

OPERATIONAL SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

OV-10A

AIRCRAFT

Contract NOw 65-0118f

THIS PUBLICATION SUPPLEMENTS T.O. 1L-10A-1 AND REPLACES INTERIM OPERATIONAL SUPPLEMENT T.O. 1L-10A-1S-43 (LIMITED DISTRIBUTION).

COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT TO THE ATTENTION OF ALL AFFECTED AIR FORCE PERSONNEL.

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5 JANUARY 1973

SHORT TITLE: IRCM

NOTICE TO PILOTS

- Write the number of this supplement alongside the changed portion of the Flight Manual.

1. PURPOSE.

To provide information resulting from the Infra-Red Counter Measures (IRCM) Defensive System installation.

2. GENERAL.

Aircraft having T.O. 1L-10A-659 incorporated, are equipped with a defensive system to provide protection against heat seeking missiles. The system is on standby to release an IRCM when the aircraft is airborne by placing the three (3) position IRCM Select Switch to either the FIRE (up) or DROP (down) positions. IRCM Select Switch center position is OFF. Release of an IRCM is accomplished by depressing the IRCM Release/Nose Wheel Steering Button.

3. INSTRUCTIONS.

SECTION I, DESCRIPTION, Page 1-65.

The following information is added prior to the Armament Systems paragraph:

DEFENSIVE SYSTEMS

On aircraft having T.O. 1L-10A-659 incorporated, an Infra-Red Counter Measures (IRCM) Defensive System dispenses IRCM weapons from sponson station number one (1).

IRCM SELECT SWITCH

A three position IRCM Select Switch, Center - OFF, Up - FIRE, and Down - DROP is provided on the Camera, Smoke, and Gunsight Control Panel adjacent to the Warning Horn Disable Switch. When the IRCM Select Switch is out of CENTER position and the aircraft weight is off the landing gear, depressing the Nose Wheel Steering/IRCM Release Button will drop or fire an IRCM weapon.

IRCM RELEASE BUTTON

On aircraft having T.O. 1L-10A-659 incorporated, the Nose Wheel Steering Button has been modified to include the IRCM Release Button function.

THE END

FLIGHT MANUAL, SAFETY SUPPLEMENT, AND OPERATIONAL SUPPLEMENT STATUS

A status page is published with each Safety Supplement, Operational Supplement, Flight Manual Change, and Flight Manual Revision. It provides a comprehensive listing of the current Flight Manuals, Flight Crew Checklist, Safety Supplements, and Operational Supplements. If you are missing any publications listed on this page, see your Publications Distribution Officer and get your copy.

FLIGHT MANUAL	DATE	CHANGE NO.
T.O. 1L-10A-1	1 Mar 71	3 - 1 Oct 72
T.O. 1L-10A-1-1 (Conf)	10 Oct 72	- - - - -

FLIGHT CREW CHECKLIST	DATE	CHANGE NO.
T.O. 1L-10A-1CL-1	1 Mar 71	2 - 1 Aug 72

CURRENT SAFETY AND OPERATIONAL SUPPLEMENTS

NUMBER	DATE	SHORT TITLE	FLIGHT MANUAL PAGES AFFECTED
S-41	15 Dec 72	Canopy Modification	1-76, 2-10
S-42	19 Dec 72	Personnel Locator Beacon	1-75, 2-3
- - - - -	- - - - -	- - - - -	- - - - -
S-44	5 Jan 73	IRCM	1-65
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REPLACED/RESCINDED SUPPLEMENTS

NUMBER	DATE	DISPOSITION
*S-43(Int)	22 Dec 72	Replaced by S-44

* Limited Distribution

OPERATIONAL SUPPLEMENT

FLIGHT MANUAL USAF SERIES

OV-10A

AIRCRAFT

(NORTH AMERICAN ROCKWELL CORPORATION)

Contract NOw 65-0118f

THIS PUBLICATION SUPPLEMENTS T.O. 1L-10A-1.

**COMMANDERS ARE RESPONSIBLE FOR BRINGING THIS SUPPLEMENT
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PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

19 DECEMBER 1972

SHORT TITLE: PERSONNEL LOCATOR BEACON

NOTICE TO PILOTS

- Write the number of this supplement alongside the changed portion of the Flight Manual.

1. PURPOSE.

To inform crewmembers of a modification to the personnel locator beacon (PLB).

2. GENERAL.

In aircraft with survival kits modified in accordance with T.O. 1L-10A-655, the PLB snap hook lanyard attached to the left side of the survival kit has been removed and replaced by a control switch located on the inside of the left leg support (see figure 1). The switch is marked with a GREEN DOT (M) for the manual or OFF position and a RED DOT (A) for the automatic armed or ON position. Selection of either position can be made at any time. With

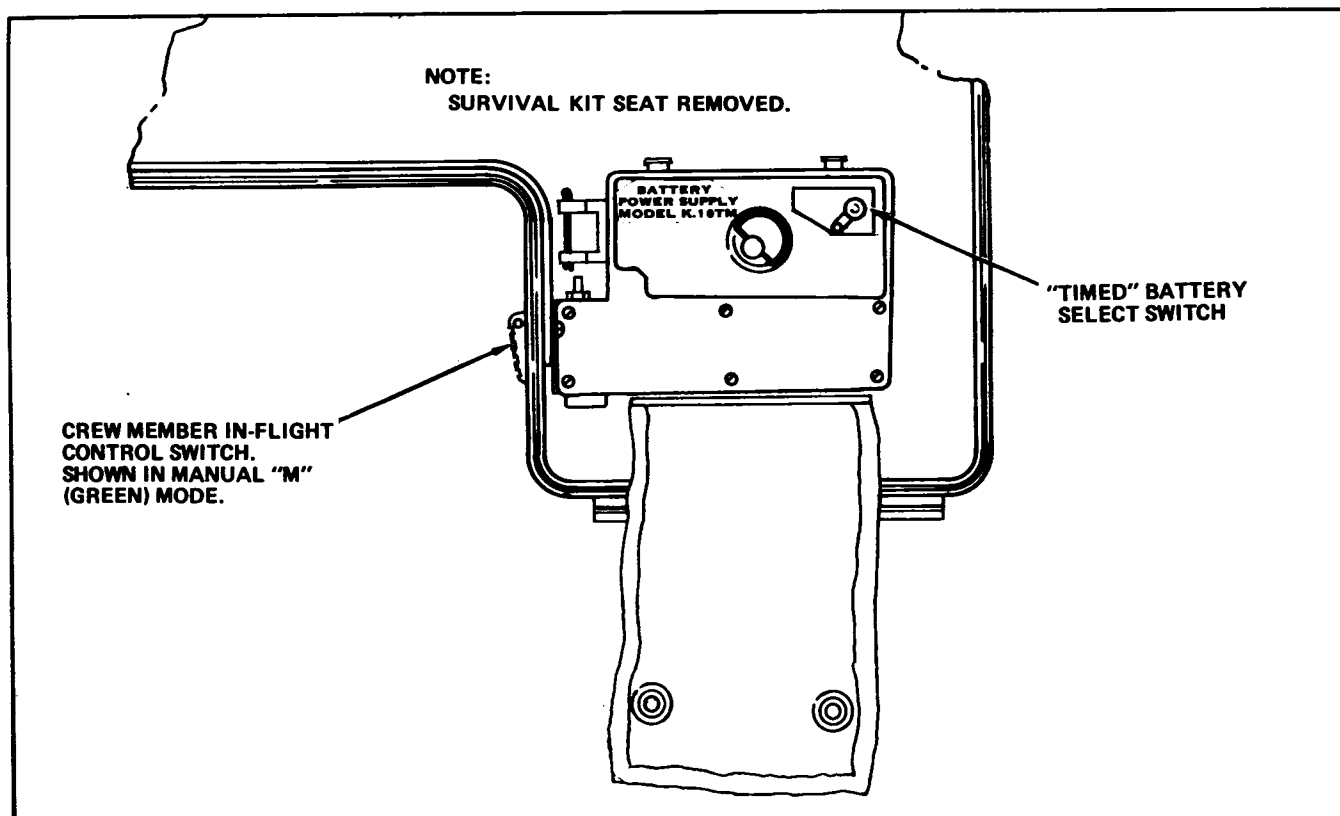
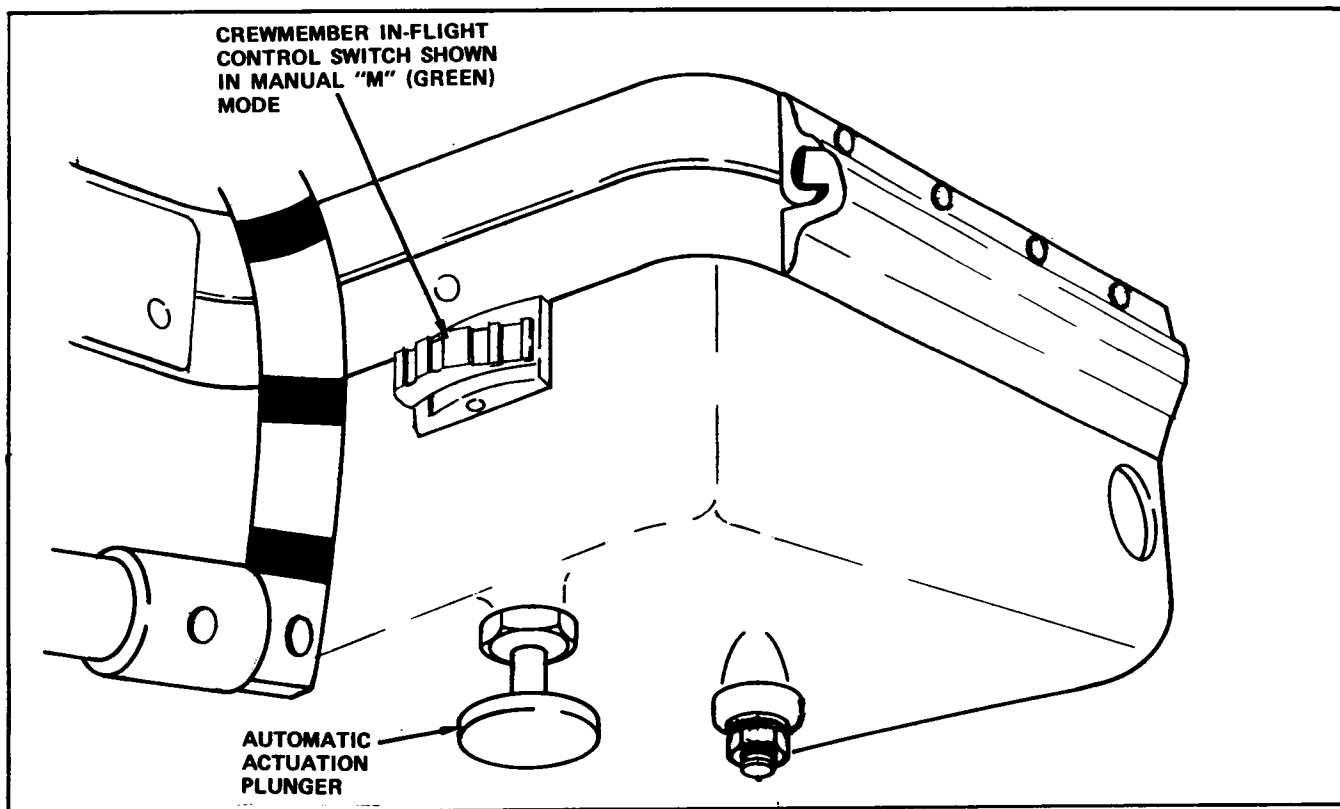


Figure 1. Personnel Locator Beacon Modification

the RED DOT (A) for ON or automatic armed selected, the PLB commences transmitting upon seat/man separation following ejection since a holding plunger is released at that time. With the GREEN DOT (M) for OFF or manual selected, the PLB is not actuated until deliberately turned on. An additional feature of this modification is the use of a "timed" battery (at the operational commander's option). The one shot timer when used will turn off all transmission in 8 to 12 minutes. The PLB may be reactivated by removing it from the survival kit and moving the small battery switch from the TIMED to the NORMAL position. The battery operates the PLB for approximately 15 hours. A complete set of operating instructions is contained on the PLB case.

3. INSTRUCTIONS.

Section I, Description, page 1-75, Survival Kit.

The last sentence of the paragraph is changed to read: "On aircraft having T.O. 1L-10A-627 and/or 655 incorporated, a personnel locator beacon, which can be set for automatic or manual operation, is installed in the kit.

Section II, Normal Procedures, page 2-3, Safety Check.

Line item 3d is changed to read:

3d. Personnel locator beacon - AS REQUIRED (P,O).

THE END

FLIGHT MANUAL, SAFETY SUPPLEMENT, AND OPERATIONAL SUPPLEMENT STATUS

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S-42	19 Dec 72	Personnel Locator Beacon	1-75, 2-3
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REPLACED/RESCINDED SUPPLEMENTS

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OPERATIONAL SUPPLEMENT

FLIGHT MANUAL

USAF SERIES

OV-10A

AIRCRAFT

Contract NOw 65-0118f

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15 DECEMBER 1972

SHORT TITLE: CANOPY MODIFICATION

NOTICE TO PILOTS

- Write the number of this supplement alongside the affected portion of the Flight Manual.

1. PURPOSE.

To inform pilots of a modification to the canopy latch indicating system.

2. GENERAL.

The continuing problem of canopies opening or being lost in flight has brought about the implementation of T.O. 1L-10A-648. This TCTO removes the canopy door lock indicator as presently shown in Figure 1-42 and adds a slide bar lock indicator assembly to the lower aft corner of each canopy. This assembly operates in conjunction with the normal canopy locking pins.

The slide bar slides inside the fixed canopy door jamb when the rear pin engages. If the slide bar strikes or is outside of the fixed canopy door jamb, the canopy rear pin is not properly engaged. See Supplement Figure 1.

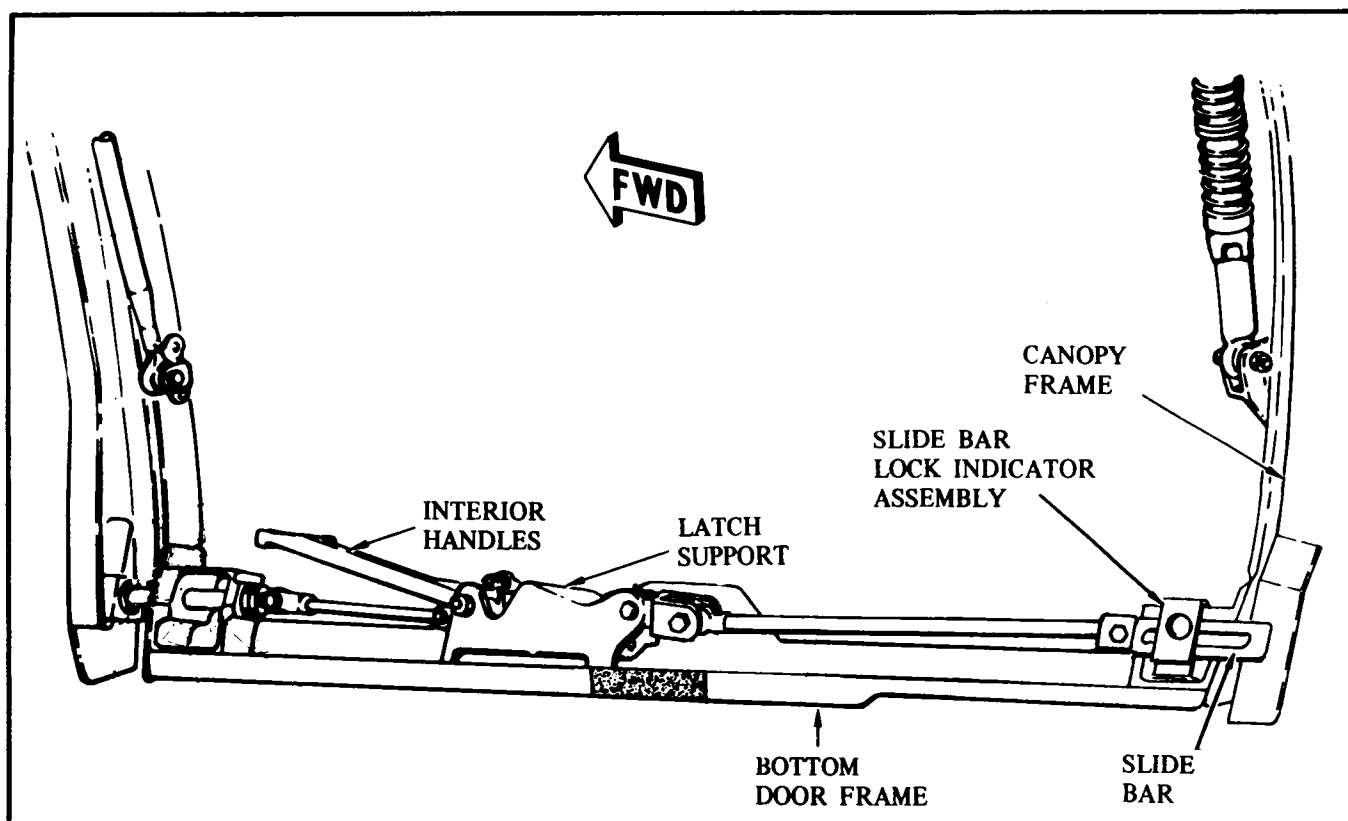


Figure 1

3. INSTRUCTIONS.

Section I, Description, page 1-76, Canopy Door Handles.

The following information is added to the end of the paragraph:

Aircraft incorporating T.O. 1L-10A-648 have a slide bar lock indicator assembly attached to the lower aft portion of each canopy. When the canopy rear locking pin is properly engaged during the canopy locking operation, the slide bar will move inside the canopy door jamb indicating proper pin engagement.

Section II, Normal Procedures, page 2-10, Before Take-off.

Line item 12 is changed as follows:

12. Canopy door lock indicators - CHECK (P, O).
Check indicator down over longeron on all canopy doors. On aircraft incorporating T.O. 1L-10A-648 check slide bar inside rear door jamb on all canopy doors.

THE END

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FLIGHT MANUAL

USAF SERIES **OV-10A** AIRCRAFT

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publication. Destroy superseded pages.

THIS PUBLICATION IS INCOMPLETE WITHOUT T.O. 1L-10A-1-1

Refer to Numerical Index T.O. 0-1-1-5 and Supplements thereto for current status
of Flight Manuals, Safety/Operational Supplements, and Flight Crew Checklists.

PUBLISHED UNDER AUTHORITY OF THE SECRETARY OF THE AIR FORCE

VA-1-1C

1 MARCH 1971
CHANGE 3 — 1 OCTOBER 1972

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LIST OF EFFECTIVE PAGES

INSERT LATEST CHANGED PAGES. DESTROY SUPERSEDED PAGES.

NOTE: The portion of the text affected by the changes is indicated by a vertical line in the outer margins of the page. Changes to illustrations are indicated by miniature pointing hands. Changes to wiring diagrams are indicated by shaded areas.

Dates of issue for original and changed pages are:

Original . . . 0. . . 1 March 1971

Change . . . 2. . . 1 August 1972

Change . . . 1. . . 1 January 1972

Change . . . 3. . . 1 October 1972

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* Status Page	3	1-57 - 1-59	0	5-1 - 5-7	0
Status Page 2 Deleted	1	1-60	2	5-8	2
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* v	3	* 1-60B Blank	3	5-12 - 5-14	2
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1-46B Blank	1	3-1 - 3-5	2	A6-10 - A6-11	0
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CURRENT FLIGHT CREW CHECKLIST

T.O. 1L-10A-1CL-1

CHANGE 2 - 1 AUGUST 1972

Upon receipt of the second and subsequent changes to this technical order, personnel responsible for maintaining this publication in current status will ascertain that all previous changes have been received and incorporated. Action should be taken promptly if the publication is incomplete.

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ADDITIONAL COPIES OF THIS PUBLICATION MAY BE OBTAINED BY USAF ACTIVITIES
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USAF

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FLIGHT MANUAL	DATE	CHANGE NO.
T.O. 1L-10A-1	1 March 1971	Change 3—1 October 1972
Supplement T.O. 1L-10A-1-1 (Confidential)	10 October 1972	

FLIGHT CREW CHECKLIST	DATE	CHANGE NO.
T.O. 1L-10A-1CL-1	1 March 1971	Change 2—1 August 1972

CURRENT SAFETY AND OPERATIONAL SUPPLEMENTS

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NONE			

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SO YOU'RE GOING TO BE

A BRONCO BUSTER!

THIS MANUAL CONTAINS
INSTRUCTIONS ON TAMING
THE BRONCO

READ IT CAREFULLY!



VA-1-2A

SCOPE

This manual contains the necessary information for safe and efficient operation of the OV-10A aircraft. These instructions provide you with a general knowledge of the aircraft, its characteristics, and specific normal and emergency operating procedures. Your flying experience is recognized, and therefore, basic flight principles are avoided.

SOUND JUDGMENT

This manual provides the best possible operating instructions under most circumstances, but it is a poor substitute for sound judgment. Multiple emergencies, adverse weather, terrain, etc, may require modification of the procedures.

PERMISSIBLE OPERATIONS

The Flight Manual takes a "positive approach" and normally states only what you can do. Unusual operations or configurations (such as asymmetrical loading) are prohibited unless specifically covered herein. Clearance must be obtained from SAAMA/MMEAF, Kelly Air Force Base, Texas 78241 (mail address) or DIR MAT MGT/MMEAF, Kelly Air Force Base, Texas (message address) through the respective major command before any questionable operation is attempted which is not specifically permitted in this manual.

HOW TO BE ASSURED OF HAVING LATEST DATA

Refer to T.O. 0-1-1-5 and supplements which list all current Flight Manuals, Safety Supplements,

Operational Supplements, and Checklists. Its frequency of issue and brevity assures an accurate, up-to-date listing of all these publications.

STANDARDIZATION AND ARRANGEMENT

Standardization assures that the scope and arrangement of all Flight Manuals are identical. The manual is divided into seven sections and Appendix I to simplify reading it straight through or using it as a reference manual.

SUPPLEMENTS

SAFETY AND OPERATIONAL SUPPLEMENTS

Safety Supplements are issued as an expeditious means of reflecting safety information when hazardous or safety conditions exist. These supplements contain operational, precautionary, and restrictive instructions that affect safety and safety modifications. Operational Supplements are issued as an expeditious means of reflecting information when mission essential operational procedures are involved. Formal Supplements are identified by red border "SS" or black border "OS" lettering on the title page designating Safety or Operational. Supplements are numbered consecutively regardless of whether it is safety or operational. Safety supplements can also be identified by the "SS" preceding the number. Operational supplements numbers are preceded by a single "S." File supplements in reverse numerical order in the front of the Flight Manual.

CHECKLISTS

The Flight Manual contains only amplified checklists. The Abbreviated Flight Crew Checklist has been issued as a separate technical order—see the back of the title page for the T.O. number of your latest checklist. Line items in the Flight Manual and checklists are identical with respect to arrangement and item number. Whenever a Supplement affects the abbreviated checklist, write in the applicable change on the affected checklist page. As

soon as possible, a new checklist page, incorporating the supplement will be issued. This will keep handwritten entries of Supplement information in your checklist to a minimum.

HOW TO GET PERSONAL COPIES

Each flight crew member is entitled to personal copies of the Flight Manual, Safety Supplements, and Checklists. The required quantities should be ordered before you need them to assure their prompt receipt. Technical Orders 00-5-1 and 00-5-2 give detailed information for properly ordering these publications. Make sure a system is established at your base to deliver these publications to the flight crews immediately upon receipt.

FLIGHT MANUAL AND CHECKLIST BINDERS

Loose leaf binders and tabbed section dividers are available for use with your manual. These are obtained through local purchase procedures and are listed in the Federal Supply Schedule (FSC Group 75, Office Supplies, Part 1). Binders are also available for carrying your condensed (abbreviated) checklist. These binders contain plastic envelopes into which individual checklist pages are inserted. They are available in three capacities and are obtained through normal Air Force supply under the following stock list numbers: 7510-766-4268, -4269, and -4270 for 15, 25, and 40 envelope binders, respectively. Check with your supply personnel for assistance in securing these items.

WARNINGS, CAUTIONS, AND NOTES

The following definitions apply to "Warnings," "Cautions," and "Notes" found throughout the manual.

WARNING

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



Operating procedures, techniques, etc, which will result in damage to equipment, if not carefully followed.

Note

An operating procedure, technique, etc, which is considered essential to emphasize.

YOUR RESPONSIBILITY—TO LET US KNOW

Every effort is made to keep the Flight Manual current. Review conferences with operating personnel and a constant review of accident and flight test reports assure inclusion of the latest data in the manual. However, we cannot correct an error unless we know of its existence. In this regard, it is essential that you do your part. Any comments, questions, or recommendations should be forwarded, using AF Form 847 in accordance with T.O. 00-5-1,

through your Command Headquarters to: SAAMA/MMEAF, Kelly Air Force Base, Texas 78241 (mail address) or DIR MAT MGT/MMEAF, Kelly Air Force Base, Texas (message address).

CHANGE SYMBOLS

Changed text is indicated by a black vertical line in either margin of the page, such as the line printed next to this paragraph. The change symbol shows what part of the text has been changed and may consist of material added or information restated.

ILLUSTRATION CHANGES

Changes to illustrations which are not readily apparent, and are considered of sufficient importance, are identified by a pointing hand symbol.

SUPPLEMENT SUMMARY

This summary of Safety and Operational Supplements is provided as a convenient method of logging supplements as they are received. Be sure to check T.O. 0-1-1-5 and supplements, to be certain your list is complete, both for new supplements, and for supplements replaced or cancelled.

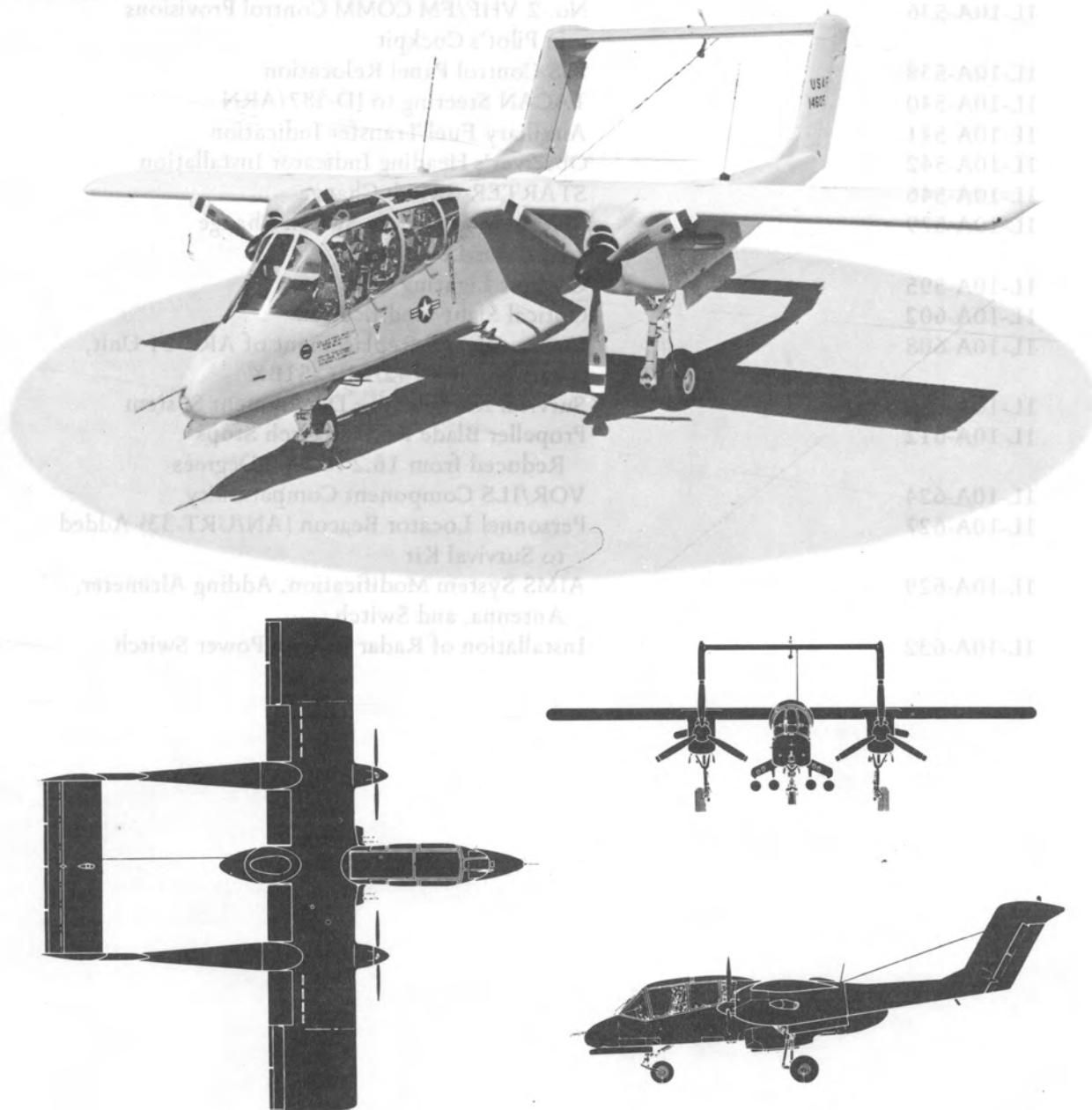
TIME COMPLIANCE TECHNICAL ORDERS

The following time compliance technical orders (T.O.s) are covered in this Flight Manual. This is not a complete listing, nor does it include rescinded T.O.s. Refer to T.O. 0-1-1-5 for a complete listing of T.O.s applicable to this aircraft.

<u>T.O. NUMBER</u>	<u>SUBJECT</u>
1L-10A-510	Additional Observer Controls Installation
1L-10A-531	Deactivation TIT System
1L-10A-536	No. 2 VHF/FM COMM Control Provisions in Pilot's Cockpit
1L-10A-538	ICS Control Panel Relocation
1L-10A-540	TACAN Steering to ID-387/ARN
1L-10A-541	Auxiliary Fuel Transfer Indication
1L-10A-542	Observer's Heading Indicator Installation
1L-10A-546	STARTER Switch Change
1L-10A-579	Station Mode Select Switch Change to Lever-Lok Type
1L-10A-595	Cockpit Lighting Changes
1L-10A-602	Optical Sight Modification
1L-10A-608	Inspection and Replacement of ARC-21 Unit, Part No. RT-742/ARC-51BX
1L-10A-610	Survival Kit Selective Deployment System
1L-10A-612	Propeller Blade Reverse Pitch Stops Reduced from 16.2 to 14.0 Degrees
1L-10A-624	VOR/ILS Component Compatibility
1L-10A-627	Personnel Locator Beacon (AN/URT-33) Added to Survival Kit
1L-10A-629	AIMS System Modification, Adding Altimeter, Antenna, and Switch
1L-10A-632	Installation of Radar Beacon Power Switch

TIME COMPLIANCE TECHNICAL ORDERS

BRONCO



VA-1-3A

Figure 1-1

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THE AIRCRAFT

The North American Rockwell OV-10A is a twin-turboprop, multipurpose aircraft. See figure 1-1. Main identification features include high mounted, straight wing; a large, glass-enclosed cockpit; twin tail booms; and swept vertical stabilizers with a high set horizontal stabilizer. The cockpit section contains a second flight crew station (observer's) with strike-recording photo capability. The cockpit section is armor-plated to provide protection from small arms penetration. Two canted sponsons are mounted on the lower fuselage, providing four external store stations and housing for four 7.62mm guns with integral ammunition supply. Additional munitions or a single external fuel tank may be installed at a centerline store station under the fuselage. A single store station under each wing provides modification capability for carrying two AIM-9B Sidewinder missiles.

DIMENSIONS

Overall static dimensions of the aircraft are as follows:

Span	40 feet
Height (vertical stabilizer)	15.1 feet
Length	39.7 feet
Tread Width	14.8 feet

GROSS WEIGHT

Take-off gross weight with sponsons, centerline pylon, armor plate, observer's equipment, oxygen equipment, one pilot, and full internal fuel is approximately 10,140 pounds with no external load. For additional weight data, refer to Appendix I. For detailed weight data, refer to the Manual of Weight and Balance Data (T.O. 1-1B-40).

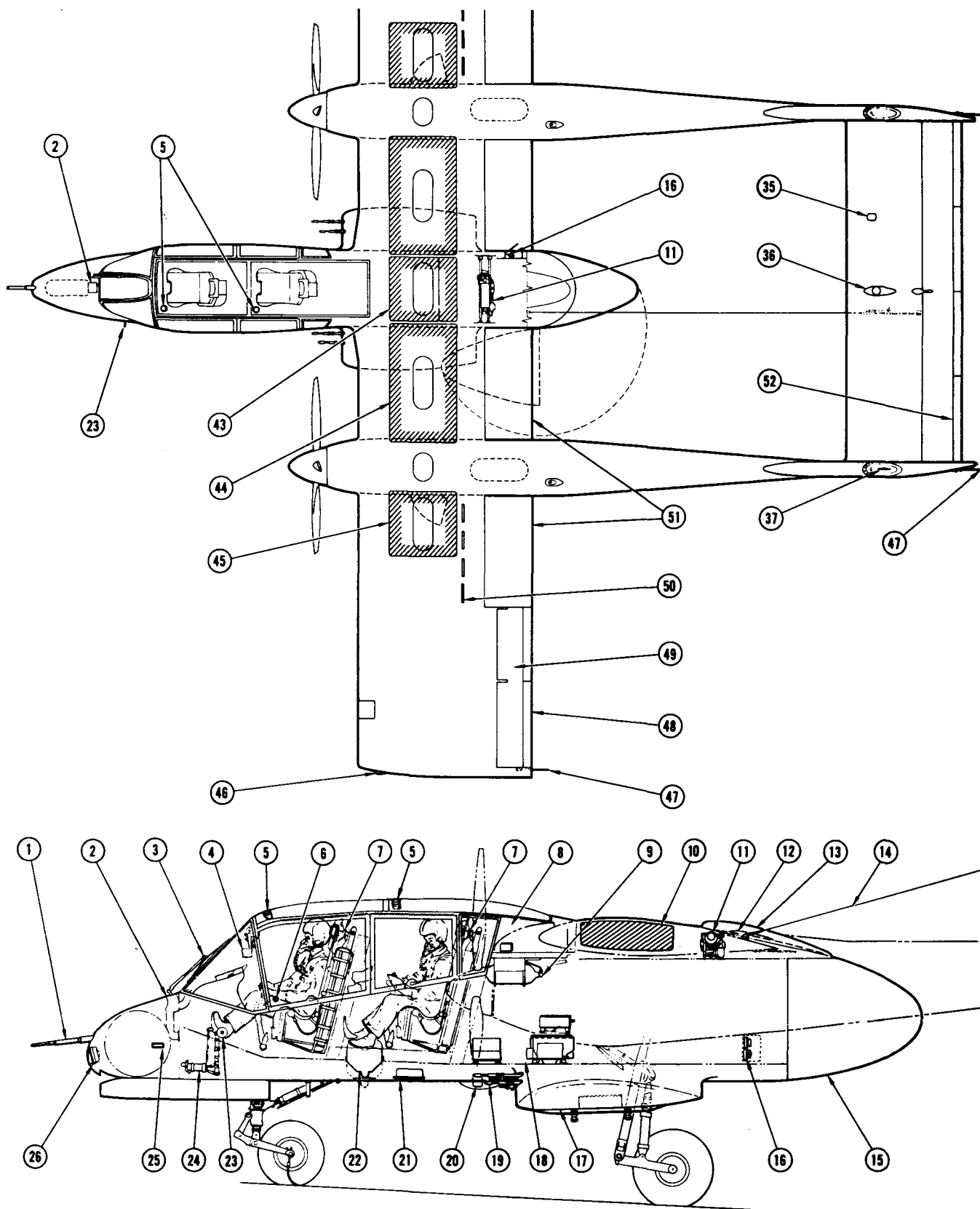
MISSIONS

The aircraft may be configured for strike-reconnaissance, forward air control (FAC) or light logistics transport missions. For certain other missions, the observer's cockpit equipment may be removed. External armament, integral guns, and communications equipment comprise the capability required. By adding the tie-down equipment and removing designated observer's cockpit equipment and the oxygen system, internal loads of up to 3200 pounds may be carried. For information on cargo delivery equipment, refer to CARGO DELIVERY EQUIPMENT, in this section.

GENERAL ARRANGEMENT

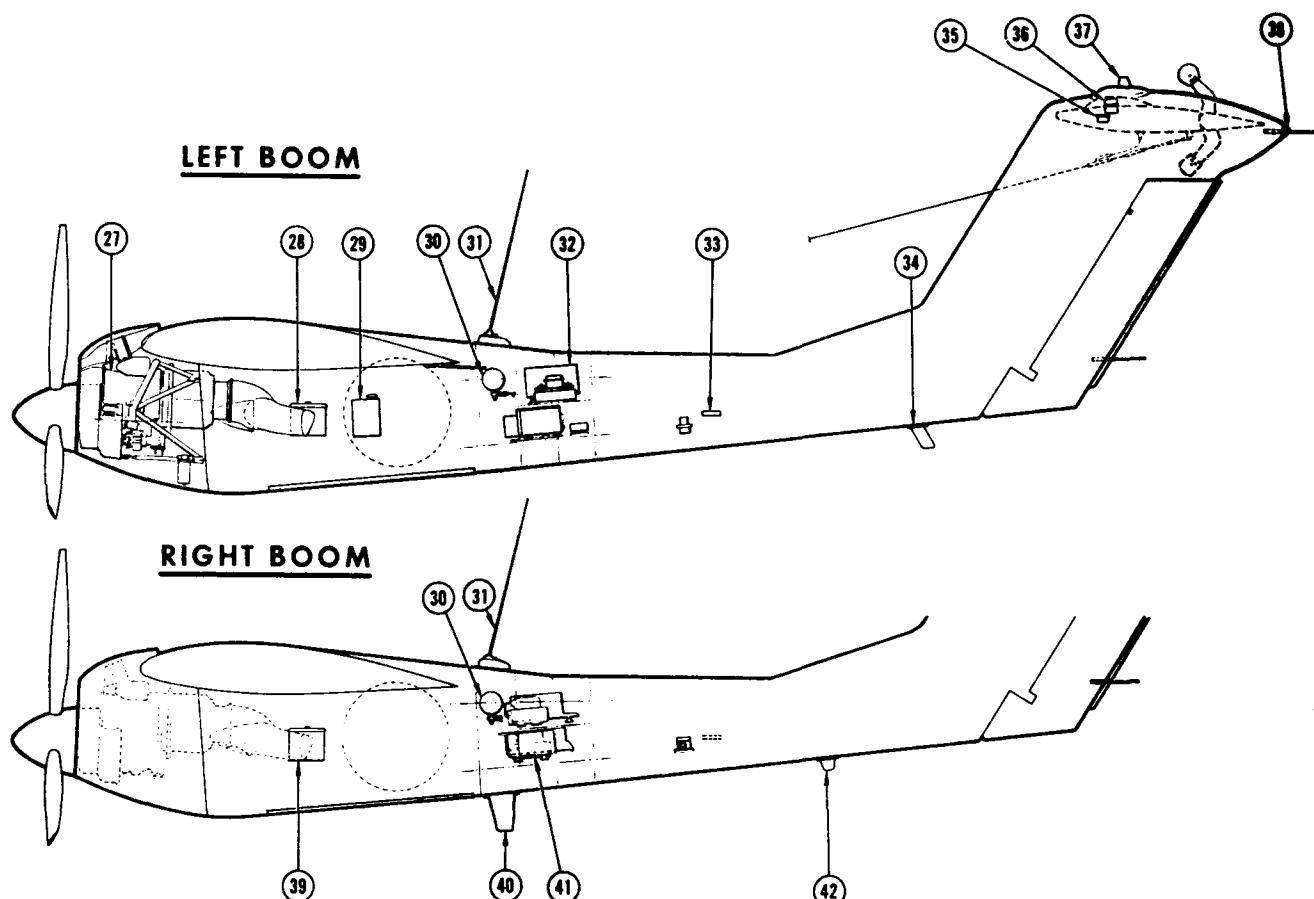
For a general arrangement of the aircraft see figure 1-2.

GENERAL ARRANGEMENT



VA-14C

Figure 1-2 (Sheet 1 of 2)



1. PITOT-STATIC TUBE
2. RAM AIR INLET
3. WINDSHIELD WIPER
4. OPTICAL SIGHT
5. COCKPIT AIR VENT
6. OAT INDICATOR
7. LW-3B EJECTION SEAT
8. ELECTRICAL EQUIPMENT BAY
9. OXYGEN SUPPLY BOTTLES
10. FUEL CELLS
11. HYDRAULIC POWER SYSTEM
12. LF ADF LOOP ANTENNA
13. LF ADF SENSE ANTENNA
14. HF RADIO ANTENNA
15. CARGO BAY DOOR
16. EXTERNAL ELECTRICAL RECEPTACLES (RIGHT SIDE)
17. SPONSON
18. ELECTRONIC EQUIPMENT (CARGO BAY)
 - HF RADIO SET, HF-103
 - LF ADF SET, AN/ARN-83
 - VOR/ILS (OPTIONAL)
 - CAMERA CONTROL, KB-18A
19. M60C 7.62mm GUNS
20. LOWER ANTI-COLLISION LIGHT
21. UHF ADF ANTENNA
22. STRIKE CAMERA, KB-18A (OPTIONAL)
23. ANGLE OF ATTACK PROBE
24. MASTER BRAKE CYLINDER
25. FORMATION LIGHT (BOTH SIDES)
26. LANDING AND TAXI LIGHT
27. T-76G-10 ENGINE (-12 RIGHT)
28. BATTERY (LEFT)
29. SMOKE GENERATOR OIL TANK

30. ENGINE FIRE EXTINGUISHER
31. VHF-FM ANTENNA
32. ELECTRONIC EQUIPMENT BAY (LEFT)
 - TACAN, AN/ARN-52V
 - VHF-FM SET, FM-622A (No. 1)
 - UHF SET, AN/ARC-147, AN/ARC-518X
 - UHF-ADF SET, AN/ARA-50
 - COMPASS CONTROLLER, AN/ASN-75
 - KY-28 CODER
33. FORMATION LIGHT (BOTH BOOMS)
34. UHF COMM ANTENNA
35. MAGNETIC COMPASS TRANSMITTER
36. UPPER ANTI-COLLISION LIGHT
37. TACAN ANTENNA (LEFT SIDE)
38. POSITION LIGHT (LEFT ONLY)
39. BATTERY (RIGHT)
40. VHF-AM ANTENNA
41. ELECTRONIC EQUIPMENT BAY (RIGHT)
 - INVERTERS
 - IFF-SIF, AN/APX-64(V)
 - VHF-FM SET, FM-622A (No. 2)
 - VHF-AM SET, WILCOX 807
42. IFF-SIF ANTENNA
43. CENTER-FEED FUEL TANK
44. INBOARD WING FUEL TANK
45. OUTBOARD WING FUEL TANK
46. POSITION LIGHT
47. STATIC DISCHARGER
48. AILERON TAB
49. AILERONS
50. SPOILERS
51. FLAPS
52. ELEVATOR TABS

* Aircraft having T.O. 1L-10A-629 incorporated.

VA-1-5E

Figure 1-2 (Sheet 2 of 2)

ENGINES

The aircraft is powered by two Garrett-AiResearch T76-G-10 (left) and T76-G-12 (right) fixed-shaft turbo-prop engines, rated at 715 shaft horsepower. See figure 1-3. The left propeller rotates clockwise and the right propeller rotates counterclockwise. The major engine components consist of the reduction gearbox, a two-stage centrifugal compressor, a three-stage axial turbine surrounded by an annular combustion chamber, and the accessory section.

Note

Flight with either two T76-G-10 (left) or two T76-G-12 (right) engines is allowed to provide a ferry capability to a maintenance/logistics area where the correct engine configuration may be installed. Refer to Sections V and VI for flight limitations and flight characteristics with two identical engines.

PROPELLERS

Each engine drives an 8.5-foot, three-blade, fully reversible aluminum propeller. At Military engine rpm (41,730), the propellers rotate at 2000 rpm. To reduce torque effect, the left propeller rotates clockwise. Propeller pitch is adjusted by varying the oil pressure in the propeller dome (figure 1-4). The propeller governor controls the volume of oil to and from the propeller dome to vary pitch, as required, and to maintain rpm. Oil for propeller control is taken from the internal engine oil flow. In the event of loss of oil supply, the propeller will be automatically feathered by the blade aerodynamic loads and the forces of the compression washers in the propeller. In the event of a propeller control system malfunction, resulting in increased propeller power demand, where the engine continues to operate, the engine underspeed governor will provide supplemental fuel to maintain operating rpm. In this case, rpm bog-down and overtemperature of the turbine can result. Automatic feathering in the event of control oil pressure loss is accomplished by the force applied against the propeller blade control shaft by a stack of compression washers. The propeller control systems incorporate dump (feather) valves which allow the pilot to manually select feathering as required.

FUEL SYSTEM (ENGINE)

Fuel is supplied by gravity flow from the wing center/feed tank to the engine-driven boost pumps. Fuel at low pressure is then directed to the combination low-/high-pressure fuel pumps, which supply fuel at high pressure to the fuel control units. The fuel control units provide engine overspeed protection through an automatic flow limiting feature set at 104% rpm. An underspeed governor on each engine sets minimum propeller rpm for selected flight conditions. For starting, extra starting fuel bypasses the fuel control and fuel shutoff valve and is fed directly into the engine. Flow of this starting fuel is cut off automatically by an EGT sensing switch or upon attaining 50% rpm.

IGNITION SYSTEM

Independent engine ignition systems each consist of an ignition unit, rpm sensing switches, and an igniter plug mounted to each engine combustor. For normal starts, the system is energized by the sensing switches as rpm passes approximately 10%. Ignition cutout switches cut off igniter operation as rpm passes approximately 50%, discontinuing the start cycle and preventing the ignition unit duty cycle from being exceeded. For air starts, the ignition systems operate continuously and are manually turned off following start. Refer to AIR START (IGNITION AND UNFEATHER) SWITCHES, in this section.

OIL SYSTEM

An independent, dry sump oil system is provided for each engine. These systems provide both engine lubrication and propeller control system supply. Oil is stored in a 1.5-gallon tank on each engine, 1.25 gallons of which is usable. At idle (65% rpm), minimum oil pressure is 50 psi. Above 91% rpm, oil pressure is regulated at 105 (± 15) psi. The flow rate of the system is 4 to 7 gallons per minute. Each system includes a ram-air oil cooler which

T-76 ENGINE

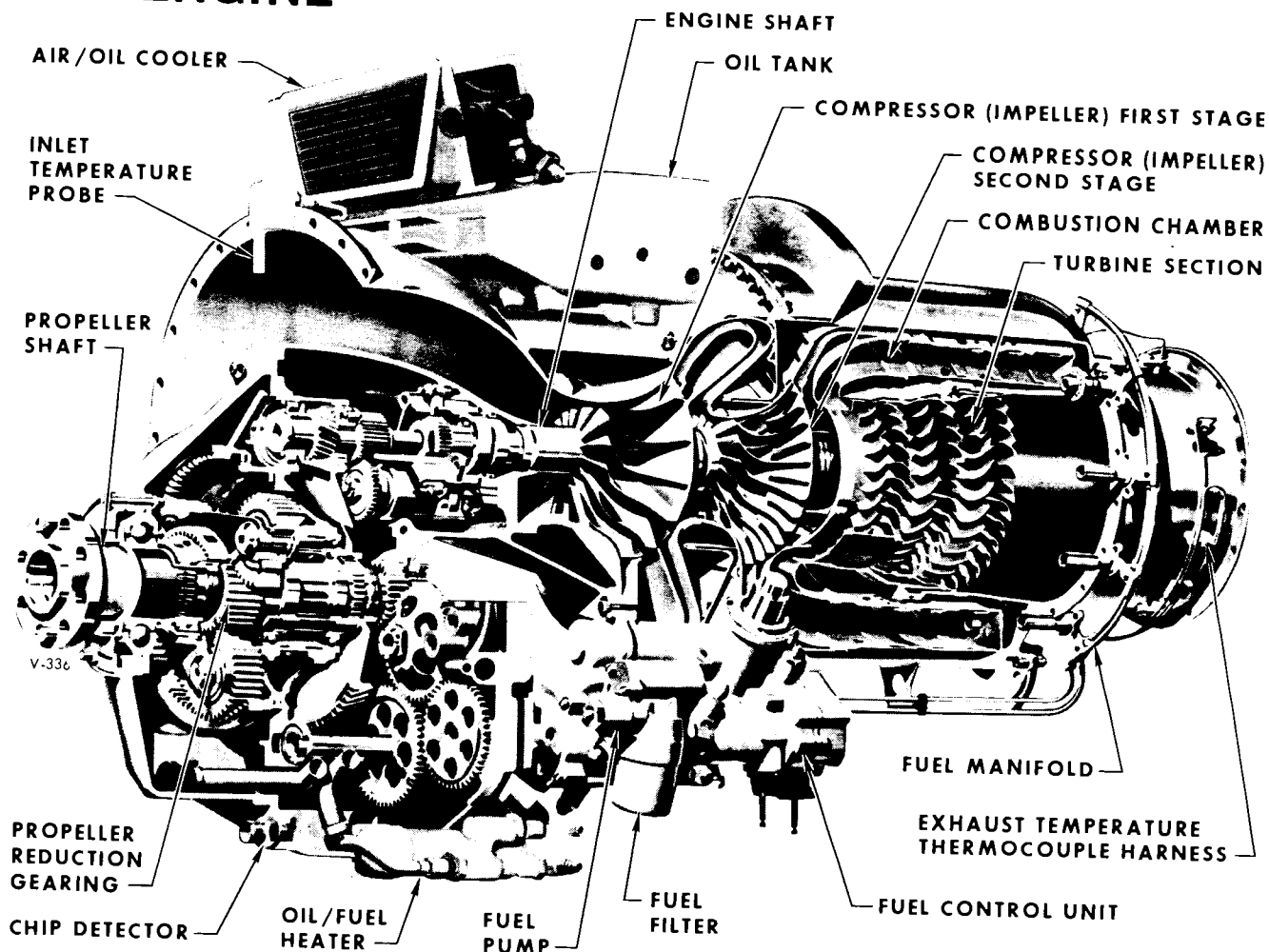


Figure 1-3

PVA-1-6

maintains oil temperature within limits. The oil cooler door opens mechanically when the respective main landing gear door is opened, providing greater oil cooling capability during ground operation. Both engine accessory gearcases are equipped with a magnetic drain plug which attracts any ferrous particles present in the lower area of the sump. The plugs provide the electrical ground for operation of the engine chip warning lights.

Engine Chip Caution Lights

- ✓ The L CHIP and R CHIP caution lights (figure 1-9) are located on the instrument panel. Collection of sufficient ferrous particles on either engine accessory case chip detector will cause the associated caution light to illuminate.

POWER PLANT CONTROLS

Power Levers

The power levers are located on the left console quadrants (figure 1-5). The quadrants are marked at FULL REVERSE, GROUND START, FLIGHT IDLE, and MILITARY positions. The power levers are linked to the engine fuel control units and the power management control systems. The primary functions of the power levers are to control engine fuel flow and propeller thrust setting, and to select reverse thrust. Selection of the FULL REVERSE (full aft) position drives the propeller blades against the reverse pitch stops to obtain maximum reverse thrust, and automatically provides required fuel flow for reverse thrust conditions. The GROUND START position results in Standard Day minimum

PROPELLER CONTROL SYSTEM

T.O. 11-10A-1

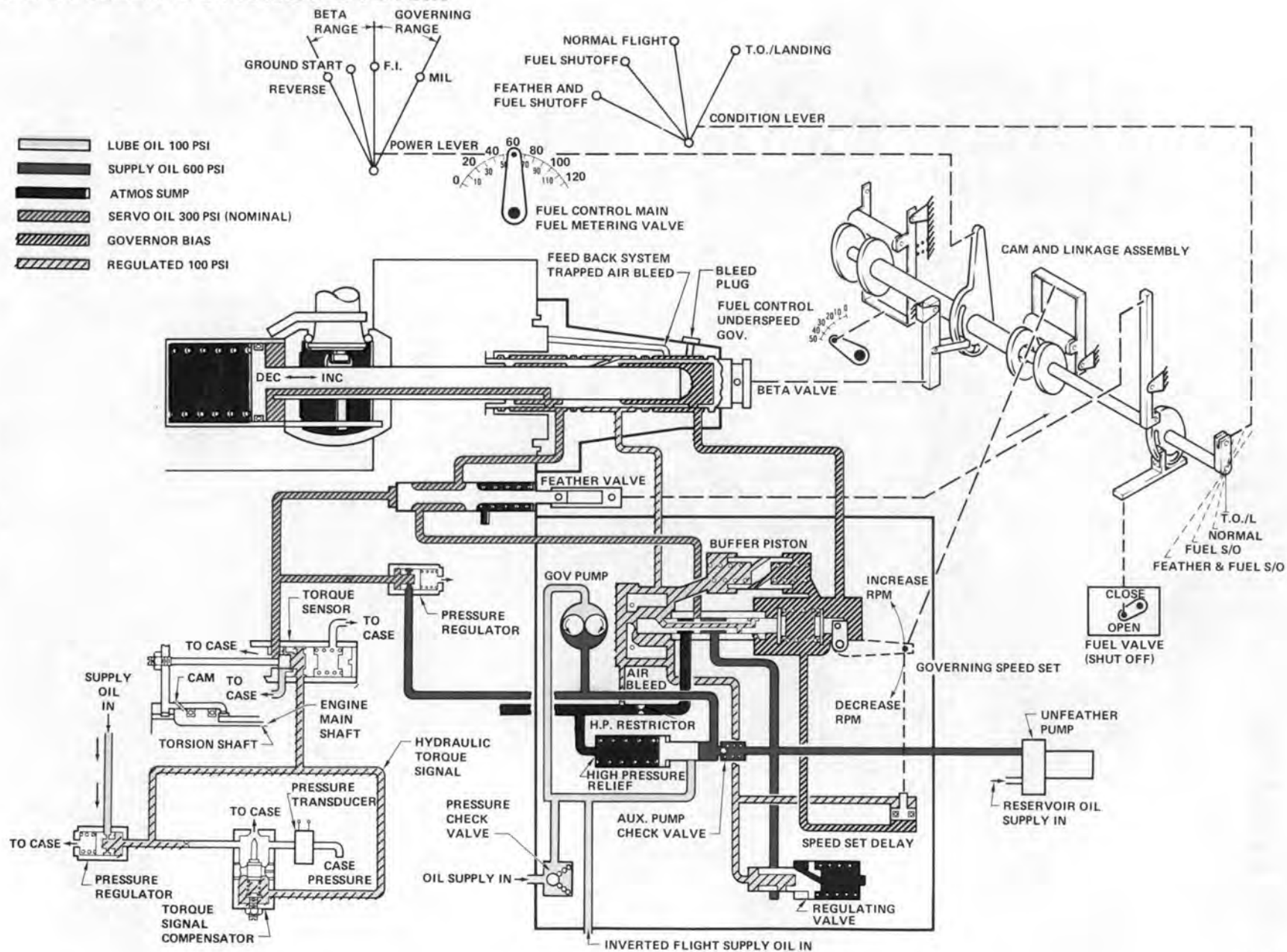


Figure 1-4

torque at idle rpm, with the propeller blades set at the flat pitch position. Placement at the FLIGHT IDLE mark provides Standard Day in-flight minimum fuel flow and torque, depending on airspeed. On the ground, reverse thrust is obtained by retarding the power levers into the reverse thrust range. Inadvertent in-flight selection of reverse thrust is prevented by a solenoid-operated gate in the pilot's power quadrant, which is retracted with the weight of the aircraft on the main landing gear. The reverse gate (solenoid) can be by-passed by lifting the power levers approximately ¼ inch and then going to the reverse thrust position if a malfunction should occur.



Do not retard the power levers aft of the "gate" in flight.

Condition Levers

The condition levers are located on the left console quadrants (figure 1-5), inboard of the power levers. The quadrants are marked T.O./LAND, NORMAL FLIGHT, FUEL SHUT-OFF, and FEATHER & FUEL SHUT-OFF. The condition levers are linked to the power management control systems, the engine fuel shutoff valve, and the propeller feather valves. The primary function of the condition levers is to select engine power/propeller rpm response to power lever setting (between T.O./LAND and NORMAL FLIGHT), to initiate or shut off fuel flow to the engines (FUEL SHUT-OFF), and to manually feather the propellers and shut off fuel to the engines (FEATHER & FUEL SHUT-OFF). Refer to ENGINE OPERATION, in this section.



Placing a condition lever in the NORMAL FLIGHT position when the engine is not running will cause the fuel trapped under pressure between the engine-driven fuel pump and the fuel shutoff valve to be injected directly into the combustion chamber. A fire is highly probable if the engine is hot.

Friction Lever

Operating friction of the pilot's and observer's power levers may be adjusted through a friction lever on the pilot's quadrant in the front cockpit only (figure 1-5). Operating friction of the condition levers is ground-adjusted.

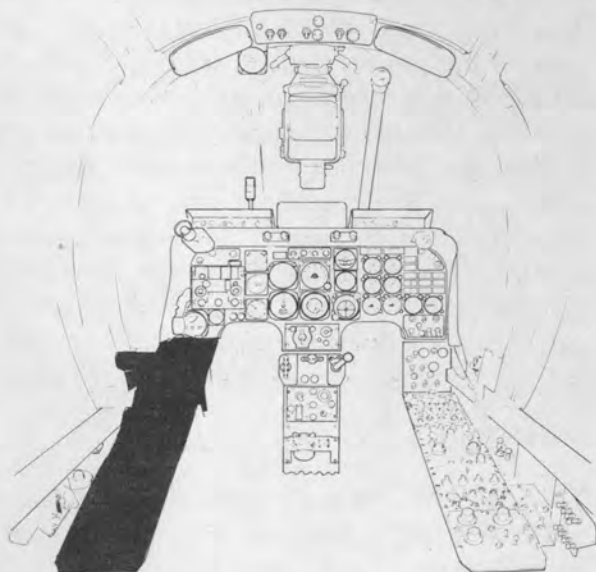
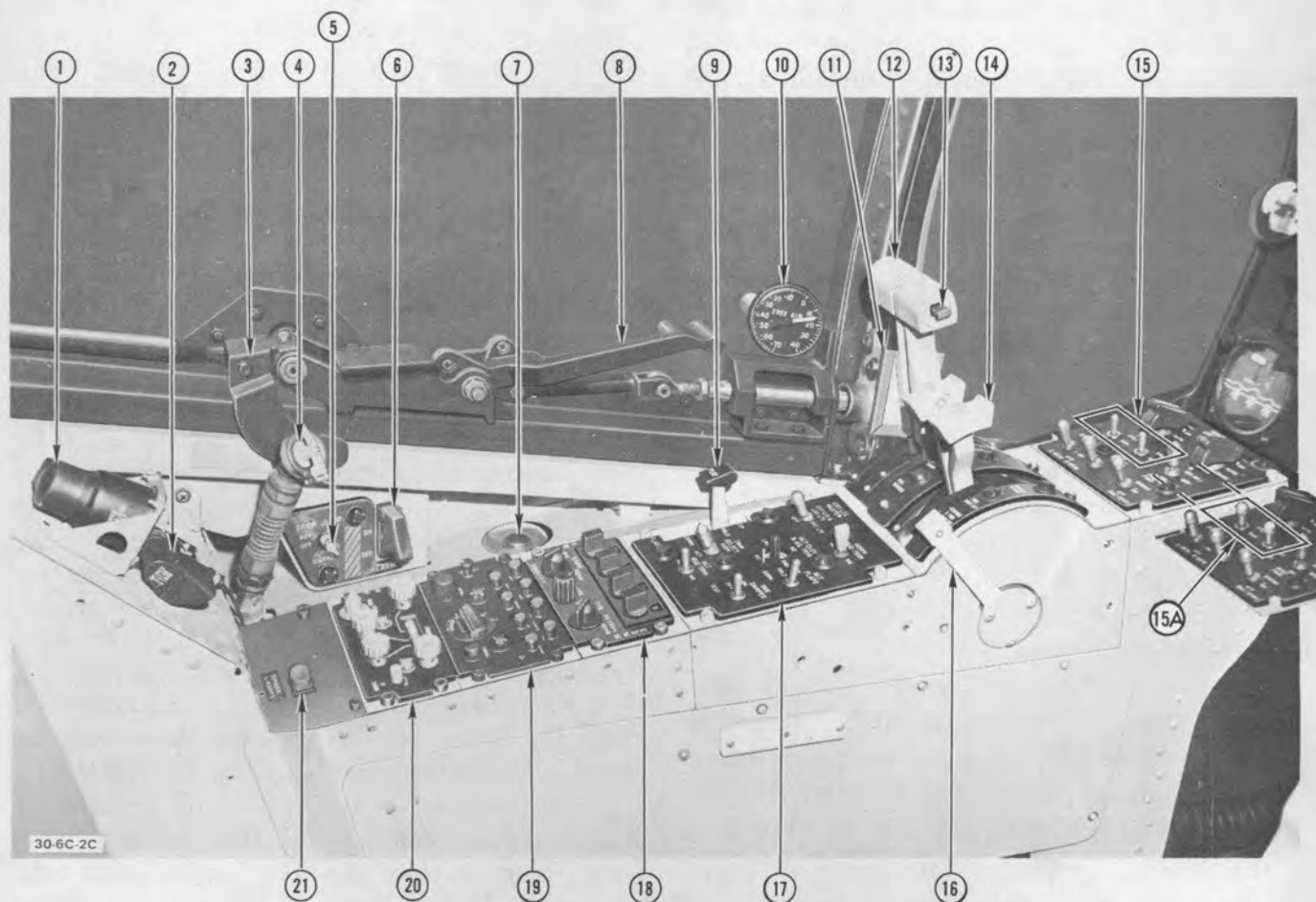
Air Start (Ignition and Unfeather) Switches

The AIR START (IGNITION & UNFEATHER) switches (figure 1-10) are located on the pilot's engine start and electrical control panel. These switches are covered by red guards labeled AIR START, and have AUTO, ON, and CRANK positions. In AUTO (guards down), the ignition systems are armed for normal automatic starts and controlled by the engine rpm sensing switches. With the primary d-c bus energized, the ON position activates the propeller unfeathering pump, provides continuous ignition system operation, and provides starting fuel, regardless of condition lever position, until the EGT reaches its temperature cutoff point 450 (±50) °C, at which time starting fuel is automatically shut off. The ON position is used for air starting the engine; the switch must be returned to the AUTO position after the start to shut off the ignition system and the unfeather pump. The ignition system is not continuous duty rated. For engine limits, refer to Section V. With the power lever in the reverse thrust range and the BATTERY switch ON or external d-c power applied, holding either switch in CRANK cuts off ignition and fuel enrichment and activates the corresponding unfeathering pump, driving the propeller blades toward the reverse pitch stops. The switch is spring-loaded to the AUTO position. Subsequently releasing the switch to AUTO and returning the power lever into the positive thrust range allows the feathering mechanism to drive the blades back toward the feathered position, engaging the flat pitch locks.

Starter Switches

The L START and R START switches (figure 1-10) are located on the pilot's engine start and electrical control panel. These three-position switches are marked START, RUN, and ABORT, and are spring-loaded to return to RUN position on release. With the BATTERY switch ON, holding the desired switch momentarily in START initiates engine

PILOT'S LEFT CONSOLE (TYPICAL)



1. HIGH INTENSITY LIGHT
2. CONSOLE FLOODLIGHT
3. CANOPY DOOR LOCK INDICATOR
4. ANTI-G SUIT HOSE
5. DROP- JUMP SIGNAL SWITCH
6. EMERGENCY ALARM SWITCH
7. ANTI-G VALVE
8. CANOPY DOOR LOCK HANDLE
9. FLAP HANDLE
10. FREE AIR TEMPERATURE INDICATOR
11. COMPASS CORRECTION CARD*
12. ENGINE POWER LEVERS
13. MICROPHONE SWITCH
14. ENGINE CONDITION LEVERS
15. START-ELECTRICAL CONTROL PANEL
- 15A. START SWITCHES §
16. POWER LEVER FRICTION LEVER
17. FLAP-TRIM CONTROL PANEL
18. VHF-FM CONTROL PANEL (No. 1)
19. INTERCOM (ICS) CONTROL PANEL †
20. HF COMM CONTROL PANEL
21. SPARE LAMPS ‡

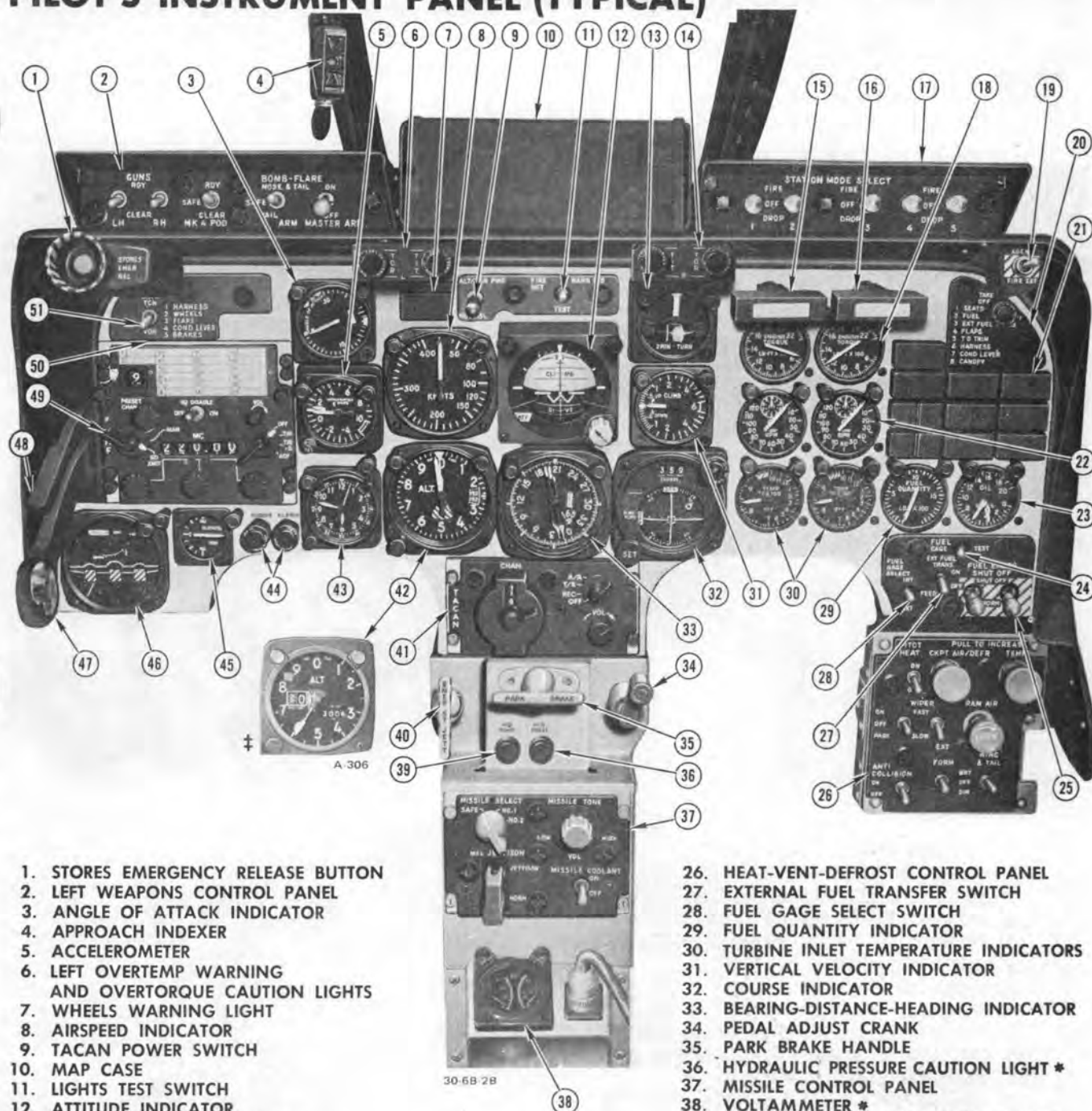
Aircraft having T.O. incorporated:

* 1L-10A-536 † 1L-10A-538
‡ 1L-10A-629 § 1L-10A-546

Figure 1-5

VA-1-7G

PILOT'S INSTRUMENT PANEL (TYPICAL)



1. STORES EMERGENCY RELEASE BUTTON
2. LEFT WEAPONS CONTROL PANEL
3. ANGLE OF ATTACK INDICATOR
4. APPROACH INDEXER
5. ACCELEROMETER
6. LEFT OVERTEMP WARNING AND OVERTORQUE CAUTION LIGHTS
7. WHEELS WARNING LIGHT
8. AIRSPEED INDICATOR
9. TACAN POWER SWITCH
10. MAP CASE
11. LIGHTS TEST SWITCH
12. ATTITUDE INDICATOR
13. TURN AND SLIP INDICATOR
14. RIGHT OVERTEMP WARNING AND OVERTORQUE CAUTION LIGHTS
15. LEFT FIRE WARNING — PULL HANDLE
16. RIGHT FIRE WARNING — PULL HANDLE
17. RIGHT WEAPONS CONTROL PANEL †
18. ENGINE TORQUE INDICATORS
19. FIRE EXTINGUISHER AGENT SWITCH
20. TAKE-OFF CHECKLIST
21. WARNING AND CAUTION LIGHTS
22. ENGINE TACHOMETERS
23. OIL PRESSURE INDICATOR
24. FUEL GAGE TEST SWITCH
25. FUEL EMERGENCY SHUTOFF SWITCHES

Aircraft having T.O. incorporated:

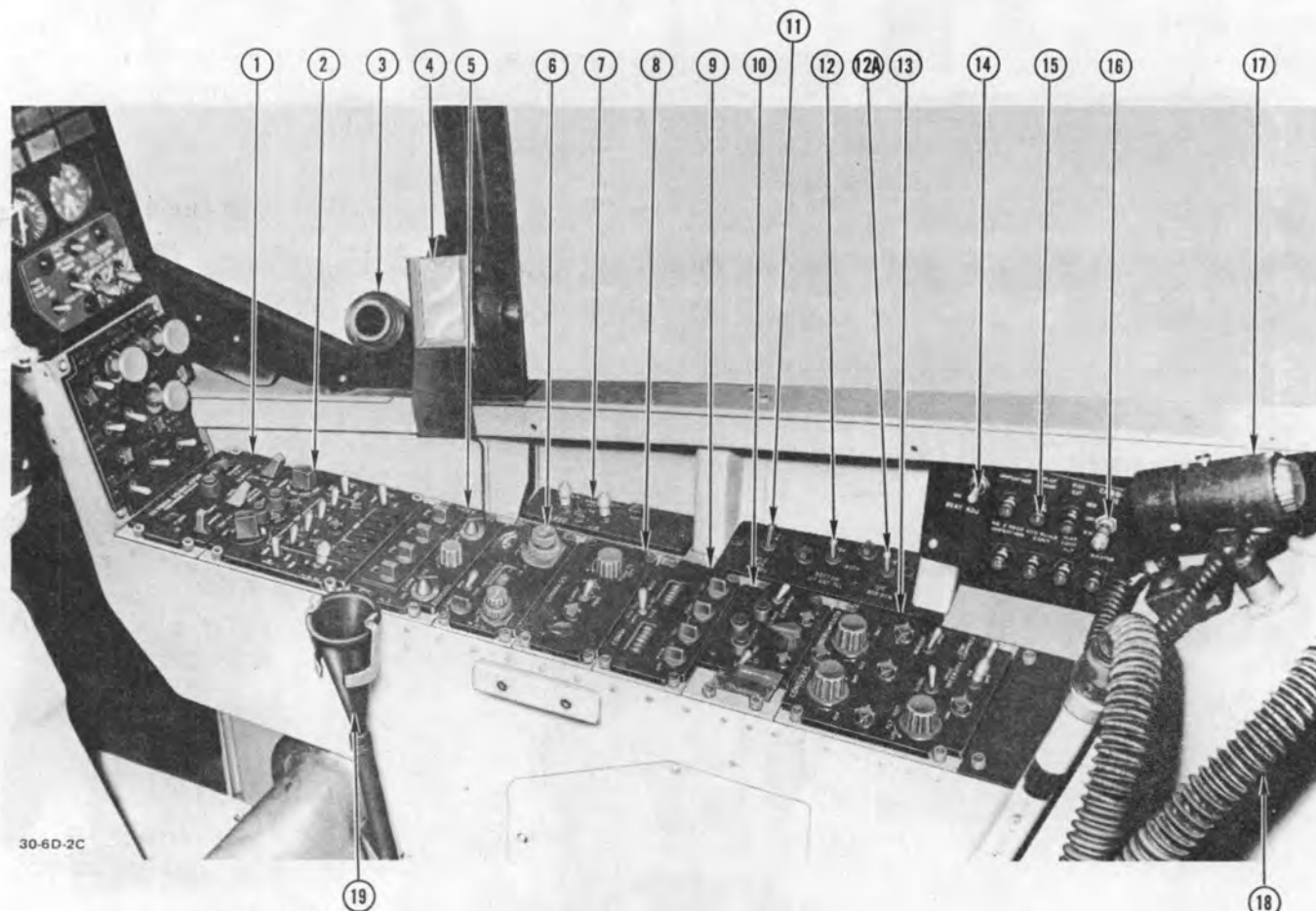
- * 1L-10A-538
- † 1L-10A-579
- ‡ 1L-10A-629

26. HEAT-VENT-DEFROST CONTROL PANEL
27. EXTERNAL FUEL TRANSFER SWITCH
28. FUEL GAGE SELECT SWITCH
29. FUEL QUANTITY INDICATOR
30. TURBINE INLET TEMPERATURE INDICATORS
31. VERTICAL VELOCITY INDICATOR
32. COURSE INDICATOR
33. BEARING-DISTANCE-HEADING INDICATOR
34. PEDAL ADJUST CRANK
35. PARK BRAKE HANDLE
36. HYDRAULIC PRESSURE CAUTION LIGHT *
37. MISSILE CONTROL PANEL
38. VOLTAMMETER *
39. HYDRAULIC PUMP INDICATING LIGHT *
40. EMERGENCY STORES JETTISON HANDLE
41. TACAN CONTROL PANEL
42. ALTIMETER
AAU-21/A AIMS ALTIMETER ‡
43. CLOCK
44. TRIM NEUTRAL LIGHTS (RUDDER-AILERON)
45. ELEVATOR TRIM INDICATOR
46. GEAR-FLAP POSITION INDICATOR
47. LANDING GEAR HANDLE
48. GEAR HANDLE RELEASE LEVER
49. UHF COMM CONTROL PANEL
50. LANDING CHECKLIST
51. VOR-TACAN SWITCH

VA-1-8F

Figure 1-6

PILOT'S RIGHT CONSOLE (TYPICAL)



1. OXYGEN REGULATOR
2. IFF-SIF CONTROL PANEL
3. DEFROST DUCT SWIVEL NOZZLE
4. HF/VHF COMM FREQ CARD†
5. PROVISIONS FOR VHF/FM CONTROL NO. 2†
6. LF-ADF CONTROL PANEL
7. BLEED AIR SWITCHES
8. COMPASS CONTROL PANEL‡
9. VHF-AM/VOR-ILS (COMM-NAV) CONTROL PANEL
10. PROVISIONS FOR KY-28 CONTROL PANEL
11. AMMETER SELECT SWITCH‡
12. IFF ANTENNA SELECT SWITCH **
- 12A. RADAR BEACON POWER SWITCH §
13. INTERIOR LIGHTS CONTROL PANEL*
14. SEAT ADJUST SWITCH
15. CIRCUIT BREAKERS
16. CARGO BAY LIGHTS SWITCH
17. UTILITY LIGHT
18. OXYGEN HOSE
19. RELIEF TUBE

Aircraft having T.O. incorporated:

- | | |
|--------------|---------------|
| * 1L-10A-595 | † 1L-10A-536 |
| ‡ 1L-10A-538 | ** 1L-10A-629 |
| § 1L-10A-632 | |

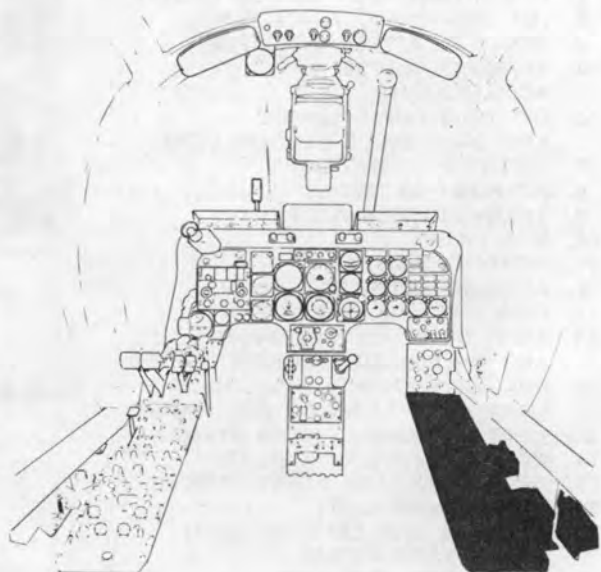
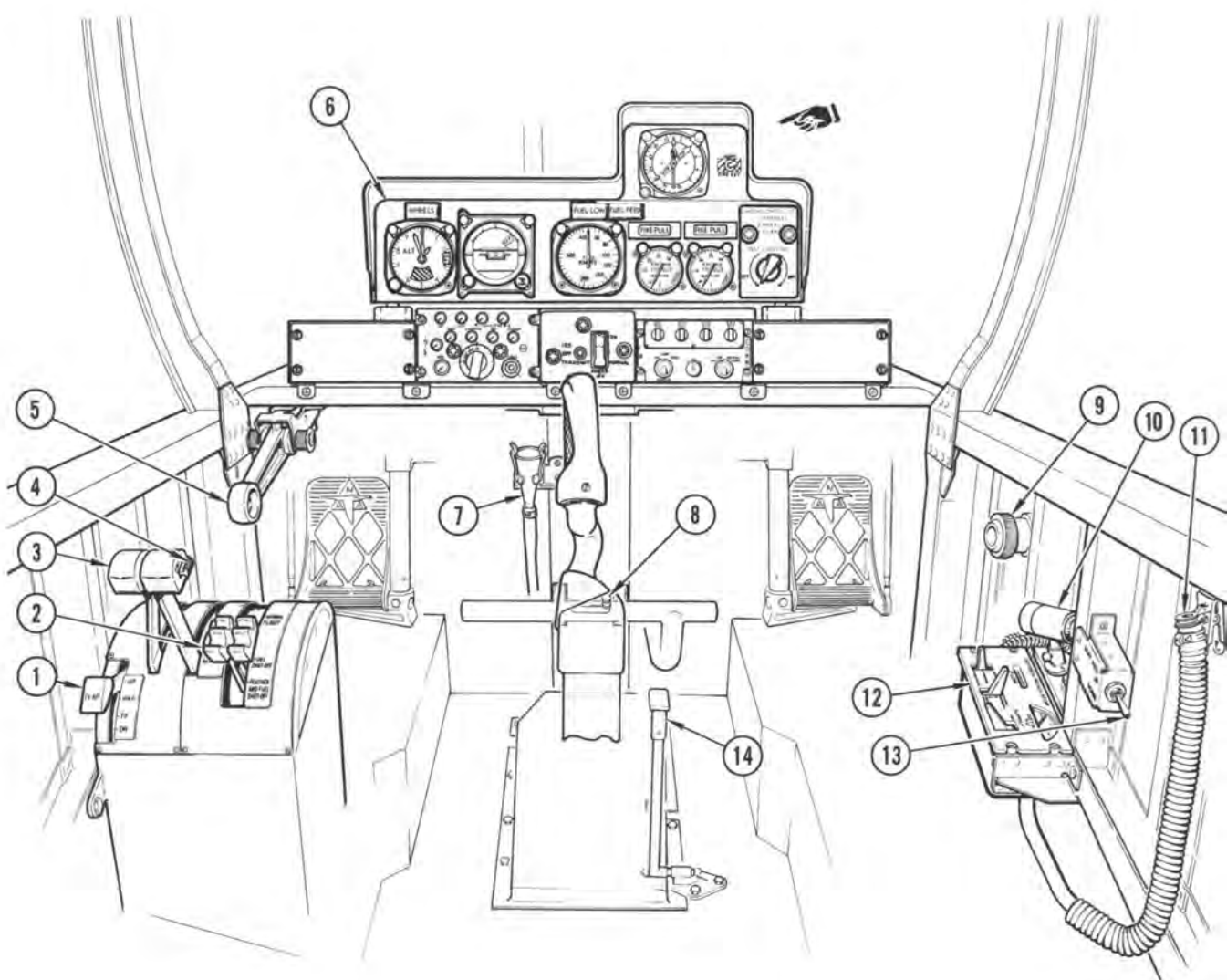


Figure 1-7

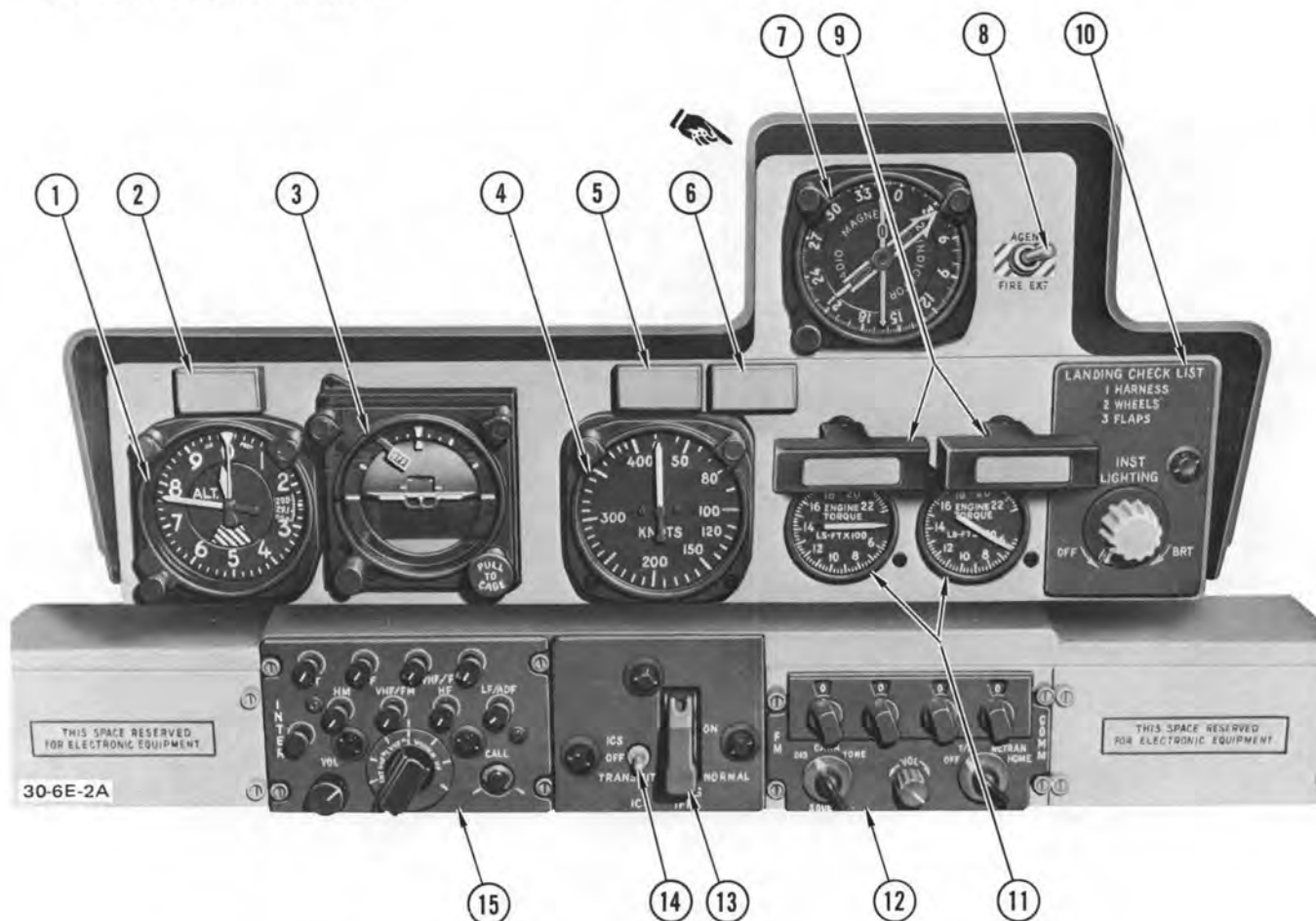
OBSERVER'S COCKPIT (TYPICAL)



- | | |
|---|---------------------------------|
| 1. FLAP HANDLE | 7. RELIEF TUBE |
| 2. ENGINE CONDITION | 8. COCKPIT AIR CONTROL VALVE |
| 3. POWER LEVERS | 9. COCKPIT AIR VENT |
| 4. MICROPHONE SWITCH | 10. UTILITY LIGHT |
| 5. LANDING GEAR HANDLE
(EXTEND CONTROL ONLY) | 11. OXYGEN HOSE |
| 6. INSTRUMENT PANEL
(SEE SHEETS 2 AND 3) | 12. OXYGEN REGULATOR |
| | 13. SEAT ADJUST SWITCH |
| | 14. CAMERA CRADLE CONTROL LEVER |

Figure 1-8 (Sheet 1 of 3)

TYPICAL INSTRUMENT PANEL OBSERVER'S COCKPIT



- | | |
|-----------------------------------|---|
| 1. ALTIMETER | 9. FIRE WARNING - PULL HANDLES |
| 2. WHEELS WARNING LIGHT | 10. INSTRUMENT LIGHTING KNOB/
LANDING CHECKLIST |
| 3. ATTITUDE INDICATOR | 11. ENGINE TORQUE INDICATORS |
| 4. AIRSPEED INDICATOR | 12. VHF-FM CONTROL PANEL (NO. 2)
(IF INSTALLED)† |
| 5. FUEL LOW CAUTION LIGHT | 13. EMERGENCY IFF SWITCH |
| 6. FUEL FEED WARNING LIGHT | 14. MIC SELECT SWITCH |
| 7. HEADING INDICATOR * | 15. INTERCOM (ICS) CONTROL PANEL |
| 8. FIRE EXTINGUISHER AGENT SWITCH | |

* AIRCRAFT HAVING T.O.1L-10A-542 INCORPORATED

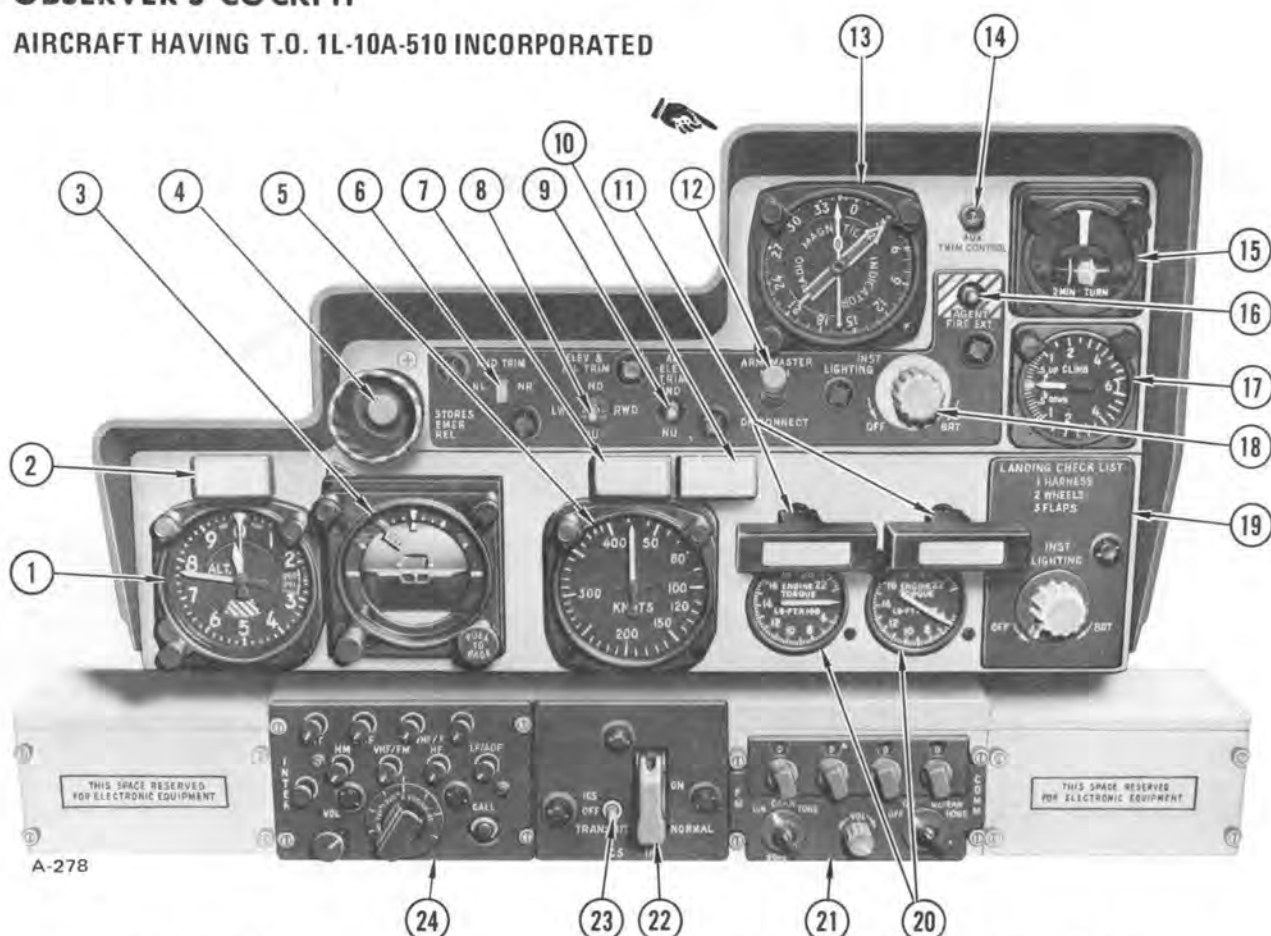
† AIRCRAFT HAVING T.O.1L-10A-536 INCORPORATED HAVE
PROVISIONS FOR INSTALLATION IN PILOT'S COCKPIT

Figure 1-8 (Sheet 2 of 3)

MODIFIED INSTRUMENT PANEL

OBSERVER'S COCKPIT

AIRCRAFT HAVING T.O. 1L-10A-510 INCORPORATED



1. ALTIMETER
2. WHEELS WARNING LIGHT
3. ATTITUDE INDICATOR
4. STORES EMERGENCY RELEASE BUTTON
5. AIRSPEED INDICATOR
6. RUDDER TRIM SWITCH
7. FUEL LOW CAUTION LIGHT
8. ELEVATOR AND AILERON TRIM SWITCH
9. ALTERNATE ELEVATOR TRIM SWITCH
10. FUEL FEED WARNING LIGHT
11. FIRE WARNING - PULL HANDLES
12. ARM MASTER SWITCH

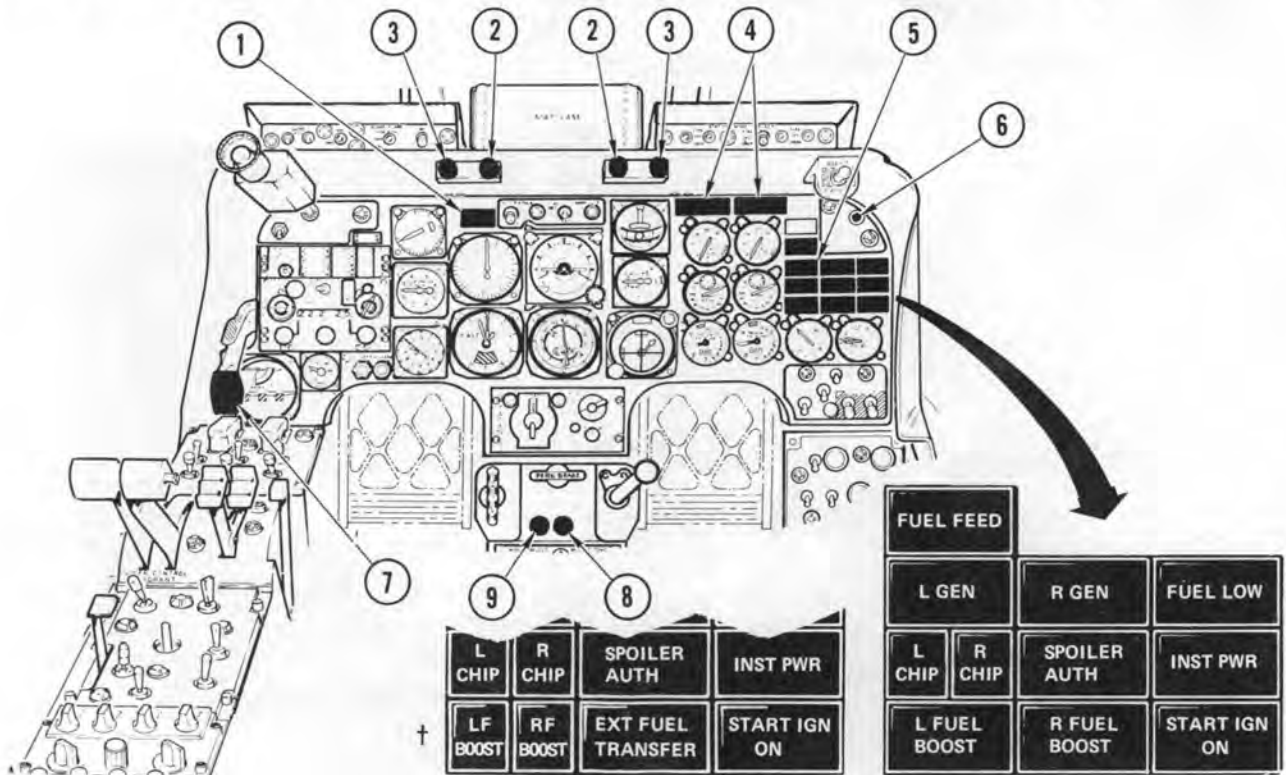
13. HEADING INDICATOR *
14. AUXILIARY TRIM CONTROL CIRCUIT BREAKER
15. TURN AND SLIP INDICATOR
16. FIRE EXTINGUISHER SWITCH AGENT
17. VERTICAL VELOCITY INDICATOR
18. AUXILIARY PANEL INSTRUMENT LIGHTING KNOB
19. INSTRUMENT LIGHTING KNOB/ LANDING CHECKLIST
20. ENGINE TORQUE INDICATORS
21. VHF-FM CONTROL PANEL (NO. 2) (IF INSTALLED) †
22. EMERGENCY IFF SWITCH
23. MIC SELECT SWITCH
24. INTERCOM (ICS) CONTROL PANEL

* AIRCRAFT HAVING T.O. 1L-10A-542 INCORPORATED

† AIRCRAFT HAVING T.O. 1L-10A-536 INCORPORATED HAVE PROVISIONS FOR INSTALLATION IN PILOT'S COCKPIT

Figure 1-8 (Sheet 3 of 3)

PILOTS WARNING AND CAUTION LIGHTS (TYPICAL)



LIGHT

COLOR

MEANING

1. WHEELS WARNING (O)	RED (FLASHING)	ANY GEAR NOT EXTENDED AND LOCKED. EITHER CONDITION LEVER AT T.O./LAND AND: 1. POWER LEVERS RETARDED, OR 2. FLAPS 30 DEGREES OR MORE
2. OVERTEMP WARNING	RED	ENGINE TURBINE INLET TEMPERATURE ABOVE 996-1000°C.
3. OVERTORQUE CAUTION	AMBER	ENGINE TORQUE ABOVE 2200 POUND - FEET.
4. FIRE WARNING (O)	RED	OVERHEAT OR FIRE IN NACELLE.
5. WARNING AND CAUTION LIGHTS: FUEL FEED WARNING (O) L CHIP, R CHIP CAUTION SPOILER AUTHORITY START IGN ON CAUTION L GEN, R GEN CAUTION FUEL LOW CAUTION (O) INST PWR CAUTION L FUEL BOOST, R FUEL BOOST EXT FUEL TRANSFER †	RED AMBER AMBER AMBER AMBER AMBER AMBER AMBER AMBER	LESS THAN 50 POUNDS FUEL IN FEED TANK IRON-METALLIC PARTICLES ON CHIP DETECTOR SYSTEM MALFUNCTIONING IF LIGHT STAYS ON EITHER ENGINE STARTER OR IGNITION OPERATING GENERATOR OFF LINE 205-236 POUNDS FUEL IN CENTER WING TANK PRIMARY A-C BUS POWER FAILURE FUEL BOOST PUMP MOTIVE FLOW OUTPUT LOW FUEL FLOW LESS THAN 2 GPM
6. IFF CAUTION	AMBER	MODE 4 INTERROGATIONS RECEIVED BUT REPLIES NOT GENERATED. *
7. LANDING GEAR UNSAFE PILOT'S GEAR HANDLE	RED	GEAR NOT LOCKED IN SELECTED POSITION
8. HYDRAULIC PRESSURE	AMBER	LESS THAN 200 PSI ON DEMAND
9. HYDRAULIC PUMP	GREEN	HYDRAULIC PUMP OPERATING

O = INSTALLED IN OBSERVER'S COCKPIT

* = WITH T. O. 1L-10A-508 INCORPORATED AND
CRYPTO COMPUTER INSTALLED

† = WITH T. O. 1L-10A-541 INCORPORATED

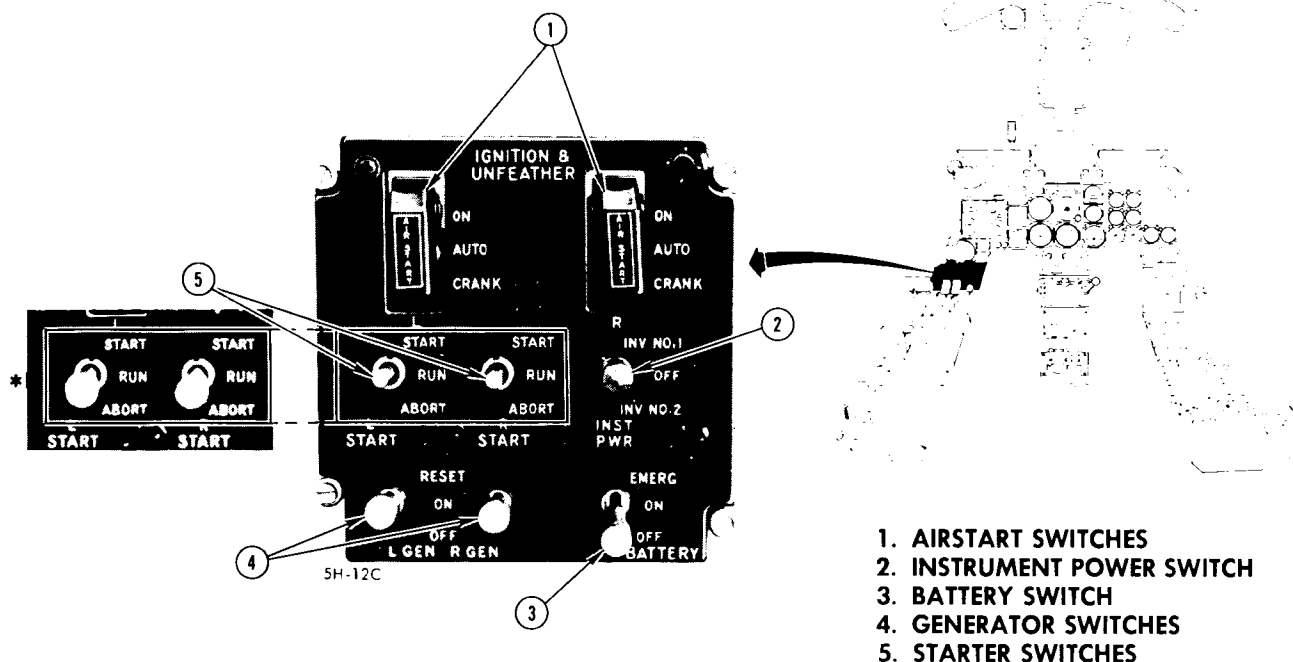
VA-1-11F

Figure 1-9

starter operation through a holding relay. The ABORT switch disengages the holding circuit, disables the automatic ignition circuit, disengages the starter, and cuts off fuel enrichment flow. If light-off has occurred, starts may be aborted by retarding the condition lever to FUEL SHUT-OFF,

then holding the START switch momentarily in ABORT if engine cranking is not desired. On aircraft having T.O. 1L-10A-546 incorporated, the START switches are changed to lever-lok-type switches, requiring positive lift-to-unlatch action prior to selecting START position. This change

START—ELECTRICAL CONTROLS



* AIRCRAFT HAVING T.O. 1L-10A-546 INCORPORATED.

VA 1-16C

Figure 1-10

also removes electrical power from the START switches through action of the ground safety switch, when the aircraft is airborne.

CAUTION

- Do not actuate the ground START switches while in flight. Actuation of a ground START switch to the START position transfers all electrical power to the start bus, making it impossible to unfeather a propeller and will result in failure of the operating generator. Placing the ground START switch in the ABORT position will restore electrical power to the primary bus.
- On aircraft having T.O. 1L-10A-546 incorporated, power is removed from the START switches while the aircraft is airborne.

Start Ignition On Light

The START IGN ON light (figure 1-9) is installed on the pilot's instrument panel. This amber light

is illuminated whenever an engine is started as in the normal start mode (one engine at a time) or when either or both engines are started on the air start system. The START IGN ON light should extinguish at 50% rpm during a normal start, and when the AIR START switches are moved to AUTO following air start.

POWER PLANT INSTRUMENTS

Turbine Inlet Temperature (TIT) Indicators

Two a-c electrically operated turbine inlet temperature indicators are installed on the instrument panel (figure 1-6). These indicators are calibrated in degrees centigrade from 100 to 1200, and are equipped with OFF warning flags. During engine starts (below 50% rpm, or generator cut-in speed), these indicators reflect exhaust gas temperature (EGT). Above approximately 50% rpm, the engine temperature signal conditioners compute TIT from the EGT input signal, switching the indicators to turbine inlet temperature operation. For engine limits, refer to Section V. For detailed information on the single red line temperature system, refer to TURBINE INLET TEMPERATURE, in this section.

On aircraft not having the TIT system installed and operational, the indicators indicate EGT. EGT limits must be corrected for ambient temperature, flight pressure altitude, indicated airspeed, and rpm. For EGT limits and corrections, refer to Section V

Tachometers

Two engine tachometers (figure 1-6) are installed on the instrument panel. These electrically independent indicators reflect engine rpm in percent of Military rated rpm.

Engine Torque Indicators

Two engine torque indicators are located on the instrument panels (figures 1-6 and 1-8). These indicators are calibrated in pound-feet from 550 to 2300.

Overtorque Caution Lights

Two amber torque caution lights TOR (L, R) (figure 1-9) are installed under the instrument panel shroud in the pilot's cockpit. These caution lights operate in conjunction with the engine torque indicators, illuminating when torque exceeds approximately 2200 to 2235 pound-feet. Should overtorque be encountered, retarding the affected engine power lever(s) will extinguish the light(s) when approximately 2165-pound-feet torque is reached. Holding the lights TEST switch in WARN LTS checks the TOR caution light bulb circuits.

Oil Pressure Indicator

A dual-needle oil pressure indicator (figure 1-6) is located on the pilot's instrument panel. This indicator is calibrated in pounds per square inch from 0 to 200.

ENGINE OPERATION

The turboprop engine combines the high power/weight efficiency ratio of the jet engine and the response characteristics of propellers. In the solid-shaft T76 engine, the rotating group (turbine wheels, compressor section, and propeller gearing), are effectively coupled in train on a common, solid power shaft, with propeller rotation speed in direct

mechanical proportion to engine speed. The fixed-shaft engine has the advantages of providing almost instantaneous response to power changes, especially for go-arounds and in reverse. This design is also highly resistant to foreign object damage. Air is drawn through an inlet above the propeller, compressed by a two-stage centrifugal compressor (impeller), mixed with fuel, and ignited within a reverse-flow-annular combustor. The resultant expanded gases drive a three-stage turbine. The compressor and turbine sections rotate on a common shaft where power is extracted to drive the propeller reduction gears. The reduction gears convert the high speed, low torque of the turbine to the lower speeds and higher torques necessary to drive the propeller and the components that control engine operation. Military power (100% rpm) is achieved at 41,730 rpm of the compressor-turbine shaft (propeller shaft rotation, 2000 rpm). The engine fuel control unit regulates fuel flow through inputs of the power lever position, compressor inlet pressure and temperature, compressor discharge pressure, and engine rpm. Engine control is provided by the power and condition levers, located on the control quadrant. The condition lever essentially selects the response mode and the power lever provides integrated control of torque, propeller blade angle (thrust), and reverse selection.

POWER MANAGEMENT CONTROL SYSTEM (PMCS)

The PMCS simplifies power/thrust management by automatic control and correlation of all functions of the engine and the propeller into a single-point input to the cockpit condition lever. A separate power lever and a condition lever are provided for each engine/propeller. The PMCS provides both governing-type control mode and a beta-type control mode.

Power Lever (P/L)

The cockpit power lever is the normal agent for thrust output selection and manipulation between the ranges of full forward thrust to full reverse

thrust. This single input lever automatically coordinates the functions of fuel flow, rpm, and a variable low pitch stop setting for the propeller.

Condition Lever (C/L)

This lever is a functional lever which permits pilot selection of essentially a constant 100% rpm or a minimum operational speed (rpm) schedule, and provides engine fuel shutoff (normal engine shutdown) and propeller feathering (emergency and air shutdown).

Governing Control Mode

In the governing mode, the engine shaft horsepower output and speed (rpm) are variables selected and set by the pilot. Fuel flow to the engine is selected by manipulation of the engine fuel control input through the cockpit power lever to set the power delivered to the propeller. Simultaneously through the PMCS, the operating speed (rpm) of the system is established by a speed set input signal to the propeller control. The propeller governor automatically provides propeller blade angle pitch control to maintain the selected speed (rpm) so that the power delivered by the engine is equal to that demanded by the propeller during steady-state operations. During normal flight operations, governing-type speed control is provided.

Beta Control Mode

In the beta mode of control, propeller blade angle is set by the power lever and the fuel control underspeed governor automatically adjusts the fuel flow and power output of the engine to maintain the selected rpm at the selected blade angle. The PMCS simultaneously coordinates these functions as selected through movement of the power lever to maintain the engine speed desired. During beta mode of control, the propeller governor speed set is rescheduled to a high level to eliminate its interaction with the underspeed governor on the engine.

Propeller Governor

The propeller governor regulates and controls the operating speed (rpm) of the engine-propeller combination by hydraulic modulation of the propeller

blade angle, as required to absorb the power output of the engine at the selected set speed. The propeller governor incorporates an internal set of spring-balanced flyweights which are mechanically coupled to the engine-propeller shaft through appropriate gearing and directly senses the operating rpm. A pilot valve actuated by the flyweights controls the flow (volume) of oil to and from the propeller to control blade angle. The pilot valve acts to port oil to the propeller (which decreases blade angle) in the event of insufficient rpm, and to port oil away from the propeller (which increases blade angle) in the event of excessive rpm. The propeller governor provides an isochronous speed control characteristic (rpm control is independent and does not vary with load). Basic speed set to the propeller governor is derived from the power lever, and except as overridden by the condition lever input, sets the operation rpm from a minimum governing speed of 70% to a maximum of 101%. 21

Underspeed Governor (USG)

The underspeed governor is physically an integral component of the engine fuel control. The purpose of the USG is to provide supplementary fuel flow to that fuel flow scheduled and provided by the fuel control main fuel metering valve if this latter fuel flow is insufficient to permit attainment of the USG set engine speed. This device, combined with the beta valve, permits achievement of reverse thrust and beta-type control mode operation. Basic speed set to the USG is derived from the power lever, and except as overridden by the condition lever input, sets the minimum operating rpm. To prevent control interaction, USG set rpm must always be below the propeller governor set rpm.

Overspeed Governor

The purpose of the overspeed governor is to limit the maximum rpm within safe limits in the event of propeller governor or underspeed governor speed control failure or malfunction. The overspeed governor is physically an integral component of the engine fuel control, and acts to limit reduce fuel flow in accordance with a speed (rpm) input. OSG

action takes precedence over all other fuel inputs to the engine. The engine OSG provides a speed-droop characteristic and nominally is set to provide a limiting rpm of 104% when the propeller blades are locked and positioned on the shutdown pitch stop (minimum torque—zero airspeed).

Beta Valve

The beta valve schedules the minimum blade angle to which the propeller governor may drive the propeller in the governing mode. In the beta mode, this valve is positioned by the power lever and hydraulically controls the propeller blade angle.

NEGATIVE TORQUE SENSING OPERATION

If a flame-out or sudden power loss occurs, airflow will attempt to turn the propeller and thus drive the engine (negative torque). The negative torque sensing system (NTS) will automatically sense this negative torque and will act to drive the propeller toward feather. When propeller blade angle reaches a point where there is effectively no load for the airspeed, the NTS system will return control to the propeller governor system. The propeller system will attempt to return the propeller to lower pitch but the NTS system will be activated as soon as the blade moves toward low pitch. The end result is a pulsating, low drag (only slightly higher than in feather), no-thrust condition with the engine windmilling at 20% to 30% rpm. At any time during this sequence, the pilot may elect to feather the propeller with the condition lever. The NTS system removes the urgency from the feathering procedure. In the event of engine failure, the pilot has time to identify the malfunctioning engine and take appropriate action. This low-drag operation will continue as long as oil pressure is available to maintain propeller control. Should control oil pressure be lost, the propeller will automatically go to full feather. However, the propeller of the failed engine should be feathered as soon as practical to avoid drag transients which occur during automatic feathering and to prevent possible additional damage due to high rpm operation without sufficient oil pressure.

TURBINE INLET TEMPERATURE

The turbine inlet temperature system consists of the engine thermocouple harness, a d-c powered temperature signal conditioner for each engine, and the TIT indicators. The system includes a d-c to a-c conversion which uses battery power to operate the TIT indicators during engine starts, up to generator cut-in rpm.

Note

EGT is displayed until generators cut in.

At engine speeds above minimum generator cut-in rpm (50% to 53%), the single red line engine temperature system provides a computed turbine inlet temperature. Operation of the overtemperature warning lights is a direct, mechanical function of the TIT indicators. These lights allow pilot attention to be directed outside the cockpit when operationally desired. By adjusting the power levers to prevent illumination of the TEMP warning lights, the pilot is assured that engine temperature limits are not being exceeded. Should a power failure to a TIT indicator occur, the OFF warning flag in the instrument will be displayed, and the overtemperature warning lights become inoperative.

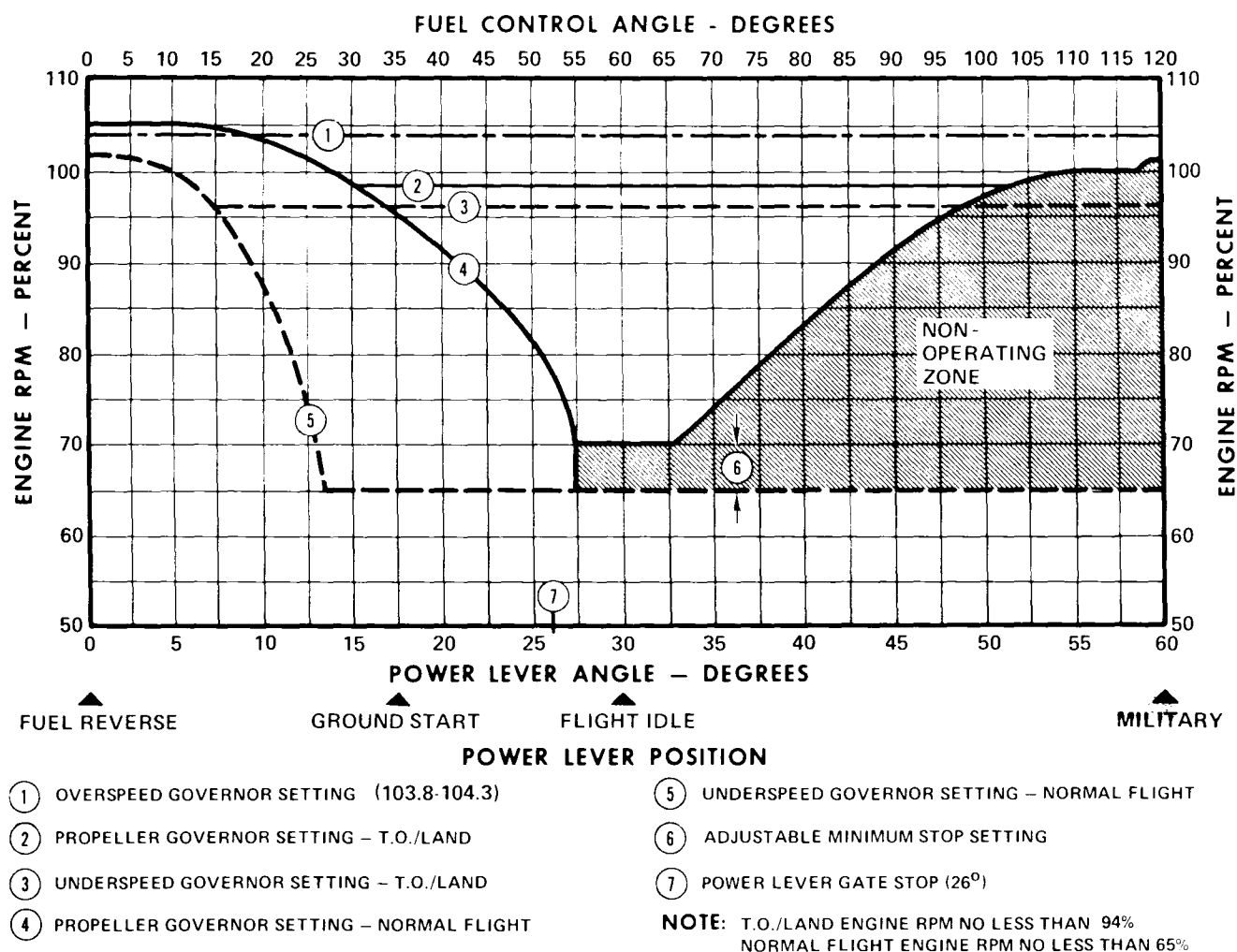
Overtemperature Warning Lights

Two red TIT (L, R) warning lights are installed under the instrument panel shroud in the cockpit (figure 1-9). These warning lights operate in conjunction with the turbine inlet temperature indicators, to illuminate when TIT reaches 996° to 1000°C, and extinguishing at 990° to 1000°C as temperature drops. With primary a-c bus electrical power available (either inverter operating), holding the lights TEST switch in WARN LTS will illuminate the TIT warning lights.

ENGINE CONDITIONS

For engine operation under various conditions, see figure 1-11.

ENGINE SPEED CONTROL



VA 1-178A

Figure 1-11

Engine Starts

Engine starts can be performed by the pilot only, and can be achieved using battery power only or battery and external d-c start power. If the propellers were feathered on the preceding shutdown, they shall be unfeathered and set in flat pitch, prior to start to avoid hot or hanging starts. To accomplish unfeathering, set the condition lever to FUEL SHUT-OFF and the power lever to FULL REVERSE, then hold the AIR START switch in CRANK until the click of the lock passing the latch is heard or the propellers stop moving. Advancing the power levers into the positive thrust region releases unfeather pump oil pressure in the propeller hub, allowing the feathering mechanism to drive the blades toward feather position, engaging

the flat pitch locks. The resulting sequence of engine cranking, light-off, and acceleration is automatic. Light-off (EGT rise) normally occurs between 10% and 12% rpm. Engine rpm should stabilize at 95% to 99% in T.O./LAND or 80% to 90% in NORMAL FLIGHT.

Note

The START IGN ON advisory light should illuminate when either engine start switch is placed in START or either AIR START switch is moved to ON. The light will go out at approximately 50% rpm for both battery-powered and externally powered starts or when the AIR START switches are placed in AUTO.

CAUTION

Should the electrical external power unit fail on initiating engine start (BATTERY switch ON, engine START switch held momentarily in START), the engine selected is motored by the starter if the external unit plug is extracted from the receptacle. To prevent undesired engine rotation, hold the applicable START switch in ABORT and/or move the BATTERY switch to OFF in the event of a bog-down failure of the external power unit.

Ground Operation

Prior to taxi, the propellers must be unlocked by retarding the power levers into the reverse thrust range and returning into the positive thrust range. Propeller unlocking action is detected by aircraft reaction to reverse thrust as the blades leave flat pitch ~~for a maximum rpm of 71%~~ when the power lever is returned to FLIGHT IDLE. A slight rise in torque may be noted during unlocking. Taxiing may be accomplished in either the T.O./LAND or NORMAL FLIGHT position of the condition levers. Normal flight results in reduced propeller rpm, reduced thrust, and lower noise level.

Note

Taxiing with one propeller still on the locks will have the same effect as a dragging brake on the same side. Engine rpm will respond to the power lever position as normal except that minimum obtainable engine rpm will be approximately 85% at FLIGHT IDLE.

Take-off

With the condition lever in either the NORMAL FLIGHT or T.O./LAND position, when the power lever is advanced, maximum fuel is scheduled. The propeller governor is set at approximately 100% (increasing to 101% in the last 2 to 3 degrees of travel for use during propeller synchronization) and the propeller governor schedules blade angle as required to maintain rpm, absorb power, and develop thrust.

Note

Propeller rpm is essentially constant in the T.O./LAND condition. Changes in airspeed and power setting do not result in sound level variations.

Flight in Take-off and Land (T.O./LAND)

As the power lever is retarded from MILITARY, the propeller governor is reset to 99% and the power lever schedules fuel to the engine. The propeller governor schedules blade angle as required by power and airspeed. At low airspeeds and power, the desired blade angle may be below the minimum blade angle schedule. Since the propeller governor may not schedule below this minimum, the propeller load is too great for the power available and rpm begins to drop. The rpm lowers to the USG set point of 96% and then the USG adds fuel to maintain rpm. Thus, as the aircraft slows further, power is increased. This is known as beta mode operation.

Flight in NORMAL FLIGHT

As the power lever is retarded from MILITARY, the propeller governor is reset to the appropriate rpm for the power desired, down to a minimum of 70%. Transition to beta mode at 65% occurs below normal flight speeds and thus should not be observed in flight. It should be noted that during power changes along the portion of the schedule where both rpm and fuel flow vary, the propeller governor will correct rpm first, then absorb the increased power. Thus an increase in power lever will result in a momentary decrease in thrust until rpm reaches the new value.

Landing in T.O./LAND

As described in FLIGHT IN TAKE-OFF AND LAND, in T.O./LAND the aircraft transitions to beta mode at FLIGHT IDLE during deceleration. Selecting gate position lowers the blade angle minimum and thus delays transition to the beta mode. As the aircraft slows following touchdown, if the power lever is not retarded below the gate

or FLIGHT IDLE position the USG will add fuel and increase thrust, and the landing roll will be increased. When the left main gear ground safety switch is closed, the gate stops are retracted and the power lever can be retarded to the GROUND START or minimum thrust position. This action reduces the blade angle and the USG then decreases fuel, providing propeller drag instead of thrust. The rpm remains at the USG setting.

Note

Slight asymmetric thrust may occur below 150 KIAS in the T.O./LAND mode with the power levers in FLIGHT IDLE.

Reverse Power

As the power lever is retarded below GROUND START increasing negative blade angle, the USG begins to add fuel to support the propeller load. When full reverse is reached, the USG has been reset to a high rpm to provide more power in reverse. It should be noted that the observed engine rpm is below the setting point as required by governor droop. To avoid interference between the propeller governor and USG, the propeller governor is reset in reverse to 105% rpm so that it always senses underspeed and attempts to decrease blade angle, holding it on the reverse schedule. The maximum power (fuel flow) available from the engine due to underspeed governor action varies with engine rpm. Typically, reducing engine speed from 100% to 90% rpm reduces maximum power available by 300 shaft horsepower; an additional 10 shaft horsepower per percent rpm is lost below 90% rpm. Movement of the power levers below FLIGHT IDLE changes both the speed set of the underspeed governor and propeller blade angle. Due to the relative difference in the transient response of the engine speed/torque characteristics and propeller blade pitch control dynamics, under certain conditions, it is possible to obtain a full reverse blade angle on the propeller without obtaining sufficient engine power and rpm to support this demand. Also at higher landing speeds, full reverse may require more propeller power than is available from the engine. Under these conditions, an engine bog-down is precipitated and immediate advancement of the power lever to the GROUND START position is required to move the propeller blade pitch to a

position requiring less engine power. An engine bog-down is usually typified by a rapid decrease in engine rpm and an equally rapid rise in TIT (EGT). If this condition is not immediately arrested, severe temperature damage to the engine will occur. To preclude engine bog-down, landings should not be made when the condition lever is positioned to NORMAL FLIGHT. The NORMAL FLIGHT position permits the power lever to schedule engine rpm as low as 65% rpm during reverse thrust operation, which will not support power demands during acceleration to full reverse thrust conditions. With the condition levers in T.O./LAND, engine rpm is never scheduled less than 96% so that engine-propeller power balance is maintained.

Engine Shutdown

Normal (Flat Pitch)—The engines are normally shut down with the propeller blades locked at flat pitch. For shutdown, the condition levers are pulled to the FUEL SHUT-OFF position, immediately followed by retarding the power levers to FULL REVERSE and holding until engine rotation stops. As engine rpm drops below 30%, the flat pitch locks extend. As engine oil pressure drops, the propeller feathering mechanism will drive the blades from full reverse toward feather, engaging the flat pitch locks.

Feathered—To obtain feathering on shutdown, adjust power lever position to obtain minimum torque and pull the condition levers full aft to FEATHER & FUEL SHUT-OFF. Subsequent start procedure must then include unfeathering, refer to ENGINE STARTS, in this section.

ENGINE FIRE WARNING SYSTEM

The engine fire warning system consists of independent a-c/d-c powered detector control units, engine compartment overheat sensing elements, the engine fire warning lights, and a system test switch. Normal power for system operation is provided by the a-c electrical system; however, the detector control units operate on d-c power in the event of a-c system failure.

Test Switch

The TEST switch (figure 1-6) is used to provide an operational test of the engine fire detection and

warning system, and to test illumination of all warning and caution light bulbs. With primary d-c or primary a-c bus power available, holding the switch in FIRE DET tests the continuity of the engine fire detection and warning system. With primary d-c bus power available, holding the switch in WARN LTS tests all warning and caution lights.

Engine Fire Warning Lights (FIRE PULL)

Two combination engine fire warning/FIRE PULL lights are located on the pilot's (figure 1-6) and observer's instrument panels (figure 1-8). When illuminated, these FIRE PULL lights indicate the presence of fire or an overheat condition in the respective engine nacelle. The FIRE PULL lights are pulled to electrically close the fuel emergency shut-off valves and arm the fire extinguishing systems.

FIRE EXTINGUISHER SYSTEM

An electrically fired, squib-activated fire extinguisher system is installed in each engine nacelle. The fire extinguisher systems are not interconnected and operate independently. Actuating electrical

power is provided by the primary d-c bus. Each extinguisher bottle contains 86 cubic inches of monotrifluoromethane (CF_3Br) at a nominal 600-psi gage pressure. The agent is odorless, nontoxic, and noncorrosive. Each system is armed by the respective FIRE PULL handle, and is completely discharged when the FIRE EXT switch is placed to AGENT.

Note

Each fire extinguisher system is "one shot" and must be recharged prior to further use.

Two nozzles in each engine nacelle direct the agent to flood the engine bay (figure 1-12).

ANTI-G SUIT SYSTEM

Engine compressor bleed air is directed to an anti-G suit valve (figure 1-5) in the pilot's cockpit and on the left side of the observer's cockpit. During maneuvering flight, air pressure regulated to between 1.5 and 2.0 psi per "g" (over and above 1.0 "g") is directed into the crew member's anti-G

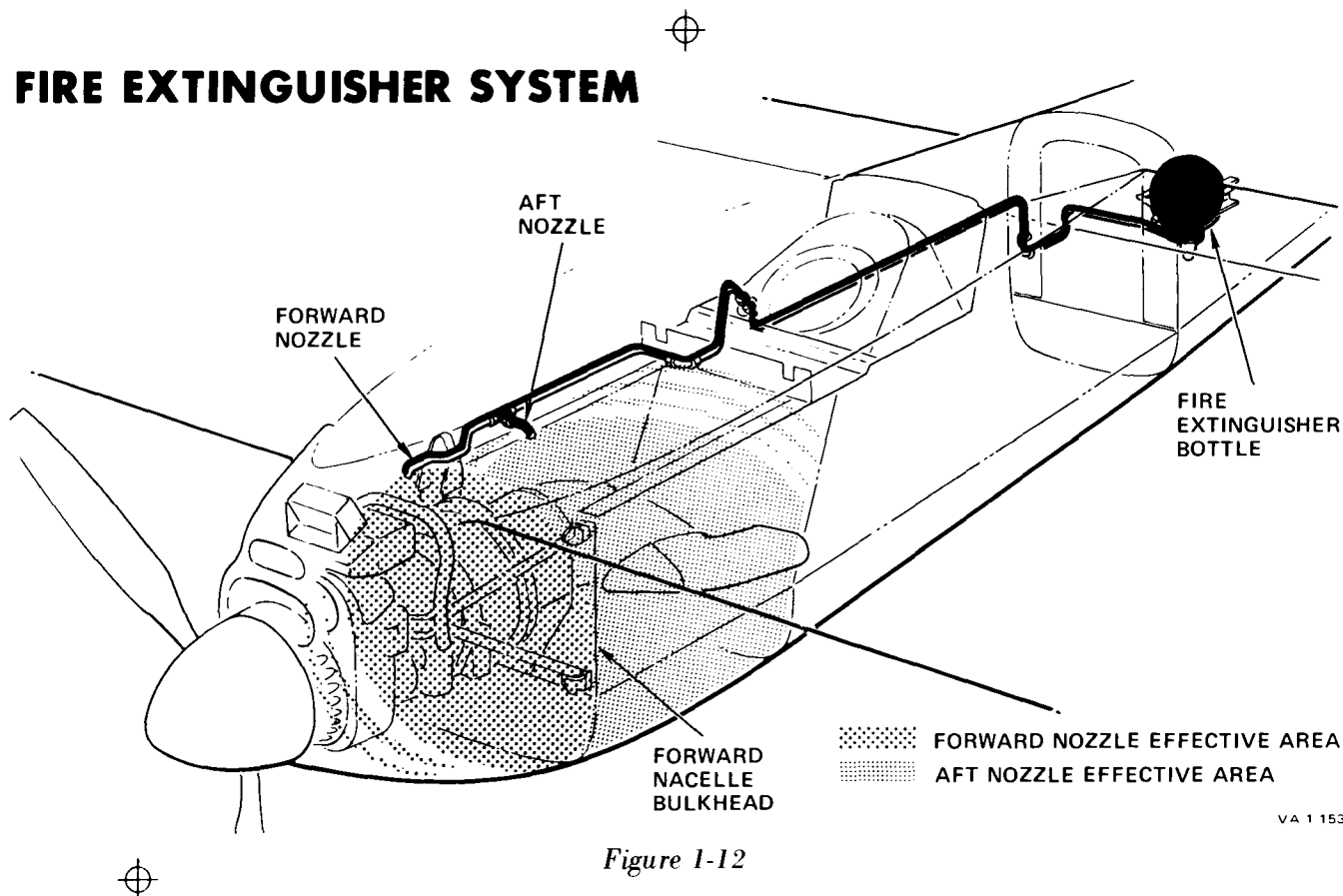


Figure 1-12

suits. A manual valve override button is provided on top of each valve, which is used to check anti-G system operation.

HEATING, VENTILATION, AND DEFROST SYSTEMS

Hot air from the engine compressors is used in combination with ram air to provide controlled temperature air for cockpit heat and to provide defrost air. Engine compressor bleed air is routed to an air mixing chamber forward of the pilot's instrument panel, and directly to anti-G valves on the left side of both cockpits. Mixing chamber air, controlled to desired temperature, is directed into the pilot's cockpit through the windshield defrost duct and footwarmer, and into the observer's cockpit by jet pump action through an air distribution tube, and through an aft footwarmer below the observer's instrument panel. For a system block schematic, see figure 1-13.

HEAT, VENT, AND DEFROST CONTROLS

Bleed Air Switches

The BLEED AIR switches (figure 1-7) on the right console are marked LH and RH (left and right engines), with NORM and EMERG OFF positions. These switches are used to close pressure-operated engine bleed air valves which open normally on engine start, and close normally as pressure drops following engine shutdown. The switches are normally left in NORM but may be positioned to EMERG OFF as desired or in the event of wing battle damage.

Temperature Knob

The TEMP knob (figure 1-13) on the heat-vent panel mechanically controls a shutoff valve in the compressor air line leading to the air mixing chamber. Pulling the TEMP knob outward increases heat input to the chamber.

Note

Selection of full heat (TEMP knob full out) results in a reduction of available engine torque by approximately 150 pound-feet per engine at Military power at sea level on a Standard Day.

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Ram-air Knob

The RAM AIR knob (figure 1-13) mechanically operates a valve which controls the flow of ram air into the top of the air mixing chamber. Pulling the RAM AIR knob outward increases ram-air flow through the footwarmers and defrost air tubes. Turning the RAM AIR knob to the right locks the knob at the desired level of airflow.

Cockpit Air/Defrost Knob

The CKPT AIR/DEFR knob (figure 1-13) on the heat-vent panel mechanically controls a diverter valve in the mixing chamber outlet duct. Pulling the knob outward decreases the amount of air directed to the windshield defrost ducts and diverts air to the cockpit. A certain amount of air bleeds through the defrost ducts under these conditions. With the knob pushed full forward, maximum air is supplied to the defrost ducts. The pilot's defrost tube is equipped with swivel nozzles which allow control of airflow direction as desired.

Observer's Cockpit Air Valve

Aft cockpit footwarmer tube airflow may be controlled by a foot-operated slide valve (figure 1-8). Airflow is increased by moving the valve to the left, or closed off by moving the valve to the right.

Canopy Ventilators

A centerline-mounted, adjustable ventilation valve (figure 1-2) is installed in the canopy center panel above each crew member's seat. Pushing the valve body upward allows air to flow into the cockpit. Airflow direction may be adjusted by turning the

HEAT-VENT-DEFROST SYSTEM

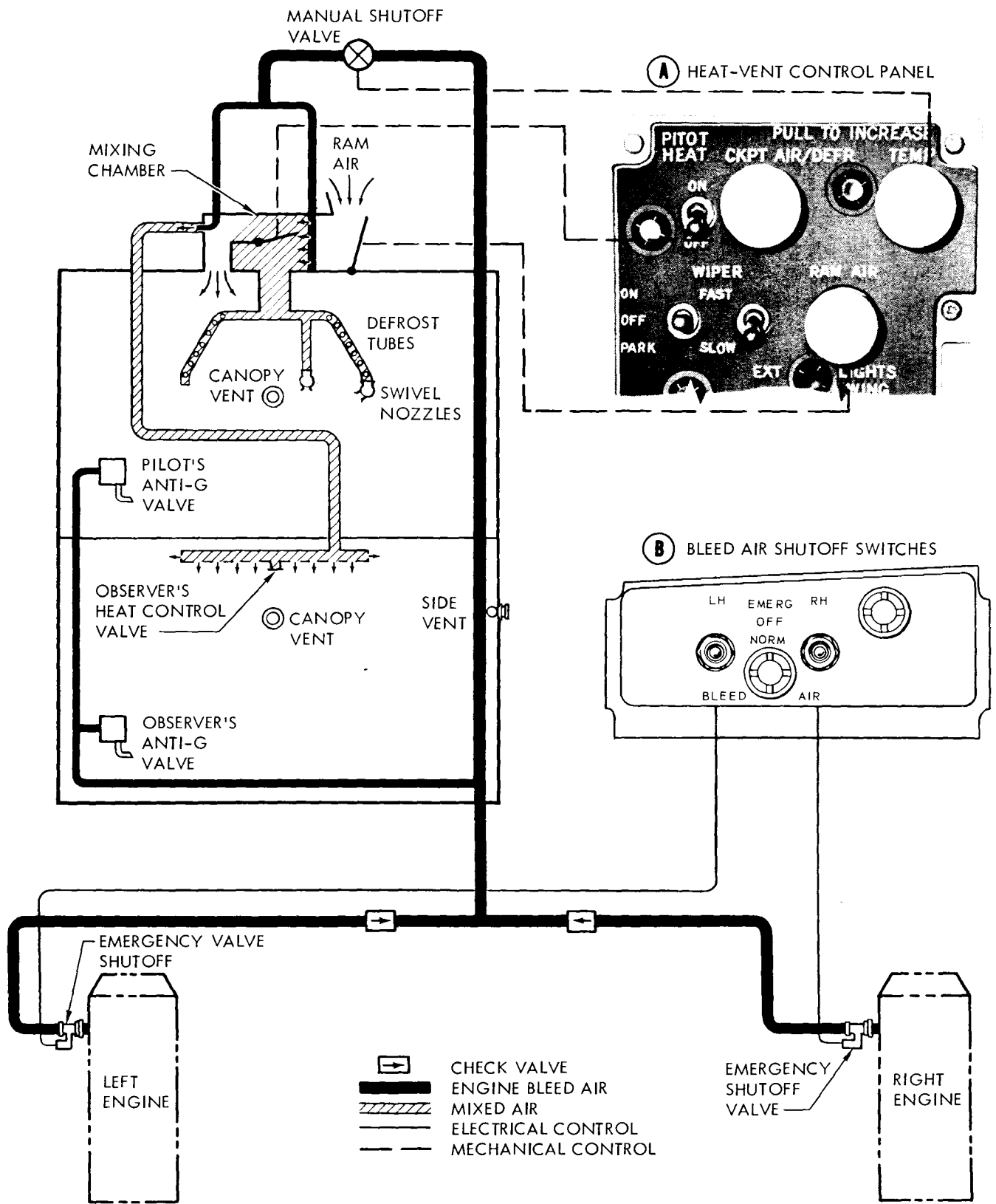


Figure 1-13

PVA-1-38

valve body as desired. Pulling the valve body downward shuts off airflow. By turning the valve body to the rear, the ram inlet may be used as an air ventilation outlet.

Observer's Air Ventilation Valve

A swivel-ball air valve (figure 1-8) is installed on the right side of the observer's cockpit area. This valve is pulled inward to close and pushed outward to open. The swivel provides control of air direction as desired.

Pitot Heat Switch

The PITOT HEAT switch (figure 1-13) on the vent panel allows selection of electrical heat element operation in the pitot-static tube when the aircraft is airborne.

HEAT, VENT, DEFROST OPERATION

To obtain warm airflow for cold weather operation, pull the RAM AIR knob out and lock as desired, then pull the TEMP knob out as required to provide sufficient heat at desired volume. Pulling the TEMP knob only, with the RAM AIR knob in, may result in insufficient airflow for comfort, even though air temperature is sufficiently high. By opening the ram-air valve, additional airflow is generated through jet pump action of the heat input diffuser in the mixing chamber. To obtain footwarmer flow, push the CKPT AIR/DEFR knob in as desired. To obtain ventilation for hot weather operation, ensure the TEMP knob is pushed completely in, pull the RAM AIR knob out, and adjust the canopy ventilators and side ventilation valve as desired. To obtain maximum defrost, pull the RAM AIR and TEMP knobs as required, and push the CKPT AIR/DEFR knob full in.

CAUTION

Pulling the TEMP knob full out with the RAM AIR knob pushed full in may result in overheat damage to the windshield panels.

WINDSHIELD WIPER

An electrically operated, two-speed windshield wiper is installed for use in rain removal from the windshield forward panel. The wiper system is designed to operate normally at a maximum speed of 200 KIAS.

WIPER CONTROL SWITCHES

The WIPER control switches (figure 1-13) are located on the heat-vent control panel. One switch provides OFF-ON-PARK selections; the other provides FAST-SLOW speed selection. SLOW and FAST position selections provide 150 and 250 sweep cycles per minute with the opposing switch in ON. On selection of OFF, the wiper blade stops in place. The PARK position moves the blade to the right side of the windshield.

CAUTION

Do not operate the windshield wiper on dry glass.

HYDRAULIC POWER SYSTEM

Hydraulic power at 1500 to 1550 psi is supplied by a closed-center, intermittent duty system. The hydraulic power package, including the reservoir and electrically operated hydraulic pump, is installed as a swing-down assembly, mounted above the cargo bay aft of the wing. Hydraulic power is supplied to operate the landing gear normal extension and retraction, wing flap normal extension and retraction, and nose wheel steering systems. During nonduty periods, the hydraulic pump is turned off, leaving slowly reducing residual pressure in the lines last pressurized. The hydraulic system does not provide sufficient flow to allow simultaneous, full-rate operation of the landing gear, and flap extend-retract functions. If both are selected in rapid order, both will operate at a reduced rate. For a block schematic of the hydraulic power system, see figure 1-14.

HYDRAULIC POWER SYSTEM

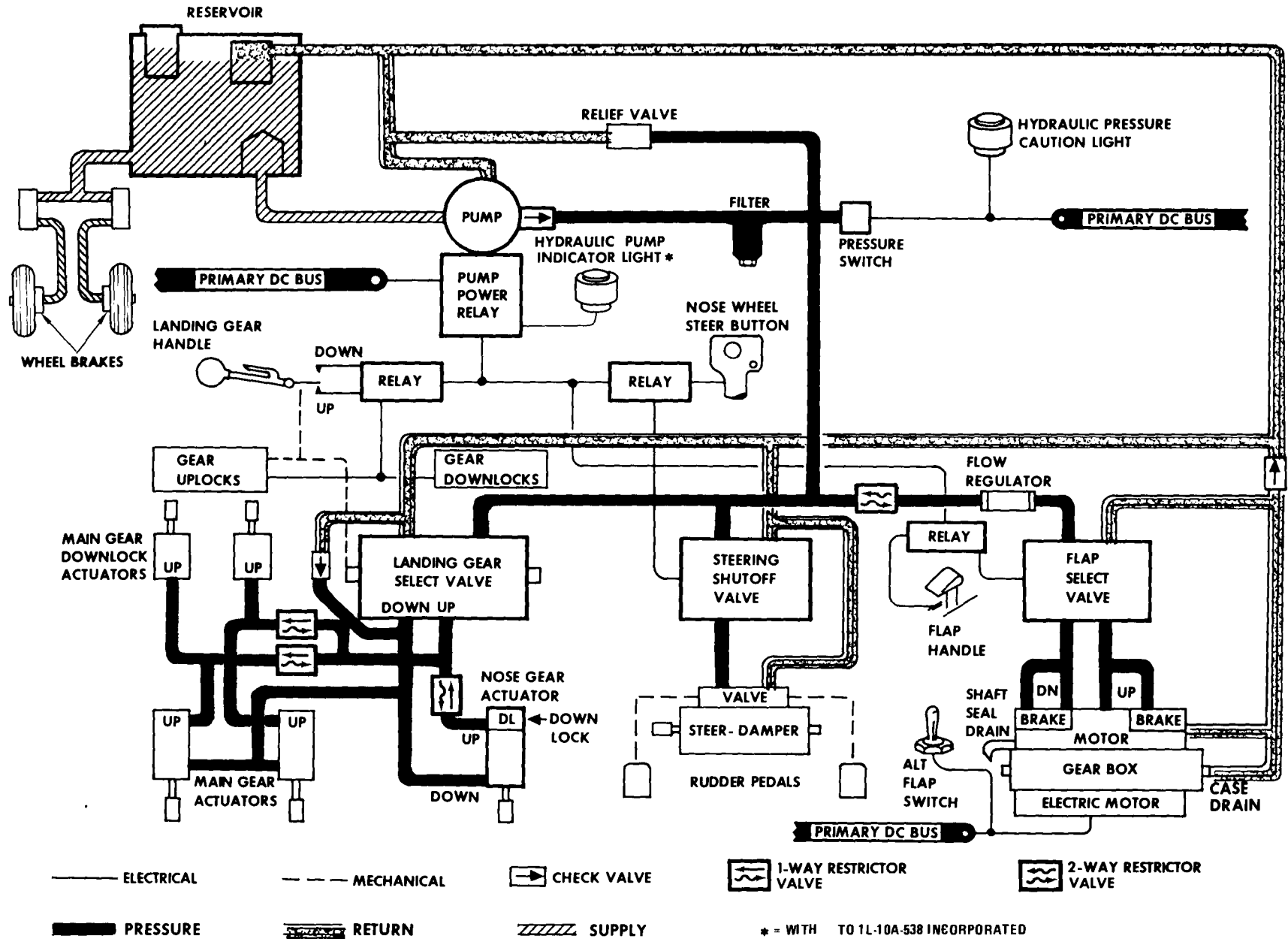


Figure 1-14

CAUTION

The hydraulic pump requires a 3-minute cooling period after 5 minutes of continuous nose wheel steering, or three continuous flap cycles, or three continuous landing gear cycles.

HYDRAULIC PUMP INDICATING LIGHT

On aircraft having T.O. 1L-10A-538 incorporated, a HYD PUMP indicating light (figure 1-6) is installed on the pilot's center pedestal. This green light illuminates whenever the hydraulic pump is operating so that the pilot can monitor pump requirements.

HYDRAULIC PRESSURE CAUTION LIGHT

A HYD PRESS caution light (figure 1-5) is installed on the left console, adjacent to the voltammeter. This amber light illuminates until hydraulic system pressure builds up to at least 200 psi on demand (gear or flap) operation. On aircraft having T.O. 1L-10A-538 incorporated, the HYD PRESS caution light is installed on the pilot's center pedestal (figure 1-6).

LANDING GEAR

Folding drag-link, trailing-arm, tricycle-type landing gear is installed. Gear retraction is hydraulically powered, with the mains retracting upward and aft, and the nose gear retracting forward. Emergency extension is accomplished by gravity, assisted by spring bungees on the main gears. The landing gear control system consists of the landing gear handles, mechanical linkage to operate the control valve, uplock mechanisms and wheel doors, the hydraulic power system, and position and warning indicators. The landing gear wheel doors remain open when the gear is extended and are closed mechanically by the gear on retraction. In the event of hydraulic power failure or failure of the normal extension circuit, the gear can be extended but not retracted. Normal retraction requires approximately 10 seconds; extension requires approximately 7 seconds.

GROUND SAFETY SWITCH

The ground safety switch is located on the left main landing gear strut. When the landing gear is compressed (on the ground), the ground safety switch

deactivates the angle-of-attack heater, pitot heater, yaw damper, missile fire, stall warning system; and activates nose wheel steering and power lever gate override system.

On aircraft having T.O. 1L-10A-546 incorporated, engine START switches are deactivated by the ground safety switch when the aircraft is in flight.

WARNING

If the ground safety switch is misaligned, the functions of the ground safety switch may be reversed.

LANDING GEAR CONTROLS AND INDICATORS**Landing Gear Handles**

A landing gear handle (figure 1-6) is installed in the pilot's cockpit. An observer's gear handle (figure 1-8) is installed as part of the observer's cockpit package. The rear cockpit landing gear handle can be used to extend the landing gear only, and does not incorporate a handle release lever or gear unsafe warning light. The pilot's handle is equipped with a release lever (figure 1-6), which must be depressed to unlock the handle for upward movement. Movement of the handle to the up position selects the retract condition of the landing gear control valve, turns on the hydraulic system pump, and hydraulically retracts the landing gear downlocks. Selection of the down position moves the landing gear control valve to the extend condition, turns on the hydraulic system pump, and mechanically retracts the landing gear uplocks.

CAUTION

The landing gear is not protected against retraction by a ground safety switch when the aircraft is on the ground. If the landing gear handle is left in or placed in the up position, the landing gear WILL RETRACT when electrical power is on, turned on, or applied to the aircraft through the external power receptacle.

Landing Gear Warning Horn

A landing gear warning horn will sound simultaneously with the WHEELS warning light illumination. The horn can be turned off by momentarily positioning the WARN HORN DISABLE switch (on camera-smoke generator panel) to OFF.

Landing Gear Unsafe Light

The pilot's landing gear handle incorporates a gear unsafe light. This red light is illuminated whenever the landing gear is not locked in the position demanded by the gear handle.

Landing Gear Position Indicator

The landing gear position indicator (figure 1-6) is located on the instrument panel, integral with the flap position indicator. Landing gear position is reflected by a separate solenoid-operated window indicator for each gear. Landing gear UP, DN, and intermediate (barber-pole) positions are indicated. With primary d-c bus power removed, the barber-pole indication is displayed.

Wheels Warning Lights

A WHEELS warning light is located on the pilot's instrument panel (figure 1-6) and on the observer's instrument panel (figure 1-8) to indicate that a landing gear is not down and locked. With primary d-c bus power available, these red warning lights flash whenever any landing gear is not locked down, either engine condition lever is at T.O./LAND, and (1) both power levers are retarded more than halfway from MILITARY to FLIGHT IDLE, or (2) the flaps are extended to 30 degrees or more.

Note

During the single-engine operation, place the power lever of the failed engine in the FLIGHT IDLE position to ensure WHEELS warning lights capability during landing. Wiring of the WHEELS warning light system precludes single power lever actuation of the WHEELS warning light unless the power lever of the failed engine is within this range.

NOSE WHEEL STEERING

Nose wheel steering is available up to 55 degrees left or right of center, through a hydraulically operated nose wheel steer-damper system. With the weight of the aircraft on the landing gear, hydraulic system pressure is ported through a steering control valve to the steer-damper unit as long as the nose wheel steering button is held depressed.

NOSE WHEEL STEERING BUTTON

The nose wheel STEER button (figure 1-16) is located on the face of the pilot's stick grip. Operation of the nose wheel steering system requires that the weight of the aircraft be on the landing gear and the button be depressed and held.

Note

The nose wheel STEER button can be used to activate the hydraulic system pump when control circuit fails.

WHEEL BRAKES

Manually operated, hydraulically independent wheel brakes are installed. Pressure applied at the rudder pedals in either cockpit operates a separate brake master cylinder for each wheel. The brakes include integral parking brake provisions, utilizing pedal pressure by a valve mechanism which traps pressure.

PARKING BRAKE HANDLE

The PARK BRAKE handle (figure 1-6) is installed on the pilot's center pedestal. Brakes are set for parking by applying pedal pressure as desired, then pulling the handle out and releasing pedal pressure. The parking brakes are released by applying sufficient pedal pressure to exceed the level of trapped pressure.

FLIGHT CONTROL SYSTEMS

The elevator, aileron/spoiler, and rudder systems (figure 1-15) are reversible, balanced mechanical

systems operated by cables, rods, and bell cranks. Primary in-flight movement of the ailerons and elevator is achieved by the aerodynamic action of spring and gear-operated boost tabs. Control force trim is achieved by electrically operated trim bungees which move the flight control systems to no-load positions as required. For flight control characteristics, refer to Section VI.

LONGITUDINAL SYSTEM

The longitudinal system consists of a horizontal stabilizer and a tab-boosted, mechanically damped, overbalanced elevator. The tab system consists of four trailing edge segments extending the entire span of the elevator. In flight, the spring (outboard) tabs are driven by the control stick in the direction opposing desired elevator movement, displacing the elevator by aerodynamic reaction until spring tab stops are contacted. The geared tab (inboard) segments are driven directly by the elevator to the same limits as the spring tabs. Movements of the control stick beyond the tab stops, either nose up or nose down, physically drive the elevator in the desired direction. Pitch trim is achieved through the action of a trim actuator/torsion bar assembly which adjusts the no-load position of the system (including the control stick) as required.

DIRECTIONAL SYSTEM

The directional system consists of twin vertical stabilizers, twin rudders, and an electromechanical yaw damper system. The rudders are not tab-boosted, and are displaced by direct mechanical action through the rudder pedals. Rudder trim is provided by an electrical actuator/bungee assembly which displaces the control linkage.

Yaw Damper

The yaw damper system supplies a control torque to the rudders proportional to aircraft yaw rate and oscillation frequency and in the opposite direction of the yaw motion. The system, powered by the monitored d-c bus, contains three major components—the yaw rate gyro, yaw damper amplifier,

and servo actuator. The yaw rate gyro signal is fed to a differential rate d-c amplifier through a capacitor to drive a pair of magnetic clutch coils in the actuator. The actuator transmits torque through an integral gearbox to a bell crank coupled to the directional control system. Pilot control of the system is obtained through a three-position (ON, OFF, TEST) toggle switch. The TEST position is selected for ground checkout only and bypasses the ground safety relay contacts. The pilot can override yaw damper action by exerting approximately 100 pounds force on the rudder pedals. When the aircraft is on the ground (struts compressed), the yaw damper is automatically disengaged.

LATERAL SYSTEM

The lateral system consists of spring and gear tab-boosted ailerons, augmented by spoilers. Operation of the outboard (spring) tabs is similar to that of the elevator spring tabs; in-flight control stick initial movement displaces the tabs, driving the ailerons by aerodynamic reaction until spring tab stops are contacted. Further lateral movement of the control stick then drives the ailerons directly.

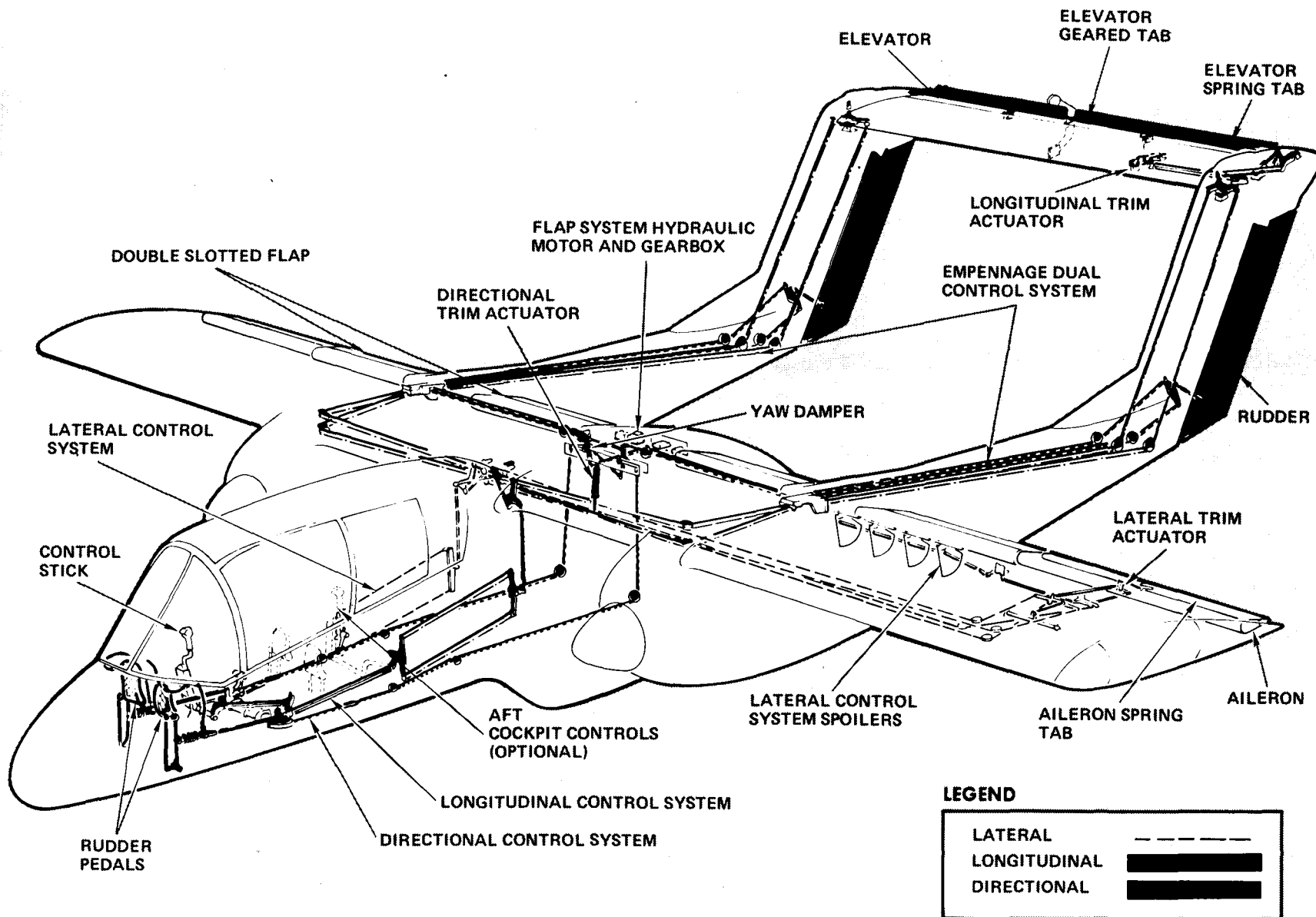
Spoilers

Four fan-shaped, upward rotating, axially hinged spoiler plates are installed in each wing. Movement of the ailerons displaces mechanical linkage to rotate upward from the down-going wing, creating additional rolling reaction due to lift loss. The spoilers are positioned with their leading edges 10 degrees below the wing upper mold line with the ailerons neutral. At full stick lateral travel the spoilers are displaced approximately 86 degrees. Delayed operation, due to the submerged neutral spoiler position, prevents projection at neutral trim and allows aileron trim operation without causing spoiler deflection.

Reduced Spoiler System

On aircraft having the reduced spoiler system incorporated, the system is identified by a caution light, located to the right of the chip detector caution lights (figure 1-9). The system, powered by

FLIGHT CONTROL SYSTEM



the primary d-c bus and controlled by ram pressure from the pitot-static system, consists of an electromechanical linkage from the ailerons which provides reduced spoiler deflection. At 338 KIAS and above, the spoiler deflection is reduced to approximately 20 degrees when the aileron is in full up position. At 338 KIAS and below, the spoiler deflection is approximately 86 degrees when the aileron is in the full up position. In the event of a pitot static (ram pressure) or electrical failure, the 20-degree spoiler is provided at all airspeeds. The 86-degree position will automatically be provided anytime the flaps are at any position other than full up. Some aircraft have had the actuator and bungee removed and a rod installed in their place so that the spoiler system operates at full deflection at all airspeeds. This modification is recognizable by full spoiler deflection with full lateral stick deflection and no electrical power on the aircraft.

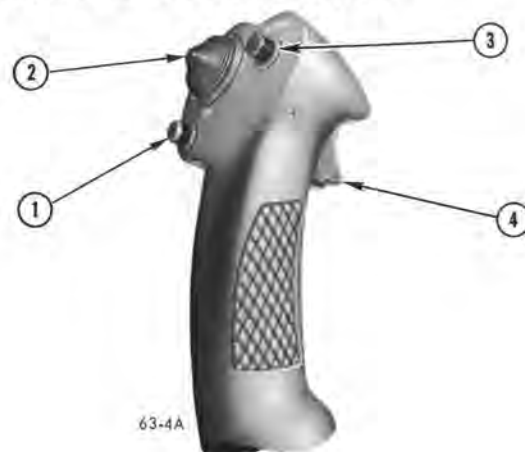
Reduced Spoiler System Caution Light—A caution light, SPOILER AUTH (figure 1-9), is provided to indicate activation of the electromechanical mechanism. An indication will be observed anytime during spoiler shift. Also immediately after power application (on the ground), the light will illuminate for 4 to 6 seconds during automatic shift to the 86-degree position. The light will illuminate anytime the system is not operating properly. The light will be inoperative in case of electrical power loss.

FLIGHT CONTROLS AND INDICATORS

Control Sticks and Rudder Pedals

A pedestal-type, pivot-mounted control stick and rudder/wheel brake control pedals are installed in the pilot's cockpit. The pilot's stick grip contains a conventional roll/pitch trim switch, as well as a nose wheel steering button, bomb release button, and a gun trigger switch. A control stick and rudder/brake pedals are installed in the rear cockpit area as part of the observer's cockpit package. The observer's control stick grip does not incorporate armament or trim controls and the rear cockpit rudder pedals are not adjustable. For a view of the pilot's stick grip, see figure 1-16.

PILOT'S STICK GRIP



1. BOMB RELEASE BUTTON
2. PITCH AND ROLL TRIM SWITCH
3. NOSE WHEEL STEER BUTTON
4. TRIGGER

PVA-1-18 A

Figure 1-16

Pedal Adjust Crank

A rudder pedal adjust crank (figure 1-6) is installed on the center pedestal in the pilot's cockpit. This foldaway crank allows pedal adjustment through a 9-inch range.

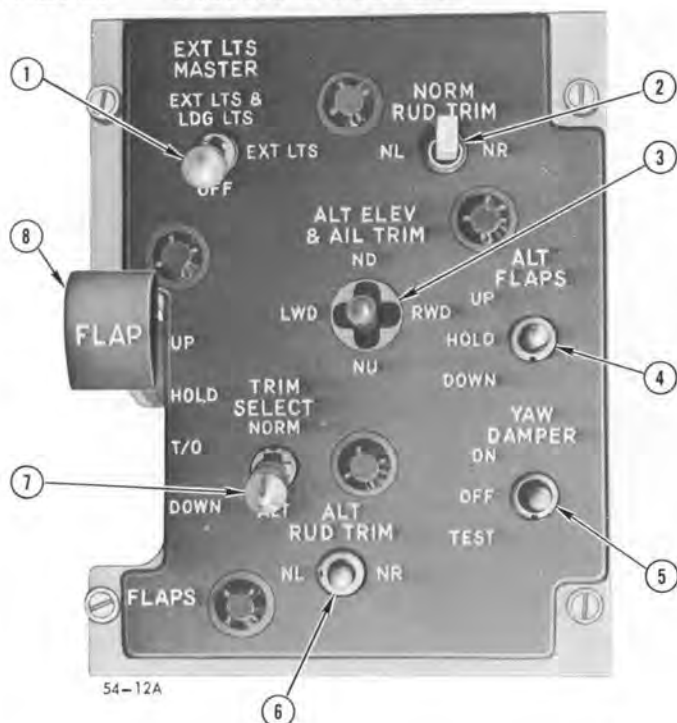
Trim Select Switch

The TRIM SELECT switch (figure 1-17) is located adjacent to the flap handle. In the NORM position, primary d-c bus power is provided for the aileron and elevator and is controlled through the stick grip trim switch and rudder trim through the NORM RUD TRIM switch (panel mounted). The ALT position provides an alternate source of primary d-c bus power and trim is controlled through use of the alternate elevator and aileron trim and alternate rudder trim switches.

Aileron and Elevator Trim Switches

The pilot's normal aileron and elevator (roll and pitch) trim switch (figure 1-16) is located on the stick grip. An ALT ELEV & AIL TRIM switch (figure 1-17) is located on the trim control panel in the pilot's cockpit. On aircraft having T.O. 1L-10A-510 incorporated, the ELEV-AIL TRIM and ALT ELEV TRIM switches are located on the observer's additional instrument panel (figure 1-8).

FLAP—TRIM PANEL



1. EXTERIOR LIGHTS MASTER SWITCH
2. NORMAL RUDDER TRIM SWITCH
3. ALTERNATE ELEVATOR AND AILERON TRIM SWITCH
4. ALTERNATE FLAPS SWITCH
5. YAW DAMPER SWITCH
6. ALTERNATE RUDDER TRIM SWITCH
7. TRIM SELECT SWITCH
8. FLAPS HANDLE

Figure 1-17

PVA-1-19

Rudder Trim Switches

The NORM RUD TRIM and ALT RUD TRIM switches (figure 1-17) are located on the pilot's trim control panel. On aircraft having T.O. 1L-10A-510 incorporated, a RUD TRIM switch is located on the observer's additional instrument panel (figure 1-8).

Yaw Damper Switch

The YAW DAMPER switch (figure 1-17) is located on the control panel. The switch has OFF, ON, and TEST positions. In OFF, the yaw damper clutch is disengaged. The momentary TEST position overrides the damper ground safety function, permitting damper system operational testing on the ground. When the aircraft is airborne, selection of ON allows the yaw damper to operate normally.

Elevator Trim Indicator

The elevator trim indicator (figure 1-6) is located on the instrument panel. This primary d-c bus powered indicator displays trim position between full NU and full ND.

Trim Neutral Lights

Aileron and rudder trim neutral lights (figure 1-6) are installed on the pilot's instrument panel. These green, press-to-test lights, powered by the primary d-c bus, are on when roll and yaw trim is set at the neutral (take-off) position. On aircraft having T.O. 1L-10A-595 incorporated, the brightness of the trim neutral lights may be adjusted through use of the INSTRUMENTS knob in the interior lights control panel.

WING FLAPS

A four-section, slotted wing flap system is installed. One section is located inboard and one section outboard of the tail boom on each wing. Normal operation is provided by hydraulic system power. Control of boundary layer airflow is provided by slot doors on the lower wing surface which extend mechanically with the flaps. An electrically powered alternate flap system is provided for extend-retract control in the event of hydraulic system failure or normal flap control circuit failure.

FLAP CONTROLS AND INDICATOR

Flap Handles

A FLAP handle (figure 1-17) is located on the left console in the pilot's cockpit, and on the left side of the rear cockpit (figure 1-8). Power is supplied from the primary d-c bus. The flaps may be operated through a 40-degree range, or stopped at any intermediate position by selecting UP, T/O (20 degrees), HOLD, or DOWN as desired. The flaps may be fully retracted in approximately 8 seconds.

Alternate Flaps Switch

The ALT FLAPS switch (figure 1-17) is located on the control panel. Power is supplied from the primary d-c bus. The switch has UP, HOLD, and DOWN positions and is spring-loaded to the HOLD position. The alternate flaps switch may be used to obtain flap operation as desired in the event of failure of normal flap hydraulic power or electrical control. Ensure the FLAP handle is in HOLD when using the ALT FLAPS switch to prevent inadvertent actuation of flaps.

Note

Full extension alternate flap operation may require up to 1 minute.

Flap Position Indicator

The flap position indicator (figure 1-6) is integral with the landing gear position indicator on the instrument panel. Flap position indications at UP, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$, and DOWN are provided.

FUEL SYSTEM (AIRCRAFT)

Internal fuel is carried in five self-sealing, unpresurized wing cells; two inboard, two outboard, and center. The center cell includes a sump portion, which acts as an engine feed tank. All wing tanks are bladder-type cells, filled with reticulated foam, and contain approximately 240 gallons of usable fuel during normal fuel transfer operation. The center tank receives all fuel from the inboard and outboard tanks. The engine feed portion of the center

tank has limited inverted flight capability and receives all fuel before it is distributed to the engines. Wing and center tank fuel is transferred by gravity and ejector-type transfer pumps which are operated by motive flow returned from the low-pressure port of the engine-driven fuel pumps. **Fuel from the feed tank is supplied by gravity to the engine-driven pumps.** Should wing or center tank ejector pump action fail, all of the fuel of the internal tanks except approximately 43 gallons will be fed from the feed tank by gravity. Refueling is accomplished manually through five filler points on top of the wing. For a schematic of the fuel system, see figure 1-18. For fuel quantity data, see figure 1-19.

EXTERNAL FUEL TANK

External fuel may be carried in a single 150- or 230-gallon tank which may be installed at the centerline fuselage station. Fuel is transferred from the external tank to the wing-center/feed tank by an electrically driven transfer pump in the external fuel transfer line. The normal rate of transfer from the external tank is approximately **345 pounds per hour (130 GPH)**.

Note

The 150-gallon external fuel tank will accept only 122 gallons of fuel unless special procedures are used to elevate the aircraft nose to level the tank for filling. The 230-gallon tank incorporates reticulated foam and will accept 229 gallons of fuel using standard filling procedures.

CAUTION

Ground clearance is marginal when the 230-gallon tank is installed. Exercise caution when operating from prepared sod fields to avoid ground contact with tank.

FUEL SYSTEM CONTROLS AND INDICATORS

Condition Levers

Normal turn-on and shutoff of engine fuel flow is controlled through the condition levers. Advancing

AIRCRAFT FUEL SYSTEM

* AIRCRAFT WITH TCTO 1L-10A-541 INCORPORATED

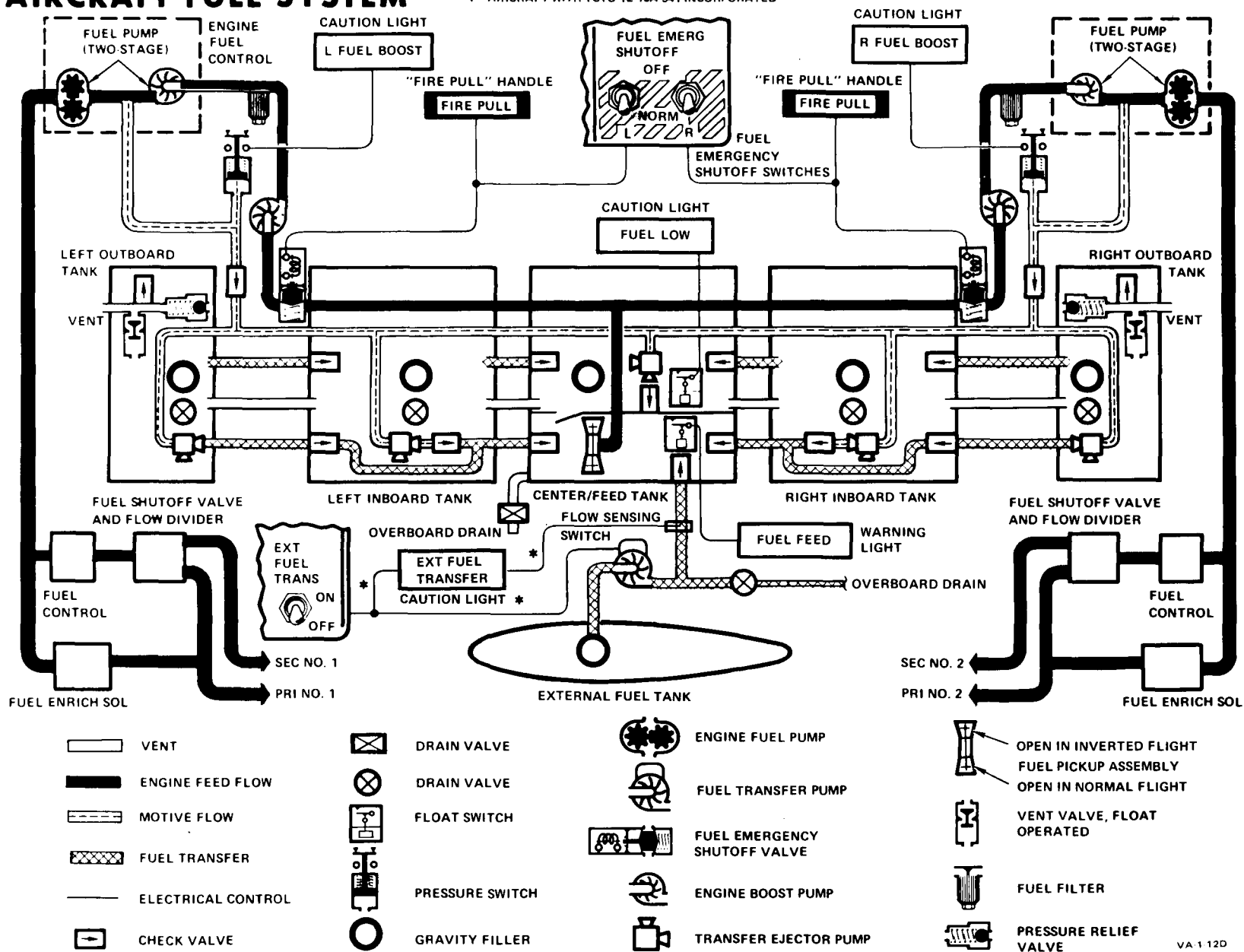


Figure 1-18

these levers from FUEL SHUT-OFF to NORMAL FLIGHT allows the main fuel valve in the respective engine fuel control unit to open when 10% rpm is reached. Retarding these levers to FUEL SHUT-OFF or FEATHER & FUEL SHUT-OFF closes the main fuel valves.

Fuel Quantity Indicator

The fuel quantity indicator (figure 1-6) on the instrument panel reflects the weight of fuel in pounds x 100 in the internal tanks or the 150-gallon external tank as selected by the FUEL GAGE SELECT switch.

Note

Fuel quantity indicating system tolerance is 6 percent of the indicated fuel (± 58 pounds) of available fuel in normal aircraft attitudes.

Fuel Gage Select Switch

The FUEL GAGE SELECT switch (figure 1-6) is installed on the instrument panel below the fuel quantity indicator. With the FUEL GAGE SELECT switch in the FEED position, the indicator shows the weight of fuel in the center wing tank. When the switch is placed in the INT or EXT position, combined weight of fuel in all internal tanks or weight of fuel in the 150-gallon external tank only is indicated.

Fuel Gage Test Switch

The FUEL GAGE TEST switch (figure 1-6) is located on the instrument panel near the FUEL GAGE SELECT switch. When the FUEL GAGE TEST switch is held in TEST, fuel quantity indicator normal operation results in the indicator motoring toward zero. The indicator may be checked in any position of the FUEL GAGE SELECT switch.

External Fuel Transfer Switch

The EXT FUEL TRANS switch (figure 1-6) is located on the instrument panel below the FUEL

GAGE TEST switch. The rate of transfer from the external tank may be sufficient to fill the center/feed tank. When this occurs, fuel will enter the inboard wing tanks through the inter-tank vent lines. The outboard wing tanks will then be filled by the same method when the inboard tanks are full. When all internal fuel tanks are full with external fuel still being transferred, excess fuel will be pumped overboard from the wing tank vents, located under each wing.

CAUTION

The EXT FUEL TRANS switch should be moved to OFF, when all external tank fuel has been transferred, to prevent the transfer pump from running dry.

On aircraft having T.O. 1L-10A-541 incorporated, an EXT FUEL TRANSFER caution light will illuminate when external fuel transfer flow drops below approximately 2 gpm, indicating that the EXT FUEL TRANS switch should be placed to OFF.

Fuel Emergency Shutoff Switches

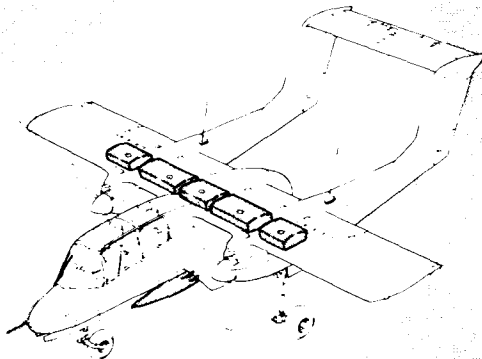
The FUEL EMERG SHUT OFF switches (figure 1-6) are located on the lower right corner of the instrument panel. These switches operate primary d-c bus powered fuel shutoff valves installed on the outer bulkhead of each inboard wing fuel tank. The shutoff valve for the applicable engine is closed by moving the appropriate switch to the SHUT OFF position.

Note

- These switches or the fire handles, both of which control power to the fuel emergency shutoff valves, may be used as an alternate method of engine shutdown for reasons of fire, ruptured fuel lines, and broken or disconnected linkage.
- When engine shutdown is accomplished by this method, the engine will continue to operate for a maximum of 1 minute.

FUEL QUANTITY DATA

BASED ON: ESTIMATED DATA (JP-4 = 6.5 LB/GAL)
DATA AS OF: 1 DECEMBER 1970



	TANK CAPACITY		USABLE	
	GALLONS	POUNDS	GALLONS	POUNDS
WING OUTBOARD (2)	75.3	489.5	72.4	470.6
WING INBOARD (2)	133.6	868.4	129.7	843
CENTER/FEED	37.6	244.4	36.5	237
TOTAL INTERNAL	246.5	1602.3	238.6	1550.6
EXTERNAL TANKS				
*150 GALLON (TOTAL)	122 (368.5)	793 (2395.3)	122 (360.6)	793 (2343.6)
†150 GALLON (TOTAL)	150 (396.5)	975 (2577.3)	150 (388.6)	975 (2525.6)
230 GALLON (TOTAL)	229 (475.5)	1489 (3091.3)	223 (461.6)	1450 (3000.6)

* TANK REFUELED IN NORMAL ATTITUDE

† TANK "PACKED" (NOSE RAISED 4 DEGREES)

VA-1-13D

Figure 1-19

Fuel Low Caution Lights

The FUEL LOW caution lights (figures 1-6 and 1-8), located on the instrument panels, illuminate whenever center wing tank fuel quantity falls below approximately 205 to 236 pounds. The FUEL LOW caution lights should illuminate when the lights TEST switch is held in WARN LTS.

Fuel Feed Warning Lights

The FUEL FEED warning lights (figures 1-6 and 1-8), located on the instrument panel, illuminate whenever fuel level in the engine feed tank is reduced from full (71 pounds) to approximately 50 (± 4) pounds. The FUEL FEED warning lights should illuminate when the lights TEST switch is held in WARN LTS.

Fuel Boost Caution Lights

The L BOOST and R BOOST caution lights (figure 1-9) are installed on the instrument panel. These lights illuminate when motive flow output fuel pressure from the respective fuel boost pump falls from normal to 4 (± 1) psi. The L BOOST and R BOOST caution lights should illuminate when the lights

TEST switch is held in WARN LTS. On aircraft having T.O. 1L-10A-541 incorporated, the FUEL BOOST caution lights are combined into one split indicator light located in the position previously occupied by L FUEL BOOST caution light.

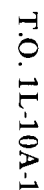
External Fuel Transfer Caution Light

On aircraft having T.O. 1L-10A-541 incorporated, an EXT FUEL TRANSFER caution light (figure 1-9) has been installed in the space formerly occupied by the R FUEL BOOST caution light. This light is powered through the EXT FUEL TRANS switch and is actuated by a fuel flow sensing switch. The light will illuminate when external fuel transfer flow drops below approximately 2 gpm indicating that the EXT FUEL TRANS switch should be placed to OFF.

ELECTRICAL SYSTEM

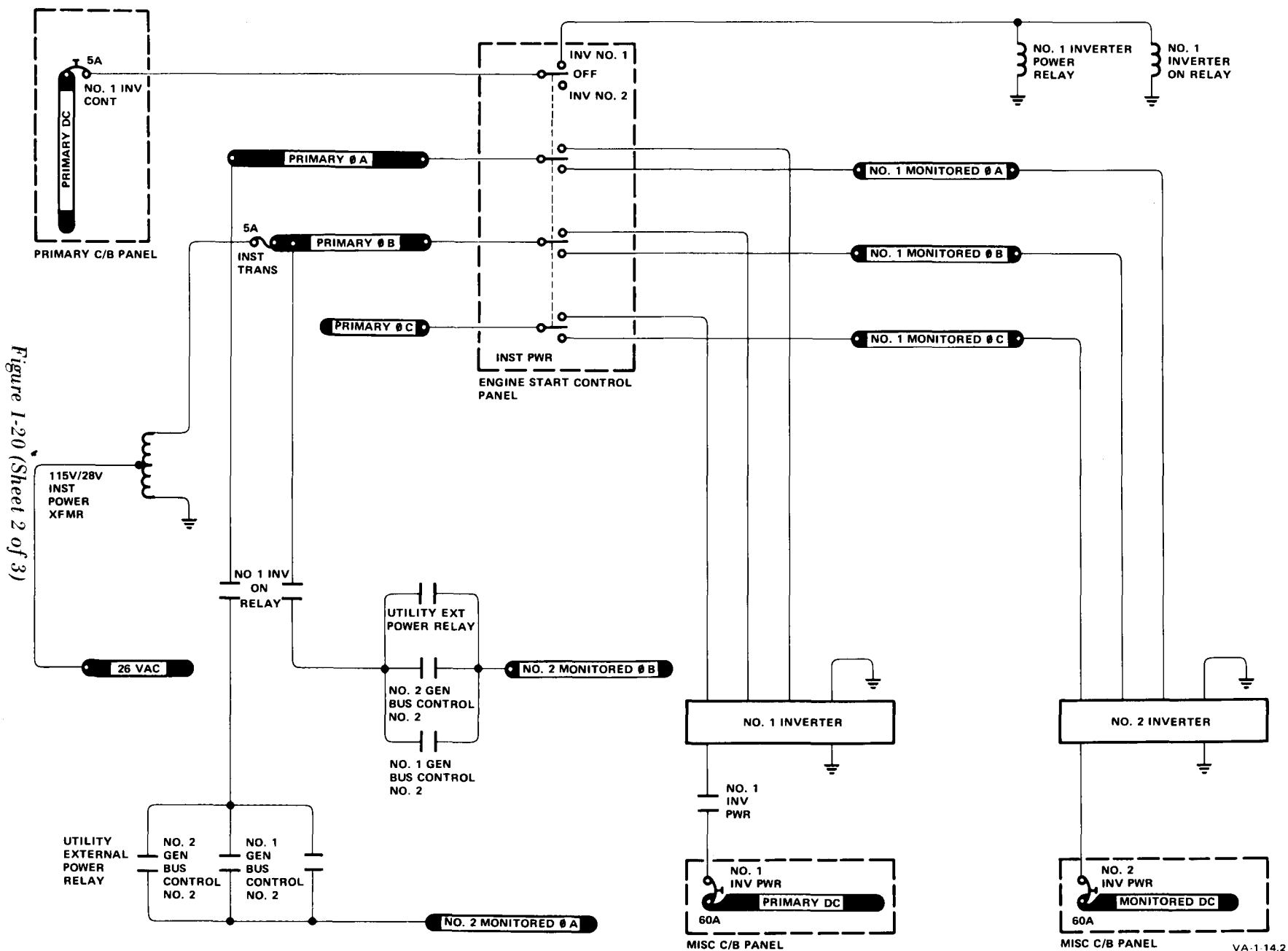
The normal electrical system consists of two d-c generators and two a-c inverters. Emergency d-c power is supplied by two nickel-cadmium storage batteries. For schematics of a-c and d-c electrical power distribution, see figure 1-20.

D-C POWER



A-C POWER

T.O. 1L-10A-1



ELECTRICAL POWER DISTRIBUTION

DC POWER

PRIMARY BUS

- ANGLE OF ATTACK HEATER
- ANGLE OF ATTACK INDICATOR
- APPROACH LIGHTS
- APX-64 NO. 1 POWER
- APX-64 NO. 2 POWER
- APX-64 TEST
- AUXILIARY TRIM CONTROL *
- BDHI SERVO
- CARGO LIGHTS
- ENGINE CHIP DETECTOR
- ENGINE OVERTEMP WARN
- ENGINE OVER TORQUE CAUTION
- FLAP ALTERNATE CONTROL
- FLAP CONTROL (NORMAL)
- FIRE DETECTOR TEST
- FIRE EXTINGUISHER
- FUEL PRESSURE CAUTION
- FUEL QTY IND SELECT
- FUEL WARNING
- GROUND & AIR SAFETY
- HYD PRESS CAUTION
- HYD PUMP CONTROL
- HYD PUMP POWER
- INST POWER CAUTION
- INST UTILITY LIGHTS
- INTERCOM
- INT GUNS CHARGE PWR LH PAIR
- INT GUNS CHARGE PWR RH PAIR
- LDG GR HANDLE POSITION
- LDG GR WARN & IFF DISABLE
- LH GUNS SAFE
- MONITOR BUS CONTROL
- NO. 1 ENG HEAT SHUT-OFF VALVE
- NO. 2 ENG HEAT SHUT-OFF VALVE
- NO. 1 GENERATOR CONTROL
- NO. 2 GENERATOR CONTROL
- NO. 1 GEN FAIL IND & VM
- NO. 2 GEN FAIL IND
- NO. 1 GEN RESET
- NO. 2 GEN RESET
- NO. 1 INVERTER CONTROL
- NO. 1 INVERTER POWER
- NO. 1 PROP UNFEATHER
- NO. 2 PROP UNFEATHER
- NOSE WHEEL STEER
- OBS SEAT ACTUATOR
- PILOT FLOOD LIGHTS
- PILOT HI-INTENSITY LIGHTS
- PILOT SEAT ACTUATOR
- PITOT HEATER
- POWER LEVER STOP OVERRIDE
- PRI BUS FEED NO. 1
- PRI BUS FEED NO. 2
- RH GUNS SAFE
- SECONDARY BUS CONTROL
- STALL WARN
- STALL WARN HEATER
- SPOILER AUTH CONT
- SPOILER IND
- TRIM ALTERNATE CONTROL
- TRIM INDICATORS

PRIMARY BUS

- TRIM NORMAL CONTROL
- TURN & SLIP INDICATOR
- WARNING & CAUTION LIGHTS TEST
- WHEELS & FLAP INDICATOR
- WINDSHIELD WIPER

SECONDARY D-C BUS

- ANTI-COLLISION LIGHTS
- FORMATION LIGHTS
- KY-28
- LANDING & TAXI LIGHT
- LF/ADF (ARN-83)
- POSITION LIGHTS
- UHF/ADF (ARA-50)
- UHF COMM (ARC-147, ARC-51BX)
- VHF/AM COMM
- VHF/FM COMM
- VHF/FM (OBS)
- VOR-LOC & GLIDE SLOPE
- X-BAND RADAR BCN

ARMAMENT BUS

- ARMAMENT DROP CONTROL
- ARMAMENT FIRE CONTROL
- BOMB & FLARE ARM
- INT GUNS CHARGE (LH PAIR)
- INT GUNS CHARGE (RH PAIR)
- INT GUNS FIRE (LH INBD)
- INT GUNS FIRE (LH OUTBD)
- INT GUNS FIRE (RH INBD)
- INT GUNS FIRE (RH OUTBD)
- MISSILE COOL
- MISSILE FIRE SELECT
- NO. 1 MISSILE FIRE
- NO. 2 MISSILE FIRE
- STATION WEAPON POWER (1,2,3,4,5)
- STATION WEAPON SELECT (1,2,3,4,5)

BATTERY BUS

- BATTERY BUS CONTROL
- NO. 1 ENGINE START
- NO. 2 ENGINE START
- NO. 1 MISSILE JETTISON
- NO. 2 MISSILE JETTISON
- START POWER SELECT
- STORE EMER RELEASE CONTROL
- STORE EMER RELEASE POWER
- TROOP JUMP IND
- TROOP ALARM

START CONTROL BUS

- INSTRUMENT LIGHTS
- NO. 1 ENG IGNITION
- NO. 2 ENG IGNITION
- NO. 1 ENGINE TIT
- NO. 2 ENGINE TIT
- NO. 1 FIRE DETECTOR
- NO. 2 FIRE DETECTOR
- NO. 1 FUEL EMERG SHUT-OFF VALVE
- NO. 2 FUEL EMERG SHUT-OFF VALVE

START CONTROL BUS

- PILOT CONSOLE LIGHTS
- START IGN ADVISORY LT

MONITOR D-C BUS

- ARMAMENT BUS CONTROL
- ARM MASTER
- CAMERA (KB-18A)
- EXTERNAL FUEL TRANSFER
- GUNSIGHT
- HF/SSB COMM CONTROL
- HF/SSB COMM POWER
- NO. 2 INVERTER POWER
- NO. 1 MISSILE STANDBY
- NO. 2 MISSILE STANDBY
- SMOKE GENERATOR
- TACAN
- UTILITY POWER CONTROL
- YAW DAMPER

START BUS

- (DISTRIBUTES POWER TO START POWER RELAYS).

AC POWER

PRIMARY A-C BUS

- APX-64 IFF
- ASN-75 COMPASS
- FUEL QUANTITY
- GYRO HORIZON θ A, B, C
- INST. POWER CAUTION
- INST. TRANSFORMER
- No. 1 ENGINE TIT
- NO. 2 ENGINE TIT
- NO. 1 FIRE DETECTOR
- NO. 2 FIRE DETECTOR
- UHF/ADF (ARA-50)
- VGI θ C

INSTRUMENT A-C BUS

- BDHI NO. 1 POINTER
- BDHI NO. 2 POINTER
- COMPASS INSTRUMENT
- ENGINE TORQUE
- LF/ADF TUNE
- OIL PRESS INDICATOR

NO. 1 MONITOR A-C BUS

- CAMERA (KB-18A) θ C
- HF COMM
- HF COMM COUPLER
- MK 4 GUN POD θ B, C
- TACAN
- YAW DAMPER θ C

NO. 2 MONITOR A-C BUS

- TACAN
- NO. 1 MISSILE θ A
- NO. 2 MISSILE θ B

- COCKPIT CIRCUIT BREAKER
- * AIRCRAFT HAVING T.C.T.O
- 11-10A-510 INCORPORATED

Figure 1-20 (Sheet 3 of 3)

D-C SYSTEM

Starter-Generators

Above approximately 50% engine rpm, each engine starter-generator functions as an independent generator, supplying 30-volt dc 300 amperes to the d-c buses. During normal operation, generator output is paralleled, providing a total load capacity of 600 amperes. Single-generator operation is capable of supplying sufficient power required for all electrical loads.

Batteries

Two 24-volt, 22-ampere-hour nickel-cadmium batteries are installed for engine starting and emergency electrical power. A solution of potassium hydroxide and distilled water is used as the electrolyte. Fully charged batteries are capable of providing sufficient power for three unsuccessful engine ground start attempts and a fourth (successful) start without recharge under all conditions from 0° to 160°F. The batteries can be charged with external utility power applied or with generator power when the BATTERY switch is positioned to ON or EMERG. The amperage used when charging the batteries, not the specific gravity reading, determines the battery state of charge.

Note

A 20-minute flying time with both generators operating should assure two fully charged batteries. Assuming fully charged batteries and both generators failed in flight, emergency power for essential systems is available for a period of 60 minutes. This includes interior lights, anti-collision light, inverter and UHF radio ON, and communicating 1 minute out of each 5-minute period.

Battery Bus

The battery bus provides power to emergency equipment and is powered by the batteries at all times, regardless of BATTERY switch position. With both generators OFF, the battery bus can power all

the buses except the monitor and armament buses by positioning the BATTERY switch to ON or EMERG. During a first engine battery start, all buses except the battery, start, and start control deenergize to ensure sufficient power for starting and to prevent battery overload.

Primary Bus

The primary d-c bus provides power to all normal mission d-c powered equipment and is the main distributor of aircraft electrical power. The primary bus may receive battery, generator, or external d-c power, the primary bus may be energized by moving the BATTERY switch to ON or EMERG.

Start Control Bus

The start control bus provides power to selected items of essential equipment required during battery starts. Start control bus power is received from the battery bus during battery-powered starts, and from the primary bus during externally powered starts.

Note

When starting engines on battery power only, the start control and battery buses are automatically reconnected to the primary bus when the generator of the first engine started provides power.

Start Bus

The start bus is energized by either external power, when a constant-current type d-c external power source is plugged into the engine start external power receptacle, or by the aircraft battery system power when making a self-sufficient engine start.

Secondary Bus

The secondary d-c bus provides power for lighting and communications equipment and receives power

directly from the primary bus, providing one generator is operating or external d-c power is applied. In the event of failure of both generators, secondary bus emergency power may be provided by the aircraft batteries through the primary bus by moving the BATTERY switch to EMERG or placing the landing gear handle down.

Monitor Bus

The monitor d-c bus provides power to items considered nonessential and receives power from the primary bus, provided at least one generator is operating or external d-c power is applied.

Armament Bus

The armament d-c bus receives power from the primary bus, providing the MASTER ARM switch is ON with the landing gear handle up. With the gear down and aircraft weight depressing the struts, the armament bus may be energized by moving the MASTER ARM switch to ON and holding the ARMT SAFETY DISABLE switch (left main gear well) momentarily in the DISABLE position. Subsequent armament ground safe operation is restored only by moving the MASTER ARM switch to OFF, moving the BATTERY switch OFF (without external power applied), or disconnecting external electrical power.

A-C SYSTEM

Inverters

A-C power is provided by two 750-volt-ampere a-c inverters. The No. 1 inverter is powered by the primary d-c bus. The No. 2 inverter is powered by the monitor d-c bus and supplies power directly to the No. 1 monitor a-c (three-phase) bus. With the INST PWR switch in the INV NO. 1 position, the No. 1 inverter supplies 115-volt, 400-cycle, three-phase a-c power to the primary a-c bus.

Primary A-C Bus

The primary (three-phase) a-c bus is normally powered by the No. 1 inverter when the INST PWR

switch is in the INV NO. 1 position. Should the No. 1 inverter fail, the No. 2 inverter will restore primary a-c bus power when the INV NO. 2 position is selected.

Note

The INST PWR caution light illuminates on failure of primary a-c bus power, regardless of inverter selection.

Instrument A-C Bus

The instrument a-c bus receives primary a-c bus power through an instrument transformer, supplying 26-volt a-c power for navigation and engine instrument operation.

Monitor A-C Buses

The monitor a-c buses provide nonessential instrument and armament power. The No. 1 monitor bus receives power from the No. 2 inverter only; the No. 2 monitor bus receives power from the No. 1 inverter only. In the event of failure of No. 1 monitor a-c bus power (failure of the No. 2 inverter), loss of TACAN operation will be noted with the alternate TACAN power switch in the NO. 1 MSL position. TACAN operation may be restored by moving the alternate TACAN power switch to ALT/TCN PWR position. If No. 1 missile power is then desired, the alternate TACAN power switch must be placed in NO. 1 MSL position, sacrificing TACAN operation.

Note

In the event of failure of both generators, monitor a-c bus power is not available.

EXTERNAL POWER

External d-c power may be applied for engine starts or for energizing the d-c system for maintenance purposes. The external power access is located on the right side of the fuselage, forward of the cargo door. Two receptacles are provided: a START receptacle (rectangular), and a UTILITY

receptacle (oval). The start receptacle incorporates a switch that prevents the aircraft electrical system from powering the START bus when the external power cord is inserted. External starting power should be used for all engine starts at ambient temperatures below 0°F. For acceptable start and service electrical power units, refer to AIRCRAFT SERVICING, in this section.

Note

During battery starts with external utility power only applied, the utility power is automatically cut out during the start cycle of the first engine until a generator is operating.

INTER-AIRCRAFT STARTING POWER

The UTILITY (oval) electrical receptacle may be used as a 28-volt d-c power output. With an engine running and the UTILITY POWER SELECT switch (in the external power receptacle access) positioned to PWR OUT, a jumper cable may be used to supply power to another aircraft. The UTILITY POWER SELECT switch must be in NORM (guard closed) position at all other times.

ELECTRICAL SYSTEM CONTROLS AND INDICATORS

Generator Switches

The L GEN and R GEN switches (figure 1-10) are located on the IGNITION & UNFEATHER panel. These lift-to-unlock switches have RESET, ON, and OFF positions, and are spring-loaded from RESET to ON. When engine rpm passes approximately 50% during start with the GEN switch ON, generator output is automatically supplied. The RESET position is used to attempt to restore generator operation in the event of failure. Placing the switches to OFF disconnects generator output from the electrical system, illuminating the generator-out caution lights.

Battery Switch

The ON position of the BATTERY switch (figure 1-10), located on the IGNITION & UNFEATHER

panel, connects the battery bus to the primary bus. The OFF position disconnects the battery bus from the primary bus. The EMERG position provides alternate methods of connecting the secondary d-c bus to the primary bus if failure of both generators occurs.

Instrument Power Switch

The INST PWR switch (figure 1-10) is located on the IGNITION & UNFEATHER panel. With the INST PWR switch OFF, the No. 2 (main) inverter remains operative with monitor d-c bus power available and supplies three-phase a-c power to the No. 1 monitor a-c bus. With the INST PWR switch in INV NO. 1 position, the No. 1 inverter provides three-phase a-c power to the primary a-c bus and to the No. 2 monitor a-c bus if either generator is operating or external utility power is applied. Selection of INV NO. 2 turns the No. 1 inverter off, directs the output of the No. 2 inverter to the primary a-c bus, and deenergizes the No. 2 monitor a-c bus.

Generator-out Caution Lights

The L GEN and R GEN caution lights are located on the instrument panel. With the primary d-c bus energized (battery or external power), these lights are on whenever the respective generator is disconnected from the electrical system. When starting on battery power only, the respective generator-out caution lights should extinguish during engine start as rpm passes approximately 50%.

Note

When utility external power is used to obtain full systems operation during an engine start, the generator-out caution lights will not extinguish until external utility power is disconnected, if generator output voltage is less than utility power voltage.

Instrument Power Caution Light

The INST PWR caution light is located on the instrument panel. This light illuminates in the event of failure of primary a-c bus power. Primary a-c bus power may be restored by selecting INV NO. 2 position of the INST PWR switch.

Note

Failure of the No. 2 inverter with INV NO. 1 selected is indicated by loss of monitor No. 1 a-c bus powered systems.

Voltammeter

The voltammeter (figure 1-5) is located on the left console. The voltmeter indicates primary d-c voltage. Proper generator output is 27 to 30 volts. The ammeter indicates system load as selected by the AM SEL switch. Ammeter indications above 200 may indicate an excessive load (defective equipment) and action should be taken to isolate the defective equipment. On aircraft having T.O. 1L-10A-538 incorporated, the voltammeter is located on the pilot's center pedestal (figure 1-6).

Ammeter Select Switch

The AM SEL (ammeter select) switch (figure 1-5) is located on the left console, adjacent to the voltammeter. This two-position switch provides selection of NO. 1 GEN and NO. 2 GEN and is spring-loaded in the No. 1 GEN position. On aircraft having T.O. 1L-10A-538 incorporated, the AM SEL switch is located on the pilot's right console (figure 1-7).

D-C Circuit Breakers

The d-c electrical power supply system is protected by push-pull circuit breakers (figure 1-21), mounted on panels located in the electrical equipment bay above and behind the observer's seat and on separate panels above the pilot's right console and the left side of the observer's compartment. The circuit

breakers function to protect the d-c power system by disengaging automatically whenever an overloaded or short circuit exists. Should a circuit breaker pop out, it can be reset by manually pushing in on the circuit breaker. A d-c circuit can also be opened manually by pulling out on the respective circuit breaker for that line.

A-C Fuses

The a-c electrical power supply system is protected by fuses, which are mounted on a panel located in the right boom.

LIGHTING SYSTEMS

INTERIOR LIGHTS

The pilot's and observer's cockpits are equipped with the following interior lighting equipment:

Pilot's Cockpit

- Instrument integral lights (red).
- Console edge lights (red).
- Console and instrument floodlights (red).
- High-intensity lights (red).
- Standby compass light (red).
- Utility (red or white).

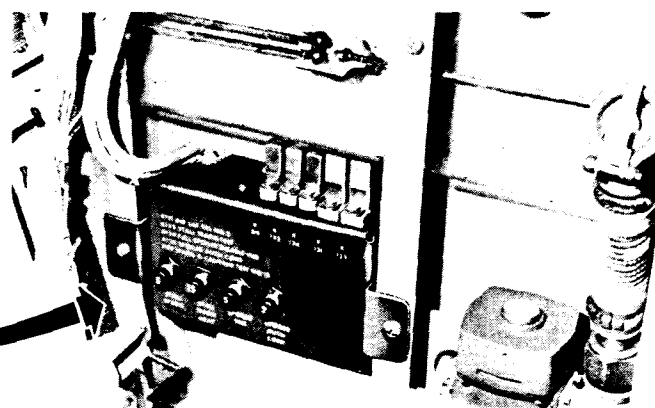
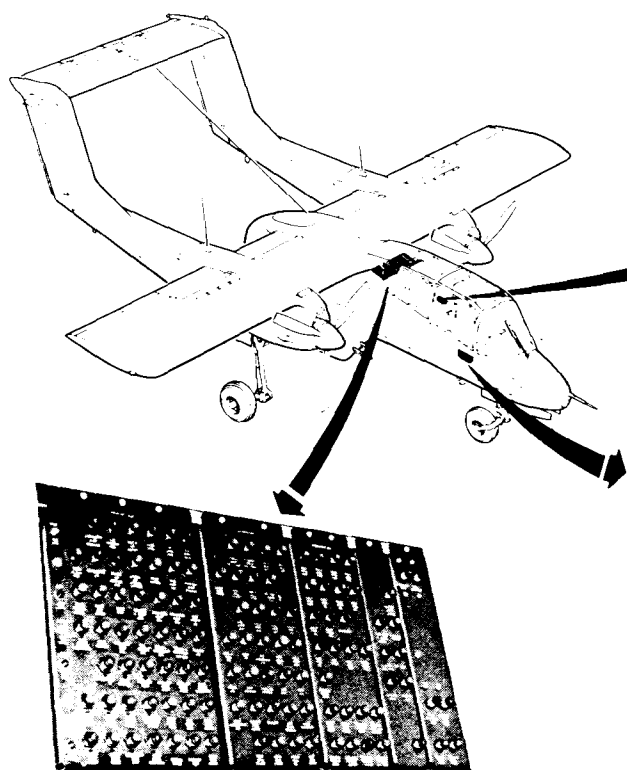
Observer's Cockpit

- Instrument integral lights (red).
- Control shelf, oxygen regulator edge light (red).
- Utility light (red or white).

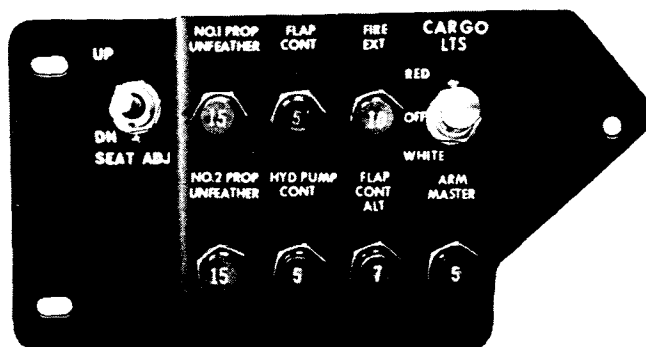
Cargo Bay Lights

Two dome-type cargo bay lights are installed on the right side of the cargo bay. These lights provide red or white illumination of the cargo bay interior as selected.

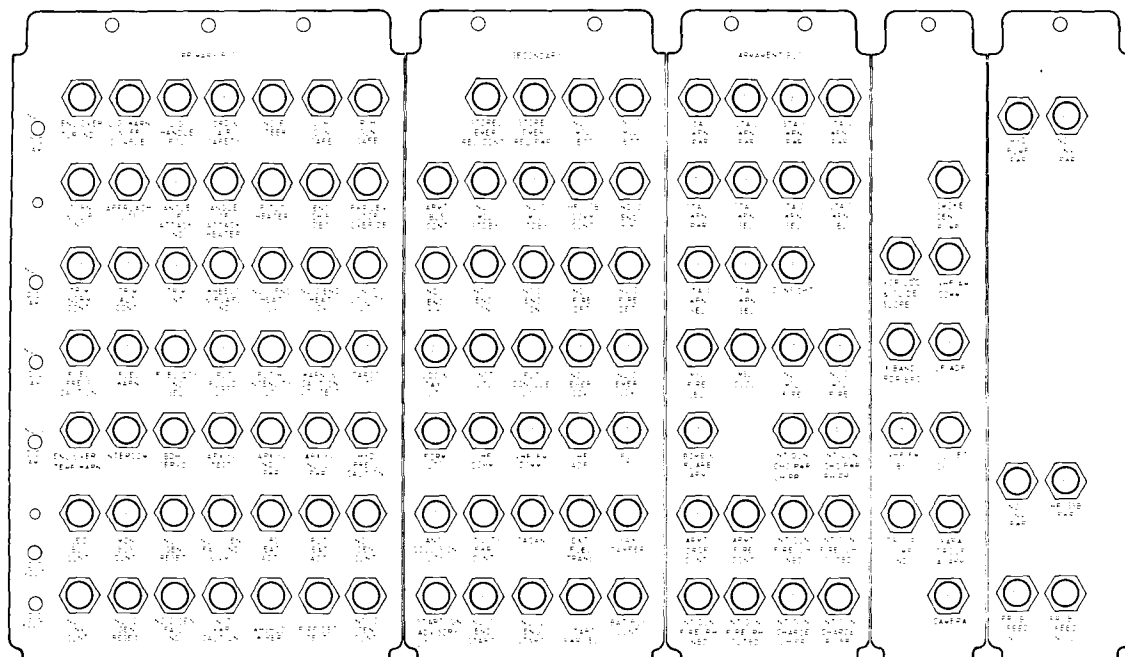
CIRCUIT BREAKER PANELS



STALL WARNING CIRCUIT BREAKER PANEL



PILOT'S CIRCUIT BREAKER PANEL



D-C CIRCUIT BREAKER PANELS

Figure 1-21

Interior Lights Controls

Floodlights Switch—DIM, MEDIUM, and BRIGHT (DIM, OFF, BRIGHT on aircraft having T.O. 1L-10A-595 incorporated) selection of the console and instrument panel floodlights is available through the FLOOD switch (figure 1-22) on the interior lights control panel.

High-intensity Lights Switch—The high-intensity (thunderstorm) lights are controlled through the HIGH INTENSITY switch (figure 1-22) on the interior lights control panel.

Instrument Lights Knob—Brightness of the individual instrument integral lights and trim neutral lights, on aircraft having T.O. 1L-10A-595 incorporated, may be adjusted through the INSTRUMENTS knob (figure 1-22) on the interior lights control panel. With the INSTRUMENTS knob rotated from OFF, potential brightness of all caution lights is reduced to a dim setting. The INST LIGHTING knob on the observer's instrument panel (figure 1-22) controls the instrument lights as well as the panel edge lights on the control shelf and oxygen regulator. On aircraft having T.O. 1L-10A-510 incorporated, an additional INST LIGHTING knob is installed on the additional observer's instrument panel (figure 1-8) to control the lights in that panel. On aircraft having T.O. 1L-10A-602 incorporated, intensity of the pilot's optical sight inclinometer post light is controlled by the INSTRUMENTS knob.

Console Lights Knob—Console edge lighting is adjusted by the CONSOLES knob (figure 1-22) on the interior lights control panel. The console floodlights are controlled by the CONSOLES knob, as are the instrument panel floodlights, when the FLOOD switch is in the BRIGHT position.

Flight Instruments Light Knob (Aircraft Having T.O. 1L-10A-595 Incorporated)—Brightness of seven primary flight instruments (airspeed, attitude, turn-and-slip, vertical velocity, altimeter, BDHI, and course indicators) may be adjusted through the FLT INSTR knob (figure 1-22) on the interior lights control panel.

Indexer Lights Switch—With the INSTRUMENTS lights ON, the approach indexer lights brilliance is controlled to either DIM or MEDIUM through the INDEXER switch (figure 1-22) on the interior lights control panel. With the INSTRUMENTS knob in the OFF position, the bright indexer lighting is automatically selected.

Standby Compass Light Switch—Internal lighting of the standby compass is controlled through the ON and OFF positions of the STBY COMPASS switch (figure 1-22) on the interior lights control panel. On aircraft having T.O. 1L-10A-602 incorporated, the optical sight inclinometer post light illumination is controlled by this switch.

Cargo Bay Lights Switch—The CARGO BAY LIGHTS switch (figure 1-22) is located on the circuit-breaker panel aft of the right console. The CARGO BAY LIGHTS switch provides OFF, RED, or WHITE selection.

EXTERIOR LIGHTS

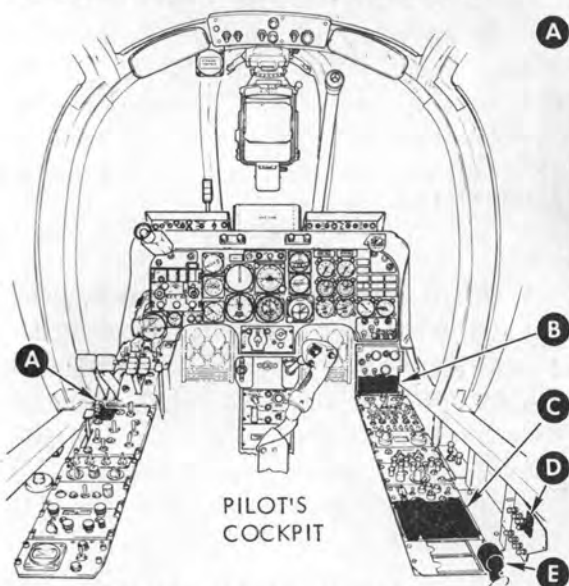
Aircraft exterior lighting consists of wing and tail position lights, formation lights, anticollision lights, and a fixed landing and taxi light.

Exterior Lights Controls

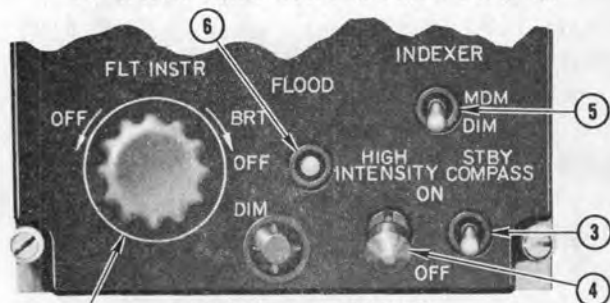
Exterior Lights Master Switch—The EXT LTS MASTER (figure 1-22), a three-position lever lock switch, is located adjacent to the flap handle on the left console. Exterior lighting, as selected through individual exterior lights switches, is energized through the EXT LTS and EXT LTS & LDG LTS positions of the EXT LTS MASTER switch. The switch is detented in the EXT LTS & LDG LTS position, requiring it to be lifted in order to select or turn off the landing light.

Wing and Tail Lights Switch—The WING & TAIL lights switch, located on the exterior lights control panel (figure 1-22), provides BRT, DIM, or OFF selection of the position lights.

LIGHTING CONTROLS

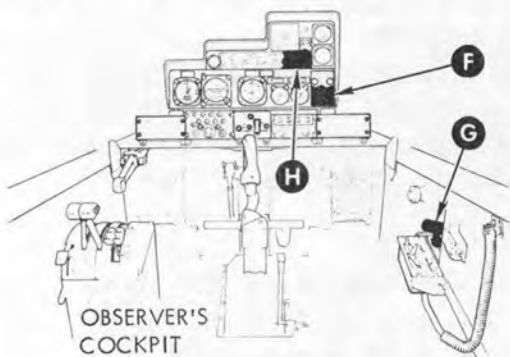


- B**
1. ANTI-COLLISION LIGHTS SWITCH
 2. FORMATION LIGHTS SWITCH
 3. WING AND TAIL LIGHTS SWITCH



C (AIRCRAFT HAVING T.C.T.O. IL-10A-595 INCORPORATED)

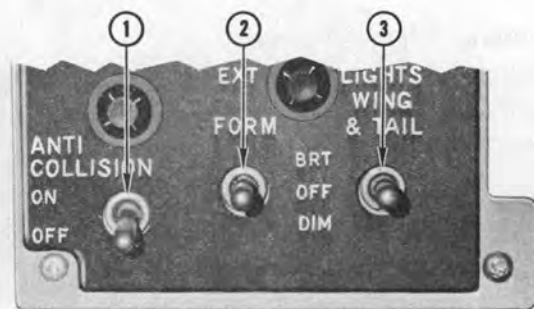
- C**
1. CONSOLE LIGHTS KNOB
 2. INSTRUMENT LIGHTS KNOB
 3. STANDBY COMPASS LIGHT SWITCH
 4. HIGH INTENSITY LIGHTS SWITCH
 5. INDEXER LIGHTS SWITCH
 6. FLOOD LIGHTS SWITCH
 7. FLIGHT INSTRUMENT LIGHTS KNOB



A **EXTERIOR LIGHTS MASTER SWITCH**

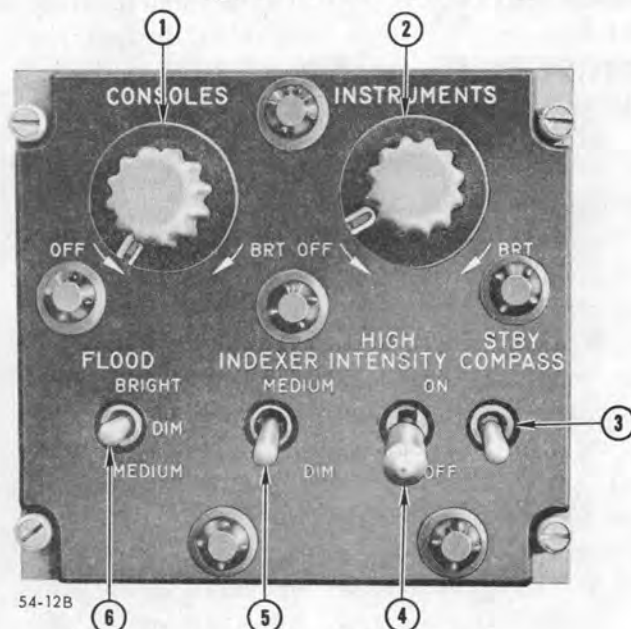


54-12A



30-6F

B **EXTERIOR LIGHTS PANEL**



C **INTERIOR LIGHTS PANEL**



54-5A

D **CARGO BAY LIGHTS SWITCH**



E **G** **UTILITY LIGHT**



30-6E

F **INSTRUMENT LIGHTING KNOB**



A-278

H **INSTRUMENT LIGHTING KNOB**
(ON AIRCRAFT HAVING T.C.T.O. IL-10A-510 INCORPORATED)

Figure 1-22

VA-1-52C

Anticollision Lights Switch—The anticollision lights are controlled by the ANTICOLLISION lights switch (figure 1-22) on the exterior lights control panel.

Formation Lights Switch—The FORM lights switch (figure 1-22), located on the exterior lights control panel, provides BRT, DIM, or OFF selection of formation lights.

INSTRUMENTS

For additional information, refer to AFM 51-37.

PITOT-STATIC SYSTEM

Ram-air pressure and static pressure are sensed by a pitot-static tube located on the nose. The altimeter, airspeed indicator, vertical velocity indicator,

ejection seat speed-altitude sensor and spoiler system pressure switches are operated by the pitot-static system. For detailed information on standard flight instruments, refer to AFM 51-37.

Airspeed Indicators

The 40- to 400-knot airspeed indicators (figures 1-6 and 1-8), installed on the instrument panels, provide the pilot and observer with a continuous indication of airspeed. No electrical power is required for operation.

Altimeter

A standard barometric pressure three-pointer altimeter (figure 1-6) is installed on the pilot's instrument panel. An altimeter (figure 1-8) is installed as part of the observer's equipment package.

Altimeter, AAU-21/A (Aircraft having T.O. 1L-10A-629 Incorporated)

An altimeter, AAU-21/A, is installed in the pilot's instrument panel (figure 1-6) to add the altitude reporting capability to the AIMS system equipment. The AAU-21/A is a barometrically operated counter drum pointer altimeter that incorporates a servo-driven encoder which provides an altitude signal to the aircraft transponder for transmission to a ground station. The single sweep hand and digital counter drum of the instrument are mechanically linked through a gear train in an evacuated bellows, plus the hand being linked to an electrical servomotor. The face of the instrument is marked from 0 to 9 (x 100) feet with graduated increments for each 50 feet. A counter window, adjacent to the sweep hand, contains three digital drums which rotate to indicate altitude in thousands and hundreds of feet. At altitudes below 10,000 feet, a barber pole appears in place of the left digit. Another window in the upper left of the instrument face indicates coder "ON," coder "OFF" modes of operation and a window in the lower right of the face indicates barometric pressure. A knob on the lower left front of the instrument case permits manual correction of the instrument for barometric pressure variations from the standard gradient.

Vertical Velocity Indicator

The vertical velocity indicator (figure 1-6) is installed on the pilot's instrument panel. This indicator is calibrated from 0 to 6000 feet per minute and is connected to the static system. On aircraft having T.O. 1L-10A-510 incorporated, a similar vertical velocity indicator (figure 1-8) is installed in the observer's cockpit.

OUTSIDE AIR TEMPERATURE INDICATOR

An outside air temperature indicating thermometer is installed in the glass panel of the pilot's left canopy door. This indicator is calibrated from -70° to $+40^{\circ}$ C.

ACCELEROMETER

A standard, three-pointer accelerometer (figure 1-6) is installed on the instrument panel. The instrument incorporates a reset button which may be

depressed to return the positive and negative acceleration recording pointers to 1 "g" as desired. No electrical power is required for operation.

ATTITUDE INDICATOR, MB-1

The attitude indicator (figure 1-8) is installed as part of the observer's equipment package. The attitude indicator incorporates a pitch angle readout within a range of 5 to 80 degrees climb or dive. The indicator requires primary a-c bus power and will operate with either inverter selected. Power failure causes an OFF flag to be displayed within the face of the indicator.

WARNING

The OFF flag indicates insufficient electrical power only, and does not appear with malfunctions of components within the instrument.

ATTITUDE INDICATOR, ARU-13/A

The attitude indicator, ARU-13/A (figure 1-6), located on the pilot's instrument panel, provides a visual reference of the aircraft pitch and roll attitude relative to a horizontal plane parallel to the earth's surface. The indicator receives signals from an MD-1 displacement gyro, located in the cargo compartment. A pitch trim knob allows the attitude sphere horizon line to be adjusted to present the desired pitch presentation relative to a miniature aircraft. The indicator is powered from the primary a-c bus and operates with either inverter selected. Power failure causes an OFF flag to be displayed within the face of the indicator.

WARNING

The OFF flag indicates insufficient electrical power only, and does not appear with malfunctions of components within the indicator.

Attitude is displayed correctly and continuously through 360 degrees of roll and 82 (± 2) degrees of climb or dive.

STANDBY MAGNETIC COMPASS

A standby magnetic compass is installed on the upper left portion of the windshield bow. A compass correction card (figure 1-7) is installed on the right console.

TURN-AND-SLIP INDICATOR

A primary d-c bus powered turn-and-slip indicator (figure 1-6) is installed on the instrument panel. An additional slip indicator is provided as an integral part of the weapons delivery optical sight. On some aircraft, a slip indicator (ball-type clinometer) is installed on the rear face of the pilot's ejection seat post for use by the observer. On aircraft having T.O. 1L-10A-510 incorporated, a turn-and-slip indicator (figure 1-8) is also provided on the additional observer's instrument panel.

CLOCK

An A-13A aircraft clock (figure 1-6) is installed on the instrument panel.

NAVIGATION INSTRUMENTS

Radio navigation displays to the pilot are provided by a bearing-distance-heading indicator (BDHI), ID-663B/U, and a course indicator, ID-387/ARN (figure 1-6). On aircraft having T.O. 1L-10A-510 incorporated, installation provisions are available on the additional observer's instrument panel (figure 1-8). For a description of the ADF, TACAN, and compass functions of these indicators, refer to NAVIGATION SYSTEMS, in this section.

ANGLE-OF-ATTACK SYSTEM

The angle-of-attack system consists of an airstream probe mounted on the left side of the forward fuselage, and angle-of-attack transmitter, the angle-of-attack indicator, and an approach indexer. Angle of attack is indicated from 0 to 30 units by the angle-of-attack indicator. On-speed indication for landing

approach is indicated by the approach indexer. For angle-of-attack indications, see figure 1-23. For detailed information, refer to AFM 51-37.

ANGLE-OF-ATTACK INDICATOR

The angle-of-attack indicator (figure 1-6), mounted on the instrument panel, displays aircraft local angle of attack as sensed by the relative airstream probe. This indicator is operated by primary d-c power and is operative whenever primary power is available (external power connected, battery on, or either generator operating). The face of the indicator is adjusted to place the nominal approach angle of attack in units under an index at the 3-o'clock position. An OFF flag, located near the center of the indicator, appears in the event of electrical failure. In the event of failure or when not powered, the indicator pointer rests at 0. A system of cam-operated switches within the indicator operates the approach indexer.

APPROACH INDEXER

The red-lighted approach indexer (figure 1-6) is located above the instrument panel as a visual aid in determining the optimum landing approach airspeed. No control action is required to utilize the approach indexer. The indexer lights function only when the landing gear is locked down and aircraft weight is not on the landing gear.

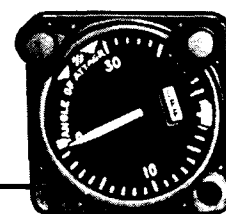
WARNING

The angle-of-attack system shall not be used in determining approach speed.

STALL WARNING SYSTEM

A stall warning rudder pedal shaker is incorporated, consisting of a lift detector-transducer installed on the leading edge of the right wing, an amplifier, and a motor-operated pedal shaker. The pedal shaker is powered by the primary d-c bus and is disabled from operating with the weight of the aircraft depressing the landing gear ground safety

ANGLE-OF-ATTACK INDICATIONS



ANGLE-OF-ATTACK INDICATOR (UNITS)	APPROACH INDEXER	CONDITION
0 — 17		NOSE LOW (FAST)
17 — 17.5		SLIGHTLY NOSE LOW
17.5 — 18.5		ON-SPEED
18.5 — 19		SLIGHTLY NOSE HIGH
19 — 30		NOSE HIGH (SLOW)

PVA-1-20A

Figure 1-23

switches. Stall warning system operation is *not* related to the angle-of-attack indicating system (indicator and indexer), but operates when the aircraft attitude approaches a stall condition. Depending on power and aircraft configuration, the rudder pedal shaker is activated 1 to 7 knots above stall speed during normal 1.0-g stalls. Dependent on rate of entry, the pedal shaker may not activate prior to accelerated stall. During single-engine operations, the airspeed differential for rudder shaker operation may decrease to within 1 knot above stall speed. The pedal shaker may be checked for operation by holding the lights TEST switch in WARN LTS position.

COMMUNICATION SYSTEMS

Communication systems include high, very-high, and ultra-high frequency radios, monitored through the intercommunications set. For a list of communications systems, see figure 1-24.

INTERCOMMUNICATIONS SET, AN/AIC-18

The intercommunications set (ICS), AN/AIC-18, is a transistorized intercom and radio monitor, providing audio and transmit selection. An ICS jack-box with audio control is installed at the rear of the cargo bay. ICS operation requires primary d-c bus power only.

ICS Controls

An ICS control panel (figure 1-25) is installed on the right console. A rear cockpit ICS panel is installed beneath the instrument panel. On aircraft having T.O. 1L-10A-538 incorporated, the ICS control panel is located on the pilot's left console.

Transmit Select Knob—The transmit select knob is positioned to select the desired system for audio voice transmission. The transmit select knob provides INT (internal), UHF, VHF/AM, #1 and #2 VHF/FM, and HF positions. The transmit select knob provides selective transmission control and

TABLE OF AVIONIC EQUIPMENT

TYPE	DESIGNATION	FUNCTION	RANGE
COMMUNICATIONS SYSTEMS			
INTERCOM	AN/AIC-18	INTERCOM, TRANSMIT SELECT, SIGNAL AMPLIFICATION	
UHF RADIO	AN/ARC-147, AN/ARC-51BX	TWO-WAY VOICE	LINE-OF-SIGHT
VHF AM RADIO	WILCOX 807	TWO-WAY VOICE	LINE-OF-SIGHT
VHF FM RADIOS	FM-622A (2)†	TWO-WAY VOICE, RE-TRANSMISSION AND HOMING	80 MILES AVERAGE
HF RADIO	HF-103	TWO-WAY LONG-RANGE VOICE	UP TO 2500 MILES
NAVIGATION SYSTEMS			
COMPASS	AN/ASN-75	MAGNETIC COMPENSATED GYRO	
TACAN	AN/ARN-52(V)	DISPLAYS BEARING, COURSE AND AIR-TO-GROUND OR AIR-TO-AIR DISTANCE	LINE-OF-SIGHT TO 196 NM (GROUND) 300 NM (AIR)
UHF ADF	AN/ARA-50	DISPLAYS BEARING TO UHF FACILITIES (AN/ARC-147, AN/ARC-51BX)	LINE-OF-SIGHT
LF ADF	AN/ARN-83	LOW FREQUENCY CODE AND VOICE RECEPTION, DIRECTION FINDING AND HOMING	20 TO 200 MILES
VOR/ILS*		DISPLAYS VOR BEARING AND COURSE TO VOR STATIONS, DISPLAYS ILS LOCALIZER AND GLIDESLOPE DEVIATION.	TO 30 MILES
IDENTIFICATION SYSTEMS			
IFF-SIF	AN/APX-64(V)	RADAR IDENTIFICATION (AIMS)	LINE-OF-SIGHT
RADAR BEACON*	SST - 181	RADAR RANGE TRACKING	LINE-OF-SIGHT
SECURITY SYSTEM			
KY-28*	—	FM-622A AND ARC-147, ARC-51BX SECURITY	—

* Provisions for Installation

† Interchangeable with AN/ARC-54

VA-141D

Figure 1-24

audio monitoring for communications systems regardless of ICS monitor knob selection as follows:

INT (Internal)	ICS, AN/AIC-18
UHF	AN/ARC-147, AN/ARC-51BX
VHF/AM	WILCOX 807
VHF/FM #1	FM-622A (Pilot's)
VHF/FM #2	FM-622A (Observer's) or (Pilot's)*
HF	HF-103

Hot Mike (Listen)(HM) Knob—The hot microphone (HM) knob, when pulled out, provides continuous, hands-free reception of intercom audio.

Hot Mike (Talk) Knob—The hot mike (talk) knob, when pulled out, provides continuous, hands-free capability to the opposite cockpit. Cold mike (knob down) operation requires use of the power lever microphone switch ICS position or use of the CALL button.

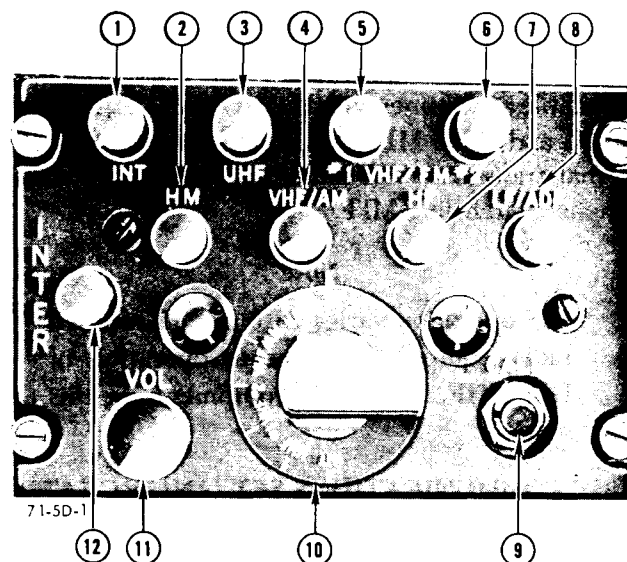
Master Volume Knob—The volume knob is used to simultaneously adjust the audio level of all inputs through the monitor and transmit select knobs.

ICS Monitor Knobs—The ICS monitor knobs are pulled out to select audio monitor of the designated communication or navigation systems and are rotated to provide additional volume. Monitor selections are provided for INT, UHF, HM, VHF/AM, #1 and #2 VHF/FM, HF, and LF/ADF.

INT	AN/AIC-18, ICS
UHF	AN/ARC-147, AN/ARC-51BX, AN/ARA-50
HM	HOT MIKE (LISTEN)
VHF/AM	WILCOX 807
VHF/FM #1	FM-622A (NO. 1)
VHF/FM #2	FM-622A (NO. 2)
HF	HF-103
LF/ADF	AN/ARN-83 (VOR/ILS)

Call Button—The CALL button, when held depressed, allows emergency transmission to the other cockpit regardless of ICS control positions, at the volume set by the receiving master volume knob.

ICS CONTROLS



1. INTERCOM MONITOR KNOB
2. HOT MIKE (LISTEN) KNOB
3. UHF MONITOR KNOB
4. VHF/AM MONITOR KNOB
5. NO. 1 VHF/FM MONITOR KNOB
6. NO. 2 VHF/FM MONITOR KNOB
7. HF MONITOR KNOB
8. LF/ADF MONITOR KNOB
9. CALL BUTTON
10. TRANSMIT SELECT KNOB
11. MASTER VOLUME KNOB
12. HOT MIKE (TALK) KNOB

VA 1 42B

Figure 1-25

Microphone Switches—A microphone switch is installed on the No. 2 engine power lever grip in both cockpits. Holding the switch upward to XMIT position keys the transmit relay for the radio set selected through the ICS transmit select knob of that cockpit. Depressing the switch downward to ICS operates the intercom system during cold microphone operation (hot microphone button in).

ICS Switch (Observer)—Selection of ICS or XMIT provides microphone switch operation as desired for either intercom or outgoing transmission.

Intercom Operation

With primary d-c bus power available (battery, external power, or generator on), the ICS is instantly

*Aircraft having T.O. 1L-10A-536 incorporated

ready for operation. To use the ICS, set the ICS select knob as desired for external transmission, pull the desired monitor knobs, and adjust volume as desired. Intercockpit "hot" communications are available at all times with the HOT MIKE (LISTEN) (HM) and HOT MIKE (TALK) buttons pulled. External transmission is made by holding the microphone switch in XMIT.

Note

ICS operation varies with use of installed radio equipment. Refer to operation of HF, VHF, and UHF equipment, in this section.

UHF COMMUNICATIONS SET, AN/ARC-147 OR AN/ARC-51BX

The UHF transceiver provides communications in the UHF band from 225.00 to 399.95 MHz on 20 preset channels or 3500 manually set frequencies. The required d-c electrical power is provided by the secondary bus. An additional receiver permits monitor of military guard frequency (243.00 MHz), while operating on any other frequency. The unit may be adjusted to provide a 400-cycle off-channel

tone which is present until channel or frequency has changed (approximately 6 seconds). UHF COMM control is located in the pilot's cockpit only; however, the observer may monitor and transmit. Relative bearing to a transmitting UHF facility is provided through the ADF set, AN/ARA-50.

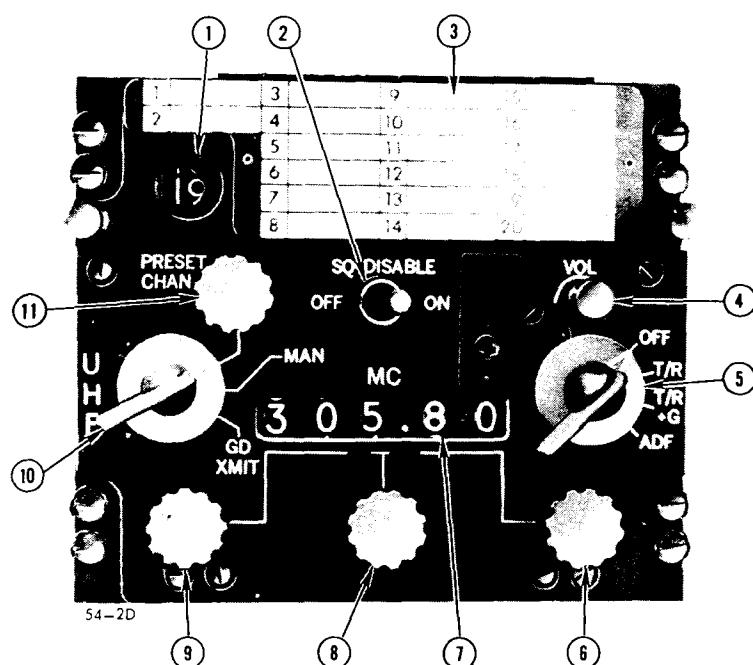
UHF COMM Controls

The UHF COMM control panel (figure 1-26) is located on the instrument panel in the cockpit.

Mode Knob—The mode knob has three positions: PRESET, MAN, and GD XMIT. The positions of the mode knob function as follows:

- | | |
|---------|---|
| PRESET | Allows selection of 20 preset channels. |
| MAN | Allows the manual selection of frequencies in the window. |
| GD XMIT | Tunes RT unit to 243.00 MHz guard channel. |

UHF COMM CONTROLS



1. PRESET CHANNEL INDICATOR
2. SQUELCH DISABLE SWITCH
3. PRESET FREQUENCY INDEX
4. VOLUME KNOB
5. UHF FUNCTION KNOB
6. FREQUENCY (DECIMAL) KNOB
7. MANUAL FREQUENCY INDICATOR
8. FREQUENCY (UNITS) KNOB
9. FREQUENCY (TENS-HUNDREDS) KNOB
10. MODE KNOB
11. PRESET CHANNEL KNOB

Figure 1-26

Volume Knob—The VOL knob is used to adjust the level of incoming receiver audio.

Preset Channel Knob—The PRESET CHAN knob is used in the PRESET position of the mode knob to select 20 preset channels. Channel selected is displayed in a small window on the upper part of the control panel.

UHF Function Knob—The function knob has four positions: OFF, T/R, T/R+G, and ADF. These positions function as follows:

OFF	UHF COMM set power off.
T/R	Transmit and receive operation.
T/R+G	Transmit-receive and monitor guard frequency.
ADF	BDHI No. 1 pointer displays relative bearing to UHF transmitter.

Manual Frequency Knobs—The manual frequency knobs are used to select any of 3500 frequencies for transmission and reception in the MAN position of the mode knob. The left knob selects hundreds of MHz in even numbers from 22 to 39. The center knob selects tens from 0 to 9. The right knob selects hundredths from 0.00 to 0.95 in increments of 0.05.

CAUTION

Frequencies below 224.95 MHz are not usable. Selection may cause malfunction.

Squelch Disable Switch—The SQ DISABLE switch allows cutout of the preadjusted receiver squelch (reception threshold) setting. This allows all detected signals to be amplified to the headsets for reception of weak signals. The OFF position provides normal squelched operation, in which only signals of a preset strength are amplified.

UHF COMM Operation

To operate the UHF COMM set, proceed as follows:

CAUTION

Allow 3 minutes for warm-up.

1. UHF function knob—T/R+G.
2. UHF mode knob—PRESET CHAN.
3. PRESET CHAN knob—DESIRED CHANNEL.
4. SQ DISABLE switch—OFF.
5. UHF ICS monitor knob—PULL.
6. UHF COMM VOL knob—ADJUST VOL and UHF monitor knobs for proper volume.
7. To cut out guard frequency monitor, select T/R.
8. To transmit, move ICS transmit select knob to UHF and depress microphone switch to XMIT.
9. To set up a manual frequency, move mode knob to MAN and set desired frequency.

Note

To augment loudness of weak audio signals due to distance, move SQ DISABLE switch to ON.

UHF COMM ADF Operation

To select relative bearing indication to UHF transmitter, move function knob to ADF. Bearing is indicated by the BDHI No. 1 bearing pointer. On aircraft having T.O. 1L-10A-542 incorporated, bearing is also displayed on No. 1 bearing pointer of ID-250/ARN in aft cockpit.

Note

UHF-ADF performance is degraded with external stores.

VHF-FM COMMUNICATIONS SETS, FM-622A

Two VHF-FM COMM sets provide FM communications on 920 frequencies between 30.00 and 75.95

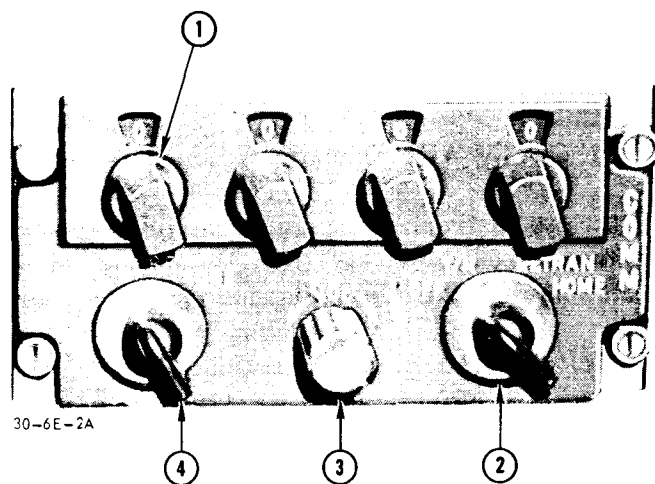
MHz. D-C power is supplied by the secondary bus. The use of two sets provides VHF-FM retransmission capability. The No. 1 set can be used for homing through reference to the course indicator, ID-387/ARN.

VHF-FM Controls

An FM COMM control panel for the No. 1 VHF-FM set (figure 1-27) is installed on the left console. An identical FM COMM control panel for the No. 2 set is installed on the rear cockpit instrument panel as part of the observer's permanent equipment. On aircraft having T.O. 1L-10A-536 incorporated, provisions are available for installing No. 2 FM COMM control panel in the pilot's right console in lieu of the observer's instrument panel.

Mode Knob—The FM mode knob provides control of set power (OFF), transmit-receive (T/R), retransmit (RETRAN), and HOME operations. During two-set operation, the pilot and observer must coordinate operation to achieve retransmission. Refer to VHF-FM OPERATION, in this section.

VHF—FM CONTROLS



1. FREQUENCY KNOBS
2. MODE KNOB
3. VOLUME KNOB
4. SQUELCH KNOB

Figure 1-27

PVA-1-44

Volume Knob—The VOL knob allows adjustment of incoming FM audio level.

Squelch Knob—The SQUELCH knob permits selection of squelch disabling (DIS) for reception of weak signals; carrier-wave (CARR), the normal operating position; or TONE, which opens the squelch only on selected signals (signals containing a 150 cps tone).

Frequency Knobs—The frequency knobs are used to select FM set operating frequency in 50-KHz increments. Off-frequency time is nominally 5 seconds, during which a tone is present in the headsets.

VHF-FM Operation

Normal Voice Communications (Either or Both Sets)—Normal voice operation may be conducted by the crew members independently as follows:

CAUTION

Allow 3 minutes for warm-up prior to transmitting.

1. VHF FM mode knob—T/R.
2. SQUELCH knob—CARR.
3. Frequency—SET AS DESIRED.
4. Transmit select knob—
VHF/FM #1. (P)
VHF/FM #2. (O)
5. VHF/FM #1 and VHF/FM #2 ICS monitor knobs—PULL.

Note

Both sets may be monitored by either crew member.

6. VHF-FM volume knob—ADJUST VOL and VHF monitor knobs for proper volume.
7. To turn off VHF/FM, move FM mode knob to OFF.

Retransmission—VHF-FM communications may be received and retransmitted automatically, using both VHF-FM sets as an operational link for two remote stations. Either set can be used as the receiver or transmitter; however, the FM radios must be tuned to a 3 MHz separation in frequency. The following procedure is recommended for simplification and standardization:

1. Turn on both VHF-FM sets in normal T/R mode. (P, O)
2. VHF/FM #1 frequency—SET to receive incoming signal. (P)
3. VHF/FM #2 frequency—SET to desired transmit frequency. (O)
4. VHF/FM mode knobs—RETRAN. (P, O)

Note

Once RETRAN is selected on both sets, the remote stations may transmit and receive as required.

VHF-FM Homing—The VHF-FM (No. 1) set may be used with the course indicator, ID-387/ARN, to home on ground-based VHF-FM stations within approximately 80 miles line-of-sight distance. With desired frequency selected, moving the mode knob to HOME places the homing function in operation. In this mode, “fly-to” heading deviations up to 20 degrees left or right of “on course” homing heading are provided on the course indicator by the vertical bar. Signal strength indication is also provided by the horizontal bar. When approaching a station, the horizontal bar progresses upward from the bottom of the instrument, approaching a maximum deflection near the center as the station is approached. As the transmitter is passed, the bar displays erratic up and down motions. Continued flight without turning causes the bar to return toward the bottom of the instrument.

Note

The course selection function of the course indicator is inoperative during VHF-FM homing.

VHF-AM COMMUNICATIONS SET, WILCOX 807

The VHF-AM set provides two-way voice communications on 1360 separate frequencies between 116.00 and 149.975 MHz. Power is supplied by the secondary d-c bus.

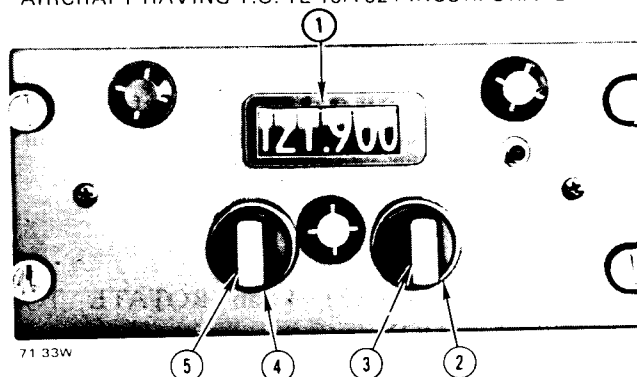
VHF-AM Controls

The VHF-COMM control panel (figure 1-28) is located on the pilot's right console. On aircraft having T.O. 1L-10A-624 incorporated, either the single control panel or the dual control panel (shared with VOR/ILS controls) may be installed.

Mode Knob—The OFF-PWR (-TEST) knob is located at the base of the frequency knob on the left side of the VHF-COMM panel. Set power-on

VHF-AM CONTROLS

AIRCRAFT AF67-14619 AND SUBSEQUENT, AND
AIRCRAFT HAVING T.O. 1L-10A-624 INCORPORATED



1. VHF-AM COMM FREQUENCY INDICATOR
2. VOLUME KNOB
3. FREQUENCY DECIMAL KNOB
4. OFF-PWR-TEST KNOB
5. FREQUENCY KNOB

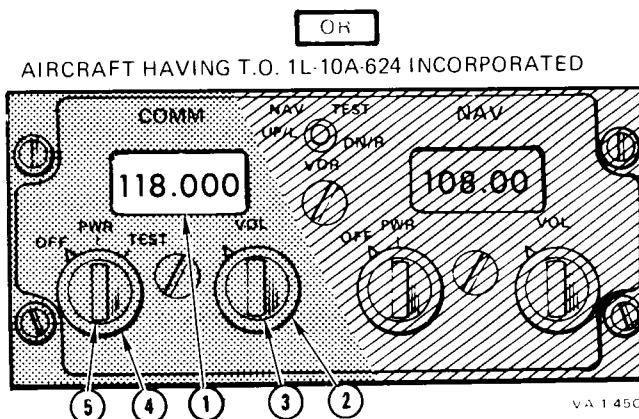


Figure 1-28

conditions are selected by moving the knurled knob clockwise until the associated white pointer moves from OFF to PWR. The COMM TEST switch (knob) allows audible check of receiver operation without transmitting.

With the set turned on and warmed up, holding the switch (knob) in COMM TEST disables the receiver squelch circuits, allowing weak signals to be amplified. In the absence of signals, a background "hiss" indicates proper operation.

Volume Knob—The VOL knob is located at the base of the decimal select knob on the right side of the VHF-COMM panel. Set audio volume is indicated by a white relative volume pointer which is geared to the VOL knob.

Frequency Knobs—The frequency knobs are mounted concentrically on the OFF-PWR (-TEST) and VOL knobs. The left knob is used to select whole MHz from 116 to 149, and the right knob is used to select decimal values in increments of 0.025 MHz. Selected VHF-AM frequency is read directly from the control panel.

VHF-AM Operation

1. OFF-PWR (-TEST) knob—ROTATE TO PWR POSITION.
2. Frequency—SET AS DESIRED.
3. VHF-AM ICS monitor knob—PULL AND ADJUST.
4. Volume—Adjust VOL knob and ICS VHF knob for proper volume.
5. Transmit select knob—VHF-AM.
6. To transmit, hold microphone switch to XMIT.
7. To turn off VHF-AM, rotate OFF-PWR (-TEST) knob to OFF.

LONG-RANGE COMMUNICATIONS SET, HF-103

The HF COMM set provides long-range AM voice communications on 28,000 separate frequencies

between 2.000 and 29.999 MHz (high frequency). Single-sideband (upper or lower), or AM (center frequency) reception and transmission, is available over the entire operating range. Power is supplied by the No. 1 monitor a-c bus.

HF COMM Controls

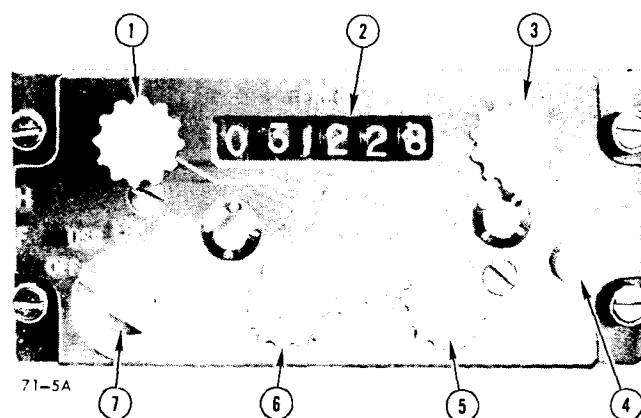
An HF COMM control panel (figure 1-29) is installed on the left console.

Frequency Knobs—Using the four knobs provided, frequency may be set in 1-KHz increments over the entire operating range.

Mode Knob—The HF mode knob provides control of set power and selection of the AM (center frequency), USB (upper side band), and LSB (lower side band) modes of operation.

RF Sensitivity Knob—The RF SENS knob is used to achieve the best available signal-to-noise ratio in all operating modes.

HF COMM CONTROLS



1. FREQUENCY KNOB (2-29)
2. FREQUENCY INDICATOR
3. FREQUENCY KNOB (.000-.009)
4. RF SENSITIVITY KNOB
5. FREQUENCY KNOB (.000-.090)
6. FREQUENCY KNOB (.000-.900)
7. MODE KNOB

PVA-1-46

Figure 1-29

HF COMM Operation

CAUTION

Allow 5 minutes for warm-up.

Note

Successful operation is greatly dependent on frequency selection and environmental conditions.

1. HF mode knob—AS REQUIRED.
2. Frequency—SET AS DESIRED.
3. HF ICS monitor knob—PULL.

Note

If the mode knob is moved from OFF to an operating position, with desired frequency set, the frequency must be changed at least one digit and back to desired frequency, to ensure the exact frequency is set.

4. To transmit, move the transmit select knob to HF and depress microphone switch to XMIT. A tone is audible while the antenna coupler tunes. When the tone ceases, transmit message.

Note

Subsequent transmissions on a set frequency may be made immediately if no tone is heard.

5. The RF SENS knob and the ICS HF monitor knob must be adjusted to obtain best signal-to-noise ratio. Proper balance exists when background noise is barely audible and a weak audio signal is raised to comfortable listening level.

6. Change mode to USB or LSB, as desired, coordinated with the communicant station for best transmission and reception.
7. To secure the HF COMM set transceiver to 29.000 MHz and move HF mode knob to OFF.

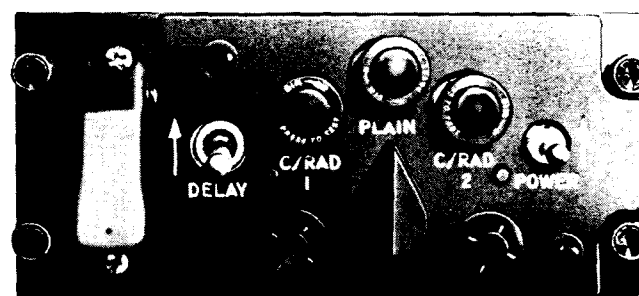
Note

This method minimizes the possibility of coil damage to the unit.

KY-28 SYSTEM

A KY-28 system may be installed. The control panel (figure 1-30) may be installed on the pilot's right console to permit secure communication through the FM-622A VHF-FM and the AN/ARC-147 or AN/ARC-51BX* UHF communication equipment. The KY-28 cockpit controls should be left in the PLAIN position when the coder is not installed.

KY-28 CONTROLS



71-33S

VA-1-27A

Figure 1-30

KY-28 Controls

Power Switch—When the power switch is moved forward, power is applied to the KY-28 system. The FM-622A and AN/ARC-51BX can be operated in the normal manner (without speech security) with the power switch in the aft (OFF) position.

Mode Switch—This switch is used to select plain or secure speech operation. With the switch positioned

* Only UHF RT-742B/ARC-51BX, RT-742C/ARC-51BX or RT-953/ARC-147 compatible with KY-28 system

to PLAIN, normal operation of either command radio is available and only uncoded reception and transmission is possible. With the switch at the C/RAD 1 position, secure speech is available through the FM-622A command radio. With the switch at the C/RAD 2 position, secure speech is available through the AN/ARC-147 or AN/ARC-51BX UHF command radio.

Mode Indicator Lights—Three press-to-test type lights indicate the position selected by the mode switch. With power applied to the system, the left (green) light illuminates when the C/RAD 1 position of the mode switch is selected; the middle (amber) light illuminates when the PLAIN position is selected; and the right (green) light illuminates when the C/RAD 2 position is selected.

Zeroize Switch—The ZEROIZE switch is guarded in the aft (OFF) position. If it becomes necessary to zero out the codes set into the system, the guard should be raised and the switch held momentarily at the forward (ON) position. Nullify codes only when security compromise is eminent.

Note

After codes are nullified, secure transmission cannot be made until system codes are reset. Placing the ZEROIZE switch in the OFF position does not automatically reset the codes.

Delay Switch—This switch presently has no function and should always be in the aft (OFF) position.

KY-28 Operation

Note

- If operation does not proceed as outlined, switch to PLAIN mode. DO NOT PASS CLASSIFIED INFORMATION.
- Unsecure transmission on any radio is prohibited during transmission or reception of secure information.

KY-28 Coder

1. Daily key—SET.

2. Connectors—CONNECTED.

KY-28 Control Unit

1. POWER switch—ON.
2. DELAY (RETRANS) switch—(OFF) DOWN.
3. Mode switch—PLAIN.
4. Make test transmission.
5. Mode switch—SELECT FM (C/RAD 1) or UHF (C/RAD 2).
6. Microphone switch—XMIT.
Listen for steady tone and then an alternating two-tone signal in headset, prior to releasing microphone button.

Note

- Step 6 is necessary only on initial operation after POWER switch is turned ON.
- Prolonged steady tone indicates trouble.
- If alternating two-tone signal does not stop, repress and hold microphone button to XMIT, then release. If trouble continues, switch to PLAIN mode and DO NOT PASS CLASSIFIED INFORMATION.

7. Microphone switch—XMIT.

Wait for beep tone which indicates system is ready for operation. Beep tone is necessary prior to each secure transmission.

Note

If no beep tone is heard, turn POWER switch to OFF and ON again. Repeat steps 6 and 7. If beep tone is still not heard, switch to PLAIN mode and DO NOT PASS CLASSIFIED INFORMATION.

8. System ready for operation.

NAVIGATION SYSTEMS

COMPASS SYSTEM, AN/ASN-75

The compass system provides an accurate stabilized aircraft heading signal through 360 degrees of azimuth. It consists of a directional gyro, amplifier-power supply unit and controller unit in the left boom, a remote compass transmitter in the horizontal stabilizer, and a compass control panel. Power is supplied by the primary a-c bus. Compass heading is indicated by the top index of the bearing-distance-heading indicator (BDHI). On aircraft having T.O. 1L-10A-542 incorporated, compass heading is displayed in the rear cockpit by a radio magnetic indicator (RMI), ID-250/ARN. The compass system operates in either a SLAVED or a FREE mode. The SLAVED mode provides a magnetic heading output slaved to the earth's magnetic field as sensed by the remote compass transmitter. The FREE mode provides a latitude corrected free gyro reference output from the directional gyro.

Compass Controls

The compass control panel (figure 1-31) is installed on the left console in the cockpit. On aircraft having T.O. 1L-10A-538 incorporated, the compass control panel is installed on the right console.

Slaved-Free Switch—The SLAVED-FREE switch is used to select compass mode of operation.

Annunciator—The annunciator, operative only in SLAVED mode, shows agreement or disagreement

COMPASS CONTROLS



51-4

PVA-1-47

Figure 1-31

between the compass gyro and the magnetic compass transmitter. Deflection toward a plus (+) indication reflects clockwise error and deflection toward a minus (●) indication reflects counterclockwise heading error.

Note

Annunciator oscillation during SLAVED mode operation is normal, indicating continuous corrective synchronization.

Push-to-Set Knob—The PUSH TO SET knob is used in the SLAVED mode to set annunciator indication as required and to set the desired aircraft heading while operating in the FREE mode.

Latitude Controls—A N-S switch and LATITUDE knob are located on the gyroscope/amplifier-power supply unit mounted in the left boom. These controls provide for correction of apparent drift due to motion of the earth (earth rate drift). Proper correction affords operation in the FREE mode with very little error.

Compass Operation



Allow 2 minutes for warm-up.

Note

The SLAVED mode is usually used at latitudes up to 60 degrees and operation should be limited to areas free of extraneous magnetic materials, which would cause deviation of earth's magnetic field. The FREE mode should be used when operating in the proximity of an extraneous magnetic field.

With a-c primary and instrument bus power available (either inverter on), and SLAVED mode

selected, compass operation is automatic. If an error between BDHI and standby compass indication is noted, or if heading indication does not agree with known aircraft heading, the annunciator indicates system misalignment. Synchronization is accomplished by pushing on the PUSH TO SET knob and rotating it in either + or ● direction until the indicator centers. In FREE mode, BDHI heading indication must be periodically corrected for gyro drift and apparent precession.

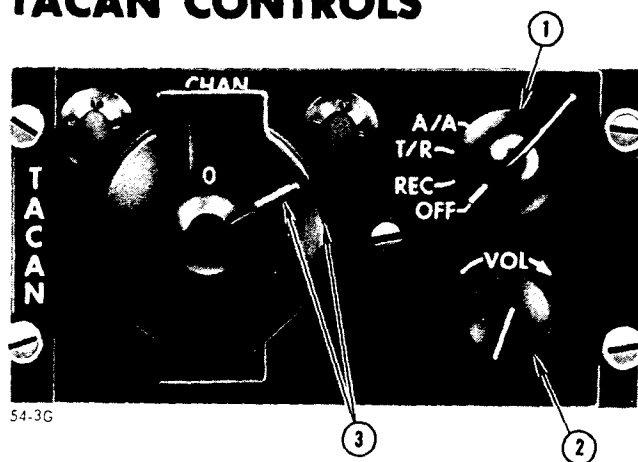
TACAN, AN/ARN-52(V)

The TACAN unit (Tactical Air Navigation) operates with ground, ship, or aircraft-installed equipment in the UHF band between 962 and 1213 MHz. This band is divided into 126 operating channels. Bearing, course deviation, and line-of-sight distances are displayed for surface-based beacons by the BDHI and course indicator. The air-to-air mode displays line-of-sight distance only to like-equipped aircraft. Power is provided by the monitor d-c bus and No. 1 monitored a-c bus.

TACAN Controls

The TACAN control panel (figure 1-32) is mounted on the instrument panel.

TACAN CONTROLS



1. FUNCTION KNOB
2. VOLUME KNOB
3. CHANNEL KNOBS

PVA-1-48

Figure 1-32

Function Knob—The TACAN function knob controls operation and mode. The knob has OFF, REC, T/R, and A/A positions. Function knob positions operate TACAN as follows:

OFF	System secured.
REC (Receive)	System receives and indicates magnetic bearing only to selected station.
T/R (Transmit/ Receive)	System receives and indicates magnetic bearing and slant-range distance in nautical miles to selected station.
A/A Air-to-Air)	System transmits and receives slant-range distance in nautical miles to TACAN-equipped aircraft set for 63-channel frequency separation between sets.

Channel Knobs—The TACAN channel knobs are used to select operating channels 001 through 126. Channels 127, 128, and 129 may be selected but are inoperative. After an initial 90-second warm-up period, 12 seconds are normally required to achieve lock-on after changing channels.

Volume Knob—The VOL knob is the only control of station identification audio signals. TACAN stations normally transmit a Morse code identification signal every 35 seconds. No identification signal is present during the absence of station lock-on and in the A/A mode.

Alternate TACAN Power Switch—The alternate TACAN power switch (figure 1-6) is normally maintained in the NO. 1 MSL position. In event of No. 2 inverter failure, TACAN is disabled due to loss of No. 1 monitored a-c bus. With INV NO. 1 selected, TACAN operation may be restored by selecting ALT/TCN PWR position of the alternate TACAN power switch; thereby selecting No. 2 monitored a-c bus as the TACAN power source.

TACAN Operation

For normal T/R mode operation, refer to AFM 51-37.

CAUTION

Allow a 3-minute warm-up in the REC position prior to selecting T/R.

Note

- The TACAN position of the VOR/TACAN (figure 1-6) switch must be selected to display TACAN bearing on the No. 2 bearing pointer of BDHI. On aircraft having T.O. 1L-10A-542 incorporated, TACAN bearing is indicated in the rear cockpit on No. 2 bearing pointer of radio magnetic indicator, ID-250/ARN.
- TACAN will occasionally lock on to a false bearing which will be 40 degrees, or any multiple of 40 degrees, in error, on either side of the correct bearing. Switching to another channel and then returning to the desired channel should recycle the search mode. This deficiency does not affect the range indication.
- Course deviation is displayed on aircraft having T.O. 1L-10A-540 incorporated.

Air-to-Air Ranging—TACAN airborne ranging provides line-of-sight distance indication up to 300 nautical miles between any suitably equipped transponder (like-equipped aircraft acting as the station)

and up to five suitably equipped interrogator (homing) aircraft. Use of the A/A mode requires prearrangement and preflight or in-flight briefing as necessary. A/A mode mechanization requires that the transponder and interrogator systems be set 63 channels apart.

Note

- When transponding to more than one interrogator, the distance displayed in the transponder aircraft will probably be to the closest interrogator beyond 0.1 nautical mile.
- During A/A mode of operation, the BDHI No. 2 bearing pointer searches (no bearing is displayed). The ADF function of the UHF COMM must be used to determine bearing between transponder and interrogator on BDHI No. 1 bearing pointer.

Air-to-Air Ranging (Homing)

1. Normal T/R mode operation—CHECK.
2. Function knob—A/A.
3. Prebriefed channel—SELECT.
4. UHF COMM—AS DESIRED (ADF function).
5. Note distance to transponder on BDHI.
6. To determine bearing to transponder, request UHF transmission and note BDHI No. 1 bearing indication.

VOR/ILS SYSTEM

Space and power provisions are available for installation of a VOR/ILS system. The all-transistor-powered system consists of a VOR/localizer receiver and an ILS glide slope receiver. This system is capable of receiving all VHF omni (VOR) stations, and all compatible ILS localizer and glide slope transmitter combinations between 108.0 and 117.9 MHz. With an ILS frequency selected, the glide slope receiver is automatically tuned to the matching frequency for ILS operation.

VOR/ILS Controls

On aircraft having T.O. 1L-10A-624 incorporated, controls for the VOR/ILS system, when installed, share a common COMM-NAV panel (figure 1-32A) with the Wilcox 807 VHF-AM system, on the right console in the cockpit.

Power Knob—The OFF-PWR knob is located on the NAV (right) side of the COMM-NAV panel. Power-on selection is achieved by rotating the knurled knob clockwise until the associated white pointer moves from OFF to PWR.

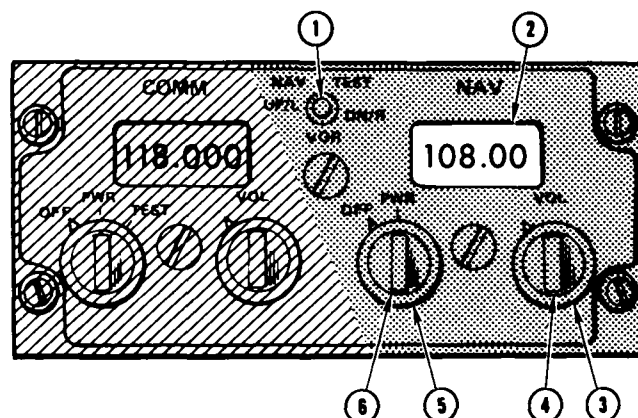
Volume Knob—The VOL knob is located on the NAV (right) side of the COMM-NAV panel. Set audio volume is indicated by a white relative volume pointer which is geared to the VOL knob.

Frequency Knobs—The frequency knobs are mounted concentrically on the OFF-PWR and VOL knobs. The left knob is used to select whole MHz; the right knob is used to select decimals in increments of 0.025 MHz. Selected VOR/ILS frequency is read directly on the panel.

Navigation Test Switch—The navigation test switch is used to test the VOR/ILS system and the course indicator, ID-387. With the OFF-PWR knob at PWR (power on), holding the switch in UP/L should result in a maximum-scale “fly up-left” indication. Holding the switch in DN/R should result in a maximum-scale “fly down-right” indication. The spring-loaded VOR position is the normal position for VOR or ILS operation.

VOR/ILS CONTROLS

AIRCRAFT HAVING T.O. 1L-10A-624 INCORPORATED



1. NAV TEST SWITCH
2. FREQUENCY INDICATOR
3. VOLUME KNOB
4. FREQUENCY DECIMAL KNOB
5. OFF-PWR KNOB
6. FREQUENCY KNOB

VA 1-49A

Figure 1-32A

VOR/ILS Operation

For operation of VOR/ILS equipment, refer to AFM 51-37.

VOR/TACAN Switch

The VOR/TACAN switch (figure 1-6) is located on the instrument panel near the landing checklist. When the set is installed, the VOR position displays VOR bearing on the BDHI No. 2 bearing pointer and course deviation on the course indicator. In the TCN position, TACAN bearing is displayed on the No. 2 bearing pointer and on aircraft having T.O. 1L-10A-540 incorporated, course deviation is displayed on the course indicator. On aircraft having T.O. 1L-10A-542 incorporated, TACAN or VOR bearing is indicated in the rear cockpit by the No. 2 bearing pointer of radio magnetic indicator, ID-250/ARN.

Note

Range indication to TACAN stations will be indicated by the BDHI in the VOR position of the VOR/TACAN switch.

RADIO COMPASS, AN/ARN-83

The radio compass, AN/ARN-83, is a low-frequency navigation aid that drives the BDHI No. 1 (ADF) pointer. Three separate frequency bands are provided: 190-400, 400-840, and 840-1750 KHz. The audio signal is directed through the AN/AIC-18 ICS. Power is supplied from the secondary d-c bus.

Radio Compass Controls

The control panel (figure 1-33) is located on the right console and is labeled ADF.

Function Select Switch—The switch provides ADF, ANT, or LOOP operation.

Gain (Volume) Knob—The knob is located concentrically on the function select switch and controls audio level.

Band Select Switch—The switch selects one of the three band ranges, which appears in the frequency window.

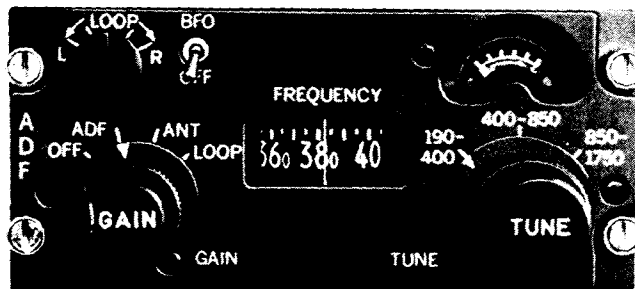
LF—ADF CONTROLS

Figure 1-33

Tune Knob—The knob is located concentrically on the band select switch and provides tuning to maximum signal strength, as indicated on the tuning meter.

Beat Frequency Oscillator Switch (BFO)—The switch in BFO position verifies that zero beat occurs when tuning meter needle is at full right deflection.

Loop Switch—The switch is used to electrically position the loop antenna to a desired azimuth when the function selector switch is in the LOOP position.

Radio Compass Operation**CAUTION**

Allow 1 minute for warm-up.

1. Function switch to ADF.
2. Set BFO-OFF switch to OFF.
3. Set range switch to the frequency range of a radio range station, an outer marker, or a broadcast station. The range selected will appear in the FREQUENCY window.
4. Rotate TUNE control to the frequency of a radio station and tune for maximum signal level on tuning meter (meter pointer swings to the right). The No. 1 BDHI pointer will show relative bearing of radio station.

Note

Five turns of the TUNE control will cover the frequency range in use. Frequencies are indicated in kilohertz.

5. If audio is desired, adjust GAIN and LF/ADF knobs for proper balance and signal-to-noise ratio. If radio station transmission is continuous wave, set BFO-OFF switch to BFO.