minimum amount of extinguishing agent at the base of the flame.

miscellaneous emergency equipment

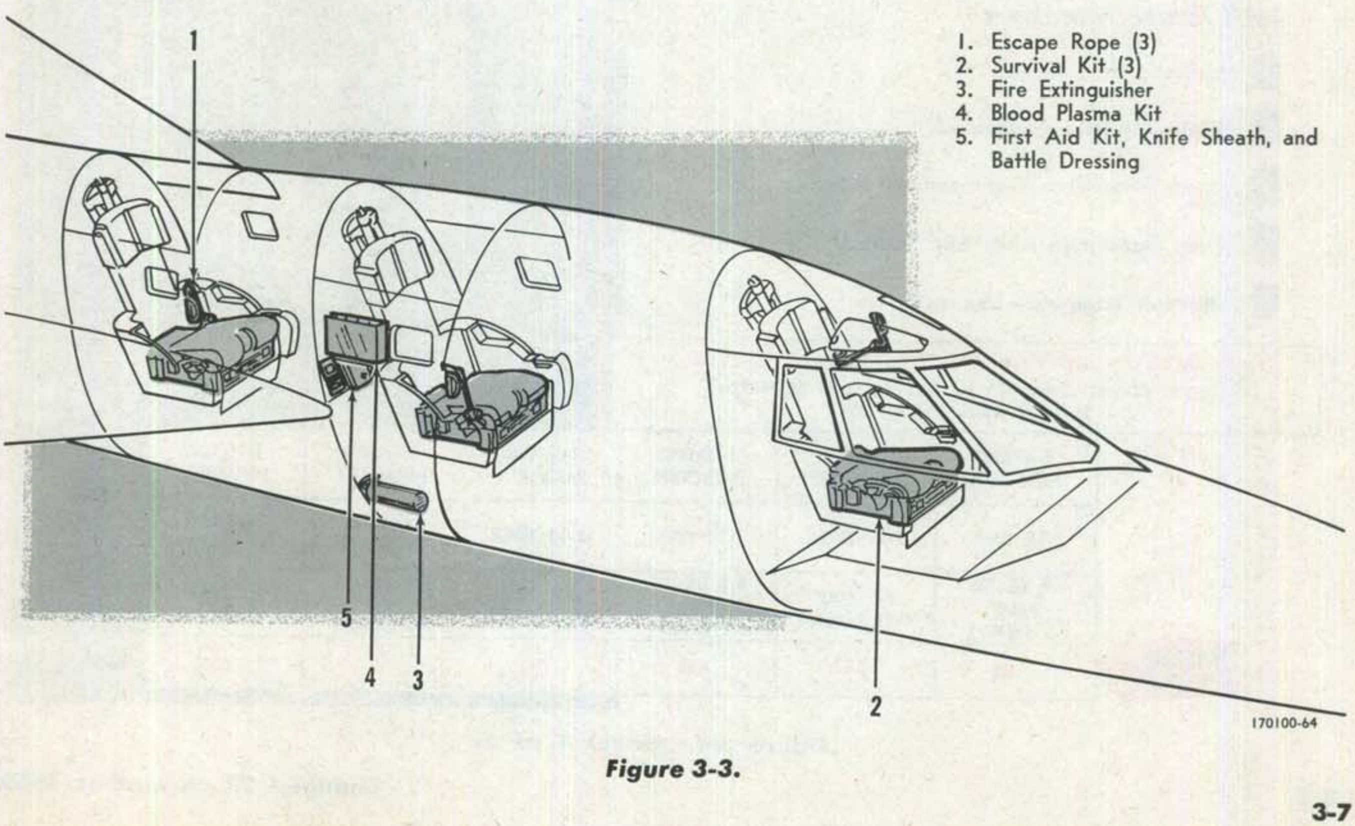

Figure 3-3.

ejection procedures

NOTE

Critical items of the ejection procedures are shown in bold type.

IMMEDIATE ESCAPE

Pilot Only

1. **Notify crew—"BAILOUT, BAILOUT, BAILOUT."**
2. Bailout switch—BAILOUT.

All Crew Members

3. Helmet visor — Down.
4. **Bailout bottle — Actuated.**
5. Insert hands through arm restraint loops.
6. **Seat handgrips — Up and locked.**
7. **Ejection triggers — Squeeze.**

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MINIMUM EMERGENCY ALTITUDES FOR EJECTION
(Level Flight, Type M-12 Safety Belt Initiator, Rocket-Type Catapult)

	2-SECOND PARACHUTE	2-SECOND PARACHUTE	1-SECOND PARACHUTE	1-SECOND PARACHUTE	0-SECOND PARACHUTE	0-SECOND PARACHUTE
	F-1A TIMER	F-1A TIMER	F-1B TIMER	F-1B TIMER	LANYARD TO D-RING	LANYARD TO D-RING
	B-4 OR B-5 PACK C-9 CANOPY	B-5 PACK C-11 CANOPY	B-4 OR B-5 PACK C-9 CANOPY	B-5 PACK C-11 CANOPY	B-4 OR B-5 PACK C-9 CANOPY	B-5 PACK C-11 CANOPY
MINIMUM ALTITUDE	300	350	125	200	0	100

170101-159

Figure 3-4. (Sheet 1 of 2)

BEFORE EJECTION

(IF TIME AND CONDITIONS PERMIT)

Pilot Only

1. Bailout switch — ALERT
2. Coordinate ejection sequence with crew.
3. Airspeed — Check.

WARNING

Decelerate to at least 530 knots IAS before ejecting.

4. Trim for nose up attitude and engage autopilot.
5. Stow all loose equipment.
6. **Give final ejection order over interphone and/or place bailout switch to BAILOUT position.**

All Crew Members

1. Personal gear — Secured.
2. Helmet visor — Down.
3. **Bailout bottle — Actuated.**
4. Assume ejection position.
5. Insert hands through arm restraint loops.
6. **Seat handgrips — Up and locked.**
7. **Ejection trigger — Squeeze**

AFTER EJECTION

All Crew Members

WARNING

Release hand hold on seat handgrips as soon as seat is clear of airplane to prevent possible hand and arm injury during separation from seat.

1. Push free of seat when safety belt opens; if automatic release fails, open belt manually (with pull tab), then push free of seat.
2. If safety belt is opened manually or if manual operation of automatic opening chute is desired, open parachute manually (either by pulling parachute ball handle control or, if at normal breathing altitude, by pulling D-ring).
3. Pull the kit release handle at an altitude of approximately 1000 feet to separate from survival kit.

WARNING

Delay manual (D-ring) parachute openings to reduce opening shock and, if at high altitude, to reduce danger of hypoxia and exposure to cold.

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Figure 3-4. (Sheet 2 of 2)

WARNING

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

Accomplish the following procedures as necessary.

1. Cabin pressure selector knob—DUMP.

Dumping cabin pressure may aid in extinguishing the fire. Also, this will help in eliminating smoke and fumes.

2. Nonessential electrical equipment—Off.

Turn off all nonessential electrical equipment, especially those components located in the compartment area. Instruct the navigator and DSO to take the same action, pulling fuses if necessary.

3. Air conditioning control mode selector knob—MAN.

Place the control mode selector knob on the air conditioning panel to MAN.

4. When normal operations can be resumed, return equipment and systems to original operation.

SMOKE AND FUME ELIMINATION.

When smoke and/or fumes enter the cabin areas during flight, the first concern, normally, is to eliminate the condition, then attempt to eliminate the cause. In most instances the air can be cleared quickly by placing the cabin pressure selector knob to DUMP. All crew members should go on 100 percent oxygen prior to dumping cabin pressure. The source of the smoke may be determined by checking the refrigeration unit and electronic equipment temperature indicators. If a refrigeration unit overheat condition is present, reposition the refrigeration selector knob to shut down the overheating unit. Repressurize the cabin. If an electronic equipment overheat condition exists, all nonessential equipment may be turned off and then placed back in operation progressively in an attempt to locate the smoking equipment. If emergency ram operation is necessary, adjust airspeed and altitude within the limits for this operation (refer to "Ram Air Operation Limit Speed," Section V), and place the control mode selector knob to RAM. Electronic equipment that is not essential should be turned off to prevent overheating.

SEAT EJECTION.

Escape from the airplane in flight should be made with the ejection seat in the following sequence: DSO, navigator, and pilot. A crew ejection indicator signals the pilot when both crew members have ejected. See figure 3-4 for ejection procedure.

WARNING

Ejection is not recommended at airspeeds above 530 knots IAS. Present seat installations do not assure clearance of the vertical fin at airspeeds up to the restricted high speed limit.

An ejection at low altitudes is facilitated by pulling the nose of the aircraft above the horizon ("zoom-up maneuver"). This maneuver affects the trajectory of the ejection seat providing a greater increase in altitude than if ejection is performed in a level flight attitude. This gain in altitude will increase the time available for separation from the seat and deployment of the parachute. Ejection should not be delayed when the aircraft is in a descending attitude and cannot be levelled out. When circumstances permit, slow the airplane down as much as possible prior to ejection. The minimum emergency altitudes for seat ejection with different configurations of equipment are shown in figure 3-4.

WARNING

The minimum altitudes shown on figure 3-4 were determined through an extensive series of flight tests and are based on distance above terrain at the time the seat begins to eject. However, human error and equipment malfunctions were not considered in the determination of these altitudes. Therefore, whenever possible, ejection should be initiated at altitudes above the minimum shown on the figure.

Note

The minimum emergency altitudes shown for the one-second safety belt delay (M-12 initiator) and a zero-second parachute delay ("one and zero" system) are applicable only for velocities of 140 to 300 knots IAS.

In the use of the "Minimum Emergency Altitudes for Ejection" chart, it is stressed that this information should be used only as a guide. The decision as to when to eject or not eject in an emergency should not be rigidly determined by the fact that the aircraft is

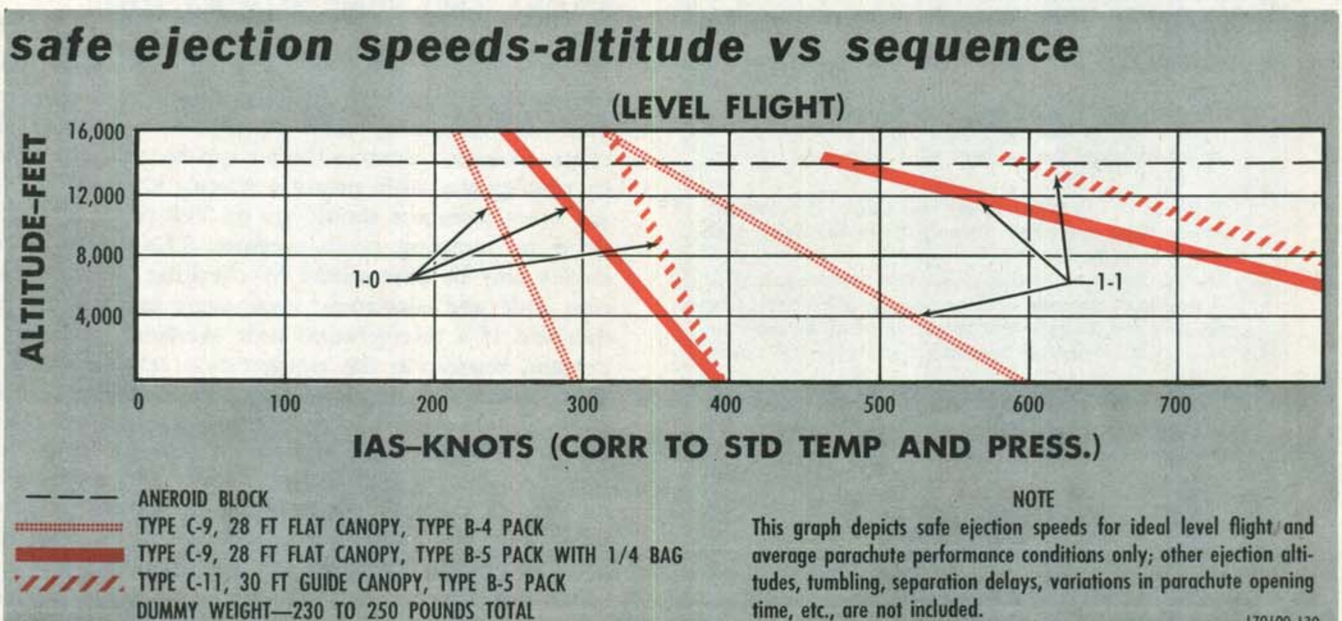


Figure 3-5.

above or below the minimum altitude as determined from the chart. Every emergency will have its particular set of circumstances involving such factors as aircraft speed, attitude and control, as well as altitude. The automatic opening safety belt should not be opened prior to ejection at any altitude. Figure 3-5 is a plot of altitude, speed, and sequence time of parachute-automatic safety belt combination. This figure shows safe ejection speeds with regard to parachute capability and body injury because of parachute opening shock. The sequence lines (slanting lines) indicate the limits above which the parachute will probably be damaged on opening or the crew member will probably suffer body injury resulting from parachute opening shock. In the event it becomes necessary to eject from the airplane, the ejection should be accomplished according to the following procedures which include both the critical and the non-critical portions of the ejection sequence. Critical items may be defined as those actions which must be performed immediately and instinctively if severe injury is to be avoided. Non-critical items consist of those actions which contribute to an orderly ejection sequence, assure that all corollary preparations are made prior to initiating the critical emergency actions, and improve the chances for the ejection to be successful. Each of the critical items in the ejection procedure are rendered in bold type.

IMMEDIATE ESCAPE.

Pilot Only.

1. Notify crew—"BAIL OUT, BAIL OUT, BAIL OUT."

2. Bailout switch—BAILOUT.

All Crew Members.

3. Helmet visor—Down.

4. Bailout bottle—Actuated.

5. Insert hands through arm restraint loops.

6. Seat handgrips—Up and locked.

7. Ejection triggers—Squeeze.

IF TIME AND CONDITIONS PERMIT.

Pilot Only.

1. Bailout switch—ALERT.
2. Coordinate ejection sequence with crew.
3. Air speed—Check.

WARNING

Decelerate to at least 530 knots IAS before ejecting.

4. Trim for nose up attitude and engage autopilot.
5. Stow all loose equipment.
6. Cabin pressure selector knob—DUMP.

7. Give final ejection order over interphone and/or place bailout switch to BAILOUT position.

All Crew Members.

1. Personal Gear—Secured.

Check that parachute lanyard, safety belt, tie-down strap, shoulder harness, leg restraints, parachute, and survival kit are secured and that arm restraints are fastened to tie-down strap.

2. Helmet visor—Down.

Pull helmet visor down over eyes (if visor equipped helmet is worn) for protection from windblast.

3. Bailout bottle—Actuated.

4. Assume ejection position.

Tuck in chin, hold head firmly against headrest and legs against leg guard.

5. Insert hands through arm restraint loops.

Insert hands through arm restraint loops and extend arms outward to tighten arm straps around wrists.

Note

DSO and navigator eject in prearranged sequence after receiving notification from pilot. Pilot ejects after crew ejection indicator lamp comes on or, in extreme emergencies, immediately after notifying crew.

6. Seat handgrips—Up and locked.

Raise both handgrips to the locked up position to extend the head restraints and lock the inertia reel.

7. Ejection trigger—Squeeze.

Squeeze either or both ejection triggers to jettison canopy and eject seat.

LOSS OF CABIN PRESSURE.

For flights above an altitude of 50,000 feet, crew members must wear a partial pressure suit. In case of loss of cabin pressure at high altitudes, the partial pressure suit will maintain sufficient pressure on the body for a descent to a lower operating altitude or, if deemed necessary, for continued high altitude flight. In case of cabin pressure loss while wearing an oxygen mask rather than a pressure suit, it is imperative that the pilot immediately descend to an altitude of 30,000 feet (or less) where cabin pressure is not required. Refer to "Emergency Descent" of this section.

EMERGENCY DECELERATION.

Information on emergency deceleration will be included when additional flight test data becomes available.

EMERGENCY DESCENT.

A very rapid descent can be achieved by a spiral dive maneuver at idle power. For speeds above Mach No. 1.5, initiate spike retraction as soon as practical to prevent inlet buzz. While decelerating and prior to reaching Mach No. 1.2, determine if the cg location is forward enough to allow controlled subsonic flight. If the cg location is too far aft, transfer fuel forward concurrently with deceleration.

TAKEOFF AND LANDING EMERGENCIES.

ABORT.

If it is necessary to abort a takeoff, accomplish the following steps.

1. Throttles—IDLE.

Immediately retard all throttles to the idle stop.

2. Drag chute—Deploy.

3. Brakes—Apply.
On airplanes not equipped with the anti-skid system, use caution not to lock wheels or skid tires.

4. No. 1 and 4 engine throttles—OFF (if desired).
Shut down outboard engines to further reduce thrust. The inboard engines should remain in idle operation to provide hydraulic and electrical power.

The above steps are the basic procedure for aborting a takeoff. For additional instructions applicable to specific emergencies which will cause an abort, refer to "Engine Failure During Takeoff, Takeoff Refused," and "Engine Fire During Takeoff, Takeoff Refused."

LANDING EMERGENCIES.

WARNING

Serious consideration should be given to ejection rather than attempting an emergency landing on an unprepared surface or where the terrain is unknown. Recent studies indicate that an emergency landing under these conditions is extremely critical from the standpoint of crew safety and damage to the aircraft.

An emergency landing is recommended only when a prepared surface is available and when weather conditions, visibility, and airplane control are adequate for a safe descent and touchdown. Approach and landing speeds will vary depending upon the type of landing emergency, the airplane gross weight, the cg location, and the angle of attack. Generally, however, a normal approach and touchdown should be made as follows:

1. Execute a normal approach at approximately 40 knots faster than intended touchdown speed.

2. With a gross weight of 65,000 pounds, touchdown should be made at approximately 130 knots IAS for a 16-degree angle of attack and 150 knots IAS for a 12-degree angle of attack.

a. Add one knot to the touchdown speed for each 1000 pounds over 65,000 pounds landing weight; or, subtract one knot from the touchdown speed for each 1000 pounds under 65,000 pounds landing weight.

b. Add two knots to the touchdown speed for each percent that the cg is forward of 29 percent MAC.

3. For the maximum sinking speed at touchdown for landings at gross weights above 95,000 pounds, refer to "Miscellaneous Operational Limitations," Section V.

Note

The recommended touchdown angle of attack for the various types of emergency landings is noted in the specific procedures for the respective landing.

Under certain conditions, an emergency landing can be accomplished with a malfunction of the landing gear. A landing gear malfunction may result in any one of five gear configurations; nose gear up or unlocked, one main gear up or unlocked, both main gear up or unlocked, nose gear and one main gear up or unlocked, or, all gear up or unlocked (belly landing). An emergency landing attempt is not recommended under any of these circumstances unless all conditions (landing surface, airplane control, weather, visibility, etc.) indicate a reasonably good chance that the landing can be safely accomplished.

WARNING

- Do not attempt an emergency landing with one main gear down and the other two gear up or unlocked, or, with a pod attached to the airplane. If the extended main gear cannot be retracted and/or, if the pod cannot be jettisoned, it is recommended that the crew eject from the airplane. For information on jettisoning the pod including cg limits, refer to "Pod Jettisoning" of this section.
- A belly landing is recommended only in case it is impossible to obtain a situation with any two landing gear down and locked or the nose gear alone down and locked, since it is expected that a belly landing will involve more risk to the crew and more damage to the airplane.

The following procedures are recommended in case it is considered reasonably safe to attempt an emergency landing with malfunctioning landing gear.

Nose Gear Up Or Unlocked.

Before landing with the nose gear up or unlocked, a cg of 30.7 percent MAC should be obtained. This cg will permit the airplane to stop with the aft portion of the fuselage and outboard nacelles contacting the runway. It is anticipated that this type of emergency landing with a gear malfunction will impose the least amount of risk on the crew and will result in relatively minor damage to the airplane. In the event that the nose gear remains up or unlocked and all procedures to extend have failed, proceed as follows:

Note

It is assumed that the normal "Before Landing" procedures will have been accomplished before the following emergency procedures are utilized.

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

For information on jettisoning the pod including cg limits, refer to "Pod Jettisoning," this section.

3. Nonessential electrical and electronic equipment —Off.

De-energize all equipment not required for landing.

4. Battery switch—OFF.
5. Landing cg—Check.

Check that fuel distribution provides the required cg for landing.

Note

In event there is not enough fuel in the tanks to obtain the necessary cg, check to see if a tanker is available for air refueling.

6. Fuel system configuration—Check.

Use same panel configuration as for normal landing.

7. Landing data—Check.
8. No. 1 and 4 engine fire pull switches—Pull.

Shut down the outboard engines immediately prior to flare by pulling the No. 1 and 4 engine fire pull switches.

9. Execute a normal flare and touchdown at an angle of attack of approximately 16 degrees.

After touchdown increase angle of attack as much as possible without contacting runway with aft portion of fuselage and outboard nacelles. Use braking as long as the nose does not tend to pitch down. Near end of landing roll, the tail should slowly settle to the runway.

10. Canopies—Jettison.

CAUTION

Be sure helmet visors are pulled down before jettisoning canopies.

11. Manual cg shift switch—AFT.

Position the switch to AFT immediately after touchdown so that fuel will be transferred aft.

12. No. 2 and 3 throttles—OFF.

When the airplane stops, shut down the inboard engines.

13. Abandon the airplane.

Refer to "Abandoning the Airplane on the Ground," this section.

One Main Gear Up Or Unlocked.

A landing with one main gear up or unlocked should be accomplished in much the same manner as a normal landing. However, the landing should be made as close as possible to the edge of the runway opposite the inoperative main gear. A normal approach and touchdown should be executed at an angle of attack of approximately 16 degrees while maintaining a slight bank angle away from the inoperative main gear during touchdown and as long as possible during ground roll. Directional control and balance should be maintained at first with the rudder and then at lower speeds with nose wheel steering. The drag chute and any available braking on the operative gear should be utilized for stopping and directional stability. As the airplane slows to approximately 90 knots IAS, the wing should slowly settle, contacting the runway on the outboard nacelle. Immediately before the nacelle contacts the runway, all engines should be shut down. Upon contact and during the ground roll, the brakes and nose wheel steering should be utilized to compensate for a tendency of the airplane to veer toward the affected gear. In event one of the main gear will not extend and lock down, proceed as follows:

Note

It is assumed that the normal "Before Landing" procedures will have been accomplished before the following emergency procedures are utilized.

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

For information on jettisoning the pod including cg limits, refer to "Pod Jettisoning," this section.

3. Nonessential electrical and electronic equipment—Off.

De-energize all equipment not required for landing.

4. Battery switch—OFF.
5. Landing cg—Check.

Check that fuel distribution provides the required cg for landing.

6. Fuel system configuration—Check.

Use same panel configuration as for normal landing.

7. Landing data—Check.
8. No. 1 and 4 engine fire pull switches—Pull.
9. Inertia reel lock handle—MANUAL LOCK.

Lock inertia reel immediately before touchdown.

10. Approach and touchdown angle of attack—16 degrees (approximately).

Execute normal flare and touchdown at an angle of attack of approximately 16 degrees except maintain a slight bank angle away from the inoperative main gear.

11. Canopies—Jettison.

CAUTION

Be sure helmet visors are pulled down before jettisoning canopies.

12. Drag Chute—Deploy (after touchdown).

Deploy drag chute when nose wheel contacts runway.

13. Brakes—As required.

Utilize the brakes (if available) on the operative main gear for directional stability and stopping.

14. Nose Wheel Steering—As required.

15. No. 2 and 3 throttles—OFF (immediately before nacelle contacts runway).

Shut down engines No. 2 and 3 immediately before nacelle on affected side of airplane contacts runway.

16. Abandon the airplane.

Refer to "Abandoning the Airplane on the Ground," this section.

Both Main Gear Up Or Unlocked.

A landing with both main gear up or unlocked should be accomplished in much the same manner as a normal landing. A normal approach and touchdown should be made with an angle of attack not exceeding 12 degrees. The sinking speed at touchdown should not exceed 120 feet per minute. Immediately before touchdown all engines should be shut down. Maintain directional control with the rudder or nose wheel steering as long as possible. The following procedures are recommended for a "Both Main Gear Up Or Unlocked" landing after all attempts to extend and lock down the gear have failed.

Note

It is assumed that the normal "Before Landing" procedures will have been accomplished before the following emergency procedures are utilized.

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

Do not jettison the pod until a safe airplane cg has been established. Refer to "Pod Jettisoning," this section.

3. Nonessential electrical and electronic equipment—Off.

De-energize all equipment not required for landing.

4. Landing cg—Check.

Check that fuel distribution provides the required cg for landing.

5. Fuel system configuration—Check.

Use same panel configuration as for normal landing.

6. Landing data—Check.
7. No. 1 and 4 engine fire pull switches—Pull.
8. Inertia reel lock handle—MANUAL LOCK.

Lock inertia reel before touchdown.

9. Touchdown angle of attack—12 degrees (maximum).

WARNING

A landing with the angle of attack exceeding 12 degrees is likely to result in an extreme pitchdown of the nose at the time of initial contact with the runway.

10. Canopies—Jettison.

CAUTION

Be sure helmet visors are pulled down before jettisoning canopies.

11. No. 2 and 3 engine throttles—OFF (immediately before touchdown).

Shut down both inboard engines immediately before touchdown.

WARNING

Do not exceed a sink rate of 120 feet per minute at time of touchdown.

12. Nose wheel steering—As required (after touchdown).

13. No. 2 and 3 engine fire pull switches—Pull (after stopping).
14. Battery switch—OFF.
15. Abandon the airplane.

Refer to "Abandoning the Airplane on the Ground," this section.

All Gear Up Or Unlocked (Belly Landing).

It is anticipated that a belly landing will impose more risk on the crew and will result in more damage to the airplane than a situation with any two gear down and locked or the nose gear alone down and locked. If all effort to extend and lock the nose gear or a combination of any two gear has failed, proceed as follows:

Note

It is assumed that the normal "Before Landing" procedures will have been accomplished before the following emergency procedures are utilized.

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

Do not jettison the pod until a safe airplane cg has been established. Refer to "Pod Jettisoning," this section.

3. Nonessential electrical and electronic equipment—Off.

De-energize all equipment not required for landing.

4. Battery switch—OFF.
5. Landing cg—Check.

Check that fuel distribution provides the required cg for landing.

6. Fuel system configuration—Check.

Use same panel configuration as for normal landing.

7. Landing data—Check.
8. No. 1 and 4 engine fire pull switches—Pull.
9. Inertia reel lock handle—MANUAL LOCK.
10. No. 2 and 3 throttles—OFF.

Immediately before contact with runway, shut down engines No. 2 and 3.

11. Execute a normal flare and touchdown at an angle of attack of approximately 12 degrees.

The sinking speed at touchdown should not exceed 120 feet per minute.

WARNING

- A landing with an angle of attack exceeding 12 degrees is likely to result in an extreme pitchdown of the nose at the time of initial contact with the runway.
- Sinking speeds in excess of 120 feet per minute will probably fail the inboard nacelles and supporting structure on initial impact.

12. Canopies—Jettison.

CAUTION

Be sure helmet visors are pulled down before jettisoning canopies.

13. Drag chute—Deploy.

As the airplane pitches down, hold full up elevator and deploy drag chute.

14. Utilize rudder for directional control.

When rudder effectiveness is lost, remove feet from pedals.

15. Abandon the airplane.

Refer to "Abandoning the Airplane on the Ground," this section.

ABANDONING THE AIRPLANE ON THE GROUND.

In an emergency requiring ground abandonment, the primary concern should be to leave the immediate area of the airplane as soon as possible. The following procedures are for use in the event of fire, explosion, etc., or expectation of such hazards; salvaging emergency and survival equipment has not been considered. These procedures provide the fastest means of abandoning the airplane; they should be accomplished as soon and as rapidly as possible after the decision to abandon has been made.

1. Notify crew—"ABANDON AIRPLANE".

Notify crew on interphone to prepare to abandon.

2. Canopies—Jettisoned (or open).

Jettison canopies, or open pneumatically if practical.

3. Oxygen control lever—OFF.

Turn oxygen off before pulling kit release to prevent hazardous oxygen leakage at kit-to-man disconnect.

4. Kit release handle—Pulled.
5. Upper (knee belt) and lower (ankle strap) leg restraints—Unfastened (if installed).
6. Safety belt—Unfastened.

WARNING

Be sure all straps, harness, etc., are out of the way, leaving a clear path for exit. If kit release fails, unbuckle chute harness.

7. Exit from compartment (using escape rope, or jumping to ground).

Exit on side opposite fire or damage and proceed to a safe distance from airplane.

EMERGENCY ENTRANCE.

See figure 3-6 for emergency entrance.

DITCHING.

Do not attempt to ditch this airplane except as a last resort. Ditching should be performed only if lack of altitude or ejection system failure would prevent successful bailout. Specific ditching procedures have not been established.

EMERGENCY JETTISONING.

FUEL DUMPING.

Fuel dumping provides a means of rapidly reducing the airplane gross weight in event of an emergency. The airplane cg must be closely monitored during the operation.

1. Airspeed—Check.

WARNING

Do not exceed the maximum allowable airspeed for fuel dumping.

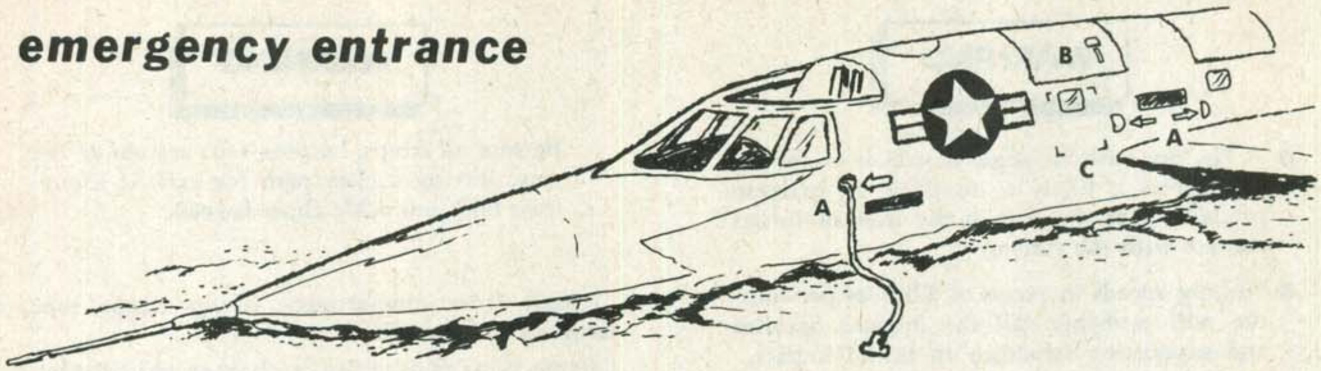
2. Fuel panel configuration—Check.
3. Fuel dump switch—DUMP.
4. Fuel dump switch—NORM.

Return the dump switch to NORM when the desired airplane gross weight is attained.

Airspeed Limits for Fuel Dumping.

The following table presents the maximum allowable airspeed for fuel dumping operations. When fuel is dumped at airspeeds above these limits, fuel impinges on the fuselage and may collect in the tail section void areas.

emergency entrance



1 JETTISON CANOPIES

A Extend cable to limit; then pull hard on handle (typical of all three canopies).

WARNING

Stay clear of canopy path when canopies are jettisoned.

B

IF CANOPIES CANNOT BE JETTISONED

Open navigator's station canopy with handle located on left side of canopy.

C

AS A LAST RESORT

Chop hole through left side of fuselage in designated space.

2 DISARM SEAT CATAPULT

WARNING

When entering a crew compartment, immediately check the position of the handgrips on the ejection seat. Be extremely careful not to raise either seat handgrip. If a handgrip has already been raised, DO NOT touch, squeeze, or move the exposed seat ejection trigger.

WARNING

The catapult hoses are not readily accessible in the crew compartments; therefore, it may be extremely difficult for rescue personnel to disarm the seat catapult by severing the ballistic hoses. An alternate method of disarming the seat catapult is by manually pulling the hose loose at the quick-disconnect fitting behind the seat.

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Figure 3-6.

Altitude (Feet)	Maximum Airspeed For Fuel Dumping (Knots IAS)
Sea Level	295
5,000	270
10,000	245
15,000	225
20,000	200
25,000	185
30,000	165

CANOPY JETTISONING.

The following procedures are recommended for jettisoning canopies from the crew compartments without seat ejection.

1. Helmet visor—Down.

All crew members check that helmet visor is down to shield face from windblast.

2. Canopy seal control lever—UNSEALED.

Instruct the navigator to deflate canopy seals.

Note

Deflating canopy seals before jettisoning canopies during flight will depressurize the cabin and prevent the possibility of explosive decompression.

3. Canopy jettison handle—Pull up.

Pull up canopy jettison handle to jettison canopy; then instruct crew members to jettison canopies in proper sequence.

Note

The recommended sequence for jettisoning canopies without seat ejection is: pilot, navigator, DSO.

POD JETTISONING.

The shift of the center of gravity aft, due to the release of the pod, together with the sudden loss of weight, causes the airplane to pitch up with a resultant increase in load factor. The magnitude of this increased load factor depends upon the location of the airplane center of gravity and the weight of the pod at the time of release. Therefore, the airplane center of gravity location is extremely critical from the standpoint of maintaining control of the airplane and/or preventing structural damage when jettisoning the pod.

Note

Under certain conditions, the aft cg limits for jettisoning the pod may be forward of the normal forward cg loading limits. Refer to "Center of Gravity Limitations," Section V, for cg operating limits.

aft cg limits for pod jettisoning

DATA BASIS: ESTIMATED
DATE: 4 JUNE 1959

MB-1C POD
SUBSONIC FLIGHT
ALTITUDE 20,000 FEET AND ABOVE

POD WITH WARHEAD OR BALLAST	
POUNDS OF FUEL IN POD	AIRPLANE (WITH POD) AFT CG LIMIT % MAC
0	25.1
2000	24.5
4000	23.8
6000	23.2
8000	22.5
10,000	22.0
12,000	21.3
14,000	20.7
16,000	20.1
18,000	19.5
20,000	19.0
22,000	18.4
24,000	17.8
26,000	17.2
27,500	16.8

POD WEIGHT (WITHOUT FUEL)
BALLASTED POD, 8550 LBS (APPROX)

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Figure 3-7.

To assure safe pod release, the cg should be well ahead of the established limits. (See figure 3-7.) If the cg is determined to be aft of or near the pod jettison aft cg limit, every effort should be made to move the airplane cg forward by dumping or transferring fuel before releasing the pod. The following procedure is applicable for pod jettisoning at altitudes above 20,000 feet at subsonic speeds.

WARNING

It is not recommended that the pod be jettisoned immediately after takeoff. Jettisoning the pod at takeoff gross weights will cause the airplane to become extremely unstable with probable catastrophic results.

1. Elevator control available mode selector switch—AUTO.

Note

If the elevator available is less than three degrees, set the elevator control available mode selector switch to TO & LAND until the elevator control available indicator shows three degrees; then move the switch to MANUAL.

2. Mach No.—Check.
Check that Mach No. is subsonic and within safe pod jettison range.
3. Center of gravity—Check.
Check to be sure center of gravity is within limits established in figure 3-7.

WARNING

If cg is determined to be near the established limits, initiate a slight pitch down maneuver concurrent with releasing pod.

4. Pod safety lockpin release handle—Pulled out.
Instruct the navigator to rotate and pull the lockpin release handle.
5. Pod pin out caution lamp—Lighted.
6. Pod lockpin indicator—OUT.
Check with navigator to be sure lockpin indicator shows OUT.
7. Pod release switch—POD RELEASE.
Release pod by placing the pod release switch to POD RELEASE, or, if desired, the navigator can release the pod by placing his pod release switch to the ELEC REL position.

Note

In case both the pod release switches are inoperative, the navigator can release the pod by rotating the pod emergency release handle 90° counterclockwise and then pulling the handle through its full length of travel.

8. Pod emergency release handle—Pulled out (if required).

INLET SPIKE SYSTEM FAILURE.

An unscheduled position of an inlet spike will probably be indicated to the pilot by a loss of thrust on the affected engine. In case of a system malfunction, attempt to retract the defective spike by placing the spike position switch to IN. If the spike cannot be retracted, do not exceed Mach No. 1.5 or a nacelle angle of attack of 6 degrees. Attempt to retract the spike at a low Mach number before landing.

CAUTION

Care should be exercised in the event it is necessary to land with the spikes not fully retracted. Large thrust losses may result due to reduction in the inlet throat area.

Note

In case of electrical power failure to the system the spikes will remain in the position they were in at the time of failure.

OIL SYSTEM EMERGENCY PROCEDURES.

An oil system malfunction (high or low oil pressure) will result in engine seizure within a very short time after actual lubrication deficiency begins, unless the engine is shut down before appreciable bearing damage occurs. Since bearing damage can occur before pressure fluctuations begin, it is imperative to shut down the engine as soon as trouble is indicated. The only positive indications of engine oil starvation are abnormal pressure or increasing engine vibration. A rapid fluctuation of pressure or a gradual change of 10 psi or more, or increasing engine vibration, should be considered sufficient cause to shut down the affected engine. The primary concern is to prevent violent engine seizure, since this can cause loss of one hydraulic system through fluid loss or contamination, fuel system damage, or structural damage. Engine-oil-driven generators may fail prior to engine oil pressure failure, if low oil level is the cause. Complete loss of oil will result in loss of exhaust nozze control, and accompanying loss of thrust may reach 70% at 100% rpm. At the first indication of oil starvation perform the following:

1. Throttle of affected engine—OFF.
2. Generator of affected engine—OFF.
3. Avoid high "G" maneuvers.

ELECTRICAL SYSTEM EMERGENCY OPERATION.

The loss of one generator does not constitute a flight emergency, since two generators remain to carry the load of the two a-c buses. Normally, with one inoperative, a mission can be completed safely. However, the loss of two generators is considered an emergency, and it is necessary to reduce the electrical load for operation with one generator. In addition, the airplane must be prepared in case of loss of the last generator.

FAILURE OF TWO GENERATORS.

If two generators fail, the bus-tie relay closes automatically and the a-c load-reducing feature automatically removes electrical power from the pod and DECM equipment. When it is determined that two generators have become inoperative, were de-excited and taken off the bus, accomplish the following:

1. Power setting and altitude—Reduce.

Reduce the power setting and begin decreasing altitude in order to get better gravity and suction fuel feed in case the last generator fails, causing subsequent loss of all fuel booster pumps.

Note

Keep in mind the altitude that might be required to make the nearest landing field under the existing emergency conditions.

2. Spike position switches—IN.

Place all spike position switches to the IN position.

3. Battery switch—ON.

Check that battery switch is in the ON position.

4. Land as soon as possible.

Restoring Electrical Power to Pod and DECM Equipment.

If it is desired to override the automatic load-reducing circuits to restore electrical power to the pod and DECM equipment, accomplish the following while closely monitoring the current loads on the good generator:

1. A-C power load—Reduce as necessary.

Make certain that the restoration of pod and DECM power does not cause power load to exceed single generator capabilities. It may be necessary to pull fuses.

2. Pod and DECM power switch—RESET.

Place the pod and DECM power switch in the RESET position to restore electrical power to the pod and DECM equipment.

FAILURE OF ALL GENERATORS.

If all generators become inoperative and the battery switch is in the ON position, the battery automatically assumes the load of the 28-volt d-c essential bus which provides power to all equipment necessary to maintain flight. Flight under these conditions is limited and a landing should be made as soon as possible.

WARNING

Under a continuous load, battery power will drain rapidly.

Note

In the event of a failure of the automatic transfer circuit, the battery may be connected to the 28-volt d-c essential bus by placing the battery switch in the EMER position.

HYDRAULIC SYSTEM EMERGENCY PROCEDURES.

LIGHTING OF ONE HYDRAULIC PUMP CAUTION LAMP.

If a caution lamp lights (especially if erratic on and off) while the engine is operating and system pressure is being maintained by other pump, the following procedure should be used to prevent the deteriorating pump from spreading contamination throughout the system.

1. Minimize duration of flight.
2. Minimize use of flight controls to the slowest safe rate of motion.

Note

If the caution lamp is in the utility system, discontinue tail turret, autopilot, and search radar operations if their operation is not essential.

3. When extending landing gear, keep engine rpm for good pump in that system higher than normal.

LIGHTING OF ONE HYDRAULIC PUMP CAUTION LAMP IN EACH SYSTEM.

If one caution lamp in each system lights, use the following procedure:

1. Minimize use of flight controls to the slowest safe rate of motion.
2. If flying supersonic, decelerate to subsonic and avoid abrupt maneuvers.
3. Emergency brake and landing gear control handle —Pull.

Before beginning descent, extend the landing gear using the emergency pneumatic system.

CAUTION

Extending the gear using the pneumatic system automatically activates the emergency pneumatic brake system. Refer to "Brake System Emergency Operation" of this section for emergency braking operation.

4. Land as soon as possible.

FAILURE OF ONE HYDRAULIC SYSTEM.

Note

An abnormal decrease in the utility or primary hydraulic system fluid quantity indicates impending system failure.

Complete failure of the utility or primary hydraulic system may be noted by the lighting of both hydraulic pump caution lamps in one system, lower than normal reading on hydraulic pressure indicator, or by sluggish control response. This condition can arise from loss of hydraulic fluid or from progressive failure of both hydraulic pumps due to system contamination. If it is suspected that either system has failed, use the following procedure:

1. Hydraulic reservoir quantity indicator—Check.

Check hydraulic reservoir quantity indicator for low fluid quantity indication.

2. Discontinue tail turret, autopilot, and search radar operations if their operation is not essential.

3. Hydraulic reservoir quantity indicator—Recheck.
Recheck quantity indicator for continued decrease in fluid quantity.

4. Hydraulic pressure indicator—Check.
Verify that system has failed by checking the hydraulic pressure indicator for lower than normal reading.

Note

All engines may be left in operation.

5. Airspeed—Check.
If flying supersonic, decelerate to subsonic and avoid control maneuvers.

Note

Control surface hinge moment and rate capability will be reduced.

6. Emergency brake and landing gear control handle —Pull.
Before beginning descent, extend the landing gear using the emergency pneumatic system.

CAUTION

Extending the gear with the pneumatic system, automatically activates the emergency pneumatic brake system. Refer to "Brake System Emergency Operation" of this section.

7. Land as soon as possible.

FAILURE OF BOTH HYDRAULIC SYSTEMS.

Note

An abnormal steady decrease in both the utility and primary system fluid quantity indicates possible impending failure of both systems.

The possibility of failure of both hydraulic systems simultaneously is very remote. However, in the event of complete hydraulic system failure, the airplane will become uncontrollable. Complete hydraulic system failure can be detected by the lighting of all hydraulic pump caution lamps, or by loss of hydraulic pressure in both systems. Upon initial detection of hydraulic power loss, the pilot should note trend of failure as to whether the pressure indicators show a definite, steady drop, or if the indicators fluctuate. With a steady drop indication, hydraulic power will probably not recover. As quickly as possible, the pilot should decrease airspeed, if possible attain level flight, and then, if hydraulic pressure has not recovered, an ejection from the airplane should be made. Refer to "Seat Ejection" of this section.

FLIGHT CONTROL EMERGENCY PROCEDURES.

The flight control emergency procedures (other than Mach-altitude gain adjustment failure) are presented in the charts of figure 3-9. Because of the difficulty in determining component malfunctions of the flight control system, these procedures are presented as corrective actions to be taken when abnormal flight characteristics are experienced by the pilot. For each abnormal symptom, the charts also indicate which component could have possibly failed, the characteristics of flight which are peculiar to these component failures, and the post-emergency procedures necessary for a safe return flight. Separate procedures are provided for malfunctions in the elevator control system and in the aileron and rudder control systems. In these procedures where the emergency increase elevator available handle is used, refer to figure 3-10 for the amount of increase in control available with each pull of the handle.

Note

The sequence of steps in figure 3-9 is determined by the degree of emergency. It may not be necessary to accomplish the complete procedure to correct a particular malfunction.

MACH-ALTITUDE GAIN ADJUSTMENT FAILURE.

Two sets of emergency gains are provided for operation at design speed and subsonic cruise speed in the event of a malfunction of the air data computer, the Mach-altitude repeater, or any stability augmentation gain potentiometer (See figure 3-8.) The emergency gains are activated by positioning the gain selector switch to HIGH SPEED or LOW SPEED. The high speed region (region A of figure 3-8) covers Mach numbers from 1.8 to 2.0 at altitudes from 40,000 to 50,000 feet. The low speed region (region B of figure 3-8) covers Mach numbers from 0.9 to 0.95 at altitudes from 30,000 to 50,000 feet. Within these operating regions the emergency gains provide the following:

1. Stability augmentation about all three axes
2. Autopilot operation in three modes
   a. Attitude stabilization
   b. Heading constant
   c. Heading navigate

emergency gain operating regions

DATA BASIS: ESTIMATES
DATE: 12 JUNE 1959

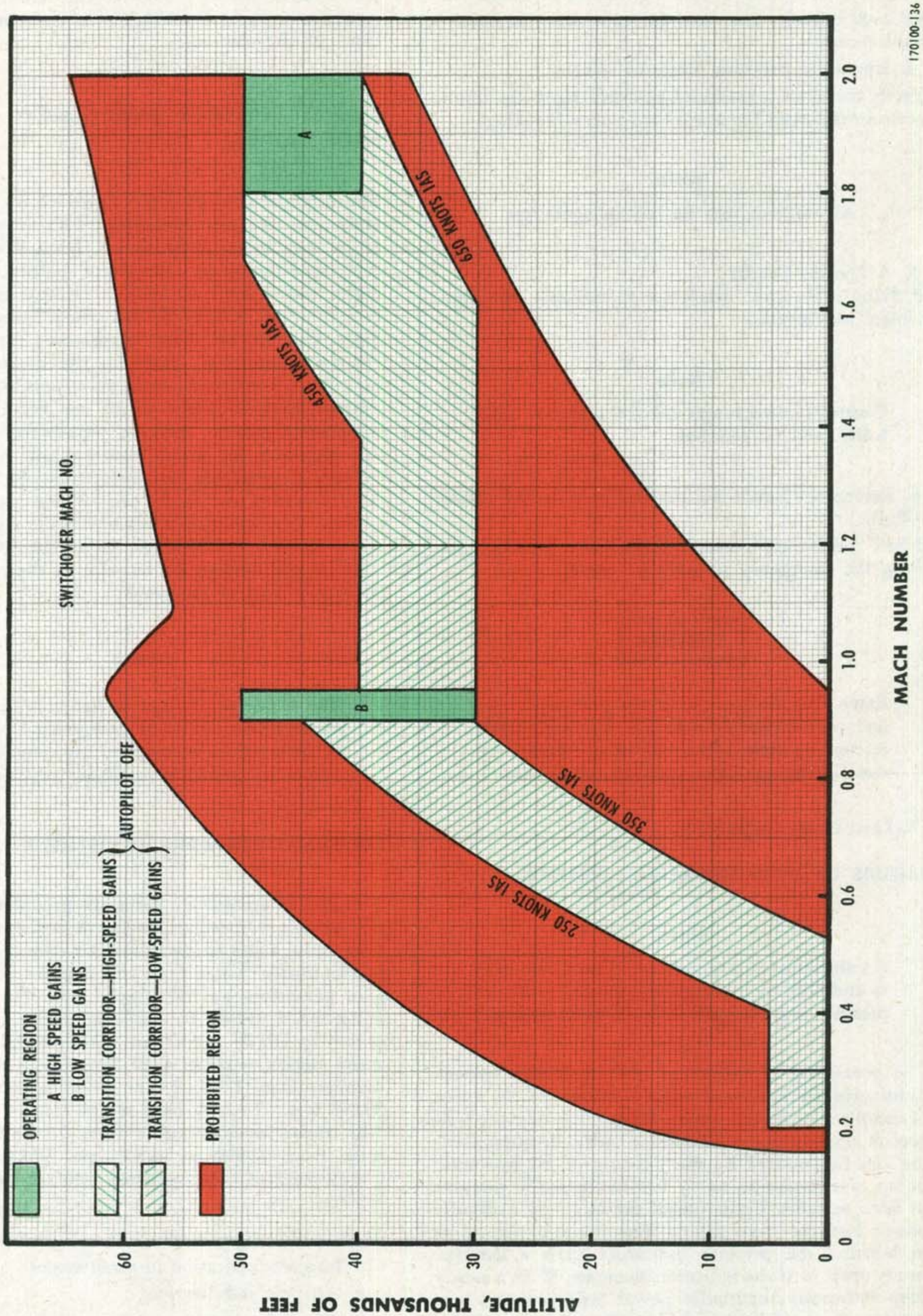

Figure 3-8.

If outside the operating regions or transition corridors (see figure 3-8), disengage autopilot. If it can be readily determined by switching off the individual damper switches that only one damper (yaw, roll, or pitch) is malfunctioning, turn off the affected damper. If this can not be determined, turn off all dampers. Then fly to the operating regions or transition corridor; then switch to emergency fixed gains; and re-engage dampers. Autopilot operation is permissible in the operating regions. Transition between these two regions must be made within the transition corridor with switchover from high speed to low speed gains at Mach No. 1.2. Autopilot operation is not allowed in the transition corridors. Landings will be performed with low speed gain. A malfunction of the automatic gains will be reflected to the pilot as a malfunction of the autopilot, the dampers, or the ratio changers. The possible symptoms resulting from such a malfunction encompass a broad region of abnormal flight control system performance that may range from an overdamped or underdamped airplane to hardover control surfaces. It is impossible to determine from the symptoms of the malfunction itself that the gain adjustment system is at fault; however, the pilot should suspect a discrepancy of the system if either of the following conditions are apparent: (1) An irregularity of the Machmeter, such as no change of indicated Mach number for a known flight condition change; (2) No changeover of the aileron ratio changer or the rudder feel spring gradient at Mach No. 0.6, or changeover at an incorrect Mach number. Since a gain adjustment system malfunction will not necessarily be evidenced by either of these indications, the only positive procedure for diagnosing such a malfunction is trial engagement of the emergency gains. If utilization of the emergency gains causes the malfunction to disappear, the trouble will have been isolated to the gain adjustment system, and the emergency gains should be used. The procedure for determining the malfunction and engaging the emergency gains is as follows:

1. Autopilot trigger switch—RELEASE.

If autopilot is engaged, depress switch to the second detent.

2. Autopilot engage switch—Check.

If autopilot engage switch did not return to OFF when autopilot trigger switch was depressed, position switch to OFF.

3. If malfunction disappears, position the autopilot engage switch to ENGAGE to determine if malfunction still exists.

4. If malfunction did not disappear when autopilot trigger switch was depressed, disengage the damper or dampers of the affected channel (roll and yaw or pitch).

5. When the malfunction has been isolated to a particular channel, the procedure for engaging the emergency gains may be started.

6. Elevator control available mode selector switch—As required.

Monitor elevator available and elevator position for 1-G flight during operation in the automatic mode. If elevator available is not maintained at the correct value, position the elevator control available mode selector switch to T.O. & LAND until the elevator control available indicator shows the desired reading; then switch to MANUAL.

7. Elevator control available manual adjust switch—INC or DEC (if required).

Hold the switch to INC or DEC as necessary to obtain the desired elevator control available.

WARNING

Structural protection is not assured during operation in the manual mode. However, selecting a desirable level of elevator control available with the elevator control available manual adjust switch will provide some measure of structural protection. The control available should be readjusted as flight conditions change. When using the emergency gains, the aileron ratio changer is in the full control available position and the airplane will be sensitive in roll.

8. Gain selector switch—As required.

Position switch to HIGH SPEED if above Mach No. 1.2, or to LOW SPEED if below Mach No. 1.2.

CAUTION

Keep within the operating regions of transition corridors.

9. Damper switches—As required.

If a damper channel was disengaged during the malfunction, the damper may be re-engaged. Then determine if the malfunction reappears.

10. Autopilot engage switch—As required.

If in the correct operating region and autopilot operation is desired, position the switch to ENGAGE and determine if malfunction reappears.

CAUTION

Disengage autopilot before entering transition corridors.

11. If the malfunction reappears when the damper and/or autopilot is re-engaged, the malfunction is not due to incorrect Mach-altitude gain adjustments. Flight must be continued manually.

flight control emergency procedures

Elevator Control System

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
NOSE UP OR DOWN.			
1. Autopilot trigger switch—RELEASE.	1. Autopilot malfunction	● Nose down or nose up may be abrupt or gradual. ● Normal pilot controlled flight will be available after corrective action is accomplished.	● Re-engage autopilot. Use only attitude stabilization of the longitudinal modes. Any lateral mode may be selected. ● Refrain from using autopilot if problem reoccurs.
2. Apply corrective stick.	1. Pitch damper runaway	● Nose up or down will be abrupt. ● Airplane will be lightly damped in pitch (may not be recognizable). ● Stick correction is initially required for level flight. However, stick for level flight will return to neutral as automatic trim operates. ● Turning pitch damper off normally will cause opposite pitch transient. If this transient does not occur, the pitch damper is stuck hardover. Automatic trim in correcting for this will provide more than normal elevator available for nose down runaway and less than normal elevator available for nose up runaway.	● Turn pitch damper off. Do not engage autopilot. ● Observe flight restrictions with pitch damper off. ● Refrain from large pitch maneuvers. ● For *nose up only*, if the transient does not occur when pitch damper is turned off, switch to TO & LAND; then to MANUAL at appropriate value of elevator available. ● For *nose up only*, use stick trim to reduce forces. ● For *nose up only*, maintain cg at least 2% ahead of normal aft limits. ● For *nose up only*, maintain adequate elevator available using elevator control available manual adjust switch.
	2. Stick trim runaway	● Nose up or nose down will be moderately rapid. ● About 12.5 lbs of force will be required to maintain level flight.	● Relieve force by using stick trim switch on control stick. ● If this does not reduce force, use the stick trim selector switch.

Figure 3-9. (Sheet 1 of 22)

	● Stick will be in neutral for level flight.	● If unsuccessful, autopilot can be used to relieve force. **Note** Large transient will occur at disengagement if stick is not held in trim position. ● For *nose up only* with elevator available greater than 7 degrees, switch to MANUAL. Reduction in elevator available will provide further reduction in stick force. **Note** Do not reduce elevator available less than value of elevator position for level flight. ● For *nose up only*, forward cg position will also relieve forces.
3. Inadvertent rapid deceleration or acceleration through the transonic region	● Nose up or nose down will be moderate and directly associated with change in airspeed. ● Stick force required to maintain level flight will ease off to zero as automatic trim catches up.	● Allow automatic trim to catch up. ● Do not use stick trim.
4. Automatic trim failure (Not runaway)	● Nose up or down will be gradual and associated with change in flight condition. ● Push or pull stick force will be required for level flight with changes in flight condition. ● Elevator available will not change automatically with elevator position for level flight.	● Switch to TO & LAND, then to MANUAL at appropriate value of elevator available. ● Use stick trim to reduce forces. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator available manual adjust switch.

Figure 3-9. (Sheet 2 of 22)

flight control emergency procedures

Elevator Control System

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
NOSE UP OR DOWN (Continued)			
	5. Automatic trim hard-over *(Nose up)*	● Nose up will be moderately rapid. ● Elevator will move to near full available (indicator at 20 degrees).	● Switch to TO & LAND, then to MANUAL. ● Adjust elevator available to appropriate value by using elevator available manual adjust switch. ● Use stick trim to reduce forces. ● Maintain cg at least 2% ahead of normal aft limits.
3. Select TO & LAND mode. (Two methods available.) a. Apply corrective stick to actuate force link switch (110 lbs), or b. Use elevator control available mode selector switch. **Note** With either method switch to MANUAL when sufficient value of elevator available is obtained.	1. Automatic trim failure (Not runaway) *(Nose down)*	● Nose over will be gradual and accompanied by change in flight condition (increase in speed). ● If this occurs at normal cruise speed, full back stick may not be sufficient to maintain altitude with acceleration to supersonic speed since elevator available will remain at near minimum value until corrective action is taken. ● Corrective action will result in the following: 1. Elevator will move to full available (indicator at 20 degrees). 2. Automatic trim will (a) remain stationary with elevator available less than 7 degrees, and (b) drive to 3 degrees up for elevator available greater than 7 degrees.	● Use stick trim to reduce forces. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator available manual adjust switch.

Figure 3-9. (Sheet 3 of 22)

	Note A controllable pitch transient will occur when elevator available reaches 7 degrees.	
2. Automatic trim hard-over	● Nose up or down will be moderately rapid. ● For *nose up,* sufficient control may not be attainable without corrective action. ● For *nose down,* elevator available will move to minimum (indicator at 2.0 degrees). Corrective action will result in the following: 1. Elevator available will move to full control available (indicator at 20 degrees). 2. Automatic trim will (a) remain stationary for elevator available less than 7 degree, and (b) drive to 3 degrees up for elevator available greater than 7 degrees. **Note** A controllable pitch transient will occur when elevator available reaches 7 degrees.	● Use stick trim to reduce forces. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator control available manual adjust switch.
3. Elevator ratio changer runaway to minimum *(Nose down)*	● This will only cause a nose down condition if rapid inadvertent acceleration from cruise speed accompanies malfunction. ● Elevator available will go to 0.8 degree or 2.0 degrees depending on malfunction.	● Use stick trim to reduce forces. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator control available manual adjust switch.

Figure 3-9. (Sheet 4 of 22)

flight control emergency procedures

Elevator Control System

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
NOSE UP OR DOWN (Continued)			
4. Actuate emergency increase elevator available handle *at least* 3 *times.*	1. Electrical failure of ratio changer *(Nose down)* 2. Automatic trim hardover *(Nose up)*	● This alone will not cause nose over maneuver. Use corrective action in the event that preceding action does not effect recovery. ● Using ratio changer emergency override handle is the final emergency procedure to obtain increased elevator available. Positive increase in elevator available can always be obtained unless there is a basically jammed PCLA. ● Corrective action will result in the following: 1. Elevator available will be manually increased. 2. Automatic trim will (a) remain stationary for elevator available less than 7 degrees, and (b) drive to 3 degrees up for elevator available greater than 7 degrees. **Note** A controllable pitch transient will occur when elevator available reaches 7 degrees.	● Adjust elevator available to desired value with emergency increase elevator available handle. **Note** Only an increase in elevator available can be obtained. ● Maintain cg at least 2% ahead of normal aft limits. ● Use stick trim to zero forces for level flight. ● If supersonic, use forward cg for deceleration. ● Use emergency increase elevator available handle to obtain full elevator available before landing.

Figure 3-9. (Sheet 5 of 22)

STICK MOTION RESTRICTED.

1. Autopilot trigger switch—RELEASE.	1. Autopilot on	• Normal autopilot operation is to resist stick motion.	
2. Autopilot engage switch—Check. Check that autopilot engage switch returns to OFF when autopilot trigger switch is depressed to the RELEASE position.	1. Autopilot trigger switch failed to disengage		
3. Elevator control available indicator — Check. If indicator reads low, accomplish the following: a. Switch to TO & LAND; then switch to MANUAL at sufficient value of elevator available. b. If elevator available fails to increase, return to AUTO for subsonic cruise. c. Prior to landing, pull emergency increase elevator available handle *at least 3 times.*	1. Elevator ratio changer runaway to minimum or jammed at low value	• Level flight is maintained by automatic trim. • Elevator available indicator reading is low. • Where large values of elevator position are required for "1-G" flight, little airplane maneuver can be obtained.	• Decelerate slowly to assure that automatic trim will keep up during transition through transonic region. • Maintain appropriate elevator available using elevator control available manual adjust switch. • Maintain cg at least 2% ahead of normal aft limit. • If elevator available can not be increased by using emergency increase elevator available handle, *do not attempt to land.*
4. If at supersonic speed and sufficient elevator available is indicated, establish 30% cg and decelerate to subsonic speed.	1. Insufficient hydraulic capacity (one system inoperative)	• Hydraulic caution lamps and indicators will indicate system malfunction. • May first be recognized by inability to produce positive desired load factors. • For extreme forward cg's it may be indicated by inability to hold level flight. • Stick cannot be pulled back but can be pushed forward.	• *Land as soon as possible.* • Shut down all unnecessary equipment on utility hydraulic system. • Avoid low altitude supersonic flight at forward cg locations.

Figure 3-9. (Sheet 6 of 22)

flight control emergency procedures

Elevator Control System

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
STICK FREE.			
1. Leave elevator control available mode selector switch in AUTO and move stick to operate automatic trim for aircraft control. **Note** Stick trim can be used for more rapid control if necessary.	1. Linkage failure	● Stick is free to move with no airplane response. ● Automatic trim should keep airplane near level flight only if stick is held in neutral.	● Flight to optimum ejection conditions can be attempted. ● If combination of automatic trim and stick trim is used: 1. Decelerate slowly through transonic region. 2. Avoid rapid thrust changes. 3. Do not fly in conditions requiring more than 7 degrees elevator for level flight. 4. Do not operate near aft cg limits subsonically.
2. Autopilot engage switch — ENGAGE.			● If autopilot is used: 1. Use autopilot Mach-altitude mode to maintain flight condition. 2. Use autopilot attitude stabilization mode when changing flight condition.
3. *Do not attempt to land.*			
STICK FREE IN ONE DIRECTION.			
1. Use stick trim in direction stick is free. Use enough trim so that force must be held for level flight. Leave the elevator control available mode selector switch in AUTO.	1. Cable failure	● Automatic trim will keep airplane near level flight. ● Normal "g" response will be available with stick motion in one direction but not the other.	● If stick trim is used: 1. Deceleration through transonic region should be slow. 2. Avoid rapid thrust changes. 3. Do not fly with conditions requiring more than 7 degrees elevator position for level flight.

Figure 3-9. (Sheet 7 of 22)

		● Using first step of corrective action provides control since the stick and input to the PCLA can be moved in one direction by the pilot and in the other direction by the stick trim feel spring when the pilot reduces force.	
2. Autopilot engage switch — ENGAGE.			● If autopilot is used: 1. Use Mach-altitude mode to maintain flight condition. 2. Use attitude stabilization mode when changing flight conditions. ● If landing attempted *(hazardous)*: 1. Transfer cg so that elevator position is 3 degrees up; then switch to TO & LAND. 2. Transfer cg within 3% of aft limit prior to landing. 3. Put in stick trim in direction stick is free. 4. Land at light gross weight. 5. Use landing technique which minimizes airplane rotation at landing.

OVER-SENSITIVE CONTROL WITH LOW ELEVATOR CONTROL AVAILABLE.

1. Autopilot engage switch — ENGAGE. 2. Move cg forward. 3. Increase airspeed (dive or thrust).	1. Center of gravity too far aft (in subsonic region)	● Airplane becomes increasingly sensitive to stick control even though elevator available is minimum. ● This is normally the result of a slowdown from supersonic or high subsonic speed with the cg position too far aft. This may be the result of inadvertent fuel transfer aft. ● If gyrations get large, additional control may be needed to keep the aircraft from becoming uncontrollable.	● Re-establish proper cg position.

Figure 3-9. (Sheet 8 of 22)

flight control emergency procedures

Elevator Control System

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
OVER-SENSITIVE CONTROL WITH HIGH ELEVATOR CONTROL AVAILABLE.			
1. Elevator control available mode selector switch — MANUAL. 2. Elevator control available manual adjust switch — DEC until appropriate value of elevator available is obtained. **Note** If elevator available cannot be reduced establish cg at 24% for subsonic flight.	1. Elevator ratio changer runaway to high available	● Level flight is maintained by automatic trim. ● Airplane is very sensitive to stick motion. ● Elevator available indicator reads larger than normal.	● Use stick trim to reduce forces. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator control available manual adjust switch.
ROLL AS WELL AS PITCH WHEN STICK DEFLECTED.			
1. Control stick — move fore or aft only—Attempt to free malfunction with stick motion fore or aft only. 2. Level Airplane—Level airplane using stick for pitch control and rudder (sideslip) for roll control. 3. Eject: a. Eject if flight condition allows	1. One elevon linkage, control valve, or surface actuator jammed.	● Since only one elevon is operating normally, it will provide roll as well as pitch, and the stick will only move diagonally (aileron as well as elevator). ● Some measure of control can be obtained by sideslipping to counter rolls while pitch attitude is maintained with stick.	● If malfunction cannot be freed and flight condition will not permit ejection, flight to more optimum conditions for ejection can be attempted but will be very hazardous. ● With these malfunctions there are only two possibilities of attaining a more optimum flight condition for ejection:

Figure 3-9. (Sheet 9 of 22)

ROLL AS WELL AS PITCH WHEN STICK DEFLECTED (Continued)

b. If not in flight condition allowing ejection—flight to more optimum ejection conditions can be attempted. *Very hazardous*		● It may be possible to free the malfunction by applying force at the stick. The force required to unstick a valve is a function of elevator and/or aileron available and should not exceed 150 pounds. However, maximum stick force may be applied if necessary.	1. Climb — This can be accomplished by: a. Slowly transferring center of gravity aft. b. Slowly increasing thrust. 2. Slowdown Turn — This can be accomplished by:
	2. One elevon linkage broken.	● Since one elevon is operating normally and there is no control over the other elevon, symmetrical stick deflection will cause roll as well as pitch. The inoperative elevon may creep either up or down from the position it held at time of failure. ● Some measure of control can be obtained by sideslipping to counter roll while pitch attitude is maintained with stick.	a. Switching to full aileron available. b. Slowly rolling airplane to initially lose altitude. During slowdown, roll angle can be used to control load factor and/or altitude. (A steep roll angle will result in a large loss of altitude and consequent high load factor). c. Upon reaching subsonic speeds: 1. Reduce thrust 2. Level airplane (airplane will pull load factor, climb, and lose speed).
c. Eject immediately. *Airplane control cannot be maintained*	3. One elevon linkage broken with rapid elevon motion. (Stick command, pitch damper command, or roll damper command).	● One elevon will drive hardover up or down (depending on the initial command) and the other elevon will operate normally. ● If one surface drives hardover down, the airplane will roll and nose down. If one surface drives hardover up, the airplane will roll and nose up. ● Airplane control cannot be maintained.	

AIRPLANE OSCILLATION IN PITCH.

1. Autopilot trigger switch — RELEASE.	1. Autopilot malfunction	● Oscillation may be very lightly damped, sustained or divergent. ● Stick will move with oscillation.	● Re-engage autopilot. Use only attitude stabilization mode. If oscillation is divergent, do not re-engage autopilot.

Figure 3-9. (Sheet 10 of 22)

flight control emergency procedures

Elevator Control System

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
AIRPLANE OSCILLATION IN PITCH (Continued)			
1. Autopilot trigger switch — RELEASE. (Continued)	1. Autopilot malfunction (Continued)	● Normal pilot controlled flight will be available after corrective action is accomplished.	
	2. Pitch damper failure (or runaway) while on autopilot	● Oscillation probably will be fairly divergent. ● Stick will move with oscillation while on autopilot. ● Airplane will be lightly damped in pitch after corrective action (may not be recognizable). ● Turning pitch damper off may cause nose up or nose down transient. ● See information on pitch damper runaway (nose up or down) to determine effect on elevator ratio changer setting.	● Do not re-engage autopilot. ● Turn pitch damper off. ● Observe flight restrictions with pitch damper off. ● Refrain from large pitch maneuvers.
2. Pitch damper switch — OFF.	1. Pitch damper malfunction	● Oscillation may be large. ● Stick will not follow oscillation.	● Do not engage autopilot. ● Observe flight restrictions with pitch damper off. ● Refrain from large pitch maneuvers.
3. Select TO & LAND mode. Switch to MANUAL when sufficient value of elevator available is obtained.	1. Automatic trim malfunction	● Oscillation will be slow. ● When airplane noses up, elevator available will increase; when it noses down, elevator available will decrease.	● Maintain adequate elevator control available by using elevator control available manual adjust switch. ● Maintain cg at least 2% ahead of normal aft limits.
4. Flight control power switch — OFF.	1. Autopilot or pitch damper malfunction with additional malfunction such that preceding corrective action did not turn off offending equipment	● All dampers and autopilot servos will be turned off.	● Place elevator control available mode selector switch to TO & LAND; then to MANUAL when sufficient elevator available is obtained.

Figure 3-9. (Sheet 11 of 22)

		● When in AUTOMATIC mode, elevator available and automatic trim will stay at value at time of turning power switch off. If TO & LAND or MANUAL is selected, normal operation will occur. ● Elevator available indicator will continue to operate.	● Use stick trim to reduce forces. ● Observe flight restrictions with dampers off. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator control available manual adjust switch.

STICK BUZZ.

1. Autopilot trigger switch — RELEASE.	1. Autopilot malfunction	● High frequency stick oscillation which is not followed by airplane. ● Normal pilot controlled flight will be available after corrective action is accomplished.	● Re-engage autopilot. Use only attitude stabilization mode. ● Refrain from using autopilot if problem reoccurs. ● Maintain cg at least 2% ahead of normal aft limits.
2. Pitch damper switch — OFF.	1. Pitch damper malfunction	● Small, high frequency stick oscillation which is not followed by airplane. It may not be noticed by pilot.	● Turn off pitch damper. Do not engage autopilot. ● Observe flight restrictions with damper off.
3. Flight control power switch — OFF.	1. Autopilot or pitch damper malfunction with additional malfunction such that preceding corrective action did not turn off offending equipment	● All dampers and autopilot servos will be turned off. ● When in AUTOMATIC mode, elevator available and automatic trim will stay at value at time of turning power switch off. If TO & LAND or MANUAL is selected, normal operation will occur. ● Elevator available indicator will continue to operate.	● Place elevator control available mode selector switch to TO & LAND; then to MANUAL at appropriate value of elevator available. ● Use stick trim to reduce forces. ● Observe flight restrictions with dampers off. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator control available manual adjust switch.

Figure 3-9. (Sheet 12 of 22)

flight control emergency procedures

Elevator Control System

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
CONTINUOUS LONG PERIOD CORRECTION OF PITCH ATTITUDE BY AUTOPILOT.			
1. Do not release autopilot. 2. Increase airspeed.	1. Cg too far aft (in subsonic region)	● Continuous small motion of stick will occur with long period oscillation. **WARNING** This stick motion may not be noticed; a dangerous condition will exist if autopilot is disengaged. ● This condition may result from slowdown from supersonic or high subsonic speed with the cg position too far aft. It may also be due to inadvertent fuel transfer aft.	● Re-establish proper cg position.
FORWARD STICK MOVEMENT WITHOUT AIRPLANE RESPONSE WHILE ON AUTOPILOT.			
1. Use post-emergency action.	1. Nose up automatic trim runaway while on autopilot	● Stick motion will be moderately rapid. Stick will move between 1/4 and 1/2 the way forward. ● Elevator control available indicator will read approximately 20 degrees available. ● Autopilot operation may be more abrupt and tend toward oscillation more than normal.	● If elevator required to trim is less than 3 degrees up, transfer fuel to move cg forward. ● Release autopilot. ● Select TO & LAND mode; then MANUAL. A moderately rapid nose down transient may occur, indicating automatic trim ran down to 3 degrees up. Sufficient control will be available since full elevator available will be set in.

Figure 3-9. (Sheet 13 of 22)

			● After transient, adjust elevator available to sufficient value, using the elevator control available manual adjust switch. ● Use stick trim to reduce forces.
LOSS OF STICK FEEL.			
1. Use post-emergency action.	1. Failure of stick feel spring	● Airplane control is maintained but there is no sense of feel. Also, there is no increase in force for stick motion; however, the airplane will respond. **Note** Airplane will appear very sensitive.	● Leave elevator available mode selector switch in AUTO until normal switchover to TO & LAND. ● Maintain cg at least 2% ahead of normal aft limit. ● Refrain from large pitch maneuvers. ■ ● Use autopilot.
Aileron and Rudder Control Systems			
ROLL OFF.			
1. Autopilot trigger switch — RELEASE.	1. Autopilot malfunction	● Roll off may be abrupt or gradual. ● Stick will move. ● Normal pilot controlled flight will be available after corrective action is accomplished.	● Re-engage autopilot. Do not use heading mode. ● Refrain from using autopilot if problem reoccurs.
2. Apply corrective stick.	1. Roll damper hardover	● Roll off will be abrupt. ● Stick will not move. ● Airplane will be lightly damped in roll (should be recognizable). ● With stick displaced to provide zero roll rate, turning off roll damper normally will cause abrupt roll in opposite direction. ● Stick will be out of center in opposite direction to maintain zero roll rate (before roll damper turned off).	● Turn off roll damper. Do not engage autopilot. ● Transient in opposite direction will most likely occur when roll damper centers itself. ● If transient does not occur when roll damper is turned off, it is most likely stuck at the hardover position. Use full aileron available for remainder of flight.

Figure 3-9. (Sheet 14 of 22)

flight control emergency procedures

Aileron and Rudder Control Systems

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
ROLL OFF (Continued)			
2. Apply corrective stick. (Continued)	1. Roll damper hardover (Continued)		● Refrain from large roll maneuvers. ● Observe flight restrictions with roll damper off.
	2. Stick trim runaway	● Roll off will be moderately rapid. ● About 7.5 lbs will be required to hold stick in neutral position. ● Stick will be in neutral position for zero roll rate. ● Changing aileron ratio changer will not reduce forces.	● Use stick trim to relieve forces. ● If this proves unsuccessful, autopilot may be used to relieve forces. **Note** Large transients will occur at disengagement if stick is not held in neutral position.
	3. Asymmetric fuel loading	● Gradual roll off. Particularly noticeable after steady sideslips or several turns in one direction.	● Fly straight and level for about 5 minutes. ● Caution should be observed to maintain adequate booster pump box fuel levels.
YAW.			
1. Maintain wings level with ailerons. 2. Reduce thrust to military (if in afterburner at other than takeoff). 3. Apply rudder gradually to reduce sideslip to zero.	1. Loss of thrust on one engine	● Yaw may be gradual, moderate, or abrupt. ● Malfunction will be difficult to determine from airplane response. Engine instruments will provide best clue. ● Straight ground track can not be maintained without slight sideslip or bank angle.	● If asymmetric thrust condition can not be corrected, set up cruise as follows: 1. Wings level 2. Slight sideslip with nose away from malfunctioning engine 3. Rudder trim to make nose go away from malfunctioning engine.

Figure 3-9. (Sheet 15 of 22)

2. Yaw damper runaway	● Yaw will be abrupt. ● Airplane may be lightly damped or undamped in Dutch roll oscillation. ● Rudder pedals will be out of neutral for zero sideslip flight. ● Straight ground track can be maintained without sideslip or bank.	● Turn off yaw damper. **Note** Similar transient may occur in opposite direction. If Dutch roll oscillation is damped, reduce airspeed to 500 knots before turning off yaw damper. With yaw damper off, observe flight restrictions. ● Refrain from large maneuvers. ● Do not engage autopilot. ● If emergency gains correct malfunction and mission must be completed above Mach No. 1.4, select emergency gains. Otherwise, operation should be limited to below Mach No. 1.4.
3. Pedal trim runaway	● Yaw will be moderately abrupt. ● About 35 lbs of force must be held to maintain zero sideslip. ● Rudder pedals will be in neutral for zero sideslip flight.	● Above Mach No. 0.6 do not use rudder trim until rudder is neutralized with rudder pedals. Relief of rudder pedal trim force can be obtained above Mach No. 0.6 by deflecting rudder pedals against the force (beyond neutral), actuating the rudder trim switch and then returning the pedals to neutral. Extent of force relief is limited by maneuver commanded by pedal deflection. ● If this proves unsuccessful, pilot must hold force. Autopilot operation will not alleviate the need for pilot to hold forces. Flight at speeds below Mach No. 0.6 will reduce the force to be held.

Figure 3-9. (Sheet 16 of 22)

flight control emergency procedures

Aileron and Rudder Control Systems

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
LATERAL-DIRECTIONAL OSCILLATION.			
1. Autopilot trigger switch — RELEASE.	1. Autopilot malfunction	● Oscillation may be lightly damped, sustained, or divergent. ● Stick will be moving during oscillation. ● Normal pilot controlled flight will be available after autopilot is disengaged.	● Re-engage autopilot. Use only attitude stabilization mode. If divergent oscillation occurs, do not re-engage autopilot.
	2. Roll or yaw damper failure (or runaway) while on autopilot	● Oscillation must be lightly damped, sustained, or divergent. ● Stick will be moving during oscillation. ● Airplane has lightly damped Dutch roll oscillation after autopilot is disengaged.	● Do not re-engage autopilot. ● Turn yaw damper off if oscillation persists. ● If rudder or aileron control deflection is required for trim, turn off yaw or roll damper. **Note** When the damper is turned off, a significant transient will probably occur. ● If dampers are turned off, observe flight restrictions and avoid large maneuvers.
2. Reduce thrust to military (if in afterburner at other than takeoff).	1. Afterburner cycling	● Afterburner cycling will cause Dutch roll oscillation. ● Oscillation should stop after corrective action.	● Oscillation may stop after airspeed change associated with thrust reduction. This indicates a malfunction other than afterburner cycling. (See damper malfunction discussion.)

Figure 3-9. (Sheet 17 of 22)

3. Roll and yaw damper switches — OFF.	1. Roll and/or yaw damper malfunction	● Airplane will be lightly damped with both dampers off.	● Turn roll damper on. 1. If no oscillation occurs, leave damper on. Do not use yaw damper. 2. If oscillation starts, turn roll damper off. ● Turn yaw damper on. 1. If no oscillation occurs, leave damper on. 2. If oscillation starts, turn yaw damper off. ● Observe restrictions with dampers off.
4. Flight control power switch — OFF.	1. Autopilot or damper malfunction such that preceding corrective action did not turn off offending equipment	● All dampers and autopilot servos will be turned off. ● Elevator ratio changer and autotrim will stay in the position they were in at time of turning power switch off. Normal operation will occur if either TO & LAND or MANUAL mode is selected.	● Place elevator available mode selector switch to TO & LAND; then to MANUAL when sufficient value of elevator available is obtained. ● Use stick trim to reduce forces. ● Observe flight restrictions with dampers off. ● Maintain cg at least 2% ahead of normal aft limits. ● Maintain adequate elevator available by using elevator available manual adjust switch. ● Leave aileron control available switch in AUTO.

EXTREME SENSITIVITY IN YAW AT HIGH SUPERSONIC SPEED.

1. Decelerate to Mach No. 1.4 by reducing thrust to military on inboard engines. **Note** Thrust reduction must be symmetrical.	1. Yaw damper failure at near restricted high speed or the cg too far aft	● This is only critical when operating near the aft cg limits. It is most critical when the airplane is carrying a pod.	● Transfer fuel to move cg forward if deceleration is not possible. ● If any oscillation is noticed after or during deceleration to Mach No. 1.4, turn yaw damper off.

Figure 3-9. (Sheet 18 of 22)

flight control emergency procedures

Aileron and Rudder Control Systems

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
EXTREME SENSITIVITY IN YAW AT HIGH SUPERSONIC SPEED (Continued)			
1. Decelerate to Mach No. 1.4 by reducing thrust to military on inboard engines. **Note** Thrust reduction must be symmetrical. (Continued)	1. Yaw damper failure at near restricted high speed or the cg too far aft (Continued)	● Airplane will tend to wallow directionally or have a tendency not to return from a sideslip angle. ● Any thrust asymmetry is serious. A sudden engine failure may be disastrous.	● Observe flight restrictions with yaw damper off.
STICK RESTRICTED. (LOSS OF ROLL MANEUVER CONTROL)			
1. Autopilot trigger switch — RELEASE.	1. Autopilot on	● Normal autopilot operation is to resist stick motion.	
2. Autopilot engage switch — Check. Check that autopilot engage switch returns to OFF when autopilot trigger switch is depressed to the RELEASE position.	1. Autopilot trigger switch failed to disengage.		
3. Control roll by sideslipping.	1. Jammed aileron channel	● Some measure of roll control is available by sideslipping airplane. Nose right sideslip will pick up left wing and vice versa. **Note** When carrying a pod at near restricted high speed, this will be reversed.	● Do not turn roll damper off.

Figure 3-9. (Sheet 19 of 22)

4. Check for hydraulic system malfunction.	1. Insufficient hydraulic capacity (one system inoperative). Elevons or rudder may be limited by hinge moment.	● Hydraulic caution lamps and indicators will indicate system malfunction. ● Stick or rudder pedal movement will be heavily restricted.	● *Land as soon as possible.* ● Shut down all unnecessary equipment on utility hydraulic system. ● Move cg aft to 30% before decelerating from supersonic speed. ● Avoid low altitude supersonic flight at forward cg locations.

STICK FREE IN BOTH DIRECTIONS. (LOSS OF ROLL MANEUVER CONTROL)

1. Use stick trim to control airplane. 2. Autopilot engage switch — ENGAGE.	1. Linkage failure	● Stick free to move with no airplane response.	● Use sideslip for additional control. ● Place aileron control available switch to FULL.

STICK FREE IN ONE DIRECTION. (LOSS OF ROLL MANEUVER CONTROL)

1. Use stick trim to control airplane.	1. Cable failure	● Normal roll response will be available with stick motion in one direction, but not in the other. ● Roll control by the stick can be obtained by trimming stick in direction stick is free so that force must be held for zero roll. This provides control since the input to the PCLA is moved in one direction by stick motion and in the other direction by the stick feel spring as the pilot reduces force.	● If stick trim is used: 1. Place aileron control available switch to FULL. 2. Use sideslip for additional roll control.
2. Autopilot engage switch — ENGAGE.			● If autopilot is used: 1. Place aileron control available switch to AUTO. 2. Use attitude stabilization mode.

Figure 3-9. (Sheet 20 of 22)

flight control emergency procedures

Aileron and Rudder Control Systems

CORRECTIVE ACTION (Order Determined by Degree of Emergency)	POSSIBLE FAILURE (If Alleviated by Corrective Action)	CHARACTERISTICS OF FLIGHT (If Malfunction Caused by Possible Failure)	POST-EMERGENCY ACTION (Use Recommended Sequence)
PEDAL MOTION RESTRICTED. (LOSS OF YAW CONTROL)			
1. Control yaw with asymmetric thrust.	1. Jammed rudder channel	● Roll and yaw dampers will probably keep airplane damped.	● Decelerate to subsonic speed. ● Avoid large or abrupt rolls at subsonic speed. ● Do not turn yaw damper off.
2. Check for hydraulic system malfunction.	1. Insufficient hydraulic capacity (one system inoperative)	● Hydraulic caution lamps and indicators will indicate system malfunction.	● *Land as soon as possible.* ● Shut down all unnecessary equipment on utility hydraulic system. ● Move cg aft to 30% before decelerating from supersonic speed. ● Avoid low altitude supersonic flight with forward cg locations.
PEDALS FREE IN BOTH DIRECTIONS. (LOSS OF YAW CONTROL)			
1. Use rudder trim to maintain straight flight. 2. Use asymmetric thrust to obtain additional control.	1. Linkage failure	● Roll and yaw damper will probably keep airplane well damped and coordinated during turns. ● Greatest danger is occurrence of asymmetric thrust either slowly or abruptly.	● Decelerate to subsonic speed. ● Avoid large or abrupt rolls at low speed. ● Do not turn roll or yaw dampers off.

Figure 3-9. (Sheet 21 of 22)

PEDALS FREE IN ONE DIRECTION. (LOSS OF YAW CONTROL)

1. Use rudder trim to maintain straight flight. 2. Use asymmetric thrust to obtain additional control.	1. Cable failure	● Normal directional control will be available with pedal movement in one direction but not in the other. ● Directional control to pedals can be obtained by trimming rudder in direction pedals are free, so that force is required to maintain straight flight. This provides control since input to PCLA is moved in one direction by pedal motion and in the other direction by the pedal feel spring as the pilot reduces forces.	● Decelerate to subsonic speed. ● Maintain balanced thrust. ● Avoid large or abrupt rolls at low speed.

Figure 3-9. (Sheet 22 of 22)

LANDING GEAR SYSTEM EMERGENCY OPERATION.

1. Landing gear handle — DOWN.
2. Emergency brake and landing gear control handle —Pull. Pull handle out to extend gear.

CAUTION

Do not exceed airspeed limits for emergency landing gear extension and do not attempt to retract gear after an emergency gear extension.

Note

If the emergency system is used to extend the gear, only emergency brakes will be available for landing.

BRAKE SYSTEM EMERGENCY OPERATION.

1. Emergency brake and landing gear control handle — Pull (if required).

If the emergency brake and landing gear control handle is not already pulled as a result of emergency gear extension, pull the handle out through its full length of travel to pressurize emergency brake system.

2. Brakes — Apply as required.

Operate brake pedals as required for stopping airplane.

CAUTION

With extremely cold temperatures, a minimum of three full brake applications can be obtained with normal pressure in the emergency system. The pilot must, therefore, apply the brakes with a gradual steady pressure and avoid releasing them until the desired braking action has been accomplished.

AIR CONDITIONING SYSTEM EMERGENCY OPERATION.

CABIN PRESSURIZATION FAILURE.

Unpressurized Cabin Above 8000 Feet.

1. Cabin pressure selector knob — COMBAT or NORMAL (as required).
2. Altitude — Minimum consistent with normal safety procedures.

TEMPERATURE CONTROL MALFUNCTIONS.

Electronic Overheat Caution Lamp Lights.

1. Flow switch — REVERSE (if applicable).
2. No. 2 and 3 throttles — Set to 90 percent rpm (or above).

Set rpm on inboard engines to at least 90 percent and allow 2.5 minutes for the lamp to go out. If the lamp remains on proceed to next step.

3. Control mode selector knob — MAN.

Place the mode selector knob to MAN and check that the overheat lamp goes out. If the lamp remains lighted after approximately 4 minutes, proceed with the following steps.

4. Altitude and airspeed—Within ram air limits.

Adjust altitude and airspeed within limits for ram air operation. (Refer to "Airspeed Limitations," Section V.)

5. Control mode selector knob — RAM.
6. Electronic equipment — Off (if necessary).

Turn off all electronic equipment which requires cooling and is not absolutely required to be in operation.

Note

If an overheat condition exists which cannot be corrected, land as soon as practical.

All Crew Compartments Overheated.

1. Control mode selector knob — MAN.

Note

Allow a reasonable length of time for the cabin temperature to lower before making further adjustments. If the temperature is still too high, proceed with step 2.

2. Flow switch — RESET TO NORMAL, (if required).

If the system is in reverse flow, position the flow switch to RESET TO NORMAL momentarily to return the system to normal operation. If the condition still exists, proceed with the following steps.

3. Refrigeration temperature indicators — Check.

If the temperature of one unit is appreciably higher than that of the other unit, the unit which is overheated should be shut down according to the following step.

4. Refrigeration unit selector knob — L or R (as required).

Select the refrigeration unit which is not overheating. If, after a reasonable length of time the condition still exists, proceed with the following steps.

5. Airspeed and altitude — As required.

If required, reduce altitude and airspeed to comply with ram air operating limits. (Refer to "Airspeed Limitations," Section V.)

6. Control mode selector knob — RAM.

7. Electronic equipment — Off (as required). Turn off all electronic equipment which requires cooling and is not absolutely required to be in operation.

Note

If an overheat condition exists which cannot be corrected, land as soon as practical.

Pilot's Compartment is Overheated.

1. Windshield defog switch — DEC.
2. Windshield defog outlet — Check.

Place hand above glare shield to see whether defog system is off. If not, proceed with step 3.

3. Control mode selector knob—MAN.

Note

Allow sufficient time for the manual control to change the cabin temperature. If the condition still exists, proceed with the following steps.

4. Altitude and airspeed — Reduced (if necessary). If required, reduce altitude and airspeed to comply with ram air operating limits. (Refer to "Airspeed Limitations," Section V.)

5. Control mode selector knob — RAM.

6. Electronic equipment — Off (as required). Turn off all electronic equipment which requires cooling and is not absolutely required to be in operation.

Note

If an overheat condition exists which cannot be corrected, land as soon as practical.

Cabin Too Cold.

During either automatic or manual modes of control, if cabin temperatures become extremely cold, shut down one refrigeration unit as follows:

1. Control mode selector knob — AUTO or MAN (as required).
2. Air source selector knob — BOTH.
3. Refrigeration unit selector knob — L or R (as desired).
4. Cabin temperature control knob — WARM (as required).

UNLOCKED CANOPY INDICATION DURING FLIGHT.

In case the canopy unlock caution lamp comes on during flight, immediately descend (if at high altitude) and reduce speed as much as possible. (Refer to "Emergency Descent.") Accomplish the following steps during descent.

1. Cabin pressure selector knob — COMBAT (above 30,000 feet).

Select combat pressure schedule during initial descent if flying at altitudes above 30,000 feet when lamp becomes lighted.

2. Cabin pressure selector knob — DUMP (below 30,000 feet).

Dump cabin pressure below 30,000 feet if lamp remains lighted.

3. Airspeed — Reduce.

Maintain low subsonic airspeeds to minimize turbulence in cabin in the event of loss of canopy during flight.

4. Land as soon as possible (especially if lamp is still lighted).

INFLIGHT GLASS PANEL FAILURE.

The glass panels of the windshield and windows are constructed of two plies of tempered glass bonded together by a silicone rubber interlayer. A panel failure is readily recognizable, as the tempered plate glass layers will crack (craze) over their entire surface, reducing visibility to zero. Normally a crazed panel will not blow out if the silicone rubber interlayer between the two glass layers is good. The following emergency procedures are recommended as an added precaution against complete panel blowout and explosive decompression in case of panel failure.

GLASS PANEL FAILURE WHEN SUPERSONIC.

1. Cabin pressure selector knob — COMBAT.

If the cabin pressure selector knob is at NORM when the glass panel failure occurs, immediately reposition the knob to COMBAT.

WARNING

When the pressure schedule is changed from normal to combat, monitor the cabin pressure altimeter for a rapid increase in the cabin altitude. If the cabin altitude does not increase, immediately position the cabin pressure selector knob to DUMP.

2. Decelerate and descend.
3. Cabin pressure selector knob — DUMP when subsonic.
4. Land as soon as practicable.

GLASS PANEL FAILURE WHEN SUBSONIC.

1. Cabin pressure selector knob — DUMP.
2. Land as soon as practicable.

emergency increase of elevator available

DATA BASIS: CALCULATED
DATE: 8 JANUARY 1959

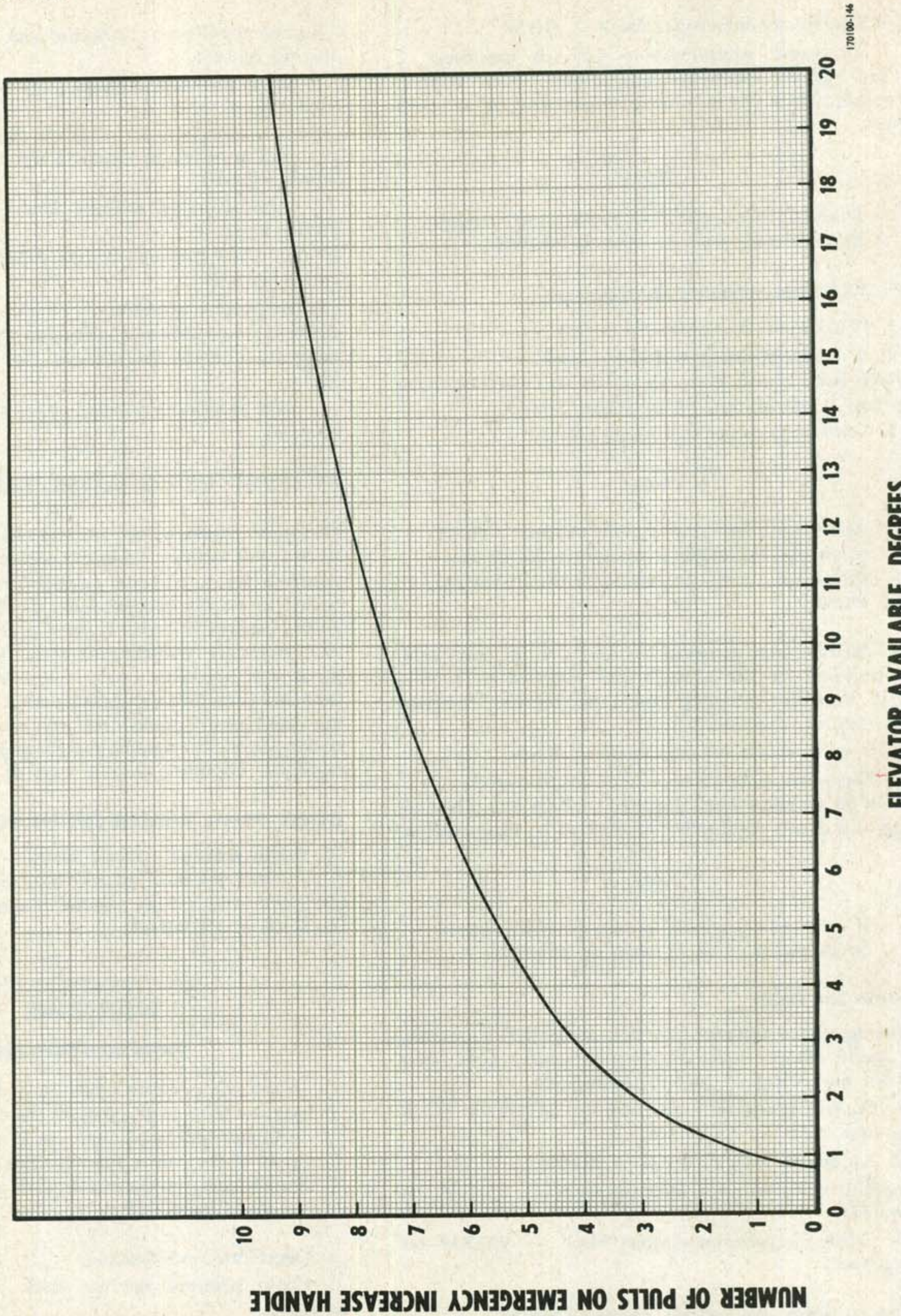

Figure 3-10.

CUT ON BLACK LINE

B/RB-58A
EMERGENCY CONDENSED CHECK LIST
AIRPLANE DESIGNATION CODES:

31 59-2428	34 59-2431	37 59-2434
32 59-2429	35 59-2432	38 59-2435
33 59-2430	36 59-2433	➧ "through" or "and on"

Example: Information applicable to airplanes AF 59-2428 through AF 59-2430 would be coded 31 ➧ 33. Information applicable to airplanes AF 59-2433 and on would be coded 36 ➧.

ENGINE FAILURE.

ENGINE FAILURE DURING TAKEOFF, TAKEOFF REFUSED.

1. Accomplish abort procedure.
2. Affected engine throttle—OFF.
3. Fire pull switch of affected engine—PULL, if required.

ENGINE FAILURE DURING TAKEOFF, TAKEOFF CONTINUED.

1. Landing gear handle—UP.
2. Affected engine throttle—OFF.
3. Fire pull switch of affected engine—PULL, if required.

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CHANGED 27 NOVEMBER 1959

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CUT ON BLACK LINE

ENGINE SHUTDOWN DURING FLIGHT.

1. Throttle of affected engine—OFF.
2. Affected generator control switch—OFF (if applicable).

ENGINE RESTART DURING FLIGHT.

1. Fire pull switch—IN.
2. Throttle—OFF.
3. Spike position switch—IN.
4. Generator control switch—OFF (as applicable).
5. Airspeed—Within air start envelope.
6. Engine start switch—AIR.
7. Throttle—Move beyond IDLE, then back to IDLE.
8. Engine start switch—OFF after light-off.
9. Generator control switch—RESET.
10. A-C meter selector knob—As required.
11. Throttle—Advance to desired power.

Engine Restart After Four-Engine Flameout.

1. Engine start switches—AIR.
2. Throttles—IDLE.
3. Reservoir tank booster pump switch—NORM.
4. Throttles—Adjust as required.
5. Fuel control panel—Check.
6. Electrical control panel—Check.

Unsatisfactory Air Start.

1. Throttle—OFF.
2. Engine start switch—OFF.

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CUT ON BLACK LINE

FIRE.

ENGINE FIRE ON GROUND.

1. Applicable fire pull switch—Pull.
2. Throttles—IDLE.
3. Air source selector knob—L or R (if applicable).

ENGINE FIRE DURING TAKEOFF, TAKEOFF REFUSED.

1. Accomplish abort procedure.
2. Affected engine fire pull switch—Pull.
3. Affected engine throttle—OFF.

Note

If a stop cannot be made before reaching an obstacle, perform these additional steps.

4. Remaining fire pull switches—Pull.
5. Remaining throttles—OFF.
6. Landing gear and brake emergency handle—Pull.
7. Canopy jettison handle—UP, if necessary.

ENGINE FIRE DURING TAKEOFF, TAKEOFF CONTINUED.

1. Landing gear handle—UP.
2. Affected engine throttle—IDLE.
3. Affected fire pull switch—Pull (if fire continues).
4. Affected engine throttle—OFF (if fire continues).

CAUTION

Do not attempt to restart the engine.

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CUT ON BLACK LINE

ENGINE FIRE DURING FLIGHT.

1. Applicable fire pull switch—Pull.
2. Affected engine throttle—OFF.

CAUTION

Do not attempt to restart the engine.

FUSELAGE FIRE.

CAUTION

All crew members must go on 100 percent oxygen.

1. Cabin pressure selector knob—DUMP.
2. Nonessential electrical equipment—Off.
3. Air conditioning control mode selector knob—MAN.
4. When normal operations can be resumed, return equipment and systems to original operation.

EJECTION.

IMMEDIATE ESCAPE.

Pilot Only.

1. **Notify crew—"BAIL OUT, BAIL OUT, BAIL OUT."**
2. Bailout switch—BAILOUT.

All Crew Members.

3. Helmet visor—Down.
4. **Bailout bottle—Actuated.**
5. Insert hands through arm restraint loops.

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CUT ON BLACK LINE

E E E E E E E E E

6. **Seat handgrips—Up and locked.**
7. **Ejection triggers—Squeeze.**

IF TIME AND CONDITIONS PERMIT.

Pilot Only.

1. Bailout switch—ALERT.
2. Coordinate ejection sequence with crew.
3. Air speed—Check.

WARNING

Decelerate to at least 530 knots IAS before ejecting.

4. Trim for nose up attitude and engage autopilot.
5. Stow all loose equipment.
6. Cabin pressure selector knob—DUMP.
7. **Give final ejection order over interphone and/or place bailout switch to BAILOUT position.**

All Crew Members.

1. Personal gear—Secured.
2. Helmet visor—Down.
3. **Bailout bottle—Actuated.**
4. **Assume ejection position.**
5. Insert hands through arm restraint loops.
6. **Seat handgrips—Up and locked.**
7. **Ejection trigger—Squeeze.**

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CUT ON BLACK LINE

TAKEOFF AND LANDING EMERGENCIES.

ABORT.

1. Throttles—IDLE.
2. Drag chute—Deploy.
3. Brakes—Apply.
4. No. 1 and 4 engine throttles—OFF (if desired).

LANDING EMERGENCIES.

Nose Gear Up or Unlocked.

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

Do not jettison pod until a safe airplane cg has been established.

3. Nonessential electrical and electronic equipment—Off.
4. Battery switch—OFF.
5. Landing cg—Check.
6. Fuel system configuration—Check.
7. Landing data—Check.
8. No. 1 and 4 engine fire pull switches—Pull.
9. Execute a normal flare and touchdown at an angle of attack of approximately 16 degrees.

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10. Canopies—Jettison.
11. Manual cg shift switch—AFT.
12. No. 2 and 3 throttles—OFF.
13. Abandon the airplane.

One Main Gear Up or Unlocked.

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

Do not jettison pod until a safe airplane cg has been established.

3. Nonessential electrical and electronic equipment—Off.
4. Battery switch—OFF.
5. Landing cg—Check.
6. Fuel system configuration—Check.
7. Landing data—Check.
8. No. 1 and 4 engine fire pull switches—Pull.
9. Inertia reel lock handle—MANUAL LOCK.
10. Approach and touchdown angle of attack—16 degrees (approximately).
11. Canopies—Jettison.
12. Drag Chute—Deploy (after touchdown).
13. Brakes—As required.
14. Nose Wheel Steering—As required.

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15. No. 2 and 3 throttles—OFF (immediately before nacelle contacts runway).
16. Abandon the airplane.

Both Main Gear Up or Unlocked.

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

Do not jettison the pod until a safe airplane cg has been established.

3. Nonessential electrical and electronic equipment—Off.
4. Landing cg—Check.
5. Fuel system configuration—Check.
6. Landing data—Check.
7. No. 1 and 4 engine fire pull switches—Pull.
8. Inertia reel lock handle—MANUAL LOCK.
9. Touchdown angle of attack—12 degrees (maximum).

WARNING

A landing with the angle of attack exceeding 12 degrees is likely to result in an extreme pitchdown of the nose at the time of initial contact with the runway.

10. Canopies—Jettison.

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CUT ON BLACK LINE

E E E E E E E E E

11. No. 2 and 3 engine throttles—OFF (immediately before touch-down).

WARNING

Do not exceed a sink rate of 120 feet per minute at time of touchdown.

12. Nose wheel steering—As required (after touchdown).
13. No. 2 and 3 engine fire pull switches—Pull (after stopping).
14. Battery switch—OFF.
15. Abandon the airplane.

All Gear Up or Unlocked (Belly Landing).

1. Crew—Alerted.
2. Pod—Jettison.

WARNING

Do not jettison the pod until a safe airplane cg has been established.

3. Nonessential electrical and electronic equipment—Off.
4. Battery switch—OFF.
5. Landing cg—Check.

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E E E E E E E E E

CUT ON BLACK LINE

6. Fuel system configuration—Check.
7. Landing data—Check.
8. No. 1 and 4 engine fire pull switches—Pull.
9. Inertia reel lock handle—MANUAL LOCK.
10. No. 2 and 3 throttles—OFF.
11. Execute a normal flare and touchdown at an angle of attack of approximately 12 degrees.

WARNING

- A landing with an angle of attack exceeding 12 degrees is likely to result in an extreme pitchdown of the nose at the time of initial contact with the runway.
- Sinking speeds in excess of 120 feet per minute will probably fail the inboard nacelles and supporting structure on initial impact.

12. Canopies—Jettison.
13. Drag chute—Deploy.
14. Utilize rudder for directional control.
15. Abandon the airplane.

ABANDONING THE AIRPLANE ON THE GROUND.

1. Notify crew—"ABANDON AIRPLANE."
2. Canopies—Jettisoned (or open).
3. Oxygen control lever—OFF.
4. Kit release handle—Pulled.

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E E E E E E E E E

CUT ON BLACK LINE

5. Upper (knee belt) and lower (ankle strap) leg restraints—Unfastened (if installed).
6. Safety belt—Unfastened.
7. Exit from compartment (using escape rope or jumping to ground).

EMERGENCY JETTISONING.

FUEL DUMPING.

1. Airspeed—Check
2. Fuel panel configuration—Check.
3. Fuel dump switch—DUMP.
4. Fuel dump switch—NORM.

Airspeed Limits for Fuel Dumping.

Altitude (Feet)	Maximum Airspeed For Fuel Dumping (knots—IAS)
Sea Level	295
5000	270
10,000	245
15,000	225
20,000	200
25,000	185
30,000	165

CANOPY JETTISONING.

1. Helmet visor—Down.
2. Canopy seal control lever—UNSEALED.
3. Canopy jettison handle—Pull up.

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POD JETTISONING.

WARNING

It is not recommended that the pod be jettisoned immediately after takeoff. Jettisoning the pod at takeoff gross weights will cause the airplane to become extremely unstable with probable catastrophic results.

1. Elevator control available mode selector switch—AUTO.

Note

If the elevator available is less than three degrees, set the elevator control available mode selector switch to TO & LAND until the elevator control available indicator shows three degrees; then move the switch to MANUAL.

2. Mach No.—Check.
3. Center of gravity—Check.
4. Pod safety lockpin release handle—Pulled out.
5. Pod pin out caution lamp—Lighted.
6. Pod lockpin indicator—OUT.

WARNING

If cg is determined to be near the established limits, initiate a slight pitchdown maneuver concurrent with releasing pod.

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7. Pod release switch—POD RELEASE.
8. Pod emergency release handle—Pulled out (if required).

OIL SYSTEM EMERGENCY PROCEDURES.

1. Throttle of affected engine—OFF.
2. Generator of affected engine—OFF.
3. Avoid high "G" maneuvers.

ELECTRICAL SYSTEM EMERGENCY CONTROL.

FAILURE OF TWO GENERATORS.

1. Power setting and altitude—Reduce.
2. Spike position switches—IN.
3. Battery switch—ON.
4. Land as soon as possible.

Restoring Electrical Power to Pod and DECM Equipment.

1. A-C power load—Reduce as necessary.
2. Pod and DECM power switch—RESET.

HYDRAULIC SYSTEM EMERGENCY PROCEDURES.

LIGHTING OF ONE HYDRAULIC PUMP CAUTION LAMP.

1. Minimize duration of flight.
2. Minimize use of flight controls to the slowest safe rate of motion.
3. When extending landing gear, keep engine rpm for good pump in that system higher than normal.

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LIGHTING OF ONE HYDRAULIC PUMP CAUTION LAMP IN EACH SYSTEM.

1. Minimize use of flight controls to the slowest safe rate of motion.
2. If supersonic, decelerate to subsonic and avoid abrupt maneuvers.
3. Emergency brake and landing gear control handle—Pull.
4. Land as soon as possible.

FAILURE OF ONE HYDRAULIC SYSTEM.

1. Hydraulic reservoir quantity indicator—Check.
2. Discontinue use of turret, autopilot, and search radar if not essential.
3. Hydraulic reservoir quantity indicator—Recheck.
4. Hydraulic pressure indicator—Check.
5. Airspeed—Check.
6. Emergency brake and landing gear control handle—Pull.
7. Land as soon as possible.

FLIGHT CONTROL EMERGENCY PROCEDURES.

MACH-ALTITUDE GAIN ADJUSTMENT FAILURE.

1. Autopilot trigger switch—RELEASE.
2. Autopilot engage switch—Check.
3. If malfunction disappears, position the autopilot engage switch to ENGAGE to determine if malfunction still exists.
4. If malfunction did not disappear when autopilot trigger switch was depressed, disengage the damper or dampers of the affected channel (roll and yaw or pitch).
5. When the malfunction has been isolated to a particular channel, the procedure for engaging the emergency gains may be started.

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6. Elevator available switch—As required.
7. Elevator available manual adjust switch—INC or DEC (if required).
8. Gain selector switch—As required.
9. Damper switches—As required.
10. Autopilot engage switch—As required.
11. If the malfunction reappears when the damper and/or autopilot is re-engaged, the malfunction is not due to incorrect Mach-altitude gain adjustments. Flight must be continued manually.

ELEVATOR CONTROL SYSTEM.

Nose Up or Down.

1. Autopilot trigger switch—RELEASE.
2. Apply corrective stick.
3. Select TO & LAND mode; then MANUAL when sufficient elevator control is available.
4. Emergency increase elevator available handle—Actuate *at least 3 times.*

Stick Motion Restricted.

1. Autopilot trigger switch—RELEASE.
2. Autopilot engage switch—Check.
3. Elevator control available indicator—Check.
   If indicator reads low, accomplish the following:
   a. Select TO & LAND mode; then MANUAL when sufficient elevator control is available.
   b. Return to AUTO, if elevator available fails to increase.
   c. Prior to landing, pull emergency increase elevator available handle *at least 3 times.*

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4. If supersonic with sufficient elevator available, establish 30 percent cg and decelerate to subsonic speed.

Stick Free.

1. Elevator control available mode selector switch—AUTO.

Note

Move stick to operate automatic trim for aircraft control. Stick trim can be used for more rapid control if necessary.

2. Autopilot engage switch—ENGAGE.
3. *Do not attempt to land.*

Stick Free in One Direction.

1. Use stick trim in direction stick is free.

Note

Use enough trim so that force must be held for level flight. Leave the elevator control available mode selector switch in AUTO.

2. Autopilot engage switch—ENGAGE.

Oversensitive Control With Low Elevator Control Available.

1. Autopilot engage switch—ENGAGE.
2. Move cg forward.
3. Increase airspeed (dive or thrust).

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CUT ON BLACK LINE

Oversensitive Control With High Elevator Control Available.

1. Elevator control available mode selector switch—MANUAL.
2. Elevator control available manual adjust switch—DEC until appropriate value of elevator available is obtained.

Note

If elevator available cannot be reduced, establish cg at 24 percent for subsonic flight.

Roll as Well as Pitch When Stick Deflected.

1. Control stick—Attempt to free with movement fore or aft only.
2. Level airplane for ejection.

Note

Use stick for pitch control and rudder (sideslip) for roll control.

3. Eject.

Airplane Oscillation in Pitch.

1. Autopilot trigger switch—RELEASE.
2. Pitch damper switch—OFF.
3. Select TO & LAND mode; then MANUAL when sufficient elevator control is available.
4. Flight control power switch—OFF.

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CUT ON BLACK LINE

Stick Buzz.

1. Autopilot trigger switch—RELEASE.
2. Pitch damper switch—OFF.
3. Flight control power switch—OFF.

AILERON AND RUDDER CONTROL SYSTEMS.

Roll Off.

1. Autopilot trigger switch—RELEASE.
2. Apply corrective stick.

Yaw.

1. Maintain wings level with ailerons.
2. Reduce thrust to military (if in afterburner at other than take-off).
3. Apply rudder gradually to reduce sideslip to zero.

Lateral-Directional Oscillation.

1. Autopilot trigger switch—RELEASE.
2. Reduce thrust to military (if in afterburner at other than take-off).
3. Roll and yaw damper switches—OFF.
4. Flight control power switch—OFF.

Extreme Sensitive in Yaw At High Supersonic Speed.

1. Decelerate to Mach No. 1.4 by reducing thrust to military on inboard engines.

Note

Thrust reduction must be symmetrical.

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CUT ON BLACK LINE

Stick Restricted.

1. Autopilot trigger switch—RELEASE.
2. Autopilot engage switch—Check.
3. Control roll by sideslipping.
4. Check for hydraulic system malfunction.

Stick Free in One or Both Directions.

1. Use stick trim to control airplane.
2. Autopilot engage switch—ENGAGE.

Pedal Motion Restricted.

1. Control yaw with asymmetric thrust.
2. Check for hydraulic system malfunction.

Pedals Free in One or Both Directions.

1. Use rudder trim to maintain straight flight.
2. Use asymmetric thrust to obtain additional control.

LANDING GEAR SYSTEM EMERGENCY OPERATION.

1. Landing gear handle—DOWN.
2. Emergency brake and landing gear control handle—Pull.

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BRAKE SYSTEM EMERGENCY OPERATION.

1. Emergency brake and landing gear control handle—Pull (if required).
2. Brakes—Apply as required.

AIR CONDITIONING SYSTEM EMERGENCY OPERATION.

CABIN PRESSURIZATION FAILURE.

Unpressurized Cabin Above 8000 Feet.

1. Cabin pressure selector knob—COMBAT or NORMAL (as required).
2. Altitude—Minimum consistent with normal safety procedures.

TEMPERATURE CONTROL MALFUNCTIONS.

Electronic Overheat Caution Lamp Lights.

1. Flow switch—REVERSE (if applicable).
2. No. 2 and 3 throttles—Set to 90 percent rpm (or above).
3. Control mode selector knob—MAN.
4. Altitude and airspeed—Within ram air limits.
5. Control mode selector knob—RAM.
6. Electronic equipment—Off (if necessary).

All Crew Compartments Overheated.

1. Control mode selector knob—MAN.
2. Flow switch—RESET TO NORMAL (if required).

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3. Refrigeration temperature indicators—Check.
4. Refrigeration unit selector knob—L or R (as required).
5. Airspeed and altitude—As required.
6. Control mode selector knob—RAM.
7. Electronic equipment—Off (as required).

Pilot's Compartment is Overheated.

1. Windshield defog switch—DEC.
2. Windshield defog outlet—Check.
3. Control mode selector knob—MAN.
4. Altitude and airspeed—Reduced (if necessary).
5. Control mode selector knob—RAM.
6. Electronic equipment—Off (as required).

Cabin Too Cold.

1. Control mode selector knob—AUTO or MAN (as required).
2. Air source selector knob—BOTH.
3. Refrigeration unit selector knob—L or R (as desired).
4. Cabin temperature control knob—WARM (as required).

UNLOCKED CANOPY INDICATION DURING FLIGHT.

1. Cabin pressure selector knob—COMBAT (above 30,000 feet).
2. Cabin pressure selector knob—DUMP (below 30,000 feet).
3. Airspeed—Reduce.
4. Land as soon as possible (especially if lamp is still lighted).

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INFLIGHT GLASS PANEL FAILURE.

GLASS PANEL FAILURE WHEN SUPERSONIC.

1. Cabin pressure selector knob—COMBAT.

WARNING

When the cabin pressure schedule is changed from normal to combat, monitor the cabin pressure altimeter for a rapid increase in the cabin altitude. If the cabin altitude does not increase, immediately position the cabin pressure selector knob to DUMP.

2. Decelerate and descend.
3. Cabin pressure selector knob—DUMP when subsonic.
4. Land as soon as practicable.

GLASS PANEL FAILURE WHEN SUBSONIC.

1. Cabin pressure selector knob—DUMP.
2. Land as soon as practicable.

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section IV auxiliary equipment

TABLE OF CONTENTS.

AIR CONDITIONING SYSTEM.

The air conditioning system utilizes bleed air from the 17th stage compressor discharge of the inboard (No. 2 and No. 3) engines to provide conditioned air for the following purposes:

1. Crew compartment and electronic equipment cooling, heating, pressurization, and ventilation.
2. Windshield rain removal and defog.
3. Canopy seal inflation.
4. Fuel tank pressurization.

In general, operation of the system is fully automatic throughout normal flight. The cool air and warm air furnished by the system enables the pilot to select the desired cabin temperature and at the same time prevent overheating of electronic equipment. This same air automatically furnishes cabin pressurization according to the cabin pressurization schedule selected by the pilot. (See figure 4-2.)

REFRIGERATION AND COLD AIR DISTRIBUTION.

Cooling of engine bleed air is accomplished by two separate refrigeration units, each of which consists of a two-stage (primary and secondary) air-to-air heat exchanger, an air-to-water heat exchanger, a throttle valve, a refrigeration compressor-turbine, and a water separator. The left refrigeration unit is located in the nacelle pylon of the No. 2 engine pylon and wing area and normally cools the bleed air furnished by that same engine; the right unit is in the No. 3 engine pylon and wing area and normally cools the bleed air from that engine. This cooling arrangement can be modified, however, so that both units will cool the bleed air from either inboard engine, or, so that either unit will cool the bleed air from both engines. This cross-feed feature is possible since the engine bleed air inlet ducts join in a single warm air manifold duct. The hot bleed air which is to be cooled flows from each inboard engine through a flow limiting nozzle, a bleed air check-and-shutoff valve, and then through the primary stage of the air-to-air heat exchanger. The nozzle limits the maximum amount of air which can enter the air conditioning system. When electrically energized, the bleed air check and shutoff valve stops the entire flow of bleed air from its respective engine into the system. The valve also prevents any back flow of bleed air through the valve from the opposite engine. The

air conditioning system

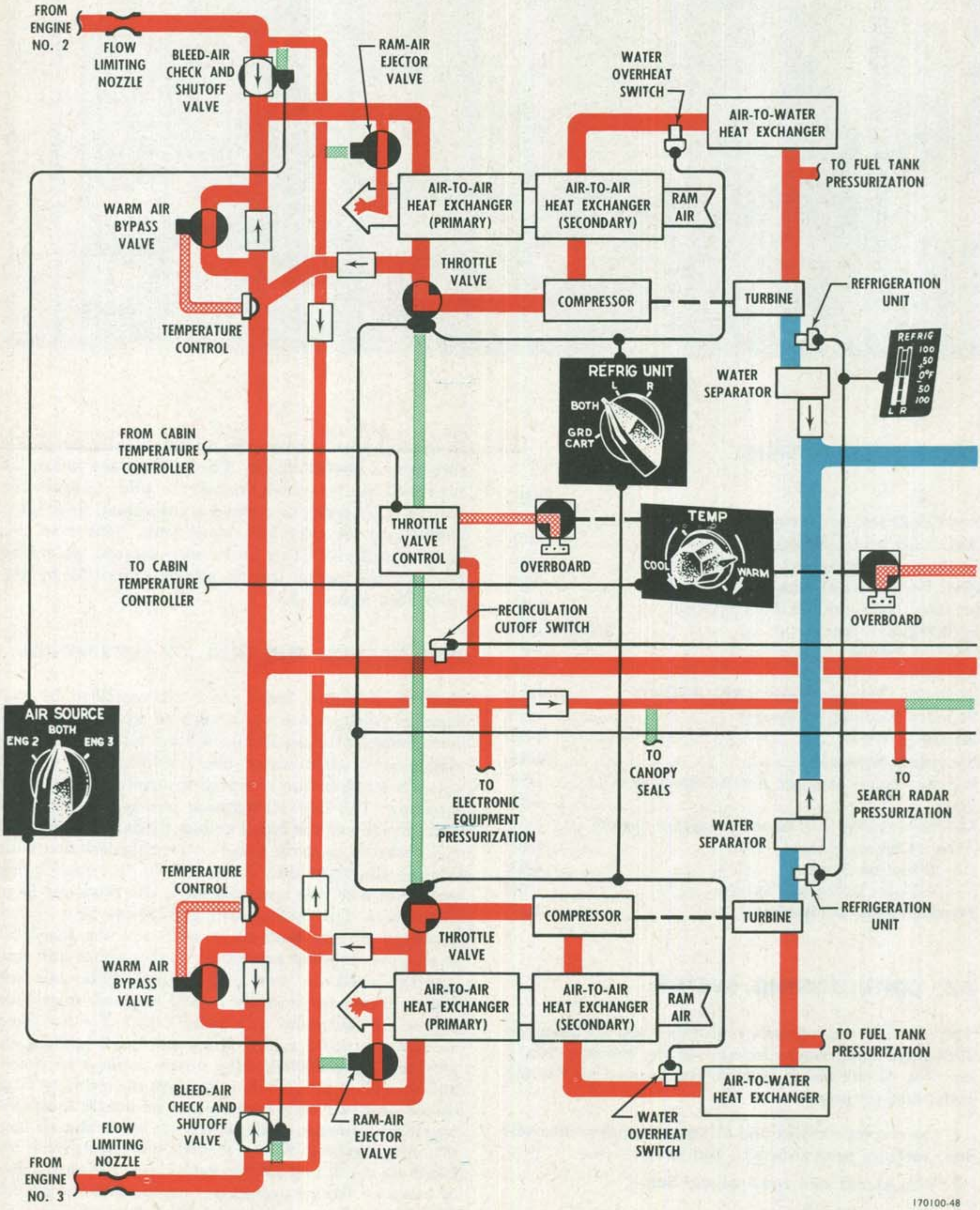


Figure 4-1. (Sheet 1 of 2)

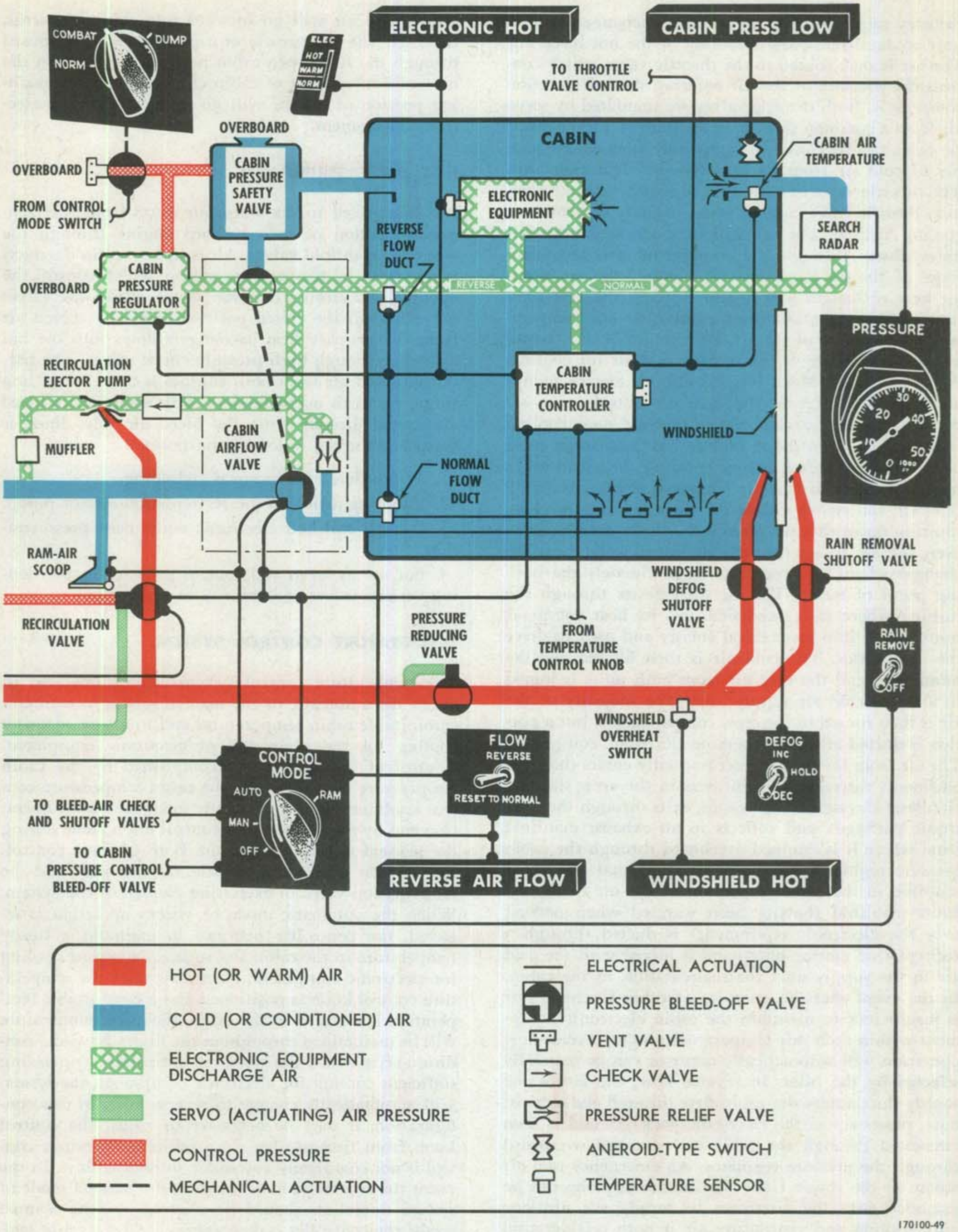


Figure 4-1. (Sheet 2 of 2)

primary stage of the air-to-air heat exchanger in each unit accomplishes partial cooling of the hot bleed air. The air is then routed to the throttle valve which controls the pressure of the air entering the refrigeration compressor. Both throttle valves are regulated by servo air from a common throttle valve control. Either throttle valve can be closed to completely shut off the supply of cold air from its respective refrigeration unit. The throttle valve of each unit, together with the common throttle valve control, is the primary controller of cooling airflow. The air which is admitted past this valve passes through the compressor, the secondary stage of the air-to-air heat exchanger, the air-to-water heat exchanger and finally through the refrigeration turbine. The compressor increases the temperature and pressure of the air. Both stages of each air-to-air heat exchanger utilize outside ram air for cooling. At speeds below Mach No. 0.6 ram air ejector pumps automatically increase the flow of outside ram air through the heat exchangers to increase their cooling capacity. Air from the secondary heat exchanger must pass a thermal switch before entering the air-to-water heat exchanger. If this air temperature exceeds 460°F (238°C), the switch causes the throttle valve to close, shutting down that refrigeration unit. Normally, however, the air passes through the air-to-water heat exchanger where it is cooled to approximately the boiling point of water. The air then passes through the turbine where it is expanded and its heat energy is transformed into mechanical energy and used to drive the compressor. The cold air is then filtered and dehumidified and the cold air from both units is joined in a single cold air supply duct. The majority of the air is then routed to the crew compartments, but a portion is ducted aft to cool remote electronic equipment. The air from the supply duct normally enters the compartments through inlet diffusers in the crew stations, circulates throughout the cabin, exits through the electronic packages, and collects in an exhaust manifold from where it is dumped overboard through the cabin pressure regulator. In the event additional heating is required in the cabin, a portion of the air in the exhaust manifold (having been warmed when passing over the electronic equipment) is ducted through a recirculation ejector pump and is mixed with the cold air in the supply duct for recirculation in the cabin. In the event that the quantity of cabin discharge air is insufficient to maintain the cabin electronic equipment within their safe temperature ranges, reverse flow operation will automatically occur or can be manually selected by the pilot. In reverse flow, the air in the supply duct enters the cabin first through the exhaust duct, passes across the electronic packages and is then circulated through the cabin and dumped overboard through the pressure regulator. An emergency ram air scoop on the lower right side of the airplane can be extended into the airstream to supply the airplane with cooling and ventilating air if both refrigeration systems fail. The air will flow directly into the cold air ducts, bypassing the refrigeration systems. A portion of the air will go forward into the cabin areas, through the electronic equipment, and overboard through the fully open cabin pressure regulator in the normal flow manner of cabin circulation. The remaining portion of the air will go aft to the remote electronic equipment.

HOT AIR DISTRIBUTION.

Air is supplied to the warm air ducts from the compressor section of each inboard engine through the warm air manifold valves. Air temperature in the ducts is regulated by temperature sensors which control the opening and closing of these valves. When the valves move toward the closed position, partially cooled air from the primary heat exchangers flows into the hot air ducts through high pressure check valves. The partially cooled air from both engines is then joined in a single warm air manifold duct. This air, plus hot bleed air routed directly from the bleed air inlet lines, is furnished for the following purposes:

1. Windshield rain removal and defog.
2. Pumping action in the recirculation ejector pump.
3. Canopy seal and electronic equipment pressurization.
4. For use as servo and control pressure in positioning various valves and controls of the system.

TEMPERATURE CONTROL SYSTEM.

The temperature control system can be operated in either the automatic or the manual modes to maintain comfortable cabin temperatures and to assure adequate cooling for the protection of electronic equipment. Control of the system is accomplished by the cabin temperature controller and the cabin temperature control knob during the automatic mode of system operation and by the temperature control knob alone during the manual mode of operation. Both of these controlling devices utilize the throttle valve control and the recirculation valve in exercising control of the system. When the automatic mode of system operation is selected, the controller operates to maintain a steady temperature in the cabin and to select adequate cooling for electronic equipment. Normally, once the temperature control knob is positioned and a comfortable temperature is attained in the cabin, the same temperature will be maintained throughout the flight. Should a condition arise where the system is incapable of providing sufficient cooling for electronic equipment, the system will automatically change to reverse flow. In this configuration, it may be necessary to adjust the control knob from time-to-time since cabin temperature control is not completely automatic in reverse flow. In the event the controller malfunctions, the manual mode of system operation should be selected. In the manual mode, the controller is de-energized and the cabin temperature control knob has complete control of the system. In this mode, the temperature control knob is pneumatically coupled to both throttle valves and the recirculation valve. Rotating the knob for warmer temperatures causes the recirculation valve to move toward open and the throttle valve to reposition toward closed. Since the electronic protective features of the controller are inactive during manual operation, the electronic equipment temperature indicator and caution lamp should be closely monitored. In case the temperature begins to rise it may be necessary to rotate the knob towards cool for protection of electronic equipment at the expense of lower than desirable temperatures in the cabin. If electronic temperatures cannot be maintained within limits during normal flow and manual (or automatic) operation, it will be necessary for the pilot to select reverse flow. Automatic reverse flow will not occur during manual operation. Once the system is in reverse flow during either automatic or manual operation, the system will remain in reverse until the pilot resets to normal flow. Cabin temperature is controlled in the same manner during reverse flow as during normal flow.

Note

> A reverse flow caution lamp on the pilot's caution lamp panel remains lighted when the system is in the reverse flow configuration. An electronic overheat caution lamp on that same panel will light when the system reverses but should go out within approximately 2.5 minutes if adequate cooling is available. If the overheat lamp comes on and the system fails to reverse automatically, the caution lamp will remain on requiring that the pilot manually select reverse flow.

PRESSURIZATION CONTROL.

Cabin pressure is controlled automatically by means of a cabin pressure regulator, a cabin pressure safety valve, and a manually operated cabin pressure control. The pressurization schedule (figure 4-2) is selected by means of the cabin pressure selector knob on the air conditioning control panel. In both the normal and combat schedules the cabin pressure regulator controls the flow of air overboard from the crew compartment retaining a sufficient amount of the circulating air to maintain the pressure schedule. When the airplane is below 8000 feet, the pressure regulator is open, maintaining an unpressurized condition in the cabin. At altitudes above 8000 feet when the normal schedule is selected, pressure is controlled to remain constant at a pressure altitude of 8000 feet until a 7.45 psi differential between cabin and atmosphere is reached at 35,000 feet altitude. Above 35,000 feet the pressure is maintained at a constant differential of 7.45. When the combat schedule is selected above 8000 feet, the cabin pressure remains constant at a pressure altitude of 8000 feet until a 4.75 psi differential is reached at 22,000

cabin pressure schedule

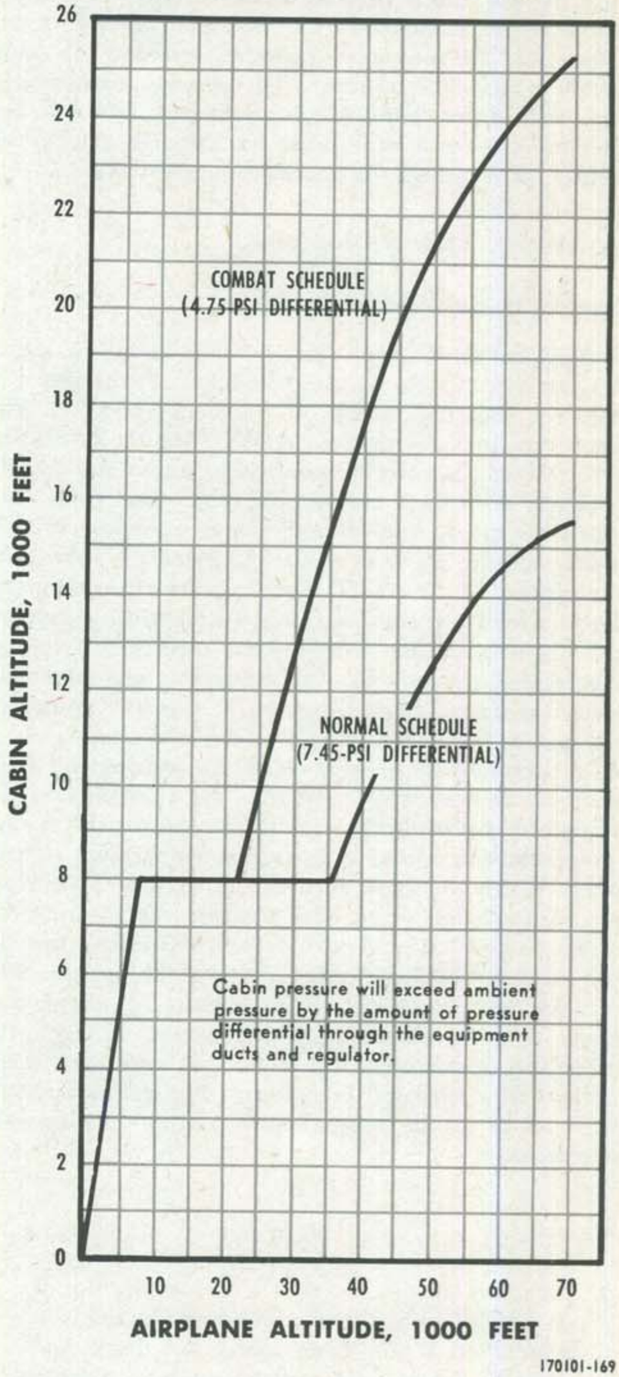


Figure 4-2.

feet. This differential is maintained at all higher levels of flight. In the event of a malfunction where the cabin pressure regulator assumes a closed position, an 8 psi pressure differential is automatically maintained by the cabin pressure safety valve during either normal or reverse flow. Cabin pressure can be dumped overboard during an emergency by means of the cabin pressure selector knob. A vacuum relief feature in the cabin pressure safety valve prevents the cabin pressure from dropping significantly lower than atmospheric pressure. A low cabin pressure caution lamp provides a visual signal to the pilot in case cabin pressure drops below a 27,000-foot cabin pressure altitude. The cabin pressure altimeter indicates the existing pressure altitude within the cabin. A minimum flow sensor in the pressure regulator will cause an increase in cold air output (if required) to maintain pressurization.

CONTROLS AND INDICATORS.

Control Mode Selector Knob.

A four-position control mode selector knob (10, figure 4-3) on the pilot's air conditioning control panel is used for selecting the mode of system operation. The knob positions are marked AUTO, MAN, RAM, and OFF. When the selector knob is in either the AUTO or MAN position, a close signal is removed from both bleed air check and shutoff valves allowing the air source selector knob to select the bleed air source for the system. In the AUTO position, the cabin temperature controller is energized and automatically controls the opening of the refrigeration throttle valves and the recirculation valve. The controller also evaluates electrical signals from temperature sensors throughout the system and automatically selects the amount of air flow necessary to prevent electronic equipment overheating. In the MAN position, the controller is deenergized requiring that the pilot monitor the system temperature by means of the cabin temperature control knob. When the knob is placed in the RAM position, the recirculation valve, both throttle valves, and both bleed air check and shutoff valves will close, preventing engine bleed-air from entering the system. The ram air scoop and the cabin pressure regulator will open allowing outside ram air to flow through the cabin and out through the wide open regulator in the normal flow circulation pattern. The cabin air flow valve locks in the normal flow position during ram operation.

Note

In the event that the rain removal switch is at REMOVE when the control mode knob is placed to RAM, both bleed air check and shutoff valves will remain open to supply warm air for rain removal but the air cannot flow through the refrigeration units to the cabin since the throttle valves will remain closed.

When the control mode knob is at OFF, the bleed air check and shutoff valves, throttle valves, recirculation valve, and ram air scoop are each maintained in a closed position and the temperature controller is deenergized. The knob should not be positioned to OFF during flight since this will result in stopping the circulation of air. The control mode selector knob controls 28-volt direct current and 115-volt alternating current for operating the system.

Refrigeration Unit Selector Knob.

A four-position refrigeration unit selector knob (6, figure 4-3) is provided on the air conditioning control panel for use in selecting the source of air conditioning cold air. The knob positions are marked BOTH, L, R, and GRD CART. When the knob is placed in the BOTH position, refrigerated air is supplied from both units according to the amount of throttle valve opening selected by the throttle valve control. In the L position, a close solenoid is energized on the right throttle valve to shut down that unit and cold air is supplied from the left unit. With the knob placed to R, the right unit supplies cold air since the left unit is shut down in the same manner. Placing the knob to the GRD CART position energizes the close solenoid on both refrigeration unit throttle valves so that cold air can be supplied from the air conditioning ground cart only. In this position, the system is locked in reverse flow so that normal flow is not possible. The knob controls 28-volt direct current for selecting the source of cold air.

Note

The supply of ground cart air can be continued during the transition to air conditioning system supplied air.

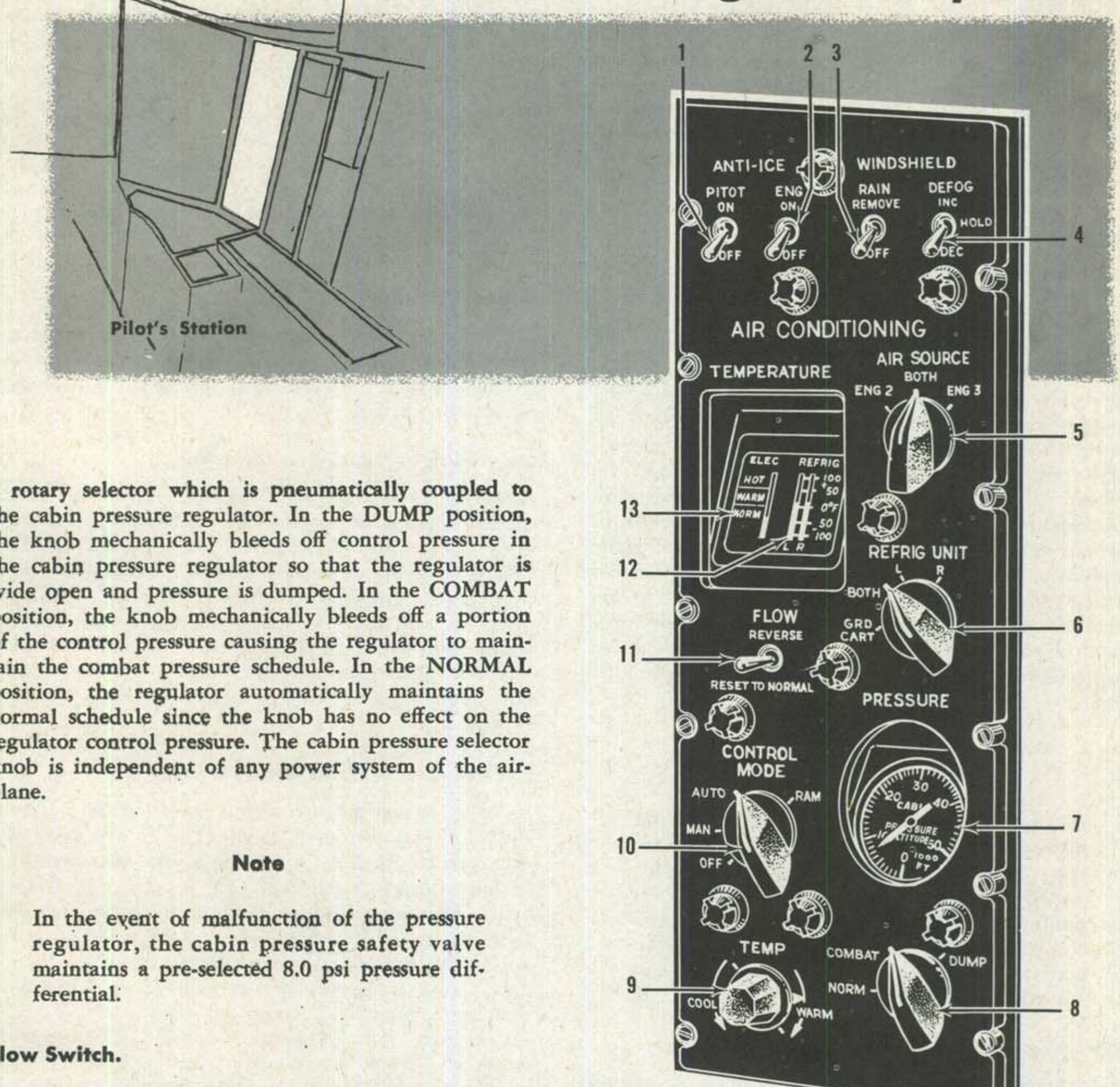
Air Source Selector Knob.

A three-position air source selector knob (5, figure 4-3) is located on the air conditioning control panel and is used in selecting the source of engine bleed air for the air conditioning system. The knob positions are marked BOTH, ENG 2, and ENG 3. When the knob is placed in the BOTH position, bleed air from both inboard engines enters the system through their respective bleed air check and shutoff valves. With the knob in the ENG 2 position, bleed air is supplied from the left inboard engine only, since the No. 3 engine bleed air check and shutoff valve is closed. Placing the switch in the ENG 3 position shuts off the supply of bleed air from No. 2 engine and allows the right inboard engine to furnish bleed air. The selector knob controls 28-volt direct current for selecting the source of bleed air.

Cabin Pressure Selector Knob.

The three-position cabin pressure selector knob (8, figure 4-3) located on the air conditioning control panel is used to select the desired cabin pressure schedule (figure 4-2), which is maintained during either normal or reverse flow. The knob has positions marked NORMAL, COMBAT, and DUMP and is used to position

air conditioning control panel



1. Pitot Anti-Ice Switch
2. Engine Anti-Ice Switch
3. Windshield Rain Removal Switch
4. Windshield Defog Switch
5. Air Source Selector Knob
6. Refrigeration Unit Selector Knob
7. Cabin Pressure Altimeter
8. Cabin Pressure Selector Knob
9. Cabin Temperature Control Knob
10. Control Mode Selector Knob
11. Flow Switch
12. Refrigeration Temperature Indicator
13. Electronic Equipment Temperature Indicator

170100-33

Figure 4-3.

a rotary selector which is pneumatically coupled to the cabin pressure regulator. In the DUMP position, the knob mechanically bleeds off control pressure in the cabin pressure regulator so that the regulator is wide open and pressure is dumped. In the COMBAT position, the knob mechanically bleeds off a portion of the control pressure causing the regulator to maintain the combat pressure schedule. In the NORMAL position, the regulator automatically maintains the normal schedule since the knob has no effect on the regulator control pressure. The cabin pressure selector knob is independent of any power system of the airplane.

Note

In the event of malfunction of the pressure regulator, the cabin pressure safety valve maintains a pre-selected 8.0 psi pressure differential.

Flow Switch.

A three-position airflow switch (11, figure 4-3) is located on the air conditioning control panel and is used to manually select reverse or normal flow operation of the system. The switch is marked REVERSE and RESET TO NORMAL and is spring-loaded from each of these positions to a center unmarked neutral position. Momentarily placing the switch to the REVERSE position energizes a relay in the cabin temperature controller to reposition the cabin air flow valve which, in turn, routes the conditioned air across the electronic equipment before the air is circulated through the cabin. Momentarily positioning the switch to RESET TO NORMAL energizes a solenoid which shuts off servo air pressure causing the cabin air flow valve to reposition to the normal flow configuration. The switch controls 28-volt direct current for selecting normal or reverse flow.

Note

The system can be either in normal or reverse flow with the air flow switch in the neutral center position. The direction of flow can be determined by observing the reverse air flow caution lamp.

Cabin Temperature Control Knob.

The cabin temperature control knob (9, figure 4-3) is located on the air conditioning control panel for use in adjusting temperature in the cabin. The control knob can be positioned at any setting between the marked COOL and WARM positions. When the control mode selector knob is in the AUTO position, the temperature control knob sends electrical signals to the cabin temperature controller which, in turn, electrically controls the volume of cold air output and the amount of recirculation to maintain the desired cabin temperature. Clockwise rotation of the knob results in warmer cabin temperatures. When the control mode knob is in the MAN position, the knob is pneumatically coupled to the recirculation valve and to the throttle valves. Rotation of the temperature knob mechanically controls bleed-off of control pressure for proportioning the cold air output and cabin recirculation.

CAUTION

In the event of electronic overheat during manual operation, it may be necessary to rotate the temperature control knob towards COOL in order to accomplish increased output of cold air for the protection of electronic components. Knob adjustments should be minimized, especially during automatic system operation.

Refrigeration Temperature Indicators.

Two refrigeration temperature indicators (12, figure 4-3) are located on the air conditioning control panel, one indicator marked L for the left refrigeration unit and the other marked R for the right unit. With both refrigeration units in operation, an appreciable difference in the temperature readings of the two indicators is an indication of a malfunction or failure of that unit whose indicator shows the highest reading. However, the malfunctioning unit should not be shut down as long as the cabin temperature remains satisfactory and electronic cooling is adequate.

Electronic Equipment Temperature Indicator.

An electronic equipment air temperature indicator (13, figure 4-3) on the air conditioning control panel provides a continuous indication of electronic equipment temperatures in the AN/ARC-57 receiver-transmitter unit and the ADS radar receiver unit. The indicator has increments marked HOT, WARM, and NORM. In automatic operation of the system the indicator serves as a reference in monitoring system operation. In manual operation of the system, the indicator aids the pilot in adjusting cabin air temperature to satisfy the electronic cooling requirements. In the event any one of the electronic units becomes overheated, the electronic overheat caution lamp (figure 1-12) will light when the indicator reading reaches HOT. The indicator operates on 28-volt direct current.

Cabin Altimeter.

The cabin altimeter (7, figure 4-3), located on the air conditioning control panel, is a barometric-type instrument which indicates cabin air pressure in feet of equivalent altitude.

Low Cabin Pressure Caution Lamp.

A low cabin pressure lamp (figure 1-12) on the pilot's caution lamp panel lights when cabin pressure drops to the equivalent of 27,000 feet. When lighted, CABIN PRESS LOW appears on the face of the lamp in yellow illuminated letters. The lamp is powered by 28-volt direct current and is tied-in to the master caution lamp. (For testing and dimming the cabin pressure caution lamp and for information on the master caution lamp, refer to "Pilot's Indicator Lamp System," Section I.)

Electronic Overheat Caution Lamp.

An electronic overheat caution lamp (figure 1-12) on the pilot's caution lamp panel lights in the event the electronic equipment in the cabin area becomes overheated. When lighted, ELECTRONIC HOT appears in yellow illuminated letters on the face of the lamp. The lamp should light when the air conditioning system automatically changes from normal flow to reverse flow. However, if the lamp remains lighted for more than approximately 2.5 minutes, a malfunction of the temperature control system is indicated. The lamp operates on 28-volt direct current and is tied-in to the master caution lamp. (For dimming and testing the overheat lamp and for information on the master caution lamp, refer to "Pilot's Indicator Lamp System," Section I.)

Reverse Flow Caution Lamp.

A reverse flow caution lamp (figure 1-12) on the pilot's caution lamp panel lights when the air conditioning system is in reverse flow. When lighted, REVERSE AIR FLOW appears in yellow illuminated letters on the face of the lamp. The lamp operates on 28-volt direct current and is tied-in to the master caution lamp. (For dimming and testing the reverse flow lamp and for information on the master caution lamp, refer to "Pilot's Indicator Lamp System," Section I.)

AIR CONDITIONING SYSTEM NORMAL OPERATION.

For normal system operation during flight, the air conditioning control panel should be set up as follows:

1. Air source selector knob—BOTH
2. Refrigeration unit selector knob—BOTH
3. Control mode selector knob—AUTO

CAUTION

Do not place control mode selector knob in AUTO position except when system is operating and cold air is being supplied.

4. Cabin pressure selector knob—NORMAL
5. Cabin temperature control knob—Between unmarked 3 o'clock and 4 o'clock position.
Make *minor* knob adjustments as required.
6. Flow switch—RESET TO NORMAL (if required)
Momentarily position flow switch to RESET TO NORMAL if it is desired to change system from reverse to normal flow.
7. Reverse flow caution lamp—Out
The reverse flow caution lamp should immediately go out when the air flow switch is positioned to RESET TO NORMAL.

Note

During any operation with only one inboard engine supplying cooling air, maintaining at least 80 per cent rpm on that engine will normally assure sufficient cooling for the electronic equipment.

8. Electronic equipment temperature indicator—NORM
9. Refrigeration temperature indicators—Same on both.
Both indicators should have approximately the same reading.

Manual Control of Cabin Temperature.

In manual operation, the temperature of both the cabin and the electronic equipment must be controlled by means of the cabin temperature control knob. Under some conditions, it may be necessary to select a less than desirable cabin temperature in order to maintain adequate cooling for the electronic equipment.

Reverse Flow Operation.

Reverse flow operation is used primarily for cooling electronic equipment with the ground cooling cart when the airplane is on the ground and the canopies are open. This arrangement permits checking of electronic equipment without operating the refrigeration system. Reverse flow is also used for inflight operation with a cabin blowout. At all other times, operate the system in normal flow, except when the electronic overheat lamp is lighted. If reverse flow operation occurs during flight without a cabin blowout, cabin pressure will be maintained according to the selected pressure schedule.

Note

If cabin blowout occurs necessitating reverse flow operation, fly at subsonic speeds only.

Compartment Pressurization.

When flying above 50,000 feet, operate the system with the cabin pressure switch in the COMBAT position. Use ram air cooling only if both refrigeration systems are inoperative.

ANTI-ICING AND DEFOGGING SYSTEMS.

WINDSHIELD RAIN REMOVAL AND DEFOG SYSTEM.

The airplane is provided with a system for removing rain from the windshield during takeoff and landing and for removing condensate when fogging conditions exist inside the airplane. A rain removal duct provides a stream of warm air across the outside surface of the front left pane of the pilot's enclosure. A defog duct directs air across the inside surface of the front four panes. Air is taken from the warm air lines in the air conditioning system. It is routed forward under the cabin floor, over a thermal switch connected to a caution lamp, and then to discharge nozzles installed at the windshield. The rain removal airstream flows over the windshield from a single flush-mounted nozzle located at the bottom left corner of the pane. The airstream for fog removal is distributed over the windshield through four nozzles located along the lower edge of the front four panes. The defog and rain removal system is controlled by means of two switches on the air conditioning control panel. A windshield overheat caution lamp on the pilot's caution lamp panel warns the pilot when the temperature of the air is high enough to damage the windshield.

Note

Rain removal is operative during ram air operation. Windshield defog is also operative during ram air operation if the rain removal switch is ON.

Windshield Rain Removal Switch.

The windshield rain removal switch (3, figure 4-3) is located on the air conditioning control panel and has positions marked REMOVE and OFF. Placing the switch in the REMOVE position routes 28-volt d-c power to open the solenoid on the rain removal shutoff valve. Opening of this solenoid permits servo (actuating) air pressure to open the shutoff valve and allow warm air to flow across the left front pane of the pilot's windshield.

Windshield Defog Switch.

The windshield defog switch (10, figure 4-3) is a three-position switch located on the air conditioning control panel. The switch controls 28-volt d-c power to the shutoff valve in the defog duct. The switch is marked DEC, HOLD, and INC. It is spring-loaded from the INC position to HOLD. Holding the switch in INC moves the valve toward the open position. Releasing it to HOLD stops the valve travel. Placing the switch in the DEC position moves the valve toward the closed position. The valve will travel from one extreme position to the other in approximately 9 seconds.

Windshield Overheat Caution Lamp.

A windshield overheat caution lamp (figure 1-12) on the pilot's caution lamp panel lights when the air temperature in the defog and rain removal warm air supply duct rises to the extent that the air could cause damage to the windshield. When lighted, WINDSHIELD HOT appears on the face of the lamp in yellow illuminated letters. Rain removal and defog should be kept to a minimum when the lamp is lit. The lamp is controlled by a thermal switch in the warm air duct upstream from the defog and rain removal shutoff valves. The lamp operates on 28-volt direct current and is tied-in to the master caution lamp. (For testing and dimming the overheat lamp and for information on the master caution lamp, refer to "Pilot's Indicator Lamp System," Section 1.)

Normal Operation.

Windshield Defogging. The windshield defog switch should not be put into operation at low altitudes unless it is absolutely necessary to clear the windshield. Do not put the windshield defog system into maximum operation below 20,000 feet. Maximum operation below this altitude may cause the cabin to overheat to the extent of putting the air conditioning system in reverse flow operation. For best results, turn on the system during subsonic cruise prior to the start of descent. Do not operate the system during supersonic flight, nor for 10 minutes following deceleration to subsonic speed. The system is inoperative during ram air operation except when the rain removal switch is in the ON position.

Rain Removal. Do not operate the rain removal system on the ground, except when necessary at the start of takeoff. Extensive ground operation may result in damage to the windshield. The rain removal system is inoperative on the ground except with one (or both) inboard engines operating or with the engine starter cart connected and operating. The system is operative during ram air operation.

Emergency Operation.

If the windshield overheat caution lamp lights, place the windshield rain removal switch and defog switch in the OFF position.

WARNING

Turn the switches off only if flight safety will not be endangered by restricting the pilot's vision.

MASK DEFOGGING SYSTEM.

Pressure helmet face plate defogging is accomplished by means of an electrical heating element in the face plate. The element is connected to the airplane power supply through the electrical quick-disconnect fitting on the ejection seat. Power to each face plate element is controlled by a mask defog control knob.

Note

The mask defogging system is for use only with the type MC-3 partial pressure suit and the type MA-2 helmet.

Mask Defog Control Knobs.

Mask defog control knobs (9, figure 1-7, 4, figure 4-16, and 6, figure 4-17) for controlling power to the face plate heating elements are located at the crew stations. The pilot's control knob is on the pilot's lower left console. The navigator's and DSO's defog knobs are located on their respective lighting control panels. The knobs regulate the supply of 28-volt alternating current to the face plate heater elements. Turning a knob clockwise increases the temperature of the face plate heater.

PITOT ANTI-ICING SYSTEM.

The pitot-static probe on the nose boom is anti-iced by an electrically operated heating system. The system consists of a control switch, and a 750-watt capacity heating element. No thermostatic control has been provided for the system.

CAUTION

The pitot-static tube and adjacent equipment can be damaged if the pitot heater is left on during ground operation when icing conditions do not exist.

Pitot Anti-Ice Switch.

The pitot anti-ice switch (1, figure 4-3) is a two-position ON-OFF switch located on the air conditioning control panel. Placing the switch ON supplies 115-volt alternating current to the heating element in the pitot tube.

ENGINE ANTI-ICING SYSTEM.

Provisions are incorporated in each engine for keeping the front frame hub, the horizontal struts, and the upper vertical strut free of ice. The lower vertical strut is not anti-iced by the system but is warmed by scavenge oil from the number one bearing sump. Hot air from the 17th stage compressor of each engine is used for anti-icing. Air from the compressor flows through a solenoid-operated engine anti-ice valve, through both horizontal front frame struts, and into a manifold in the hub. From the hub it flows through the upper vertical strut and the inlet guide vanes and is discharged through small ports into the compressor air stream. Anti-icing air pressure is regulated automatically by the engine anti-ice valve. The system is turned on and off by means of a switch on the air conditioning control panel.

Note

The engine anti-icing system is presently inoperative.

Engine Anti-Ice Switch.

An ON-OFF switch (2, figure 4-3) for engine anti-icing is located on the air conditioning control panel. When placed in the ON position, the switch energizes a 28-volt d-c relay which directs 115-volt a-c power to open the anti-icing valve in each engine. Moving the switch to the OFF position de-energizes the relay and closes the valves. In the event of electrical failure, the valves will automatically close, stopping the flow of anti-icing air to the engines.

COMMUNICATION SYSTEM (AN/ARC-57).

The communication system provides a means of crew intercommunication, plus air-to-air and air-to-ground communication. The complete system is composed of an interphone system and a UHF command radio. For the table of communication and associated electronic equipment, refer to Section IV, Confidential Supplement, T.O. 1B-58A-1A.

INTERPHONE SYSTEM.

The interphone system provides the crew with the following capabilities:

- Either push-to-talk or "hot mike" communication between crew members.
- Command radio reception and transmission for each crew member.
- Emergency communication between crew members, regardless of control settings.
- Landing gear audio warning to the pilot. (Refer to "Landing Gear System," Section I.)
- Communication with the ground crew by means of an external receptacle.

The interphone system portion of the communication system consists mainly of a communication control panel (figure 4-5) on the pilot's lower left console, interphone control panels (figures 4-6 and 4-7) on the left console of the navigator's and DSO's stations, an external interphone receptacle (figure 1-1) located on the fuselage near the leading edge of the right wing, and microphone buttons or switches at each crew station. The external interphone receptacle provides a means of connecting an AN/AIC-17 ground interphone set to the airplane interphone system. The interphone system operates on 28-volt direct current through fuses on the 28-volt d-c power panel.

UHF COMMAND RADIO.

A UHF command radio provides plane-to-plane and plane-to-ground line-of-sight voice communication. The radio also provides for transmitting a continuous tone signal. The frequency range of the radio is 225.0

Figure 4-4 deleted.

pilot's communication control panel

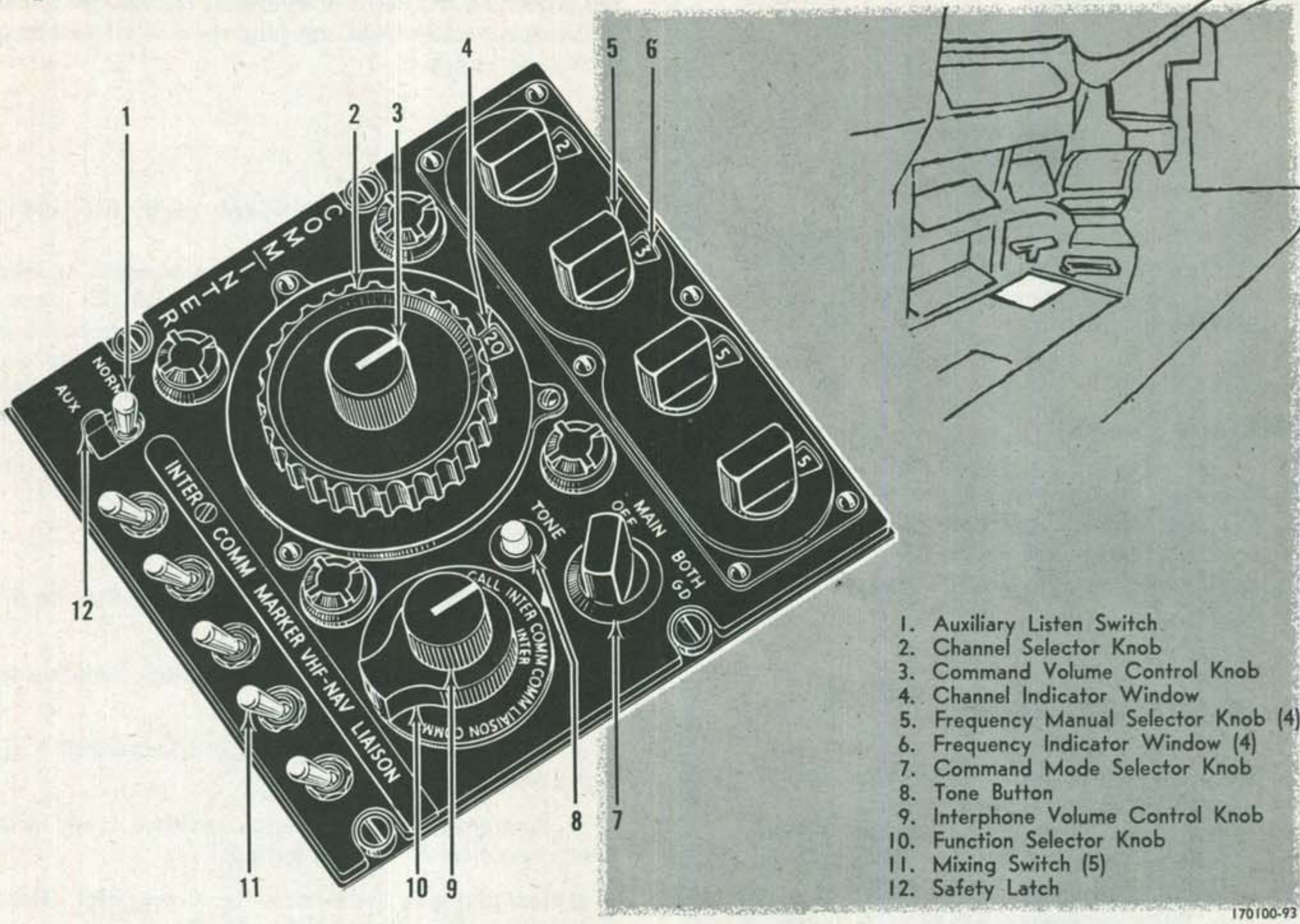


Figure 4-5.

to 399.9 megacycles in increments of one-tenth megacycle, thus permitting the pilot to manually select any one of 1750 frequencies. Twenty-three of these frequencies, including a guard frequency, may be preset and selected by channel number. A separate guard receiver, with a frequency range of 238.0 to 248.0 megacycles, allows the crew to monitor a preset guard channel and receive on another command channel simultaneously. Channel selection and mode of operation of the command radio must be determined by the pilot. However, once the set is placed in operation, other crew members may transmit and receive through their interphone controls. The command radio portion of the communication system includes a transmitter, a main receiver, a guard receiver, a flush-mounted antenna, and controls on the pilot's communication control panel. The command radio operates on 28-volt d-c power from the 28-volt d-c power panel; 115-volt, 400-cycle, a-c power from the right a-c power panel; and 150-volt, minus 150-volt, and 250-volt direct current from the 28-volt a-c and high voltage d-c power panel.

Function Selector Knob.

A function selector knob (10, figure 4-5, 3, figure 4-6, and 3, figure 4-7) is located on the pilot's communication control panel and on the navigator's and DSO's interphone control panels. At each crew station the function selector knob selects the operating function of the communication system. The knob has six positions: CALL, INTER, COMM INTER, COMM, LIAISON, and COMM 2. The CALL position, which is spring-loaded to INTER, is for emergency use. With the knob in the CALL position, the crew member at the calling station interrupts all normal interphone functions at all stations and may contact other crew members at high volume level without depressing his microphone button. With the function selector knob at the INTER position, normal interphone transmission is accomplished by depressing the microphone button. With the knob at the COMM INTER position, the crew member has a "hot mike" capability on interphone plus a receiving-transmitting capability on the selected command channel. With the "hot mike" function selected at any station, the interphone transmitting and receiving circuits at that station are live at all times, permitting the crew member to contact any other crew member without depressing his microphone button or manipulating any other controls; he must depress his microphone button to transmit on the command channel. With the function selector knob at the COMM position, the crew member may receive and transmit on the command channel only, utilizing his microphone button.

Note

> Although each crew member has the capability of receiving and transmitting on the command radio, only the pilot can place the radio in operation and select frequencies.

The LIAISON and COMM 2 positions on the function selector knobs are inoperative.

Control Stick Microphone Switch.

The pilot is provided with a three-position microphone switch (1, figure 1-27) located on the control stick grip. Two positions are spring-loaded to an unmarked center OFF position. With his function selector knob at INTER, the pilot may hold the control stick microphone switch to either TRANS or INPH in order to contact other crew members. With his function selector knob in the COMM INTER ("hot mike") position, the pilot must hold the microphone switch to the TRANS position in order to transmit on the command channel. With his function selector knob in the COMM position, he must hold the switch to the TRANS position for command transmission and to the INPH position for interphone transmission.

Foot-Operated Microphone Buttons.

The navigator's and DSO's stations each have a foot-operated microphone button (figures 4-21 and 4-43) on the floor forward of the seat. The crew member must depress his microphone button to transmit on all functions of the function selector knob except CALL and the interphone ("hot mike") function of COMM INTER.

Note

> The pilot's control stick microphone switch and the foot-operated microphone buttons also serve the I/P function of the air-to-ground IFF equipment. Refer to "Military Navigational Aids System" of this section.

navigator's interphone control panel

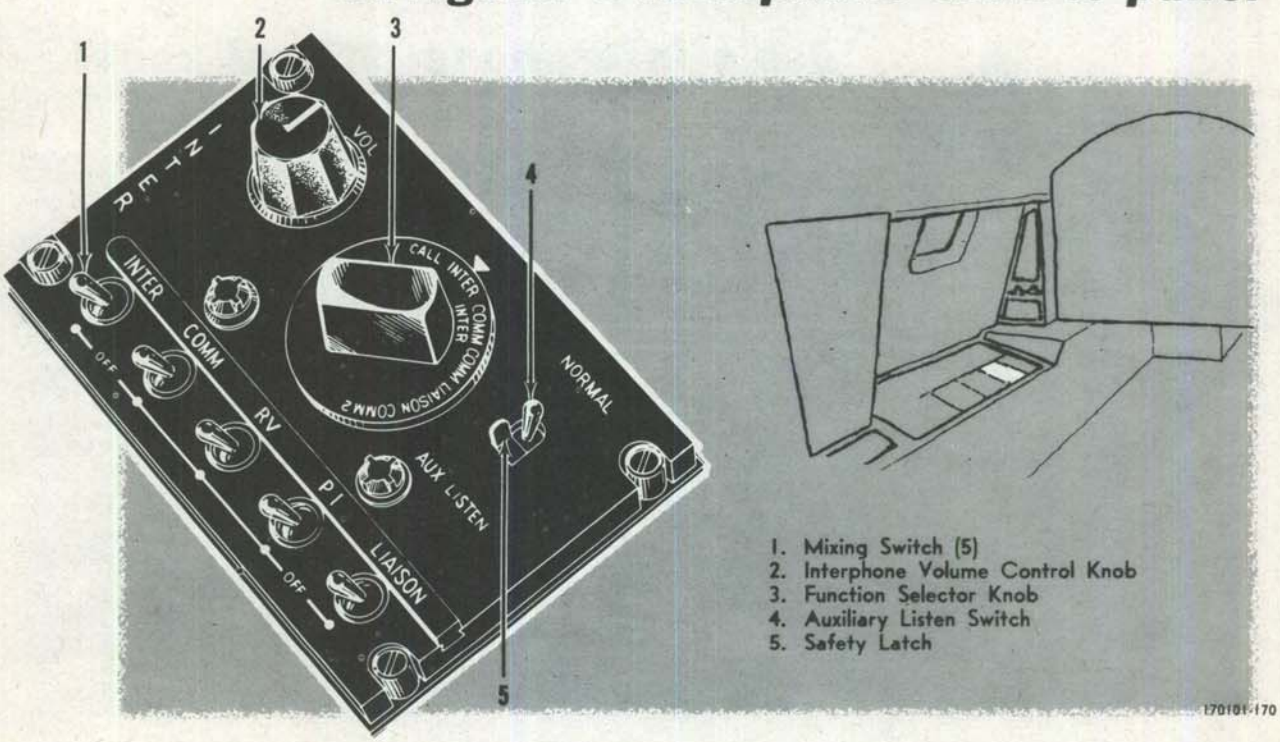


Figure 4-6.

Interphone Volume Control Knob.

An interphone volume control knob (9, figure 4-5, 2, figure 4-6, and 2, figure 4-7) is located on the pilot's communication control panel and on the navigator's and DSO's interphone control panels. At each crew station this knob provides a means of adjusting the volume of the audio signal received at the headset. The knob is inoperative when the auxiliary listen switch is at AUX LISTEN or when the function selector knob is held at CALL.

Mixing Switches.

The pilot's communication control panel, the navigator's interphone control panel, and the DSO's interphone control panel each have five two-position mixing switches (11, figure 4-5, 1, figure 4-6, and 1, figure 4-7). The switches on the pilot's communication control panel are marked INTER, COMM, MARKER, VHF-NAV, and LIAISON. The switches on the navigator's interphone control panel are marked INTER, COMM, RV BEACON, and LIAISON, with one switch unmarked. The switches on the DSO's interphone control panel are marked INTER, COMM, DECM, and LIAISON, with one switch unmarked. Each switch, when placed in the up (ON) position, allows the crew member at that station to monitor, through the headset, the facility indicated by the switch marking. The INTER and COMM switches at each station allow the crew member to monitor interphone and command radio, respectively. The MARKER and VHF-NAV switches allow the pilot to monitor the marker beacon frequency and an omnirange frequency, respectively, provided the CNAS equipment is operating. The DECM switch allows the DSO to monitor audio signals from the radar warning system. Equipment associated with the RV beacon and LIAISON mixing switches is not installed on the airplane.

Auxiliary Listen Switch.

A two-position auxiliary listen switch (1, figure 4-5, 4, figure 4-6, and 4, figure 4-7) is located on the pilot's communication control panel and on each of the interphone control panels. The positions are marked NORMAL and AUX (or AUX LISTEN). With the switch in the NORMAL position, interphone facilities at that station will operate normally. With the switch in the AUX (or AUX LISTEN) position, the interphone circuitry at that station bypasses the listen amplifier in the control panel and provides the crew member with reception of only one mixing switch facility at a fixed volume level. If more than one mixing switch on the control panel is up (ON), the facility associated with the switch farthest to the left will be heard. If all mixing switches on the panel are down (OFF), the facility selected by the function selector knob will be heard. The auxiliary listen switch should be placed in the auxiliary position only when the listen amplifier at that control panel is malfunctioning or inoperative. A safety latch on the switch prevents it from being moved inadvertently to the auxiliary position.

dso's interphone control panel

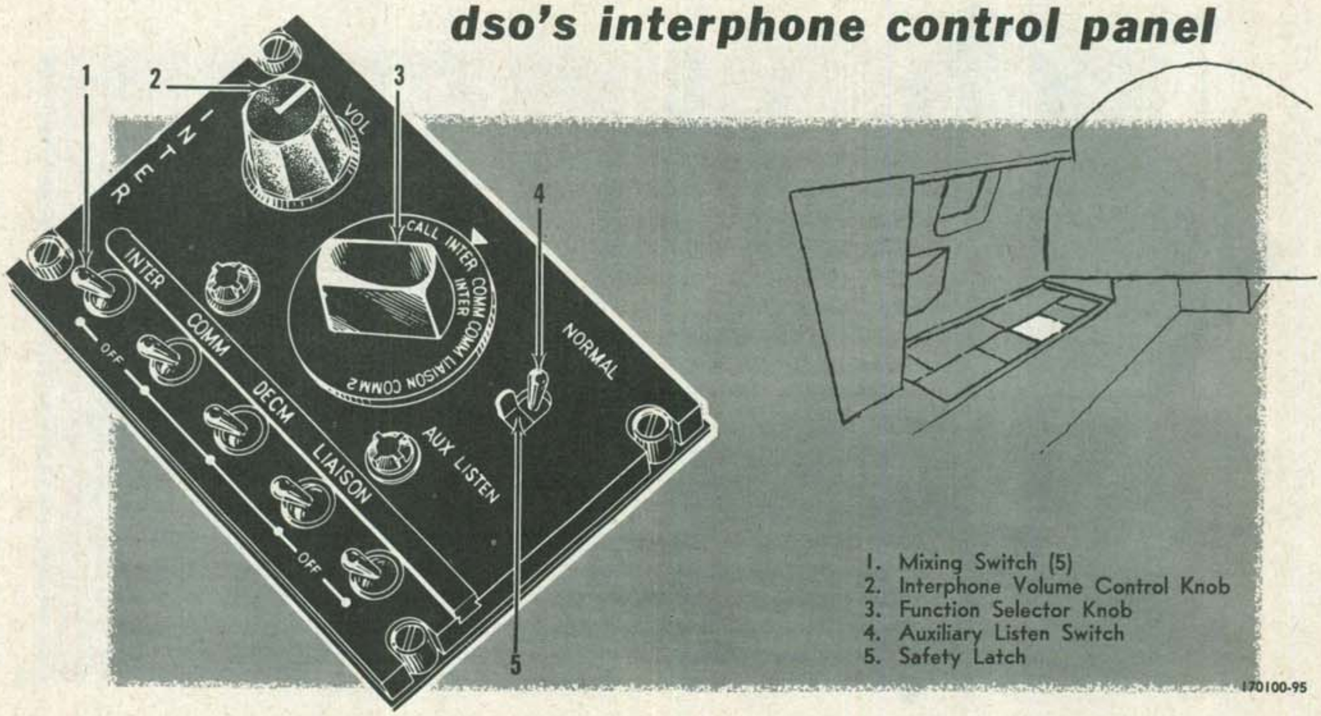


Figure 4-7.

Command Mode Selector Knob.

A four-position mode selector knob (7, figure 4-5), located on the pilot's communication control panel, enables the pilot to select the operating mode of the command radio. The knob positions are marked OFF, MAIN, BOTH, and GD. With the knob in the MAIN position, the command transmitter and main receiver are operative on the same selected frequency. With the knob in the BOTH position, the transmitter and main receiver are again operative on the same selected frequency and in addition, the guard receiver is receiving on the preset guard frequency. With the knob in the GD position, the transmitter and both receivers are tuned to the preset guard frequency. The GD position should be selected only when the command tuning system malfunctions or becomes inoperative. Placing the mode selector knob in the OFF position de-energizes the entire command radio system.

Channel Selector Knob.

The channel selector knob (2, figure 4-5), located on the pilot's communication control panel, permits the pilot to select the desired channel or frequency for command radio transmission and reception. The knob has 24 positions marked 1 through 22, G, and M. The selected position appears in a channel indicator window (4, figure 4-5) located immediately above the knob. Placing the knob at one of the 22 numbered channel positions allows transmission and reception on a preset frequency. Placing the knob at the G position allows transmission and reception on the preset guard frequency. Placing the knob at the M position allows transmission and reception on the frequency selected by the frequency manual selector knobs.

Frequency Manual Selector Knobs.

Four frequency manual selector knobs (5, figure 4-5) are located on the pilot's communication control panel. Each knob selects a frequency digit, which appears in a window (6, figure 4-5) above the knob. The frequency manual selector knobs may be manipulated to select any one of the 1750 frequencies available within the 225.0 to 399.9 megacycle range of the command radio.

Command Volume Control Knob.

The command volume control knob (3, figure 4-5) on the pilot's communication control panel permits the pilot to standardize the command radio audio volume with the volume level of other signals received by the interphone system.

Tone Button.

A tone button (8, figure 4-5) is located on the pilot's communication control panel. With the command radio in operation, depressing the tone button interrupts reception and transmits a continuous tone signal on the selected frequency. This tone serves as an aid to ground stations in obtaining a DF bearing on the airplane.

Remote Channel Indicator.

A remote channel indicator (6, figure 1-5) is located on the pilot's main instrument panel. The indicator, which displays the position selected by the channel selector knob, permits the pilot to switch channels on the command radio without taking his eyes from the main instrument panel.

Note

> The remote channel indicator is covered when the command mode selector knob is in the OFF position. All other positions expose the indicator.

Normal Operation of Communication System.

Normal operation of the AN/ARC-57 communication system is accomplished for the various crew members as follows:

Note

> The interphone system is energized whenever d-c power is applied to the 28-volt d-c power panel.

Pilot Operation. The interphone and command radio functions are operated from the pilot's station according to the following procedures:

1. Check that auxiliary listen switch is at NORMAL.
2. Place function selector knob at COMM INTER.
3. Adjust interphone volume control knob to obtain a comfortable volume level.
4. Place command mode selector knob at BOTH. Time-delay relays will prevent command radio operation for approximately one minute while equipment warms up and completes a tuning cycle.
5. Select desired channel or frequency using the channel selector knob or the frequency manual selector knobs. If a frequency is selected using the manual selector knobs, set channel selector knob at M (manual).

Note

> Preset frequencies of the 22 numbered channels and the guard channel are listed on a channel frequency card located at the pilot's station.

6. Adjust command volume control knob to obtain a comfortable volume level.
7. Place desired mixing switches in the up (ON) position.

Note

With the communication system set up at the pilot's station as outlined above, the pilot has "hot mike" interphone capability; transmission is possible on the selected command channel by holding the control stick microphone switch in the TRANS position; reception is possible on the selected command channel through the main receiver and on the guard frequency through the guard receiver; and simultaneous reception is possible from all facilities associated with the selected mixing switches. A continuous tone transmission can be made on the selected command channel by depressing and holding the tone button.

With the function selector knob at the INTER position, the pilot may transmit on interphone by holding the control stick microphone switch either in the INPH or the TRANS position; he cannot transmit on command radio. With the funcition selector knob at the COMM position, the pilot may transmit on interphone by holding the control stick microphone switch to INPH; he may transmit on the selected command channel by holding the microphone switch to TRANS. All microphone buttons and switches must be released before a new channel or frequency is selected on the command radio. This is to allow the tuning mechanism to drive to the new frequency. After approximately ten seconds the tuning cycle is complete and communication may be resumed. The command radio is turned off by moving the command mode selector knob to OFF.

Navigator and DSO Operation. The interphone and command radio functions are operated from the navigator's and DSO's stations according to the following procedures.

1. Check that auxiliary listen switch is at NORMAL.
2. Place function selector knob at COMM INTER.
3. Adjust interphone volume control knob to obtain a comfortable volume level.
4. Place desired mixing switches in the up (ON) position.

Note

With the communication system set up at the navigator's and DSO's stations as outlined above, the respective crew member has "hot mike" interphone capability; transmission is possible on the selected command channel by depressing and holding the foot-operated microphone button; command radio reception is possible according to the mode selected by the pilot; and simultaneous reception is possible from all facilities associated with the selected mixing switches. A tone transmission cannot be made from the navigator's and DSO's stations.

With the function selector knob at the INTER position, the crew member may communicate on interphone by depressing the foot-operated microphone button; he cannot transmit on command radio. With the function selector knob at the COMM position, the crew member may transmit on the selected command channel by depressing the microphone button; he cannot transmit on interphone.

Operation with Ground Interphone Set. An AN/AIC-17 ground interphone set may be plugged into the airplane interphone system at the external interphone receptacle. This enables any crew member to communicate with ground personnel. Follow normal interphone procedures for operation with the ground interphone set.

Emergency Operation of Communication System.

Procedures for various abnormal and emergency conditions of the communication system are outlined in the following paragraphs.

Reception Garbled or Headset Silent. If all audio signals at any station become garbled or if headset becomes totally silent, it is possible that the listen amplifier at that control panel is malfunctioning. After checking to make sure that the personal interphone lead is securely connected, proceed as follows:

1. Select one mixing switch facility if desired. Place all other mixing switches in the down (OFF) position.
2. Move safety latch and place auxiliary listen switch at AUX (or AUX LISTEN).

Note

With the auxiliary listen switch in the AUX (or AUX LISTEN) position, it is possible to receive only one mixing switch facility. If all mixing switches are down (OFF), the facility selected by the function selector knob will be heard. If more than one mixing switch is up (ON), the facility associated with the switch farthest to the left will be heard.

Command Radio Does Not Tune Selected Channel. If it becomes apparent that the command radio is not tuning the selected channel, it is possible that the tuning system is malfunctioning, or a time-delay relay has rendered the system temporarily inoperative due to 20 seconds of failure to tune. Proceed as follows:

antenna locations

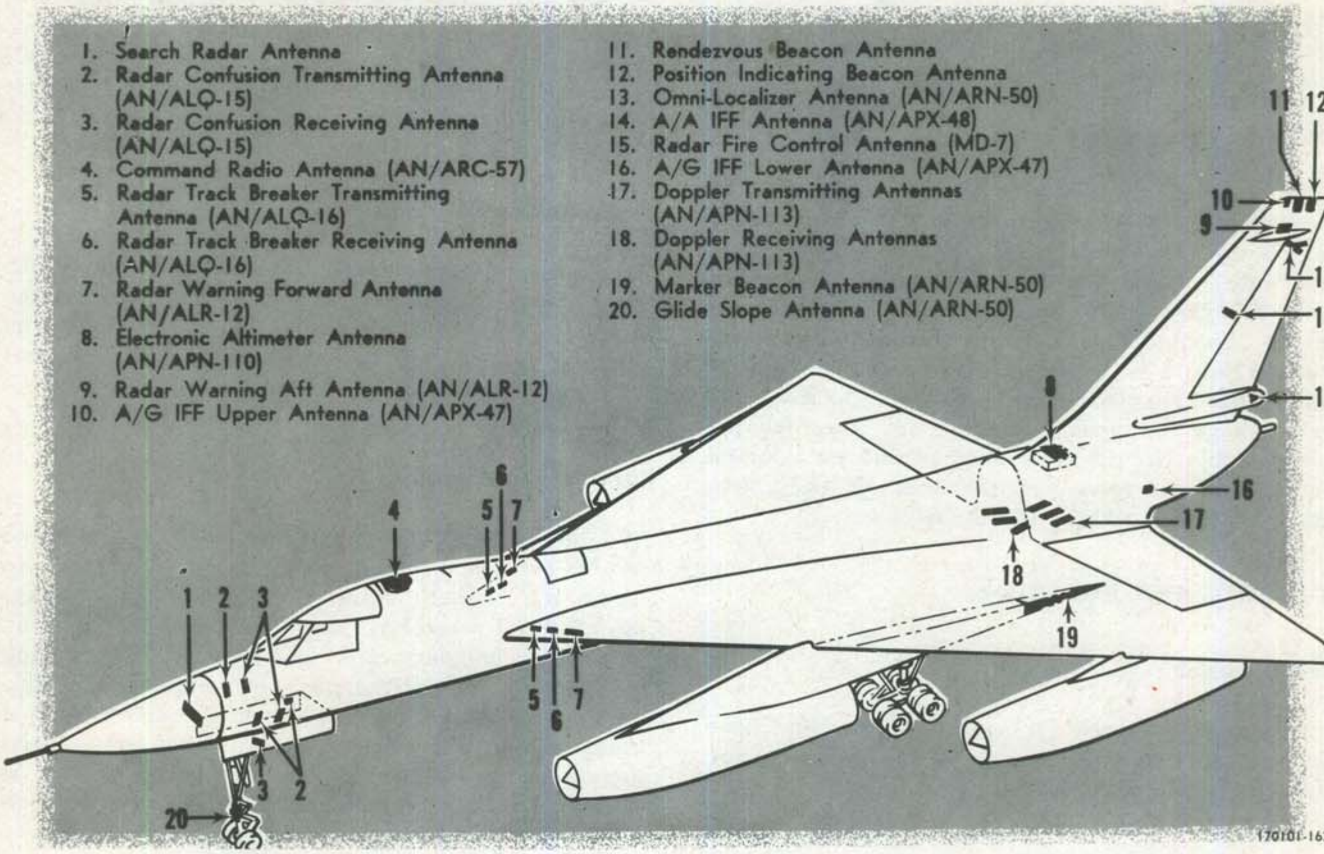


Figure 4-8.

1. Place command mode selector knob to OFF.

2. After a one-minute cooling period, place mode selector knob to MAIN or BOTH, as desired.

3. Select desired channel with channel selector knob. After waiting approximately one minute to allow for stabilization and completion of the tuning cycle, communication may be attempted.

4. If the desired channel cannot be obtained, place the channel selector knob at M and manually select the desired frequency using the frequency manual selector knobs. If this procedure fails, try a different frequency.

Note

If a frequency below 225 megacycles is selected manually, the tuning system will be rendered inoperative. This condition will be evidenced by a lack of sidetone during attempted transmission. To clear the condition, repeat steps 1 through 4 above.

5. If all attempts to tune a desired frequency fail, place the command mode selector knob to GD. This bypasses the normal tuning system and allows transmission and reception on the fixed guard frequency.

NOTE

No transmission will be made on emergency (distress) frequency channels except for emergency purposes in order to prevent transmission of messages that could be construed as actual emergency messages.

Crew Emergencies. If it becomes necessary to contact other crew members immediately, hold the function selector knob to the CALL position. This interrupts all functions at all stations and allows immediate transmission to other crew members at a high volume level.

CIVIL NAVIGATIONAL AIDS SYSTEM.

The civil navigational aids system (CNAS) consists chiefly of marker beacon, glide slope, and localizer and VHF omnidirectional range equipment. MARKER and VHF-NAV mixing switches, lccated on the pilot's communication control panel, permit the pilot to monitor the audio signals received by the VHF navigation and marker beacon equipment. The controls for the system are located on the CNAS panel (figure 4-9) on the pilot's lower left console. A radio magnetic indicator and a course indicator are located on the pilot's main instrument panel. The system operates on 28-volt d-c power from the main d-c power panel; 115-volt a-c power from the left a-c power panel; and 150-volt dc and —150-volt dc from the high voltage d-c power panel. Spare fuses for the power supply circuits are located behind the door on the front of the receiver package in the equipment rack back of the pilot in the tunnel area.

CONTROLS AND INDICATORS.

Power Switch.

A two-position switch (2, figure 4-9) on the CNAS control panel controls power to all CNAS equipment. The switch is marked ON and OFF.

Frequency Selector Knobs.

Two frequency selector knobs (1 and 4, figure 4-9) on the CNAS control panel provide the pilot with a means of tuning the localizer and VHF omnidirectional range system to the desired operating frequency, as shown on the frequency indicator above the controls. Rotating the notched outer knob selects frequencies in megacycles; the inner rotary switch knob selects frequencies in tenths of megacycles. When a specific frequency is selected, the antenna which is used with the localizer and omnidirectional equipment is automatically tuned. If a localizer frequency is selected, the glide slope system will automatically be tuned to the proper glide slope channel.

Volume Control Knob.

The volume control knob (3, figure 4-9) on the CNAS control panel provides a means of standardizing the audio level of the localizer and omnidirectional range receiver with that of other receivers. If this adjustment is made, interphone volume will not have to be readjusted when the omnirange audio is received.

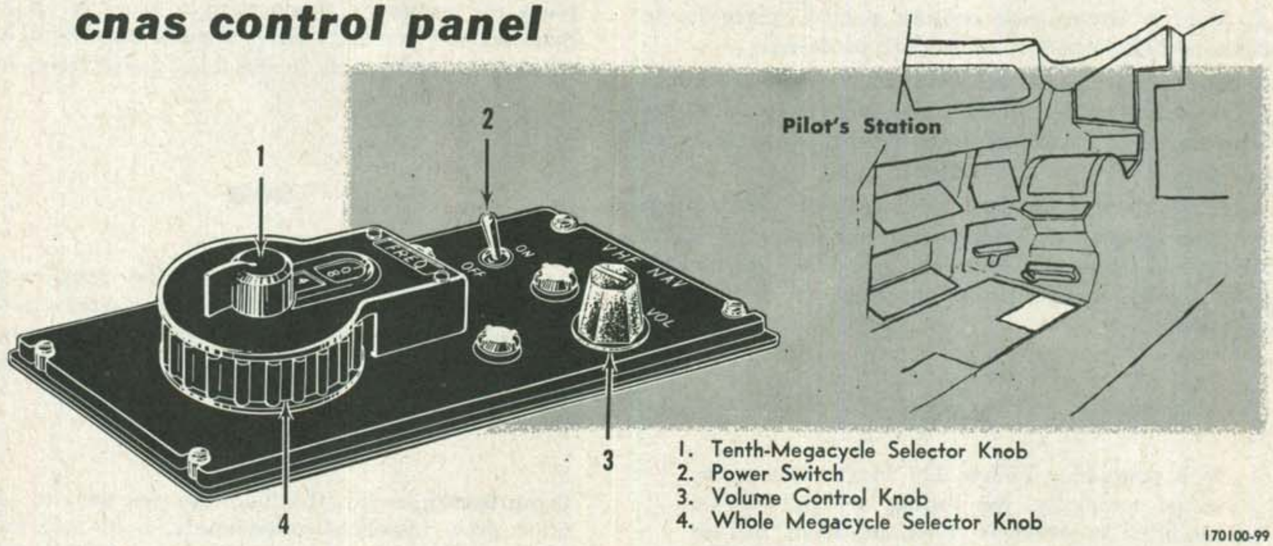
Radio Magnetic Indicator.

A radio magnetic indicator (figure 4-10) is located on the pilot's main instrument panel. The instrument shows the magnetic heading of the airplane by means of a fiducial marker at the top of the instrument and a rotating compass card. The two relative bearing pointers on the instrument travel together and furnish aximuth indication of the VHF omnidirectional range signal. The pointers indicate the relative bearing from the airplane to the omnirange station as measured from magnetic north. The indicator receives signals from the primary navigation system; therefore, a malfunction of the primary navigation system renders the indicator inoperative.

Course Indicator.

A course indicator (figure 4-11) on the pilot's main instrument panel gives the pilot glide slope, marker bea-

cnas control panel

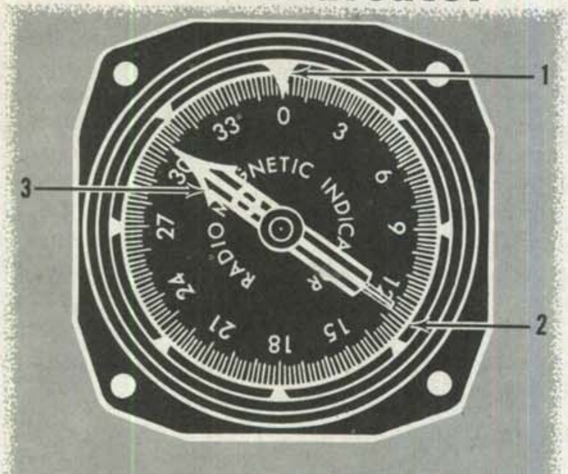


1. Tenth-Megacycle Selector Knob
2. Power Switch
3. Volume Control Knob
4. Whole Megacycle Selector Knob

170100-99

Figure 4-9.

radio magnetic indicator



1. Fiducial Marker
2. Rotating Compass Card
3. Relative Bearing Pointers

170100-113

Figure 4-10.

con, localizer, and VHF omnidirectional bearing indications. A three-tab course window located at the top of the indicator can be set to show the desired inbound or outbound magnetic bearing of an omnidirectional range station, or the desired inbound magnetic bearing of the localizer. The bearing is set in the window by means of the course set knob on the lower left corner of the instrument. A vertical bar on the indicator face shows the relative position of the airplane with respect to the localizer beam or the omnirange course selected in the tab window. A to-from window in the upper left area of the instrument face indicates TO when the omnirange bearing selected is toward the station. It indicates FROM when the bearing is from the station. A heading pointer which receives signals from the primary navigation system indicates airplane heading with respect to the bearing set in the course window. In the omnirange mode, deviation of the heading pointer from the vertical position shows the drift angle of the airplane from the selected course. A horizontal bar indicates airplane position relative to the glide slope beam. Two OFF flags, one for the vertical bar and one for the horizontal bar, come into view when signal levels fall below a value sufficient to provide reliable operation of the associated bar. The flags are indentified as GLIDE SLOPE for the horizontal bar and LOC OR RANGE for the vertical bar.

Marker Beacon Indicator Lamp.

An amber press-to-test lamp (2, figure 4-11) located on the upper right corner of the course indicator lights when the airplane crosses a marker beacon signal. Rotating the lamp counterclockwise dims it; rotating it clockwise makes it brighter.

NORMAL OPERATION OF CNAS EQUIPMENT.

Put the CNAS equipment into operation as follows:

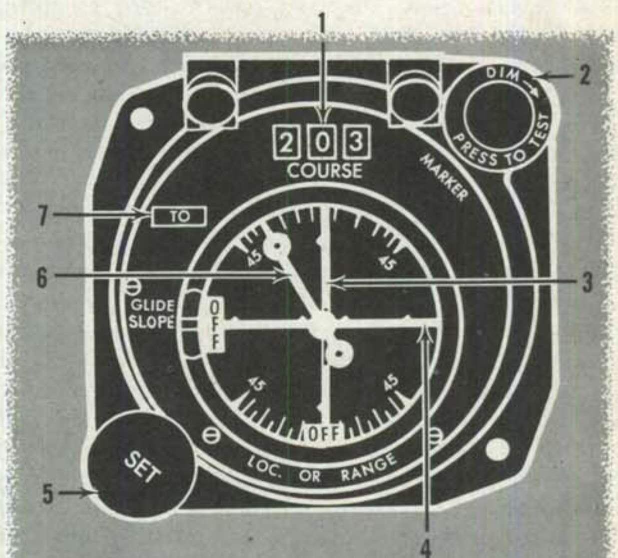
1. Power switch—ON.
2. MARKER and VHF-NAV mixing switches—ON.
3. Frequency selector knobs—Omnidirectional range, localizer, or communication channel, as required.

WARNING

Respective flag alarms for vertical and horizontal bars on the course indicator must disappear before bar indication is reliable.

4. Course set knob—Select desired course, if required. Turn the course set knob to the magnetic bearing of a desired course if an omnidirectional range frequency was selected in step 3.

course indicator



1. Course Window
2. Marker Beacon Indicator Lamp
3. Vertical Bar
4. Horizontal Bar
5. Course Set Knob
6. Heading Pointer
7. To-From Window

170100-100

Figure 4-11.

MILITARY NAVIGATIONAL AIDS SYSTEM.

The military navigational aids system (MNAS) consists of air-to-ground IFF, air-to-air IFF, position indicating beacon, and rendezvous beacon equipment.

AIR-TO-GROUND IFF EQUIPMENT.

The air-to-ground IFF equipment provides the airplane with an automatic means of selective identification to ground, shipboard, or airborne IFF recognition installations operating in the L-band frequency range. The equipment replies to proper interrogations from Mark X IFF systems and SIF (selective identification feature) stations. Operation is possible in three modes, plus I/P (identification of position) and emergency identification. The modes of operation have the following significance at ground recognition stations:

Mode 1—Security Identity
Mode 2—Personal Identity
Mode 3—Traffic Identity

The equipment consists of an air-to-ground IFF control panel, an air-to-ground SIF control panel, a transmitter-receiver, a decoder-coder, an antenna lobing switch, and two radiator-type antennas. The control panels are located on the lower left console at the pilot's station. The equipment does not perform interrogation but only transmits coded replies to correctly coded interrogation. The two radiator-type antennas are arranged to provide an upper and lower antenna. (Refer to figure 4-8 for antenna locations.) The motor-driven lobing switch rapidly transfers contact of the transmitter-receiver from one radiator to the other. This constant alternation eliminates blind spots in the antenna pattern caused by airplane structure. The transmitter-receiver package is located in the aft fuselage unpressurized area and incorporates a duplexer which permits use of the same antennas for receiving and transmitting. The receiver is sensitive to all signals within its frequency range; however, only those signals meeting the complete predetermined requirements of the code being used will be recognized and answered. This is a function of the decoder-coder, as directed and modified by switch settings within the decoder-coder and on the two control panels. The decoder-coder is located below the navigator's left console. Mode 2 code settings are screwdriver adjustments, made by means of slotted-shaft switches reached through openings in the front panel of the decoder-coder. All other codes are set up at the control panels. Mode 1 is always on whenever the equipment is operating. All other modes can be turned on or off at the IFF control panel. The equipment replies to mode 1 interrogations at all times, even while replying to other modes. Replies to modes 1, 2, and 3, as well as to I/P and emergency interrogations, are shown on the ground station radar scope. In the case of the more complicated SIF codes, ground stations will use a plan position indicator (PPI) and letter symbol indicator to decode and indicate supplementary information such as specific identification and location, and flight or aircraft conditions. Mode 1 has 32 possible code combinations. Mode 2 has 4,096, though only a portion of these are useable with existing ground facilities. Mode 3 has 64 combinations. Code numbers to be used at any given time will be assigned by area commanders. An optional low-power setting provision restricts sensitivity so that replies are made only to local interrogations. The transmitter-receiver package is cooled by the airplane air conditioning system. Four thermostatically controlled electric heaters provide warmup heat as required. The heaters operate automatically when the airplane electrical system is energized.

Master Control Knob.

The five-position master control knob (5, figure 4-12), located on the air-to-ground IFF control panel, controls operation of the air-to-ground IFF equipment. The knob positions are marked OFF, STDBY, LOW, NORM, and EMER. When the knob is turned to the STDBY position, the equipment is placed and maintained in a ready state, but it will not transmit. When the knob is turned to LOW, only local (strong) interrogations are recognized and answered. With the knob in the NORM position, full range recognition and replies occur. When the knob is placed in the EMER position, an emergency-indicating pulse group is transmitted each time a mode 1 or mode 3 interrogation is recognized.

Note

> The master control knob is prevented from being inadvertently moved to the EMER position by an internal lock. A lock release button (1, figure 4-12), when depressed and held, allows the knob to be placed in the EMER position. The knob can be moved out of the EMER position without pressing the lock release button.

Mode Switches.

Two two-position mode switches (3 and 4, figure 4-12), one for mode 2 and one for mode 3, are located on the air-to-ground IFF control panel to control transmission of mode 2 and 3 replies. When a mode switch is in the up position, its corresponding selected code will be transmitted to answer correctly coded interrogating reception. When a switch is in the OUT position, its corresponding code is not transmitted.

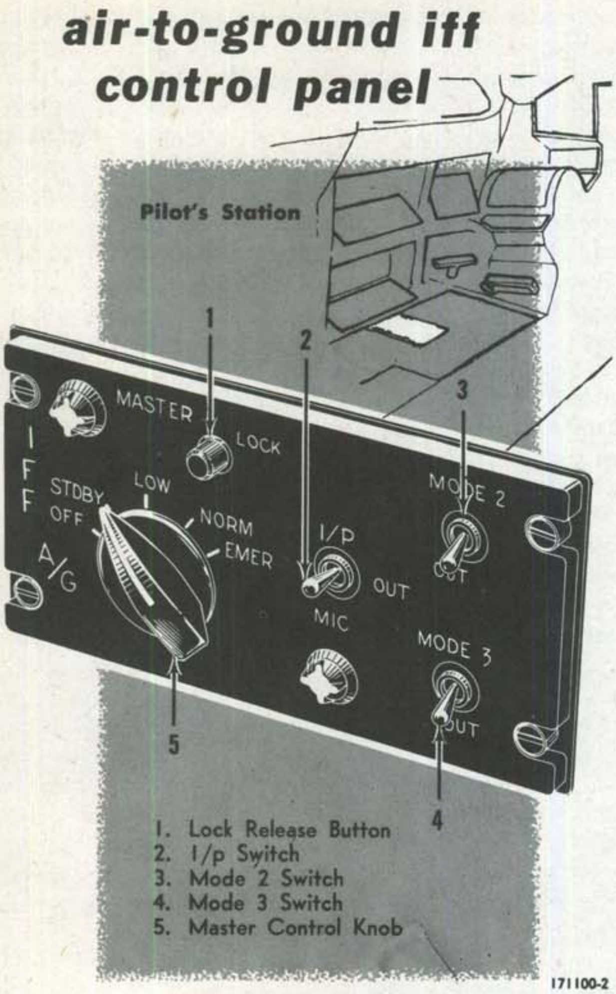


Figure 4-12.

Identification-of-Position (I/P) Switch.

The identification-of-position (I/P) switch (2, figure 4-12), located on the air-to-ground IFF control panel, is used to control transmission of I/P pulse groups. The switch has three positions—a MIC position, an OUT position, and a spring-loaded I/P position. When the switch is momentarily held in the I/P position, the I/P timer is energized for 30 seconds. If a mode 1 or mode 3 interrogation is recognized within this 30-second period, I/P replies will be made. When the switch is placed in the MIC position, the circuit is set up so that when the command radio is operating and either of the foot-operated microphone buttons or the control stick microphone switch is closed, the I/P timer is energized for 30 seconds. If a mode 1 or mode 3 interrogation is recognized within this 30-second period, I/P replies will be made. When the switch is in the OUT position, transmission of the I/P pulse groups will be withheld.

Code Selector Knobs.

Two code selector knobs (figure 4-13), one for mode 1 and one for mode 3, are located on the air-to-ground SIF panel. Each selector knob consists of an inner and outer selector ring. The inner selector ring of the mode 1 knob is marked 0, 1, 2, and 3; the outer selector ring is marked 0, 1, 2, 3, 4, 5, 6, and 7. Each selector ring of the mode 3 knob is marked 0, 1, 2, 3, 4, 5, 6, 7. Code numbers are read from left to right. For example, code 32 is selected by setting the 3 of the inner selector ring and the 2 of the outer selector ring at the index marker.

Normal Operation of Air-to-Ground IFF Equipment.

The transmitter-receiver package requires a one-hour warmup period before being placed in fully frequency-stabilized operation. If the airplane electrical system has been energized continuously for at least one hour, place the IFF equipment in operation as follows:

1. Code selector knobs—As required.
2. Mode switches—As required.
3. I/P switch—OUT or MIC.
4. Master control knob—STDBY for at least one minute, then LOW or NORM, as required by flight conditions.

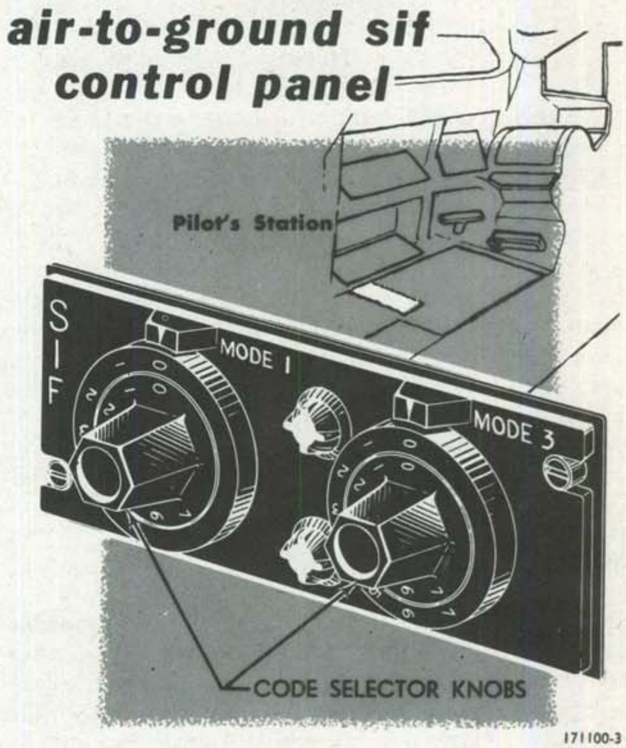


Figure 4-13.

air-to-air iff control panel

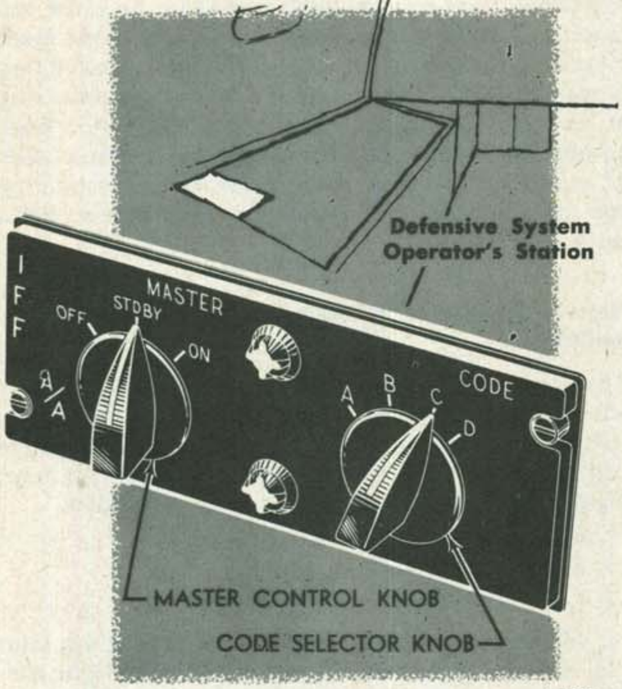


Figure 4-14.

Note

If the A/G IFF equipment must be placed in operation as soon as power is available, leave the master control knob in STDBY for at least 5 minutes, then LOW or NORM as required.

CAUTION

Disregarding the 5-minute minimum warm-up time may result in damage to the equipment.

AIR-TO-AIR IFF EQUIPMENT.

The air-to-air IFF equipment consists of airborne electronic equipment which automatically replies to properly coded signals from airborne interrogation equipment operating in the X-band frequency range. The equipment consists of a receiver-transmitter unit, a synchronizer, an antenna, and a control panel. The receiver section of the receiver-transmitter unit delivers incoming interrogation signals to the synchronizer; the transmitter section sends a reply when triggered by a coded pulse from the synchronizer. The receiver-transmitter unit is located in the leading edge of the vertical stabilizer and is force-cooled and pressurized by the airplane air conditioning system. Two thermostatically controlled heating elements heat the unit to optimum operating temperatures whenever electrical power is on the airplane. The synchronizer is composed essentially of a decoder-coder which analyzes incoming interrogation signals from the receiver and, when appropriate, sends a coded reply trigger pulse to the transmitter. The synchronizer replies only to those interrogation signals which conform to a predetermined code. This component is located in the cabin crawlway and does not require cooling air or pressurization. The antenna consists of two horizontal horn elements connected to a waveguide. It provides coverage of 360 degrees in azimuth and 20 degrees above and below the horizontal axis of level flight. Provisions are made to allow the antenna to receive and transmit without mechanical switching. The antenna, which is located in the vertical stabilizer (refer to figure 4-8), is pressurized but does not require cooling air. The control panel contains switches for placing the system in operation and for selecting one of four reply codes, each of which establishes security identification to an interrogating aircraft. The panel (figure 4-14) is located on the lower left console at the third crew station. The air-to-air IFF system operates on 115-volt alternating current from the right a-c power panel, positive 150-volt direct current and negative 150-volt direct current from the high-voltage d-c power panel, and 28-volt direct current from the 28-volt d-c power panel.

Master Control Knob.

A three-position master control knob (figure 4-14), located on the air-to-air IFF control panel, controls operation of the air-to-air IFF system. The knob positions are marked OFF, STDBY, and ON. When the knob is placed at STDBY, the equipment is energized but will not transmit. This maintains the equipment at a ready state. When the knob is placed at ON, the equipment is energized for normal operation. With the knob in the OFF position, electrical power is removed from all of the equipment except the receiver-transmitter unit heating elements.

Code Selector Knob.

This four-position knob (figure 4-14) on the air-to-air IFF control panel is used to select the reply code to be transmitted. The positions are marked A, B, C, and D.

Normal Operation of Air-to-Air IFF Equipment.

Place the air-to-air IFF system in operation as follows:

1. Electrical power—On the airplane for warm-up period.

Connect external electrical power or energize the airplane electrical system for one hour to allow the receiver-transmitter unit to warm up and stabilize at the optimum operating temperature.

Note

Insufficient warm-up will not damage the equipment, but degraded performance will result until the receiver-transmitter unit has stabilized at optimum operating temperature.

2. Code selector knob—As required.

Select code A, B, C, or D as required. Codes will be used as directed by area commanders.

3. Master control knob—STDBY one minute, then ON.

Place the master control knob at STDBY for at least one minute before placing to ON.

POSITION INDICATING BEACON EQUIPMENT.

The position indicating (PI) beacon is a K-band airborne beacon system which, when used in conjunction with the airplane search radar unit provides a means of inter-aircraft position indication. In response to appropriate interrogation from a search radar system, operating in beacon mode, the beacon automatically transmits a coded reply which results in a PPI presentation on the interrogating radar scope. This presentation indicates the range, bearing, and identity of the interrogated airplane. Pulse width discrimination prevents the beacon equipment from responding to radars operating in modes other than the beacon interrogation mode. System equipment consists of a receiver-transmitter, control panel, and antenna. The receiver-transmitter unit is cooled by the airplane air conditioning system. The PI beacon equipment is controlled from the navigator's station.

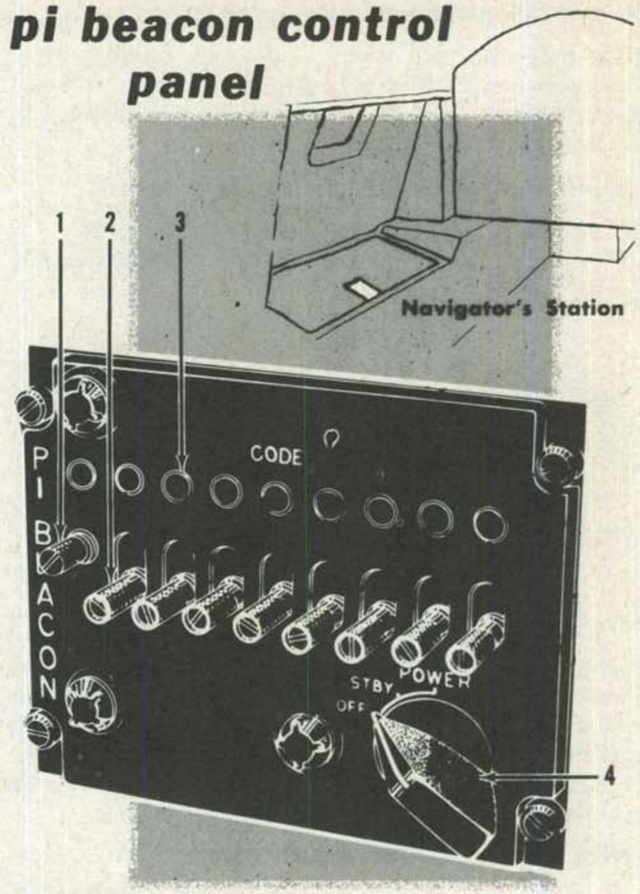
PI Beacon Power Knob.

This knob (4, figure 4-14A), located on the PI beacon control panel is marked OFF, STBY, and POWER. Placing the knob to the STBY position energizes the receiver-transmitter low voltage circuits; enables the unit to receive but not reply; and maintains the equipment in a ready state. The POWER position energizes the system for normal operation. The OFF position removes all power from the unit.

PI Beacon Code Element Knobs.

Eight spring-loaded PI beacon code element knobs (2, figure 4-14A), located on the PI beacon control panel, are used to set up code combinations for beacon response. The code element corresponding to an individual knob can be included in the reply by pulling out on the knob and lifting upward to the unmarked ON position.

pi beacon control panel



1. PI Beacon Common Code Element Knob
2. PI Beacon Code Element Knob (8)
3. PI Beacon Code Element Indicator Lamp (9)
4. PI Beacon Power Knob

171101-60

Figure 4-14A.

Note

Normally, a code should contain a maximum of six elements. The first element is stationary and included in all codes, therefore, under normal conditions the operator is not required to select more than five elements.

PI Beacon Common Code Element Knob.

This knob (1, figure 4-14A), located on the PI beacon control panel, is stationary and corresponds to the first code element. The first element is preset and automatically included in every code combination.

PI Mixing Switch.

The PI mixing switch (1, figure 4-6), located on the navigator's interphone control panel, provides aural monitoring of beacon interrogation and reply when in the unmarked ON position.

PI Beacon Code Element Indicator Lamps.

Nine code element indicator lamps (3, figure 4-14A), located on the PI beacon control panel, indicate when lighted that the associated code element is included in the beacon response.

Normal Operation of PI Beacon Equipment.

1. PI beacon code element knobs—As required.
2. PI beacon power knob—STBY for approximately fifteen minutes, then POWER.

Note

> Placing the beacon power knob in the POWER position prior to the fifteen minute warm-up period will not damage the equipment. However, temporary degraded performance will result.

3. PI Mixing Switch—ON.
4. Search radar—Beacon mode.

Emergency Operation of PI Beacon Equipment.

If the system fails to operate in a selected code, the operator may switch to an alternate code after coordination with the aircraft commander and interrogating aircraft. If the system still fails to function, turn the PI beacon power knob to OFF. The nature of this equipment prohibits any inflight maintenance.

RENDEZVOUS BEACON EQUIPMENT.

The rendezvous (RV) beacon is an X-band airborne navigational aid system which enables a rendezvous between bomber and compatibly equipped tanker aircraft for air refueling. When interrogated by a tanker APN/59 radar the beacon automatically transmits a coded reply. This response results in a presentation on the tanker radar scope which indicates the range, bearing, and identity of the bomber. By utilizing the search radar, in beacon mode, to interrogate the tanker the bomber obtains a similar presentation of tanker range, bearing, and identity. The bomber command radio can also be used during rendezvous operations unless radio silence conditions prohibit. System equipment consists of a receiver-transmitter, control panel, and an antenna. The receiver-transmitter unit is cooled by the airplane air-conditioning system. RV beacon operating controls are on the RV beacon control panel at the navigator's station. An additional control for aural monitoring of beacon interrogation and reply is on the navigator's interphone panel.

RV Beacon Power Knob.

This knob (4, figure 4-14B), located on the RV beacon control panel, is marked OFF, STBY, and POWER. Positioning the knob to STBY energizes the receiver-transmitter low voltage circuits; enables the unit to receive but not reply; and maintains the equipment in a ready state. Positioning the knob to POWER energizes the system for normal operation. The OFF position removes all power from the unit.

RV Beacon Code Element Knobs.

Eight spring-loaded RV beacon code element knobs (2, figure 4-14B), located on the RV beacon control panel, are used to set up a code combination for the beacon response. The code element corresponding to an individual knob can be included in the reply by pulling out on the knob and lifting upward to the unmarked ON position.

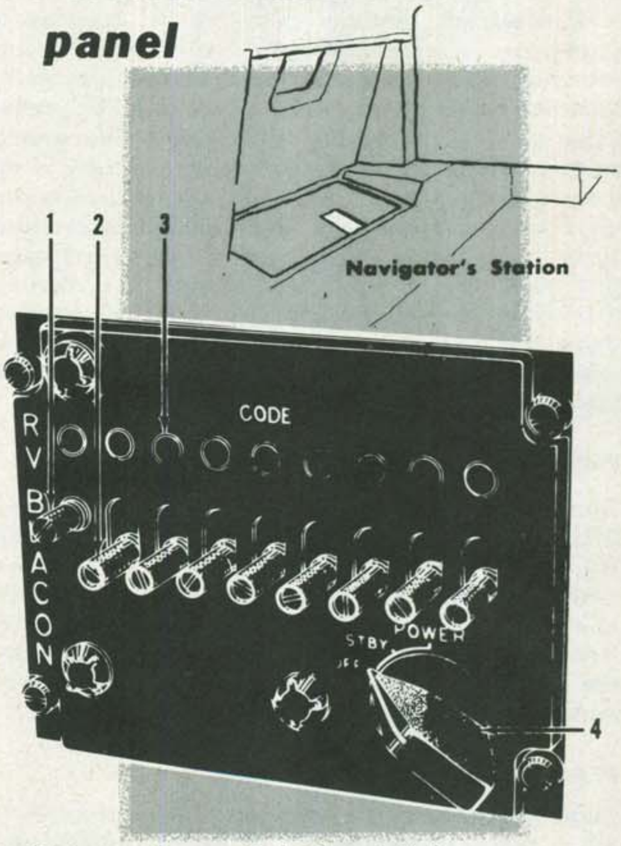
Note

> Normally, a code should contain a maximum of six elements. The first element is stationary and included in all codes, therefore, under normal conditions the operator is not required to select more than five elements.

RV Beacon Common Code Element Knob.

This knob (1, figure 4-14B), located on the RV beacon control panel, is stationary and corresponds to the first code element. The first element is preset and automatically included in every code combination.

rv beacon control panel



1. RV Beacon Common Code Element Knob
2. RV Beacon Code Element Knob (8)
3. RV Beacon Code Element Indicator Lamp (9)
4. RV Beacon Power Knob

171101-61

Figure 4-14B.

RV Mixing Switch.

The RV mixing switch (1, figure 4-6), located on the navigator's interphone control panel, provides aural monitoring of beacon interrogation and reply when in the unmarked ON position.

RV Beacon Code Element Indicator Lamps.

Nine of these lamps (3, figure 4-14B), on the RV beacon control panel, indicate when lighted that the associated code element is included in the beacon response.

Normal Operation of RV Beacon Equipment.

1. RV beacon code element knobs—As required.
2. RV beacon power knob—STBY for approximately fifteen minutes then POWER.

Note

Placing the beacon power knob in the POWER position prior to the fifteen minute warm-up period will not damage the equipment. However, temporary degraded performance will result.

3. RV Mixing Switch—ON.
4. Command Radio—As required.
5. Search radar—Beacon mode.

Emergency Operation of RV Beacon Equipment.

If the system fails to operate in a selected code, the operator may switch to an alternate code after coordination with the aircraft commander and interrogating aircraft. If the system still fails to function, turn the RV beacon power knob to OFF. The nature of this equipment prohibits any inflight maintenance.

LIGHTING EQUIPMENT.

The airplane lighting equipment is divided into two groups: exterior lighting and interior lighting. The exterior group includes landing lights, taxi lights, navigation lights, anticollision lights, and air refueling slip way lights. The interior group consists of various instrument, panel, flood, and tunnel area lights necessary to provide adequate lighting in the crew compartments.

EXTERIOR LIGHTS.

Two sealed-beam landing lights are mounted on the nose landing gear, one on each drag strut. The lights are ground-adjustable and retract with the nose gear. A switch is provided for each light. One sealed-beam taxi light is mounted on the left drag strut of the nose landing gear above the left landing light. A micro-switch on the landing gear prevents the taxi and landing lights from being energized when the landing gear is in the retracted position. The landing lights receive 115-volt alternating current supplied from the left and right a-c power panels; the 115-volt a-c power is reduced to 28-volts by a transformer located on each light. The taxi light operates on 28-volt direct current supplied from the main d-c power panel. The navigation lighting system, which is used to indicate position and direction of the airplane, consists of six lights. A wing light is located just forward of each wing tip on the leading edge. The left wing light is red and the right wing light is green. A white light is located on top of the fuselage between the navigator's and DSO's canopies. A white light is also mounted on the bottom of the fuselage aft of the drag chute door. Two white taillights are mounted side-by-side between transparent glass fairings in the rudder tip just forward of the trailing edge. All of the navigation lights operate on 28-volt alternating current. The wing and taillights will burn steady or can be made to flash alternately through control of a switch in the pilot's compartment. These lights can be made to burn bright or dim in either the steady or flashing mode of operation. The two white fuselage lights do not flash, but they can be made bright or dim. Two red flashing, oscillating, high-intensity anticollision lights are located on the vertical stabilizer. The upper anticollision light is located on the leading edge near the top. The lower light is located on the trailing edge between the fuselage and the fire control system radome. Together, the oscillating anticollision lights provide 360 degree coverage. The lights receive 115-volt a-c power from the left and right a-c power panels. A white light is located in the air-refueling slipway. This light, which comes on when the slipway doors open, provides a target for the tanker boom operator during night refueling operations. The slipway light has a variable intensity and receives 28-volt a-c power from the 28-volt a-c and high-voltage d-c power panel.

Landing Light Switches.

Two on-off switches (7, figure 1-32), marked L and R and located on the pilot's forward left console, control the landing lights. Placing a switch in the ON position closes a 28-volt d-c circuit to the associated landing light relay, which in turn closes the 115-volt circuit to the light. The landing lights may be switched ON or OFF simultaneously or separately.

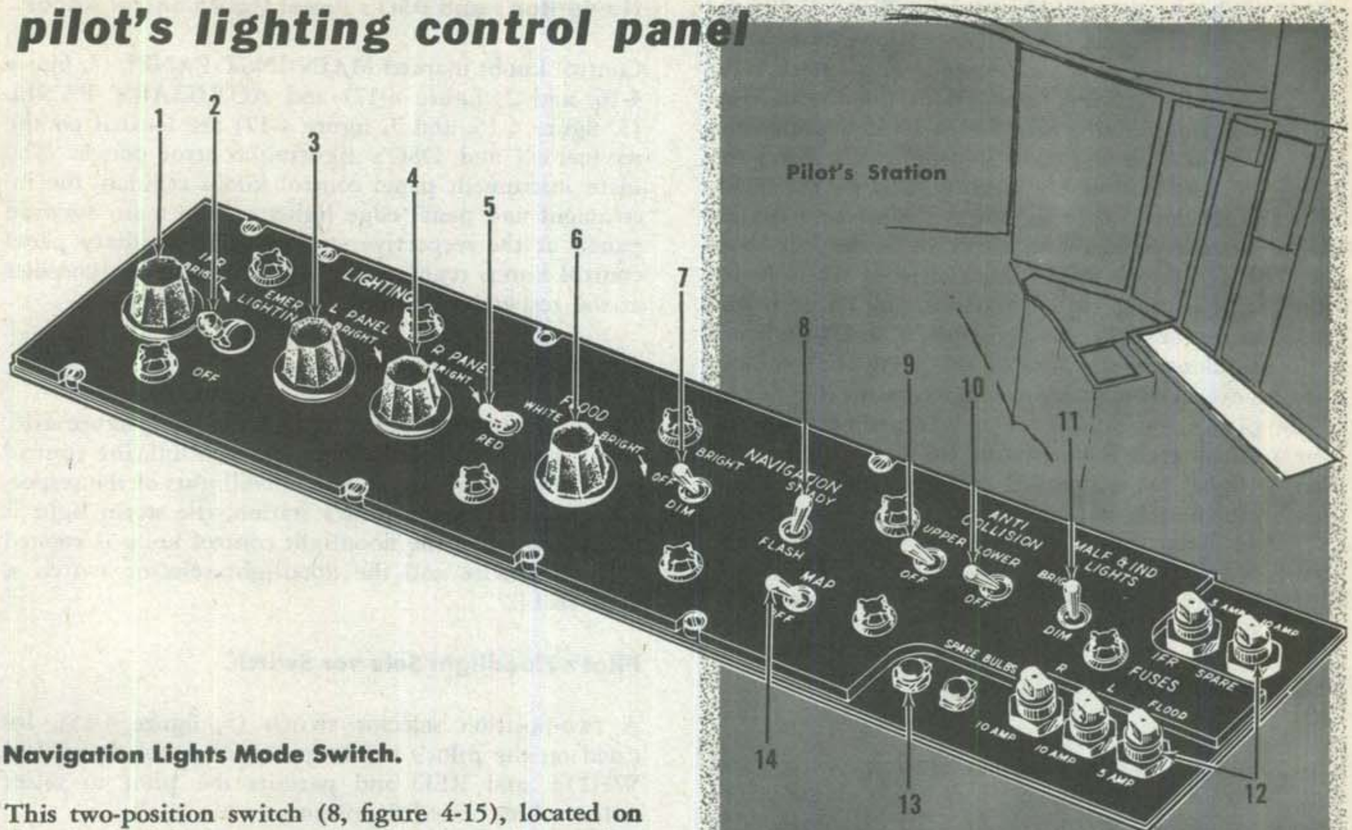
Taxi Light Switch.

One on-off switch (10, figure 1-32), located on the pilot's forward left console, controls the taxi light. Moving the switch to the ON position connects 28-volt direct current to the taxi light filament.

Navigation Lights Control Switch.

This three-position switch (7, figure 4-15), located on the pilot's lighting control panel, is used to turn the navigation lights on and off and to control their intensity. The switch positions are marked BRIGHT, DIM, and OFF.

pilot's lighting control panel



1. Air Refueling (IFR) Slipway Light Control Knob
2. Emergency Lighting Switch
3. Left Panel Lights Control Knob
4. Right Panel Lights Control Knob
5. Floodlights Selector Switch
6. Floodlights Control Knob
7. Navigation Lights Control Switch
8. Navigation Lights Mode Switch
9. Upper Anticollision Light Switch
10. Lower Anticollision Light Switch
11. Malfunction and Indicator Lights Dimming Switch
12. Lighting Control Panel Fuses (5)
13. Spare Bulb Holder (2)
14. Map Light Switch

170100-2

Figure 4-15.

Navigation Lights Mode Switch.

This two-position switch (8, figure 4-15), located on the pilot's lighting control panel, is used to select either the steady or the flashing mode of operation for the navigation lights. The switch positions are marked STEADY and FLASH.

Anticollision Light Switches.

A pair of two-position switches (9 and 10, figure 4-15), located on the pilot's lighting control panel, control power to the anticollision lights. One switch is marked UPPER and OFF; the other is marked LOWER and OFF. When a switch is placed in the up (ON) position the respective anticollision light will flash and oscillate.

Note

The anticollision lights should be turned off during actual instrument flight conditions. With the lights on, the pilot may experience vertigo from the oscillating light reflections. In addition, the lights will be ineffective during instrument flight conditions.

Air Refueling (IFR) Slipway Light Control Knob.

This knob (1, figure 4-15), located on the pilot's lighting control panel, is used to regulate the intensity of the air refueling slipway light. The light will be brightest with the knob at the fully clockwise position.

Note

This knob does not turn the slipway light on or off. The light comes on when the slipway doors are opened and goes out when the doors are closed.

INTERIOR LIGHTS.

The interior lighting equipment consists of instrument lights, panel edge lights, indirect and direct floodlights, a map light, and tunnel area lights. All instruments are lighted either integrally or by post lights mounted on the instrument. The instrument lights at the pilot's station are red; those at the other stations are white. Edge lighting of the panels at the pilot's station is accomplished by small red lights set into the acrylic panels. The other stations have white edge lights. Floodlights are provided at all stations to provide overall lighting. The pilot's floodlights consist of small red and white lamps located under the glare shield and in the control panel wells along the left side of the station. In addition, a large red floodlight and a white storm light are mounted on the aft wall of the compartment to the right of the seat headrest. The navigator's floodlights consist of white lamps located in two long baffled fixtures, one on each side of the station near the canopy ledge. The DSO's floodlights are identical to those of the navigator's station. A white overhead map light is mounted in the canopy at the pilot's station. The tunnel areas between the crew stations each have two white dome lights. The interior lights are controlled entirely from the lighting control panels at each station and receive 28-volt a-c power from the 28-volt a-c and high-voltage d-c power panel. For some instrument lights, the 28-volt a-c power is reduced to 5 volts by transformers.

Pilot's Panel Light Control Knobs.

Two control knobs on the pilot's lighting control panel regulate the instrument and panel lights at the pilot's station. The knob marked L PANEL (3, figure 4-15) regulates the lights on the left side of the station up to but not including the engine instruments. The knob marked R PANEL (4, figure 4-15) regulates the lights on the right side of the station up to and including the engine instruments.

Navigator's and DSO's Panel Light Control Knobs.

Control knobs marked MAIN INST PANEL (3, figure 4-16, and 2, figure 4-17) and AUXILIARY PANEL (5, figure 4-16, and 7, figure 4-17) are located on the navigator's and DSO's lighting control panels. The main instrument panel control knobs regulate the instrument and panel edge lights on the main forward panels at the respective stations. The auxiliary panel control knobs regulate the lights on the left consoles at the respective stations.

Floodlight Control Knobs.

Floodlight control knobs (6, figure 4-15, 2, figure 4-16, and 1, figure 4-17) are located on each lighting control panel. The knobs regulate the floodlights of the respective stations. At the pilot's station, the storm light is turned on when the floodlight control knob is rotated fully clockwise and the floodlight selector switch is at WHITE.

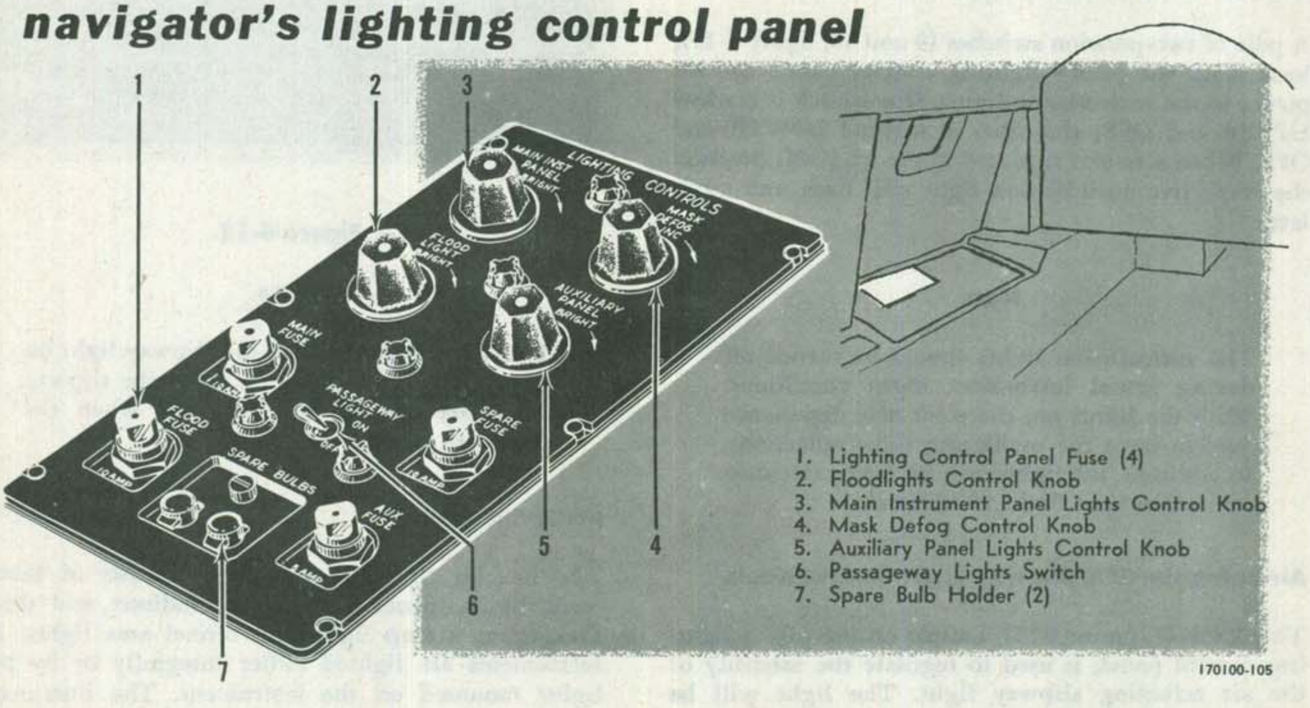
Pilot's Floodlight Selector Switch.

A two-position selector switch (5, figure 4-15), located on the pilot's lighting control panel, is marked WHITE and RED and permits the pilot to select either white or red floodlights at his station.

Map Light Switch.

A two-position switch (14, figure 4-15), located on the pilot's lighting control panel, is marked MAP and

navigator's lighting control panel



1. Lighting Control Panel Fuse (4)
2. Floodlights Control Knob
3. Main Instrument Panel Lights Control Knob
4. Mask Defog Control Knob
5. Auxiliary Panel Lights Control Knob
6. Passageway Lights Switch
7. Spare Bulb Holder (2)

170100-105

Figure 4-16.

dso's lighting control panel

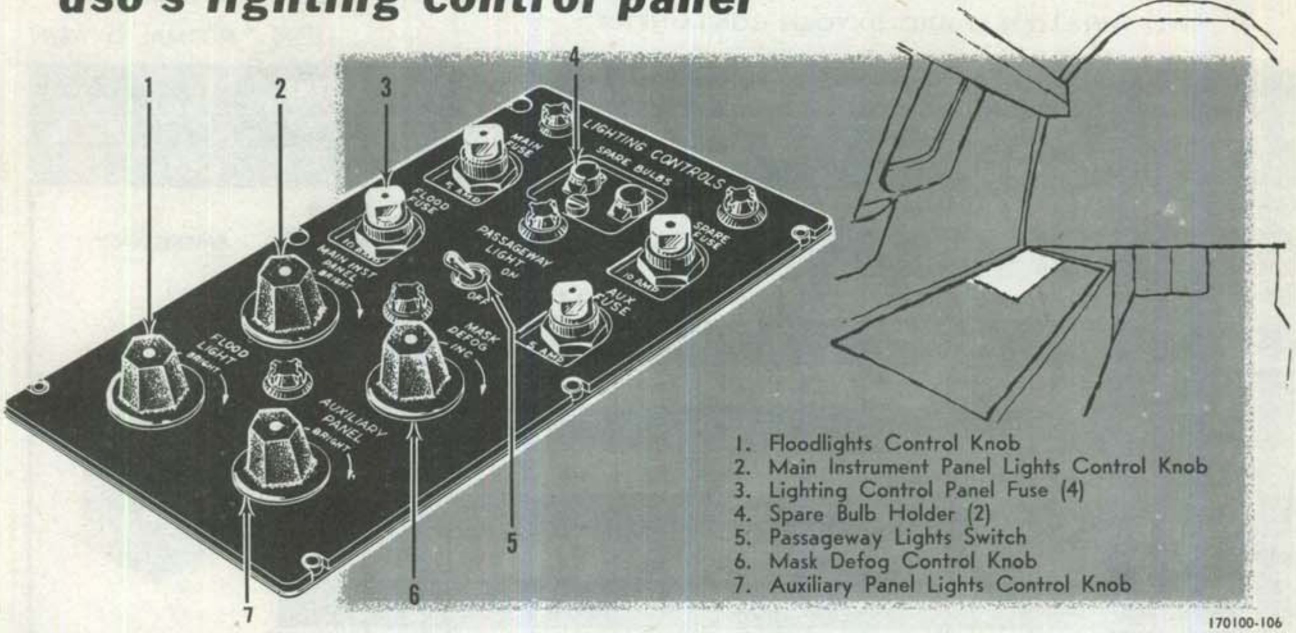


Figure 4-17.

OFF. Placing the switch in the MAP position turns on the overhead map light at the pilot's station.

Passageway Light Switches.

The tunnel area dome lights are turned on and off by switches marked PASSAGEWAY LIGHT (6, figure 4-16, and 5, figure 4-17) on the navigator's and DSO's lighting control panels. The lights in the tunnel area between the pilot and navigator are controlled by the switch on the navigator's control panel. The lights in the tunnel area between the navigator and DSO are controlled by the switch on the DSO's control panel.

Emergency Lighting Switch.

An internally guarded, two-position emergency lighting switch (2, figure 4-15) is located on the pilot's lighting control panel. The switch is marked EMER LIGHTING and OFF. When the switch handle is pulled outward and placed in the EMER LIGHTING position, the pilot's white floodlights are lighted by power from the 28-volt d-c essential bus in the 28-volt d-c power panel. This feature assures lighting at the pilot's station in case of a-c power failure. When the switch is in the OFF position, the white floodlights can be connected to their normal 28-volt a-c power source through the floodlight controls on the panel.

Fuses and Spare Bulb Holders.

Each lighting control panel has fuses (12, figure 4-15, 1, figure 4-16, and 3, figure 4-17) for each lighting control knob. Amperages are marked under each fuse. Each panel also has a spare fuse and two spare bulb holders.

OXYGEN SYSTEM.

The airplane is provided with a liquid oxygen system which supplies all crew stations and is designed for use with an A-13A oxygen mask. The system consists essentially of two 10-liter vacuum-insulated liquid oxygen containers, a quantity indicating system, and three automatic pressure-breathing diluter-demand regulators. The containers, located in the forward portion of the nose wheel well, each have a buildup circuit which maintains an operating system pressure of 75 ($\pm$5) psi. This pressure remains constant until the oxygen supply is virtually depleted. Relief valves prevent excessive pressure buildup. The liquid oxygen is converted to a gas as it passes through lines from each container to the crew stations. At each station, the lines converge into a single tube for delivery to the regulator. Check valves assure continued oxygen supply in the event that one of the containers or its plumbing should fail. A conditioning coil warms the gaseous oxygen at the pilot's station to a comfortable breathing temperature; at the navigator's and DSO's stations, the plumbing distance from the containers is sufficient to adequately warm the gas. The quantity indicating system incorporates a capacitance-type quantity indicator and a probe in each container to electrically measure total liquid oxygen quantity. The indicating system, which operates on 115-volt

oxygen duration

TWO TEN-LITER LIQUID OXYGEN CONTAINERS

☐ 100% OXYGEN
▬ NORMAL OXYGEN

CABIN ALTITUDE FEET	HOURS REMAINING FOR THREE CREW MEMBERS										
	QUANTITY INDICATOR READING—LITERS										
	20	18	16	14	12	10	8	6	4	2	BELOW 2
35,000 AND UP	38.6	34.8	30.9	27.0	23.1	19.3	15.4	11.6	7.7	3.8	EMERGENCY
	38.6	34.8	30.9	27.0	23.1	19.3	15.4	11.6	7.7	3.8	
30,000	27.8	25.1	22.3	19.5	16.7	13.9	11.1	8.3	5.5	2.7	DESCEND TO ALTITUDE NOT REQUIRING OXYGEN
	28.6	25.8	22.9	20.0	17.2	14.3	11.4	8.6	5.7	2.8	
25,000	21.6	19.3	17.2	15.6	12.9	10.7	8.5	6.7	4.3	2.1	
	19.8	17.8	21.6	18.9	16.2	13.5	10.8	8.1	5.4	2.7	
20,000	16.3	14.7	13.1	11.4	9.8	8.2	6.5	4.9	3.2	1.6	
	30.6	27.5	24.4	21.3	18.3	15.3	12.2	9.2	6.1	3.0	
15,000	13.1	11.8	10.5	9.2	7.8	6.5	5.2	3.9	2.6	1.3	
	37.0	33.4	29.8	25.9	22.2	18.5	14.8	11.1	7.4	3.7	
10,000	10.5	9.5	8.4	7.4	6.3	5.3	4.2	3.2	2.1	1.0	
	37.0	33.4	29.8	25.9	22.2	18.5	14.8	11.1	7.4	3.7	
5,000	8.7	7.9	7.0	6.1	5.3	4.4	3.5	2.6	1.7	0.8	
	37.0	33.4	29.8	25.9	22.2	18.5	14.8	11.1	7.4	3.7	170100-28

Figure 4-18.

single-phase a-c power from the left a-c power panel, also provides a low level warning. The oxygen system is serviced through two automatic filler-buildup and vent valves located in the nose wheel well, one for each container. (Refer to figure 1-41 for servicing information.) Each valve automatically positions to vent for filling when the servicing cart hose is connected. When the hose is removed, the valve repositions to the buildup position. This feature insures correct valve position at all times. The oxygen system is ready for use immedately after filling the last container. Total oxygen duration for a fully serviced system varies from 38.6 hours under optimum conditions to 8.7 hours for the most demanding conditions. (Refer to figure 4-18 for oxygen duration.) With the airplane on the ground and with no oxygen demand, a fully serviced system will completely boil off in approximately 16 days.

OXYGEN REGULATOR.

An automatic pressure-breathing, diluter-demand oxygen regulator is mounted directly beneath the oxygen control panel (figure 4-19) at each station. The regulator and panel are located on the lower right console at the pilot's station and on the left consoles at the other crew stations. From sea level to 30,000 feet cabin altitude, the regulator mixes air with oxygen in varying amounts and delivers a quantity of the mixture with each inhalation. Above 30,000 feet cabin altitude, where the regulator delivers pure oxygen, the mask pressure increases sharply until the regulator delivers maximum design pressure. In emergencies or for ground-testing, the regulator can be set to deliver positive pressure, continuous flow, and pure oxygen at all altitudes.

OXYGEN CONTROLS AND INDICATORS.

Supply Lever.

A green on-off supply lever (4, figure 4-19) is located on the lower right portion of each oxygen control panel. Placing the lever in the ON position opens a shutoff valve to permit a flow of oxygen to the regulator.

WARNING

The supply lever should be in the OFF position when oxygen is not being used. This is

to prevent depletion of the supply in case the regulator is inadvertently left in the continuous-flow emergency setting.

Diluter Lever.

A white two-position diluter lever (5, figure 4-19) is located on the lower center portion of each oxygen control panel. With the supply lever at ON, and the emergency lever at NORMAL, placing the diluter lever in the NORMAL OXYGEN position causes the regulator to deliver an air-oxygen mixture to the mask upon breathing demand. Placing the diluter lever in the 100% OXYGEN position closes the regulator air valve and allows pure oxygen to be delivered to the mask.

Emergency Lever.

A red three-position emergency lever (1, figure 4-19) is located on the lower left portion of each oxygen control panel. With the supply lever at ON, placing the emergency lever in the EMERGENCY position causes the regulator to deliver a continuous flow of pure oxygen at a pressure slightly higher than normal for the existing cabin altitude. Placing the emergency lever in the NORMAL position allows the diluter lever to command oxygen delivery. With the emergency lever in the momentary TEST MASK position, a positive, continuous, fixed pressure is delivered for ground-testing the mask. The emergency lever should remain in the NORMAL position at all times unless an unscheduled pressure increase and continuous flow is required.

CAUTION

When positive pressure and continuous flow is required, it is important that the oxygen mask be well fitted to the face. Unless special precautions are taken to prevent leakage, continued use of positive pressure may result in the rapid depletion of the oxygen supply.

Pressure Gage.

A pressure gage (3, figure 4-19) is located on the upper right portion of each oxygen control panel. The gage, which is marked from 0 to 500 psi, indicates oxygen system pressure at the regular inlet. Normal system pressure is 75 (±5) psi, but under standby conditions (no usage at any station) the pressure may be as high as 110 psi. The gage will indicate system pressure whether the supply lever is ON or OFF. For the range markings of the pressure gage, refer to "Instrument Markings," figure 5-1.

Flow Indicator.

A shutter-type flow indicator (2, figure 4-19) is located on the upper left portion of each oxygen control panel. The indicator shows black and white alternately during the breathing cycle.

Oxygen Quantity Indicator.

A quantity indicator (8, figure 1-26), located on the pilot's lower right console, indicates the total quantity of liquid oxygen in the containers. The indicator is marked from 0 to 20 liters. When the containers are full after normal servicing, the indicator needle will read between 18 and 20 liters (approximately). In the event of electrical power failure to the quantity indicating system, the needle will remain in the position it held at the time of failure.

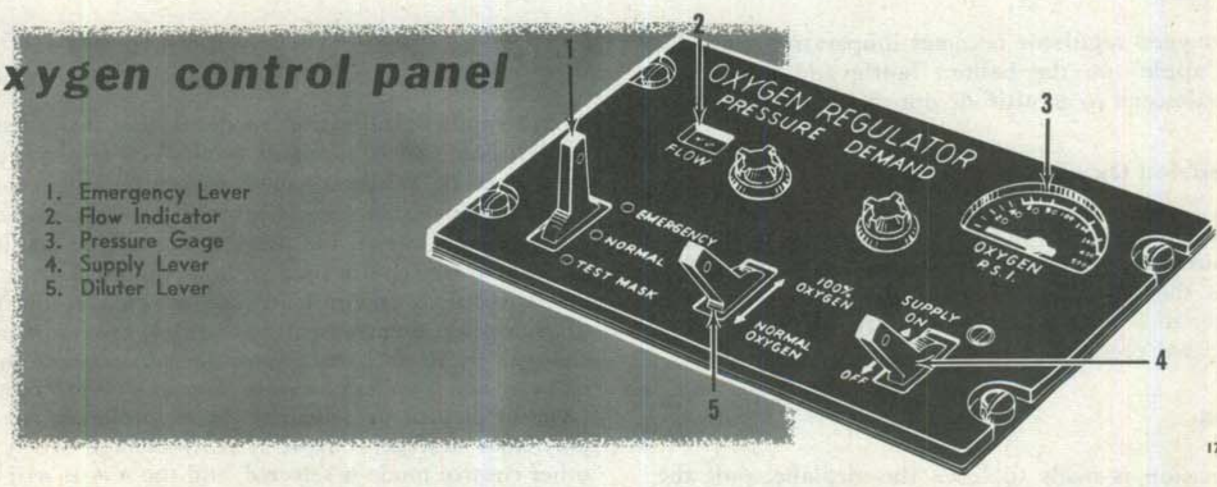


Figure 4-19.

Quantity Indicator Test Button.

A test button (3, figure 1-26) is located on the pilot's lower right console adjacent to the oxygen quantity indicator. When the button is pressed, the quantity indicator needle will move toward zero if the indicating system is operating properly. When the button is released, the indicator needle should move back to the proper reading.

Oxygen Quantity Caution Lamp.

An oxygen quantity caution lamp (figure 1-12) is located on the caution lamp panel at the pilot's station. The lamp lights when the oxygen quantity indicator shows less than two liters remaining. When lighted, OXYGEN LOW appears on the face of the lamp in yellow illuminated letters. The caution lamp is tied into the master caution lamp circuit and receives 28-volt direct current from the 28-volt d-c power panel. (For testing and dimming the oxygen quantity caution lamp and for information on the master caution lamp, refer to "Pilot's Indicator Lamp System", Section I.)

NORMAL OPERATION OF OXYGEN SYSTEM.

The oxygen system is put into normal operation for any crew member by accomplishing the following at the respective crew station:

1. Oxygen pressure gage—70-110 psi.
2. Oxygen supply lever—ON.
3. Diluter lever—NORMAL OXYGEN.
4. Emergency lever—NORMAL.
5. Flow indicator—Check periodically.

EMERGENCY OPERATION OF OXYGEN SYSTEM.

Regulator Failure.

If the oxygen regulator becomes inoperative, pull the "green apple" on the bailout bottle and notify the pilot to descend to an altitude not requiring oxygen.

Unscheduled Oxygen Requirements.

If for any reason a greater-than-normal flow of oxygen is required at any crew station, place the emergency lever at the EMERGENCY position. This causes the regulator to deliver a continuous flow of pure oxygen at increased pressure.

Ejection.

If a decision is made to leave the airplane, pull the "green apple" before ejecting.

AUTOPILOT SYSTEM.

The autopilot system consists of electronic, mechanical, and hydraulic components which control the airplane during various selected modes of autopilot flight. These modes, several of which may be in operation simultaneously, are: attitude stabilization, constant Mach, constant Mach-altitude, navigation ground track, constant ground track, and automatic approach. Attitude stabilization is the basic mode and is in effect at all times when the autopilot is engaged. The other modes, when selected, merely modify the basic mode references to accomplish specific tasks. The autopilot (attitude stabilization) may be engaged with the airplane in any desired pitch and roll attitude within the limits of the primary navigation system stable table. Pitch and bank synchronizers assure that the autopilot servos are constantly synchronized with actual attitude in order to prevent transient maneuvers during engagement. Attitude stabilization will then hold the airplane at the reference pitch and roll attitude until selection of another autopilot control mode or until the pilot initiates control stick steering. Through control stick steering, the pilot may at any time manually maneuver the airplane with the control stick without disengaging the autopilot. This feature replaces the turn and pitch knobs common to other types of autopilot systems. During autopilot operation, the control stick reflects the position of the control surfaces, and the airplane is automatically trimmed for one-g flight and damped in the same manner as for manual flight control. (Refer to "Flight Control System," Section I.) In case of emergency or for manual corrections during bomb runs, pitch and bank control of the autopilot may be transferred to the navigator's station. The autopilot servos are electrically controlled and hydraulically operated and they receive hydraulic pressure from the utility hydraulic system. The servos and other autopilot components receive 28-volt d-c and 115-volt a-c electrical power from the 28-volt d-c power panel and the left a-c power panel.

ATTITUDE STABILIZATION (BASIC AUTOPILOT) MODE.

The attitude stabilization mode is the basic control mode upon which all other modes act to accomplish specific tasks. When engaged, the autopilot servos receive attitude error signals through the amplifier-computer assembly from the primary navigation stable table. These signals are used to hold the airplane at the reference pitch and roll attitude existing at the time of autopilot engagement. Required control surface changes are made by the autopilot servos through the elevator and aileron channels. The mode requirements (type of control provided by the autopilot servos in a particular surface control system) change when any other control mode is selected, and the servos will control the airplane according to the new requirements.

However, when the new mode is discontinued, the autopilot reverts back to attitude stabilization in the affected surface control system and will maintain the pitch or roll attitude that existed at the time of disengagement. For example, if the autopilot is engaged with the airplane in a twenty-degree bank, this bank angle will be held constant. If the constant ground track mode is then selected, the airplane will respond by leveling the wings and holding constant ground track; the original pitch angle will continue to be controlled by attitude stabilization and will remain unchanged. If the constant ground track mode is subsequently discontinued, the autopilot will revert back to attitude stabilization in the aileron control system, again holding a constant bank angle at the new reference wings-level attitude. The pilot may change the attitude stabilization pitch and bank references at any time by using control stick steering.

CONSTANT MACH MODE.

The constant Mach mode provides cruise control for optimum range performance. When operating in this mode, the autopilot receives actual Mach signals originating in the air data system. These signals are compared to a constant reference Mach signal equal to the Mach number existing at the time of mode selection. The resulting error signal controls pitch through the elevator control system. Airplane velocity is held at the reference Mach number by varying altitude. The aileron control system remains unaffected by this mode. The pilot may increase or decrease the reference Mach number in small increments by means of the autopilot airspeed control switch.

CONSTANT MACH–ALTITUDE MODE.

The constant Mach-altitude mode provides for the constant Mach number and constant altitude performance required by stabilized bomb runs and by air traffic control (ATC) procedures. When operating in this mode, the autopilot receives Mach and barometric altitude signals originating in the air data system. These signals are compared to the reference Mach and altitude signals equal to the altitude and Mach number existing at the time of mode selection. The resulting Mach error signals are applied to a throttle servo to maintain the reference Mach number by varying engine thrust. Likewise, the resulting altitude error signals control pitch through the elevator control system to maintain the reference altitude. The aileron channel remains unaffected by this mode. The pilot may change the reference Mach number in small increments by means of the autopilot airspeed control switch; he may change the reference altitude by using control stick steering.

NAVIGATION GROUND TRACK MODE.

When operating in this mode, the autopilot receives steering error signals from the primary navigation system. With the primary navigation system in the navigation mode (navigator's function selector knob at NAVIGATE) these signals will steer the airplane to follow a computed great circle ground track. In the bomb mode (navigator's function selector knob at BOMB) the airplane is steered on a computed aim-point ground track to the target by the navigation system. Required heading changes are made through the aileron control system. The elevator control system remains unaffected by this mode. Since the required ground track is determined by the navigation system, the pilot usually will not desire to change the heading reference while operating in this mode.

CONSTANT GROUND TRACK MODE.

In this mode, the autopilot receives primary navigation system steering error signals which are derived from the ground track reference existing at the instant of mode selection. These signals are used to steer the airplane to follow a rhumb line constant ground track. Required heading changes are made through the aileron control system. The elevator control system remains unaffected by this mode. The pilot may change the ground track (heading) reference by using control stick steering.

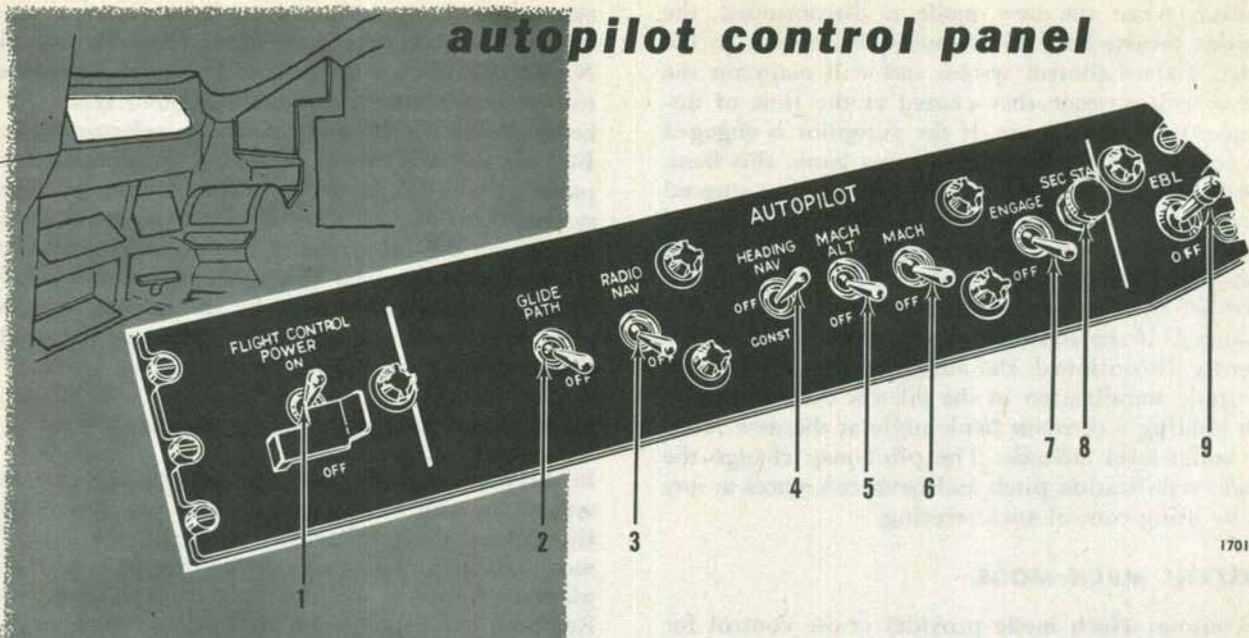
AUTOMATIC APPROACH MODE.

The autopilot is designed to accept standardized localizer and glide path radio signals from the civil navigational aids system (CNAS). When used in conjunction with the course indicator, the automatic approach mode permits automatic all-weather instrument approaches with ILS equipment. The automatic approach mode consists of separate localizer and glide path functions. With the CNAS equipment tuned to the proper frequency, with the correct runway heading set on the course selector, and with the radio navigation switch at RADIO NAV, the autopilot will control heading changes through the aileron control system to vector and hold the airplane on the center line of the localizer beam. With the glide path function of the automatic approach mode selected, interception of the glide path beam center line causes an immediate and recognizable 2-1/2 degree pitch-down maneuver through the elevator control system. Subsequent signal sensing controls pitch changes to correct and hold the airplane to the actual glide path beam. Once the airplane is locked to the glide path, the autopilot will hold the airplane to a constant Mach number through use of the throttle servo. The pilot may change the reference Mach number (approach airspeed) in small increments by means of the autopilot airspeed control switch. The glide slope function cannot be selected unless the localizer function is engaged.

CONTROLS AND INDICATORS.

Autopilot controls and indicators are located at the pilot's station. The engage and control mode switches,

autopilot control panel



1. Flight Control Power Switch
2. Glide Path Switch
3. Radio Navigation Switch
4. Heading Switch
5. Constant Mach-Altitude Switch
6. Constant Mach Switch
7. Autopilot Engage Switch
8. Second Station Control Indicator Lamp
9. Boom Latch Control Switch

Figure 4-20.

all located on the autopilot control panel, are spring-loaded, solenoid-held toggle switches. The entire autopilot switching circuit is electrically interlocked to prevent incompatible control modes from being energized at the same time, and to drop out all modes when the autopilot is disengaged. When a change in the panel switching combination causes power to be removed from the solenoid of a switch, the switch handle physically moves to the OFF position, thereby deactivating the associated autopilot function. A switch will not remain in the ON position until the panel switching combination allows a closed circuit to the switch solenoid.

Flight Control Power Switch.

The on-off flight control power switch (1, figure 4-20), located on the autopilot control panel, controls electrical power for autopilot operation and for certain functions of manual flight control system operation. The autopilot is normally ready to engage after the power switch is placed in the ON position and the primary navigation system stable table is properly erected. A guard must be raised in order to position the switch to OFF.

Note

Since the flight control power switch also controls electrical power to certain functions of the manual flight control system, this switch should normally remain in the ON position throughout all flights. For additional information, refer to "Flight Control System", Section I, and "Flight Control System Emergency Operation", Section III.

Autopilot Engage Switch.

The engage switch (7, figure 4-20), located on the autopilot control panel, is marked ENGAGE and OFF. When the switch is placed in the ENGAGE position, the autopilot servos will engage and maintain constant pitch and roll attitude, and the switching circuitry will allow selection of other autopilot modes. The engage switch will not latch in the ENGAGE position unless the flight control power switch is ON, the damper switches are ON, and the autopilot servos are properly synchronized with airplane attitude. When the engage switch is placed to OFF, the servos will disengage, all mode switches will move to OFF, and the airplane will revert to pilot-controlled flight.

Mach Switch.

The Mach switch (6, figure 4-20), located on the autopilot control panel, is marked MACH and OFF. When the switch is placed in the MACH position, the autopilot will control the airplane in the constant Mach mode and the Mach-altitude switch, if ON, will move to OFF. The Mach switch will not latch in the MACH position if the engage switch is at OFF or if the airplane is locked onto a glide path in the automatic approach mode. When the switch is placed in the OFF position, the autopilot will discontinue controlling the airplane in the constant Mach mode, reverting to attitude stabilization in the elevator control system.

Mach-Altitude Switch.

The Mach-altitude switch (5, figure 4-20), located on the autopilot control panel, is marked MACH ALT and OFF. When the switch is placed in the MACH ALT position, and the throttle lock lever is pushed forward, the autopilot will control the airplane in the constant Mach-altitude mode and the Mach switch, if ON, will move to the OFF position. The Mach-altitude switch will not latch in the MACH ALT position if the engage switch is at OFF or if the airplane is locked onto a glide path in the automatic approach mode. When the switch is placed in the OFF position, the autopilot will discontinue controlling the airplane in the constant Mach-altitude mode, reverting to attitude stabilization in the elevator control system.

Heading Switch.

The three-position heading switch (4, figure 4-20), located on the autopilot control panel, is marked NAV, OFF, and CONST. When the switch is placed in the NAV position, the autopilot will control the airplane in the navigation ground track mode. With the switch in the CONST position, the autopilot will control the airplane in the constant ground track mode. When the switch is placed in either the NAV or the CONST position, the radio navigation switch, if ON, will move to OFF. The heading switch will not latch in the NAV or CONST positions if the engage switch is at OFF or if the navigator's auto steering switch is at OFF. When the heading switch is placed in the OFF position, the autopilot will discontinue controlling the airplane in a ground track mode, reverting to attitude stabilization in the aileron control system.

Radio Navigation Switch.

The radio navigation switch (3, figure 4-20), located on the autopilot control panel, is marked RADIO NAV and OFF. With the switch in the RADIO NAV position, the autopilot will vector and lock the airplane to a localizer beam in the automatic approach mode and the heading switch, if ON, will move to OFF. The radio navigation switch will not latch in the RADIO NAV position if the engage switch is at OFF or if the CNAS equipment is not providing a reliable localizer signal as indicated by an OFF flag on the vertical bar of the course indicator. When the radio navigation switch is placed to the OFF position, the autopilot will no longer guide the airplane along the localizer beam, reverting to attitude stabilization in the aileron control system.

Glide Path Switch.

The glide path switch (2, figure 4-20), located on the autopilot control panel, is marked GLIDE PATH and OFF. With the switch in the GLIDE PATH position, the autopilot will lock the airplane to the intercepted glide path in the automatic approach mode and the Mach-altitude switch, if ON, will move to OFF. The glide path switch will not latch in the GLIDE PATH position if the engage switch is at OFF, if the radio navigation switch is at OFF, if a signal of improper polarity is being received by the CNAS equipment, or if the OFF flag on the horizontal bar of the course indicator appears. If the glide path beam signals become unreliable after the glide path has been intercepted, the glide path switch will move to OFF and the autopilot will no longer guide the airplane along the glide path beam, reverting to attitude stabilization in the elevator control system.

Autopilot Trigger Switch.

The autopilot trigger switch (5, figure 1-27), located on the control stick grip, permits the pilot to disengage the autopilot without removing his hand from the stick, or to utilize control stick steering without fully disengaging the autopilot. The trigger switch has two detent positions, marked CSS (control stick steering) and RELEASE. These positions are spring-loaded to an unmarked OFF position. When the switch is squeezed to the first-detent CSS position and held, the aileron and elevator autopilot servos are deactivated, thus allowing the pilot to manually maneuver the airplane. When the switch is released from the CSS position, the autopilot will regain control and maintain flight according to the corrected or new references. Squeezing the trigger switch all the way to the second-detent RELEASE position de-energizes the holding solenoid of the autopilot engage switch, allowing it to return to OFF. This disengages all autopilot functions and places the airplane under pilot control.

Autopilot Airspeed Control Switch.

The autopilot airspeed control switch (2, figure 1-28), located on the trim control panel, is marked INC or DEC. These positions are spring-loaded to a center unmarked OFF position. Holding the switch to the INC or DEC position causes the reference Mach number to increase or decrease accordingly at a fixed rate. In the glide path and constant Mach-altitude modes, this change is accomplished through a throttle servo which drives the throttles to vary engine thrust. In the constant Mach mode, the change is accomplished by pitch control through the elevator control system.

Note

> The autopilot airspeed control switch can change the reference Mach number within a range of ±.12 Mach at a constant rate of .0054 Mach per second.

Second Station Control Indicator Lamp.

An amber second station control indicator lamp (8, figure 4-20), marked SEC STA, is located on the autopilot control panel. The lamp lights when the autopilot is engaged and the navigator places the tracking and flight controller selector switch in the AUTOPILOT position. The lighted lamp informs the pilot that the navigator has taken control. The lamp goes out when autopilot control is returned to the pilot's station.

Manual Steering Indicator Lamp.

An amber press-to-test lamp (5, figure 4-26), marked MANUAL STEERING, is located on the navigator's auxiliary flight instrument panel. The lamp lights when the autopilot is engaged and the navigator places the tracking and flight controller selector switch in the AUTOPILOT position. The lamp goes out when autopilot control is returned to the pilot's station.

NORMAL OPERATION OF AUTOPILOT.

Engaging the Autopilot.

1. Attain a safe altitude and trim the airplane to the desired attitude.
2. Check the attitude indicator for normal indications to make certain that primary navigation stable table is functioning properly.
3. Check that elevator control available mode switch is in the AUTO position.
4. Check that flight control power switch is ON with guard closed.
5. Check that all damper switches are ON and that dampers are operating properly.

Note

If damping in any axis is erratic or inoperative, the associated damper switch should be placed OFF. With any damper switch OFF, the autopilot cannot be engaged. (Refer to "Flight Control Emergency Procedures", Section III.)

6. Gain selector switch—AUTO.

Check that gain selector switch is in the AUTO position.

Note

If it is desired to engage the autopilot using the emergency gains (gain selector switch at either HIGH SPEED or LOW SPEED), check first that airplane is operating within the speed and altitude range shown in figure 3-8. Refer to "Flight Control System", Section I for a description of the gain selector switch. Refer to "Flight Control System Emergency Operation", Section III, for specific procedures to follow in case of Mach-altitude gain adjustment failure.

7. Place autopilot engage switch to ENGAGE. The airplane is now under autopilot control in the attitude stabilization mode.

Note

If the engage switch does not remain in the ENGAGE position, and if the flight control power switch and damper switches are ON, it is possible that the autopilot servos are not fully synchronized with airplane attitude. Fly a steady attitude while holding the engage switch up for several seconds. This should be sufficient time to allow the servos to synchronize, permitting the engage switch to latch in the ENGAGE position.

Selecting Autopilot Control Modes.

After the autopilot is initially engaged in attitude stabilization, the pilot may select a single control mode or a combination of compatible modes by means of the mode switches on the autopilot control panel. A mode affecting the elevator control system (constant Mach or constant Mach-altitude) may be selected simultaneously with a mode affecting the aileron control system (constant ground track, navigation ground track, or localizer). However, two elevator control modes or two aileron control modes cannot be selected simultaneously. If an attempt is made to do so, one of the incompatible mode switches will automatically return to OFF. The following procedures are for selecting each control mode after the autopilot is initially engaged.

Selecting the Constant Mach Mode. Manually maneuver the airplane to achieve the desired Mach number and attitude for optimum range, using control stick steering. Then place the Mach switch to MACH. If it is desired to increase or decrease the reference Mach number while operating in this mode, hold the autopilot airspeed control switch to INC or DEC, as applicable.

Note

The autopilot airspeed control switch can change the reference Mach number within a range of ±.12 Mach at a constant rate of .0054 Mach per second.

Selecting the Constant Mach-Altitude Mode. Manually maneuver the airplane to the desired altitude, using control stick steering, and trim for level flight at the desired Mach number. Then place the Mach-altitude switch in the MACH ALT position. Adjust the throttles to achieve symmetric thrust and lock the throttle lock lever. If it is desired to increase or decrease the reference Mach number while operating in this mode, hold the autopilot airspeed control switch to INC or DEC, as applicable.

Note

If asymmetric power conditions develop as a result of changing the reference Mach number, thrust may be equalized by unlocking the throttle lock lever, readjusting the throttles, and relocking the lever.

Selecting the Navigation Ground Track Mode. Manually maneuver the airplane to zero the steering error according to the pilot's data indicator, using control stick steering. Check with navigator that the primary navigation system is in auto steering. Then place the heading switch to NAV.

Note

Manually maneuvering the airplane to zero the steering error is a time-saving step, since the autopilot is slower than manual control in turning the airplane through a large azimuth change to the computed navigation ground track.

Selecting the Constant Ground Track Mode. Manually maneuver the airplane to the desired heading and level the wings, using control stick steering. Check with navigator that the primary navigation system is in auto steering. Then place the heading switch to CONST.

Selecting the Automatic Approach Mode. Refer to "Automatic Approach", Section IX, for automatic approach procedures.

Control Stick Steering Operation.

If it is desired to change the autopilot attitude, heading, or altitude references while operating in any control mode, squeeze, and hold the autopilot trigger switch to the first detent CSS position and maneuver the airplane with the control stick as in manual flight. When the desired conditions are attained, release the trigger switch. The autopilot will resume control according to the newly selected references. While the pilot is using control stick steering, the switches on the autopilot control panel will remain in their selected positions. The use of control stick steering also will remove autopilot control from the navigator's station.

Navigator's Station Control Operation.

After the autopilot is initially engaged by the pilot, control may be transferred to the navigator's station by placing the navigator's tracking and flight controller selector switch to AUTOPILOT. Check that the manual steering lamp lights. The second station control indicator lamp at the pilot's station should light also. Maneuver the airplane by means of the navigator's tracking and flight control stick. If the pilot initiates control stick steering, autopilot control is transferred back to the pilot. Control may be regained at the second station only after the pilot releases the trigger switch and the tracking and flight controller selector switch is moved out of, then back to the AUTOPILOT position. Autopilot control is also transferred back to the pilot when the navigator moves the controller selector switch out of the AUTOPILOT position.

Disengaging the Autopilot.

To disengage all autopilot functions and place the airplane under pilot control, either squeeze the autopilot trigger switch all the way back to the second detent RELEASE position or place the autopilot engage switch to OFF. In either case, all mode switches will move to OFF.

EMERGENCY OPERATION OF AUTOPILOT.

If a malfunction occurs, disengage the autopilot electrically by squeezing the autopilot trigger switch all the way to the second detent. Check that engage switch moves to OFF. In case of a severe hardover malfunction, exert a positive stick force in the appropriate direction to override the affected servo.

Note

A stick force of at least 25 pounds (approximately) to the left or right is required to override the aileron servo. A force of approximately 100 pounds forward or aft is required to override the elevator servo.

If this stick override is utilized, the autopilot servos may be reset by squeezing the trigger switch or placing the engage switch to OFF. The autopilot can then be re-engaged in the normal manner. If the malfunction is not severe, the gain selector switch may be placed in the appropriate position. (Refer to "Flight Control System Emergency Operation," Section III, for specific procedures to follow for Mach-altitude gain adjustment failure.) If the malfunction is still present upon autopilot re-engagement, disengage the autopilot and do not attempt further autopilot emergency procedures.

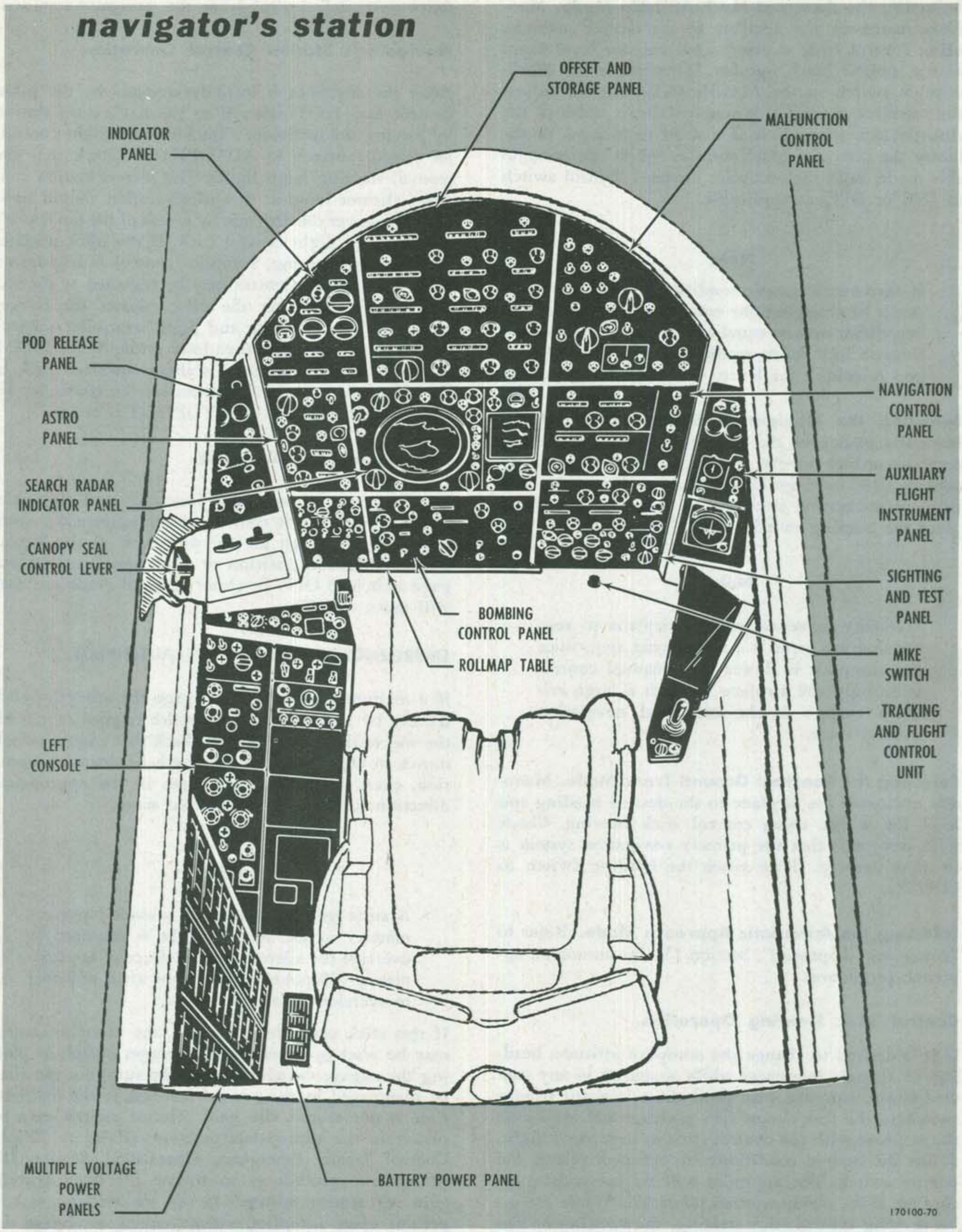

navigator's station
OFFSET AND STORAGE PANEL
MALFUNCTION CONTROL PANEL
INDICATOR PANEL
POD RELEASE PANEL
ASTRO PANEL
SEARCH RADAR INDICATOR PANEL
CANOPY SEAL CONTROL LEVER
NAVIGATION CONTROL PANEL
AUXILIARY FLIGHT INSTRUMENT PANEL
SIGHTING AND TEST PANEL
BOMBING CONTROL PANEL
ROLLMAP TABLE
MIKE SWITCH
TRACKING AND FLIGHT CONTROL UNIT
LEFT CONSOLE
MULTIPLE VOLTAGE POWER PANELS
BATTERY POWER PANEL
170100-70

Figure 4-21.

WEAPONS CONTROL SYSTEM (AN/ASQ-42).

The airplane is equipped with an AN/ASQ-42 navigation-bombing integrated system. This system consists of the following: the AN/APN-113 radar set (Doppler), the AN/APN-110 electronic altimeter set, an astrotracker system, a computation and stabilization system, a search radar system, a ballistics computer system, and a malfunction detection and switching system. Information on these systems can be found under "Primary Navigation System" and "Bombing System" of this section.

PRIMARY NAVIGATION SYSTEM.

The primary navigation system (figure 4-23), controlled from the navigator's station, guides the airplane over a great circle course to any desired destination without visual references and with a minimum of radio-radar transmission. It is assisted by the bombing system during bomb run, which enables it to maintain a correct bombing course and to accomplish automatic pod release. Two modes of operation are provided: navigation and bombing. The navigation mode is used for the entire flight on reconnaissance missions. For bombing missions, the bombing mode is used during the bomb run only, the navigation mode being used for guidance to and from the target area. Automatic radar photography can be accomplished whenever the system search radar is not being used for navigation checks. The primary navigation system is basically a Doppler-inertial system using an astrotracker for a standard heading reference. Aircraft course and position are continuously computed by a precise dead reckoning operation, which may be checked and corrected by periodic search radar sightings. Aircraft attitude is sensed by inertial elements. Altitude above terrain is obtained by a radio altimeter. All radiating equipment may be operated intermittently if desired, or kept off for as long as five hours, without seriously degrading system accuracy. Automatic great circle steering is performed in the navigation mode. In the bomb mode, rhumb line steering is performed, suitably altered to allow for wind drift and Coriolis effects on the pod after release. Evasive action may be taken in the target area without making a new bomb run. Transverse coordinate operation is provided for accurate polar navigation. A pilot's data indicator at the pilot's station indicates groundtrack, steering error (navigation mode), steering error for pod release (bomb mode), distance to destination or target, and, during the last five minutes prior to pod release, the number of seconds remaining until pod release. The navigator is

primary navigation system tie-ins

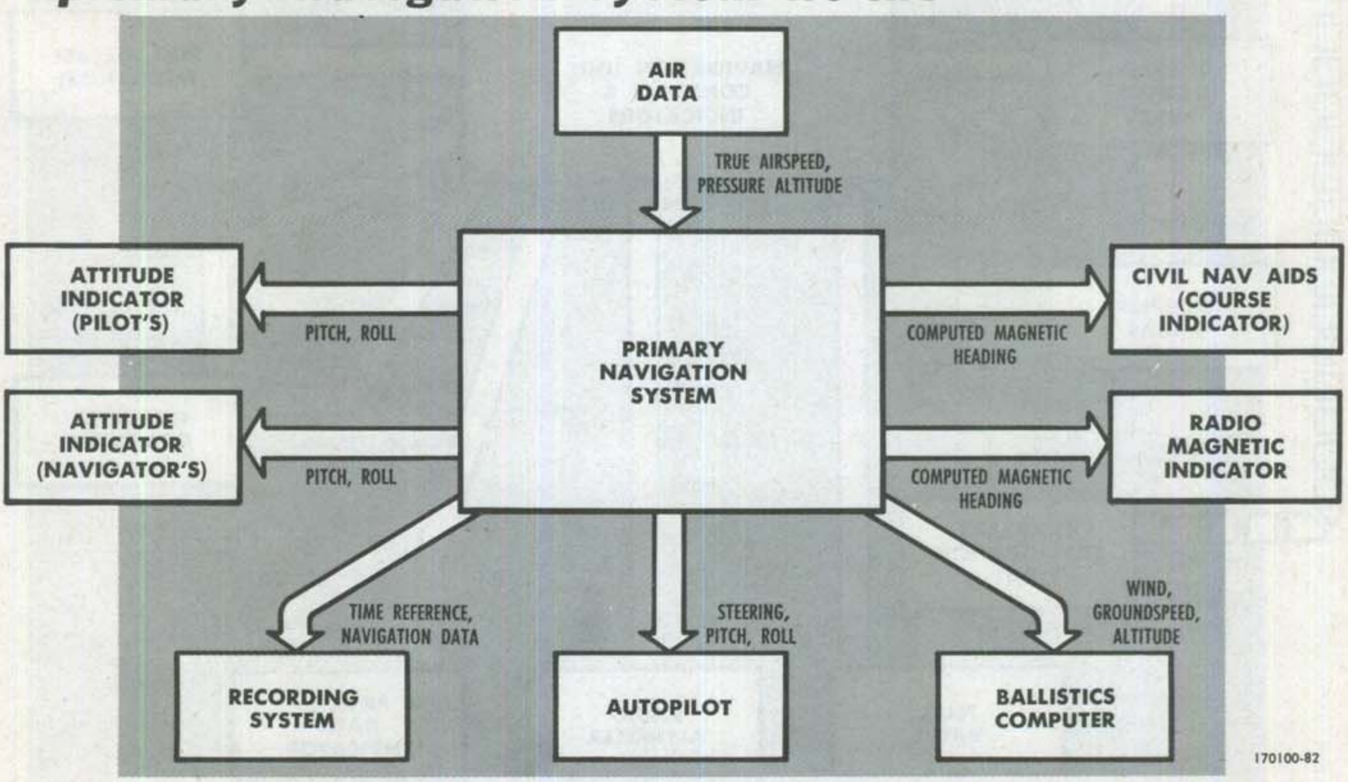


Figure 4-22.

primary navigation system

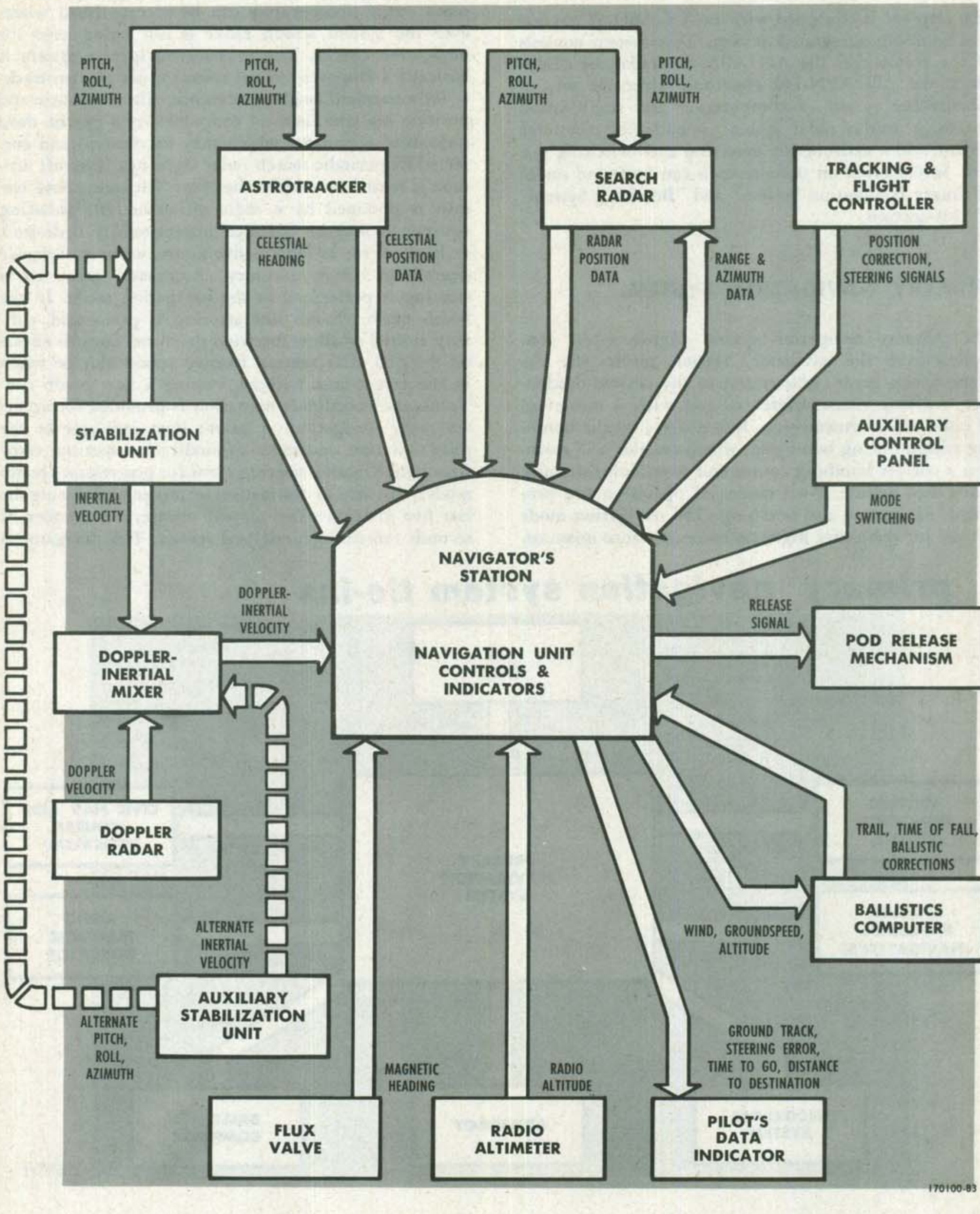
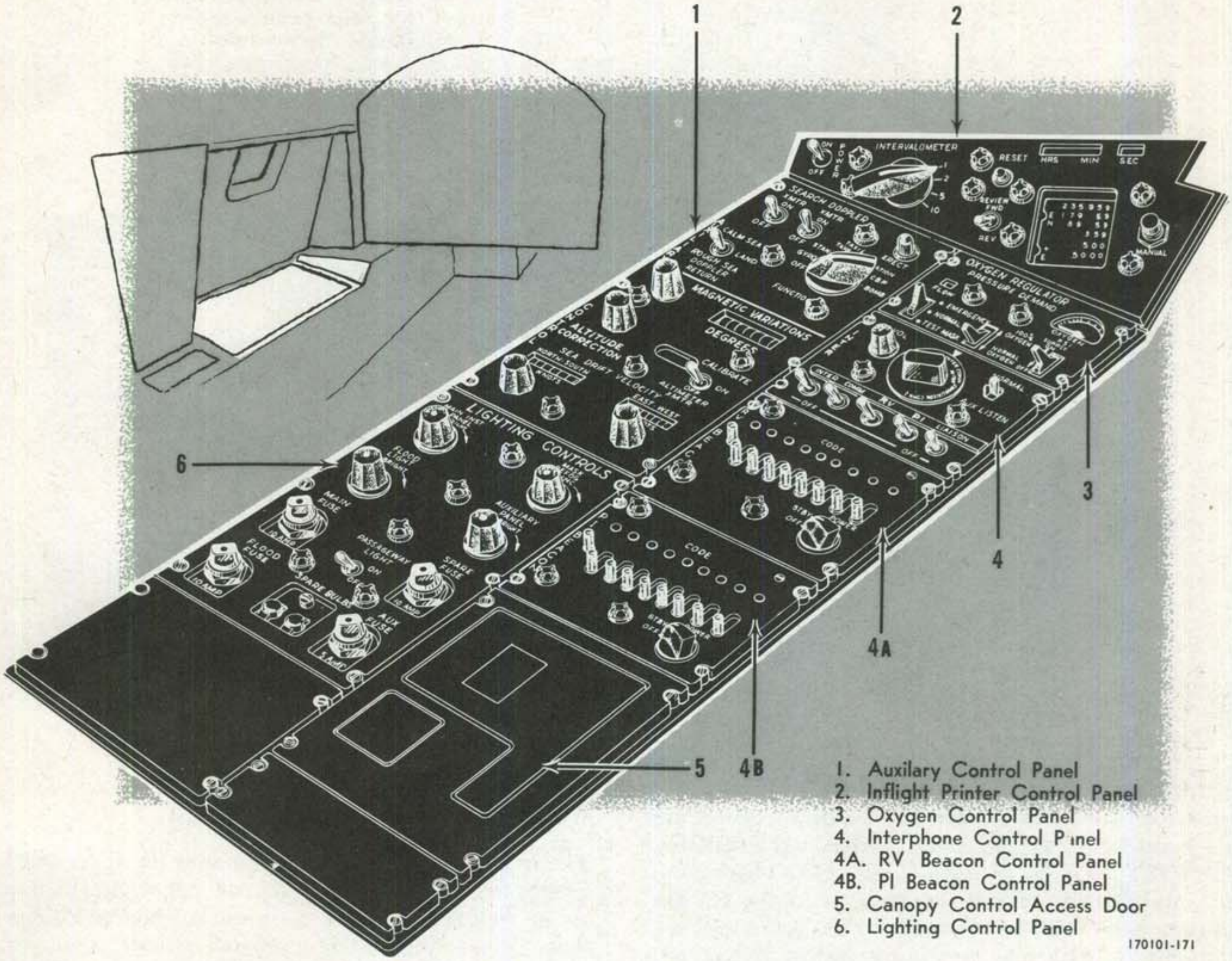


Figure 4-23.

navigator's left console



1. Auxilary Control Panel
2. Inflight Printer Control Panel
3. Oxygen Control Panel
4. Interphone Control P nel
4A. RV Beacon Control Panel
4B. PI Beacon Control Panel
5. Canopy Control Access Door
6. Lighting Control Panel

170101-171

Figure 4-24.

supplied the same data, plus a radar view of the terrain ahead, present latitude and longitude, true heading, barometric altitude, radio altitude, terrain elevation, groundspeed, cumulative system error, true airspeed, star data, malfunction indications, and an illuminated radar map picture of expected fixpoints and targets. The primary navigation system is divided functionally into the following subsystems: computation and stabilization (inertial), Doppler radar, astrotracker, search radar, radio altimeter, and malfunction detection and switching.

COMPUTATION AND STABILIZATION SYSTEM.

The computation and stabilization system provides the airplane with inertial guidance facilities and computer functions necessary for normal navigation system operation. The system consists of an analog computer, coupled with a continuously compensated gyro stabilized stable table with accelerometers, and interconnected with the Doppler radar, search radar, astrotracker, radio altimeter, air data, and flux valve systems. Using a combination of preset values, inertial sensing, screened Doppler data, air data signals, search radar and astro fixes, and flux valve comparison, the system derives true heading, groundspeed, groundtrack, true airspeed, distance to destination, great circle steering signals, wind speed and direction, navigation error, and present position in both true and transverse coordinates. In the bomb mode, the system works with the bombing system ballistics computer to derive steering signals for the bomb runs and compute and deliver a release point signal.

Function Selector Knob.

The function selector knob (9, figure 4-25), located on the auxiliary control panel, turns the entire navigation

auxiliary control panel

1. Sea Drift Velocity Knob (2)
2. Sea Drift Velocity Indicator (2)
3. Altitude Correction Knob
4. Magnetic Variation Knob
5. Doppler Return Switch
6. Search Transmitter Switch
7. Doppler Transmitter Switch
8. Erect Indicator Lamp
9. Function Selector Knob
10. Magnetic Variation Indicator
11. Radio Altimeter Switch

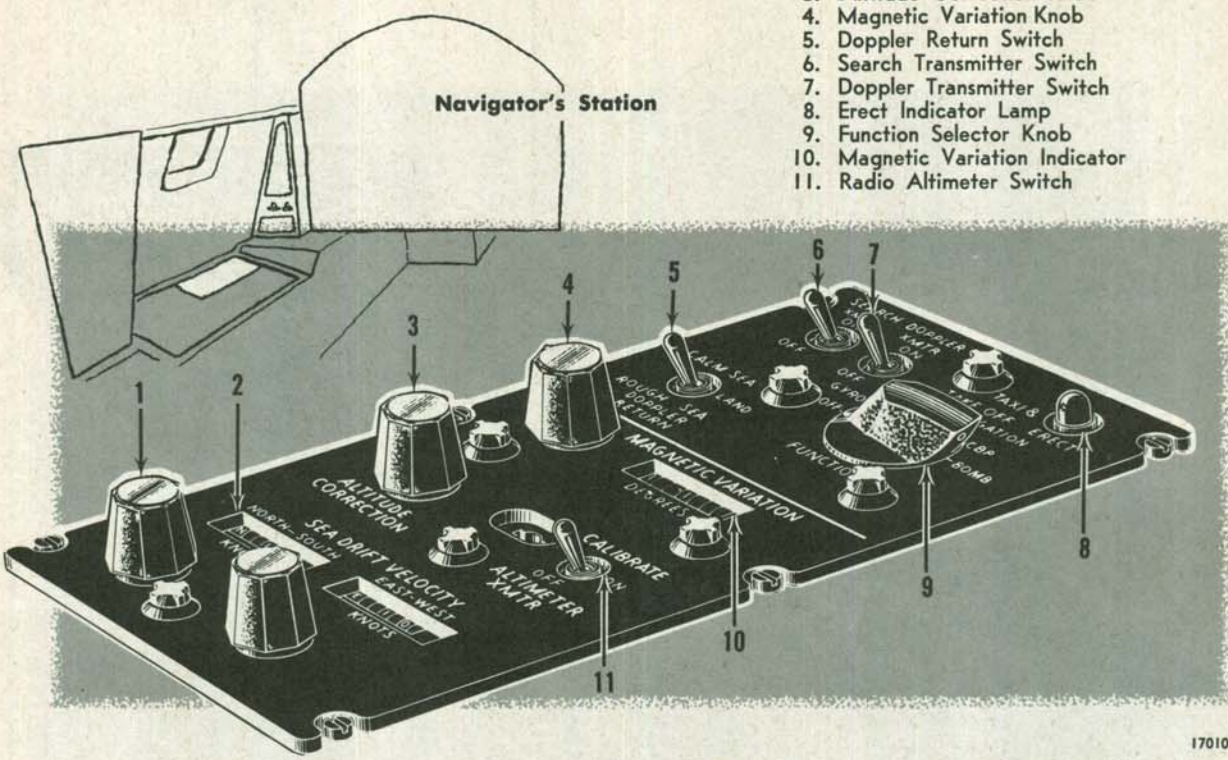


Figure 4-25.

system on or off, and selects the mode of operation. The knob has seven positions, marked OFF, GYRO, STANDBY, TAXI & TAKEOFF, NAVIGATION, CBP, and BOMB. When the knob is in the GYRO position, heater power is routed to the gyros and accelerometers, with the remaining system power off. When the knob is advanced to the STANDBY position, system power is turned on, and gyro (table) erection begins. When the knob is advanced to the TAXI & TAKEOFF position, the system operates in a pure inertial mode, since taxi and takeoff maneuvers prevent the generation of precise Doppler, astro, and magnetic heading data. When the knob is advanced to the NAVIGATION position, the entire system is operative, with continuous great circle computing and great circle steering. When the knob is advanced to the BOMB position, great circle operation ceases, and the navigation system, coupled with the free fall bombing equipment, sets up and maintains a course which will bring the airplane to the proper point for automatic bomb release.

Note

The knob must be raised slightly in order to turn it back to TAXI & TAKEOFF (or lower positions) from NAVIGATION. The CBP position is inoperative.

Transverse Present Position Knobs.

The transverse present position knobs (6, figure 4-27), located on the navigation control panel, are used to set in transverse present position latitude and longitude. When the polar/non-polar switch is in the POLAR position, these values will be used and indicated as such in the transverse position indicators above the knobs. When the polar/non-polar switch is in the NON-POLAR position, these indicators will show true latitude and longitude.

Polar/Non-Polar Switch.

The polar/non-polar switch (3, figure 4-27), located on the navigation control panel, and marked POLAR and NON-POLAR, is used to select either true or transverse coordinate reference data to be stored for use, and displayed on the transverse present position indicators.

Coordinate Reference Switch.

The coordinate reference switch (4, figure 4-27), located on the navigation control panel, is used to change coordinate reference systems when entering or leaving polar areas. The switch has two positions marked TRANSVERSE and TRUE. The switch is placed in the TRANSVERSE position for polar operation (above

70°N.), and in the TRUE position for non-polar operation.

Destination Position Knobs.

The destination position knobs (2, figure 4-28), located on the sighting and test panel, are used to set in destination latitude and longitude. This data is displayed on the destination position indicators above the knobs. This setting establishes the end point for computation of great circle course and steering, time to go, and distance to destination.

Altitude Correction Knob.

The altitude correction knob (3, figure 4-25), located on the auxiliary control panel, is used to correct the altitude above sea level.

Airspeed-Inertial Switch.

This two-position toggle switch (1A, figure 4-26) located on the auxiliary flight instrument panel, and marked NORMAL and AIRSPEED INERTIAL, allows the substitution of airspeed signals for Doppler data when necessary or desirable. Placing the switch to NORMAL, with Doppler operating and locked, supplies Doppler data to the navigation system. When the switch is in the AIRSPEED INERTIAL position the navigation system is supplied airspeed signals and Doppler is withheld.

Airspeed Calibration Switch.

The airspeed calibration switch (9, figure 4-29), located on the malfunction control panel, and marked CAL and NORMAL, is used to calibrate airspeed by placing the switch in the CAL position and making a double heading run.

Auto Steering Switch.

The auto steering switch (8, figure 4-29), located on the malfunction control panel, and marked ON and OFF, is used to control automatic steering signals to the autopilot as desired. When the switch is OFF, automatic steering signals are withheld.

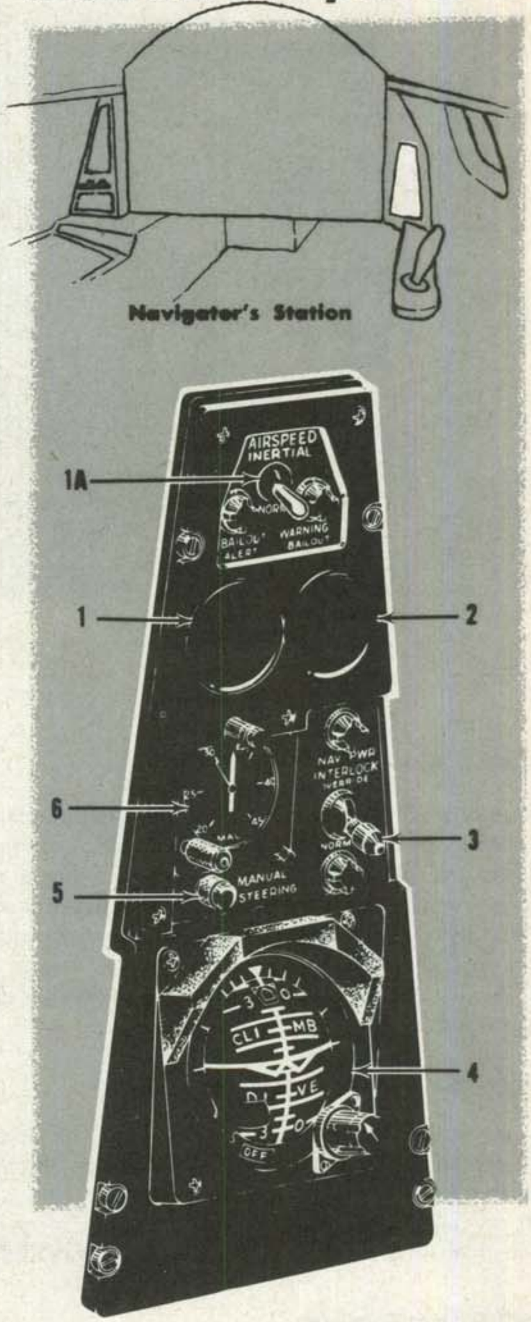
True Present Position Knobs.

The true present position knobs (2, figure 4-27), located on the navigation control panel, are used to set in present position latitude and longitude and to make adjustments, if needed, after enroute fixtaking. Latitude and longitude settings are displayed on indicators above the knobs. It is from the point determined by these settings that the system determines course and distance to destination.

Magnetic Variation Knob.

The magnetic variation knob (4, figure 4-25), located on the auxiliary control panel, is used to correct the flux valve compass for local variation. The correction value set in at any time is shown on the magnetic variation indicator next to the knob.

auxiliary flight instrument panel



1. Bailout Alert Lamp
1A. Airspeed Inertial Switch
2. Bailout Warning Lamp
3. Navigation Power Interlock Switch
4. Attitude Indicator
5. Manual Steering Indicator Lamp
6. CG Repeater Indicator

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Figure 4-26.

navigation control panel

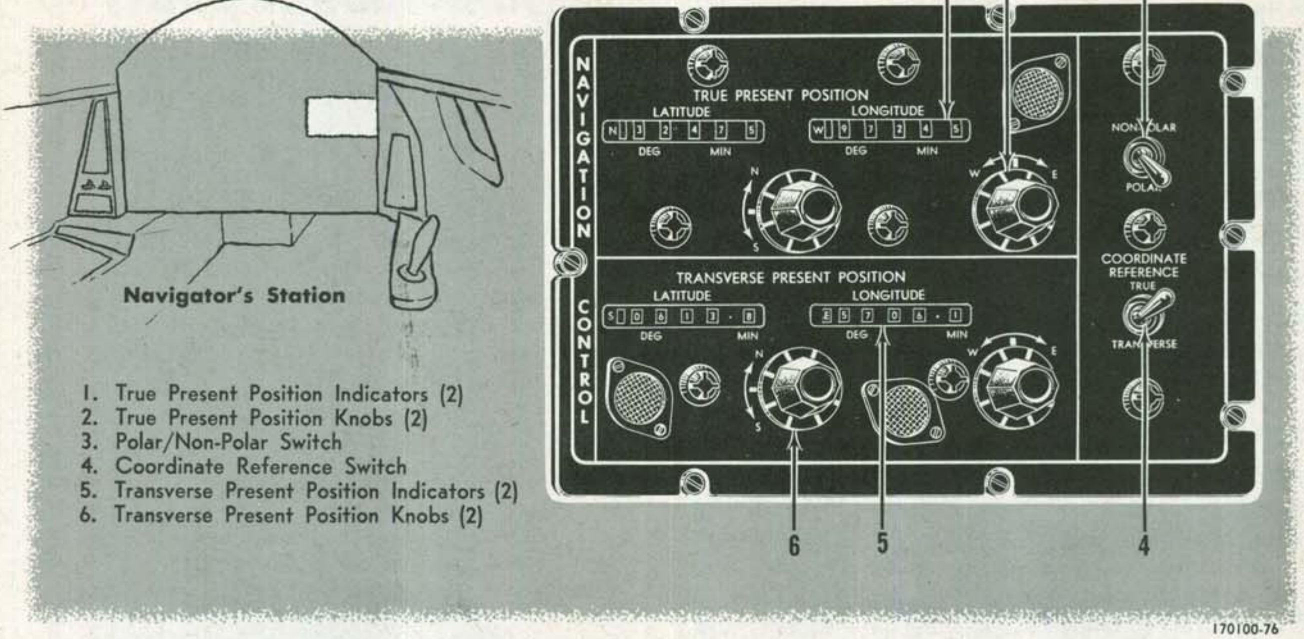


Figure 4-27.

Isolation Switch.

This guarded type switch (1, figure 4-36), located in the tunnel area between the pilot's and navigator's stations, and marked ON and OFF, provides a means of isolating the computation and stabilization system while operating other portions or the remainder of the navigation system. When in the OFF position the entire computation and stabilization system is electrically isolated.

Navigation Power Interlock Switch.

This switch (3, figure 4-26), located on the auxiliary flight instrument panel, is used to override the system failure interlock relays and to restore partial system functions after one system has failed and dropped out. It has positions marked NORMAL and OVERRIDE.

Groundtrack Indicator.

The groundtrack indicator (11, figure 4-30), located on the indicator panel, indicates the angle between aircraft groundtrack and the north pole of the coordinate system in use.

True Heading Indicator.

The true heading indicator (2, figure 4-30), located on the indicator panel, indicates aircraft heading with respect to the north pole of the coordinate system in use.

Distance to Destination Indicator.

The distance to destination indicator (6, figure 4-30), located on the indicator panel, displays nautical miles to destination.

True Airspeed Indicator.

The true airspeed indicator (8, figure 4-30), located on the indicator panel, indicates true airspeed in knots.

Time to Go Indicator.

The time to go indicator (7, figure 4-30), located on the indicator panel, indicates the time in seconds before pod release. This timing sequence begins 300 seconds before release.

Altitude Above Sea Level Indicator.

The altitude above sea level indicator (5, figure 4-30), located on the indicator panel, normally indicates aircraft altitude above sea level. This indicator displays altitude above terrain during altitude malfunction mode operation.

Pilot's Data Indicator.

The pilot's data indicator (figure 4-31), located on the pilot's main instrument panel, indicates groundtrack, steering error during navigation mode, steering error for pod release during bomb mode, distance to destination, and time to go before pod release.

Vertical Error Indicator.

The vertical error indicator (1, figure 4-30), located on the indicator panel, is lighted whenever the inertial groundspeed data and the Doppler groundspeed data differ excessively.

Groundspeed Indicator.

The groundspeed indicator (9, figure 4-30), located on the indicator panel, indicates computed groundspeed in knots. The groundspeed value shown here is used in the automatic dead reckoning process.

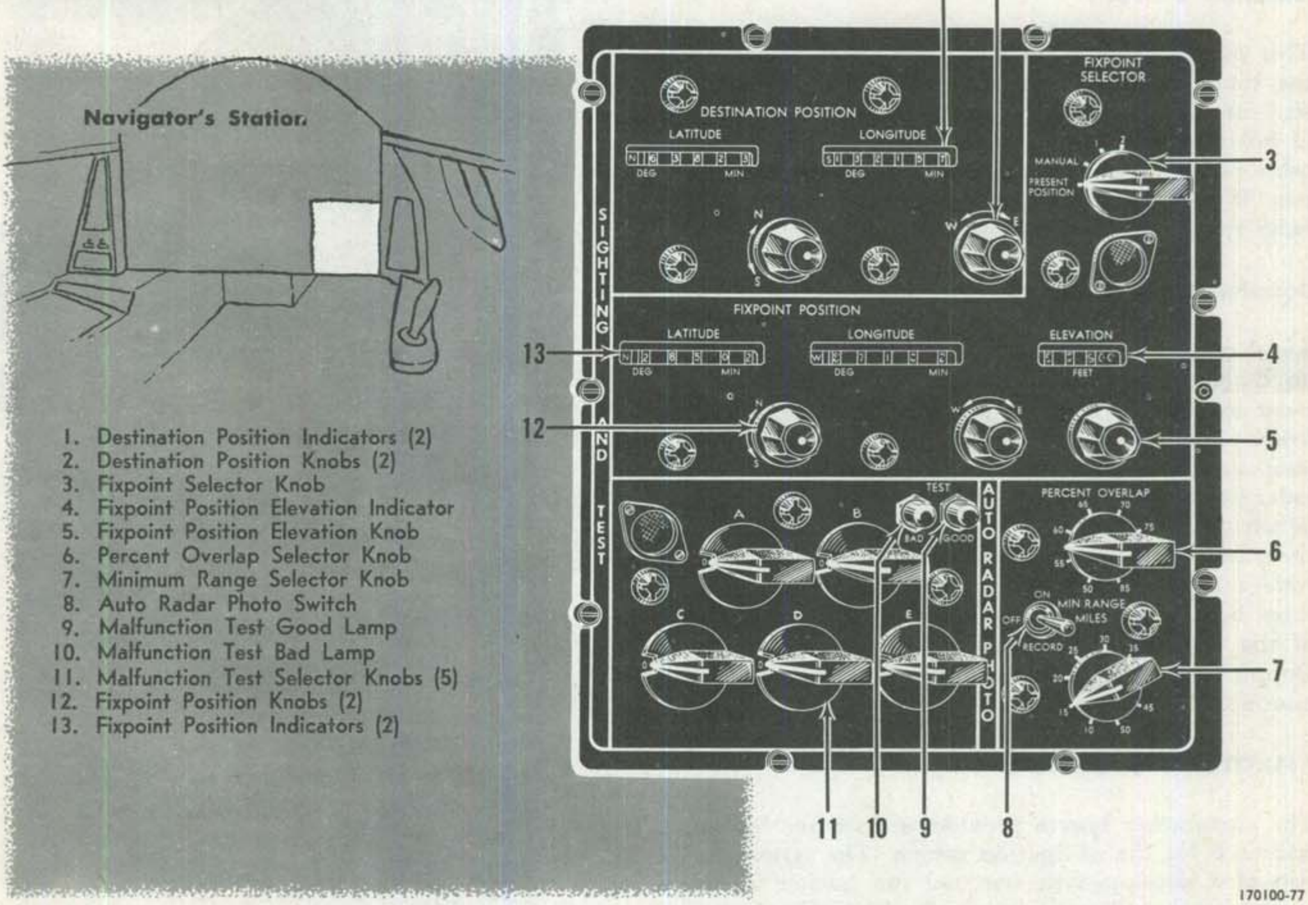
Erect Indicator Lamp.

The erect indicator lamp (8, figure 4-25), located on the auxiliary control panel, when lighted indicates that table erection is in progress, but not complete. When this indicator lamp goes out, with the function selector knob in the STANDBY position, it indicates that primary table erection is complete and the function selector knob may be advanced to the next position.

DOPPLER RADAR SYSTEM.

The Doppler radar system supplies groundspeed signals which are mixed with inertial velocity signals to provide accurate groundspeed data to the navigation system. The system consists of a radar transmitter, three transmitting antennas, three receiving antennas, a radar receiver, and a velocity computer. The system may be turned off for a ten-minute period each half hour without a noticeable drop in total system accuracy. This feature allows the airplane to cover several hundred miles at a time as a nonradiating carrier. Provision is made for surface feature variation by compensating circuits selectable for calm sea, rough sea, or land returns. Sea returns may be further corrected by the sea drift velocity compensators.

sighting and test panel



1. Destination Position Indicators (2)
2. Destination Position Knobs (2)
3. Fixpoint Selector Knob
4. Fixpoint Position Elevation Indicator
5. Fixpoint Position Elevation Knob
6. Percent Overlap Selector Knob
7. Minimum Range Selector Knob
8. Auto Radar Photo Switch
9. Malfunction Test Good Lamp
10. Malfunction Test Bad Lamp
11. Malfunction Test Selector Knobs (5)
12. Fixpoint Position Knobs (2)
13. Fixpoint Position Indicators (2)

170100-77

Figure 4-28.

Doppler Transmitter Switch.

The Doppler transmitter switch (7, figure 4-25), located on the auxiliary control panel, and marked ON and OFF, is used to turn the Doppler radar transmitter on or off.

Doppler Return Switch.

The Doppler return switch (5, figure 4-25), located on the auxiliary control panel, is used to select compensating circuits for varying surface conditions. The switch is marked CALM SEA, LAND, and ROUGH SEA.

Sea Drift Velocity Knobs.

The sea drift velocity knobs (1, figure 4-25), located on the auxiliary control panel, are used to set in compensations for known ocean currents, so as to minimize Doppler return errors when operating over ocean areas having consistent or predictable currents. Values set in are shown on the sea drift velocity indicators above the knobs.

Isolation Switch.

This guarded type switch (4, figure 4-36) located in the tunnel area between the pilot's and navigator's stations, and marked ON and OFF, provides a means of isolating the Doppler radar system while operating other portions or the remainder of the navigation system. When in the OFF position, the entire Doppler radar system is electrically isolated.

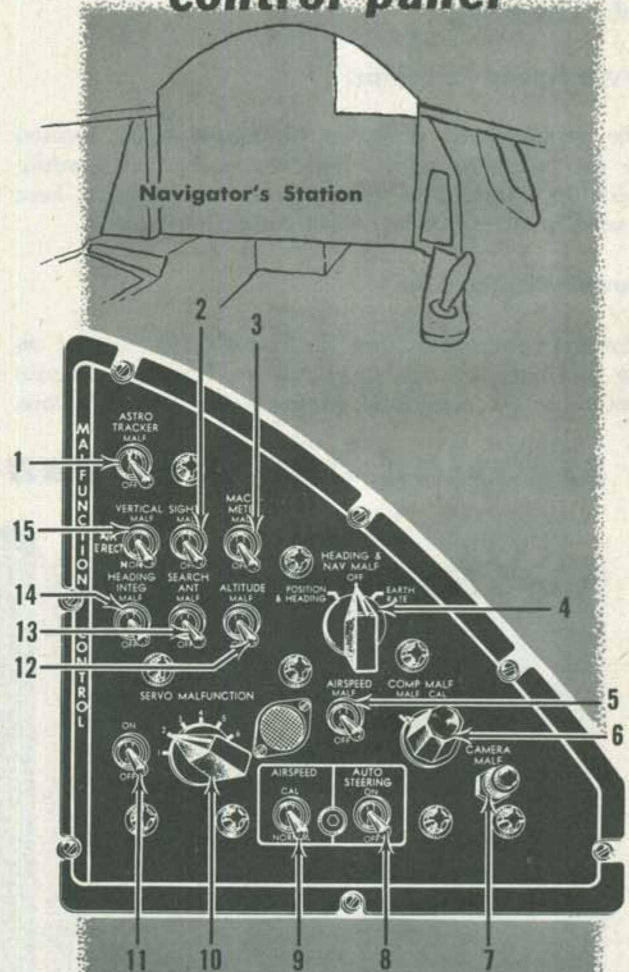
Doppler Timer Indicator.

The Doppler timer indicator (3, figure 4-30), located on the indicator panel, is used to indicate Doppler radar activity. When the Doppler radar is off, the lower scale of the indicator is lighted by an amber lamp and indicates how many minutes the Doppler radar has been off, up to a maximum of ten minutes. When the Doppler radar is on, the upper scale of the timer indicator is lighted by a white lamp. The lighted scale indicates the Doppler radar is locked on all three legs. The indicator pointer on the upper scale of the instrument indicates how many minutes the Doppler radar has been on, up to a maximum of 20 minutes.

ASTROTRACKER SYSTEM.

The astrotracker system provides a drift-free heading reference for the navigation system. The system consists of a telescope-type star and sun tracker capable of the search and tracking of celestial bodies (magnitude 2.63 or brighter) within a range of —4 to +78 degrees in altitude and 360 degrees in azimuth. This system provides automatic heading information by tracking the sun or a star whenever weather conditions aloft permit celestial observation. A series of interchangeable filters provide compensation for the different optical conditions required for sun tracking, star tracking, and star tracking through an aurora display.

malfunction control panel



1. Astrotracker Malfunction Switch
2. Sight Malfunction Switch
3. Machmeter Malfunction Switch
4. Heading and Navigation Malfunction Knob
5. Airspeed Computer Malfunction Switch
6. Airspeed Computer Malfunction Knob
7. Camera Malfunction Indicator Lamp
8. Auto Steering Switch
9. Airspeed Calibration Switch
10. Servo Malfunction Selector Knob
11. Servo Malfunction Switch
12. Altitude Malfunction Switch
13. Search Antenna Malfunction Switch
14. Heading Integrator Malfunction Switch
15. Vertical Reference Selector Switch

170100-71

Figure 4-29.

Greatest accuracy is attained by tracking stars below 50 degrees in altitude and with a relative bearing of less than ±90 degrees. If desired, the system may be used for semi-automatic position fixing, by sighting on two or more stars.

Heading Reference Selector Knob.

The heading reference selector knob (1, figure 4-32), located on the astro control panel, is a five-position selector knob, marked as follows: ASTRO, FREE GYRO, FLUX VALVE, MAN SLEW +, and MAN SLEW —. When the knob is in ASTRO, the astrotracker is supplying the system heading reference. When the knob is in FREE GYRO, the system heading is inertially generated. When the knob is in FLUX VALVE, the remote compass transmitter supplies the system heading. Placing the knob in MAN SLEW + or MAN SLEW — will cause the true heading indicator to slew to any desired position.

Greenwich Hour Angle Knob.

The Greenwich hour angle knob (9, figure 4-32), located on the astro control panel, is used to set the Greenwich hour angle of Aries or the Greenwich hour angle of the sun into the astro computer. This set-in value is shown on the Greenwich hour angle indicator near the knob.

Sidereal Hour Angle Knob.

The sidereal hour angle knob (8, figure 4-32), located on the astro control panel, is used to set the sidereal hour angle of a star into the astro computer, when the GHA indicator indicates the GHA of Aries. When the GHA indicator indicates the GHA of the sun, the sidereal hour angle is left at zero. The sidereal hour angle indicator is the indicator nearest the sidereal hour angle knob.

Star Declination Knob.

The star declination knob (7, figure 4-32), located on the astro control panel, is used to set the declination of a star or the sun into the astro computer. The value set in is displayed on the star declination indicator near the knob.

Astro Filter Switch.

The astro filter switch (3, figure 4-32), located on the astro control panel, is used to select the proper atmospheric filter for various viewing conditions. The switch is marked STAR, SUN, and AUR. The AUR position is provided for star tracking through aurora displays.

Isolation Switch.

This guarded type switch (2, figure 4-36) located in the tunnel area between the pilot's and navigator's stations, and marked ON and OFF, provides a means of isolating the astrotracker system while operating other portions or the remainder of the navigation system. When in the OFF position, the entire astrotracker system is electrically isolated.

Star Azimuth Indicator.

The star azimuth indicator (10, figure 4-30), located on the indicator panel, displays computed star azimuth.

Star Altitude Indicator.

The star altitude indicator (13, figure 4-30), located on the indicator panel, indicates measured star altitude.

Star Altitude Error Indicator.

The star altitude error indicator (12, figure 4-30), located on the indicator panel, displays in minutes the difference between computed and measured star altitude, which serves as an index of the accuracy of position error data. When the indication reaches 112 minutes, the star lost indicator lamp lights and an automatic changeover to flux valve heading reference occurs.

Star Lost Indicator Lamp.

The star lost indicator lamp (2, figure 4-32), located on the astro control panel, indicates loss of a star being tracked. The lamp lights when this occurs. When a star is lost, an automatic switchover to inertial heading occurs.

SEARCH RADAR SYSTEM.

The search radar system provides a vernier correction to the computed aircraft present position based on radar observation of a known point on the earth (a fixpoint or target). It also has provisions for aiding tanker rendezvous operations. The system consists of a radar transmitter, antenna, receiver, indicator console, and radar photo unit. The system can provide a continuous view of the terrain ahead, if desired, and at the same time furnish accurate fixpointing for position correction. A map comparator screen shows the operator what he should be seeing on the radar indicator. If non-radiating flight is desired, the transmitter may be kept off until quite near the fixpoint, since the crosshair distance is shown on the crosshair distance indicator whether the transmitter is on or off. Unknown or previously unmapped landmarks in

indicator panel

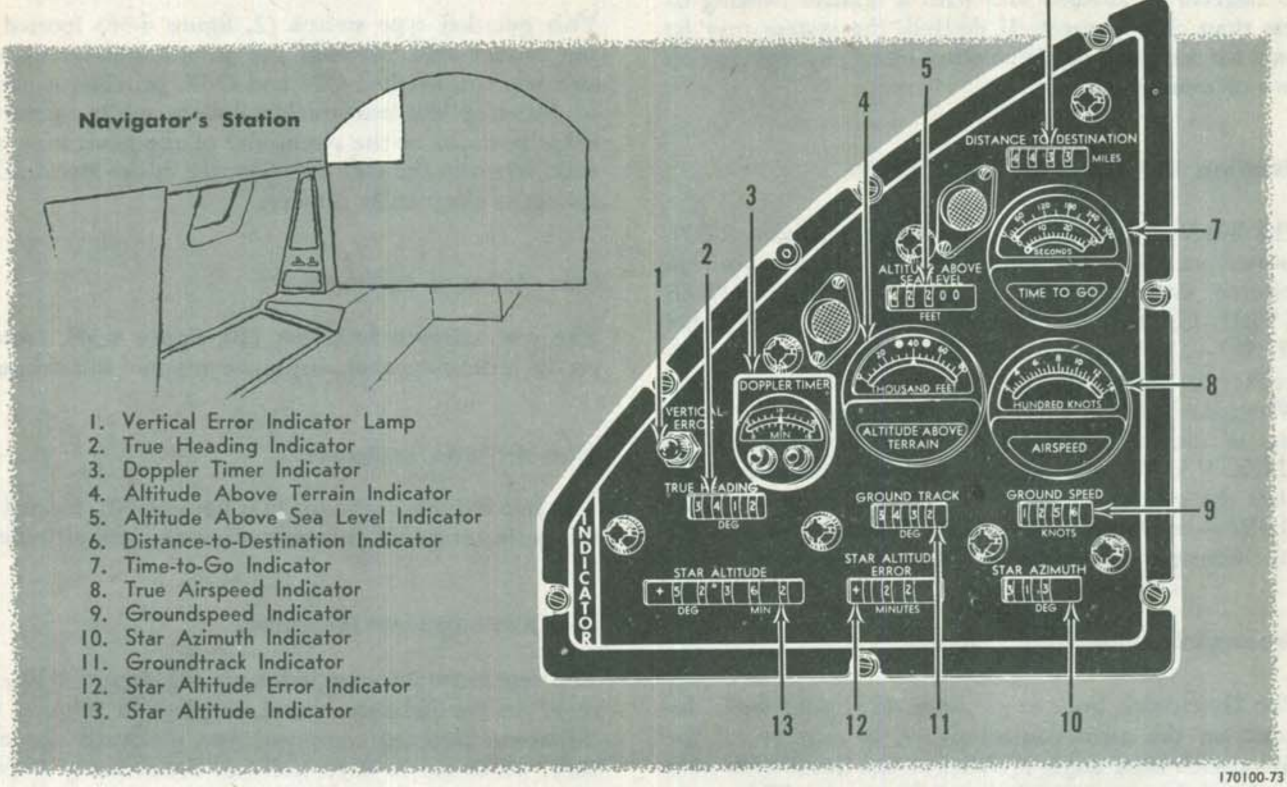


Figure 4-30.

the flight path may be radar photographed, and the latitude, longitude, and elevation recorded. A single 3-exposure radar photo may be made at any time, or a continuous strip-type radar map may be made, with controllable overlap, range, and contrast/threshold.

Search Transmitter Switch.

The search transmitter switch (6, figure 4-25), located on the auxiliary control panel, and marked ON and OFF, is used to turn the search radar transmitter on or off.

Tracking and Flight Controller Selector Knob.

This knob (3, figure 4-33) is located on the tracking and flight controller and is used to select the function of the tracking and flight control stick. The knob positions are marked OFF, FIX PT POS CORR, PRES POS CORR, and AUTOPILOT. When the knob is in FIX PT POS CORR, the tracking and flight control stick corrects the fixpoint position indicators or sets the position of an unknown point into the fixpoint position indicators. When the knob is in PRES POS CORR, the tracking and flight control stick corrects the true present position indicators. When the switch is in AUTOPILOT, the tracking and flight control stick sends coordinated flight control signals to the autopilot. The amber manual steering indicator lamp (5, figure 4-26) will light when this flight condition exists. The knob must be raised to turn to or from any position.

Tracking and Flight Control Stick.

The tracking and flight control stick (2, figure 4-33), located on the tracking and flight controller, is used to make tracking corrections and aircraft heading changes, in conjunction with the tracking and flight controller selector knob. Operation is similar to an aircraft control stick. An engaging switch (1, figure 4-33) is embedded in the handgrip, which serves to bypass the recording system and connect the tracking control system. The engaging switch is inoperative when the tracking and flight controller selector knob is in the AUTOPILOT position.

Search Radar Mode Selector Knob.

This knob (1, figure 4-34), located on the search radar indicator panel, is used to select various radar functions. It has one beacon position, marked BCN, and two search positions, marked GRD and SLANT. The GRD position is used for navigation fixes and the SLANT position is used to locate aircraft within altitude range. The BCN position is used for tanker rendezvous provided the tanker has compatible equipment.

Range and Magnification Selector Knob.

The range and magnification selector knob (14, figure 4-34), located on the search radar indicator panel, is used to select six combinations of range, in nautical miles, and magnification, in nautical miles per indicator diameter. Appropriate range markers appear as each combination is selected. Combinations are arranged for optimum viewing.

Variable Threshold Knob.

The variable threshold knob (17, figure 4-34), located on the search radar indicator panel, is used to make smooth variations in threshold between positions selected by the contrast/threshold selector.

Crosshair Distance/Film Footage Switch.

The crosshair distance/film footage switch (7, figure 4-34), located on the search radar indicator panel, is used to select crosshair distance, in nautical miles, or unexposed film remaining, in feet, for display on the crosshair distance/film footage indicator (6, figure 4-34). The switch is marked XHAIR-MI and FILM-FT CRT MON. When the switch is in the XHAIR-MI position, crosshair distance is shown on the indicator. When the switch is in the FILM-FT CRT MON position, the number of feet of unexposed film remaining in the photo recorder is shown on the indicator. When the switch is in this position, and the search radar transmitter switch is on, the photo recorder cathode ray tube display is also shown on the search radar indicator.

Automatic Radar Photography Switch.

The automatic radar photography switch (8, figure 4-28), located on the sighting and test control panel, is used to control the automatic radar photography functions. The switch is marked ON, OFF, and RECORD. When the switch is in the RECORD position, a regular series of radar photographs will be taken automatically, subject to settings of the percent overlap selector knob and minimum range selector knob. The equipment is in standby condition when the switch is in the ON position, and will not photograph unless the manual button on the inflight printer is depressed, at which time a single 3-exposure set is made.

Minimum Range Selector Knob.

The minimum range selector knob (7, figure 4-28), located on the sighting and test control panel, is used to select the range at which radar photographs will be taken.

Percent Overlap Selector Knob.

The percent overlap selector knob (6, figure 4-28), located on the sighting and test control panel, is used to select the desired overlap between successive sets of radar photographs taken automatically.

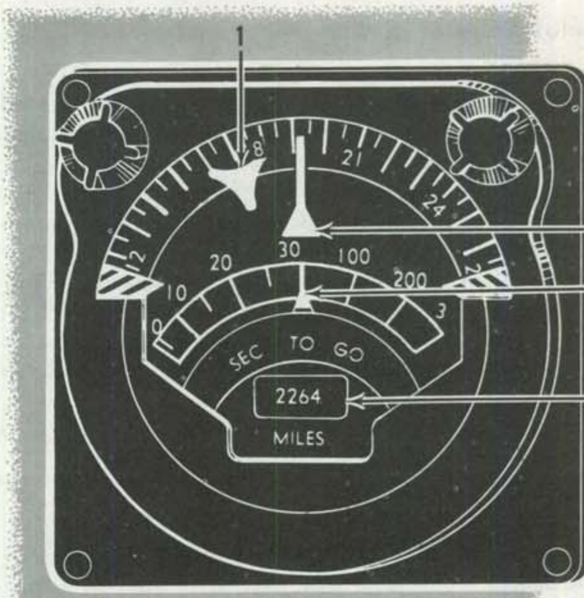
Map Screen Film Drive Knob.

The map screen film drive knob (13, figure 4-34), located on the search radar indicator panel, is used to advance the radar map film, thus changing the picture displayed on the comparator screen. A normally retracted handle recessed into the knob face may be extended, enabling the operator to use the knob as a crank, for more rapid film movement. Sixty frames are selectable for reference.

Aimpoint Selector Knob.

The aimpoint selector knob (9, figure 4-35), located on the offset and storage panel, is marked FIX, 1, and 2, and is used to select a fixpoint or either of two offset aimpoints for display on the search radar indicator. The switch is left in the FIX position when sighting on a fixpoint or target. When the target is invisible to radar, an offset aimpoint may be used.

pilot's data indicator

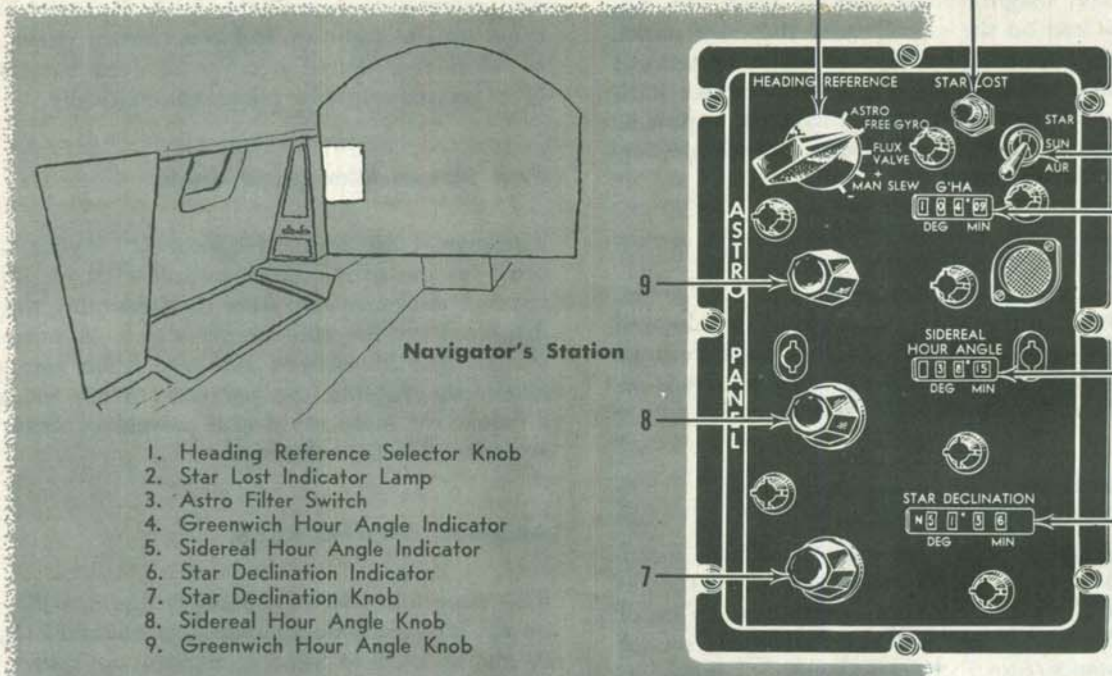


1. Groundtrack
2. Steering Error
3. Time to Go
4. Distance to Destination

170100-114

Figure 4-31.

astro control panel



170100-74

Figure 4-32.

Fixpoint Selector Knob.

The fixpoint selector knob (3, figure 4-28), located on the sighting and test panel, is used to insert fixpoint data into the fixpoint position indicators. The switch is marked PRESENT POSITION, MANUAL, 1, and 2. The MANUAL position is used when manually setting fixpoint data. Position 1 or 2 is used for automatic data transfer from fixpoint storage. During navigation mode operation the PRESENT POSITION is used to slave the fixpoint position indicators to the true present position indicators in order to keep the indicators up to date.

Display Intensity Knob.

The display intensity knob (3, figure 4-34), located on the search radar indicator panel, is used to adjust intensity of the search radar indicator display.

Crosshair Brightness Knob.

The crosshair brightness knob (2, figure 4-34), located on the search radar indicator panel, is used to adjust intensity of the electronically generated crosshair.

Antenna Tilt Knob.

The antenna tilt knob (8, figure 4-34), located on the search radar indicator panel, is used to increase or decrease the amount of search radar antenna tilt from that used during automatic control. The automatic position is marked B.

Manual/Automatic Receiver Tuning Switch.

The manual/automatic receiver tuning switch (9, figure 4-34), located on the search radar indicator panel, and marked MFC and AFC, is used to select automatic receiver frequency control or manual receiver frequency control, as desired. When the switch is in MFC, tuning is accomplished with the receiver frequency tuning knob.

Receiver Frequency Tuning Knob.

The receiver frequency tuning knob (5, figure 4-34), located on the search radar indicator panel, is used for receiver frequency control when the manual/automatic receiver tuning switch is in the MFC position.

Transmitter Frequency Tuning Knob.

This knob (4, figure 4-34), located on the search radar indicator panel, is used to tune the transmitter frequency, except when in beacon mode. Turning the knob clockwise increases the frequency.

Manual-Automatic Contrast/Threshold Switch.

The manual-automatic contrast/threshold switch (10, figure 4-34), located on the search radar indicator panel, and marked MAN and AUTO, is used to select automatic contrast/threshold control or manual contrast/threshold, as desired.

Contrast/Threshold Selector Knob.

The contrast/threshold selector knob (15, figure 4-34), located on the search radar indicator panel, is used to adjust search radar indicator contrast/threshold when the manual-automatic contrast/threshold switch is in the MAN position.

Map Screen Brightness Selector Knob.

The map screen brightness selector knob (12, figure 4-34), located on the search radar indicator panel, is used to turn on and regulate the brightness of the map comparator screen illumination. The switch is marked OFF, 1, 2, 3, and 4. The brightness is increased progressively as the knob is turned from 1 to 4.

Fixpoint Position Knobs.

The fixpoint position knobs (12, figure 4-28), located on the sighting and test control panel, are used to set fixpoint latitude and longitude into the system. The values being used are shown on the fixpoint position indicators (13, figure 4-28).

Fixpoint Position Elevation Knob.

The fixpoint position elevation knob (5, figure 4-28), located on the sighting and test control panel, is used to set fixpoint position elevation into the system. The elevation value being used is shown on the fixpoint position elevation indicator (4, figure 4-28). This indicator shows terrain altitude when altitude above sea level is being calibrated.

Storage Fixpoint Knobs.

The storage fixpoint knobs (7, figure 4-35), located on the offset and storage control panel, are used to set storage fixpoint latitude and longitude into the system. Values used are displayed on the storage fixpoint indicators (8, figure 4-35).

Storage Fixpoint Elevation Knobs.

The storage fixpoint elevation knobs (6, figure 4-35), located on the offset and storage control panel, are used to set storage fixpoint elevation into the system. Values used are displayed on the storage fixpoint elevation indicators (5, figure 4-35).

Offset Aimpoint Knobs.

The offset aimpoint knobs (2, figure 4-35), located on the offset and storage control panel, are used to set into the system the rectangular offset distances from target or fixpoint to two offset aimpoints. Values used

tracking and flight controller unit

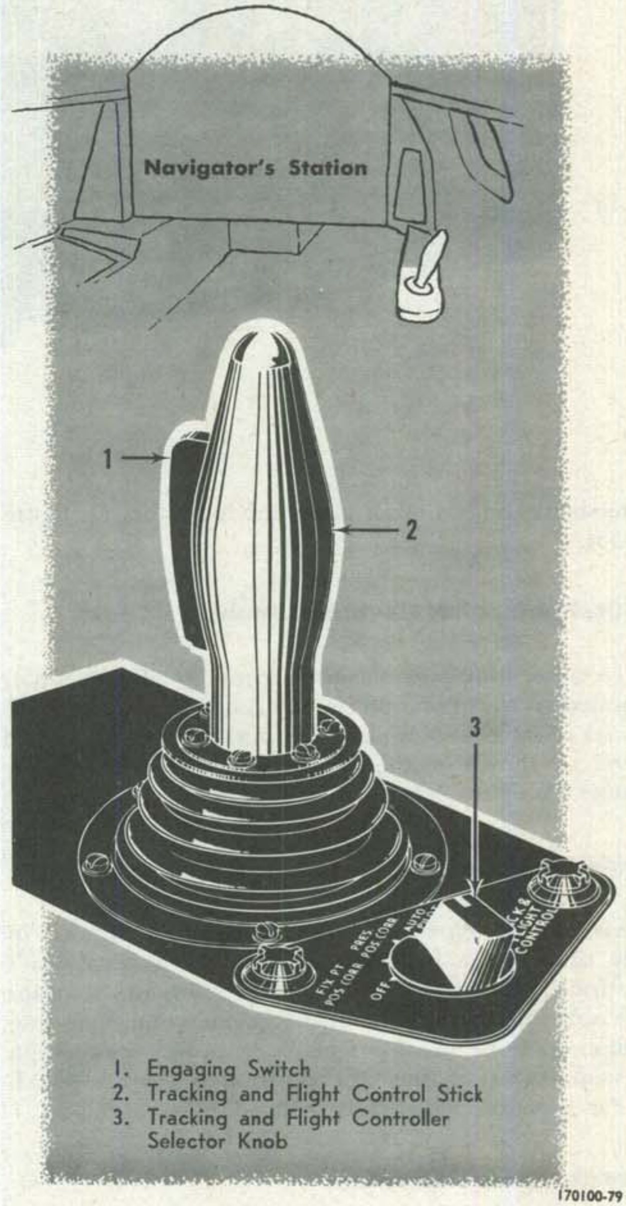
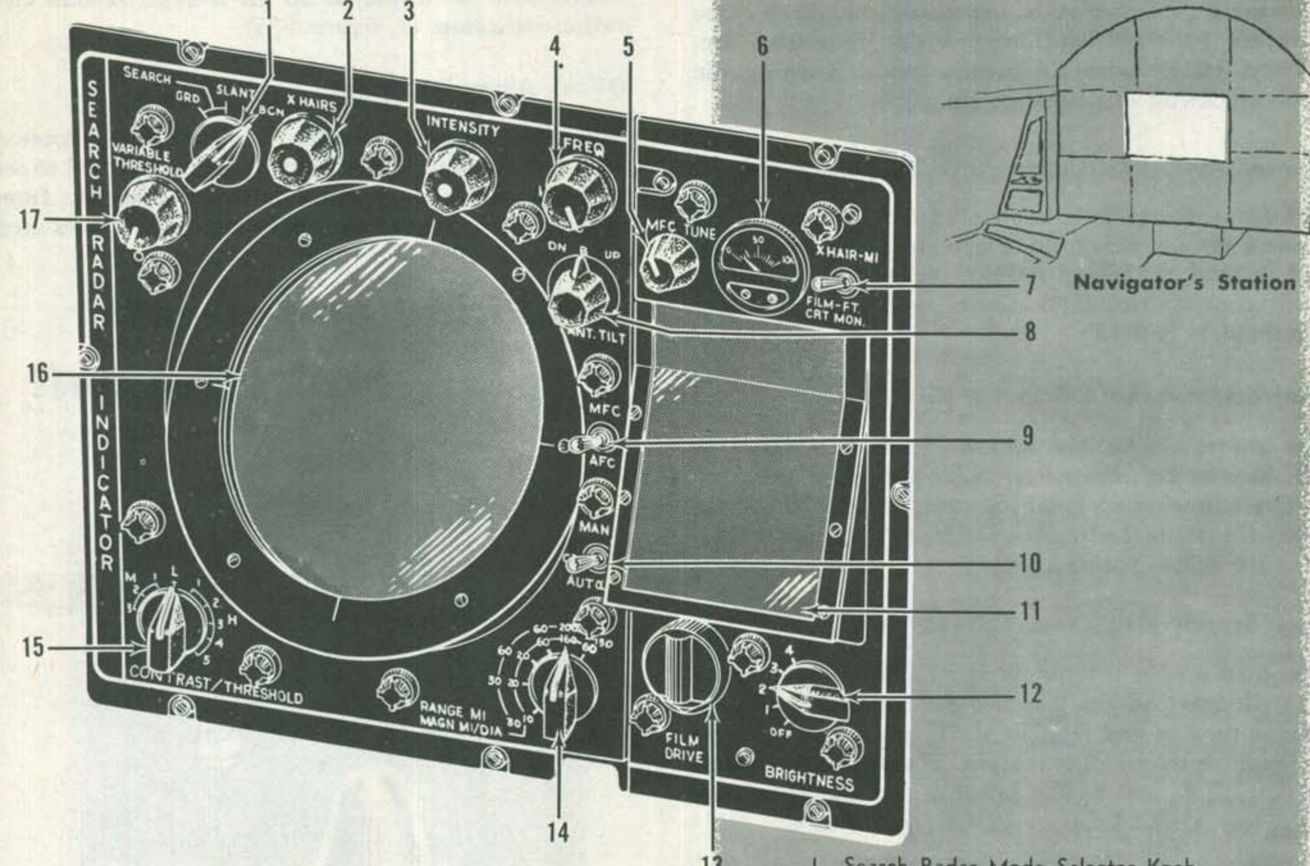


Figure 4-33.

search radar indicator panel



1. Search Radar Mode Selector Knob
2. Crosshair Brightness Knob
3. Display Intensity Knob
4. Transmitter Frequency Tuning Knob
5. Receiver Frequency Tuning Knob
6. Crosshair Distance—Film Footage Indicator
7. Crosshair Distance—Film Footage Switch
8. Antenna Tilt Knob
9. Manual/Automatic Receiver Tuning Switch
10. Manual/Automatic Contrast/Threshold Switch
11. Map Comparator Screen
12. Map Screen Brightness Selector Knob
13. Map Screen Film Drive Knob
14. Range/Magnification Selector Knob
15. Contrast/Threshold Selector Knob
16. Search Radar Indicator
17. Variable Threshold Knob

170100-75

Figure 4-34.

are shown on the offset aimpoint indicators (1, figure 4-35).

Offset Aimpoint Elevation Knobs.

The offset aimpoint elevation knobs (4, figure 4-35), located on the offset and storage control panel, are used to set offset aimpoint elevation into the system. Values used are shown on the offset aimpoint elevation indicators (3, figure 4-35).

Isolation Switch.

This guarded type switch (3, figure 4-36), located in the tunnel area between the pilot's and navigator's stations, and marked ON and OFF, provides a means of isolating the search radar system while operating other portions or the remainder of the navigation system. When in the OFF position the entire search radar system is electrically isolated.

Search Radar Indicator.

The search radar indicator (16, figure 4-34), located on the search radar indicator panel, is used to display a north-oriented sector scan, with electronically generated crosshairs.

Map Comparator Screen.

The map comparator screen (11, figure 4-34), located on the search radar indicator panel, is used to display radar map pictures for comparison with the radar display on the search radar indicator.

RADIO ALTIMETER SYSTEM.

The radio altimeter system provides altitude above terrain information which is used to calibrate altitude above sea level when flying over terrain of known elevation. The system consists of a transmitter, antenna, receiver, and control unit. Transmitter power is restricted below 30,000 feet, and an automatic barometric switch allows full power operation above 30, 000 feet. This feature yields more accurate operation at all altitudes. Automatic calibration, which requires 4 seconds, is accomplished each time the transmitter is turned on, and occurs once every 15 minutes while operating. The calibration is made known to the operator by means of the calibration and malfunction warning lamp located in the dial of the altitude above terrain indicator, which is lighted while calibration is in progress. A continuous light indicates a radio altimeter system malfunction.

Radio Altimeter Switch.

This switch (11, figure 4-25), located on the auxiliary control panel, is used to turn the radio altimeter transmitter on or off, and to calibrate altitude above sea level. The switch positions are marked OFF, ON, and CALIBRATE. When the switch is in the ON position, radio altitude is displayed on the altitude above terrain indicator. When flying over known terrain, the CALIBRATE position is used to calibrate altitude above sea level.

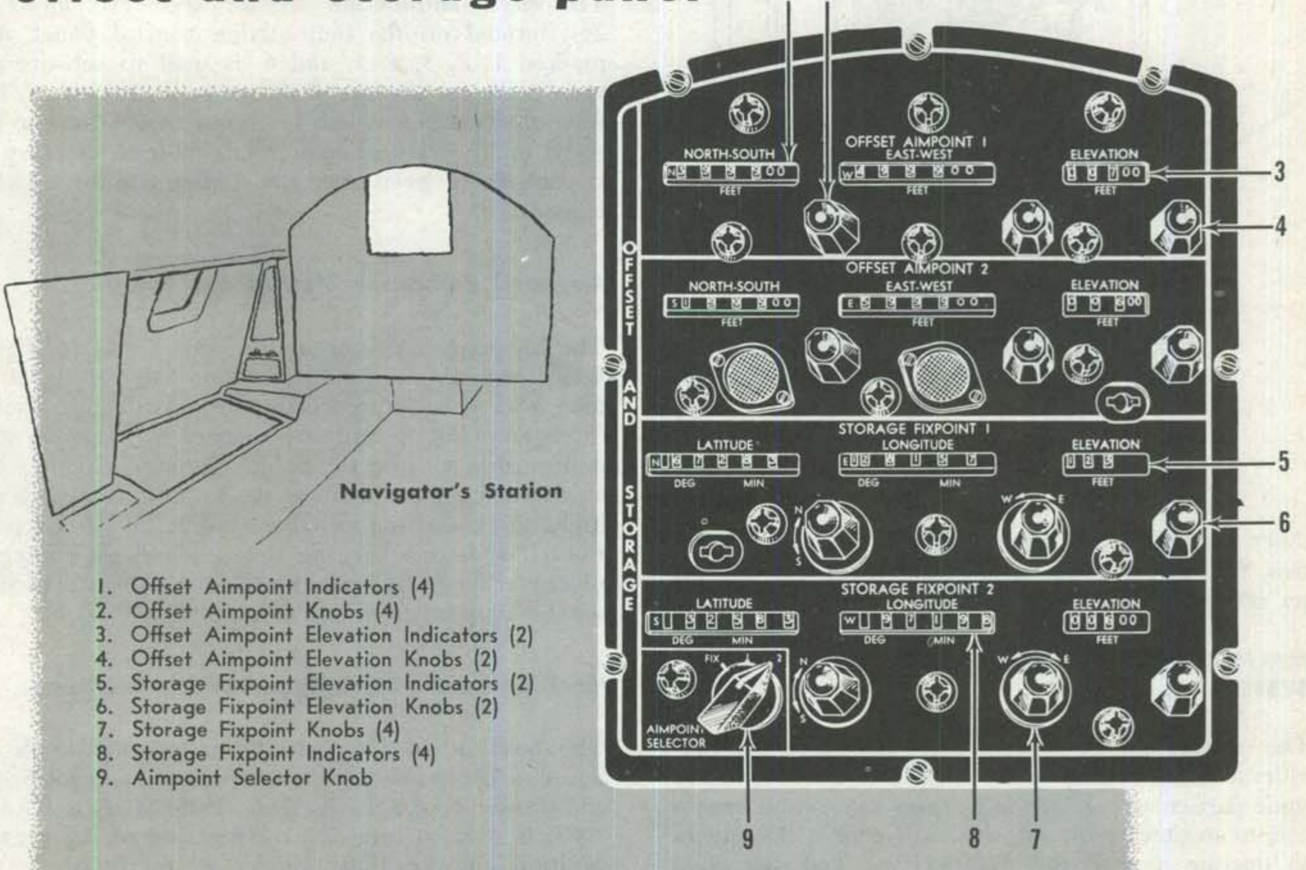
Altitude Above Terrain Indicator.

The altitude above terrain indicator (4, figure 4-30), located on the indicator panel, is used to display aircraft altitude above terrain when the radio altimeter transmitter is operating. The indicator dial shows amber when the radio altimeter is not operating properly. During radio altimeter malfunction mode operation, the indicator displays altitude above sea level.

Isolation Switch.

This guarded type switch (5, figure 4-36) located in the tunnel area between the pilot's and navigator's stations, and marked ON and OFF, provides a means of isolating the radio altimeter system while operating

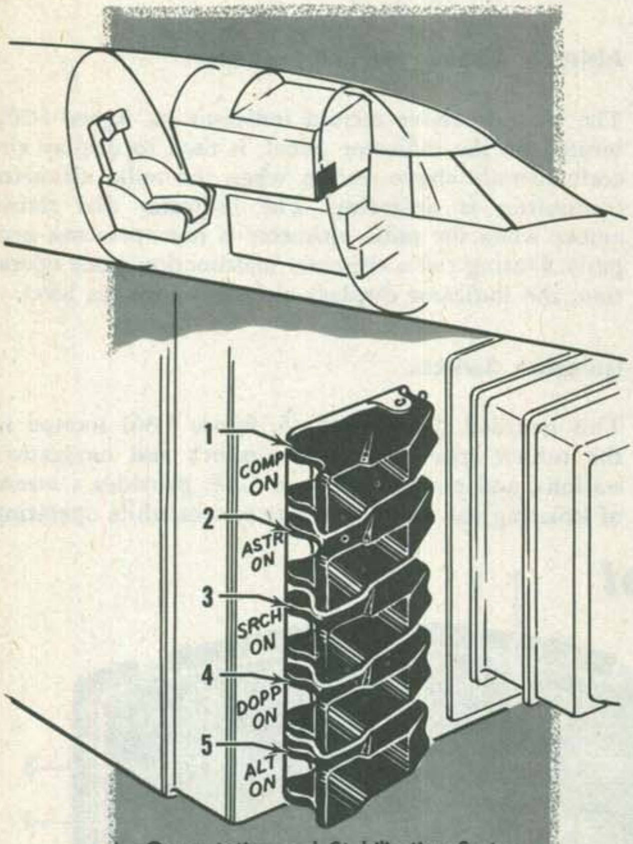
offset and storage panel



1. Offset Aimpoint Indicators (4)
2. Offset Aimpoint Knobs (4)
3. Offset Aimpoint Elevation Indicators (2)
4. Offset Aimpoint Elevation Knobs (2)
5. Storage Fixpoint Elevation Indicators (2)
6. Storage Fixpoint Elevation Knobs (2)
7. Storage Fixpoint Knobs (4)
8. Storage Fixpoint Indicators (4)
9. Aimpoint Selector Knob

Figure 4-35.

primary navigation system isolation switches



1. Computation and Stabilization System Isolation Switch
2. Astrotracker System Isolation Switch
3. Search Radar System Isolation Switch
4. Doppler Radar System Isolation Switch
5. Radio Altimeter System Isolation Switch

170100-84

Figure 4-36.

other portions or the remainder of the navigation system. When in the OFF position the entire radio altimeter system is electrically isolated.

MALFUNCTION DETECTION AND SWITCHING SYSTEM.

The malfunction detection and switching system provides a means of tracing the cause of a malfunction to some particular part of the primary navigation system and to initiate switching that will enable the system to operate despite the malfunction. The system is designed either to bypass a malfunctioning unit by using an alternate mode of operation, or to automatically switch in an auxiliary unit. The system consists of five malfunction test switches, a test good lamp, a test bad lamp, various circuits and switches for comparison, substitution and bypassing, and spare servos. A malfunction will become evident through improper system operation or readings of the various indicators on the navigation system panels.

Malfunction Test Selector Knobs.

The malfunction test selector knobs (9, figure 4-28), located on the sighting and test panel, are used to perform inflight troubleshooting of the various portions of the navigation system. The knobs are identified by letter, A, B, C, D, and E. The knob positions are identified by number, each having zero through 13. Only one knob may be used at any one time, thus erroneous test indications due to human error are eliminated. Each knob position initiates a different system test. Test results are indicated by the lighting of either of two lamps, the test bad lamp (10, figure 4-28), or the test good lamp (11, figure 4-28), located just above the knobs. The knob letter and position number may be used as an index to provide corrective information.

Servo Malfunction Selector Knob.

The servo malfunction selector knob (10, figure 4-29), located on the malfunction control panel, and marked 1, 2, 3, 4, 5, and 6, is used to substitute a spare servo for any one of six servos in the system. The servo malfunction switch (11, figure 4-29), next to the servo malfunction selector knob, is used to energize the substitute servo after the proper selector position is made.

Airspeed Computer Malfunction Knob.

The airspeed computer malfunction knob (6, figure 4-29), located on the malfunction control panel, is used with the airspeed computer malfunction switch (5, figure 4-29) to calibrate airspeed in the event of a malfunction of the airspeed computer circuits. For an average flight condition the knob is turned to the index mark and the switch placed in the MALF position. If a double heading run is made, the switch is placed in the MALF position, and the knob is used to set the airspeed indicator to a calculated value.

Heading and Navigation Malfunction Knob.

The heading and navigation malfunction knob (4, figure 4-29), located on the malfunction control panel, and marked EARTH RATE and POSITION & HEADING, is used to correct a malfunction in the present position and heading circuits when placed in the POSITION & HEADING position, or to correct a malfunction in the earth rate computation when placed in the EARTH RATE position.

Astrotracker Malfunction Switch.

The astrotracker malfunction switch (1, figure 4-29), located on the malfunction control panel, is used to energize and connect a standby amplifier in parallel with the amplifier normally used in the astro computer circuits. The switch is marked MALF and OFF.

Vertical Reference Selector Switch.

The vertical reference selector switch (15, figure 4-29), located on the malfunction control panel, is used to select either the primary stable table or the auxiliary stable table as the source of inertial data. The switch is marked NORMAL, AIR ERECT, and MALF. In the NORMAL position, the primary stable table is used, and the auxiliary stable table is kept in a standby condition. When the switch is placed in the AIR ERECT position, the auxiliary stable table is used, and the primary stable table is kept in a standby condition. When the switch is placed to the MALF position, the auxiliary table is used, and the primary table is disconnected and de-energized.

WARNING

Do not move this switch to AIR ERECT or MALF positions without first going to manual flight control. Check condition of attitude indicators with switch at AIR ERECT or MALF before restoring autopilot. If neither stable table is satisfactory, autopilot operation must not be attempted.

Sight Malfunction Switch.

The sight malfunction switch (2, figure 4-29), located on the malfunction control panel, and marked MALF and OFF, is used to substitute the destination latitude and longitude assemblies and north and east ground range assemblies for the fixpoint latitude and longitude assemblies and circuits. While this switch is in the MALF position, great circle computation is not possible, since some of the transferred units are portions of the great circle computer. For this reason, it is desirable to return the switch to OFF as soon as a position fix has been made.

Machmeter Malfunction Switch.

The machmeter malfunction switch (3, figure 4-29), located on the malfunction control panel, and marked MALF and OFF, is used to substitute the malfunction calibration potentiometer for the autopilot airspeed potentiometer. After placing the switch in MALF, an airspeed calibration run is made, during which time the malfunction calibration potentiometer is adjusted so that an indication appears on the airspeed indicator.

Heading Integrator Malfunction Switch.

The heading integrator malfunction switch (14, figure 4-29), located on the malfunction control panel, is used to substitute the heading slew integrator for the heading integrator. The switch is marked MALF and OFF.

Search Antenna Malfunction Switch.

The search antenna malfunction switch (13, figure 4-29), located on the malfunction control panel, and marked MALF and OFF, is used to substitute the roll and pitch limit switches in the search antenna unit for the servo amplifiers in the same unit. The roll and pitch limit switches will maintain antenna alignment within limits of 1/2 degree of pitch and 1/4 degree of roll.

Altitude Malfunction Switch.

The altitude malfunction switch (12, figure 4-29), located on the malfunction control panel, and marked MALF and OFF, is used to substitute the north ground range servo for the altitude above sea level assembly. If the radio altimeter is off, altitude above sea level will be shown on the altitude above terrain meter at this time.

Camera Malfunction Indicator Lamp.

The camera malfunction indicator lamp (7, figure 4-29), located on the malfunction control panel, is used to indicate the presence of a malfunction in the photo recorder camera. There is no provision for inflight malfunction correction of this camera unit.

PRIMARY NAVIGATION SYSTEM OPERATION.

Under ordinary conditions the viscous-floated elements in the stable table will require warmup before successful table erection can be initiated. This is done by placing the function selector knob in the GYRO position, with airplane power on, for a period of 3 minutes. Under arctic conditions proportionately more time may be required. If these conditions have been met prior to starting the following operations, the function selector knob may be moved to STANDBY without delay.

Starting Procedure.

1. Function selector knob—GYRO.
2. Warhead power switch—OFF.
3. Burst selector switch—SAFE.
4. Pod release switch—OFF.

5. Pod safety lockpin release handle—IN.
6. Pod pitot tube switch—RETRACT.
7. Air conditioning system—Check.

Check that the air conditioning system is in operation for equipment cooling.

8. Navigation power interlock switch—NORMAL.
9. Function selector knob—STANDBY.

After the equipment is warmed up as necessary, rotate function selector knob to STANDBY.

CAUTION

Before moving function selector knob to STANDBY check that present position indication and fixpoint position indication do not differ by more than 3 degrees, and that inflight printer power switch is in the OFF position.

WARNING

Make sure all transmitter switches are OFF before turning function selector knob to STANDBY. Do not operate search radar when personnel are within 100 feet of radome hemisphere, or when fuel vapors or explosives are within 200 feet of radome hemisphere. Refer to figure 2-5.

10. Erect lamp—Lighted.

Check that the erect lamp lights, after a delay of approximately 30 seconds, indicating table erection in progress. The lamp should go out in approximately 6 minutes, indicating completion of table erection. Navigator's attitude indicator will reflect stable table position.

Note

During the previous operation, if the equipment was shut off during a timing cycle, the erect lamp may light without delay. In this event, wait for the lamp to go out; then return the function selector knob to GYRO. After a momentary delay, repeat the preceding steps 9 and 10.

Stopping Procedure.

1. Transmitter switches—OFF.
2. Inflight printer power switch—OFF.
3. Function selector knob—OFF.

Note

Do not shut off air conditioning when function selector knob is at STANDBY or beyond.

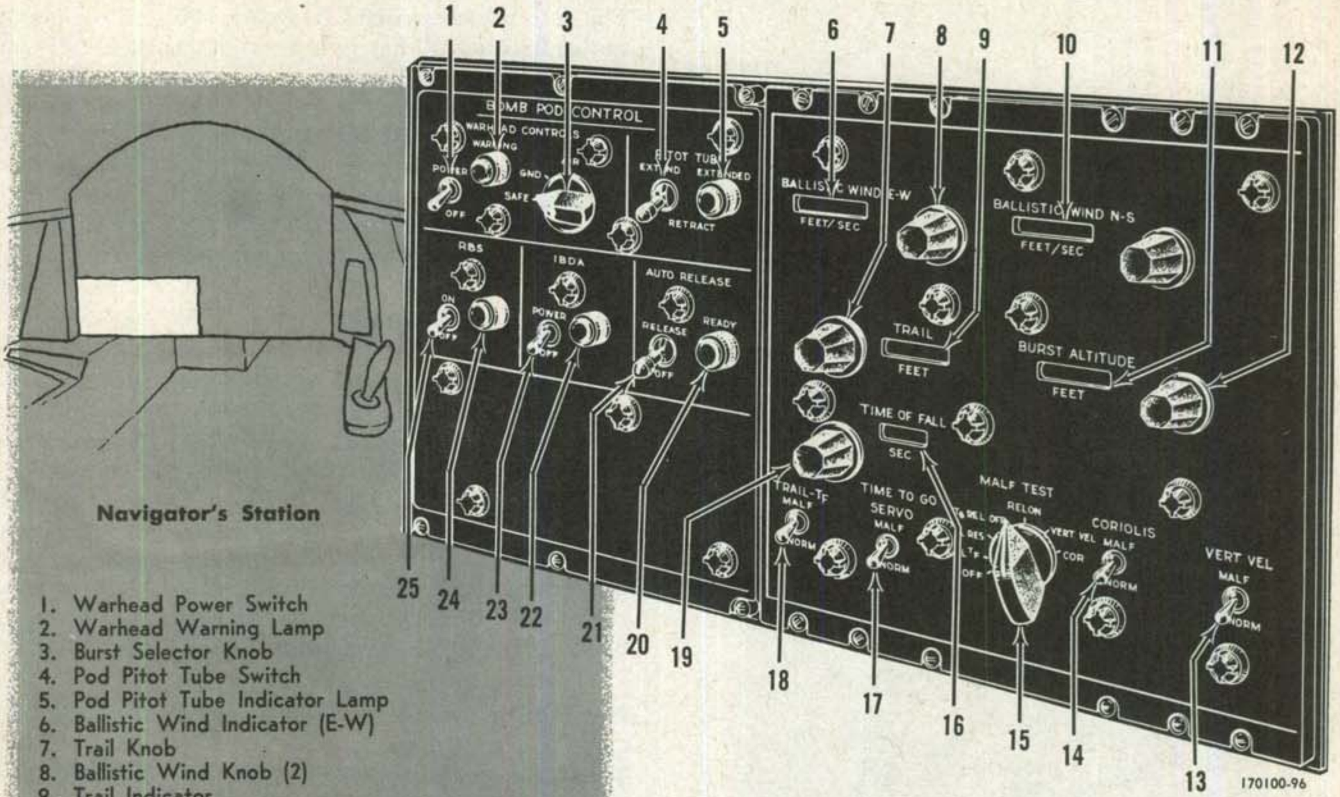
BOMBING SYSTEM.

The airplane is equipped with a bombing system which is used in conjunction with the primary navigation system to steer the airplane on the bomb run and to automatically drop a type MB-1 free fall bomb pod at a time calculated to provide burst at a predetermined point. The system consists essentially of a ballistics computer and the necessary controls. The ballistics unit and the bombing control panel, located at the navigator's station as an interchangeable unit can be replaced by other units, or omitted, if ballistic bombing is not planned. The ballistics unit is an analog computer which supplies trail and time-of-fall signals to the primary navigation system. The primary navigation system uses this information in computing steering error signals and an automatic release signal. The ballistics computer receives signals for its computations from the primary navigation system, the air data computer, and data set into the control panel on ballistic winds and desired burst altitude. Controls are provided for performing inflight malfunction checks and for substituting circuits if malfunction circuits are detected. Other controls allow the selection of an air burst, a ground burst, or a safe condition of the warhead. The warhead is armed automatically on release; firing is controlled by pressure signals from a retractable pitot tube on the nose of the pod. Although the pod is normally released automatically, it can be released by means of a release switch on the pod release panel if the automatic circuit malfunctions. Release can also be accomplished electrically by means of a pod release switch on the pilot's bomb panel. An emergency release handle at the navigator's station is provided for use if a malfunction exists in the electrical release system. A pod safety lockpin is provided which, when inserted, prevents inadvertent pod release. The lockpin position is controlled by a handle at the navigator's station. A radar bomb scoring system is installed to provide simulated pod drops whereby the accuracy of the bomb run can be determined. This system is controlled by a switch on the bombing control panel.

Warhead Power Switch.

A two-position warhead power switch (1, figure 4-37) on the bombing control panel is marked POWER and OFF. Placing the switch in the POWER position allows the selection of an air or ground burst by means of the burst selector knob. The switch must also be in this position for the red warhead warning lamp (2, figure 4-37) to give an indication.

bombing control panel



1. Warhead Power Switch
2. Warhead Warning Lamp
3. Burst Selector Knob
4. Pod Pitot Tube Switch
5. Pod Pitot Tube Indicator Lamp
6. Ballistic Wind Indicator (E-W)
7. Trail Knob
8. Ballistic Wind Knob (2)
9. Trail Indicator
10. Ballistic Wind Indicator (N-S)
11. Burst Altitude Indicator
12. Burst Altitude Knob
13. Vertical Velocity Malfunction Switch
14. Coriolis Malfunction Switch
15. Ballistic Malfunction Test Knob
16. Time-of-Fall Indicator
17. TG Servo Malfunction Switch
18. Trail—TF Malfunction Switch
19. Time-of-Fall Knob
20. Auto Release Indicator Lamp
21. Auto Release Switch
22. IBDA Indicator Lamp
23. IBDA Switch
24. RBS Indicator Lamp
25. RBS Switch

Figure 4-37.

Burst Selector Knob.

A three-position burst selector knob (3, figure 4-37), located on the bombing control panel, is marked SAFE, GND, and AIR. When placed to SAFE, the warhead is unarmed. Moving the knob to GND sets the warhead arming and fuzing system for a ground burst; the AIR position sets it for an air burst. The selector knob is inoperative unless the warhead power switch is positioned at POWER.

Pod Pitot Tube Switch.

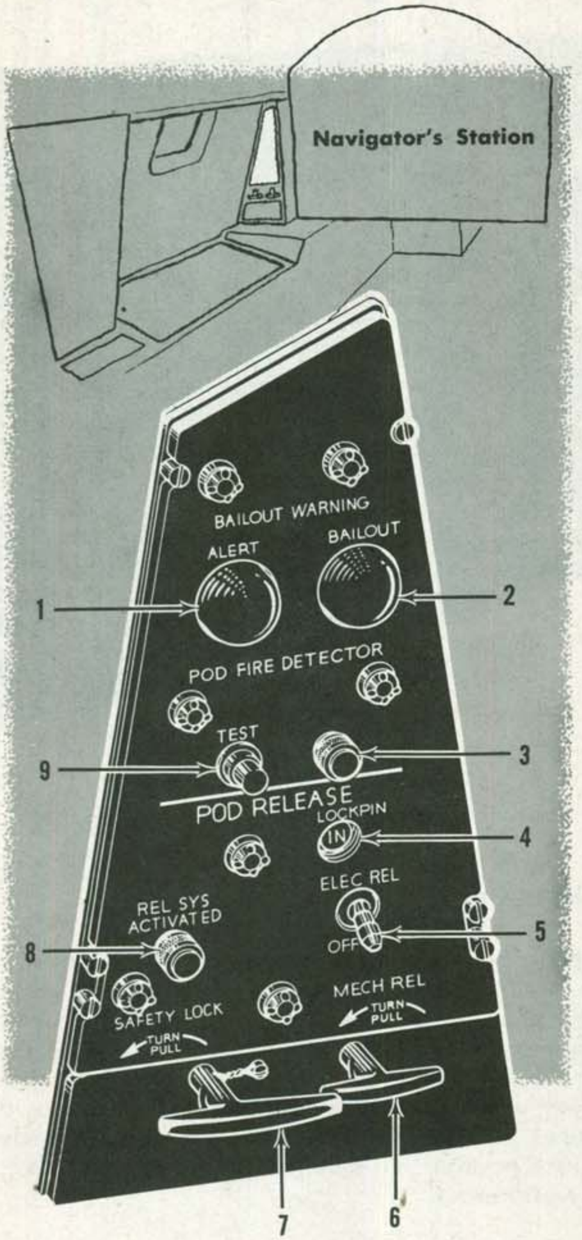
A pod pitot tube switch (4, figure 4-37), is located on the bombing control panel for extending and retracting the pod pitot tube. The switch is a two-position toggle switch marked EXTEND and RETRACT. Placing the switch in either position supplies 115-volt a-c power to the tube actuator, driving the tube to the desired position. The switch is mechanically latched in each position and must be pulled out before it can be repositioned.

A green push-to-test pod pitot tube indicator lamp (5, figure 4-37) next to the switch lights when the pod pitot tube is extended. It will remain lighted until the pitot tube is retracted or until the pod is dropped.

CAUTION

The pod pitot tube must be retracted before landing gear extension or retraction to prevent the nose gear from damaging the tube. Refer to Section V for limitations on tube extension.

pod release panel



1. Bailout Alert Lamp
2. Bailout Warning Lamp
3. Pod Fire Detector Warning Lamp
4. Pod Lockpin Indicator
5. Pod Release Switch
6. Pod Emergency Release Handle
7. Pod Safety Lockpin Release Handle
8. Release System Activated Warning Lamp
9. Pod Fire Detector Circuit Test Button

170100-80

Figure 4-38.

Auto Release Switch.

The auto release switch (21, figure 4-37), on the bombing control panel, has two positions marked OFF and RELEASE, providing selection of a manual or an automatic release. When the switch is positioned at RELEASE, the pod will be released automatically by the primary navigation system. When the switch is placed to RELEASE, the amber, push-to-test auto release indicator lamp (20, figure 4-37) will light if the system configuration is correct for automatic release.

Pod Release Switches.

Two pod release switches, one (figure 4-39) on the pilot's bomb panel and one (5, figure 4-38) on the navigator's pod release panel, are provided for emergency release of the pod. The pilot's switch is marked POD RELEASE and OFF. The navigators switch is marked ELEC REL and OFF. Moving either of the switches from OFF directs power from the airplane battery bus to both pod pneumatic control valves. The control valves then direct pneumatic pressure to the release hooks, releasing the pod from the airplane.

Pod Safety Lockpin Release Handle.

This handle (7, figure 4-38), located at the lower edge of the pod release panel, is provided to remove the pod safety pin from the release mechanism. Turning the handle counterclockwise and pulling it to its full length of travel unlocks the pod emergency release handle and removes the pod safety lockpin from the pod release actuator rod. The safety lockpin must be removed before any type of pod release can be made. A pod lockpin indicator, (4, figure 4-38) with IN and OUT markings, indicates lockpin position as determined by the handle operation and position.

Pod Emergency Release Handle.

A pod emergency release handle (6, figure 4-38), is located at the lower edge of the pod release panel. The handle provides a means of releasing the pod, in the event of a malfunction of the electrical release system, by mechanically actuating the pod release pneumatic system. The handle must be turned 90 degrees counterclockwise and pulled aft to its full length of travel for actuation of the release system. Operation is blocked until the pod safety lockpin release handle has been turned and pulled. A fail-safe feature prevents the handle from being pulled before it is rotated. Repositioning of the handle is accomplished during ground servicing.

RBS Switch.

This switch (25, figure 4-37), located on the bombing control panel and marked ON and OFF, is used to energize the radar bomb scoring system. When the switch is ON, an amber RBS indicator lamp (27, figure 4-37) adjacent to the switch, is lighted.

Ballistic Malfunction Test Knob.

The ballistic malfunction test knob (15, figure 4-37) on the bombing control panel allows the navigator to perform a malfunction test of the bombing equipment before making the bomb run. The knob has seven positions marked OFF, L-TF, L RES, TG-REL OFF, REL ON, VERT VEL, and COR. When the knob is placed in one of the six test positions, the operator can check for malfunctioning in the equipment being selected by observing the test good and test bad lamps located on the navigation sighting and test panel. Positioning the knob at L-TF checks the trail and time-of-fall computer circuits. The L RES position checks the trail resolver circuits.

Note

Substitution for a malfunctioning trail resolver circuit is made with the servo malfunction selector switch on the navigation malfunction control panel. (Refer to "Primary Navigation System" of this section.)

The time-to-go circuit and the release relay are checked by moving the test switch to TG REL OFF and REL ON. The VERT VEL position checks the vertical acceleration circuits, and the COR position, the circuits for Coriolis correction.

Vertical Velocity Malfunction Switch.

A vertical velocity malfunction switch (13, figure 4-37) marked NORM and MALF is located on the bombing control panel. When the switch is positioned at NORM, the vertical velocity correction circuit in the ballistics computer receives signals from a vertical velocity measuring device. Placing the switch to MALF replaces the circuit from the measuring device with a signal from the autopilot.

Coriolis Malfunction Switch.

The Coriolis malfunction switch (14, figure 4-37) on the bombing control panel has two positions marked MALF and NORM. The NORM position allows normal operation of the Coriolis correction circuits; the MALF position substitutes alternate circuits which generate Coriolis correction.

Time-to-Go Servo Malfunction Switch.

The time-to-go servo malfunction switch (17, figure 4-37) on the bombing control panel provides for the substitution of alternate circuits for the generation of time-to-go and automatic release signals. The switch is marked NORM and MALF. The NORM position allows normal operation of the time-to-go circuit and release relay. Putting the switch in the MALF position automatically substitutes an operative circuit for a malfunctioning time-to-go circuit or a release relay.

pilot's bomb panel

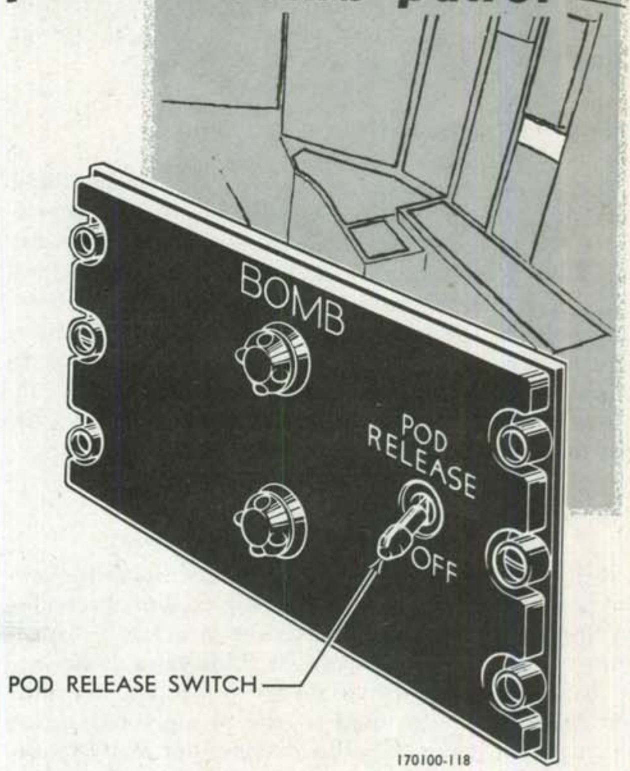


Figure 4-39.

Trail and Time-of-Fall Malfunction Switch.

A two-position trail and time-of-fall malfunction switch (18, figure 4-37) on the bombing control panel supplies alternate trail and time-of-fall values to the primary navigation system if these computers in the ballistic unit are malfunctioning. The switch is marked NORM and MALF. When the switch is positioned at NORM, computer circuits in the ballistics unit supply signals to the primary navigation system for use in solving the bombing problem. When the switch is placed to MALF, the set-in values of trail and time-of-fall shown on the indicators are substituted for the computed values.

Warhead Warning Lamp.

The red warhead warning lamp (2, figure 4-37) on the bombing control panel has two functions: (1) It will light automatically to indicate a malfunction in the warhead. (2) When pressed, the lamp will light to indicate a satisfactory condition of the continuity in the arming, fuzing, and warhead monitoring circuits. The lamp is inoperative unless the warhead power switch is positioned to POWER.

Time-of-Fall Indicator.

A time-of-fall indicator (16, figure 4-37) on the right side of the bombing control panel shows the time-of-fall value (estimated time lapse between pod release and burst) for the pod. This value is set into the ballistics computer circuits for use during the malfunction check. In the event of ballistics computer malfunction, it is used by the primary navigation system in solving the bombing problem. The time-of-fall information is set in with a knob (19, figure 4-37) adjacent to the indicator.

Trail Indicator.

A trail indicator (9, figure 4-37) on the bombing control panel shows in feet the ballistic trail of the pod—the horizontal distance between the target and the airplane at time of impact or burst. This value is set into the ballistics computer circuit for use in the malfunction check. It is also used by the primary navigation system, in the event of ballistics computer malfunction, in solving the bombing problem. The trail information is set in with a knob (7, figure 4-37) adjacent to the indicator.

Burst Altitude Indicator.

The burst altitude indicator (11, figure 4-37) on the right side of the bombing control panel shows the desired burst altitude of the bomb in feet above sea level. The burst altitude shown on the indicator is set into the ballistics computer circuits as a correction to be used in the computation of trail and time of fall. The burst altitude correction is set in with a knob (12, figure 4-37) adjacent to the indicator.

Ballistic Wind Indicators.

Two ballistic wind indicators (6 and 10, figure 4-37), one for east and west and one for north and south, are located on the bombing control panel. The indicators show in feet per second the partial ballistic wind components set into the ballistic computer circuits as correction factors to be used in the computation of trail. The wind components are set in by means of a knob (8, figure 4-37) adjacent to each indicator.

Release System Activated Warning Lamp.

This amber warning lamp (8, figure 4-38), located on the pod release panel, when lighted warns the navigator that pneumatic pressure is attempting to release the pod, but that the pod lockpin is inserted. The system must be restored to a no-release configuration before the lamp will go out and before the lockpin can be pulled. The lamp will blink briefly when a pod is released.

Pod Pin Out Caution Lamp.

A pod pin out caution lamp (figure 1-12) on the pilot's caution lamp panel lights when the pod safety lockpin is removed from the pod release actuator rod. The lamp operates on 28-volt direct current and is tied into the master caution lamp. For testing and dimming the pod pin out lamp and for information on the master caution lamp, refer to "Pilot's Indicator Lamp System," Section I.

BOMBING SYSTEM OPERATION.

For bombing system operating procedures, refer to "Navigator's Checklist," Section VIII.

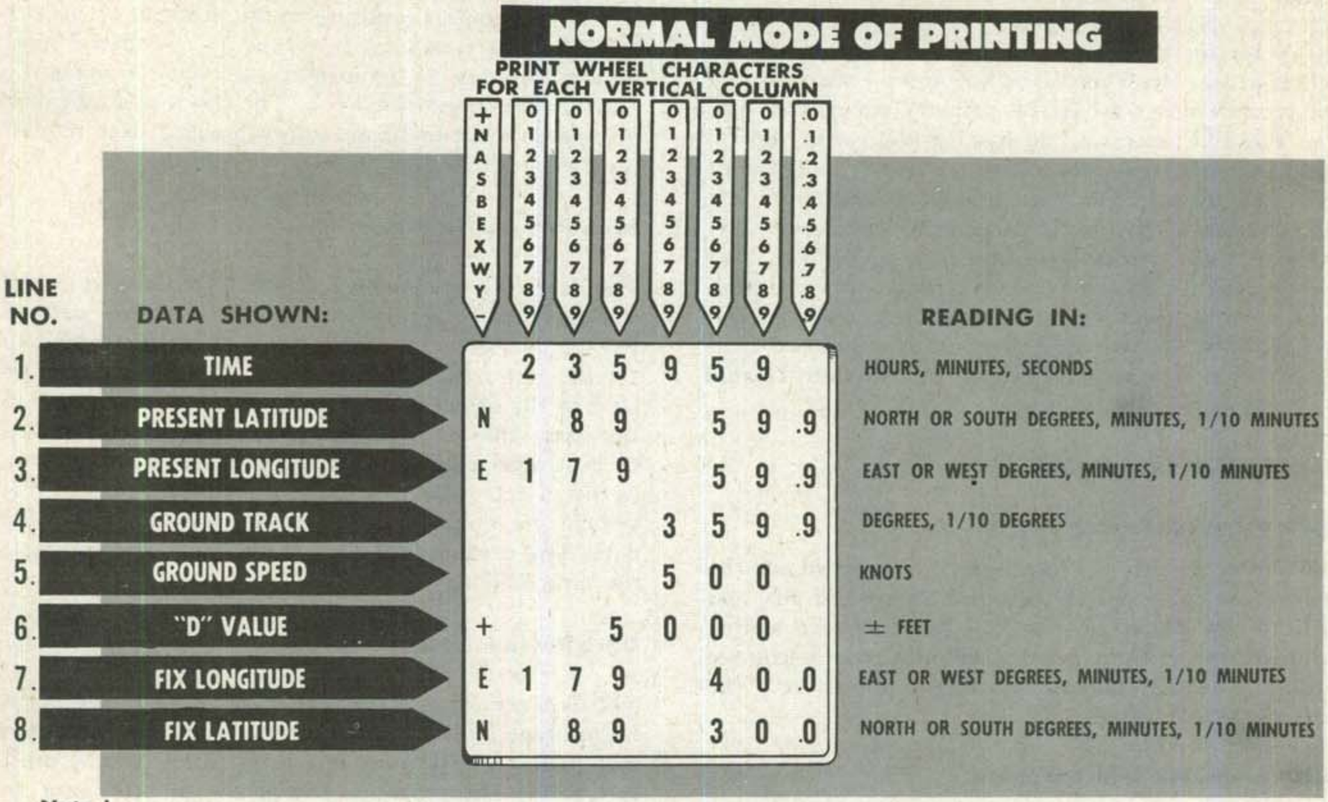
RECORDING SYSTEM.

The recording system is an automatic, electronically operated, data handling system which records flight information for inflight reference and for post flight evaluation. The recording system also supplies digitized time to other intelligence-gathering systems of the airplane. The recording system is composed of an inflight printer and a printer control unit (PCU), both of which are located at the navigator's station. Flight data from the primary navigation system and from the air data computer is received and decoded by the PCU and printed by the inflight printer. The recording system is controlled from the navigator's station. Direct current for the system is supplied from the 28-volt a-c and high voltage d-c power panel. Alternating current for the system is supplied from the left a-c power panel.

INFLIGHT PRINTER.

The inflight printer is a high speed, general purpose type printer located at the forward end of navigator's left console. The printer receives flight data from various systems of the airplane and records this data on paper tape. The printed flight data provides information for routine inflight decisions; provides a permanent log of the flight; provides the crew with sufficient data to begin manual navigation in the event of failure of the primary navigation system; and provides information for postflight bomb damage assessment. Basic components of the printer include the printing mechanism, the timing mechanism, the paper advance and reverse mechanism, and the inflight printer control panel (figure 4-41). All of these printer components are in the printer cabinet except for the printer control panel which is located

inflight printer format



Note :

Lines No. I through 5 appear on each block of data during all modes of printing.
Lines No. 7 and 8 are added only when a block of data resulting from a radar camera data request is printed.
"D" Value represents the difference between barometric and radar altitudes.

170100-115

Figure 4-40.

on the upper aft corner of the cabinet. Normal operation of the printer is virtually automatic after the printer timing mechanism has been set to the correct Greenwich mean time and the printer has been regulated to print at the desired time intervals. The printer will record flight data at regular intervals of 1, 2, 5, or 10 minutes depending upon the position of the intervalometer selector switch. Printed flight data can be obtained any time between the regular printing intervals by depressing the manual data request button. Previously printed information can be reviewed by means of the data review switch. The printer records flight information a block at a time with each block consisting of from six to nine lines of printed data. In the normal printing mode, a block of flight data is recorded each time the printer receives a data request from the intervalometer, the manual data request switch, or the primary navigation system radar camera. The number of lines of data printed in each block depends upon what type of data request has been received in the printer. An intervalometer data request results in the printing of a format (figure 4-40) of data containing six lines. These lines consist of Greenwich mean time, present latitude, present longitude, ground track, ground speed, and "D" value (the difference between barometric and radar altitude). A radar camera data request can be initiated either automatically by the primary navigation system or manually by the manual data request button when the automatic radar photography switch of the primary navigation system sighting and test panel is in the ON position. Either of these data requests results in the printing of an eight line block of data which consists of fix latitude and fix longitude in addition to the same six lines of data which result from an intervalometer data request. In the IBDA printing mode, a block of flight data is printed once every second throughout the IBDA recording cycle. Refer to "Indirect Bomb Damage Assessment (IBDA) System," this section.

PRINTER CONTROL UNIT.

The printer control unit (PCU) is an electronic controlling unit located at the navigator's station beneath the inflight printer. The PCU receives digital and analog data from the primary navigation system and from the air data computer. This data is stored until needed and then transmitted to the printer upon receipt of a data request. The PCU also initiates printing cycles for the printer and drives the time index indicator digitalizer in the printer upon receipt of one per second pulses from the primary navigation system. The PCU receives and handles the radar camera, intervalometer, and manual data requests as often as once per second. The functional subsystems of the PCU consist of the timing pulse generator, radar time index read-out, multiplexer, multiplexer control, data request register, storage read-in circuits, servo digitalizers, central recorder storage, printer storage, and decoder. The operation of the PCU is automatic after the power switch on the inflight printer control panel is placed in the ON position.

CONTROLS AND INDICATORS.

Inflight Printer Power Switch.

The power switch (1, figure 4-41) is located on the printer control panel. This switch is marked ON and OFF. When placed in the ON position, the switch energizes the inflight printer and the printer control unit. The switch controls 28-volt d-c power from the main d-c power panel.

Intervalometer Selector Knob.

The intervalometer selector knob (2, figure 4-41) is a four-position selector switch located on the printer control panel. The knob has positions marked 1, 2, 5, and 10, and controls the intervalometer, which initiates data requests resulting in the printing of a block of flight data at regular intervals of 1 minute, 2 minutes, 5 minutes, or 10 minutes, depending upon the position of the selector knob. The block of flight data printed as a result of an intervalometer data request consists of six lines of flight information.

Data Review Switch.

The data review switch (9, figure 4-41), located on the inflight printer control panel, has positions marked FWD and REV. These positions are spring-loaded to a center unmarked OFF position. When the switch is held to the FWD or REV positions, the paper tape in the data window (8, figure 4-41) will move forward or in reverse, respectively. The tape will move as long as the switch is held in the position. By means of this switch the operator may review previously printed data. The printer will not accept data requests while the tape is being reviewed.

Data Review Reset Button.

The data review reset button (4, figure 4-41) is a pushbutton-type switch located on the inflight printer control panel. The button is marked RESET and must be pressed after each review of the printed tape, in order that the inflight printer will again accept standard data requests.

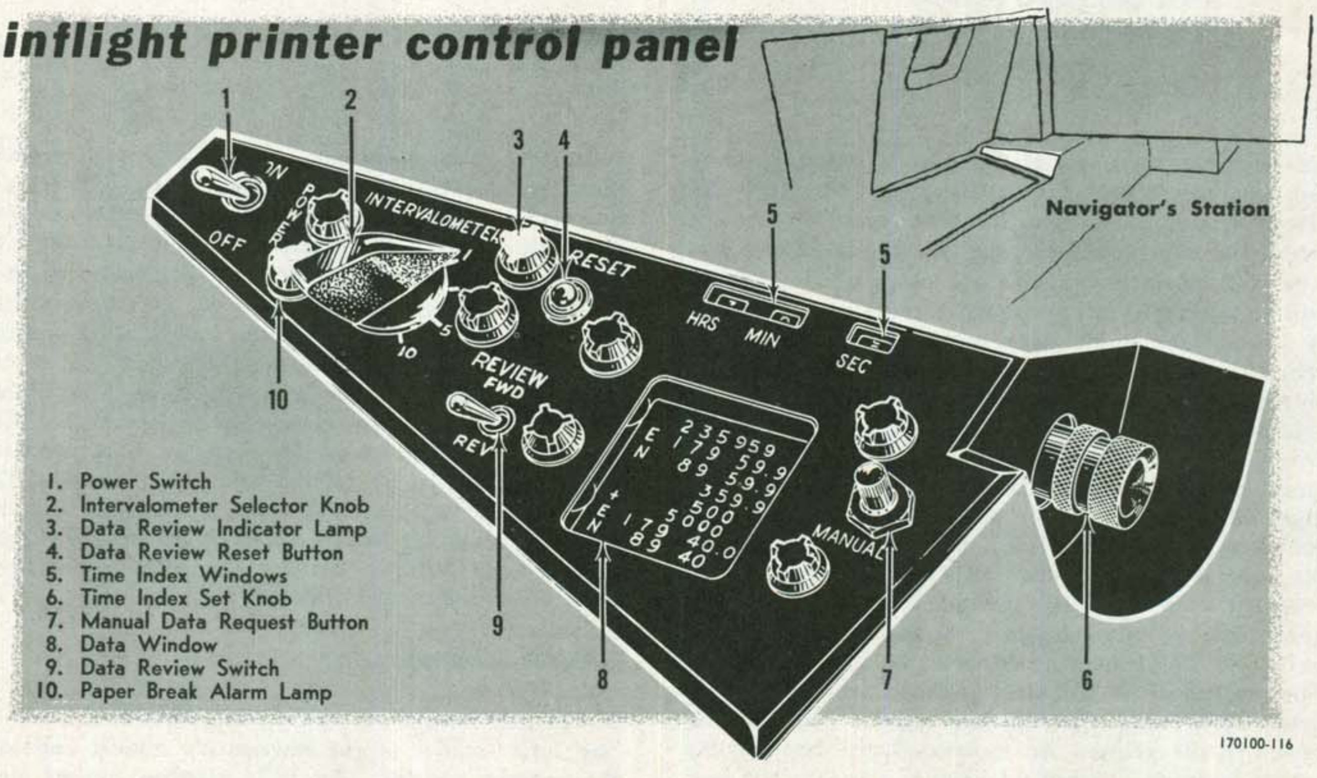


Figure 4-41.

Manual Data Request Button.

The manual data request button (7, figure 4-41) is a pushbutton-type switch located on the printer control panel. By momentarily depressing the manual button, a data request is initiated which results in the immediate printing of a block of flight data consisting of Greenwich mean time, present latitude, present longitude, ground track, ground speed, "D" value (the difference between barometric and radar altitudes), and under certain conditions, fix longitude and fix latitude.

Time Index Set Knob.

The time index set knob (6, figure 4-41) is used to set the speedometer-type digit indicators of the time index indicator digitalizer (TIID), which are visible on the inflight printer control panel, to the correct Greenwich mean time. The TIID can be set at the beginning of or during a mission in which the inflight printer is to be utilized. The set knob is located on the inboard side of the printer cabinet. To set the second, tens of seconds, and the minute indicators, the set knob must be pushed in; to set the tens of minutes, hours, and tens of hours indicators, the set knob must be pulled out. When pushed in and rotated, the set knob adjusts the digit indicators in increments of 1 second with the maximum range of adjustment being 9 minutes and 59 seconds. When pulled out and rotated, the set knob adjusts the digit indicators in increments of 10 minutes with the maximum range of adjustment being 23 hours and 50 minutes. The set knob is spring-loaded to return to a neutral disengaged position when not in use. When setting the TIID, the marking on the minute indicator must agree with the marking on the tens-of-minutes indicator. If a red vertical mark is visible on one, a red mark should be visible on the other, or else no markings should be visible on either. The significance of the red marks is discussed in this section under "Time Index Indicator Digitalizer."

Time Index Indicator Digitalizer.

The time index indicator digitalizer (TIID) is essentially an elapsed time indicator synchronized by one per second pulses from the primary navigation system. The TIID displays the current Greenwich mean time on cylindrical speedometer-type digit indicators in two time index windows (5, figure 4-41) at the right upper edge of the inflight printer control panel. Time is shown in increments of hours, minutes, and seconds with the maximum possible reading being 23 hours, 59 minutes, and 59 seconds. The odd numbers on the tens-of-minutes indicator have red vertical lines at the right of the numerals. The minute indicator has two complete sets of digits, one set which has red vertical marks adjacent to the numerals and the other set which has no markings. These red vertical marks are for reference when setting the indicators to correct Greenwich mean time. To assure an accurate reading from the TIID coding mechanism, it is necessary that the minute indicator be set to agree with the tens-of-minutes indicator as follows: if a red mark appears on the tens-of-minutes indicator, a similar mark must appear on the minute indicator; conversely, if no marking appears on one, no mark should appear on the other. When a maximum time reading is attained by the time indicators, all the digits revert to zero and begin another cycle. A set knob located in a recess on the inboard side of the printer cabinet is used to set the TIID digit indicators to the correct time either before or during flight. The same time reading as displayed by the TIID is printed on the first line of each new block of flight data. The TIID also converts time to a binary-coded form and transmits this coded time to other intelligence gathering systems for the correlation of data. The TIID operates on 28-volt d-c power furnished from the main d-c power panel.

Paper Break Alarm Lamp.

The paper break alarm lamp (10, figure 4-41) is an amber lamp located on the printer control panel. When lighted, the lamp indicates the roll of paper tape in the printer is broken. The printer discontinues printing when the alarm lamp is lighted and remains inoperative until the roll of paper is repaired. The alarm lamp receives 28-volt d-c power from the main d-c power panel.

Data Review Indicator Lamp.

The unmarked data review indicator lamp (3, figure 4-41) is located on the inflight printer control panel. The lamp lights whenever the data review switch is held to the FWD or REV position, and remains lighted until the reset button is pressed. The lighted lamp thus indicates that the inflight printer cannot accept data requests until the reset button is pressed.

NORMAL OPERATION OF RECORDING SYSTEM.

Turning On Recording System.

1. Intervalometer selector knob—10.
2. Power switch—ON.
3. Time index set knob—Set correct Greenwich mean time in time index windows.

Note

Be sure that presence (or absence) of red vertical mark is in agreement on both the tens-of-minutes and the minute indicators.

4. Intervalometer selector knob—1.

5. Data window—Check format.
Allow one minute after setting intervalometer; then check that printer has printed a normal format.

6. Manual data request button—Press; check format.
Momentarily press manual button and check that the printer prints a normal format.

7. Intervalometer selector knob—As required.
Set intervalometer as required for desired format printing intervals.

Reviewing Printed Data.

If it is desired to review previously printed data, proceed as follows:

1. Hold data review switch to REV. Data review indicator lamp will light. When desired data appears in data window, release switch. Make adjustments with review switch as necessary to review all necessary data. Printer will not accept data requests during review.
2. When review is complete, hold data review switch to FWD until blank paper tape appears in data window, then release.
3. Momentarily press data review reset button. Data review indicator lamp will go out and printer will again accept normal data requests.

INDIRECT BOMB DAMAGE ASSESSMENT (IBDA) SYSTEM.

The indirect bomb damage assessment (IBDA) system, in conjunction with the inflight printer and the primary navigation system records inflight information from which weapon ground zero may be derived. Using this information, trained ground personnel may assess target damage without requiring post-strike reconnaissance. The system consists of a camera and a data package. The camera is located in a compartment on the underside of the fuselage just forward of the drag chute doors. Operating automatically, the camera makes one exposure per second throughout the IBDA recording cycle. The camera carries 50 feet of 35-mm film and is mounted in a fixed position looking aft along the aircraft centerline and down 25 degrees from the level flight path. The viewing field of the lens is large enough to get adequate coverage of either a ground or air burst with the aircraft tail-on to the burst. Lens opening, shutter speed, film type and filter must be selected on the ground prior to flight. The IBDA data package is located in the cabin area. It contains the components necessary to program the IBDA recording cycle and to effect the proper interrelated operations of the primary navigation system, the recording system, and the IBDA camera. The data package is cooled by cabin air conditioning. Controls for the IBDA system are located at the navigator's station. The IBDA system receives positive and negative 150-volt d-c power from the 28-volt a-c and high-voltage d-c power panel, 115-volt a-c power from the right a-c power panel, and 28-volt d-c power from the 28-volt d-c power panel.

IBDA RECORDING CYCLE.

The IBDA recording cycle is an electronically controlled schedule during which the IBDA system, the primary navigation system, and the recording system function together to produce and record the information necessary to assess nuclear bomb damage. The recording cycle is initiated and programmed by the IBDA data package. The cycle begins 15 seconds prior to pod release and continues for approximately 125 seconds. During this time, the IBDA camera makes one exposure per second. Each time the camera shutter opens, the inflight printer prints a block of flight data. Therefore, completely synchronized photographic and printed information is recorded every second throughout the pod drop. The flight data blocks printed during the IBDA recording cycle consist of nine lines of data. The lines printed during the first portion of the cycle are time, present latitude, present longitude, ground track, ground speed, barometric altitude, heading, vertical velocity, and airspeed. Fifteen seconds after pod release, the vertical velocity and airspeed lines are replaced by roll and pitch data, respectively.

CONTROLS AND INDICATORS.

IBDA Power Switch.

The two-position IBDA power switch (23, figure 4-37) is located on the bombing control panel. The switch has positions marked POWER and OFF. With the switch in the POWER position, the IBDA system is energized and placed in a standby condition, ready to begin the automatic recording cycle. Placing the switch in the OFF position de-energizes the entire system.

IBDA Indicator Lamp.

An amber press-to-test IBDA indicator lamp (22, figure 4-37) is located on the bombing control panel. The lamp lights when electrical power is applied to the system; it goes out when power is removed.

NORMAL OPERATION OF IBDA SYSTEM.

The IBDA system is put into operation by placing the IBDA power switch in the POWER position at least one minute prior to pod release. At the end of the recording cycle, the system will automatically return to a standby condition, allowing the inflight printer to return to the normal mode of printing. The power switch may be returned to the OFF position approximately three minutes after pod release.

mb-1 free fall bomb pod

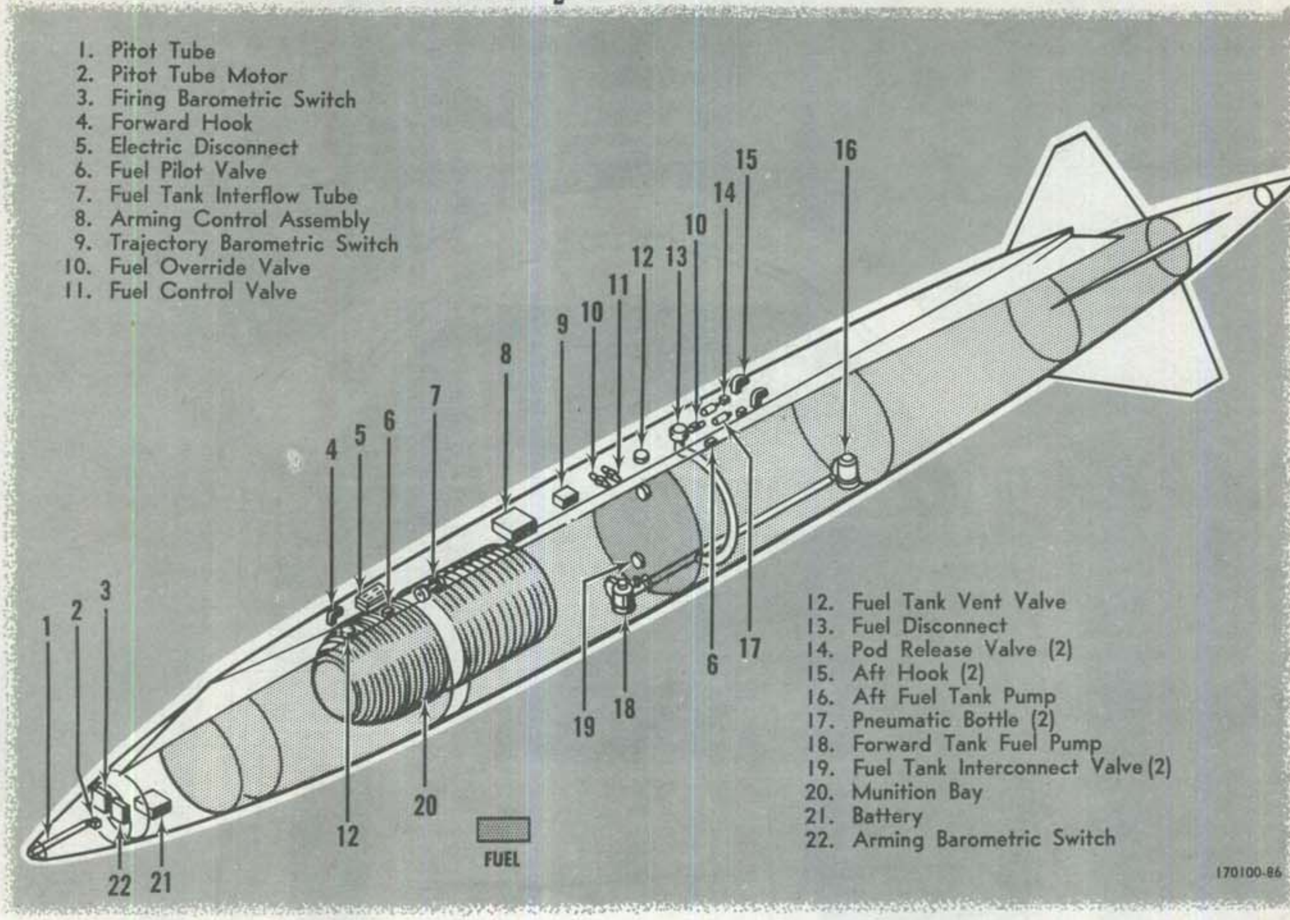


Figure 4-42.

PODS.

The airplane is designed to carry an MB-1 free-fall bomb pod. The pod is carried on pneumatically actuated hooks beneath the fuselage of the airplane and is equipped with a pylon-type fairing which encloses the hooks and release equipment. The pod (figure 4-42) is designed to carry a warhead through a natural ballistic trajectory after release from the airplane. The pod has the added capability of carrying a fuel load to supplement the airplane fuel supply. (Refer to "Fuel Supply System," Section I.) The pod consists of an equipment bay, a forward fuel tank and munitions bay, an aft fuel tank, a tail cone and the pylon. It incorporates a 28-volt battery package to serve as a power source after pod release, a pitot tube, and barometric switches for arming and fuzing the warhead. The pitot tube serves as a pressure source for the arming and fuzing switches and is extended and retracted by means of a switch on the bombing control panel. (Refer to "Bombing System" of this section.) The pod battery supplies power for arming and fuzing and is activated automatically on pod release. Before release, pod components receive power from the airplane electrical system. Pod stabilization after release is achieved by means of four fins mounted in cruciform fashion on the tail cone. The fins are at 45 degrees from the horizontal center line of the pod and are slightly offset to give the pod a slow rotation during its trajectory. Normal release is accomplished automatically by the bombing system. (Refer to "Bombing System" of this section.) In the event of malfunction in the automatic circuit, it may be released manually with the pod release switch on the pod release panel, or the pod release switch on the pilot's bomb panel. If there is an electrical system failure, release can be made manually with the emergency release handle at the navigator's station.

Principal Dimensions.

- Overall Length — 57 feet
- Maximum Diameter — 5 feet

Gross Weights.

- With full load of fuel — 36,087 pounds
- Weight empty — 8550 pounds

defensive system operator's station

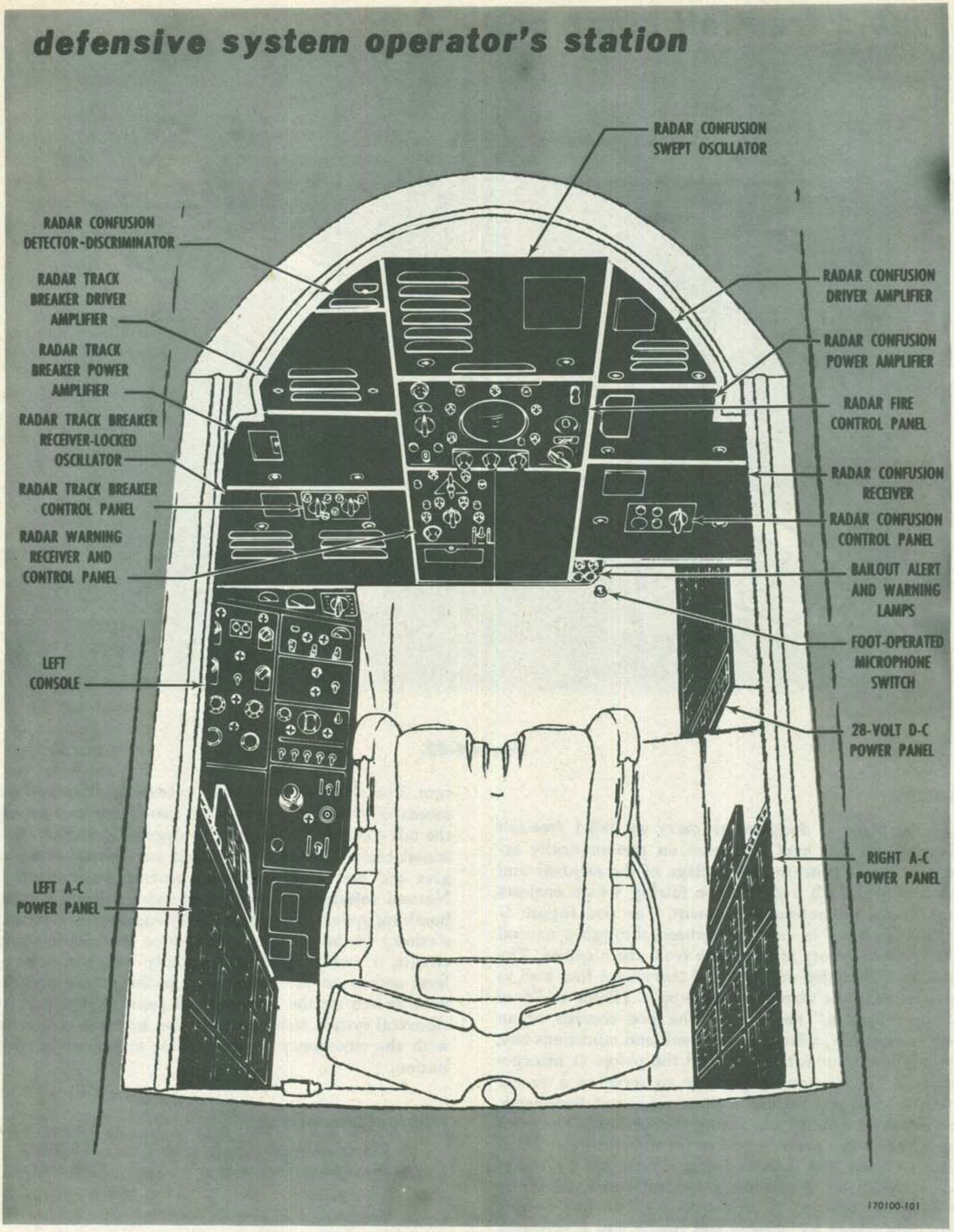
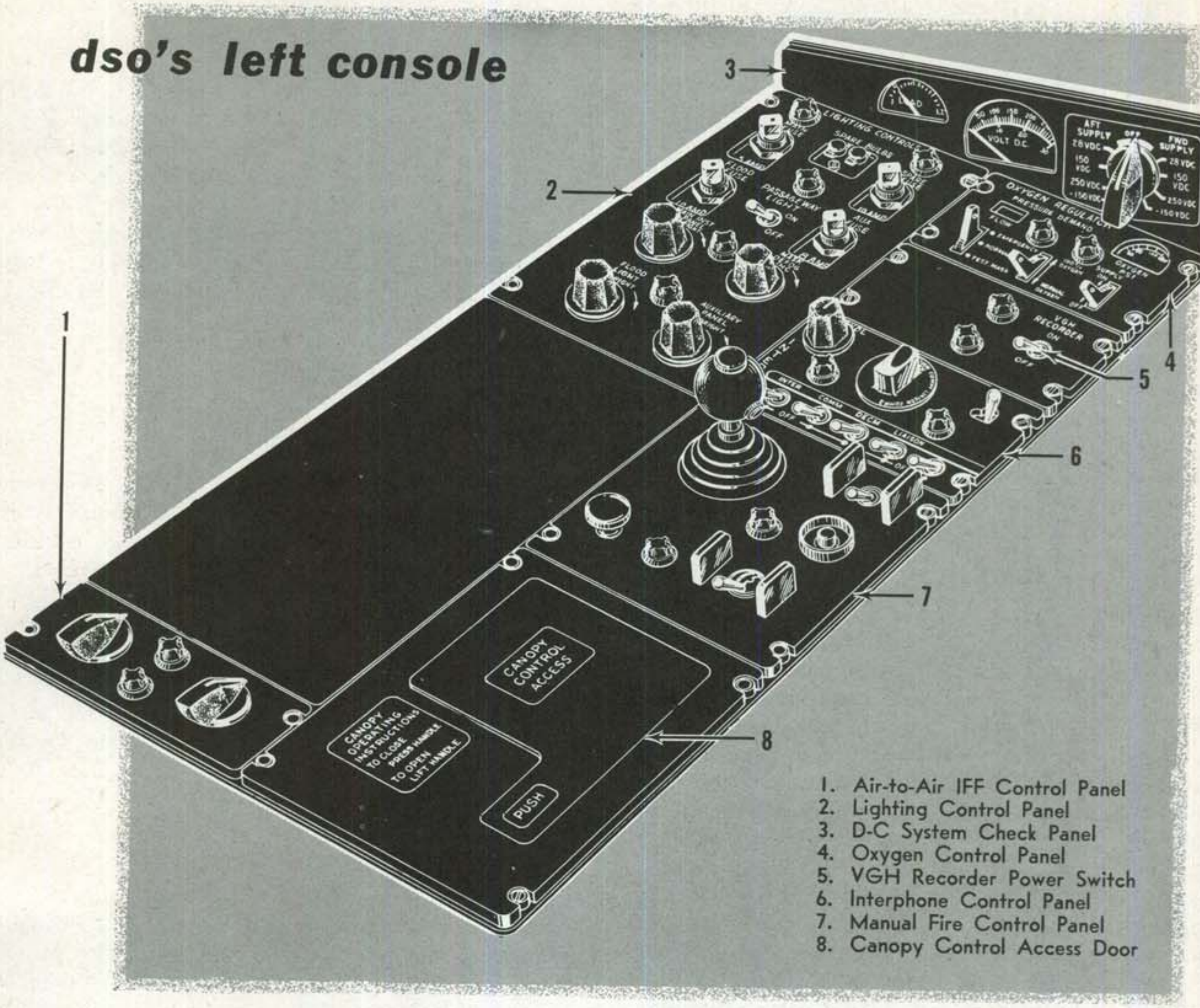


Figure 4-43.

dso's left console



1. Air-to-Air IFF Control Panel
2. Lighting Control Panel
3. D-C System Check Panel
4. Oxygen Control Panel
5. VGH Recorder Power Switch
6. Interphone Control Panel
7. Manual Fire Control Panel
8. Canopy Control Access Door

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Figure 4-43A.

DEFENSIVE ELECTRONIC COUNTER-MEASURE SYSTEM.

For information pertaining to the defensive electronic countermeasure (DECM) system, refer to the Confidential Supplement, T.O. 1B-58A-1A.

ACTIVE DEFENSE SYSTEM.

For information pertaining to the active defense system, refer to the Confidential Supplement, T.O. 1B-58A-1A.

Figures 4-44 and 4-45 deleted.

Figures 4-46 thru 4-49 deleted.

AIR REFUELING SYSTEM.

The airplane is equipped with an air refueling system capable of receiving fuel from a KC-135 boom-type tanker aircraft. The system, consisting of a flying boom receptacle, slipway door, hydraulic valves and actuators, a hydraulic reservoir, and a signal amplifier, is controlled from the pilot's station. The system hydraulic power is supplied from the utility hydraulic system; the electrical power is supplied from the 28-volt d-c power panel. The canopy actuating system supplies pneumatic pressure to pressurize the air refueling system hydraulic reservoir for emergency operation. The receptacle and slipway door are located in the upper portion of the radome forward of the pilot's station. When the slipway door is open, it forms a guide for the flying boom. The door is flush with the contour of the radome when closed. Two lamps in the receptacle slipway aid the tanker boom operator during night refueling. During normal operation, electrical power is supplied through the signal amplifier to the ready lamp and to the nozzle latch controls. In the event of a failure of the signal amplifier and limit switches in the receptacle slipway, electrical power can be supplied to the nozzle latch controls through a boom latch control switch and a disconnect switch. The fuel panel configuration for air refueling must be established prior to making contact with the tanker boom. When contact is made and the refueling operation started, fuel enters the refueling manifold and flows into the forward, aft, and reservoir tanks of the airplane, and tanks of the pod simultaneously. When the aft tank becomes full, a float-type switch in the aft tank opens the balance tank refuel valve allowing fuel to flow into the balance tank. When the tanks are full, a float-type shutoff valve in each tank closes the corresponding tank refuel valve. Normally, the tanker boom operator initiates a disconnect when the fuel flow stops. However, the pilot of the receiver airplane is also provided a control for initiating a disconnect any time during the refueling operation. An automatic disconnect will occur if the receiver refueling manifold pressure exceeds 67 ($\pm$3) psig or when the boom extension force exceeds 5400 pounds. An automatic disconnect will also occur if the air refueling boom envelope limits (figure 4-50) are exceeded. This is a feature of the tanker boom assembly and may be made inoperable by the boom operator if for some reason the automatic disconnect provision is not desired.

CAUTION

If the automatic disconnect feature malfunctions or is made inoperable by the boom operator, the receiver airplane can foul the boom under some flight conditions.

If the receiver airplane is disconnected from the tanker boom after the initial hookup, a reset button located on the control stick grip must be momentarily depressed before another contact can be made. Information relative to area, altitude, and airspeed for air refueling operations is predetermined during preflight planning. For flight characteritsics of the aircraft during air refueling, refer to "Air Refueling," Section VI.

CONTROLS AND INDICATORS.

Air Refueling Door Switch.

The air refueling door switch (5, figure 1-10), located on the fuel control panel, is marked OPEN and CLOSE. The switch is mechanically latched in both positions; it is necessary to pull out on the switch handle to move the switch out of either position. Placing the switch in the OPEN position hydraulically opens the slipway door, energizes the signal amplifier and lights the ready lamp. The OPEN position also lights two lamps in the receptacle slipway. Placing the switch to the CLOSE position hydraulically closes the door flush with the contour of the radome. The switch requires 28-volt d-c power.

IFR Disconnect Button.

The pushbutton-type switch (figure 1-27), located on the control stick grip and marked IFR DISC, provides a means of disconnecting from the tanker boom anytime during the refueling operation. During normal refueling operation, momentarily depressing the button will cause an immediate disconnect from the tanker boom. Also a disconnect signal is transmitted to the tanker through the boom signal coil to indicate a disconnect. In addition the button is used in conjunction with the boom latch control switch to open and close the boom latch toggles during emergency boom latching. The button requires 28-volt d-c power.

NWS-IFR (Nose Wheel Steering — Inflight Refueling) Reset Button.

The pushbutton-type switch (figure 1-27) is located on the control stick grip and is marked NWS and IFR RESET.

Note

The IFR RESET function is operative only when the air refueling door switch is in the OPEN position.

air refueling boom envelope limits

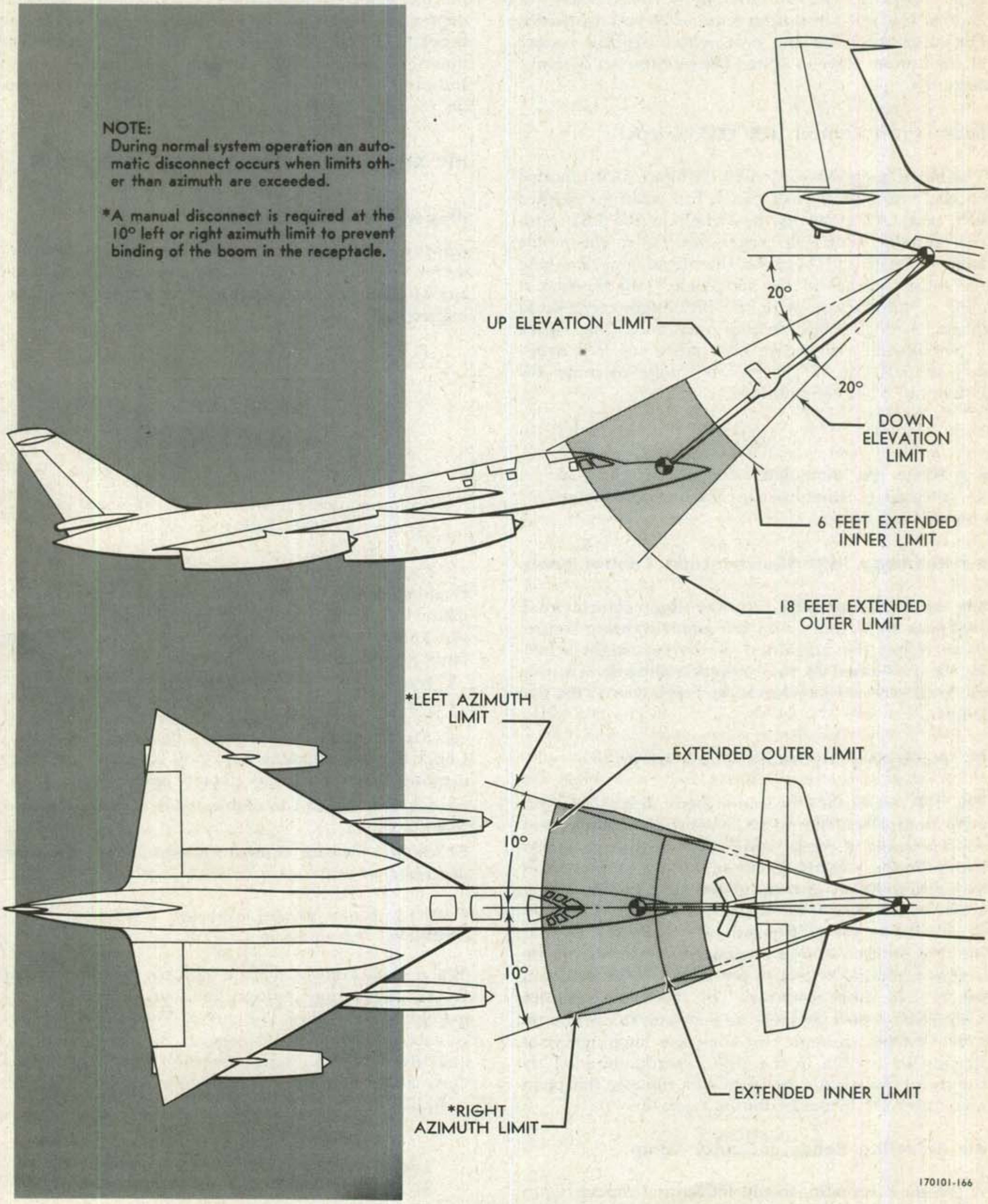

Figure 4-50.

After a disconnect has been accomplished, momentarily depressing the button resets the automatic control circuits of the signal amplifier and lights the ready lamp. After resetting, the air refueling system is ready for another contact. The button requires 28-volt d-c power. For information on the nose wheel steering feature of the button, refer to "Nose Wheel Steering System," Section I.

Boom Latch Control (IFR EBL) Switch.

The boom latch control switch (9, figure 4-20), located on the autopilot control panel, has positions marked EBL and OFF. Placing the switch in the EBL position supplies electrical power directly to the nozzle latch controls and bypasses the signal amplifier and the limit switches in the receptacle. This position is used in conjunction with the IFR disconnect button during manual boom latching operations. The switch is mechanically latched in both positions; it is necessary to pull out on the switch handle to move the switch out of either position.

Note

When the boom latch control switch is in the EBL position, the air refueling ready lamp will not light.

Air Refueling (IFR) Slipway Light Control Knob.

The air refueling (IFR) slipway light control knob (1, figure 4-15), located on the pilot's lighting control panel, varies the brightness of the two night refueling lamps located in the receptacle slipway. Turning the knob clockwise increases the brightness of the two lamps.

IFR Emergency Hydraulic Boost Lever.

The IFR emergency hydraulic boost lever (1, figure 1-26), located on the pilot's lower right console, provides a means of pressurizing the air refueling system hydraulic fluid in the event of failure of the utility hydraulic system upstream of the air refueling system check valves. The lever is marked ON and OFF, and is guarded in the OFF position. Placing the lever in the ON position allows pneumatic pressure from the canopy actuating system to pressurize the air refueling system hydraulic reservoir. This provides sufficient hydraulic pressure to open the door and to operate the nozzle latches through two complete latching cycles. Placing the switch in the OFF position shuts off the supply of pneumatic pressure and relieves the pneumatic pressure in the hydraulic reservoir.

Air Refueling Ready Indicator Lamp.

A green air refueling ready indicator lamp (4, figure 1-10), located on the fuel control panel, will light when the slipway door is open and the air refueling system is electrically ready for contact with the tanker boom. The lamp will go out when the boom is latched into the receptacle or when the NWS-IFR reset button is depressed. Also the lamp will not light when the boom latch control switch is in the EBL position. For dimming and testing of the lamp, refer to the "Pilot's Indicator Lamp System," Section I. The lamp operates on 28-volt d-c power.

AIR REFUELING SYSTEM NORMAL OPERATION.

Preparation for Contact.

Approach tanker from aft and below so as to arrive at the predetermined position at the desired airspeed and altitude. Before contact is made accomplish the following steps:

WARNING

Turn off all non-essential electrical and electronic equipment which might create a hazardous condition during air refueling.

1. Fuel panel configuration—Check.

Establish engine supply from aft tank, position the manual cg control switch to MANUAL, and position the knobs of the tank refuel valves to REFUEL for tanks scheduled to receive fuel.

2. Boom latch control switch—OFF.
3. Air refueling door switch—OPEN.
4. Air refueling ready lamp—Lighted.

Check that the air refueling ready lamp is lighted, indicating that the slipway door is open.

5. Elevator control available mode selector switch—MANUAL.

Check that elevator control available is at least eight degrees.

Contact.

When visual contact is made with the tanker, move up to the observation position 100 feet aft and approximately 50 feet below the tanker. Then move into the contact position while observing the boom markings and director lights on the tanker for visual instructions. On making contact the following steps will be accomplished.

Note

If radio silence is not observed, the tanker boom operator will instruct the receiver pilot into position when both airplanes are ready for contact and will continue to instruct him during contact.

1. Ready lamp—Out.
Check that ready lamp goes out, indicating that boom is latched into the slipway receptacle, and report to boom operator "Receiver contact made."

CAUTION

If the boom operating limits are exceeded, an automatic disconnect will occur unless the bomb operator overrides the automatic disconnect limits.

Note

During contact, the receiver pilot must observe the boom markings and director lights as well as receive instructions from the boom operator so that the proper position can be maintained.

After Air Refueling.

When the refueling is complete, accomplish the following:

Note

Normally, the boom operator will initiate a disconnect; however, the disconnect can also be initiated by the receiver pilot if desirable.

1. Air refueling door switch—CLOSE.
After the boom has been retracted and the receiver airplane is clear of the tanker, position the air refueling door switch to CLOSE.
2. Fuel panel configuration—Check.
Establish a fuel panel configuration for the desired flight condition. Refer to FUEL MANAGEMENT (Section VII).
3. Elevator control available mode selector switch—AUTO.
4. CG—Check as required.
Check gross weight and cg; readjust cg as required.

AIR REFUELING SYSTEM EMERGENCY OPERATION.

Engine Failure.

A tanker engine failure is more serious than a receiver aircraft engine failure. A receiver engine failure will result in extension of the boom and a probable disconnect. However, a tanker engine failure will probably cause the receiver aircraft to overrun the tanker. In the event of tanker engine failure the "Breakaway Procedure" should be accomplished.

Manual Boom Latching.

If a failure of the signal amplifier or of the limit switches in the receptacle should occur, the boom may be latched in the receptacle by placing the boom latch control switch in the EBL position and depressing the IFR disconnect button until the boom nozzle has bottomed in the receptacle. The receiver pilot will be able to feel the boom nozzle bottom in the receptacle. When latching the boom manually, the following procedure should be used.

1. Move up to the contact position with the boom latch control switch in the EBL position and the IFR disconnect button depressed.
2. Boom operator will place nozzle in bottom of receptacle and advise pilot "Nozzle is bottomed."
3. Receiver pilot will then release the IFR disconnect button; the nozzle latches will lock the nozzle in the receptacle.

CAUTION

If the disconnect button is released before the nozzle is in the bottom of the receptacle, it is possible for the nozzle to damage or break the extended nozzle latches, preventing any further refueling.

Disconnect after manually latching the boom is accomplished by depressing and holding the IFR disconnect button to hold the nozzle latches open until the boom nozzle leaves the receptacle.

CAUTION

It is possible to cause structural damage to the air refueling boom and slipway by severe relative movement between the two airplanes when using the manual boom latching provisions as the boom limit switches are deactivated. The receiver pilot must initiate all disconnects before exceeding any of the limits.

Note

The boom operator is unable to release the nozzle latches during manual boom latching.

Emergency Operation of Slipway Door.

Failure of the utility hydraulic system will prevent actuation of the slipway door in the normal manner. In such an emergency, placing the IFR emergency hydraulic boost lever in the ON position will supply pneumatic pressure from the canopy actuating system to pressurize the hydraulic reservoir. Normal operation of the air refueling door switch may then be used for controlling operation of the slipway door.

Note

Sufficient hydraulic fluid is contained in the reservoir to open the slipway door and to operate the nozzle latches through two complete latching cycles.

Breakaway Procedure.

The word "Breakaway" has been established and reserved for use as a code word to indicate an emergency condition. At any time during contact, any crew member of the tanker or receiver should call the other airplane call sign and then "Breakaway" three times when he feels that the circumstances are hazardous to the safety of the airplane or when a malfunction of equipment warrants a disconnect. On the word "Breakaway", the following action will be taken simultaneously by the indicated crew members.

1. Tanker pilot will increase power if available, climb straight ahead with wings level, and hold until clear of the receiver airplane.
2. Boom operator will immediately actuate the disconnect switch, and retract and stow the boom.
3. Receiver pilot will immediately actuate the disconnect button, retard throttles, and execute a gentle nose over, maintaining wings level until clear of the tanker.

SINGLE-POINT REFUELING SYSTEM.

The airplane and pod fuel tanks are normally serviced on the ground by means of a single-point pressure refueling system. The single-point refueling adapter is located in the right side of the nose wheel well. Fuel is routed from the adapter to the reservoir, aft, and balance tanks of the airplane and the tanks of the pod through refuel valves located in each tank. The forward tank refuel valve is located in the reservoir tank. Fuel routed to the forward tank flows through the forward tank refuel valve and into the reservoir tank. If the reservoir tank is full, fuel will flow through the reservoir tank overflow line and into the forward tank. The reservoir tank refuel valve is controlled by a float-type pilot valve in the reservoir tanks. The refuel valves of the forward, aft, and balance tanks of the airplane and the tanks of the pod are controlled by switches located on the fuel control panel. These tanks are also equipped with float-type pilot valves which allow fuel under pressure to close the refuel valves when the tanks are full. Four fuel system maintenance test buttons, located on the upper exterior surface of the reservoir and aft tanks, provide a means of checking the operation of the individual tank high level shutoff valves during refueling.

CAUTION

The fuel quantity indicators at the pilot's station must be closely monitored during the refueling operation. The refuel valves must be closed by the control switches if they do not operate automatically.

The refuel valves are also used to direct fuel during fuel transfer operations. On airplanes without a pod attached, the tanks are refueled in the following sequence: reservoir tank, forward tank, aft tank, and balance tank. With pod attached, the tanks are refueled in the following sequence: reservoir tank, balance tank, forward tank, aft pod tank, aft tank, and forward pod tank. If pressure refueling equipment is not available, the reservoir, forward, and aft tanks of the airplane can be serviced in the order listed through three fillers located on the top of the fuselage. Also the tanks of the pod may be fueled through the negative relief valves.

CAUTION

The proper sequence of refueling must be followed in order to minimize dangerous cg conditions which could result in upsetting the airplane.

FORWARD TANK REFUEL-SCAVENGE KNOB.

The forward tank refuel-scavenge knob (6, figure 1-10), located on the fuel control panel, has three positions marked REFUEL, SCAV, and OFF. Placing the knob in the REFUEL position opens the forward tank refuel valve. For information on the other functions of this switch refer to "FUEL SUPPLY SYSTEM," Section I.

BALANCE TANK REFUEL-SCAVENGE KNOB.

The balance tank refuel-scavenge knob (14, figure 1-10), located on the fuel control panel, has three positions marked REFUEL, SCAV, and OFF. Placing the knob in the REFUEL position opens the balance tank

INITIATOR SAFETY PIN STOWAGE PROVISIONS.

The navigator's and DSO's stations are each provided with a bag (1, figure 4-51) in which to stow the initiator safety pin assembly during flight. At each of the two stations, the bag is attached to the bulkhead near the upper outboard side of the left seat rail. At the pilot's station, the initiator safety pin assembly is stowed in a compartment in the safety pin stowage door (5, figure 4-51) located in the right sidewall aft of the window.

FLIGHT RECORDS STOWAGE DOOR.

A flight records stowage door (6, figure 4-51) is located at the pilot's station in the left sidewall aft of the window. A compartment inside the door provides for stowing the Form 781 and other aircraft records.

FLIGHT CHARTS STOWAGE COMPARTMENT.

A flight charts stowage compartment (8, figure 4-51) is located in the upper portion of the center pedestal forward of the control stick.

PILOT'S MAP AND DATA CASE.

A map and data case (9, figure 4-51, and 6, figure 1-26) is stowed in the pilot's lower right console. The case lid is spring-loaded so as to remain open when unlatched. A release button (5, figure 1-26) permits removal of the case from the console.

PILOT'S TUNNEL ANTIGLARE CURTAIN.

An antiglare curtain (11, figure 4-51) is installed at the pilot's entrance to the tunnel area. The curtain, which is provided to exclude light coming from the navigator's station, is attached to the forward side of the bulkhead and hangs across the tunnel opening. The curtain may be rolled up and fastened in a stowed position when not in use.

NAVIGATOR'S MAP STOWAGE COMPARTMENT.

A map stowage compartment (4, figure 4-51) is located at the navigator's station forward of the left window and directly beneath the pod release panel.

NAVIGATOR'S ROLL MAP TABLE.

A roll map table (figure 4-21) is provided at the navigator's station. The forward end of the table is hinged and attaches to the bottom of the navigation unit when the table is in use. The aft end of the table rests on the navigator's knees. When not in use, the table is stowed at the forward right side of the station near the tunnel entrance. In the stowed position, the hinged end of the table is attached to the floor and the upper end is held secure by a spring.

ELAPSED TIME INDICATORS.

A group of elapsed time indicators is installed at the navigator's station on the right sidewall aft of the window. These indicators measure the amount of operating time accumulated by the various major airplane systems. The indicators, which require no monitoring or manipulation by the crew members, are used by ground personnel in determining system reliability.

VGH RECORDER. 35 ➧

The airplane is equipped with a VGH recorder located on the floor of the pilot's station at the tunnel opening. The VGH recorder receives velocity, gravity, and acceleration signals from a remotely located transmitter. It records these signals on a magnetic tape for postflight inspection. The tape record is used by ground personnel in maintaining a structural fatigue history of the airplane. Once the VGH recorder is turned on prior to flight by means of a switch (5, figure 4-44) on the DSO's left console, it requires no further attention by the crew.

section V operating limitations

NOTE

For Section V, refer to Confidential Supplement, T.O. 1B-58A-1A.

section VI flight characteristics

NOTE

For Section VI, refer to Confidential Supplement, T.O. 1B-58A-1A.

section VII systems operation

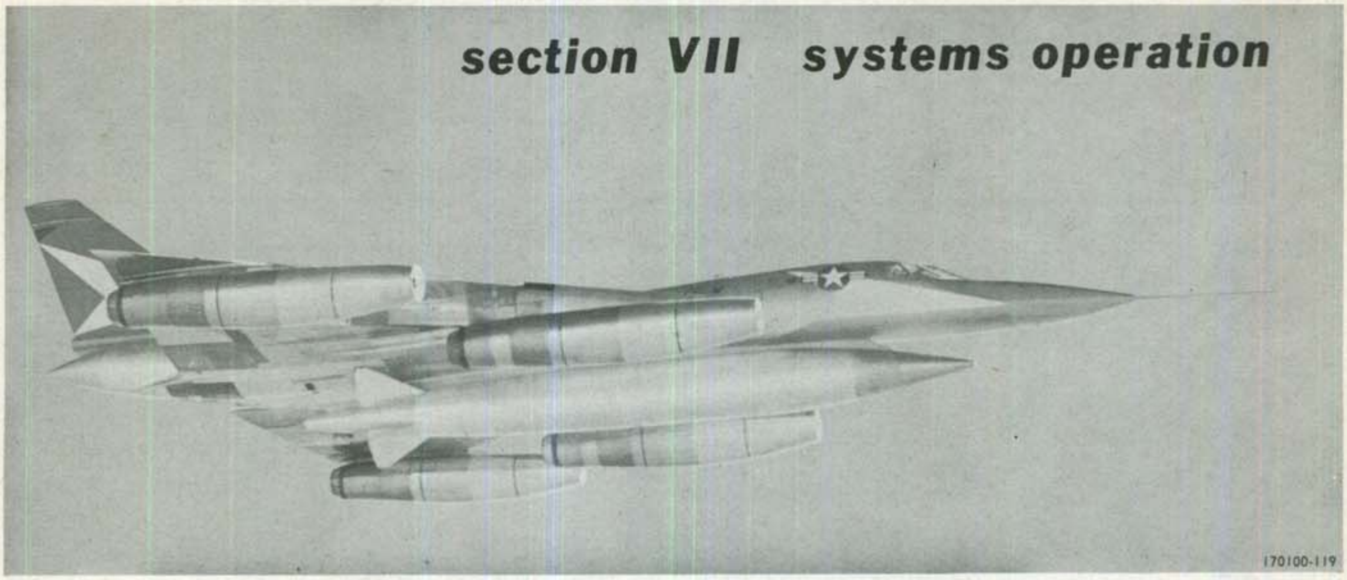

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TABLE OF CONTENTS.

ENGINES.

T_2 RESET.

The T_2 reset feature of the engine fuel control system permits engine speed to increase beyond rated speed (7460 rpm—100 percent rpm) at high compressor inlet temperatures. This increase in engine speed is necessary to obtain the airflow and thrust required for design speed. At compressor inlet temperature above 97°C as shown on figure 7-A1, idle speed and rated speed become equal and remain equal as the temperature increases. In this region, engine speed is independent of throttle position. However, as compressor inlet temperature drops below 97°C, the T_2 reset feature is cutout and normal throttle control is re-established.

T_2 CUTBACK.

At low compressor inlet temperatures, the T_2 cutback feature of the fuel control system prevents high corrected engine speed compressor stalls by decreasing the rated engine speed from 100 to 94.2 percent as shown on figure 7-A1. When operating in the T_2 cutback region, advancing the throttles will have no effect on engine rpm until a higher compressor inlet temperature is obtained.

FUEL SUPPLY SYSTEM.

Inflight management of the fuel system varies with the airplane configuration and the desired cg for the particular flight condition. The following fuel management procedures are the recommended methods of fuel system operation for various flight conditions.

FUEL MANAGEMENT.

During all normal fuel system operation, the reservoir tank will automatically be maintained full until all other available fuel has been depleted. No minimum quantity is required in the forward or aft tanks for engine supply. Sufficient fuel must be maintained in the balance tank during supersonic flight to provide the required cg shift forward for deceleration to subsonic flight. Refer to "Center of Gravity Limitations," Section V for the operational cg limits. For all normal flight conditions, the reservoir tank booster pump switch and the reservoir to manifold shutoff valve switches must be placed in the guarded normal position. Inflight management of the fuel for cg control can be accomplished either automatically or manually. The following panel configurations are recommended during the manual or automatic mode of cg control.

Note

- The cg control system is designed to accurately indicate and control the aircraft cg when the aircraft is at a deck angle of plus 2.5 degrees during stable flight. However, under transient conditions such as acceleration and deceleration the system accuracy is degraded.

t_2 reset and cutback versus engine speed

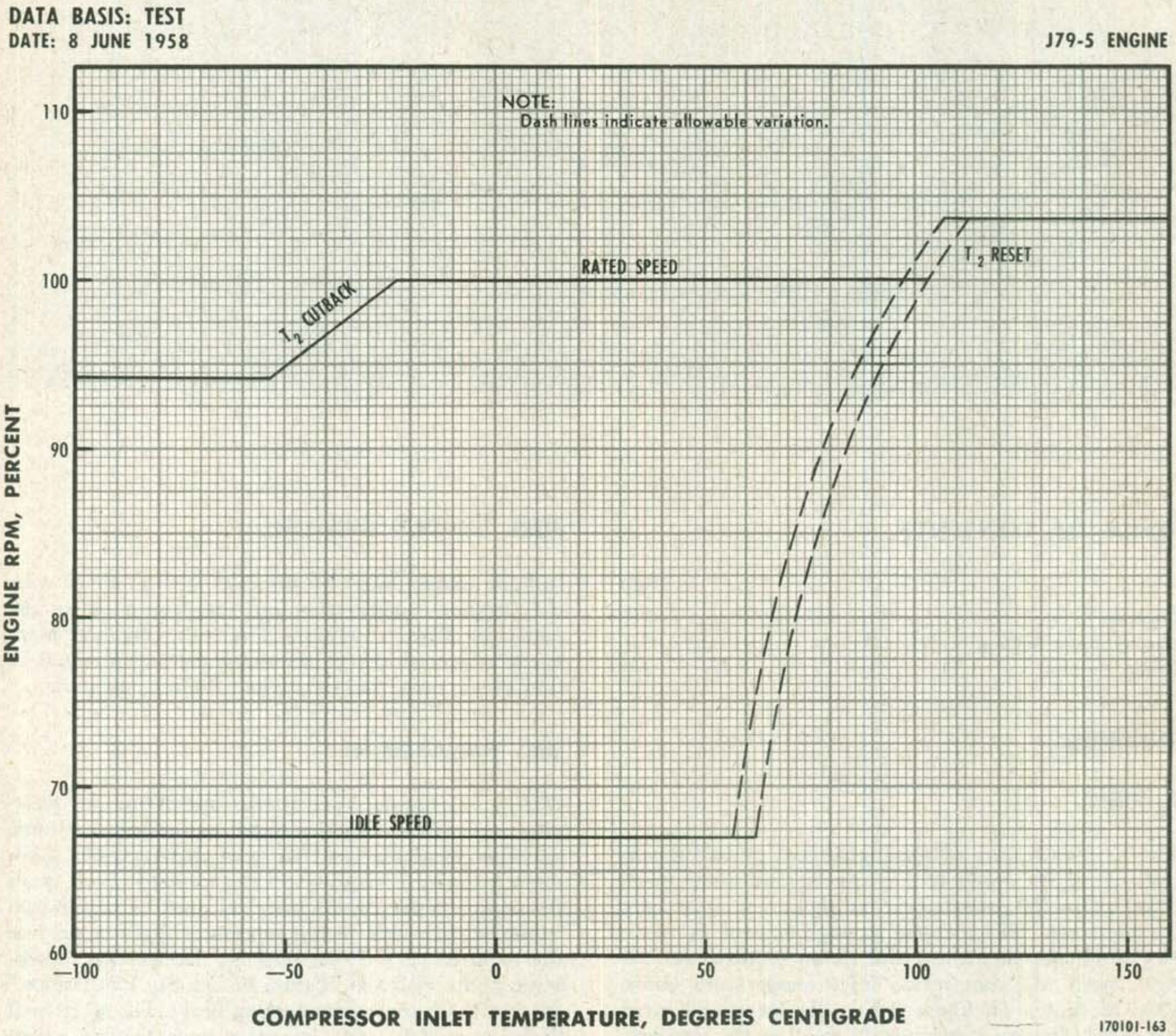

Figure 7-A1.

- A shift from automatic cg control to manual cg control should be accomplished when insufficient fuel is available to attain a selected cg. This condition will be noted during an aft cg shift by the lighting of the forward tank booster pump low pressure caution lamps, low fuel quantity reading on forward tank indicator and subsequent lighting of the automatic cg off caution lamp. During a forward cg shift, this condition is indicated by the lighting of the balance tank booster pump low pressure caution lamps and a low fuel quantity reading on the balance tank indicator; however, automatic cg control may be continued until lighting of the aft tank booster pump low pressure caution lamps, aft tank quantity indicator indicates low fuel quantity and subsequent lighting of the automatic cg off caution lamp.

Takeoff.

Fuel must not be transferred during takeoff. The panel configuration for takeoff is as follows:

1. Reservoir tank booster pump switch—NORM.
2. Reservoir to manifold shutoff valve switches—NORMAL.

3. CG control switch—MANUAL.

4. Forward tank to engine supply control knob—OFF.

5. Aft tank to engine supply control knob—ON.

6. Balance to aft tank interconnect valve switch—CLOSE.

7. Forward tank refuel-scavenge knob—OFF.

8. Manual cg shift switch—OFF.

9. Balance tank refuel-scavenge knob—OFF.

10. Aft tank refuel valve knob—OFF.

11. Fuel dump switch—NORM.

12. Forward pod tank transfer-refuel knob—OFF.

13. Aft pod tank transfer-refuel knob—OFF.

14. Pod tank interconnect valve switch—CLOSE.

Climb.

For fuel flows greater than 90,000 pounds per hour, climb should be accomplished with the same panel configuration as for takeoff. For fuel flows less than 90,000 pounds per hour, either the forward or aft tank to engine supply control knob, or both, may be positioned to ON. Fuel may be transferred during climb.

Acceleration.

Acceleration is accomplished with the same panel configuration as for climb.

Cruise.

Cruise can be accomplished with a fueled or nonfueled pod using the following panel configuration:

1. For manual cg control:

a. Reservoir tank booster pump switch—NORM.

b. Reservoir to manifold shutoff valve switches—NORMAL.

c. CG control switch—MANUAL.

d. Manual cg shift switch—FWD or AFT (as required).
Place switch in the FWD or AFT position for a brief period as required to obtain the desired cg.

CAUTION

The manual cg shift switch must be returned to OFF after the desired cg is obtained.

e. Forward tank to engine supply control knob—ON.

f. Aft tank to engine supply control knob—ON.

g. Balance to aft tank interconnect valve switch—CLOSE.

h. Forward tank refuel-scavenge knob—OFF.

i. Balance tank refuel-scavenge knob—OFF.

j. Aft tank refuel valve knob—OFF.

k. Fuel dump switch—NORM.

l. Forward pod tank transfer-refuel knob—OFF.

m. Aft pod tank transfer-refuel knob—OFF.

n. Pod tank interconnect valve switch—CLOSE.
If fuel is in the pod tanks, it may be transferred to the airplane tanks using the panel configuration specified for "Fuel Transfer From Pod Tanks to Airplane Tanks" of this section.

2. For automatic cg control, the panel configuration is same as manual control except as follows:

a. CG selector knob—Select the desired cg.

b. Manual cg shift switch—OFF.

c. CG control switch—AUTO.

Note

Although fuel may be transferred from the pod tanks to the airplane tanks during automatic cg control, it is not recommended because fuel delivery from the pod to the airplane may be delayed when fuel shifts are dictated by the automatic cg control system.

Deceleration.

When decelerating to the subsonic region, forward transfer of fuel to obtain a subsonic cg should be completed prior to deceleration. However, the system has the capability to transfer fuel forward from the balance tank during the deceleration. The panel configuration for deceleration is as follows.

1. For manual cg control:

a. Reservoir tank booster pump switch—NORM.

b. Reservoir to manifold shutoff valve switches—NORMAL.

c. CG control switch—MANUAL.

d. Forward tank to engine supply control knob—As required.
If engines are scheduled to be supplied from forward tank, position knob to ON.

e. Aft tank to engine supply control knob—As required.
If engines are scheduled to be supplied from aft tank, position knob to ON.

f. Balance to aft tank interconnect valve switch—CLOSE.

g. Forward tank refuel-scavenge knob—OFF.

h. Manual cg shift switch—FWD, then OFF.
Place switch in the FWD position until the desired cg is obtained.

i. Balance tank refuel-scavenge knob—OFF.

j. Aft tank refuel valve knob—OFF.

k. Fuel dump switch—NORM.

l. Forward pod tank transfer-refuel knob—OFF.

m. Aft pod tank transfer-refuel knob—OFF.

n. Pod tank interconnect valve switch—CLOSE.

2. For automatic cg control, the panel configuration is same as manual control except as follows:

a. CG selector knob—Select a forward cg.

b. Manual cg shift switch—OFF.

c. CG control switch—AUTO.

Descent.

Descent is accomplished with the same panel configuration as for normal deceleration.

Landing.

The panel configuration for landing is as follows:

1. Reservoir tank booster pump switch—NORM.

2. Reservoir to manifold shutoff valve switches—NORMAL.

3. CG control switch—MANUAL.

4. Manual cg shift switch—OFF.

5. Forward tank to engine supply control knob—As required.
If engines are scheduled to be supplied from forward tank, position the knob to ON.

6. Aft tank to engine supply control knob—As required.
If engines are scheduled to be supplied from aft tank, position the knob to ON.

7. Balance to aft tank interconnect valve switch—CLOSE.

8. Forward tank refuel-scavenge knob—OFF.

9. Balance tank refuel-scavenge knob—OFF.

10. Aft tank refuel valve knob—OFF.

11. Fuel dump switch—NORM.

12. Forward pod tank transfer-refuel knob—OFF.

13. Aft pod tank transfer-refuel knob—OFF.

14. Pod tank interconnect valve switch—CLOSE.

Fuel Transfer.

The airplane cg is controlled either automatically or manually by transferring fuel forward or aft as necessary for the various flight conditions. The method in which fuel is to be transferred depends upon the airplane configuration, the flight condition, and the rate at which fuel is to be transferred. The rate of transfer from the airplane forward and aft tanks varies with the engine supply configuration and total engine fuel flow. (For the fuel transfer rates from the airplane forward and aft tanks see figure 7-1.) The transfer rate from the balance tank to the forward tank is approximately 125,000 pounds per hour with both inlets of each booster pump submerged. At a deck angle of 2-1/2 degrees, the upper inlet of the pumps will be uncovered when the fuel quantity in the balance tank decreases to approximately 2200 pounds. For this condition, the transfer rate is approximately 75,000 pounds per hour. The transfer rate from a pod tank is approximately 40,000 pounds per hour. Pod fuel should be transferred to the airplane tanks as early in the flight as practical.

WARNING

It should be noted that all pod fuel must be transferred to the airplane before the airplane gross weight decreases to 100,000 pounds.

The desired airplane cg is obtained by transferring fuel forward or aft using the following panel configurations.

Transfer From Balance and Aft Tanks to Forward Tank. The following panel configuration transfers fuel to the forward tank from the balance tank, or from the aft tank if the balance tank is empty. The pod tank pumps are electrically locked out when this configuration is used.

1. For manual cg control:

a. Reservoir tank booster pump switch—NORM.

b. Reservoir to manifold shutoff valve switches—NORMAL.

c. Forward tank to engine supply control knob—As required.

d. Aft tank to engine supply control knob—As required.

e. CG control switch—MANUAL.

f. Manual cg shift switch—FWD.

g. Balance to aft tank interconnect valve switch—CLOSE.

h. Forward tank refuel-scavenge knob—OFF.

i. Balance tank refuel-scavenge knob—OFF.

j. Aft tank refuel valve switch—OFF.

k. Fuel dump switch—NORM.

l. Forward pod tank transfer-refuel knob—OFF.

m. Aft pod tank refuel-transfer valve knob—OFF.

n. Pod tank interconnect valve switch—CLOSE.

2. For automatic cg control, the panel configuration is the same as for manual cg control except as follows:

a. CG selector knob—Select the desired forward cg.

b. Manual cg shift switch—OFF.

c. CG control switch—AUTO.

Transfer From Balance Tank to Aft Tank (Forward Tank Full).

1. Reservoir tank booster pump switch—NORM.
2. Reservoir to manifold shutoff valve switches—NORMAL.
3. CG control switch—MANUAL.
4. Manual cg shift switch—FWD.
5. Forward tank to engine supply control knob—As required.

If engines are scheduled to be supplied from forward tank, position the switch to ON.

6. Aft tank to engine supply control knob—As required.

If engines are scheduled to be supplied from aft tank, position the knob to ON.

7. Balance to aft tank interconnect valve switch—CLOSE.
8. Forward tank refuel-scavenge knob—OFF.
9. Balance tank refuel-scavenge knob—OFF.
10. Aft tank refuel valve knob—REFUEL.
11. Fuel dump switch—NORM.
12. Forward pod tank transfer-refuel—OFF.
13. Aft pod tank transfer-refuel—OFF.
14. Pod tank interconnect valve switch—CLOSE.

Transfer From Balance Tank to Aft Tank (Forward Tank Not Full).

1. Reservoir tank booster pump switch—NORM.
2. Reservoir to manifold shutoff valve switches—NORMAL.
3. CG control switch—MANUAL.
4. Manual cg shift switch—OFF.
5. Forward tank to engine supply control knob—OFF.
6. Aft tank to engine supply control knob—ON.
7. Balance to aft tank interconnect valve switch—CLOSE.
8. Forward tank refuel-scavenge knob—OFF.
9. Balance tank refuel-scavenge knob—SCAV.
10. Aft tank refuel valve knob—REFUEL.
11. Fuel dump switch—NORM.
12. Forward pod tank transfer-refuel knob—OFF.
13. Aft pod tank transfer-refuel knob—OFF.
14. Pod tank interconnect valve switch—CLOSE.

Transfer From Forward Tank to Aft Tank (No Fuel Desired in Balance Tank).

1. Reservoir tank booster pump switch—NORM.

fuel transfer rates

DATA BASIS: TEST
DATE: 12 MAY 1958

FORWARD TANK

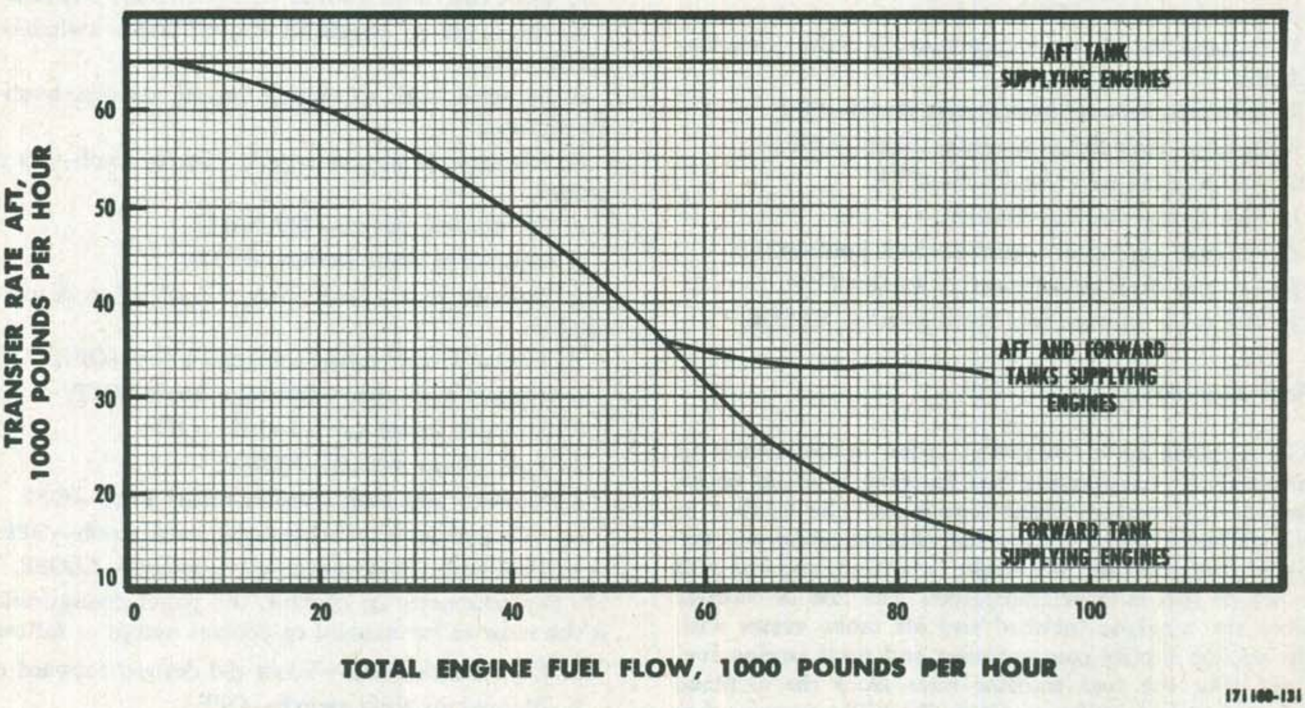

Figure 7-1. (Sheet 1 of 2)

fuel transfer rates

DATA BASIS: TEST
DATE: 12 MAY 1958

AFT TANK

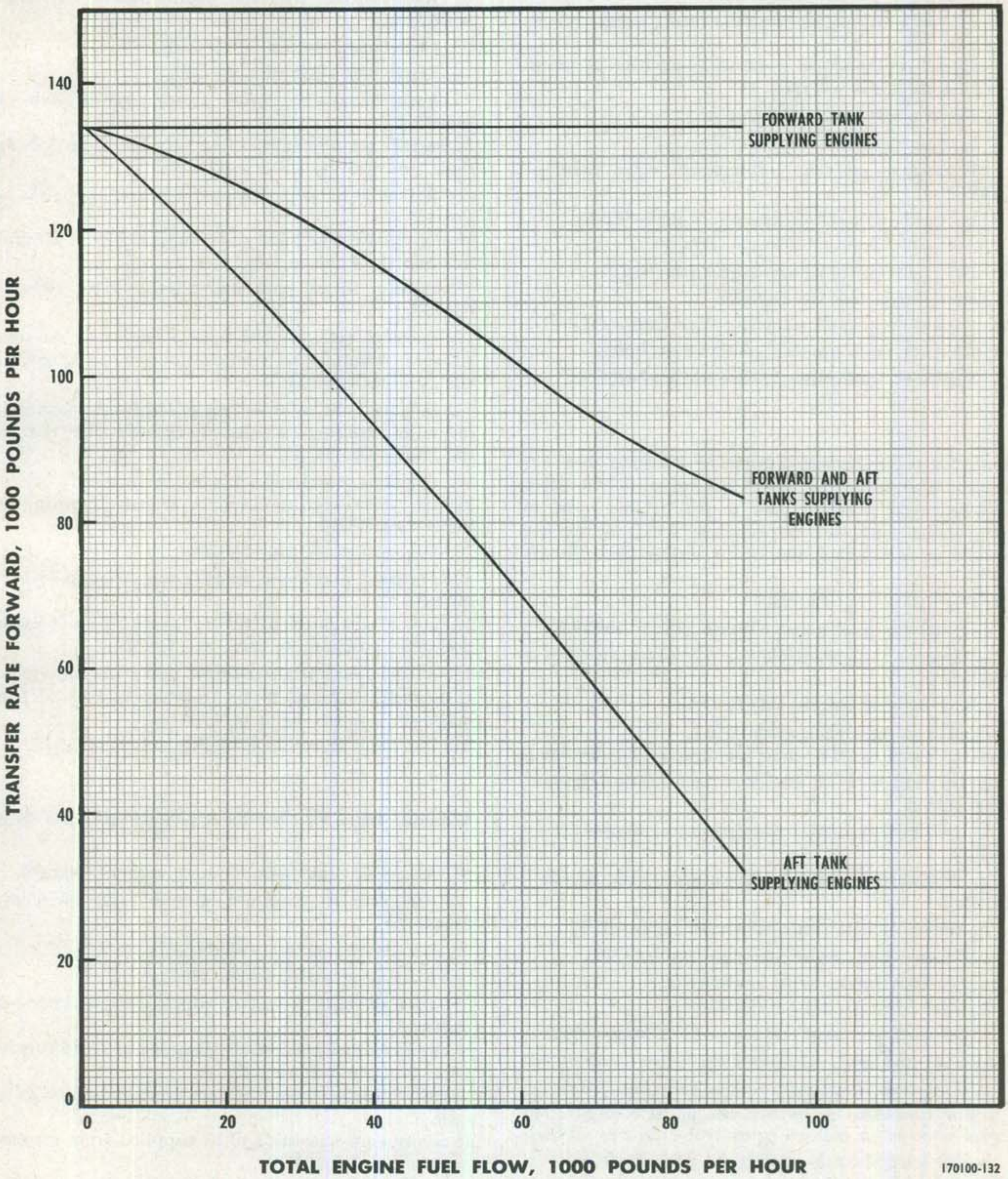

Figure 7-1. (Sheet 2 of 2)

2. Reservoir to manifold shutoff valve switches—NORMAL.

3. Forward tank to engine supply control knob—As required.
If engines are scheduled to be supplied from forward tank, position the knob to ON.

4. Aft tank to engine supply control knob—As required.
If engines are scheduled to be supplied from aft tank, position the knob to ON.

5. CG control switch—MANUAL.

6. Manual cg shift switch—OFF.

7. Balance to aft tank interconnect valve switch—CLOSE.

8. Forward tank refuel-scavenge knob—SCAV.

9. Aft tank refuel valve knob—REFUEL.

10. Balance tank refuel-scavenge knob—OFF.

11. Fuel dump switch—NORM.

12. Forward pod tank transfer-refuel knob—OFF.

13. Aft pod tank transfer-refuel knob—OFF.

14. Pod tank interconnect valve switch—CLOSE.

Transfer From Forward Tank to Balance and Aft Tanks. The following panel configuration transfers fuel from the forward tank to the balance tank. If the balance tank is full, or becomes full before the desired cg is attained, fuel will overflow into the aft tank.

1. For manual cg control:

a. Reservoir tank booster pump switch—NORM.

b. Reservoir to manifold shutoff valve switches—NORMAL.

c. CG control switch—MANUAL.

d. Manual cg shift switch—AFT.
Return switch to OFF when the desired cg is attained.

e. Forward tank to engine supply control knob—As required.

f. Aft tank to engine supply control knob—As required.

g. Balance to aft tank interconnect valve switch—CLOSE.

h. Forward tank refuel-scavenge knob—OFF.

i. Balance tank refuel-scavenge knob—OFF.

j. Aft tank refuel valve switch—OFF.

k. Fuel dump switch—NORM.

l. Forward pod tank transfer-refuel knob—OFF.

m. Aft pod tank refuel-transfer valve knob—OFF.

n. Pod tank interconnect valve switch—CLOSE.

2. For automatic cg control, the panel configuration is the same as for manual cg control except as follows:

a. CG selector knob—Select the desired aft cg.

b. Manual cg shift switch—OFF.

c. CG control switch—AUTO.

Transfer From Pod Tanks to Airplane Tanks. The following panel configuration transfers fuel from the pod tanks to the selected airplane tank or tanks as required to maintain the desired cg.

1. Reservoir tank booster pump switch—NORM.

2. Reservoir to manifold shutoff valve switches—NORMAL.

3. CG control switch—MANUAL.

4. Manual cg shift switch—OFF.

5. Forward tank to engine supply control knob—As required.
If engines are scheduled to be supplied from forward tank, position the knob to ON.

6. Aft tank to engine supply control knob—As required.
If engines are scheduled to be supplied from aft tank, position the knob to ON.

7. Balance to aft tank interconnect valve switch—CLOSE.

8. Forward tank refuel-scavenge knob—As required.
If fuel is scheduled to enter the forward tank, position the knob to REFUEL.

9. Balance tank refuel-scavenge knob—As required.
If fuel is scheduled to enter the balance tank, position the knob to REFUEL.

10. Aft tank refuel valve knob—As required.
If fuel is scheduled to enter the aft tank, position the knob to REFUEL.

11. Fuel dump switch—NORM.

12. Forward pod tank transfer-refuel knob—As required.
If fuel is scheduled to be transferred from forward pod tank, position the knob to TRANS.

13. Aft pod tank transfer-refuel knob—As required.
If fuel is scheduled to be transferred from aft pod tank, position the knob to TRANS.

14. Pod tank interconnect valve switch—CLOSE.

Transfer From Pod Aft Tank to Pod Forward Tank.

1. Reservoir tank booster pump switch—NORM.

2. Reservoir to manifold shutoff valve switches—NORMAL.

3. CG control switch—MANUAL.

4. Manual cg shift switch—OFF.

5. Forward tank to engine supply control knob—As required.
If engines are scheduled to be supplied from forward tank, position knob to ON.

6. Aft tank to engine supply control knob—As required.
If engines are scheduled to be supplied from aft tank, position knob to ON.

7. Balance to aft tank interconnect valve switch—CLOSE.

section VIII crew duties

TABLE OF CONTENTS.

Each flight crew member has alternate duties, other than primary functions, which must be performed to insure successful accomplishment of a mission. The pilot's primary duties are covered in Section II. The other crew members' duties are covered in this section.

CREW COORDINATION.

Prior to accomplishment of any of the following, verbal coordination between applicable crew members will be required when:

1. Changing fuel control settings.
2. A crew member goes off interphone or airplane oxygen system.
3. Autopilot is being engaged or disengaged.
4. Autopilot control of airplane is transferred between the navigator and pilot, or vertical reference (stable table) is changed.
5. Any electrical power source is changed.

COMMUNICATIONS.

The pilot will make the necessary calls for taxi instructions and will receive and acknowledge the ARTC clearance. He will also normally make the necessary calls to departure and approach control. The navigator and DSO will normally make the routine position reports, calls to GCI and RBS sites, and any other calls directed by the pilot. The DSO will normally make the necessary calls on the HF radio.

PILOT.

The pilot is the aircraft commander and is responsible for the airplane and crew. The successful accomplishment of the mission is of prime importance; in no instance, however, will the safety of the airplane or crew be compromised. The pilot is responsible for the issuance of instructions governing all phases of flight operation. In addition to his regular function, the pilot will perform the following:

Mission Preparation.

1. Attend general briefing.
2. Coordinate with other crew members on route charts, targets, items pertinent to individual crew procedures, and supervise the completion of required forms.

3. Complete and file Form 175.

4. Attend specialized briefings for air refueling, weather, and other pertinent information.

5. Complete latest information relative to flight to brief the crew at crew inspection.

Cruise.

1. Level off at predetermined altitude and establish appropriate power setting.

2. Monitor navigation to insure knowledge of airplane position at all times.

3. Check with DSO at regular intervals concerning aircraft performance, fuel transfer, gross weight and cg, and actual fuel consumption versus predicted.

4. Analyze incidents or discrepancies which necessitate change of flight plan and make appropriate decisions.

5. Monitor all engine and systems instruments periodically.

6. Insure that position reports and the required GCI, RBS and HF radio contacts are completed.

7. Direct oxygen and station checks at appropriate intervals.

Bomb Run.

1. Establish and maintain bomb run Mach No.

2. Perform required heading corrections as requested by navigator.

3. Zero steering error on PDI at navigator's request and transfer control of the airplane to the navigator until after bomb release.

4. Call time-to-go at 300, 200, 100, 60, 30, 20, 10 & 0 second intervals. For RBS—request "Tone On" at 20 seconds time to go.

After Bomb Release.

Resume control of aircraft and at appropriate time, zero steering error on PDI.

NAVIGATOR.

The navigator must work continuously with the pilot to insure successful completion of the mission.

Mission Preparation.

1. Attend general briefing.

2. Map and chart information.

a. Select maps and charts of suitable scale and projection as dictated by the requirements of the mission. Additional maps should be procured to provide coverage for emergency changes in flight plan.

b. Coordinates of prominent radar returns along the route will be noted on a navigation chart for ready use by the navigator for fixing.

c. Points or areas for altitude measurement will be selected and the terrain elevation noted on a navigation chart.

d. Point for performing bombing malfunction check will be noted on a navigation chart.

e. Acceleration point will be noted on the chart.

3. Accomplish target study with pilot and DSO on assigned target and compute emergency bombing data. Other navigation and bombing mission planning will be completed as required on the mission flight plan.

4. Attend specialized briefings when applicable.

5. Coordinate with A&E personnel to determine the maintenance history and condition of the navigation system. Complete operational preflight if required.

Cruise.

1. After reaching cruise altitude, request pilot to zero steering error on PDI, and engage automatic steering.

2. Coordinate with pilot periodically on airplane position, heading, and groundspeed.

3. Request airspeed runs and steering changes, when necessary.

Air Refueling.

Monitor airplane position during air refueling by use of the primary navigation system. Turn search radar off prior to contact.

DSO.

The primary responsibility of the DSO is the utilization of defensive systems to provide electronic defense against ground based and airborne electronic devices and active fire control against airborne interceptors which threaten the safety of the aircraft and the completion of its mission. The secondary responsibility of the DSO is to monitor aircraft performance and advise the pilot on fuel management, power settings, fuel consumption, and aircraft gross weight and cg.

Mission Preparation.

1. Attend general briefing.

2. Accomplish study of all intelligence data necessary

for the accomplishment of the DECM and fire control portion of the mission.

3. Accomplish flight planning in coordination with the pilot and navigator.

4. Accomplish weight and balance portion of mission planning.

5. Attend specialized briefing when applicable.

6. Coordinate with armament and electronics personnel to determine history and status of DECM and MD-7 equipment.

Cruise.

1. Advise pilot as necessary concerning performance, fuel configuration, gross weight, cg, and fuel consumption.

2. Coordinate on communication procedures as necessary.

NAVIGATOR'S CHECK LIST.

STATIONS INSPECTION.

Note

The procedures for control and monitoring a weapon are not included in this checklist.

1. Stations inspection—Completed.
Attend stations inspection conducted by the pilot as outlined in Section II. Equipment display is shown in figure 2-1.

POWER-OFF INTERIOR INSPECTION.

1. Canopy lock—Installed.
Check that the canopy lock is installed and that canopy actuator warning pin is not visible.

WARNING

The red pin, when visible, indicates that the canopy actuator ballistics charge has been fired, thus making ballistic canopy jettisoning impossible.

2. Ejection seat safety pins (3)—Installed.
Before entering the airplane, check that safety pins are installed in both seat handgrips and in the canopy jettison handle.

3. Canopy actuator and seal—Check.
Check actuator condition, and check the canopy seal properly seated and the inflation tube connected.

4. Liquid container—Check.
Check liquid container for servicing and operation of the flow valve.

5. Canopy emergency release handle—Closed.

6. Exterior emergency canopy jettison access door—Secure.

7. Left and right windows—Check.
Check for cleanliness, cracks and general condition.

8. Ejection seat, survival kit and parachute—Check.

a. Ejection seat:

(1) Check that pins are removed from 6 initiators (2 lower left arm rest, 2 lower right arm rest, 1 lower left side fuselage behind seat, and 1 middle right rear of seat).

(2) Check that oxygen and radio personal leads are connected and secure.

(3) Check operation of shoulder harness in automatic and manual locked positions.

(4) Check general condition of safety belt, shoulder harness, safety belt tiedown strap, arm restraints, leg restraints, and knee strap.

(5) Check quick disconnect fittings connected underneath seat.

b. Survival kit:

(1) Check parachute attachment straps securely attached in kit release fittings and attached to parachute.

Note

The attachment straps should not be connected to the parachute over the safety belt or routed between the safety belt and the safety belt release hose. Improper connection could result in not separating from the seat or in the lap belt initiator not firing.

(2) Check the harness and kit release handle stowed down.

9. First aid, battle dressing and blood plasma kits—Stowed.

10. Escape rope—Check.
Check that rope is connected and secure.

11. Fire extinguisher—Stowed and serviced.

12. Relief container—Empty.

13. High voltage d-c power panel—Check.
Check the high voltage power panel for blown fuses and presence of adequate spares.

14. Canopy seal control—UNSEALED.

15. Security of navigation units—Check.

Check security of all components of the navigation unit, auxiliary panels, and inflight printer and control unit.

16. Auxiliary control panel:

a. Function selector knob—GYRO.

b. Search transmitter switch—OFF.

c. Doppler transmitter switch—OFF.

d. Doppler return switch—LAND.

e. Magnetic variation knob—Local value.

f. Altimeter calibrate switch—OFF.

g. Sea drift indicators—Set to zero.

17. Inflight printer power switch—OFF.

18. Pod release panel:

a. Pod release switch—OFF.

b. Pod safety lockpin release handle—In and horizontal.

c. Pod emergency release handle—In and horizontal.

19. Heading reference selector knob—FLUX VALVE.

20. Aimpoint selector knob—FIX.

21. Malfunction control panel:

a. Astrotracker malfunction switch—OFF.

b. Vertical reference selector switch—NORMAL.

c. Sight malfunction switch—OFF.

d. Machmeter malfunction switch—OFF.

e. Heading integrator malfunction switch—OFF.

f. Search antenna malfunction switch—OFF.

g. Altitude malfunction switch—OFF.

h. Heading and navigation malfunction knob—OFF.

i. Servo malfunction switch—OFF.

j. Airspeed malfunction switch—OFF.

k. Airspeed calibration switch—NORMAL.

l. Airspeed computer malfunction knob—Aligned with index.

m. Auto steering switch—OFF.

22. Navigation power interlock switch—NORMAL.

Note

Use the OVERRIDE position for instrument or night flight.

23. Search radar indicator panel:

a. Search radar mode selector knob—GRD.

b. Crosshair brightness knob—Fully CCW.

c. Display intensity knob—Fully CCW.

d. Contrast/threshold selector knob—H-1.

e. Range and magnification selector knob—30/10.

f. Manual/automatic contrast/threshold switch—AUTO.

g. Manual/automatic receiver tuning switch—AFC.

h. Map screen brightness selector knob—OFF.

24. Navigation control panel:

a. Polar/non-polar switch—NON-POLAR (unless entry into polar regions is anticipated).

b. Coordinate reference switch—TRUE.

c. True present position indicators—Manually set to within 3° of fixpoint position indicators.

25. Bombing control panel:

a. Pod pitot tube switch—RETRACT.

b. Auto release switch—OFF.

c. IBDA switch—OFF.

d. RBS switch—OFF.

e. All malfunction controls—OFF or NORM.

26. Sighting and test panel—Checked.

a. Fixpoint selector knob—PRESENT POSITION.

CAUTION

Fixpoint position indicators and present position indicators must never differ by more than 3 degrees.

b. Malfunction test knobs—All at zero.

c. Automatic radar photography switch—OFF.

27. Tracking and flight controller selector knob—OFF.

28. Report to pilot—Navigator's power-off check complete.

POWER-ON INTERIOR INSPECTION.

The check list items fully enclosed in parenthesis will be called for by the pilot and the indicated response will be made at that time. Placement of these items provides an indication of sequence used by the pilot but does not show any sequence for action by the navigator who may proceed with other check list items until the parenthesized items are called for by the pilot.

Note

The first action by the pilot on his "Power-on Interior Inspection" will be a check of the bailout warning system. This will be the signal to the navigator to prepare to respond to check list items.

(1. Bailout warning lamp—Checked.)

Acknowledge bailout lamp operation to the pilot and relay the acknowledgment by the DSO if necessary.

(2. Oxygen and interphone—On call, on normal, oxygen check complete.)

a. Oxygen pressure 70 to 110 psi.

b. Diluter lever NORMAL OXYGEN and check regulator.

Place diluter lever to NORMAL OXYGEN and check regulator breathing valve by blowing gently into end of seat hose. There should be resistance to blowing. Little or no resistance indicates leakage or faulty operation.

c. Place diluter lever to 100% OXYGEN and perform check as in preceding step.

d. Connect oxygen mask and seat hoses to manifold block.

e. Oxygen supply lever ON.

f. Check system flow and mask leakage.

With the mask fitted snugly to the face, breathe normally and conduct the following check:

(1) Observe flow indicator and note that shutter moves with each breathing cycle.

(2) Place emergency lever to EMERGENCY and notice a continuous flow with noticeable pressure increase in the mask.

(3) Place emergency lever to TEST MASK and hold.

A continuous flow and positive pressure increase should be felt in the mask. Hold breath to determine that there is no leakage around the mask. Release the emergency lever and note that positive pressure ceases.

(4) Check that oxygen pressure reads 70 to 110 psi after the check.

g. Diluter lever NORMAL OXYGEN.

h. Supply lever OFF.

i. Check seat hose quick-disconnect fitting at the manifold block for approximately 10 to 15 pounds pull.

(3. Command radio—Checked.)

Rotate the function selector to COMM and call the tower for a radio check, then return selector to INTER.

4. Seat—Adjust.

5. Interior lights—Check.

Turn ON and check all interior lights, then turn them OFF. Check for spare bulbs and fuses.

6. Mask de-fog—OFF.

7. Navigation isolation switches—ON.

EXTERIOR INSPECTION.

There is no specified exterior inspection for the navigator. The items of equipment peculiar to navigator functions are checked visually by the pilot as part of his exterior Inspection.

BEFORE STARTING ENGINES.

(1. Personal gear—Survival kit attached, safety belt, shoulder harness, safety belt tie-down strap and arm restraints, and both parachute lanyards connected.)

a. Each crew member connects personal gear and harness as shown in figure 2-4.

WARNING

Operational usage of the leg restraints and knee belt has not been fully determined. Until such information is available, crew members will utilize these devices as specified in the operations briefing prior to each mission.

(2. Mask, bailout bottle, and mike cord—Oxygen hoses and mike cord connected.)

Note

The manifold block is normally attached to the right side of the parachute harness and should be checked for security prior to connecting hoses.

a. Plug seat hose into manifold block on parachute harness and listen for click.

b. Plug mask hose connector into manifold block and twist to secure bayonet fitting.

c. Route bailout bottle tubing underneath parachute harness and connect bayonet fitting to manifold block.

d. Plug mike cord into receptacle.

(3. Oxygen—Oxygen check complete.)

a. Oxygen supply lever ON and check system pressure 70 to 110 psi.

b. Check oxygen flow blinker and hose connection.

(4. Ejection seat and initiator safety pins—Removed and stowed.)

(5. Canopy—Closed and latched.)

Close canopy when instructed and report when the latching mechanism indicator flags are out of sight.

WARNING

Each canopy latching mechanism indicator flag must be out of sight behind its shield to indicate positive locking of the canopy.

(6. Canopy seal control—SEALED.)

7. Function selector knob—STANDBY.

8. Erect indicator lamp—Lighted.

Check that erect indicator lamp lights in approximately 20 seconds, indicating table erection in progress.

9. Plate power—Checked.

Check presence of plate power, approximately 27 seconds after going to STANDBY, by movement of heading and groundspeed indicators.

10. Destination position indicators—Set.

Set coordinates of destination or first steering point into destination position indicators.

11. True present position indicators—Set.

Set coordinates of takeoff Base into true present position indicators.

12. Transverse present position indicators—Set.

Set true coordinates of takeoff Base into transverse present position indicators if no polar flight is planned; set in transverse coordinates if polar flight is planned.

13. Offset distance and elevation indicators—Set.

Set in precomputed offset distance and elevation of anticipated offset points.

14. Storage fixpoint indicators—Set.

Set in coordinates and elevation of anticipated stored fixpoints. Set target coordinates in fixpoint 2.

15. Polar/non-polar switch—Set.

Set switch at NON-POLAR if no polar flight is planned; set at POLAR if polar flight is planned.

16. Coordinate reference switch—TRUE or TRANSVERSE (as applicable).

Position the switch to TRUE if below 70°N. Lat. or to TRANSVERSE if above 70°N. Lat.

17. Fixpoint position and elevation indicators—Set as required.

If first fixpoint is less than 3 degrees from base this data may be set in, with fixpoint selector knob at MANUAL. If more than 3 degrees, set same as present position indicators, with fixpoint selector knob at PRESENT POSITION.

18. Fixpoint selector knob—Set as required.

Set at PRESENT POSITION unless first fixpoint is set in fixpoint indicators; if so, set at MANUAL.

19. Astro filter switch—Set.

20. GHA indicator—As required.

21. SHA indicator—As required.

Set the SHA indicator for star if the GHA indicator indicates the GHA of Aries. However, if the GHA of the sun is indicated, leave the SHA indicator at zero.

22. Star declination indicator—As required.

23. Heading reference selector knob—ASTRO, if possible.

Set at ASTRO if possible; if not, use FLUX VALVE.

24. Erect indicator lamp—Out.

25. Vertical error indicator lamp—Out.

26. Attitude indicator—Normal (both tables).

27. Inflight printer—On and set.

Set TIID, turn inflight printer power switch ON, and set printing interval.

BEFORE TAXIING.

1. Function selector knob—TAXI & TAKEOFF.
2. Groundspeed—Check for zero.
3. True heading—Check.

(4. Navigator and DSO—Ready to taxi.)

BEFORE LINE-UP.

1. True heading—Checked.
2. Groundspeed—Checked.
3. Present position—Checked.
4. Altitude above sea level indicator—Checked.
5. Auto steering switch—ON.
6. Malfunction test knob "A"—3.
7. Doppler transmitter switch—ON.
8. Search transmitter switch—ON.
9. Airspeed-inertial switch—NORMAL.

(10. Navigator and DSO—Ready for takeoff.)

AFTER TAKEOFF.

1. Radio altimeter switch—ON (at 500 feet).

(2. Parachute zero delay lanyard—Disconnected and stowed.)

3. Function selector knob—NAVIGATION, after reaching 250 knots TAS.

Note

A stored fixpoint can be made good by turning the fixpoint selector knob to the desired number and setting the function selector knob at BOMB.

(4. Oxygen and station check—Completed.)

During the climb, at approximately 12,000 feet and at level-off the pilot will request an oxygen and station check. During cruise the crew will accomplish these checks at hourly intervals. Sequence for report will be pilot, navigator and DSO.

5. Navigation system indicators—Monitor and compare with expected progress.

LEVEL-OFF.

1. Doppler lock—Check.

Check Doppler lock with malfunction test knob positions A3, A4, A5, B3 and B4. If test good lamp lights at all 5 positions, turn knobs to zero. If test bad lamp lights, turn Doppler transmitter OFF and airspeed-inertial switch to AIRSPEED INERTIAL.

2. Function switch—NAVIGATION.

3. Altitude calibration—Performed.

Note

An altitude calibration should be accomplished: (1) after each airspeed change of more than 300 knots; (2) after an altitude change of more than 5000 feet; (3) not more than 400 nautical miles prior to each fixpoint.

a. While over terrain of known elevation, turn altimeter transmitter switch to CALIBRATE (this switch must have been in the ON position for at least 4 seconds) while setting terrain elevation on fixpoint position elevation indicator with altitude correction knob.

b. Turn altimeter transmitter switch to the OFF or ON position, as desired.

Note

If the warning lamp in the altitude above terrain indicator lights during this procedure, indicating periodic automatic self-calibration of the radio altimeter, the procedure must be repeated.

4. Airspeed calibration—Performed.

a. Request pilot to make 15-degree airspeed turn.

b. Place airspeed calibration switch to CAL.

c. After flying a minimum of 15 seconds on new heading, request pilot to zero on PDI.

d. Place airspeed calibration switch to NORMAL.

5. Radar position fix—Performed.

a. Place map screen brightness selector knob to any numbered position and adjust for desired brightness.

b. Turn map screen film drive knob to bring radar map of fixpoint area into view.

c. Turn aimpoint selector knob to FIX.

d. Set fixpoint altitude above sea level on fixpoint position elevation indicator.

e. Monitor present position indicators. When present latitude is within 200 minutes of fixpoint latitude and present longitude is within 300 minutes of fixpoint longitude, turn fixpoint selector knob to MANUAL.

f. Set fixpoint latitude and longitude on fixpoint position indicators.

g. Adjust contrast/threshold, variable threshold, crosshairs, and intensity for optimum indicator presentation. Progressively increase range/magnification setting to 200/160.

h. Compare radar image with map comparator screen and identify fixpoint. Fixpoint acquisition should occur at a range of about 80 nautical miles.

i. Monitor crosshair distance indication, and as aircraft closes on fixpoint, turn range and magnification selector knob progressively to decrease range and increase magnification.

j. If crosshairs do not coincide with fixpoint, turn tracking and flight controller selector knob to PRES POS CORR, depress engaging switch, center crosshairs with tracking and flight control stick, and release engaging switch. True present position indicators now show corrected latitude and longitude.

k. Turn fixpoint selector knob to PRESENT POSITION.

l. Turn search transmitter switch to OFF, if desired.

m. Turn tracking and flight controller selector knob to OFF.

n. Turn map screen brightness selector knob to OFF.

6. Heading reference selector knob—ASTRO, if possible.

Use ASTRO heading reference if conditions permit. If not, use FREE GYRO or FLUX VALVE.

7. Navigation system steering—On.

Request pilot to zero PDI and set up autopilot.

CRUISE.

1. Present position—Monitor.

Check present position progress against time, groundspeed, and true heading. Compare search radar indication with map comparator; correct present position as necessary.

2. Steering point—Check and change.

Change to new steering point before present position becomes closer than 100 miles from present steering point.

3. Star reference change—Perform.

Check flight progress against mission profile. When present position indicators reach area to change star reference, proceed as follows:

a. Turn heading reference selector knob to FREE GYRO.

b. Set SHA of new star on SHA indicator.

c. Set declination of new star on star declination indicator.

d. Check astro filter switch for proper position for conditions.

e. Turn heading reference selector knob to ASTRO.

BEFORE ACCELERATION.

1. Ballistic data—Set.

Set ballistic wind, trail, burst altitude, and time of fall on bombing control panel indicators.

2. Pod and ballistic malfunction check:

a. Malfunction self test, A1 and A2—Check for test good lights.

b. D2 and D6 test—Check for test good lights.

c. Ballistic malfunction test knob, all positions—Check for test good lights.

Note

The REL ON position should give a test bad light, followed, after a moment's delay, by a test good light. All remedies for test bad lights, except L RES, consist of placing the corresponding malfunction switch to the MALF position. The L RES remedy consists of turning the servo malfunction selector knob to 6, and the servo malfunction switch to ON. If the spare servo is in use, proceed as follows: Set trail indicator at zero. Place trail-time-of-fall malfunction switch at MALF. Set time of fall from the equation $T_F - \frac{V_A}{L}$, where T_F is time of fall from ballistics table, L is trail from ballistics table, and V_A is TAS expected at release. Set ballistic wind at 0.8 north component and 0.8 east component, respectively, from the equations: north component = groundspeed cosine groundtrack — true airspeed cosine true heading, and, east component = groundspeed sine groundtrack — true airspeed sine true heading.

3. Acceleration point—Notify pilot.

AFTER ACCELERATION.

1. Destination position indicators—Set.
Set target latitude and longitude on destination position indicators.
2. Pre-bomb run calibrations—Perform.
After reaching target dash altitude and Mach No., calibrate airspeed and altitude.
3. Bomb run altitude slope—Computed.
4. Ballistic wind indicators—Check for zero.
5. Check cg within limits.
6. Safety check:
a. Pod safety lockpin release handle—In.
b. Auto release switch—OFF.

BOMB RUN. (RBS)

1. Fixpoint selector knob—Set.
2. Autopilot heading control mode switch—OFF, when within 150 miles of target.
3. Function selector knob—BOMB.
4. Request pilot to zero PDI.
5. Autopilot heading control mode switch—NAV.
6. If conditions permit, make a radar fix on the target, leaving fixpoint selector knob on selected position until after "release."
7. Pilot calls TG—300, 200, 100, 60, 30, and 20.
8. RBS tone—ON, at 20 seconds TG.
9. If automatic (tone) "release" fails, change UHF channel to interrupt tone.

AFTER BOMB RELEASE.

1. Autopilot heading control mode switch—OFF.
2. Destination position indicators—Set.
Set coordinates of base or first return steering point into destination position indicators.
3. Function selector knob—NAVIGATION.
4. Request pilot to zero PDI.
5. Autopilot heading control mode switch—ON.
6. Auto release switch—OFF.

DESCENT AND BEFORE LANDING.

1. Autopilot heading switch—OFF.
2. Jet penetration and GCA or ILS—Monitor as required.
(3. Parachute zero delay lanyard—Connected.)
Connect parachute zero delay lanyard to rip cord D-ring when instructed by pilot. This provides "one and zero" escape capability during approach and landing.
(4. Navigator and DSO—Ready for landing.)
5. Radio altimeter switch OFF (at 500 feet).

AFTER LANDING.

1. Inflight printer power switch—OFF.
2. Function selector knob—STANDBY.
(3. Unnecessary electrical and electronic equipment—OFF.)
De-energize all electrical and electronic equipment not required.

ENGINE SHUTDOWN.

1. Function selector knob—GYRO or OFF.
Turn to GYRO or OFF while air conditioning is still operating.
(2. Canopy seal control—UNSEALED.)
(3. Canopies—OPEN.)
Open canopy at pilot's request after his is open.
4. All switches—OFF or SAFE.

BEFORE LEAVING AIRPLANE.

1. Ejection seat safety pins installed.

Install safety pins at each handgrip and canopy jettison handle.

2. Canopy lock installed.
3. Oxygen system 100% and OFF.
4. All switches OFF.

Check that all switches are OFF or positioned properly for leaving the airplane.

NAVIGATION SYSTEM MALFUNCTION PROCEDURES.

Procedures for inflight trouble shooting of the primary navigation system are presented in the following tables. The malfunctions are divided into two types: direct and suspected. Direct malfunctions are detected by the lighting of an indicator lamp, by an abnormal indication, or by the lack of an indication. The direct malfunctions have direct remedies, accomplished without the use of the malfunction test knobs and the test bad and test good lamps. Suspected malfunctions are detected by the use of the circuits controlled by the malfunction test knobs and the test bad and test good lamps. Remedies for suspected malfunctions are listed by knob letter and number. In any case where a direct remedy fails, a complete suspected malfunction test should be made. A suspected malfunction test is performed by turning each malfunction test knob through all its numbered positions. These knobs must be cycled through in numerical order, starting with knob "A".

All information deleted from page 8-10.

A few seconds must be allowed in each knob position for test circuit stabilization. If the test good lamp lights and remains lighted, the the knob should be advanced to the next position (with exceptions noted). If the test bad lamp lights and remains lighted, the procedure for remedy should be performed before advancing to the next position (except as noted). The function selector knob will be in the NAVIGATION position unless otherwise noted.

DIRECT MALFUNCTIONS AND REMEDIES.

Vertical Error Lamp Lighted.

1. Place the vertical reference selector switch to AIR ERECT. If operation improves, turn to MALF; if not, return to NORMAL.

WARNING

Airplane must be flown manually when changing tables. Do not attempt use of autopilot when selected table is not fully erect.

True Airspeed Indication Drops to Zero During True Airspeed Calibration Run.

1. Airspeed computer malfunction switch—MALF.
2. Airspeed computer malfunction knob—Aligned with index mark.
3. True airspeed indicator—Check.

Check true airspeed indication with pilot's airspeed indicator. If in approximate agreement, leave airspeed computer malfunction switch on MALF, and make all airspeed calibrations manually. If not in approximate agreement, position airspeed computer malfunction switch OFF, machmeter malfunction switch to MALF, and adjust airspeed computer malfunction knob until true airspeed indication agrees with pilot's airspeed indicator. If true airspeed indication drops to zero during subsequent true airspeed calibration runs, adjust airspeed computer malfunction knob until true airspeed indicator shows some indication.

Star Lost Lamp Lighted Continuously.

1. Check star data set in astro control panel; reset any data found to be erroneous.
2. If star lost lamp remains lighted, place astrotracker malfunction switch to MALF.

Search Radar Indicator Presentation Smeared.

1. Adjust contrast / threshold, variable threshold, crosshair, and intensity control knobs.
2. If presentation does not improve, place search antenna malfunction switch to MALF. Aircraft roll will cause a jittered presentation when this switch is in MALF.

Search Radar Indicator Presentation Disappears.

1. Manual/automatic frequency control switch—MFC.
2. Adjust manual tuning knob to return presentation.

Programmed Video Settings Not Changing Properly During Automatic Radar Photography.

1. Contrast/threshold switch—MAN.
2. Adjust contrast/threshold and variable threshold knobs for desired settings.

Camera Malfunction Lamp Lighted.

Camera is malfunctioning or out of film. No inflight correction is provided.

SUSPECTED MALFUNCTION TEST PROCEDURE.

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
A-1 and A-2	Detection system.	1. Discontinue test. Malfunction detection system has failed.

Note

Before rotating the "A" knob to the 3, 4, and 5 positions, the Doppler transmitter switch must be in the ON position.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
A-3, A-4, A-5	Doppler radar.	1. Doppler transmitter switch—OFF. 2. Airspeed-inertial switch—AIRSPEED INERTIAL. 3. Make celestial or radar position fixes as often as possible. 4. Correct groundspeed at 15-minute intervals.
A-6, A-7, A-8, A-9	Pitch and roll synchro excitation.	1. Auto steering switch—OFF. 2. Place vertical reference selector switch to AIR ERECT. If operation improves, turn auto steering switch ON; if not, return to NORMAL, request manual flight, and monitor table for possible return to auto steering. **WARNING** Airplane must be in manual flight mode when switching tables.
A-10, A-11, B-1, B-2 **Note** Positions 12 and 13 of knob "A" are inoperative. However, it must be rotated to 12 and 13; then returned to O before continuing test with knob "B".	Stabilization unit pitch and roll synchro.	Use same remedial procedures as for A-6 through A-9.
Note Before moving the "B" knob to the 3 and 4 positions, the Doppler transmitter switch must be in the ON position. B-3 B-4	Doppler data converter and Doppler stabilization computer pitch and roll servo.	1. Doppler transmitter switch—OFF. 2. Airspeed-inertial switch—AIRSPEED INERTIAL. 3. Make position fixes as often as possible. 4. Correct groundspeed at 15-minute intervals.
B-5	Relative table heading shaft resolver and synchro.	1. Auto steering switch—OFF.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
B-5 (Continued)	Relative table heading shaft resolver and synchro. (Continued)	2. Monitor heading with astrotracker. If this is not possible, place heading reference selector switch to FREE GYRO. Do not use FLUX VALVE position. 3. Servo malfunction selector knob—2. 4. Servo malfunction switch—ON. 5. Make position fix as soon as possible. 6. Ballistic wind indicators—zero. 7. Airspeed computer malfunction switch —ON. 8. Perform manual true airspeed calibration. 9. Airspeed computer malfunction switch —MALF. 10. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed. 11. Auto steering switch—ON.
Note For the following test, the different latitude conditions are identified with encircled numbers.		
B-6 ❶ Latitude *above* 65°N. Place polar/nonpolar switch to NON/POLAR and coordinate reference switch to TRUE.	"A" accelerometer axis-to-north angle synchros and groundspeed resolver.	1. Auto steering switch—OFF. 2. Heading and navigation malfunction knob—POSITION & HEADING. 3. Check true heading indication with pilot's compass (making allowance for local variation). Correct true heading indicator, if necessary, by turning heading reference selector knob to MAN SLEW+ or MAN SLEW— as needed. 4. Calibrate altitude. 5. Make position fix as soon as possible. 6. Auto steering switch—ON.
❷ Latitude *below* 65°N. Place polar/non-polar switch to POLAR and coordinate reference switch to TRUE.		1. Auto steering switch—OFF. 2. Set transverse present position indicators at best known values of true latitude and longitude. 3. Heading and navigation malfunction knob—POSITION & HEADING. 4. Check true heading indication with pilot's compass (making allowance for local variation). Correct true heading indicator, if necessary, by turning heading reference selector knob to MAN SLEW+ or MAN SLEW— as needed. 5. Calibrate altitude. 6. Make position fix as soon as possible. 7. Auto steering switch—ON.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
❷ Latitude *below* 65°N. Place polar/non-polar switch to POLAR and coordinate reference switch to TRUE. (Continued)	"A" accelerometer axis-to-north angle synchros and groundspeed resolver. (Continued)	8. When changing to transverse coordinate operation, place heading and navigation malfunction knob to OFF. Set transverse present position indicators at best known values of transverse latitude and longitude. Compute heading as follows: aircraft heading with respect to transverse north=true aircraft heading (relative to north) minus the angle between transverse north and true north. Set in this computed heading at the true heading indicator.
❸ Latitude *between* 65° and 70°N. Place polar/non-polar switch switch to POLAR and coordinate reference switch to TRUE.		1. Auto steering switch—OFF. 2. Coordinate reference switch—TRANSVERSE. 3. Check true heading indication for correct value of transverse heading. Compute heading as follows: aircraft heading with respect to transverse north=true aircraft heading (relative to north) minus the angle between transverse north and true north. Correct true heading indicator, if necessary, by turning heading reference selector switch to MAN SLEW + or MAN SLEW — as needed. 4. Heading reference selector knob to ASTRO or FREE GYRO. Do not use FLUX VALVE position. 5. Calibrate altitude. 6. Make position fix as soon as possible. 7. Auto steering switch—ON.
❹ Latitude *above* 75°N. Place polar/non-polar switch to POLAR and coordinate reference switch to TRANSVERSE.		1. Auto steering switch—OFF. 2. Set true present position indicators at best known values of transverse latitude and longitude. 3. Heading and navigation malfunction knob to POSITION & HEADING. 4. Check true heading indication for correct value of transverse heading. Compute heading as follows: aircraft heading with respect to transverse north=true aircraft heading (relative to north) minus the angle between transverse north and true north. Correct true heading indicator, if necessary, by placing heading reference selector switch to MAN SLEW + or MAN SLEW— as needed. 5. Heading reference selector knob to ASTRO or FREE GYRO. Do not use FLUX VALVE position.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
❹ Latitude *above* 75°N. Place polar/non-polar switch to POLAR and coordinate reference switch to TRANSVERSE. (Continued)	"A" accelerometer axis-to-north angle synchros and groundspeed resolver. (Continued)	6. Calibrate altitude. 7. Make position fix as soon as possible. 8. Auto steering switch—ON. 9. When changing to true coordinate operation, position heading and navigation malfunction knob to OFF. Set true present position indicators at best known values of true latitude and longitude. Correct true heading indication if necessary, by turning heading reference selector knob to MAN SLEW+ or MAN SLEW— as needed.
❺ Latitude *between* 70° and 75°N. Place polar/non-polar switch to POLAR and coordinate reference switch to TRANSVERSE.		1. Auto steering switch—OFF. 2. Coordinate reference switch—TRUE. 3. Check true heading indication with pilot's compass, making allowance for local variation. Correct true heading indicator, if necessary, by turning heading reference selector switch to MAN SLEW + or MAN SLEW— as needed. 4. Calibrate altitude as soon as possible. Refer to Procedure 10. 5. Make position fix as soon as possible. 6. Auto steering switch—ON.
B-7	Relative table heading shaft amplifier, motor and differential generator.	1. Auto steering switch—OFF. 2. Monitor heading with astrotracker. If this is not possible, place heading reference selector knob to FREE GYRO. Do not use FLUX VALVE position. 3. Servo malfunction selector knob—2. 4. Servo malfunction switch—ON. 5. Make position fix as soon as possible. 6. Ballistic wind indicators—zero. 7. Airspeed computer malfunction switch—ON. 8. Perform manual true airspeed calibration. 9. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed. 10. Auto steering switch—ON.
B-8	Stabilization unit relative heading shaft synchro.	1. Auto steering switch—OFF. 2. Vertical reference selector switch—AIR ERECT. If operation improves, turn to MALF; if not, return to NORMAL.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
B-8 (Continued)	Stabilization unit relative heading shaft synchro. (Continued)	**WARNING** Airplane must be in manual flight mode when switching tables. 3. Make position fix as soon as possible. 4. Auto steering switch—ON.
B-9	Relative table heading shaft groundspeed resolver.	1. Ballistic wind indicators—zero. 2. Airspeed computer malfunction switch—ON. 3. Perform manual true airspeed calibration. 4. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed. 5. Disregard test lamp indications on D-2 and D-4. **Note** The test bad lamp will remain lighted, even after remedial action.
B-10	"A" accelerometer axis-to-north-angle shaft earth rate resolver.	1. Heading and navigation malfunction knob—EARTH RATE. 2. Disregard transverse present position indicators if operating in true coordinate zone.
B-11 **Note** Positions 12 and 13 of knob "B" are inoperative. The "B" knob must be turned from 13 to 0 before continuing test with "C" knob.	"A" accelerometer axis-to-north-angle integrator.	1. Heading integrator malfunction switch—MALF.
Note For the following test, the different latitude conditions are identified with encircled numbers.		
C-1 The five different latitude conditions listed for B-6 are applicable for C-1.	True or transverse latitude integrator.	Use the same remedial procedures as listed for B-6 as related to the respective latitude conditions.
C-2 See B-6 for latitude conditions.	True or transverse longitude rate resolver.	Use remedial procedures listed for B-6.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
C-3 See B-6 for latitude conditions.	True or transverse longitude integrator.	Use remedial procedures listed for B-6.
C-4 and C-5 See B-6 for latitude conditions.	True or transverse latitude and longitude synchro excitation.	Use remedial procedures listed for B-6.
C-6 and C-7 See B-6 for latitude conditions.	True or transverse latitude and longitude synchro transmitter.	Use remedial procedures listed for B-6.
C-8	Latitude earth rate resolver.	1. Heading and navigation malfunction knob—EARTH RATE. 2. Disregard transverse present position indicators if operating in true coordinate zone. 3. When changing to transverse coordinate operation, place heading and navigation malfunction knob to POSITION & HEADING, and set transverse latitude and longitude on the present position indicators.
C-9	True or transverse latitude—"B" angle resolver.	**Operating In Transverse Coordinate Zone.** 1. Heading and navigation malfunction knob to EARTH RATE. 2. Do not use POSITION & HEADING position at any time. **Operating In True Coordinate Zone.** 1. Disregard transverse present position indicators. 2. Do not use EARTH RATE position of heading and navigation malfunction knob. 3. When changing to transverse coordinate operation, turn heading and navigation malfunction knob to OFF.
C-10	True or transverse longitude—"B" angle resolver.	**Operating In Transverse Coordinate Zone.** 1. Heading and navigation malfunction knob to EARTH RATE. **Operating In True Coordinate Zone.** 1. Disregard transverse present position indicators. 2. When changing to transverse coordinate operation, place heading and navigation malfunction knob to OFF.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
C-11	"B" angle servo null.	**Operating In True Coordinate Zone.** 1. Disregard transverse present position indicators. 2. Turn heading and navigation malfunction knob to OFF. 3. When changing to transverse coordinate operation, turn heading and navigation malfunction knob to POSITION & HEADING.
Note Positions 12 and 13 of knob "C" are inoperative. The knob must be turned from 13 to 0 before continuing test with knob "D."		**Operating In Transverse Coordinate Zone.** 1. Do not use FLUX VALVE position of heading reference selector knob. 2. Disregard true present position indicators.
Note Before turning knob "D" to the 1 position, the Doppler transmitter switch must be in the ON position.		
D-1	Stabilization unit output velocity	1. Auto steering switch—OFF. 2. Vertical reference selector switch—AIR ERECT. If operation improves, turn to MALF; if not, return to NORMAL. **WARNING** Airplane must be in manual flight mode when switching tables. 3. Make position fix as soon as possible. 4. Auto steering switch—ON.
D-2	True heading assembly.	1. Servo malfunction selector knob—6. 2. Servo malfunction switch—ON. 3. Disregard true heading indication for remainder of flight.
D-3	Groundtrack computer.	1. Auto steering switch—OFF. 2. Servo malfunction selector knob—5. 3. Servo malfunction switch—ON. 4. Auto steering switch—ON.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
D-3 (Continued)	Groundtrack computer. (Continued)	5. Disregard groundtrack indication for remainder of flight. 6. Do not attempt automatic radar photography or constant groundtrack steering.
D-4	Groundtrack computer drift differential generator.	Disregard test bad light. Proceed to next test position.
D-5	Distance to destination.	Disregard distance to destination indication for remainder of flight.
D-6	Altitude above sea level assembly.	1. Time to go servo malfunction switch—NORM. 2. Sight malfunction switch—OFF. 3. Altitude malfunction switch—MALF. 4. Make altitude calibration run. 5. Read altitude above sea level on altitude above terrain indicator for remainder of flight.
Note Before selecting D-7, move the fixpoint selector knob to MANUAL and the aimpoint selector knob to FIX. Set fixpoint position elevation indicator at 1000 feet.		
D-7 (Test good lamp lighted)	Fixpoint elevation assembly.	1. Set all elevation indicators on the offset and storage panel at 1000 feet. 2. Turn fixpoint selector switch to 1, and wait for test good or test bad lamp indication. If test bad lamp lights, storage fixpoint 1 elevation indicator cannot be used. 3. Turn fixpoint selector switch to 2, and wait for test good or test bad lamp indication. If test bad lamp lights, storage fixpoint 2 elevation indicator cannot be used. Return fixpoint selector switch to MANUAL. 4. Turn aimpoint selector switch to 1, and wait for test good or test bad lamp indication. If test bad lamp lights, offset aimpoint 1 elevation indicator cannot be used. 5. Turn aimpoint selector switch to 2, and wait for test good or test bad lamp indication. If test bad lamp lights, offset aimpoint 2 elevation indicator cannot be used. Return aimpoint selector switch to FIX.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
D-7 (Test good lamp lighted) (Continued)	Fixpoint elevation assembly. (Continued)	6. Reset all elevation indicators on offset and storage panel to original settings. If the test bad lamp lights with this system configuration, proceed with the following steps.
Test bad lamp lighted with fixpoint selector knob MANUAL aimpoint selector knob FIX, and fixpoint position elevation indicators at 1000 feet.		1. Set offset aimpoint 1 and offset aimpoint 2 N-S and E-W indicators at zero. 2. Set elevation of next fixpoint on offset aimpoint 1 (or 2) elevation indicator. 3. When making radar fix, turn aimpoint selector switch to 1 (or 2). 4. When making subsequent altitude calibration runs, proceed as follows: a. Time-to-go servo malfunction switch NORM. b. Sight malfunction switch—OFF. c. Altitude malfunction switch—MALF. d. Record value of altitude above terrain now appearing on the altitude above sea level indicator. e. Altitude malfunction switch—OFF. f. Compute altitude above sea level by adding known value of terrain elevation to recorded value of altitude above terrain. g. Adjust altitude correction knob until the altitude-above-sea level indicator shows computed value of altitude above sea level.
D-8 ❶ If the function selector knob is in NAVIGATION.	Sighting shafts control transformer null.	1. Fixpoint selector—PRESENT POSITION. 2. Compare indications of fixpoint position latitude and longitude indicators with true (or transverse) present position latitude and longitude indicators. If within 5 minutes of agreement, system will operate normally. If not within 5 minutes of agreement, astro computer and great circle computer are inoperative, and steering must be done as follows: a. Auto steering switch—OFF. b. Request pilot to use constant groundtrack autopilot mode, or have pilot fly a manually plotted course. Auto steering switch must be ON to fly constant groundtrack. c. Heading reference selector switch—FREE GYRO.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
D-8 ❶ If the function selector knob is in NAVIGATION. (Continued)	Sighting shafts control transformer null. (Continued)	d. After 5 hours, turn heading reference selector switch to FLUX VALVE, unless in polar regions. 3. Do not use automatic radar photography functions, or fixpoint position latitude and longitude indicators. 4. To make a radar fix, proceed as follows: a. Time-to-go servo malfunction switch—NORM. b. Altitude malfunction switch—OFF. c. Sight malfunction switch—MALF. d. Set latitude and longitude of fixpoint on destination position indicators. (Now readable to 0.1 minute.) e. Set altitude above sea level of fixpoint on fixpoint position elevation indicator. f. Aimpoint selector switch—FIX. g. Turn search transmitter switch to ON and adjust for optimum indicator presentation. h. Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. i. Search transmitter switch—OFF. 5. To determine position of unknown point, proceed as follows: a. Turn fixpoint selector switch to MANUAL, and aimpoint selector switch to FIX. b. Set elevation of unknown point on fixpoint position elevation indicator. c. Time-to-go servo malfunction switch—NORM. d. Altitude malfunction switch—OFF. e. Sight malfunction switch—MALF. f. Turn search transmitter switch ON and adjust for optimum indicator presentation. g. Adjust destination position knobs until image of unknown point is centered under crosshairs. Destination position indicators now show latitude and longitude of unknown point. h. Search transmitter switch—OFF.
❷ If the function selector knob is in BOMB.		1. Heading reference selector—FREE GYRO. 2. Do not use automatic radar photography functions, or fixpoint position latitude and longitude counters. 3. Turn time-to-go servo malfunction switch to NORM, and altitude malfunction switch to OFF.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
❷ If the function selector knob is in BOMB. (Continued)	Sighting shafts control transformer null. (Continued)	4. Sight malfunction switch—MALF. 5. Set latitude and longitude of target on destination position indicators. (Now readable to 0.1 minute.) 6. Set target altitude above sea level on fixpoint position elevation indicator. 7. To make a radar fix on the target, proceed as follows: a. Aimpoint selector switch—FIX. b. Turn search transmitter switch to ON, and adjust for optimum indicator presentation. c. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. d. Search transmitter switch—OFF. 8. If the target position is not known accurately, proceed as follows: a. Aimpoint selector—FIX. b. Place search transmitter switch to ON, and adjust for optimum indicator presentation. c. Adjust destination position knobs until target image is centered under crosshairs. d. Destination position indicators now show target latitude and longitude. e. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. f. Search transmitter switch—OFF.
D-9 ❶If function selector knob is in NAVIGATION.	Sighting control transformer null and airplane latitude-fixpoint latitude difference	1. Turn fixpoint selector switch to PRESENT POSITION. 2. If the fixpoint position latitude and longitude indicators agree within 5 minutes with the true (or transverse) present position indicators, proceed as follows: a. With auto steering switch at ON, monitor progress of flight profile under automatic great circle steering.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
D-9 ❶ If function selector knob is in NAVIGATION. (Continued)	Sighting control transformer null and airplane latitude-fixpoint latitude difference. (Continued)	b. If course appears satisfactory, continue automatic steering; if not, turn auto steering switch to OFF, and have pilot fly a manually plotted course. The heading reference selector switch may remain at ASTRO as long as the star lost lamp does not light. c. If the star lost lamp lights and remains lighted, turn heading reference selector switch to FREE GYRO. d. After 5 hours turn heading reference selector switch to FLUX VALVE unless in polar areas. e. To make a radar position fix, accomplish the following: (1) Auto steering switch—OFF. (2) Turn time-to-go servo malfunction switch to NORM, and altitude malfunction switch to OFF. (3) Sight malfunction switch—MALF. (4) Set fixpoint latitude and longitude in destination position indicators (now readable to 0.01 minute). (5) Set fixpoint altitude above sea level in fixpoint position elevation indicator. (6) Aimpoint selector switch—FIX. (7) Turn search transmitter switch to ON, and adjust for optimum indicator presentation. (8) Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. (9) Search transmitter switch—OFF. 3. If the fixpoint position latitude and longitude indicators do not agree within 5 minutes with the true (or transverse) present position indicators, proceed as follows: a. Auto steering switch—OFF. b. Use constant heading control mode of the autopilot, or have pilot fly a manually plotted course. Turn heading reference selector switch to FREE GYRO. c. After 5 hours turn to FLUX VALVE unless in polar area. d. Do not use automatic radar photography functions, or fixpoint position latitude and longitude indicators. e. To make a radar position fix, proceed as follows:

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
D-9 ❶ If function selector knob is in NAVIGATION. (Continued)	Sighting control transformer null and airplane latitude-fixpoint latitude difference. (Continued)	(1) Turn time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF. (2) Sight malfunction switch—MALF. (3) Set fixpoint latitude and longitude on destination position indicators (now readable to 0.1 minute). (4) Set fixpoint altitude above sea level on fixpoint position elevation indicator. (5) Aimpoint selector switch—FIX. (6) Turn search transmitter switch to ON and adjust for optimum indicator presentation. (7) Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. (8) Search transmitter switch—OFF.
❷ If the function selector knob is in BOMB.		1. If star lost lamp remains unlighted, heading reference selector switch may be left at ASTRO; if not, turn to FREE GYRO. 2. Do not use automatic radar photography functions or fixpoint position latitude and longitude indicators. 3. Turn time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF. 4. Sight malfunction switch—MALF. 5. Set target latitude and longitude on destination position indicators (now readable to 0.1 minute). 6. Set target altitude above sea level on fixpoint position elevation indicator. 7. To make a radar fix on the target, proceed as follows: a. Aimpoint selector switch—FIX. b. Turn search transmitter switch to ON and adjust for optimum indicator presentation. c. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. d. Search transmitter switch—OFF.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
D-10 ❶ If the function selector knob is in NAVIGATION.	Sighting circuits, sine airplane latitude and fixpoint latitude difference cosine latitude of fixpoint and offset aimpoint.	1. To make a radar position fix, proceed as follows: a. Auto steering switch—OFF. b. Place time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF. c. Sight malfunction switch—MALF. Test bad lamp should now go out. d. Set fixpoint latitude and longitude on destination position indicators (now readable to 0.1 minute). e. Set fixpoint altitude above sea level on fixpoint position elevation indicator. f. Aimpoint selector knob—FIX. g. Turn search transmitter switch to ON and adjust for optimum indicator presentation. h. Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. i. Search transmitter switch—OFF. j. Auto steering switch—ON. 2. To determine position of unknown point, proceed as follows: a. Turn fixpoint selector switch to MANUAL and aimpoint selector switch to FIX. b. Set elevation of unknown point on fixpoint position elevation indicator. c. Auto steering switch—OFF. d. Place time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF. e. Sight malfunction switch—MALF. f. Adjust destination position knobs until image of unknown point is centered under crosshairs. Destination position indicators now show latitude and longitude of unknown point. g. Search transmitter switch—OFF. h. Auto steering switch—ON.
❷ If the function selector knob is in BOMB.		1. Do not use automatic radar photography functions, or fixpoint position latitude and longitude indicators.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
❷ If the function selector knob is in BOMB. (Continued)	Sighting circuits, sine airplane latitude and fixpoint latitude difference cosine latitude of fixpoint and offset aimpoint. (Continued)	2. Turn time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF. 3. Turn sight malfunction switch to MALF. Test bad lamp should now go out. 4. Set target latitude and longitude on destination position indicators (now readable to 0.1 minute). 5. Set target altitude above sea level on fixpoint position elevation indicator. 6. To make a radar fix on the target, proceed as follows: a. Aimpoint selector switch—FIX. b. Turn search transmitter switch to ON and adjust for optimum indicator presentation. c. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. d. Search transmitter switch—OFF. 7. If the target location is not accurately known, proceed as follows: a. Aimpoint selector knob—FIX. b. Turn search transmitter switch to ON and adjust for optimum indicator presentation. c. Adjust destination position knobs until target image is centered under crosshairs. Destination position indicators now show latitude and longitude of target. d. Make radar position fix as follows: (1) Aimpoint selector switch—FIX. (2) Turn search transmitter switch to ON, and adjust for optimum indicator presentation. (3) Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude. (4) Search transmitter switch—OFF.
D-11 See D-10 for position of function selector knob.	Sighting circuits, correction to north ground range due to variation of earth radius.	Use the same remedial procedures as listed for D-10.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
D-12 See D-10 for position of function selector knob.	Sighting circuits, correction to east ground range due to variation of earth radius, and airplane latitude-fixpoint latitude difference correction.	Use the same remedial procedures as listed for D-10.
Note Knob "D" must be returned to 0 before continuing test with knob "E."		
E-1	Aimpoint bearing assembly, north component of ground range to aimpoint.	1. Servo malfunction selector knob—3. 2. Servo malfunction switch—ON.
E-2	Aimpoint bearing assembly, east component of ground range to aimpoint.	Use remedial procedures listed for E-1.
E-3	Aimpoint bearing assembly, true bearing of radar ground target and ground range to aimpoint.	Use remedial procedures listed for E-1.
E-4	Aimpoint bearing assembly, true bearing of radar ground target and true airplane heading.	Use remedial procedures listed for E-1.
E-5	Sighting angle assembly, airplane to fixpoint altitude.	1. Servo malfunction selector knob—4. 2. Servo malfunction switch—ON. 3. Adjust antenna tilt knob for optimum indicator presentation.
E-6	Sighting angle assembly.	Use same remedial procedures as listed for E-5.
E-7	Course angle computer.	1. Auto steering switch—OFF. 2. Servo malfunction selector knob—1. 3. Servo malfunction switch—ON. 4. Auto steering switch—ON.
E-8 Function selector knob — BOMB.	Course angle computer, north component of ground range to target.	Use the same remedial procedures as listed for E-7.

SUSPECTED MALFUNCTION TEST PROCEDURE (Continued)

Knob and Position	*Circuits Being Tested*	*Remedial Procedures*
E-9 Function Selector knob — BOMB.	Course angle computer, east component of ground range to target.	Use the same remedial procedures as listed for E-7.
E-10	Course angle computer servo null and synchro.	Use the same remedial procedures as listed for E-7.
E-11	Course angle computer resolver output.	Use the same remedial procedures as listed for E-7.
E-12	Airspeed computer and Mach source.	1. Airspeed computer malfunction switch—MALF. 2. Turn airspeed computer malfunction knob to index mark. 3. Compare true airspeed indication with pilot's airspeed indicator. If in approximate agreement, leave airspeed computer malfunction switch at MALF and make manual true airspeed calibration. 4. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed. 5. If true airspeed indicator does not read properly, proceed as follows: a. Airspeed computer malfunction switch—OFF. b. Machmeter malfunction switch—MALF. c. Adjust airspeed computer malfunction knob until true airspeed indicator agrees with pilot's airspeed indicator. d. If true airspeed indication drops to zero during automatic true airspeed calibration runs, adjust airspeed computer malfunction knob until true airspeed indicator begins to indicate.
Note Position 13 of knob "E" is inoperative. Turn "E" from 13 to 0 after completing test.		

DEFENSIVE SYSTEM OPERATOR'S CHECK LIST.

STATIONS INSPECTION.

1. Stations inspection—Completed.

Attend stations inspection conducted by the pilot as outlined in Section II. Equipment display is shown in figure 2-2.

POWER-OFF INTERIOR INSPECTION.

1. Canopy lock—Installed.

Check that the canopy lock is installed and that canopy actuator warning pin is not visible.

WARNING

The red pin, when visible, indicates that the canopy actuator ballistics charge has been fired, thus making ballistic canopy jettisoning impossible.

2. Ejection seat safety pins (3)—Installed.

Before entering the airplane, check that safety pins are installed in both seat handgrips and in the canopy jettison handle.

3. Canopy actuator and seal—Check.

Check actuator condition, and check the canopy seal properly seated and the inflation tube connected.

4. Liquid container—Check.

Check liquid container for servicing and operation of the flow valve.

5. Exterior emergency canopy jettison access door—Secure.

6. Left and right windows—Check.

Check for cleanliness, cracks and general condition.

7. Ejection seat, survival kit and parachute—Check.

a. Ejection seat:

(1) Check that pins are removed from 6 initiators (2 lower left arm rest, 2 lower right arm rest, 1 on floor structure beneath seat, and 1 middle right rear of seat).

(2) Check that oxygen and radio personal leads are connected and secure.

(3) Check operation of the shoulder harness in automatic and manual locked positions.

(4) Check general condition of safety belt, shoulder harness, safety belt tie-down strap, arm and leg restraints, and knee strap.

(5) Check quick disconnect fittings connected underneath seat.

b. Survival kit:

(1) Check parachute attachment straps securely attached in kit release fittings and attached to parachute.

Note

The attachment straps should not be connected to the parachute over the safety belt or routed between the safety belt and the safety belt release hose. Improper connection could result in not separating from the seat or in the lap belt initiator not firing.

(2) Check that the harness and kit release handle is down.

8. Escape rope—Check.

Check that rope is connected and secured.

9. D-C power panel—Check.

Check the 28-volt d-c power panel for blown fuses and presence of adequate spares.

10. Relief container—Empty.

11. Left a-c power panel—Check.

Check the left power panel for blown fuses and presence of adequate spares.

12. Cabin warm air selector—OFF.

13. A/A IFF master switch—OFF.

14. MD-7 manual fire control panel:

a. Master switch—OFF.

b. Marker generator switch—OFF.

15. Interphone panel—Set.

Set the function selector to INTER, the mixing switches OFF and the auxiliary listen switch guarded NORMAL.

16. VGH recorder power switch—OFF. 35 ➧

17. ALQ-16 track breaker power switch—OFF.

18. ALR-12 radar warning power switch—OFF.

19. MD-7 radar fire control panel:

a. Fire-safe switch—SAFE (safetied).

b. Function controls (4)—CCW.

20. ALQ-15 radar confusion power switch—OFF.

21. Right a-c power panel—Check.

Check the right power panel for blown fuses and presence of adequate spares.

22. Report to pilot—DSO power-off checks complete.

POWER-ON INTERIOR INSPECTION.

The check list items fully enclosed in parentheses will be called for by the pilot and the indicated response will be made at that time. Placement of these items provides an indication of sequence used by the pilot but does not show any sequence for action by the DSO who may proceed with other check list items until the parenthesized items are called for by the pilot.

Note

The first action by the pilot on his Power-on Interior Inspection will be a check of the bailout warning system. This will be the signal to the DSO to prepare to respond to check list items.

(1. Bailout warning lamp—Checked.)
Acknowledge bailout lamp operation to the navigator who will relay the acknowledgment to the pilot.

(2. Oxygen and interphone—On call, on normal, oxygen check complete.)

a. Oxygen pressure 70 to 110 psi.

b. Diluter lever NORMAL OXYGEN and check regulator.

Place diluter lever to NORMAL OXYGEN and check regulator breathing valve by blowing gently into end of seat hose. There should be resistance to blowing. Little or no resistance indicates leakage or faulty operation.

c. Place diluter lever to 100% OXYGEN and perform check as in preceding step.

d. Connect oxygen mask and seat hoses to manifold block.

e. Oxygen supply lever ON.

f. Check system flow and mask leakage.

With the mask fitted snugly to the face, breathe normally and conduct the following check:

(1) Observe flow indicator and note that shutter moves with each breathing cycle.

(2) Place emergency lever to EMERGENCY and notice a continuous flow with noticeable pressure increase in the mask.

(3) Place emergency lever to TEST MASK and hold.

A continuous flow and positive pressure increase should be felt in the mask. Hold breath to determine that there is no leakage around the mask. Release the emergency lever and note that positive pressure ceases.

(4) Check that oxygen pressure reads 70 to 110 psi after the check.

g. Diluter lever NORMAL OXYGEN.

h. Supply lever OFF.

i. Check seat hose quick disconnect fitting at the manifold block for approximately 10 to 15 pounds pull.

(3. High voltage d-c power—Checked.)
Position meter selector knob to each position and note proper voltage and if the ammeter is indicating a load to determine that all units are functioning. Tolerance includes meter tolerance.

Unit	*Tolerance*
28 volt	24 to 30.0 volts (full scale acceptable)
150 volt	141 to 159 volts
—150 volt	141 to 159 volts
250 volt	226 to 277 volts

(4. Command radio—Checked.)
Rotate the function selector to COMM and call the tower for a radio check, then return selector INTER.

(5. Fuel, hydraulic, and oxygen quantities—Recorded.)
Record the data as the pilot calls them out during his check of the various systems.

6. Seat—Adjust.

7. Left a-c power panel—Check.

Check the left power panel for blown fuses and the phase indicator lamps on.

8. A/A IFF master switch—STBY.

9. VGH recorder power switch—ON. 35 ◆

10. Fire control fuse—RADAR 1A pulled out (if applicable).

If a live load of ammunition is carried, pull the RADAR 1A fuse in the right a-c power panel to deactivate the firing circuit:

11. MD-7 fire control master switch—STBY, lights press-to-test.

12. ALQ-16 track breaker power switch—STBY, light press-to-test.

13. ALR-12 radar warning power switch—POWER, lights press-to-test.

14. ALQ-15 radar confusion power switch—STBY, light press-to-test.

15. Right a-c power panel—Check.

Check the right power panel for blown fuses and the phase indicator lamps on.

16. Interior lights—Check.

Turn ON and check all interior lights, then turn them OFF. Check for spare bulbs and fuses.

17. Mask defog—OFF.

18. ALR-12 radar warning (after 30-second warmup):

a. Interphone DECM mixing switch—DECM.

b. Audio selector—Check and set.

Check each position for signal in headset. Signal reception will depend on operation of radar equipment in the area.

19. ALQ-16 track breaker (after 3-minute warmup):

a. Power switch—ON.

b. Test button—Press momentarily.
Check that the transmitter warning lamp goes on.

Note

Test button should not be held down longer than five seconds.

c. Power Switch—STBY.

20. ALQ-15 radar confusion (after 3-minute warmup):

a. Power switch—ON.

b. Test button—Press momentarily.
Check that the transmitter warning lamp goes on.

Note

Test button should not be held down longer than five seconds.

c. Power switch—STBY.

21. MD-7 fire control system scope dimming knob—As desired.

EXTERIOR INSPECTION.

There is no specified exterior inspection for the DSO. The items of equipment peculiar to DSO functions are checked visually by the pilot as part of his Exterior Inspection.

BEFORE STARTING ENGINES.

STARTING ENGINES.

BEFORE TAXIING.

TAXIING.

BEFORE LINE-UP.

TAKEOFF.

AFTER TAKEOFF.

There are no specified check lists for the DSO in the above areas. He will read the pilot's check lists to him and respond to the applicable common response items indicated.

CRUISE.

1. Fuel management schedule—Advise pilot as necessary.
Keep pilot informed as to fuel management requirements, such as starting point and duration of fuel transfers, tank feed sequencing, actual fuel consumed versus predicted, etc.

2. CG and gross weight—Check periodically.

3. Fire control system—Target acquisition check as desired.

a. Master switch—OPR (after 5-15 minutes at STBY).

b. Receiver gain control knob—CW until targets or noise appear.

Note

Check that target warning lamp lights when antenna sweeps target.

c. Scope gain and storage control knobs—As required.

d. Erase button—Press momentarily to clear scope.

e. Marker generator switch—ON if range markers required for test lock-on.

f. Cursor button—Press and hold.

g. Manual control handle—Adjust to place cursor on selected target.

h. Manual button—Press and release for lock-on.

Note

Check that ready-fire lamp lights after lock-on when target is within range.

i. Resume search button—Press momentarily to break lock.

j. Antijam button—Press if required.

k. ATA range control knob—CW to set desired range on future range meter.

Note

The target warning lamp will dim during lock-on.

l. Resume search button—Press momentarily to break lock.

4. Active defense system—Live firing as required.

a. Range clearance—As required.

b. Fire control system target acquisition—Perform as in step 3.

c. Burst length control knob—Set at 0.6.

d. Fire control fuse—RADAR 1A inserted.

e. Safe-fire switch—FIRE.

f. Scope—Observe to clear area.

WARNING

Maintain scope vigilance throughout training firing. If a malfunction disables the radar system, cease firing immediately.

g. Firing button—Press for each burst.

h. Safe-fire switch—SAFE and safetied at end of firing run.

i. Master switch—STBY.

j. Scope control knobs—Fully CCW.

5. DECM equipment—Operation as required.

a. Radar warning control panel—Monitor audio and visual indicators during flight.

b. Radar confusion power switch knob—ON during runs.

c. Radar track breaker power switch knob—ON, MODE 1, or MODE 2 during runs.

BEFORE ACCELERATION.

DURING ACCELERATION.

DECELERATION.

DESCENT.

BEFORE LANDING (SHORT).

BEFORE LANDING.

AFTER LANDING.

ENGINE SHUTDOWN.

There are no specified check lists for the DSO in the above areas. He will read the pilot's check list to him and respond to the applicable common response items indicated.

BEFORE LEAVING AIRPLANE.

1. Ejection seat safety pins installed.

Install safety pins at each handgrip and canopy jettison handle.

2. Canopy lock installed.
3. Oxygen system 100% and OFF.
4. All switches OFF.

Check that all switches are OFF or positioned properly for leaving the airplane.

MANUAL GROUNDSPEED CORRECTION PROCEDURE.

1. Select a radar target of known or determinable elevation.
2. Turn fixpoint selector knob to MANUAL.
3. Turn aimpoint selector knob to FIX.
4. Set elevation of selected target on fixpoint position elevation indicator.
5. Turn tracking and flight controller selector knob to FIXPT POS CORR.
6. Turn search transmitter switch to ON, and adjust for optimum indicator presentation.
7. Depress engaging switch, center image under crosshairs with tracking and flight control stick, and release engaging switch.
8. If crosshairs drift, adjust sea drift velocity knobs to cancel drift. (Turn knob toward direction of drift.)
9. Turn fixpoint selector knob to PRESENT POSITION.
10. Turn search transmitter switch to OFF.
11. Turn tracking and flight controller selector knob to OFF.

MANUAL CALIBRATION OF TRUE AIRSPEED.

1. Record present groundspeed, groundtrack, and true heading.

2. Request pilot to change heading at least 15 degrees (more than 20 degrees is unnecessary) and to hold the new heading for a few seconds.

3. Record new groundspeed, groundtrack, and true heading.

4. Request pilot to resume original course.

5. Compute the north and east groundspeed for both headings from the following expressions:

Original north groundspeed = original groundspeed × cosine of original groundtrack

New north groundspeed = new groundspeed × cosine of new groundtrack

Original east groundspeed = original groundspeed × sine of original groundtrack

New east groundspeed = new groundspeed × sine of new groundtrack

6. Compute true airspeed from the following expression:

Calculated true airspeed =

$$\frac{\left(\text{original east groundspeed} - \text{new east groundspeed}\right)\text{cosine of original heading} - \left(\text{original north groundspeed} - \text{new north groundspeed}\right)\text{sine of original heading}}{\text{sine (original heading — new heading)}}$$

ASTRO FIXTAKING (2-STAR), USING ERROR ZEROING.

This method is based on the premise that if star altitude error is continually reduced to zero, alternately locking on two stars 90 degrees apart, the computed position must converge to the actual position. Proceed as follows:

1. With the tracker locked on STAR 1, change the present position indicators until start altitude error indicator reads zero.

2. With the tracker locked on STAR 2, change the present position indicators until star altitude error indicator reads zero.

3. Reset tracker to lock on STAR 1, and again zero star altitude error. Aircraft position should now be computed position.

4. Repeat above steps as necessary to keep star altitude error down to 3 or 4 minutes.

ASTRO FIXTAKING (3-STAR), USING STAR ALTITUDE ERROR INDICATOR.

1. Check and record present reading of star altitude error indicator. Note that T indicates positive error; A indicates negative error.
2. Check and record present reading of star azimuth indicator.
3. Turn heading reference selector knob to FREE GYRO.
4. Set sidereal hour angle indicator to read SHA of a suitable second star at least 30 degrees from original star.
5. Set star declination indicator to read declination of second star.
6. Turn heading reference selector knob to ASTRO.
7. Check and record second reading of star altitude error indicator.
8. Check and record second reading of star azimuth indicator.
9. Turn heading reference selector knob to FREE GYRO.
10. Set sidereal hour angle indicator to read SHA for suitable third star at least 30 degrees in azimuth from original and second star.
11. Set star declination indicator to read declination of third star.
12. Turn heading reference selector knob to ASTRO.
13. Check and record third reading of star altitude error indicator.
14. Check and record third reading of star azimuth indicator.
15. On plotting paper, navigation chart, or grid type plotting computer, draw from one point the three values of true (or transverse) star azimuth.
16. Using an appropriate scale, lay off along each azimuth line the corresponding value of star altitude error in minutes. Positive error is toward the star; negative error is away.
17. Draw a perpendicular to each azimuth line at the point of maximum altitude error (absolute) and extend the three so that they intersect to form a triangle.
18. Mark the estimated mass center of the triangle, and measure the true (or transverse) north and east distances in nautical miles from this point to the origin.
19. Determine the latitude correction by converting the true (or transverse) north component to minutes. Set the correction on the true (or transverse) present position latitude indicator.
20. Determine the longitude correction by multiplying the true (or transverse) east component by

$$\frac{1}{\text{Cosine of true (or transverse) latitude of aircraft}}$$

or scaling off the equivalent mileage on the chart and reading minutes. Set the correction on the true (or transverse) present position longitude indicator.

MISCELLANEOUS DATA.

LIST OF USABLE STARS.

The following stars may be tracked during twilight when the altitude of the sun is between —10 degrees and —18 degrees.

Achernar*
Acrux*
Aldebaran*
Altair*
Antares*
Arcturus*
Betelgeuse*
Canopus*
Capella*
Deneb*
Fomalhaut*
Hadar*
Pollux*
Procyon*
Regulus*
Rigel*
Rigil Kentaurus*
Sirius*
Spica*
Vega*

In addition to the stars listed above, the following stars may be tracked after twilight (altitude of sun lower than —18 degrees):

Adhara
Alhena
Alioth
Alkaid
Al Na'ir*
Alnilam
Alphecca
Alpheratz*
Atria
Avior
Bellatrix
beta Canis Marjoris
beta Crux
Castor*
delta Orionis
delta Velorum
Denebola*
Dschubba
Dubhe
Elnath
epsilon Centauri
eta Canis Majoris
Gacrux
gamma Cassiopeia
gamma Centauri
gamma Velorum*
iota Carinae
kappa Orionis
kappa Scorpii
kappa Velorum
Kaus Australis
Markab
Menkalinan
Merak
Miaplacidus*
Mirfak
Mizar
Nunki*
Peacock*
Phecda
Polaris*
Rasalhauge*
Shaula*
theta Scorpii
Wezen
zeta Orionis
zeta Puppis

*Recommended stars (least possibility of ambiguity)

Note

Planets may be tracked successfully, but require more operator attention. No object should be tracked closer than 10 degrees from a full moon. Magnitude of any object being tracked must not be less than 2.63.

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servo malfunction priority and guide list

Servo Malfunction Selector Knob Position	*Servo Replaced*	*Essential to Following Functions and/or Mode*
1	Course angle	Great circle steering; bomb mode.
2	Relative heading	All.
3	Aimpoint bearing	Radar position fixing; automatic radar photography.
4	Sighting angle	Radar position fixing; automatic radar photography.
5	Ground-track	Great circle steering; automatic radar photography.
6	True heading	Bomb mode.

Figure 8-1.

CUT ON BLACK LINE

B/RB-58A
NAVIGATOR'S CONDENSED CHECK LIST

AIRPLANE DESIGNATION CODING.

31	59-2428	34	59-2431	37	59-2434
32	59-2429	35	59-2432	38	59-2435
33	59-2430	36	59-2433	➧	"through" or "and on"

Example: Information applicable to airplane AF 59-2428 through AF 59-2430 would be coded 31 ➧ 33. Information applicable to airplanes AF 59-2433 and on would be coded 36 ➧.

STATIONS INSPECTION.

1. Stations inspection—Completed.

POWER-OFF INTERIOR INSPECTION.

1. Canopy lock—Installed.
2. Ejection seat safety pins (3)—Installed.
3. Canopy actuator and seal—Check.
4. Liquid container—Check.
5. Canopy emergency release handle—Closed.
6. Exterior emergency canopy jettison access door—Secure.
7. Left and right windows—Check.
8. Ejection seat, survival kit and parachute—Check.
9. First aid, battle dressing and blood plasma kits—Stowed.
10. Escape rope—Check.
11. Fire extinguisher—Stowed and serviced.
12. Relief container—Empty.

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13. High voltage d-c power panel—Check.
14. Canopy seal control—UNSEALED.
15. Security of navigation units—Check.
16. Auxiliary control panel:
    a. Function selector knob—GYRO.
    b. Search transmitter switch—OFF.
    c. Doppler transmitter switch—OFF.
    d. Doppler return switch—LAND.
    e. Magnetic variation knob—Local value.
    f. Altimeter calibrate switch—OFF.
    g. Sea drift indicators—Set to zero.
17. Inflight printer power switch—OFF.
18. Pod release panel:
    a. Pod release switch—OFF.
    b. Pod safety lockpin release handle—In and horizontal.
    c. Pod emergency release handle—In and horizontal.
19. Heading reference selector knob—FLUX VALVE.
20. Aimpoint selector knob—FIX.
21. Malfunction control panel:
    a. Astrotracker malfunction switch—OFF.
    b. Vertical reference selector switch—NORMAL.
    c. Sight malfunction switch—OFF.
    d. Machmeter malfunction switch—OFF.
    e. Heading integrator malfunction switch—OFF.
    f. Search antenna malfunction switch—OFF.
    g. Altitude malfunction switch—OFF.
    h. Heading and navigation malfunction knob—OFF.
    i. Servo malfunction switch—OFF.
    j. Airspeed malfunction switch—OFF.
    k. Airspeed calibration switch—NORMAL.
    l. Airspeed computer malfunction knob—Aligned with index.
    m. Auto steering switch—OFF.

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22. Navigation power interlock switch—NORMAL.

Note

Use the OVERRIDE position for instrument or night flight.

23. Search radar indicator panel:
   a. Search radar mode selector knob—GRD.
   b. Crosshair brightness knob—Fully CCW.
   c. Display intensity knob—Fully CCW.
   d. Contrast/threshold selector knob—H-1.
   e. Range and magnification selector knob—30/10.
   f. Manual/automatic contrast/threshold switch—AUTO.
   g. Manual/automatic receiver tuning switch—AFC.
   h. Map screen brightness selector knob—OFF.
24. Navigation control panel:
   a. Polar/non-polar switch—NON-POLAR (unless entry into polar regions is anticipated).
   b. Coordinate reference switch—TRUE.
   c. True present position indicators—Manually set to within 3° of fixpoint position indicators.
25. Bombing control panel:
   a. Pod pitot tube switch—RETRACT.
   b. Auto release switch—OFF.
   c. IBDA switch—OFF.
   d. RBS switch—OFF.
   e. All malfunction controls—OFF or NORM.
26. Sighting and test panel—Checked.
   a. Fixpoint selector knob—PRESENT POSITION.

CAUTION

Fixpoint position indicators and present position indicators must never differ by more than 3 degrees.

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b. Malfunction test knobs—All at zero.

c. Automatic radar photography switch—OFF.

27. Tracking and flight controller selector knob—OFF.

28. Report to pilot—Navigator's power-off check complete.

POWER-ON INTERIOR INSPECTION.

(1. Bailout warning lamp—Checked.)

(2. Oxygen and interphone—On call, on normal, oxygen check complete.)

(3. Command radio—Checked.)

4. Seat—Adjust.

5. Interior lights—Check.

6. Mask defog—OFF.

7. Navigation isolation switches—ON.

BEFORE STARTING ENGINES.

(1. Personal gear—Survival kit attached, safety belt, shoulder harness, safety belt tie-down strap and arm restraints, and both parachute lanyards connected.)

(2. Mask, bailout bottle, and mike cord—Oxygen hoses and mike cord connected.)

(3. Oxygen—Oxygen check complete.)

(4. Ejection seat and initiator safety pins—Removed and stowed.)

(5. Canopy—Closed and latched.)

(6. Canopy seal control—SEALED.)

7. Function selector knob—STANDBY.

8. Erect indicator lamp—Lighted.

9. Plate power—Checked.

10. Destination position indicators—Set.

11. True present position indicators—Set.

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12. Transverse present position indicators—Set as required.
13. Offset distance and elevation indicators—Set.
14. Storage fixpoint indicators—Set.
15. Polar/non-polar switch—Set.
16. Coordinate reference switch—TRUE or TRANSVERSE (as applicable).
17. Fixpoint position and elevation indicators—Set as required.
18. Fixpoint selector knob—Set as required.
19. Astro filter switch—Set.
20. GHA indicator—As required.
21. SHA indicator—As required.
22. Star declination indicator—As required.
23. Heading reference selector knob—Astro, if possible.
24. Erect indicator lamp—Out.
25. Vertical error indicator lamp—Out.
26. Attitude indicator—Normal (both tables).
27. Inflight printer—On and set.

BEFORE TAXIING.

1. Function selector knob—TAXI & TAKEOFF.
2. Groundspeed—Check for zero.
3. True heading—Check.
4. Navigator and DSO—"Ready to taxi."

BEFORE LINE-UP.

1. True heading—Checked.
2. Groundspeed—Checked.
3. Present position—Checked.

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4. Altitude above sea level indicator—Checked.
5. Auto steering switch—ON.
6. Malfunction test knob "A"—3.
7. Doppler transmitter switch—ON.
8. Search transmitter switch—ON.
9. Airspeed-inertial switch—NORMAL.
(10. Navigator and DSO—Ready for takeoff.)

AFTER TAKEOFF.

1. Radio altimeter switch—ON (at 500 ft).
(2. Parachute zero delay lanyard—Disconnected and stowed.)
3. Function selector knob—NAVIGATION, after reaching 250 knots TAS.
(4. Oxygen and station check—Completed.)
5. Navigation system indicators—Monitor and compare with expected progress.

LEVEL-OFF.

1. Doppler lock—Check.
2. Function switch—NAVIGATION.
3. Altitude calibration—Performed.

Note

An altitude calibration should be accomplished: (1) after each airspeed change of more than 300 knots; (2) after an altitude change of more than 5000 feet; (3) not more than 400 nautical miles prior to each fixpoint.

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a. While over terrain of known elevation, turn altimeter transmitter switch to CALIBRATE (this switch must have been in the ON position for at least 4 seconds) while setting terrain elevation on fixpoint position elevation indicator with altitude correction knob.

b. Turn altimeter transmitter switch to the OFF or ON position, as desired.

Note

If the warning lamp in the altitude above terrain indicator lights during this procedure, indicating periodic automatic self-calibration of the radio altimeter, the procedure must be repeated.

4. Airspeed calibration—Performed.

a. Request pilot to make 15-degree airspeed turn.

b. Place airspeed calibration switch to CAL.

c. After flying a minimum of 15 seconds on new heading, request pilot to zero PDI.

d. Place airspeed calibration switch to NORMAL.

5. Radar position fix—Performed.

a. Place map screen brightness selector knob to any numbered position and adjust for desired brightness.

b. Turn map screen film drive knob to bring radar map of fixpoint area into view.

c. Turn aimpoint selector knob to FIX.

d. Set fixpoint altitude above sea level on fixpoint position elevation indicator.

e. Monitor present position indicators. When present latitude is within 200 minutes of fixpoint latitude and present longitude is within 300 minutes of fixpoint longitude, turn fixpoint selector knob to MANUAL.

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f. Set fixpoint latitude and longitude on fixpoint position indicators.

g. Adjust contrast/threshold, variable threshold, crosshairs, and intensity for optimum indicator presentation. Progressively increase range/magnification setting to 200/160.

h. Compare radar image with map comparator screen and identify fixpoint. Fixpoint acquisition should occur at a range of about 80 nautical miles.

i. Monitor crosshair distance indication, and as aircraft closes on fixpoint, turn range and magnification selector knob progressively to decrease range and increase magnification.

j. If crosshairs do not coincide with fixpoint, turn tracking and flight controller selector knob to PRES POS CORR, depress engaging switch, center crosshairs with tracking and flight control stick, and release engaging switch. True present position indicators now show corrected latitude and longitude.

k. Turn fixpoint selector knob to PRESENT POSITION.

l. Turn search transmitter switch to OFF, if desired.

m. Turn tracking and flight controller selector knob to OFF.

n. Turn map screen brightness selector knob to OFF.

6. Heading reference selector knob—ASTRO, if possible.

7. Navigation system steering—On.

CRUISE.

1. Present position—Monitor.
2. Steering point—Check and change.
3. Star reference change—Perform.

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BEFORE ACCELERATION.

1. Ballistic data—Set.
2. Pod and ballistic malfunction check:
   a. Malfunction self test, A1 and A2—Check for test good lights.
   b. D2 and D6 test—Check for test good lights.
   c. Ballistic malfunction test knob, all positions—Check for test good lights.
3. Acceleration point—Notify pilot.

AFTER ACCELERATION.

1. Destination position indicators—Set.
2. Pre-bomb run calibrations—Perform.
3. Bomb run altitude slope—Computed.
4. Ballistic wind indicators—Check.
5. Check cg within limits.
6. Safety check:
   a. Pod safety lockpin release handle—IN.
   b. Auto release switch—OFF.

BOMB RUN. (RBS)

1. Fixpoint selector knob—Set.
2. Autopilot heading control mode switch—OFF, when within 150 miles of target.
3. Function selector knob—BOMB.
4. Request pilot to zero PDI.
5. Autopilot heading control mode switch—NAV.
6. If conditions permit, make a radar fix on the target, leaving fixpoint selector knob on selected position until after "release".
7. Pilot calls TG—300, 200, 100, 60, 30, and 20.

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8. RBS tone—On, at 20 seconds TG.

9. If automatic (tone) "release" fails, change UHF channel to interrupt tone.

AFTER BOMB RELEASE.

1. Autopilot heading control mode switch—OFF.
2. Destination position indicators—Set.
3. Function selector knob—NAVIGATION.
4. Request pilot to zero PDI.
5. Autopilot heading control mode switch—ON.
6. Auto release switch—OFF.

DESCENT AND BEFORE LANDING.

1. Autopilot heading switch—OFF.
2. Jet penetration and GCA or ILS—Monitor as required.

(3. Parachute zero-delay lanyard—Connected.)

(4. Navigator and DSO—Ready for landing.)

5. Radio altimeter switch—OFF, at 500 feet.

AFTER LANDING.

1. Inflight printer power switch—OFF.
2. Function selector knob—STANDBY.

(3. Unnecessary electrical and electronic equipment—OFF.)

ENGINE SHUTDOWN.

1. Function selector knob—GYRO or OFF.

(2. Canopy seal control—UNSEALED.)

(3. Canopies—OPEN.)

4. All switches—OFF or SAFE.

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CUT ON BLACK LINE

BEFORE LEAVING AIRPLANE.

1. Ejection seat safety pins installed.
2. Canopy lock installed.
3. Oxygen system 100% and OFF.
4. All switches OFF.

NAVIGATION SYSTEM MALFUNCTION PROCEDURES CONDENSED CHECK LIST.

DIRECT MALFUNCTIONS AND REMEDIES.

Vertical Error Lamp Lighted.

1. Place the vertical reference selector switch to AIR ERECT. If operation improves, turn to MALF; if not, return to NORMAL.

WARNING

Airplane must be flown manually when changing tables. Do not attempt use of autopilot when selected table is not fully erect.

True Airspeed Indication Drops to Zero During True Airspeed Calibration Run.

1. Airspeed computer malfunction switch—MALF.
2. Airspeed computer malfunction knob—Align with index mark.
3. True airspeed indicator—Check.

Star Lost Lamp Lighted Continuously.

1. Check star data set in astro control panel; reset any data found to be erroneous.

Pages 13 and 14 deleted.

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Pages 8-49 and 8-50 deleted.

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7. Warhead control power switch—OFF.*
8. Warhead control burst selector switch—SAFE.*
9. Auto release switch—OFF.*
10. IBDA switch—OFF.*
11. Pod pitot tube switch—RETRACT.*
12. Pod release safety lockpin release handle—In and horizontal.*

DESCENT AND BEFORE LANDING.

1. Auto steering switch—OFF.
2. Jet penetration and GCA—Monitor as required.
3. Zero-delay lanyard—Hook up at pilot's request.
4. Radio altimeter switch—OFF at 500 feet.
5. Function selector knob—TAXI & TAKEOFF.

AFTER LANDING.

1. Inflight printer power switch—OFF.
2. Function selector knob—GYRO or OFF.

ENGINE SHUTDOWN.

1. Canopy seal control lever—UNSEALED.
2. Canopy control lever—OPEN.
3. All switches OFF or safe.

BEFORE LEAVING AIRPLANE.

1. Ejection seat safety pins and canopy lock—Installed.
2. Oxygen supply lever—OFF.
3. Personal gear—Disconnected.

*Refer to T.O. 1B-58A-25-1 for amplification.

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POST FLIGHT.

1. Personal and professional equipment—Removed.
2. Form 781—Completed.

NAVIGATION SYSTEM MALFUNCTION PROCEDURES CONDENSED CHECK LIST.

DIRECT MALFUNCTIONS AND REMEDIES.

Vertical Error Lamp Lighted.

1. Place the vertical reference selector switch to AIR ERECT. If operation improves, turn to MALF; if not, return to NORMAL.

WARNING

Airplane must be flown manually when changing tables. Do not attempt use of autopilot when selected table is not fully erect.

True Airspeed Indication Drops to Zero During True Airspeed Calibration Run.

1. Airspeed computer malfunction switch—MALF.
2. Airspeed computer malfunction knob—Align with index mark.
3. True airspeed indicator—Check.

Star Lost Lamp Lighted Continuously.

1. Check star data set in astro control panel; reset any data found to be erroneous.

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2. If star lost lamp remains lighted, place astrotracker malfunction switch to MALF.

Search Radar Indicator Presentation Smeared.

1. Adjust contrast/threshold, variable threshold, crosshair, and intensity control knobs.
2. If presentation does not improve, turn search antenna malfunction switch to MALF. Aircraft roll will cause a jittered presentation when this switch is in MALF.

Search Radar Indicator Presentation Disappears.

1. Manual/automatic frequency control switch to MFC.
2. Adjust manual tuning knob to return presentation.

Programmed Video Settings Not Changing Properly During Automatic Radar Photography.

1. Contrast/threshold switch—MAN.
2. Adjust contrast/threshold and variable threshold knobs for desired settings.

Camera Malfunction Lamp Lighted.

A lighted camera malfunction lamp indicates the camera is malfunctioning or out of film. No inflight correction is provided.

SUSPECTED MALFUNCTION TEST PROCEDURE.

A-1 and A-2, Detection System.

1. Discontinue test. Malfunction detection system has failed.

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A-3, A-4, and A-5, Doppler Radar.

1. Doppler transmitter switch—OFF.
2. Airspeed-inertial switch—AIRSPEED INERTIAL.
3. Make celestial or radar position fixes as often as possible.
4. Correct groundspeed at 15-minute intervals.

A-6, A-7, A-8, and A-9, Pitch and Roll Synchro Excitation.

A-10, A-11, B-1, and B-2, Stabilization Unit Pitch and Roll Synchro.

1. Auto steering switch—OFF.
2. Vertical reference selector switch—AIR ERECT.

If operation improves, turn auto steering switch ON; if not, request manual flight, and monitor table for possible return to auto steering.

WARNING

Airplane must be in manual flight mode when switching tables.

B-3 and B-4, Doppler Data Converter and Doppler Stabilization Computer Pitch and Roll Servo.

1. Doppler transmitter switch—OFF.
2. Airspeed-inertial switch—AIRSPEED INERTIAL.
3. Make position fixes as often as possible.
4. Correct groundspeed at 15-minute intervals.

B-5, Relative Table Heading Shaft Resolver and Synchro.

1. Auto steering switch—OFF.
2. Monitor heading with astrotracker. If this is not possible, turn heading reference selector switch to FREE GYRO. Do not use FLUX VALVE position.

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2. If star lost lamp remains lighted, place astrotracker malfunction switch to MALF.

Search Radar Indicator Presentation Smeared.

1. Adjust contrast/threshold, variable threshold, crosshair, and intensity control knobs.
2. If presentation does not improve, turn search antenna malfunction switch to MALF. Aircraft roll will cause a jittered presentation when this switch is in MALF.

Search Radar Indicator Presentation Disappears.

1. Manual/automatic frequency control switch to MFC.
2. Adjust manual tuning knob to return presentation.

Programmed Video Settings Not Changing Properly During Automatic Radar Photography.

1. Contrast/threshold switch—MAN.
2. Adjust contrast/threshold and variable threshold knobs for desired settings.

Camera Malfunction Lamp Lighted.

A lighted camera malfunction lamp indicates the camera is malfunctioning or out of film. No inflight correction is provided.

SUSPECTED MALFUNCTION TEST PROCEDURE.

A-1 and A-2, Detection System.

1. Discontinue test. Malfunction detection system has failed.

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A-3, A-4, and A-5, Doppler Radar.

1. Doppler transmitter switch—OFF.
2. Make celestial or radar position fixes as often as possible.
3. Correct groundspeed at 15-minute intervals.

A-6, A-7, A-8, and A-9, Pitch and Roll Synchro Excitation.

A-10, A-11, B-1 and B-2, Stabilization Unit Pitch and Roll Synchro.

1. Auto steering switch—OFF.
2. Vertical reference selector switch—AIR ERECT.

If operation improves, turn to MALF; if not, return to NORMAL.

WARNING

Airplane must be in manual flight mode when switching tables.

B-3 and B-4, Doppler Data Converter and Doppler Stabilization Computer Pitch and Roll Servo.

1. Doppler transmitter switch—OFF.
2. Make position fixes as often as possible.
3. Correct groundspeed at 15-minute intervals.

B-5, Relative Table Heading Shaft Resolver and Synchro.

1. Auto steering switch—OFF.
2. Monitor heading with astrotracker. If this is not possible, turn heading reference selector switch to FREE GYRO. Do not use FLUX VALVE position.

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3. Servo malfunction selector knob—2.
4. Servo malfunction switch—ON.
5. Make position fix as soon as possible.
6. Set ballistic wind indicators to zero.
7. Airspeed computer malfunction switch—ON.
8. Perform manual true airspeed calibration.
9. Airspeed computer malfunction switch—MALF.
10. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed.
11. Auto steering switch—ON.

B-6, "A" Accelerometer Axis-to-North Angle Synchros and Groundspeed Resolver.

Note

The malfunction procedures for B-6 vary at different latitudes and are identified by encircled numbers.

❶ Latitude above 65°N. Place polar/non-polar switch in NON-POLAR and coordinate reference switch in TRUE.

1. Auto steering switch—OFF.
2. Heading and navigation malfunction knob—POSITION & HEADING.
3. Check true heading indication with pilot's compass (making allowance for local variation). Correct true heading indicator, if necessary, by turning heading reference selector knob to MAN SLEW + MAN SLEW — as needed.
4. Calibrate altitude.
5. Make position fix as soon as possible.
6. Auto steering switch—ON.

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❷ Latitude below 65°N. Place polar/non-polar switch on POLAR, coordinate reference switch in TRUE.

1. Auto steering switch—OFF.

2. Set transverse present position indicators at best known values of true latitude and longitude.

3. Heading and navigation malfunction knob—POSITION & HEADING.

4. Check true heading indication with pilot's compass (making allowance for local variation). Correct true heading indicator, if necessary, by turning heading reference selector knob to MAN SLEW + or MAN SLEW — as needed.

5. Calibrate altitude.

6. Make position fix as soon as possible.

7. Auto steering switch—ON.

8. When changing to transverse coordinate operation, turn heading and navigation malfunction knob to OFF. Set transverse present position indicators at best known values of transverse latitude and longitude. Compute heading as follows: aircraft heading with respect to transverse north = true aircraft heading (relative to north) minus the angle between transverse north and true north. Set in this computed heading at the true heading indicator.

❸ Latitude between 65° and 70°N. Place polar/non-polar switch in POLAR, coordinate reference switch in TRUE.

1. Auto steering switch—OFF.

2. Coordinate reference switch—TRANSVERSE.

3. Check true heading indication for correct value of transverse heading. Compute heading as follows: aircraft heading with respect to transverse north = true aircraft heading (relative to north) minus the angle between transverse north and true north. Correct true heading indicator, if necessary, by turning heading reference selector knob to MAN SLEW + or MAN SLEW — as needed.

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4. Turn heading reference selector knob to ASTRO or FREE GYRO. Do not use FLUX VALVE position.

5. Calibrate altitude.

6. Make position fix as soon as possible.

7. Auto steering switch—ON.

❹Latitude above 75°N. Place polar/non-polar switch in POLAR, coordinate reference switch in TRANSVERSE.

1. Auto steering switch—OFF.

2. Set true present position indicators at best known values of transverse latitude and longitude.

3. Heading and navigation malfunction knob — POSITION & HEADING.

4. Check true heading indication for correct value of transverse heading. Compute heading as follows: aircraft heading with respect to transverse north = true aircraft heading (relative to north) minus the angle between transverse north and true north. Correct true heading indicator, if necessary, by turning heading reference selector switch to MAN SLEW + or MAN SLEW — as needed.

5. Turn heading reference selector knob to ASTRO or FREE GYRO. Do not use FLUX VALVE position.

6. Calibrate altitude.

7. Make position fix as soon as possible.

8. Auto steering switch—ON.

9. When changing to true coordinate operation, turn heading and navigation malfunction knob to OFF. Set true present position indicators at best known values of true latitude and longitude. Correct true heading indication, if necessary, by turning heading reference selector knob to MAN SLEW + or MAN SLEW — as needed.

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❺ Latitude between 70° and 75°N. Place polar/non-polar switch in POLAR, coordinate reference switch in TRANSVERSE.

1. Auto steering switch—OFF.
2. Coordinate reference switch—TRUE.
3. Check true heading indication with pilot's compass, making allowance for local variation. Correct true heading indicator, if necessary, by turning heading reference selector to MAN SLEW + or MAN SLEW — as needed.
4. Calibrate altitude as soon as possible.
5. Make position fix as soon as possible.
6. Auto steering switch—ON.

B-7, Relative Table Heading Shaft Amplifier, Motor, and Differential Generator.

1. Auto steering switch—OFF.
2. Monitor heading with astrotracker. If this is not possible, turn heading reference selector knob to FREE GYRO. Do not use FLUX VALVE position.
3. Turn servo malfunction selector knob to 2.
4. Servo malfunction switch—ON.
5. Make position fix as soon as possible.
6. Ballistic wind indicators—zero.
7. Airspeed computer malfunction switch—ON.
8. Perform manual true airspeed calibration.
9. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed.
10. Turn auto steering switch to ON.

B-8, Stabilization Unit Relative Heading Shaft Synchro.

1. Auto steering switch—OFF.
2. Turn vertical reference selector switch to AIR ERECT. If operation improves, turn to MALF; if not, return to NORMAL.

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WARNING

Airplane must be in manual flight mode when switching tables.

3. Make position fix as soon as possible.
4. Auto steering switch—ON.

B-9, Relative Table Heading Shaft Ground Speed Resolver.

Note

The test bad lamp will remain lighted, even after remedial action.

1. Set ballistic wind indicators at zero.
2. Turn airspeed computer malfunction switch to ON.
3. Perform manual true airspeed calibration.
4. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed.
5. Disregard test lamp indications on D-2 and D-4.

B-10, "A" Accelerometer Axis-to-North-Angle Shaft Earth Rate Resolver.

1. Turn heading and navigation malfunction knob to EARTH RATE.

2. Disregard transverse present position indicators if operating in true coordinate zone.

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B-11, "A" Accelerometer Axis-to-North-Angle Integrator.

1. Heading integrator malfunction switch—MALF.

C-1, True or Transverse Latitude Integrator.

The malfunction procedures for C-1 are the same as listed for B-6.

C-2, True or Transverse Longitude Rate Resolver.

Use same remedial procedures as listed for B-6.

C-3, True or Transverse Longitude Integrator.

Use same remedial procedures as listed for B-6.

C-4, and C-5, True or Transverse Latitude and Longitude Synchro Excitation.

Use same remedial procedures as listed for B-6.

C-6, and C-7, True or Transverse Latitude and Longitude Synchro Transmitter.

Use same remedial procedures as listed for B-6.

C-8, Latitude Earth Rate Resolver.

1. Heading and navigation malfunction knob—EARTH RATE.
2. Disregard transverse present position indicators if operating in true coordinate zone.
3. When changing to transverse coordinate operation, place heading and navigation malfunction knob to POSITION & HEADING, and set transverse latitude and longitude on the present position indicators.

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C-9, True or Transverse Latitude — "B" Angle Resolver.

Operating in transverse coordinate zone.

1. Heading and navigation malfunction knob to EARTH RATE.
2. Do not use POSITION & HEADING position at any time.

Operating in true coordinate zone.

1. Disregard transverse present position indicators.
2. Do not use EARTH RATE position of heading and navigation malfunction knob.
3. When changing to transverse coordinate operation, turn heading and navigation malfunction knob to OFF.

C-10, True or Transverse Longitude — "B" Angle Resolver.

Operating in transverse coordinate zone.

1. Heading and navigation malfunction knob to EARTH RATE.

Operating in true coordinate zone.

1. Disregard transverse present position indicators.
2. When changing to transverse coordinate operation, place heading and navigation malfunction knob to OFF.

C-11, "B" Angle Servo Null.

Operating in the true coordinate zone.

1. Disregard transverse present position indicators.
2. Turn heading and navigation malfunction knob to OFF.
3. When changing to transverse coordinate operation, turn heading and navigation malfunction knob to POSITION & HEADING.

Operating in transverse coordinate zone.

1. Do not use FLUX VALVE position of heading reference selector knob.
2. Disregard true present position indicators.

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D-1, Stabilization Unit Output Velocity.

1. Auto steering switch—OFF.
2. Vertical reference selector switch—AIR ERECT. If operation improves, turn to MALF; if not, return to normal.

WARNING

Airplane must be in manual flight mode when switching tables.

3. Make position fix as soon as possible.
4. Auto steering switch—ON.

D-2, True Heading Assembly.

1. Servo malfunction selector knob—6.
2. Servo malfunction switch—ON.
3. Disregard true heading indication for remainder of flight.

D-3, Groundtrack Computer.

1. Auto steering switch—OFF.
2. Servo malfunction selector knob—5.
3. Servo malfunction switch—ON.
4. Auto steering switch—ON.
5. Disregard groundtrack indication for remainder of flight.
6. Do not attempt automatic radar photography or constant groundtrack steering.

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D-4, Groundtrack Computer Drift Differential Generator.

Disregard test bad light. Proceed to next test position.

D-5, Distance to Destination.

Disregard distance to destination indication for remainder of flight.

D-6, Altitude Above Sea Level Assembly.

1. Time-to-go servo malfunction switch—NORM.
2. Sight malfunction switch—OFF.
3. Altitude malfunction switch—MALF.
4. Make altitude calibration run.
5. Read altitude above sea level on altitude above terrain indicator for remainder of flight.

Note

Before selecting D-7, move the fixpoint selector knob to MANUAL and the aimpoint selector knob to FIX. Set fixpoint position elevation indicator at 1000 feet.

D-7, Fixpoint Elevation Assembly.

❶ Test good lamp lighted.

1. Set all elevation indicators on the offset and storage panel at 1000 feet.
2. Turn fixpoint selector knob to 1, and wait for test good or test bad lamp indication. If test bad lamp lights, storage fixpoint 1 elevation indicator cannot be used.

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3. Turn fixpoint selector knob to 2, and wait for test good or test bad lamp indication. If test bad lamp lights, storage fixpoint 2 elevation indicator cannot be used. Return fixpoint selector knob to MANUAL.

4. Turn aimpoint selector knob to 1, and wait for test good or test bad lamp indication. If test bad lamp lights, offset aimpoint 1 elevation indicator cannot be used.

5. Turn aimpoint selector knob to 2, and wait for test good or test bad lamp indication. If test bad lamp lights, offset aimpoint 2 elevation indicator cannot be used. Return aimpoint selector knob to FIX.

6. Reset all elevation indicators on offset and storage panel to original settings.

If the test bad lamp lights with this system configuration, proceed with the following steps.

❷ Test bad lamp lighted with fixpoint selector knob MANUAL, aimpoint selector knob FIX, and fixpoint position elevation indicators at 1000 feet.

1. Set offset aimpoint 1 and offset aimpoint 2 N-S and E-W indicators at zero.

2. Set elevation of next fixpoint on offset aimpoint 1 (or 2) elevation indicator.

3. When making radar fix, turn aimpoint selector knob to 1 (or 2).

4. When making subsequent altitude calibration runs, proceed as follows:

a. Time-to-go servo malfunction switch—NORM.

b. Sight malfunction switch—OFF.

c. Altitude malfunction switch—MALF.

d. Record value of altitude above terrain now appearing on the altitude-above-sea level indicator.

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e. Altitude malfunction switch—OFF.

f. Compute altitude above sea level by adding known value of terrain elevation to recorded value of altitude above terrain.

g. Adjust altitude correction knob until the altitude-above-sea level indicator shows computed value of altitude above sea level.

D-8, Sighting Shafts Control Transformer Null.

❶ If the function selector knob is in NAVIGATION.

1. Fixpoint selector knob—PRESENT POSITION.

2. Compare indications of fixpoint position latitude and longitude indicators with true (or transverse) present position latitude and longitude indicators. If within 5 minutes of agreement, system will operate normally. If not within 5 minutes of agreement, astro computer and great circle computer are inoperative, and steering must be done as follows:

a. Auto steering switch—OFF.

b. Request pilot to use constant ground track autopilot mode, or have pilot fly a manually plotted course. Auto steering switch must be ON to fly constant groundtrack.

c. Heading reference selector knob—FREE GYRO.

d. After 5 hours, turn heading reference selector knob to FLUX VALVE, unless in polar regions.

3. Do not use automatic radar photography functions, or fixpoint position latitude and longitude indicators.

4. To make a radar fix, proceed as follows:

a. Time-to-go servo malfunction switch—NORM.

b. Altitude malfunction switch—OFF.

c. Sight malfunction switch—MALF.

d. Set latitude and longitude of fixpoint on destination position indicators. (Now readable to 0.1 minute.)

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e. Set altitude above sea level of fixpoint on fixpoint position elevation indicator.

f. Aimpoint selector knob—FIX.

g. Turn search transmitter switch to ON and adjust for optimum indicator presentation.

h. Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

i. Search transmitter switch—OFF.

5. To determine position of unknown point, proceed as follows:

a. Turn fixpoint selector knob to MANUAL, and aimpoint selector knob to FIX.

b. Set elevation of unknown point on fixpoint position elevation indicator.

c. Time-to-go servo malfunction switch—NORM.

d. Altitude malfunction switch—OFF.

e. Turn sight malfunction switch to MALF.

f. Turn search transmitter switch ON and adjust for optimum indicator presentation.

g. Adjust destination position knobs until image of unknown point is centered under crosshairs. Destination position indicators now show latitude and longitude of unknown point.

h. Search transmitter switch—OFF.

❷ If the function selector knob is in BOMB.

1. Heading reference selector knob—FREE GYRO.

2. Do not use automatic radar photography functions, or fixpoint position latitude and longitude counters.

3. Turn time-to-go servo malfunction switch to NORM, and altitude malfunction switch to OFF.

4. Sight malfunction switch—MALF.

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5. Set latitude and longitude of target on destination position indicators. (Now readable to 0.1 minute.)

6. Set target altitude above sea level on fixpoint position elevation indicator.

7. To make a radar fix on the target, proceed as follows:

a. Aimpoint selector knob—FIX.

b. Turn search transmitter switch to ON, and adjust for optimum indicator presentation.

c. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

d. Search transmitter switch—OFF.

8. If the target position is not known accurately, proceed as follows:

a. Aimpoint selector knob—FIX.

b. Place search transmitter switch to ON, and adjust for optimum indicator presentation.

c. Adjust destination position knobs until target image is centered under crosshairs.

d. Destination position indicators now show target latitude and longitude.

e. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

f. Search transmitter switch—OFF.

D-9, Sighting Control Transformer Null and Airplane Latitude — Fixpoint Latitude Difference.

❶ If function selector knob is in NAVIGATION.

1. Turn fixpoint selector knob to PRESENT POSITION.

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2. If the fixpoint position latitude and longitude indicators agree within ±5 minutes with the true (or transverse) present position indicators, proceed as follows:

a. With auto steering switch at ON, monitor progress of flight profile under automatic great circle steering.

b. If course appears satisfactory, continue automatic steering; if not, turn auto steering switch to OFF, and have pilot fly a manually plotted course. The heading reference selector knob may remain at ASTRO as long as the star lost lamp does not light.

c. If the star lost lamp lights and remains lighted, turn heading reference selector knob to FREE GYRO.

d. After 5 hours turn heading reference selector knob to FLUX VALVE unless in polar area.

e. To make a radar position fix, accomplish the following:

(1) Auto steering switch—OFF.

(2) Turn time-to-go servo malfunction switch to NORM, and altitude malfunction switch to OFF.

(3) Sight malfunction switch—MALF.

(4) Set fixpoint latitude and longitude in destination position indicators (now readable to 0.01 minute).

(5) Set fixpoint altitude above sea level in fixpoint position elevation indicator.

(6) Aimpoint selector knob—FIX.

(7) Turn search transmitter switch to ON, and adjust for optimum indicator presentation.

(8) Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

(9) Search transmitter switch—OFF.

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3. If the fixpoint position latitude and longitude indicators do not agree within ±5 minutes with the true (or transverse) present position indicators, proceed as follows:

a. Auto steering switch—OFF.

b. Use constant heading control mode of the autopilot, or have pilot fly a manually plotted course. Turn heading reference selector knob to FREE GYRO.

c. After 5 hours turn to FLUX VALVE unless in polar area.

d. Do not use automatic radar photography functions, or fixpoint position latitude and longitude indicators.

e. To make a radar position fix, proceed as follows:

(1) Turn time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF.

(2) Sight malfunction switch—MALF.

(3) Set fixpoint latitude and longitude on destination position indicators (now readable to 0.1 minute).

(4) Set fixpoint altitude above sea level on fixpoint position elevation indicator.

(5) Aimpoint selector knob—FIX.

(6) Turn search transmitter switch to ON and adjust for optimum indicator presentation.

(7) Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

(8) Search transmitter switch—OFF.

❷ If function selector knob is in BOMB.

1. If star lost lamp remains unlighted, heading reference selector knob may be left at ASTRO; if not, turn to FREE GYRO.

2. Do not use automatic radar photography functions or fixpoint position latitude and longitude indicators.

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3. Turn time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF.

4. Sight malfunction switch—MALF.

5. Set target latitude and longitude on destination position indicators (now readable to 0.1 minute).

6. Set target altitude above sea level on fixpoint position elevation indicator.

7. To make a radar fix on the target, proceed as follows:

a. Aimpoint selector knob—FIX.

b. Turn search transmitter switch to ON and adjust for optimum indicator presentation.

c. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

d. Search transmitter switch—OFF.

D-10, Sighting Circuits, Sine Airplane Latitude and Fixpoint Latitude Difference Cosine Latitude of Fixpoint and Offset Aimpoint.

❶ If the function selector knob is in NAVIGATION.

1. To make a radar position fix, proceed as follows:

a. Auto steering switch—OFF.

b. Place time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF.

c. Sight malfunction switch—MALF. Test bad lamp should now go out.

d. Set fixpoint latitude and longitude on destination position indicators (now readable to 0.1 minute).

e. Set fixpoint altitude above sea level on fixpoint position elevation indicator.

f. Aimpoint selector knob—FIX.

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g. Turn search transmitter switch to ON and adjust for optimum indicator presentation.

h. Adjust true (or transverse) present position knobs until fixpoint image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

i. Search transmitter switch—OFF.

j. Auto steering switch—ON.

2. To determine position of unknown point, proceed as follows:

a. Turn fixpoint selector knob to MANUAL and aimpoint selector knob to FIX.

b. Set elevation of unknown point on fixpoint position elevation indicator.

c. Auto steering switch—OFF.

d. Place time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF.

e. Sight malfunction switch—MALF.

f. Adjust destination position knobs until image of unknown point is centered under crosshairs. Destination position indicators now show latitude and longitude of unknown point.

g. Search transmitter switch—OFF.

h. Auto steering switch—ON.

❷ Function selector knob at BOMB.

1. Do not use automatic radar photography functions, or fixpoint position latitude and longitude indicators.

2. Turn time-to-go servo malfunction switch to NORM and altitude malfunction switch to OFF.

3. Turn sight malfunction switch to MALF. Test bad lamp should now go out.

4. Set target latitude and longitude on destination position indicators (now readable to 0.1 minute).

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5. Set target altitude above sea level on fixpoint position elevation indicator.

6. To make a radar fix on the target, proceed as follows:

a. Aimpoint selector knob—FIX.

b. Turn search transmitter switch to ON and adjust for optimum indicator presentation.

c. Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

d. Search transmitter switch—OFF.

7. If the target location is not accurately known, proceed as follows:

a. Aimpoint selector knob—FIX.

b. Turn search transmitter switch to ON and adjust for optimum indicator presentation.

c. Adjust destination position knobs until target image is centered under crosshairs. Destination position indicators now show latitude and longitude of target.

d. Make radar position fix as follows:

(1) Aimpoint selector knob—FIX.

(2) Turn search transmitter switch to ON, and adjust for optimum indicator presentation.

(3) Adjust true (or transverse) present position knobs until target image is centered under crosshairs. Present position indicators now show corrected aircraft latitude and longitude.

(4) Search transmitter switch—OFF.

D-11, Sighting Circuits, Correction to North Ground Range Due to Variation of Earth Radius.

Use same remedial procedures as for D-10.

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D-12, Sighting Circuits, Correction to East Ground Range Due to Variation of Earth Radius, and Airplane Latitude Fixpoint Latitude Difference Correction.

Use same remedial procedures as for D-10.

E-1, Aimpoint Bearing Assembly, North Component of Ground Range to Aimpoint.

1. Servo malfunction selector knob—3.
2. Servo malfunction switch—ON.

Note

The remedial procedures listed for E-1 will be used for the following knob positions E-2, E-3 and E-4.

E-2, Aimpoint Bearing Assembly, East Component of Ground Range to Aimpoint.

E-3, Aimpoint Bearing Assembly, True Bearing of Radar Ground Target and Ground Range to Aimpoint.

E-4, Aimpoint Bearing Assembly, True Bearing of Radar Ground Target and True Airplane Heading.

E-5, Sighting Angle Assembly, Airplane to Fixpoint Altitude.

1. Servo malfunction selector knob—4.
2. Servo malfunction switch—ON.
3. Adjust antenna tilt knob for optimum indicator presentation.

E-6, Sighting Angle Assembly.

Use same remedial procedures as for E-5.

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E-7, Course Angle Computer.

1. Auto steering switch—OFF.
2. Servo malfunction selector knob—1.
3. Servo malfunction switch—ON.
4. Auto steering switch—ON.

Note

For knob positions E-8 through E-11, use same remedial procedures as for E-7.

E-8, Course Angle Computer, North Component of Ground Range to Target.

Function selector knob—BOMB.

E-9, Course Angle Computer, East Component of Ground Range to Target.

Function selector knob—BOMB.

E-10, Course Angle Computer Servo Null and Synchro.

E-11, Course Angle Computer Resolver Output.

E-12, Airspeed Computer and Mach Source.

1. Airspeed computer malfunction switch—MALF.
2. Turn airspeed computer malfunction knob to index mark.
3. Compare true airspeed indication with pilot's airspeed indicator If in approximate agreement, leave airspeed computer malfunction switch at MALF and make manual true airspeed calibration.

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4. Adjust airspeed computer malfunction knob until true airspeed indicator reads calculated value of true airspeed.

5. If true airspeed indicator does not read properly, proceed as follows:

a. Airspeed computer malfunction switch—OFF.

b. Machmeter malfunction switch—MALF.

c. Adjust airspeed computer malfunction knob until true airspeed indicator agrees with pilot's airspeed indicator.

d. If true airspeed indication drops to zero during automatic true airspeed calibration runs, adjust airspeed computer malfunction knob until true airspeed indicator begins to indicate.

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B/RB-58A
DEFENSIVE SYSTEM OPERATOR'S CONDENSED CHECK LIST

AIRPLANE DESIGNATION CODING.

31	59-2428	34	59-2431	37	59-2434
32	59-2429	35	59-2432	38	59-2435
33	59-2430	36	59-2433	➧	"through" or "and on"

Example: Information applicable to airplanes AF 59-2428 through AF 59-2430 would be coded 31 ➧ 33 . Information applicable to airplanes AF 59-2433 and on would be coded 36 ➧ .

STATIONS INSPECTION.

1. Stations inspection—Completed.

POWER-OFF INTERIOR INSPECTION.

1. Canopy lock—Installed.
2. Ejection seat safety pins (3)—Installed.
3. Canopy actuator and seal—Check.
4. Liquid container—Check.
5. Exterior emergency canopy jettison access door—Secure.
6. Left and right windows—Check.
7. Ejection seat, survival kit and parachute—Check.
8. Escape rope—Check.
9. D-C power panel—Check.
10. Relief container—Empty.

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11. Left a-c power panel—Check.
12. Cabin warm air selector—OFF.
13. A/A IFF master switch—OFF.
14. MD-7 manual fire control panel:
    a. Master switch—OFF.
    b. Marker generator switch—OFF.
15. Interphone panel—Set.
16. VGH recorder power switch—OFF. 35
17. ALQ-16 track breaker power switch—OFF.
18. ALR-12 radar warning power switch—OFF.
19. MD-7 radar fire control panel:
    a. Fire-safe switch—SAFE (safetied).
    b. Function controls (4)—CCW.
20. ALQ-15 radar confusion power switch—OFF.
21. Right a-c power panel—Check.
22. Report to pilot—DSO power-off checks completed.

POWER-ON INTERIOR INSPECTION.

(1. Bailout warning lamp—Checked.)

(2. Oxygen and interphone—On call, on normal, oxygen check completed.)

(3. High voltage d-c power—Checked.)

(4. Command radio—Checked.)

(5. Fuel, hydraulic and oxygen quantities—Recorded.)

6. Seat—Adjust.
7. Left a-c power panel—Check.
8. A/A IFF master switch—STBY.
9. VGH recorder power switch—ON. 35
10. Fire control fuse—RADAR 1A pulled out (if applicable).

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CUT ON BLACK LINE

11. MD-7 fire control master switch—STBY, lights press-to-test.
12. ALQ-16 track breaker power switch—STBY, lights press-to-test.
13. ALR-12 radar warning power switch—POWER, lights press-to-test.
14. ALQ-15 radar confusion power switch—STBY, lights press-to-test.
15. Right a-c power panel—Check.
16. Interior lights—Check.
17. Mask defog—OFF.
18. ALR-12 radar warning (after 30 second warm-up):
    a. Interphone DECM mixing switch—DECM.
    b. Audio selector—Check and set.
19. ALQ-16 track breaker (after 3 minute warm-up):
    a. Power switch—ON.
    b. Test button—Press momentarily.
    c. Power switch—STBY.
20. ALQ-15 radar confusion (after 3 minute warm-up):
    a. Power switch—ON.
    b. Test button—Press momentarily.
    c. Power switch—STBY.
21. MD-7 fire control system scope dimming knob—As desired.

EXTERIOR INSPECTION.

There is no specified exterior inspection for the DSO. The items peculiar to DSO functions are checked visually by the pilot as part of his Exterior Inspection.

BEFORE STARTING ENGINES.

STARTING ENGINES.

BEFORE TAXIING.

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CUT ON BLACK LINE

TAXIING.

BEFORE LINE-UP.

TAKEOFF.

AFTER TAKEOFF.

There are no specified check lists for the DSO in the above areas. He will read the pilot's check lists to him and respond to the applicable common response items indicated.

CRUISE.

1. Fuel management schedule—Advise pilot as necessary.
2. CG and gross weight—Check periodically.
3. Fire control system—Target acquisition check as desired.

a. Master switch—OPR (after 5-15 minutes at STBY).

b. Receiver gain control knob—CW until targets or noise appears.

Note

Check that target warning lamp lights when antenna sweeps target.

c. Scope gain and storage control knobs—As required.

d. Erase button—Press momentarily to clear scope.

e. Marker generator switch—ON if range markers required for test lock-on.

f. Cursor button—Press and hold.

g. Manual control handle—Adjust to place cursor on selected target.

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CUT ON BLACK LINE

h. Manual button—Press and release for lock-on.

Note

Check that ready-fire lamp lights after lock-on when target is within range.

i. Resume search button—Press momentarily to break lock.

j. Antijam button—Press if required.

k. ATA range control knob—CW to set desired range on future range meter.

l. Resume search button—Press momentarily to break lock.

4. Active defense system—Live firing as required.

a. Range clearance—As required.

b. Fire control system target acquisition—Perform as in step 3.

c. Burst length control knob—Set at 0.6.

d. Fire control fuse—RADAR 1A inserted.

e. Safe-fire switch—FIRE.

f. Scope—Observe to clear area.

WARNING

Maintain scope vigilance throughout training firings. If a malfunction disables the radar system, cease firing immediately.

g. Firing button—Press for each burst.

h. Safe-fire switch—SAFE and safetied at end of firing run.

i. Master switch—STBY.

j. Scope control knobs—Fully CCW.

5. DECM equipment—Operation as required.

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CUT ON BLACK LINE

BEFORE ACCELERATION.

DURING ACCELERATION.

DECELERATION.

DESCENT.

BEFORE LANDING (SHORT).

BEFORE LANDING.

AFTER LANDING.

ENGINE SHUTDOWN.

There are no specified check lists for the DSO in the above areas. He will read the pilot's check list to him and respond to the applicable common response items indicated.

BEFORE LEAVING AIRPLANE.

1. Ejection seat safety pins installed.
2. Canopy lock installed.
3. Oxygen system 100% and OFF.
4. All switches OFF.

Pages 7 and 8 deleted.

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Pages 8-81 and 8-82 deleted.

section IX all weather operation

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TABLE OF CONTENTS.

INTRODUCTION: In general, this section consists of preliminary-type procedures and information which differ from, or is supplementary to, the normal operating instructions of Sections II and IV. In some cases, however, repetition has been necessary for emphasis, clarity, or continuity of thought. The contents of this section will be expanded and improved as additional procedures and information become available. Refer to Section VII for information concerning complex systems operation.

• INSTRUMENT FLIGHT PROCEDURES •

The following procedures and techniques are provided only for supplementing normal procedures during instrument flight conditions. Due to the variations in facilities and terrain from one base to another, this information should serve only as a guide to commanders in setting up uniform procedures for instrument flight. The supersonic speed and high performance capabilities of the airplane during instrument flight conditions demand that the pilot (and crew) be proficient in instrument flight techniques and conscientious in mission planning. Inflight maneuvers should be limited to a 30° bank angle where possible.

INSTRUMENT TAKEOFF.

Complete the normal procedures of Section II through the BEFORE TAKEOFF. Check that the navigator has positioned the navigation interlock switch to OVERRIDE to assure uninterrupted operation of the attitude indicator and the radio magnetic indicator (RMI).

typical jet penetration

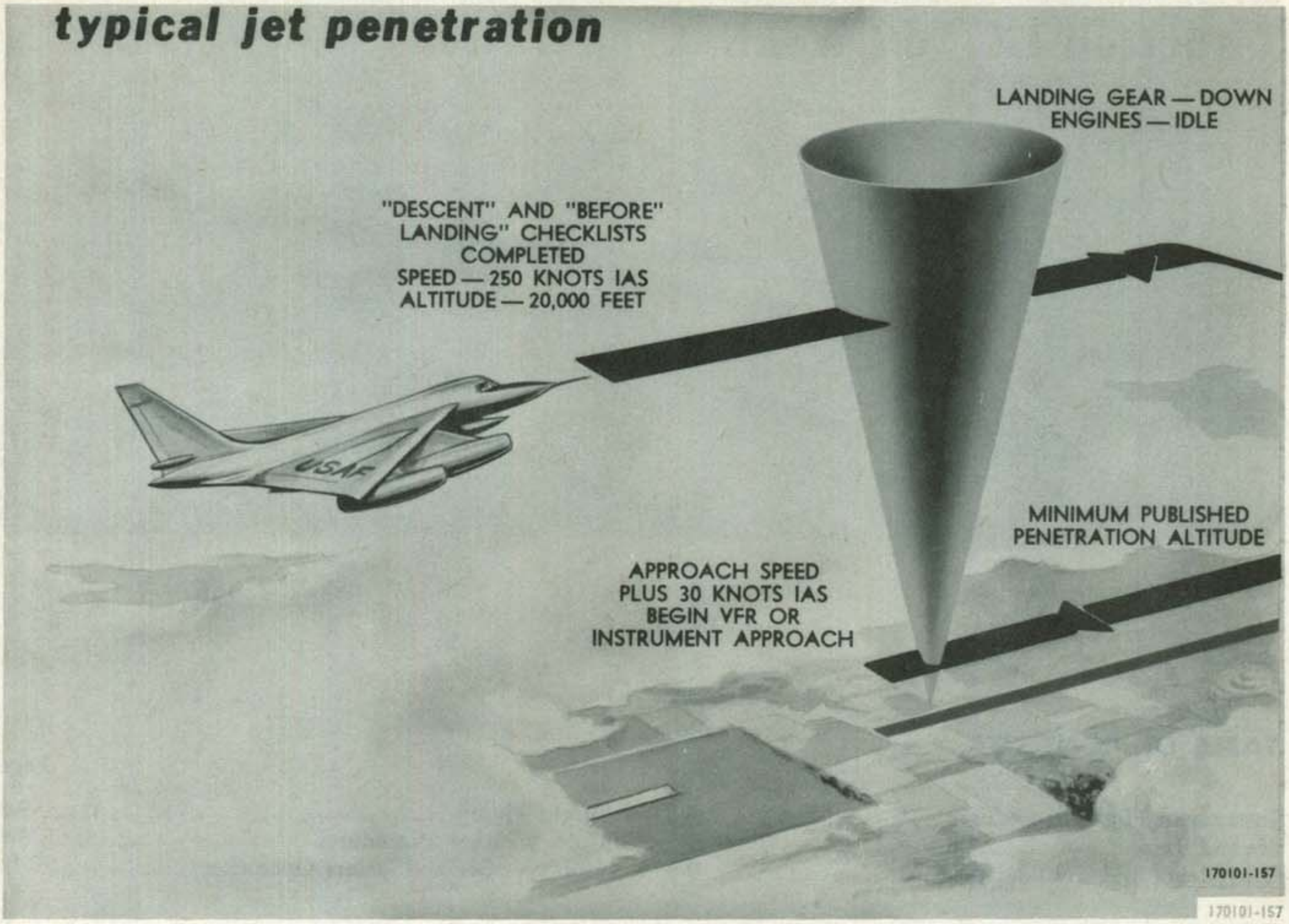

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Figure 9-1. (Sheet 1 of 2)

With the airplane aligned on the runway and ready for takeoff, check the indications of the RMI and the magnetic compass against the known runway heading.

WARNING

The anti-collision lights should be turned OFF during instrument flight conditions where the pilot could experience vertigo as a result of cloud reflections emanating from the lights. In addition, the lights would be ineffective for anti-collision purposes since it could not be observed by pilots of other aircraft.

Instrument takeoffs may be made either at MIL or MAX A/B throttle power settings. MAX A/B is recommended during conditions of poor visibility to shorten takeoff roll. Advance throttles to MIL with brake pedals depressed. For maximum thrust takeoffs, advance throttles to MIN A/B to obtain light-off; then release brakes and advance throttles to MAX A/B. Directional control should be maintained with nose wheel steering until rudder becomes effective at approximately 70 knots IAS. The RMI should be closely monitored for maintaining airplane heading on the runway but reference should also be made to the runway centerline or the runway lights if possible. All landing gear should remain in contact with runway until unstick speed is reached; then, apply back stick pressure and rotate the airplane to the 14° nose up takeoff attitude with reference to the attitude indicator. (Refer to Appendix I for unstick speed.) The airplane will become airborne with the change in attitude.

INSTRUMENT CLIMB.

Brake wheels and then retract landing gear after a definite climb indication is noted on the vertical velocity indicator. Bank angles of 30° should not be exceeded during climb.

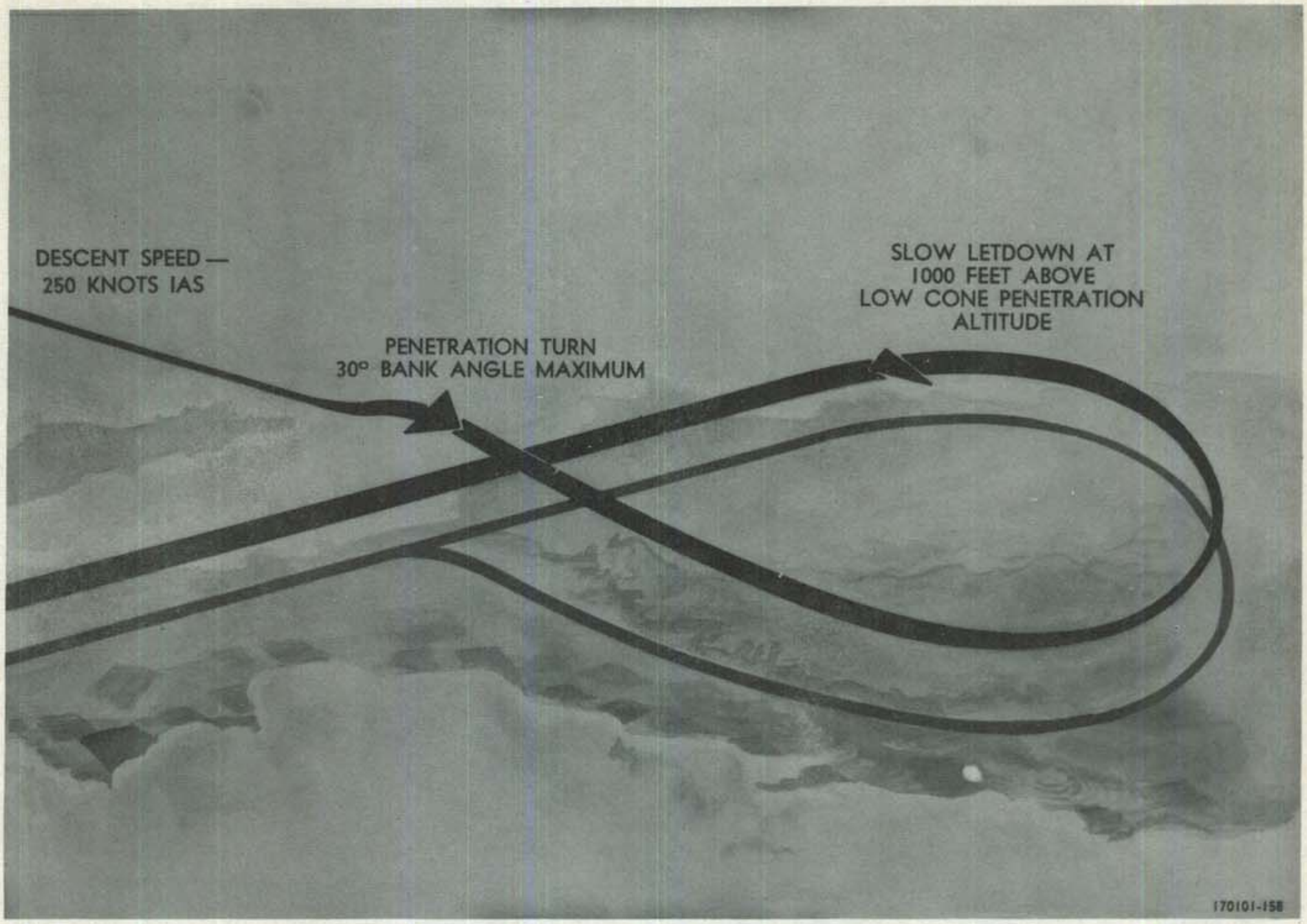


Figure 9-1. (Sheet 2 of 2)

INSTRUMENT CRUISING FLIGHT.

The flight characteristics of the airplane permit supersonic flight during instrument cruise conditions. In general, instrument cruise procedures do not differ from normal flight procedures. Refer to Section VI for cruising characteristics at high speed.

DESCENT.

Instrument descent should be made with landing gear down at a speed of 250 knots IAS and with all engine throttles retarded to IDLE. The recommended cg for descent is 29% MAC. Refer to Appendix I for the expected fuel flow, distance, and time required for descending.

HOLDING.

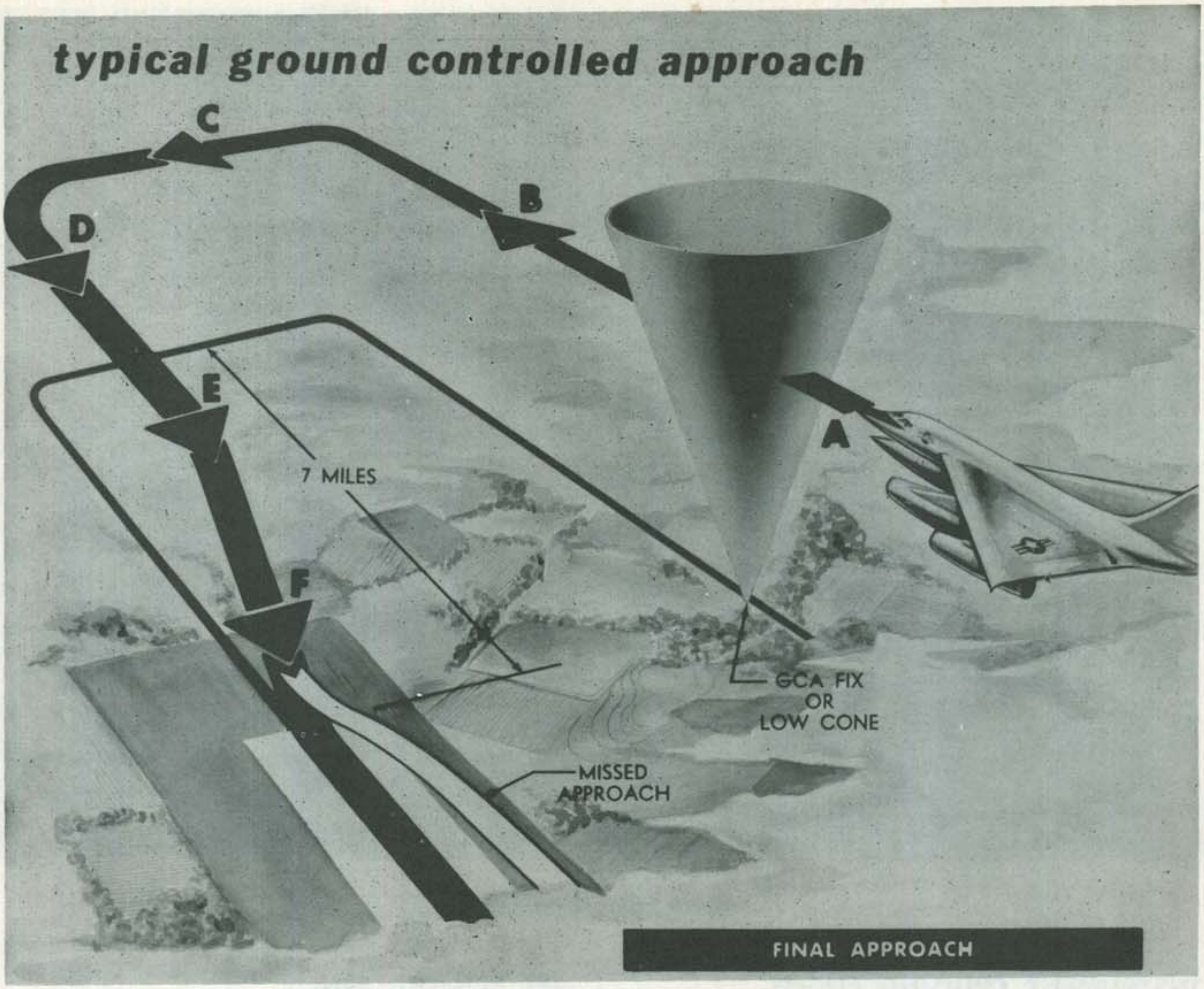
Holding should be accomplished at 20,000 feet or above, if possible, with landing gear extended. The recommended airspeed, CG, and the expected fuel flow are shown in Appendix I.

JET PENETRATION.

Jet penetrations should be accomplished according to the JAL (jet approach and landing) charts as shown in the Jet Pilot's Handbook and will vary at different bases. Both the DESCENT and the BEFORE LANDING checklists of Section II should be accomplished before crossing the upper penetration cone provided no holding is required. The penetration descent can be accomplished either with landing gear up or down. It is recommended, however, that the gear be extended during the initial descent after crossing the upper cone.

WARNING

Do not exceed landing gear structural airspeed limits during gear extension or during descent with gear down.



INITIAL APPROACH

A Contact approach control of destination for release to GCA. When cleared by approach control, contact GCA on appropriate frequency. The local GCA traffic director may give instructions for identification turns. After positive identification is made on radar screen, the pilot will be directed into the GCA traffic pattern. At this time the pilot normally will receive information on the latest weather, direction of landing, length of runway, and other pertinent data.

B Continue straight and level flight on downwind leg. Accomplish Before Landing Check if not already completed. Decelerate to an airspeed equal to gross weight plus 130 knots. (Example: if gross weight is 72,000 pounds, airspeed should be 72 + 130 or 202 knots IAS.)

C Continue straight and level flight on base leg. Prior to turning on final approach, decelerate to an airspeed equal to gross weight plus 120 knots.

FINAL APPROACH

D After completion of turn on final approach, continue straight and level flight and decelerate to an airspeed equal to gross weight plus 100 knots. Select final controller frequency and establish radio contact with final controller.

E Upon instructions from final controller, reduce power to achieve desired rate of descent along glide path. Final controller will inform pilot when GCA minimum altitude is reached. Maintain airspeed at gross weight plus 100 knots.

F If visual contact is established at GCA minimum altitude, continue approach and perform normal VFR flare and landing.

NOTE

If visual contact has not been established at GCA minimum altitude, retract the landing gear and execute a missed approach to specified altitude and heading. Contact appropriate radio facility for further instructions.

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Figure 9-2.

In general, descent should be accomplished at 275 knots IAS and at a descent rate of 5000 feet per minute; the outboard engine throttles should be at IDLE and the inboard engine throttles should be either at IDLE or as required for maintaining airspeed. If windshield defog is required during descent, it will be necessary to advance the inboard engine throttle settings to increase the warm air distribution from the air conditioning system. See figure 9-1 for a typical jet penetration.

INSTRUMENT APPROACHES.

GCA, manual ILS, or automatic approaches are readily accomplished using standard procedures. Flight characteristics during instrument approaches are satisfactory. Make all turns standard rate, not exceeding 30 degrees of bank. On final approaches, maintain airspeed at gross weight plus 100 knots. (Example: if gross weight is 72,000 pounds, airspeed should be 172 knots IAS.) This airspeed should be sufficient to prevent extreme nose high attitudes on the glide path.

WARNING

Avoid extreme nose high attitudes on the glide path. With a high angle of attack, an excessive sink rate may develop unnoticed.

After a safe pitch attitude is established, use throttle to make minor glide path corrections.

GROUND CONTROLLED APPROACH.

Figure 9-2 presents typical GCA procedures for a rectangular pattern. For a straight-in approach, the initial procedures are accomplished as far out as possible prior to entering the final approach phase.

MANUAL ILS APPROACH.

Manual ILS approaches may be accomplished using the airplane CNAS equipment in conjunction with standard ILS ground equipment. CNAS equipment is described in Section IV. Procedures for a typical ILS approach are presented in figure 9-3. Patterns must be flown according to published data on JAL charts in the Jet Pilot's Handbook.

AUTOMATIC APPROACH.

Automatic approaches are accomplished using the autopilot in conjunction with standard ILS equipment. A flight path coupler enables the autopilot to guide the airplane according to localizer and glide path beam signals received by the CNAS equipment. Refer to "Autopilot System" and "Civil Navigational Aids System," Section IV, for descriptions of the autopilot control modes and CNAS equipment. Complete procedures for automatic approach have not yet been fully established. Such procedures will be included after completion of further testing.

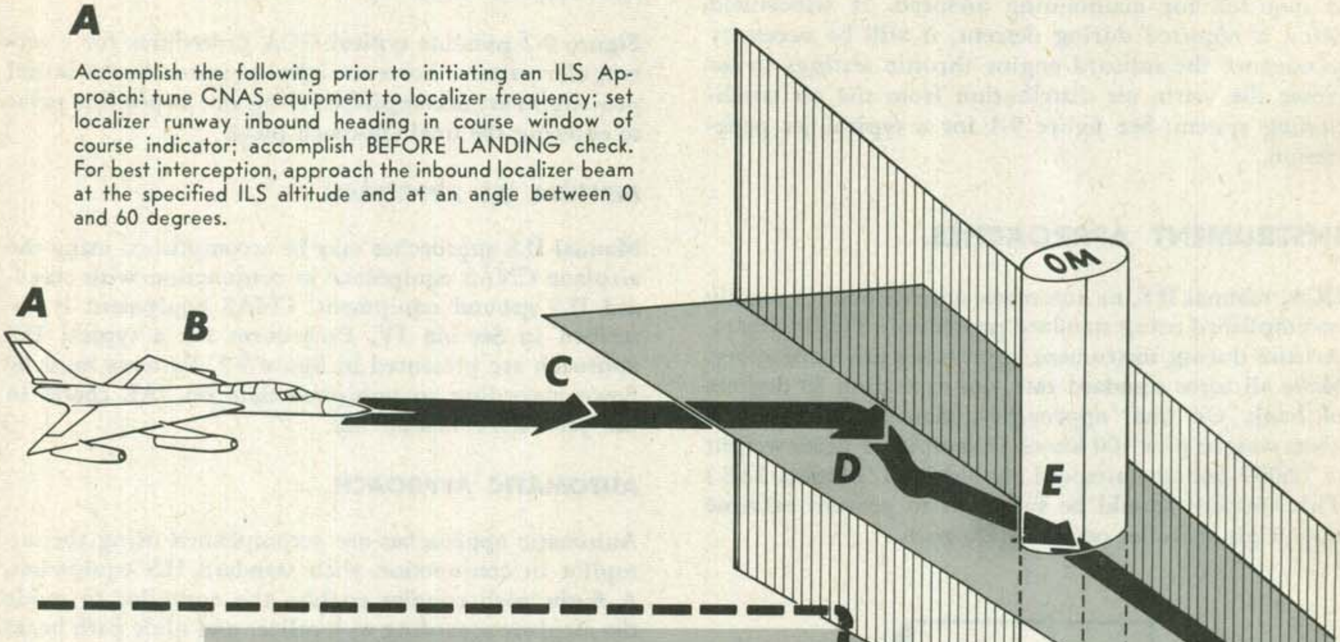
• ICE AND RAIN •

Icing conditions may be encountered during instrument (or VFR) flight, especially during takeoff and initial climb or during approach and landing. Sustained flight in heavy icing conditions is not recommended. Normal flight, however, will usually be accomplished above the altitudes where ice formation is most common. The high performance capabilities of the airplane should be utilized to avoid extreme icing conditions. When heavy icing is unavoidably encountered, a change in altitude, course, or increase in speed should be quickly accomplished to prevent ice from accumulating on the wings, vertical fin, and nacelles. Substantial ice buildups can necessitate increased power settings for maintaining airspeed and could cause distortions in the shape of airfoil surfaces, thus affecting the lift and handling characteristics of the airplane. Either of these conditions would tend to reduce the range of flight. Ice accumulations on the nacelle inlets could partially restrict the engine inlet air flow and cause increases in the exhaust temperatures. Also, the nacelle ice could enter the engine causing reductions in thrust capabilities and, in extreme cases, the ice could cause engine flameout or internal engine damage. Recent tests, however, indicate that flight during light to moderate icing conditions can be safely accomplished using normal existing procedures. The pitot anti-icing system should be in operation at all times when icing conditions exist or when icing is anticipated. The windshield defog and rain removal systems should be operated as required during adverse weather flight. Both pitot anti-icing and the defog and rain removal are extremely important for use during instrument flight involving takeoff, climb, descent, approach, and landing. The rain removal system assures adequate visibility during moderate to heavy rains. In extremely heavy rain, vision may be impaired but some vision will usually be possible. In the event of heavy rain (or icing) during descent, approach, or landing, the engine power settings should be increased as required so that sufficient air flow will be maintained for rain removal.

typical ils approach

A

Accomplish the following prior to initiating an ILS Approach: tune CNAS equipment to localizer frequency; set localizer runway inbound heading in course window of course indicator; accomplish BEFORE LANDING check. For best interception, approach the inbound localizer beam at the specified ILS altitude and at an angle between 0 and 60 degrees.



B

Plan to intercept the localizer beam at a point which will allow overshoot correction before reaching outer marker. Maintain altitude and heading. Decelerate to an airspeed equal to gross weight plus 100 knots (Example: if gross weight is 72,000 pounds, decelerate to 172 knots IAS).

C

Check that course indicator OFF flags are not visible. When vertical bar begins moving toward center, begin turning to inbound heading. Adjust rate of turn to roll out on center line of beam. Do not exceed a bank angle of 30 degrees.

D

Correct any overshoot as quickly as possible to get on beam center line. Glide slope center line should be above the airplane. As horizontal bar approaches center, begin gradual power reduction so as to intercept glide slope smoothly.

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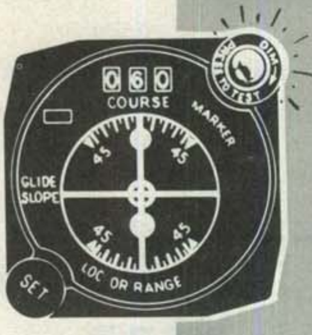
Figure 9-3. (Sheet 1 of 2)

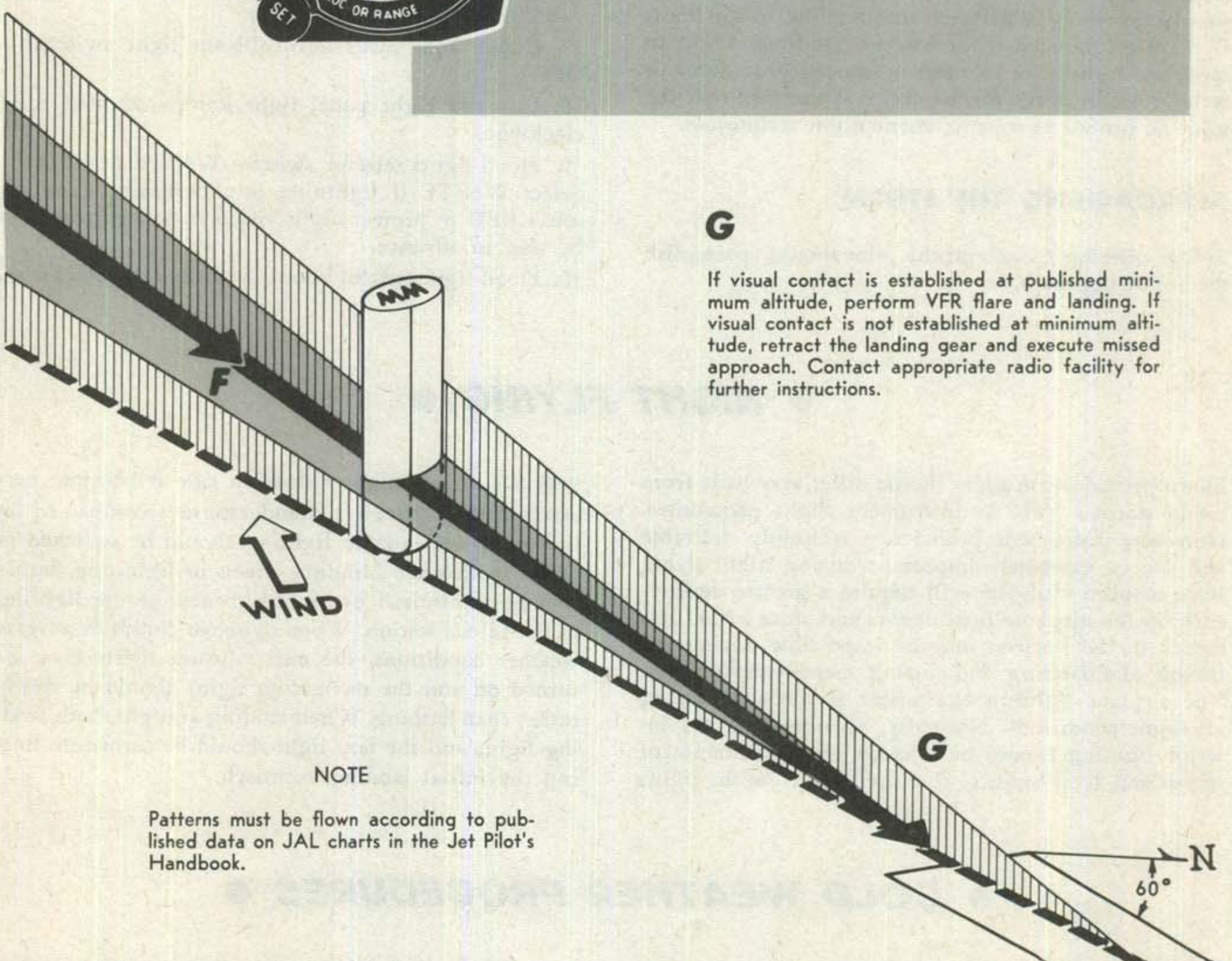


E

As glide slope is intercepted, set up rate of descent and stabilize airplane on glide slope beam center line. Maintain airspeed at gross weight plus 100 knots IAS. Marker beacon indicator lamp lights when outer marker is passed.

F

Keep airplane centered on localizer and glide slope beams. Correct airplane heading as necessary for wind drift. Maintain airspeed at gross weight plus 100 knots.



G

If visual contact is established at published minimum altitude, perform VFR flare and landing. If visual contact is not established at minimum altitude, retract the landing gear and execute missed approach. Contact appropriate radio facility for further instructions.

NOTE

Patterns must be flown according to published data on JAL charts in the Jet Pilot's Handbook.

Figure 9-3. (Sheet 2 of 2)

• TURBULENCE AND THUNDERSTORMS •

CAUTION

Intentional flight through thunderstorms is not recommended since airplane damage can occur from hail or from overstressing the airplane in extreme turbulence. In the event of roll damper malfunction it is important that heavy turbulence be avoided or minimized since excessive roll maneuvers can make precise control of the airplane difficult.

In case it becomes necessary to fly through a thunderstorm, the navigator should establish a course (by means of search radar) which will avoid the areas of most intense turbulence and possible hail. Heavy turbulence can be penetrated safely at normal cruising speeds; however, penetration speeds of 300 to 350 knots IAS are recommended for ease of handling. Light to moderate turbulence requires no special procedures or techniques; in heavy turbulence, it is essential that the pilot be proficient in instrument flight techniques.

APPROACHING THE STORM.

Before entering the storm, the pilot should accomplish the following steps.

1. Course—As required for minimum turbulence.
2. Airspeed—300 to 350 knots IAS.

NOTE

SAFE PENETRATION SPEED

300-350 KNOTS IAS

3. Pitot anti-ice switch—ON.
4. Windshield rain removal switch—REMOVE.
5. Windshield defog switch—As required.
6. Malfunction and indicator light dimming switch —BRIGHT (momentarily).
7. Upper and lower anti-collision light switches—OFF.
8. Left and right panel light knobs—Rotated fully clockwise.
9. Flood lights selector switch—WHITE or RED. Select WHITE if lightning is anticipated; at night, select RED to protect night vision if no lightning can be seen in advance.
10. Flood light control knob—Rotated fully clockwise.

• NIGHT FLYING •

Flight procedures at night should differ very little from either normal VFR or instrument flight procedures. However, instrument proficiency is highly desirable and can be extremely important during night flying since reduced visibility will require a greater dependence on the airplane instruments and since visual reference to the horizon may be impossible during the takeoff and landing and during maneuvering flight. The airplane lighting equipment is adequate during all flight conditions. Normally, at night, the red interior lighting should be selected for the instrument panels and flood lights so that the glare from the lights will not impair night vision. In case it becomes necessary to fly through a thunderstorm accompanied by lightning, the interior lighting should be switched to white so that the blinding effects of lightning flashes will be minimized by the brightness of the lighting in the pilot's station. When flying in clouds or adverse weather conditions, the anti-collision lights must be turned off and the navigation lights should be steady rather than flashing. When landing at night, both landing lights and the taxi light should be turned on during the initial landing approach.

• COLD WEATHER PROCEDURES •

The problems of arctic operations are encountered mainly on the ground. Flight and maintenance crews must cooperate closely in exercising constant vigilance to overcome the manifold cold weather hazards during preparation for flight. Flight itself is relatively unaffected by cold weather, because at the cruise altitudes of this airplane, temperatures are fairly consistent regardless of geographical location. Some phases of flight, such as takeoff and landing, are enhanced in arctic regions by virtue of the cold, dense air, which increases thrust and shortens ground runs. In general, many cold weather procedures common to other types of aircraft will also apply to this airplane. Standard precautions should be observed in regard to snow and ice removal, taxiing, braking, etc., in addition to the following specific cold weather instructions.

WARNING

Depending on the weight of ice and snow accumulated on the airplane surfaces, takeoff distances and climbout performance can be seriously affected. The roughness and distribution of the ice and snow could vary flight characteristics to an extremely dangerous degree. Loss of an engine shortly after takeoff is serious enough without the added, and avoidable, hazard of snow and ice on the wings. In view of the unpredictable and unsafe effects of such a practice, the ice and snow must be removed before flight is attempted.

Many problems may be solved by placing the airplane in a hangar for several hours prior to flight, if possible. Additional procedures for ground preparation and flight in cold weather areas will be included after completion of further cold weather testing. Icing conditions during flight are presented under "Ice and Rain," this section.

WARMUP AND GROUND TEST.

Exposure to extreme cold requires that additional preparations be made prior to flight due to congealing of fluids, thickening of lubricants, freezing of condensate, etc. The following procedures are recommended for the hydraulic and flight control systems. Additional information for other systems of the airplane will be included when available.

WARNING

Prior to takeoff, make sure all instruments and equipment have warmed up sufficiently to insure normal operation. Check for sluggish operation during taxiing.

HYDRAULIC POWER SUPPLY SYSTEM.

The hydraulic systems must be warmed before any of the hydraulic equipment is operated if the airplane has been cold soaked at temperatures below 0°F (—18°C) with the hydraulic system inoperative. Operation of the equipment while the hydraulic fluid is too cold for normal flow will result in hydraulic pump cavitation with possible damage to the pumps. Once a safe operating temperature is reached, the hydraulic fluid will remain above the minimum safe temperature as long as normal system pressure is maintained. Hydraulic system warmup shall be accomplished in three phases. If the airplane is equipped with a fire control system or a chaff dispensing system, the hydraulic power to this equipment must be off when the engines are started. If the airplane is equipped with search radar, its hydraulic supply must be warmed up before satisfactory operation can be obtained. On airplanes equipped with a fire control system, the FCS master switch must be in the OFF position before the engines are started and must remain in the OFF position until warm up of the airplane general hydraulic system is complete. After warmup is complete, the FCS master switch may be placed in any desired position. On airplanes equipped with a chaff dispensing system, the chaff dispensing power control switch must be in the OFF position before the engines are started and must remain in the OFF position until warmup of the airplane general hydraulic system is complete. After warmup, the chaff dispensing power control switch may be placed in any desired position. To warm up the hydraulic systems, there must be at least one engine operating on each side of the airplane. While starting engines, the elevons and rudder must be held in the initial position of "repose" until normal hydraulic pressure is attained in both systems. (Example: If elevons are in a drooped position, the control stick should be positioned to maintain the original elevon position rather than allowing the centering springs to bring the elevons back to the neutral position.) The primary phase of the system warmup is accomplished by allowing the system to warm up through system leakage only, without operation of hydraulically powered systems. This will require approximately 8 minutes (under the most severe conditions) for warm-up to a level where pressure sensitivity to stick motion will be substantially reduced. The intermediate phase is to move the control stick forward and aft (elevator only) at a slow rate that avoids perceptible (more than 50 psi) drops in the pressure indication on the hydraulic system pressure gages. The final phase of the warmup is to cycle the control stick, as in the intermediate phase, but at gradually increasing rates. Slightly larger drops in pressure are permissible during this phase. However, tendency for the pressure to collapse rather than reduce in accordance with motion indicates the intermediate phase is not complete. Indication of a warmed up system is indicated by a capability of the system to receive control surface demands with proportionate drops in pressure rather than the pressure collapsing.

CAUTION

If pressure collapses, stop control stick cycling until pressure fully recovers.

Note

The primary and intermediate steps are not required on airplanes having a pre-heated hydraulic system. On airplanes equipped with hydraulic system temperature indicators, completion of warmup is signified when the temperature indicator reading reaches plus 50°F. If time permits, the required amount of control stick cycling may be decreased by allowing a longer period of engine operation before initiating control stick motion.

If nose wheel steering is sluggish, operate steering until desired response is achieved, while taxiing out to the runway. Begin with very short turns to the right and left and gradually increase the rate to the maximum turns practical with existing conditions.

CAUTION

Do not operate the nose steering with the airplane static while brakes are applied.

Hydraulic supply to primary navigation radar antenna requires additional warming after the general hydraulic system is warmed up; under the most severe conditions, approximately 5 minutes will be required. This is accomplished through azimuth sweep operation of the antenna (with the primary navigation function selector knob positioned at STANDBY). Operation of the search radar antenna prior to warmup is not detrimental to hydraulic function, but search radar performance will be degraded until hydraulic supply is warm.

FLIGHT CONTROL SYSTEM.

Prior to takeoff during cold weather, the flight controls must be operated in order to overcome the excessive breakout forces resulting from thickened lubricants. Operate the rudder pedals and cycle the stick (for both elevator and aileron movement) through their maximum travel envelopes until the breakout forces are reduced to normal.

Note

If the hydraulic system warmup has been accomplished, the elevator breakout forces may already be reduced to normal.

• HOT WEATHER AND DESERT OPERATION •

Hot weather and desert operation requires that added precautions be taken against damage from dust, sand, and high temperatures. Particular attention should be given to those components and systems (engine, fuel, oil, hydraulic, pitot-static, etc.) which are most susceptible to contamination, malfunction, or damage from sand and dust. All of the filters on the airplane should be checked more frequently than is normally required. Components containing plastic or rubber parts should be protected as much as possible from blowing sand and extreme temperatures. The canopies should be closed and sealed and all protective covers should be installed when the airplane is not in use during conditions of blowing sand and dust.

BEFORE ENTERING THE AIRCRAFT.

Inspect the exposed areas of the shock strut and actuator pistons on the landing gear; have them cleaned as required. Check tires for signs of blistering and check for overinflation of tires and struts due to extreme heat. Check for fuel or hydraulic leakage due to thermal expansion of sealing materials. Inspect the area aft of the airplane to make sure that engine exhaust will not cause sand or dust to be blown onto personnel or equipment when engines are started. Check engine inlet ducts for dust or sand accumulations.

ON ENTERING AIRPLANE.

Be sure ground cooling cart is in operation and that the cooling air being supplied is adequate for the protection of the airplane electronic equipment. Check in crew compartments for excessive dust accumulation. Before starting engines, accomplish all checklists possible to avoid running engines unnecessarily before takeoff.

TAKEOFF.

Allow for longer takeoff distances in hot weather. Utilize all possible runway distance to obtain speed for unstick before rotating to nose up and assuming takeoff attitude. Refer to Appendix for recommended takeoff speeds and required takeoff distances.

APPROACH AND LANDING.

Maintain recommended approach and landing speeds as shown in the Appendix. Allow for longer landing rolls resulting from increased true airspeeds. Avoid the use of braking as much as possible to prevent tire failure; utilize all possible runway distance for stopping. Deploy drag chute as usual during initial landing roll.

BEFORE LEAVING AIRCRAFT.

In the event of blowing sand or dust, close and seal canopies before leaving airplane to prevent sand and dust accumulations in the crew compartments; check that protective covers are installed on pitot tube, engine inlets, and tailpipes. Avoid parking the airplane in the sun for prolonged periods if possible.

appendix I performance data

NOTE

For Appendix I, refer to Confidential Supplement, T.O. 1B-58A-1B.

Appendix I Performance Data

NOTE

For Appendix I, refer to Confidential Supplement T.O. 1B-58A-[illegible].

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