YF - 17

PILOTS MANUAL

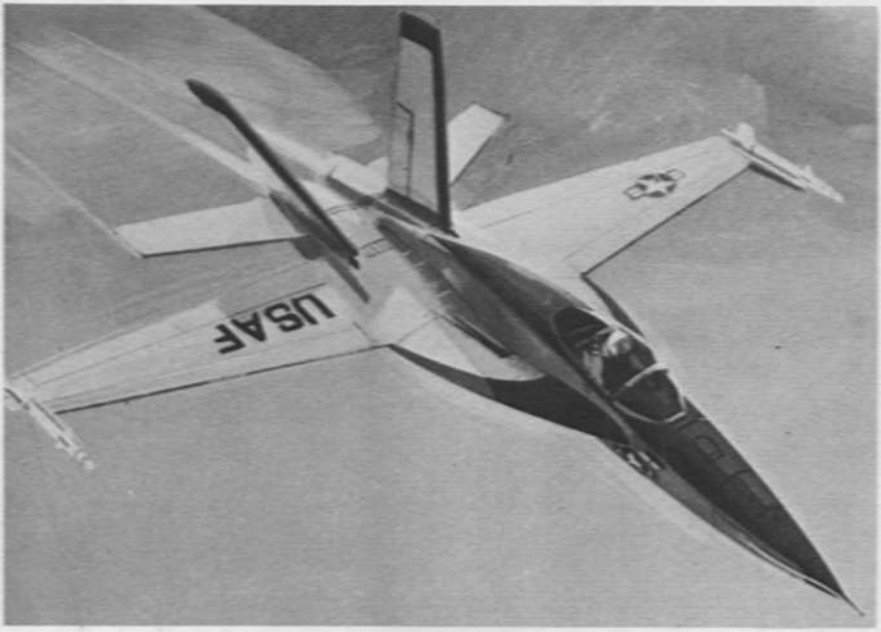
&

CHECK LIST

NOR-74-101
APR 1974

YF-17

PILOT'S MANUAL & CHECKLIST



F33657-72-C-0706

Northrop Corporation
Aircraft Division

3901 West Broadway, Hawthorne, California 90250

COPY NO. _____

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Northrop Corporation
Aircraft Division

NOR 74-101 April 1974

YF-17
PILOT'S MANUAL & CHECKLIST

CONTRACT NO. F33657-72-C-0706

PREPARED BY

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Flight and Weapons Manuals
Product Support

APPROVED BY

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F-17 Flight Test

REVISIONS

CHANGE	DATE	PREPARED BY	PAGES AFFECTED OR REMARKS
1	1 MAY 74	Wm. G. Carter	1-1,1-2,1-5,1-7,1-8,1-10,1-12,1-14,
			1-16 thru 1-18,1-29, 1-31,1-32,1-33,
			1-35 thru 1-40,1-40A Added,
			1-40B Added Blank, 1-44,1-51,1-56,1-61,
			1-66, 2-1,2-2A Added,2-2B Added Blank,
			2-3 thru 2-6,2-6A Added,2-6B Added Blank,
			2-7 thru 2-12, 3-1 thru 3-8,3-10,3-11,3-12,

CHANGE	DATE	PREPARED BY	PAGES AFFECTED OR REMARKS
			3-12A Added,3-12B Added Blank
			3-13,3-14,3-14A Added,
			3-14B Added Blank,3-15,3-16,3-18,
			3-18A Added,3-18B Added Blank,
			3-20,3-21, 4-2, 4-12, 6-2,6-3,
			7-1 thru 7-3, A-3,A-4,A-5
2	20 JUN 74	Wm. G. Castes	1-19; 1-21; 2-4; 2-7; 2-8; 3-4; 3-6; 3-7;
			3-8; 3-8A Added; 3-8B Added Blank;
			3-17. 3-18; 3-18A; 3-19; 3-20;
			4-13; 4-14; 4-15; 6-2; 6-3; 6-4; 7-3
3	20 AUG 74	Wm. G. Castes	1-32A Added, 1-32B Added Blank
			1-33; 1-45; 1-49; 1-51; 1-59; 2-5; 3-1;
			3-10; 3-10A Added; 3-10B Added
			Blank; 3-12A; 3-12B; 4-9; 6-3; 6-4
4	25 OCT 74	Wm. G. Castes	1-58; 2-5, 2-11, 2-12; 3-20; 5-2;
			6-1, 6-2, 6-2A (6-2B Blank)
			Added, 6-4; 7-1, 7-2, 7-3 (7-4
			Blank) deleted

YF-17

PILOT'S MANUAL
&
CHECKLIST

FOREWORD

USE

This publication is presented in abbreviated format and is intended for use by experienced and qualified flight personnel assigned to the YF-17 Flight Test Program. Numbered copies assigned to flight personnel will be updated as necessary by memorandum originated by the Manager, F-17 Flight Test.

AIRCRAFT MODEL CONFIGURATION

The model configuration of the YF-17, as described herein, does not include all the features of a production version. The aircraft is designed as a prototype model for test and evaluation. Combat associated equipment and armament which do not contribute to the objectives of the test program have been deleted and flight test equipment/instrumentation has been included to support test and evaluation.

AIRCRAFT IDENTIFICATION

Prototype No.	Serial No.	Northrop No.
1	AF72-1569	A1001
2	AF72-1570	A1002

FLIGHT AND OPERATING LIMITATIONS

Flight and operating limitations appearing in this manual are subject to change. Refer to "YF-17 Flight and Operating Limitations" for applicable limits.

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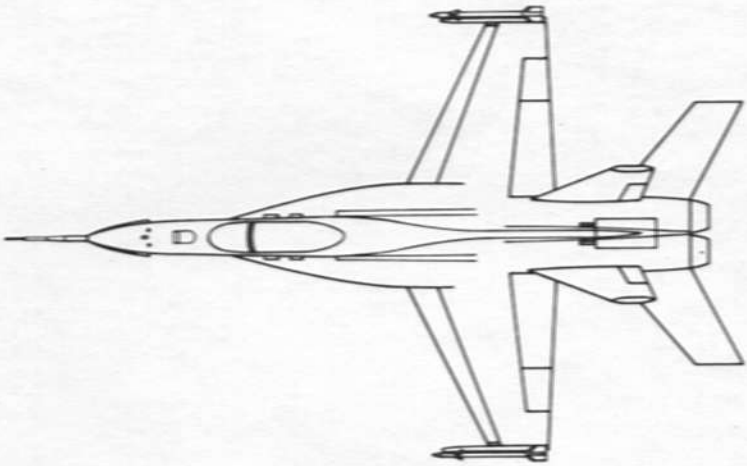
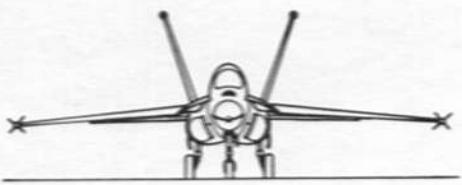
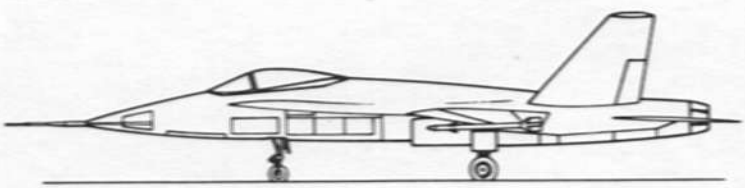
YF-17 LIGHTWEIGHT FIGHTER







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SECTION I

DESCRIPTION AND OPERATION

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THE AIRCRAFT

The YF-17 is a single-place air superiority prototype lightweight fighter aircraft built by the Northrop Corporation, Aircraft Division, Hawthorne, California. Propulsion thrust is supplied by two YJ101-GE-100 afterburner equipped turbojet engines. Increased thrust performance, stability, and reliability are enhanced by the location of the engine air inlet ducts beneath the wing, diversion of fuselage boundary layer air upstream of the air intake thru wing root slots, and fixed geometry inlets. Flying qualities throughout the flight envelope are enhanced at high lift conditions and transonic regions by the sweptback cambered wing leading edge extension, variable camber wing airfoil using automatic positioned leading and trailing edge flaps, and twin vertical tails canted outboard and positioned forward of the horizontal tail. The "hybrid" mid-wing is moderately sweptback, has slight negative dihedral, and is situated well aft on the fuselage. The wing trailing edge is fitted with conventional ailerons and landing flaps. The sweptback horizontal tail is positioned below and aft of the wing, has negative dihedral, and is the primary roll control complemented by ailerons. A speed brake is located on the upper aft fuselage between the twin vertical stabilizers. All internal fuel cells are mounted in the fuselage. Air refueling capability is provided thru a receptacle concealed behind a retractable door located forward of the windshield. Two 600-gallon external fuel tanks are provided to extend combat range. Flight controls are dual-hydraulically powered and integrated with an electronic control augmentation system (CAS). Programmed responses from sensors within the system thru a digital air data computer (DADC) provide relatively constant stick force per-g throughout the flight envelope. A feature of the control system is the rolling horizontal tail, providing differential deflection of the tail surfaces which assist in rolling this aircraft around the approximate gun lead angle. Maneuvering flaps are programmed by the DADC. The trailing edge flap is mechanically interconnected with the horizontal tail to minimize trim changes. An emergency power unit provides flight control hydraulic power in the event of dual engine failure. Individual left and right throttles may be connected to a master throttle and operated together with the one lever. The cockpit is equipped with a zero-zero rocket catapult ejection seat. The seat back is positioned to improve rearward visibility and the back angle to improve pilot high-g tolerance. The pilot is provided with 360-degree visibility at and above eye

level; 13 degrees over fuselage nose, and 55 degrees over the side. Basic armament consists of an M61A1 20mm Gatling gun pallet-mounted in the centerline forward nose section and AIM-9 series missiles carried on wingtip launcher rails. Two pylons under each wing (centerline provisions only) provide carriage of external fuel tanks and/or weapons. A computing sight provides a heads-up display (HUD) of target steering and attack.

GENERAL ARRANGEMENT

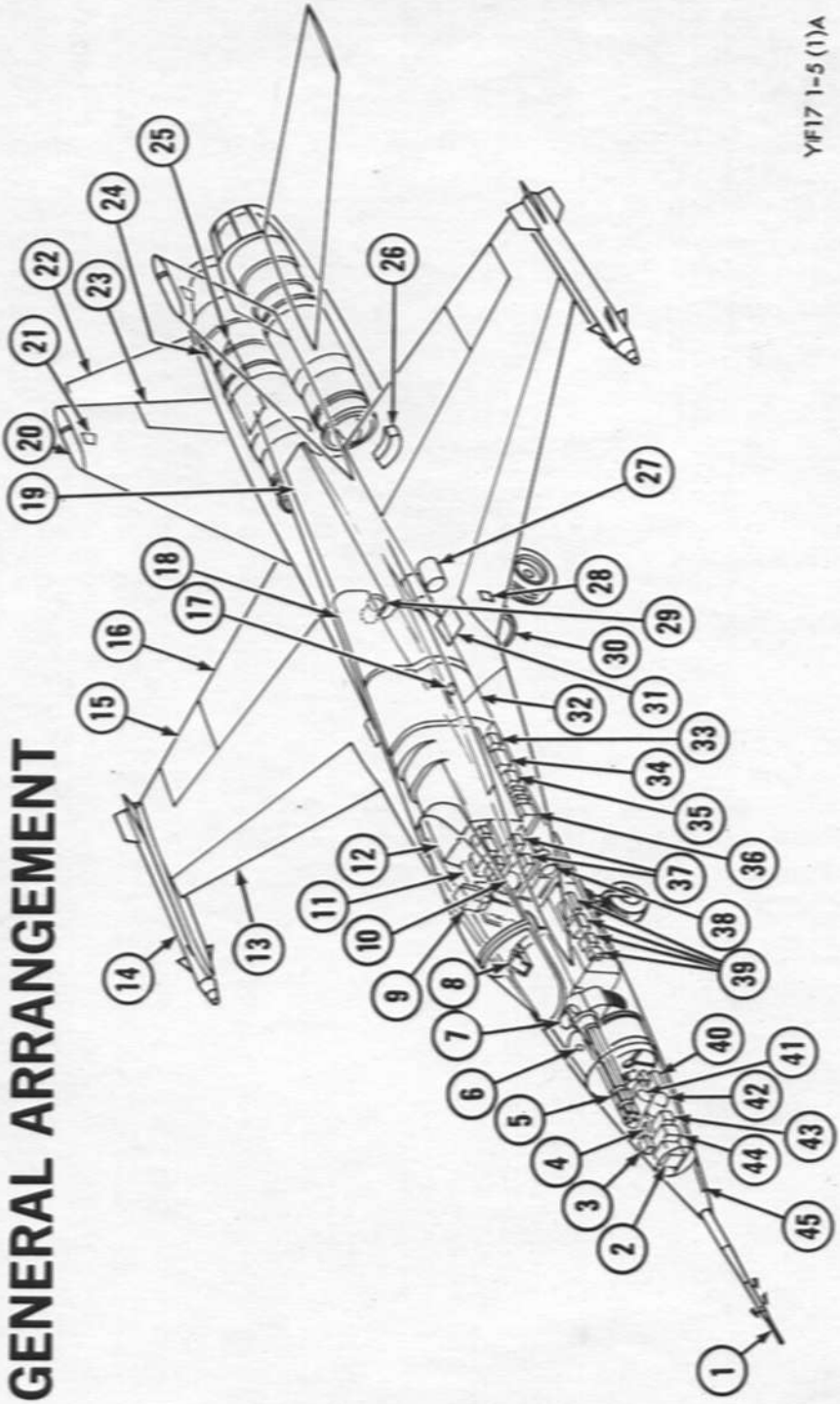

Figure 1-1. (Sheet 1)

1 FLIGHT TEST PITOT-STATIC BOOM
2 RADAR
3 EPU CONTROLLER
4 EMERGENCY POWER UNIT
5 20MM M61A1 GUN
6 AIR REFUELING RECEPTACLE
7 EMERGENCY BRAKE ACCUMULATOR
8 HUD GUNSIGHT
9 EJECTION SEAT
10 LIQUID OXYGEN CONVERTER
11 AVIONICS EQUIPMENT BAY
12 FORWARD FUEL TANK
13 LEADING EDGE FLAP
14 AIM-9E MISSILE
15 AILERON
16 TRAILING EDGE FLAP
17 GROUND VORTEX INHIBITOR
18 LEFT MAIN FUEL TANK
19 AFT FUEL TANK
20 UHF/IFF/TACAN ANTENNA (L & R)
21 ANTI-COLLISION BEACON LIGHT (L & R)
22 HORIZONTAL ROLLING TAIL
23 RUDDER (L & R)
24 YJ101-GE-100 ENGINE
25 SPEED BRAKE
26 GEARBOX ASSEMBLY
27 HYDRAULIC RESERVOIRS
28 ENGINE GROUND START PANEL & EXTERNAL ELECTRICAL RECEPTACLE
29 FIRE EXTINGUISHER BOTTLES
30 ENGINE AIR INTAKE
31 INLET RAMP DIVERTER (BLC)
32 RIGHT MAIN FUEL TANK
33 IFF TRANSPONDER
34 TAPE RECORDER
35 CONTROL AUG. SYSTEM
36 INERTIAL NAVIGATION UNIT
37 FLIGHT TEST EQUIPMENT
38 ENVIRONMENTAL CONTROL SYSTEM
39 FLIGHT TEST EQUIPMENT
40 EPU BATTERY
41 HYDRAZINE TANK
42 NITROGEN TANK
43 BATTERY
44 DIGITAL AIR DATA COMPUTER
45 RADAR ANTENNA

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Figure 1-1. (Sheet 2)

COCKPIT ARRANGEMENT

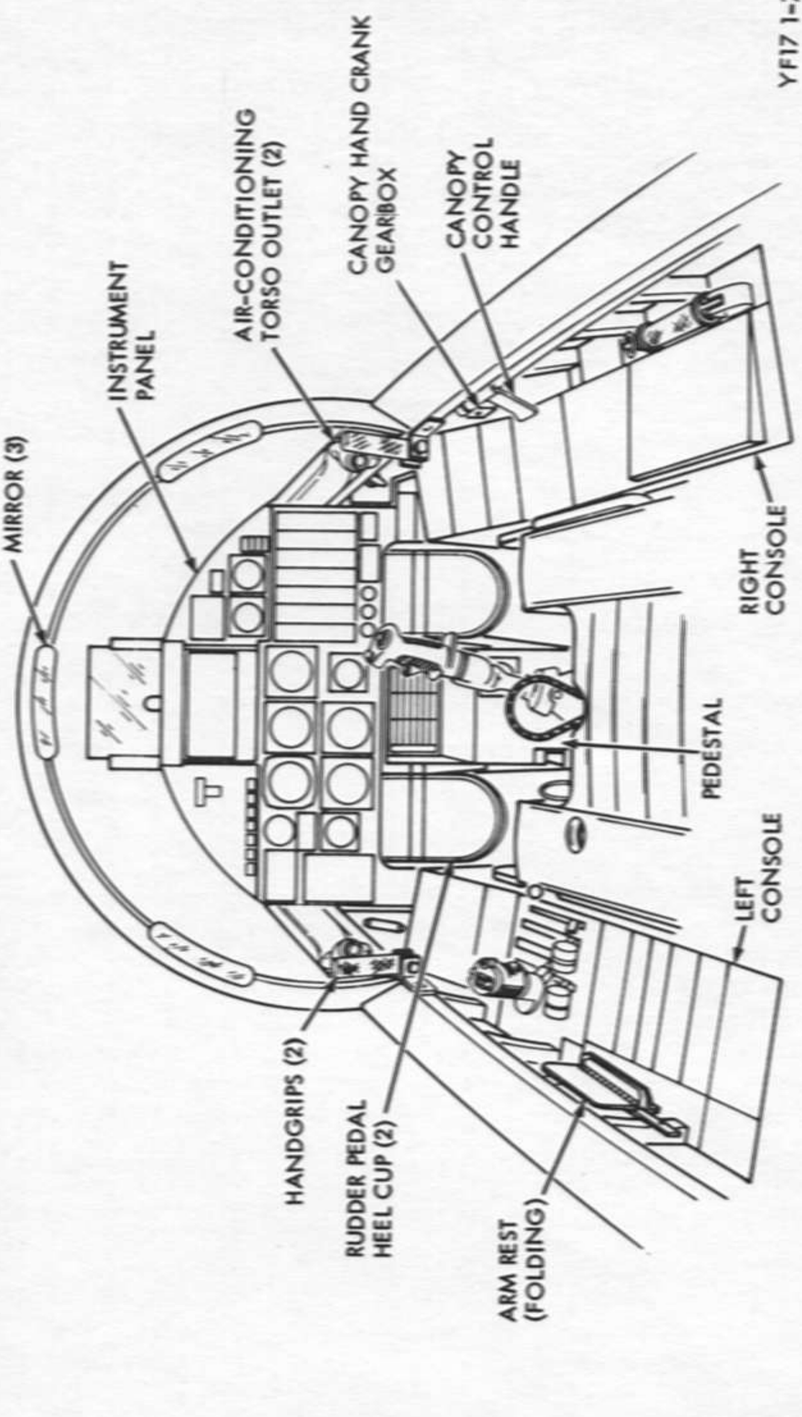

Figure 1-2.

SPECIFICATIONS

DIMENSIONS

Wingspan (w/missiles)	37.7 ft
Wingspan (w/o missiles)	35.0 ft
Horizontal Tail Span	22.2 ft
Length (overall)	62.7 ft
Height (overall)	14.5 ft
Wheelbase	17.2 ft
Wheel Tread	6.8 ft
Tail Down Angle (Takeoff and Landing)	12.0°

WEIGHTS

NOTE

Refer to Flight Test Loading Sheet for authorized configuration weight/CG loading data.

Empty	17,390 lb
Basic (empty plus unusable fuel)	17,500 lb
Operating Empty (includes: crew, unusable fuel, oxygen, engine oil)	17,740 lb
Basic Mission Takeoff (includes: full internal fuel, ammo, missiles)	24,760 lb
Ferry Mission Takeoff (includes: full internal fuel, full 600 gal inboard pylon tanks, w/o ammo and missiles)	32,870 lb
Maximum Takeoff (includes: full internal fuel, full 600 gal inboard pylon tanks, ECM pods, ammo, and missiles)	34,430 lb

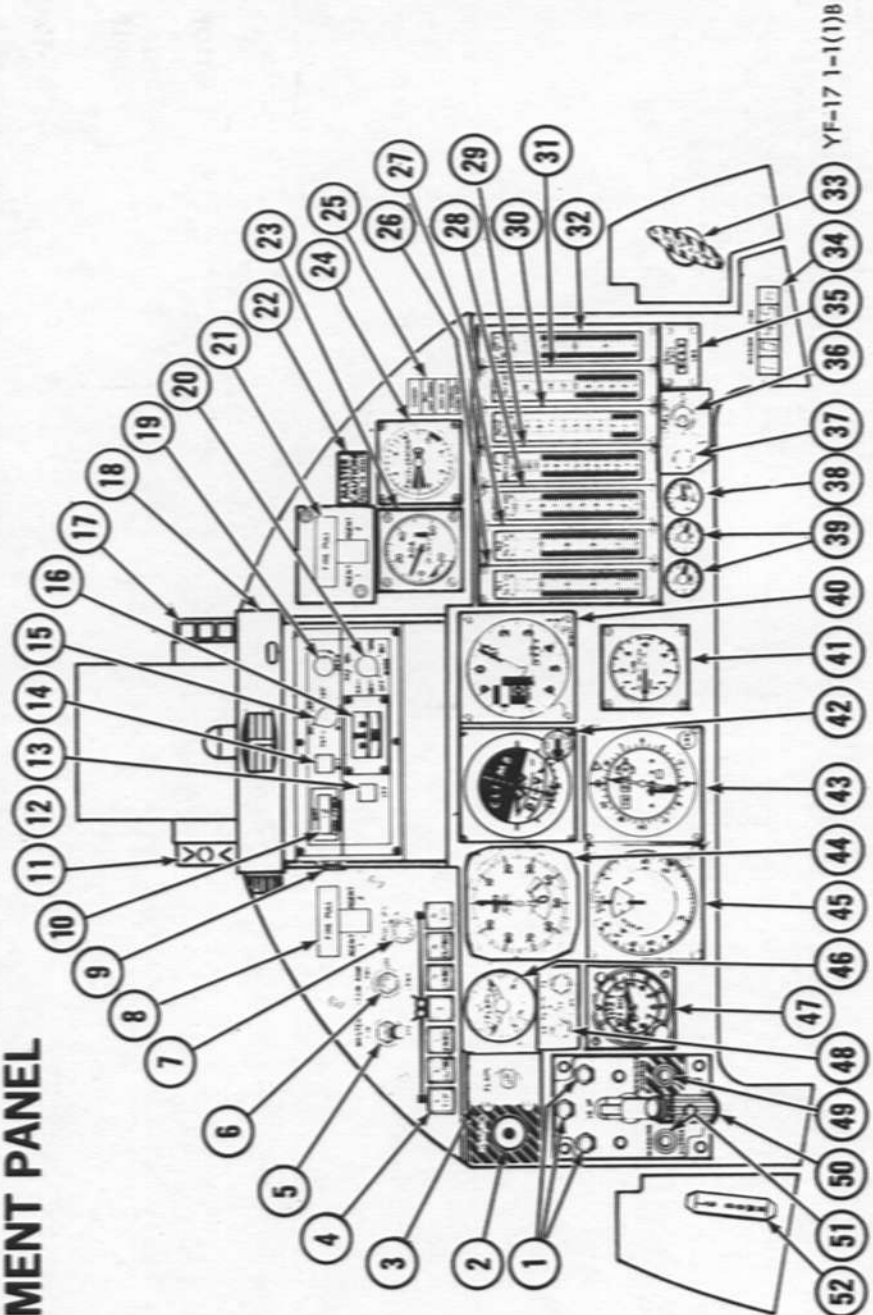

Figure 1-3. (Sheet 1)

1 LANDING GEAR POSITION INDICATOR LIGHTS
2 EMERGENCY JETTISON BUTTON
3 FLAP POSITION INDICATOR
4 ARMAMENT STATION SELECTOR/INDICATOR SWITCHES
5 MASTER ARM SWITCH
6 GUN/CAMERA ARM SWITCH
7 MISSILE VOLUME KNOB
8 L ENGINE FIRE PULL HANDLE/AGENT DISCHARGE SWITCH
9 SIGHT AUTO/MANUAL BRIGHTNESS CONTROL
10 UHF CHANNEL/FREQUENCY REMOTE INDICATOR
11 ANGLE-OF-ATTACK INDEXER
12 SIGHT COMBINING GLASS
13 IFF IDENT SWITCH/INTERROGATION INDICATOR
14 SIGHT BIT SWITCH
15 SIGHT TARGET SPAN CONTROL KNOB
16 TURN AND SLIP INDICATOR
17 AIR REFUEL INDICATOR PANEL
18 SIGHT CAMERA
19 SIGHT RETICLE DEPRESSION CONTROL KNOB
20 SIGHT MODE CONTROL SELECTOR
21 R ENGINE FIRE PULL HANDLE/AGENT DISCHARGE SWITCH
22 MASTER CAUTION LIGHT
23 ANGLE-OF-ATTACK INDICATOR
24 ACCELEROMETER
25 CANOPY/SEAT WARNING, ANTI-SKID CAUTION, & EXTERNAL TANKS EMPTY INDICATOR LIGHTS
26 ENGINE LOW PRESSURE ROTOR TACHOMETER (N1)
27 ENGINE HIGH PRESSURE ROTOR TACHOMETER (N2)
28 EXHAUST GAS TEMPERATURE INDICATOR
29 FUEL FLOW INDICATOR
30 ENGINE NOZZLE POSITION INDICATOR
31 ENGINE OIL PRESSURE INDICATOR
32 FUEL QUANTITY INDICATOR
33 CANOPY JETTISON T-HANDLE
34 *MISSION TIME INDICATOR
35 TOTAL FUEL QUANTITY INDICATOR
36 FUEL QUANTITY SELECT SWITCH
37 *EPU OPERATION LIGHT
38 *EPU FUEL QUANTITY INDICATOR
39 HYDRAULIC PRESSURE INDICATORS
40 ALTIMETER
41 VERTICAL VELOCITY INDICATOR
42 ATTITUDE INDICATOR
43 HORIZONTAL SITUATION INDICATOR
44 *AIRSPEED INDICATOR
45 AIRSPEED — MACH INDICATOR
46 *FLAP POSITION INDICATOR
47 CLOCK
48 *FLAP POSITION SWITCHES
49 LANDING GEAR DOWNLOCK OVERRIDE BUTTON
50 LANDING GEAR LEVER
51 LANDING GEAR WARNING SILENCE BUTTON
52 LANDING GEAR ALTERNATE RELEASE D-HANDLE

* FLIGHT TEST INSTRUMENTATION

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Figure 1-3. (Sheet 2)

NORTHROP F-17 SENSITIVE

LEFT CONSOLE

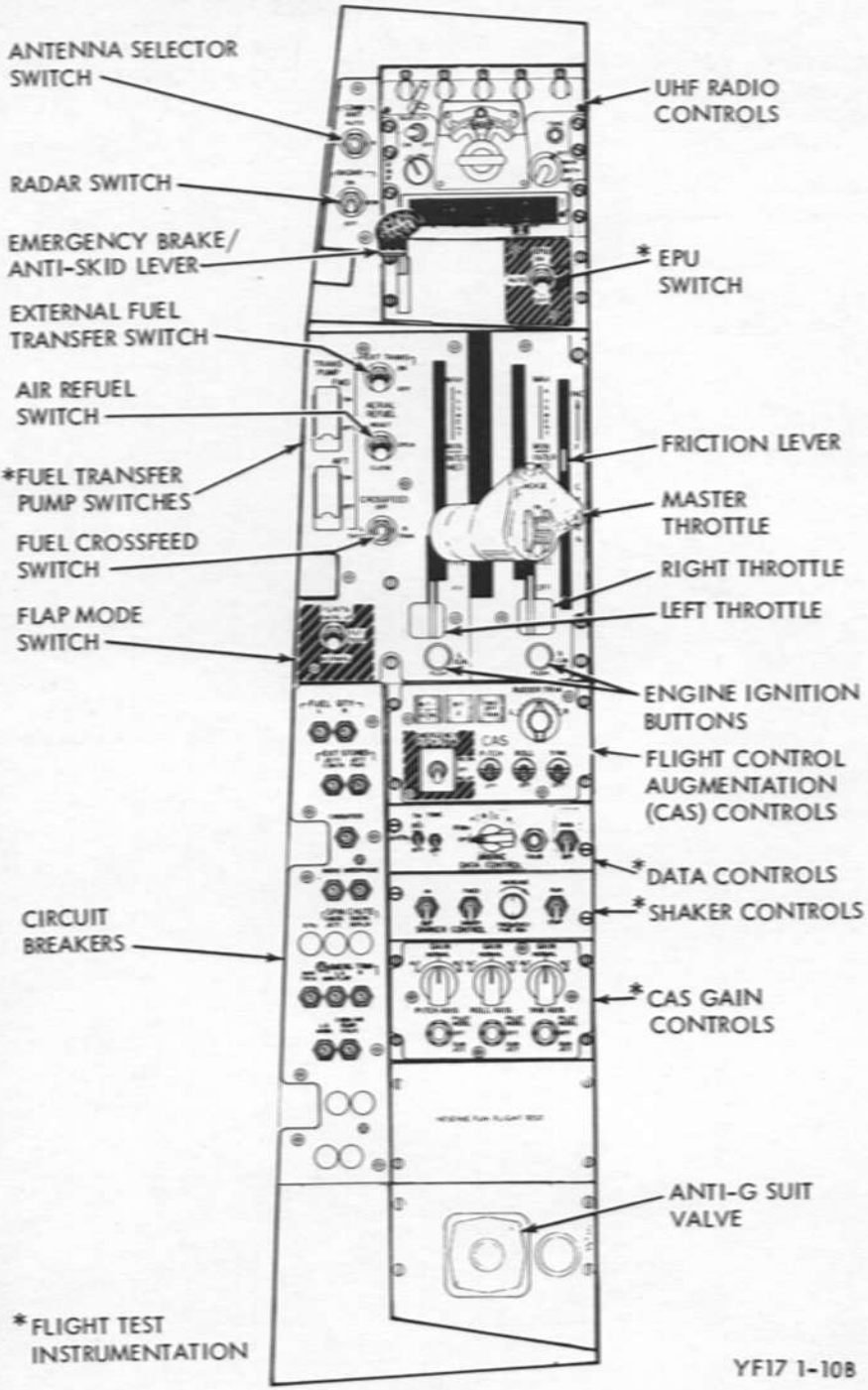

Figure 1-4.

RIGHT CONSOLE

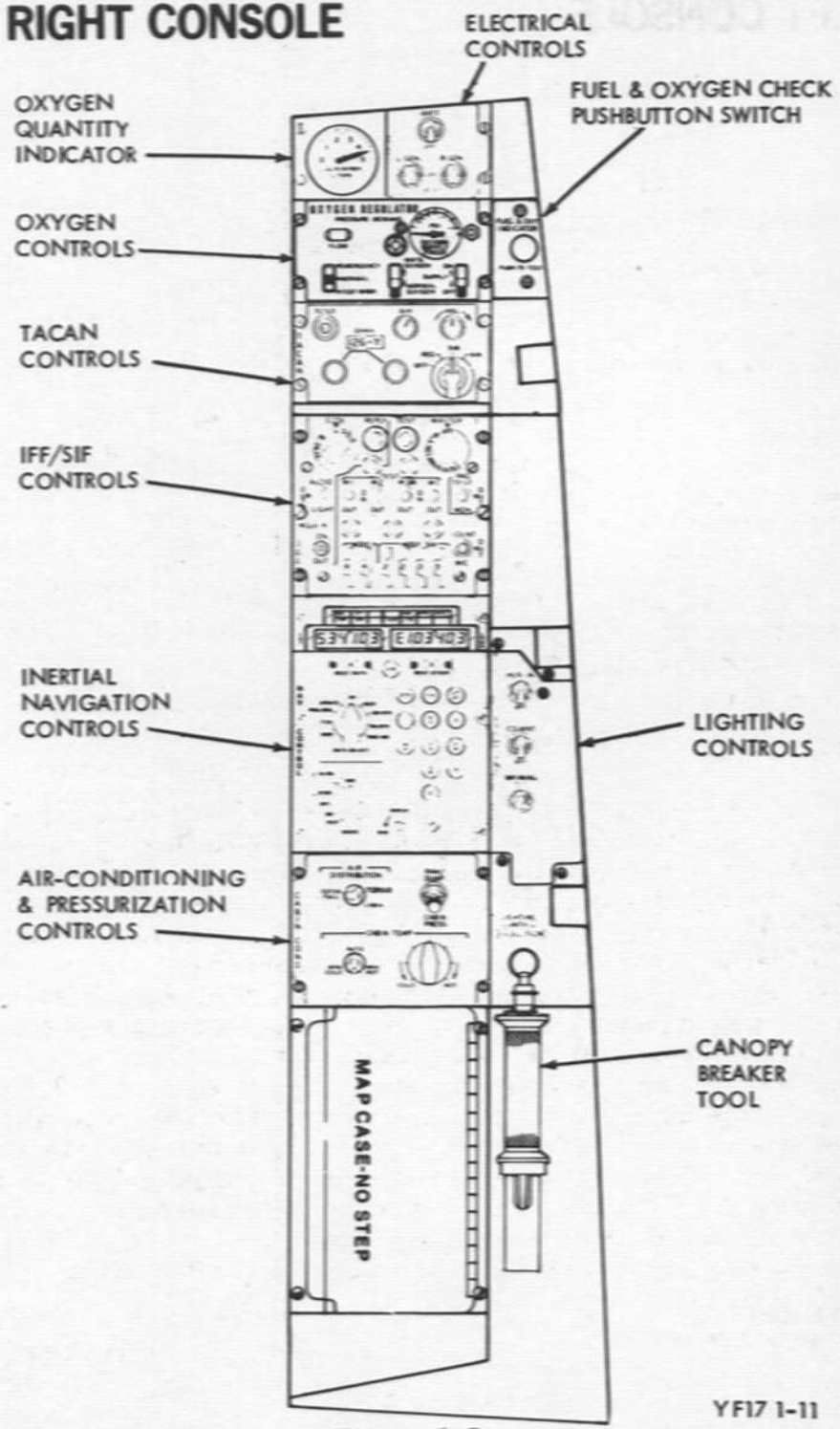

Figure 1-5.

PEDESTAL

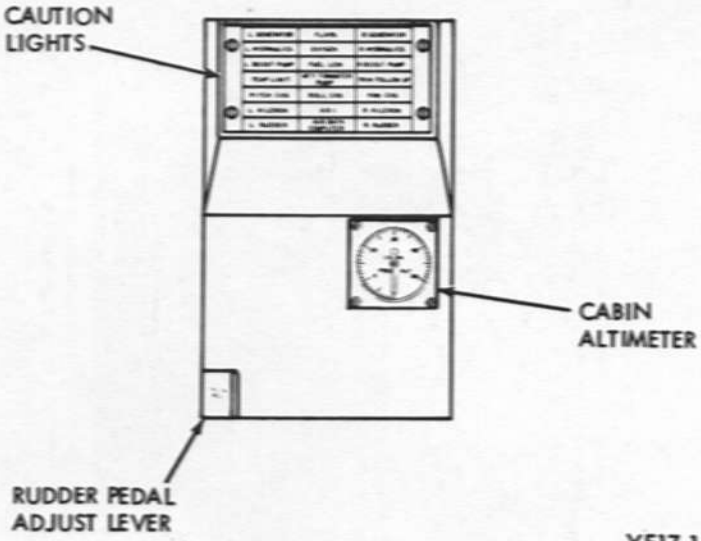

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Figure 1-6.

ENGINES

The YF-17 is powered by two YJ101-GE-100 low bypass twin-spool, continuous bleed, afterburning turbojet engines (figure 1-7) each rated at approximately 15,000 pounds static thrust (uninstalled). The engines are specifically designed to provide high thrust characteristics in the transonic region during combat maneuvering. Components are: front frame containing the variable inlet guide vanes, 3-stage low pressure compressor with 1-stage of variable stators, mid-frame, 7-stage high pressure compressor utilizing three stages of variable stators, annular-type combustor, single-stage low pressure turbine, single-stage high pressure turbine, and the afterburner section. Continuous bleed air from the low pressure compressor (approximately 20% of the engine airflow) allows the engine to be internally self-cooled. Hydraulically-actuated variable exhaust nozzles (VEN) automatically provide proper nozzle opening from intermediate (INTERMED) thrust thru all ranges of afterburner (AUGMENT) operation.

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YJ 101-GE-100 ENGINE

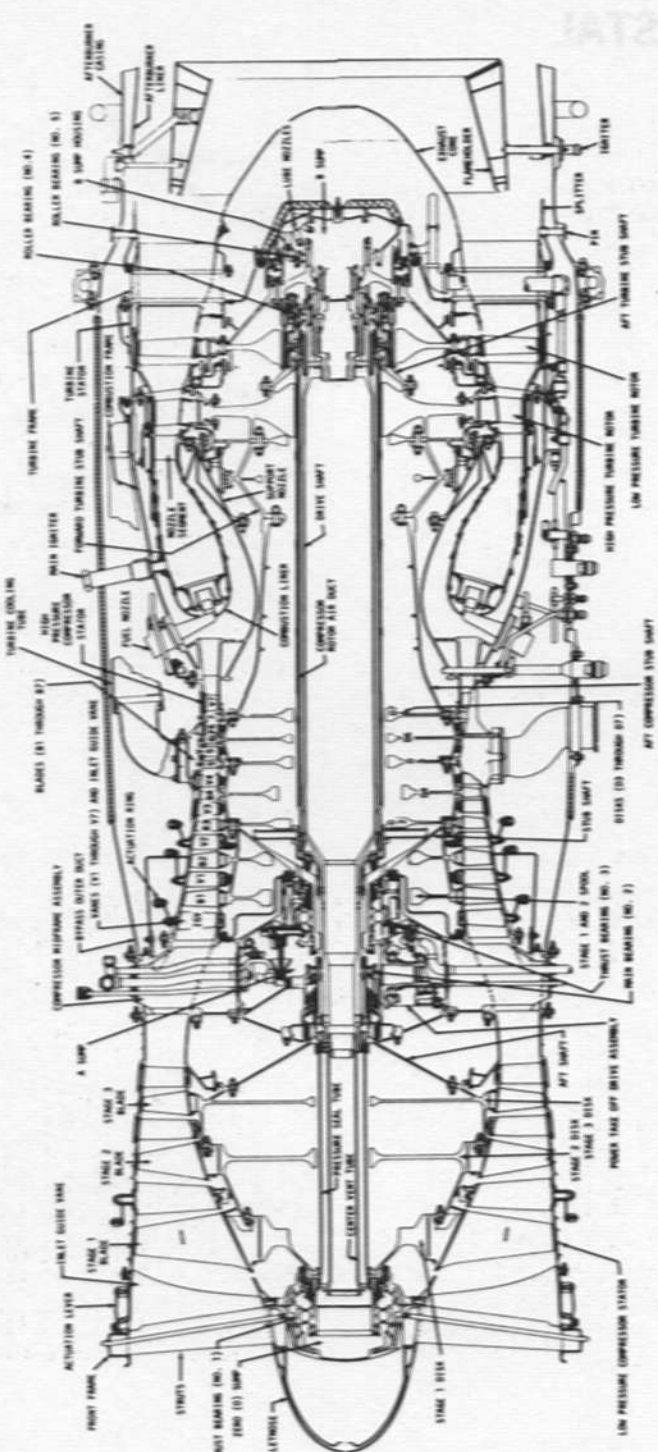


Figure 1-7.

ENGINE CONTROL SYSTEM

The engine control is an electro-hydraulic-mechanical type which provides automatic engine operation as determined by throttle positioning. Power settings below INTERMED position (military power) are determined by the main fuel control regulation of the high pressure rotor speed (N2). At INTERMED position and thru all AUGMENT position ranges, engine speeds are controlled by the low pressure rotor speed (N1) and EGT (T6). The system regulates main and afterburner fuel flows and schedules exhaust nozzle area (A8) and low/high pressure variable geometry and thereby monitors low/high pressure compressor rotor speeds and turbine discharge temperature. These functions are performed in response to signals of engine inlet air temperature (T2F), compressor discharge temperature (T2C), low pressure turbine discharge temperature (T6E), and feedback signals from each of the controlled functions. The systems automatically prevents the engine from exceeding any limits within the operating envelope. In the event of electrical failure, the system is mechanically controlled to insure satisfactory operation of the engine from IDLE cutoff to slightly below INTERMED power. The engine is protected for any single control failure, to prevent excessive overspeed or excessive overtemperature.

THROTTLES

Engine power control is regulated by the throttles (figure 1-8), one for each engine and a master which serves as a single throttle for slaved operation of both the left and right throttles. The master throttle grip contains switches for the speed brake, microphone, maneuvering flaps, missile uncage, radar reject, and one flight test function. The left and right throttles may be engaged or disengaged to the master at any position; engagement being accomplished by down and forward motion, disengagement by down and aft motion. The master may be stowed forward, when disengaged, if desired. When either throttle is disengaged and pulled back to IDLE position, it will contact a stop to prevent going into OFF position. The throttle will detent at idle cutoff. A detent located at the INTERMED position must be passed for AUGMENT operation. Afterburner thrust augmentation is provided from MIN to MAX positions. Throttle friction is manually adjusted by the pilot.

THROTTLES

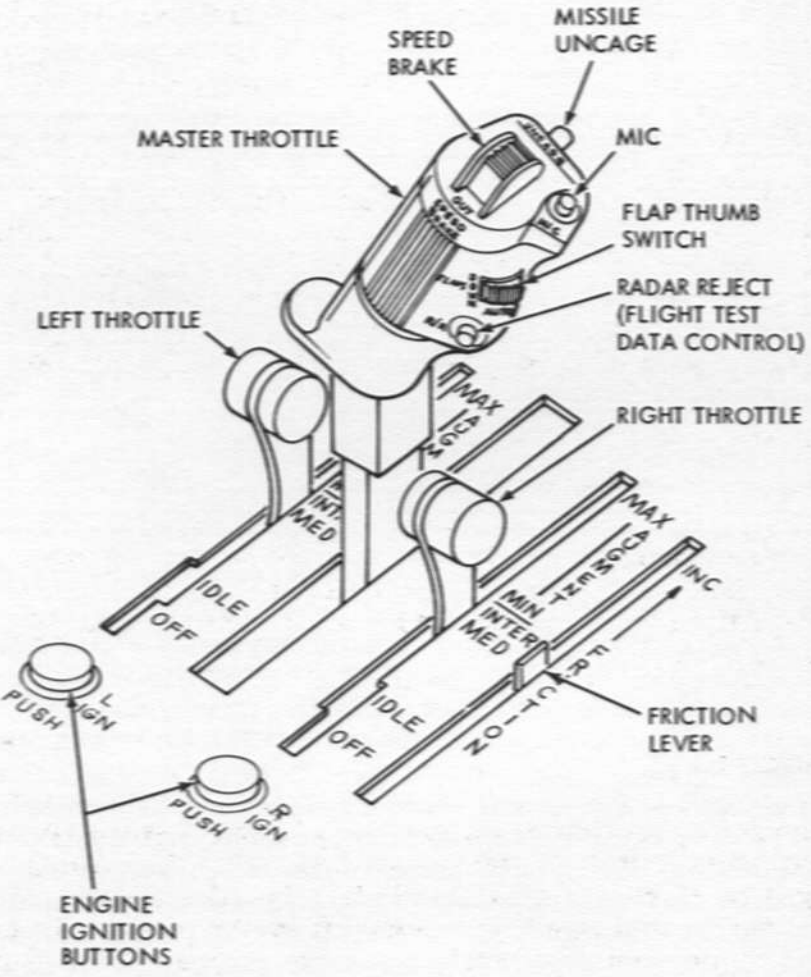


Figure 1-8.

STARTER GEARBOX

The starter gearbox is driven by a single air-turbine starter mounted on the gearbox. Power output is connected to each engine accessory gearbox thru a clutch assembly. Activation of an engine start switch, located in an access panel on the left engine air intake duct, by the ground crew during ground start will open a solenoid-operated valve to drive the respective engine clutch and, in turn, drive the engine accessory drive to motor the engine.

ACCESSORY DRIVE GEARBOXES

The airframe-mounted accessory drive gearboxes are independent accessory power systems. Power during start is transmitted to the engine thru an interconnecting power takeoff (PTO) shaft. The hydraulic pump, oil/fuel pump, and generator mounted on the gearbox will rotate during engine start. After engine start the starter and clutch cut off and the engine drives the gearbox accessories thru the PTO.

ENGINE START OPERATION

All engine indicators and start relays are powered by the 28-VDC primary bus. Either engine may be started first; however, starting the left engine is recommended to supply hydraulic power for wheel brakes.

GROUND START

Starting either engine requires external low-pressure air source to drive the air turbine starter gearbox. With the battery switch on, ground starting sequence is initiated by the ground crew thru use of an external panel (upon signal from the pilot). The engine ignition buttons on the throttle quadrants (figure 1-8) are not used during ground start. However, the lights will individually illuminate (white) whenever the ignition circuit is automatically activated and will go out when ignition is completed. When the first indication of high pressure rotor speed is indicated in the N2

tachometer, the throttle is advanced into IDLE position and engine ignition is automatically turned on. Fuel is injected and the exhaust nozzle remains fully open. At approximately 30% N2 the first indication of low pressure rotor speed should appear in the N1 tachometer. Ignition cuts off at about 40% N1. At approximately 52% N2 the starter cuts off and the engine accelerates to idle rpm. Fuel flow will reduce when idle is reached at approximately 70% N2.

INFLIGHT START

With throttles at IDLE or above in flight, ignition is automatic and continuous when N1 rpm is between 10% — 40%, and the ignition buttons will be illuminated. If N1 rpm is above 40%, the respective engine ignition/timer button the throttle quadrant provides 30-second ignition cycle for engine airstart. When pushed, the button will illuminate to indicate activation. At the end of the 30-second cycle the light will go out, terminating ignition. If required, the button may be immediately pushed to continue ignition. The buttons may be activated while the engines are running to provide the capability of automatic engine restart during high speed combat maneuvering if flameout occurs.

AUGMENTED THRUST OPERATION

Advancing the throttle into AUGMENT position turns on afterburner ignition, opens the VEN slightly above an intermediate setting which temporarily lowers the low-pressure turbine discharge temperature (T6E), and initiates minimum AUGMENT range fuel flow until lightoff occurs. The engine ignition button light will illuminate to indicate that ignition is on. A lightoff detector senses afterburner lightoff and schedules additional fuel flow as determined by throttle position. Normal low-pressure compressor rotor speed (N1) and T6E values are established and the VEN modulates to hold T6E limit. On rapid throttle advance from below INTERMED to MAX power settings, lightoff is initiated when high-pressure compressor rotor speed (N2) exceeds 85% and is held until lightoff is detected. For throttle retard, the A8 slews closed with throttle demand to hold constant T6E. The afterburner fuel pump flow shuts off when fuel flow drops below a fixed level.

ENGINE AIR INDUCTION SYSTEM

The air inlet induction system for each engine consists of an oblique shock inlet and subsonic diffuser duct. The inlets are side mounted under the wing leading edge extension (LEX) and are designed to provide reduced flow angularity to the inlet, and best performance during maneuver and cruise. A two-dimensional fixed geometry inlet with a 7° vertical ramp provides maximum performance in the transonic flight regime. A longitudinal slot thru the wing root allows fuselage boundary layer air diversion above the wing as well as below the fuselage. A ramp bleed system for each inlet eliminates adverse effects of shock/ramp boundary layer interaction at supersonic speeds. A DADC controlled ramp bleed air exit door is provided on the top surface of each LEX. In flight, closed position is provided a 5° opening; open position is 15°. In normal operation the door will start to open at approximately 1.4 Mach. In the event of a DADC failure the ramp bleed air exit door goes to a fully open 20° position. The effect of the fully open door on performance is negligible. The subsonic diffuser duct provides high pressure recovery. Approximately 1% of duct air is used for engine bay purging.

ENGINE OIL SYSTEM

Each engine has an independent, self-contained oil supply and lubrication system. A sump vented internally within the system (center-venting) prolongs carbon seal life, minimizes oil leakage thru seals, and maintains positive pressure to make the system insensitive to altitude. Full capacity of the tank is 8 quarts of MIL-L-7808G oil; 5 usable and 3 unusable. Oil is measured by a dipstick on the fill tube cap and is accessible thru a door on each side of the fuselage.

GROUND VORTEX INHIBITOR

Ingestion of runway debris (FOD) is prevented by a vortex inhibitor system. Two jet nozzles installed in the centerline lower fuselage forward of the engine air intake ducts aim a 40° directional flow of high pressure engine compressor bleed air to spoil induced ground vortices by modifying the airflow field below the inlet opening. Operation is automatic with engines running on the ground; however, the nozzles are shut off with the engines at IDLE and when the main landing gear is raised on takeoff.

NOTE

If cabin pressurization system is operated in RAM/DUMP position with engines running on ground, the vortex eliminator system will be inoperative.

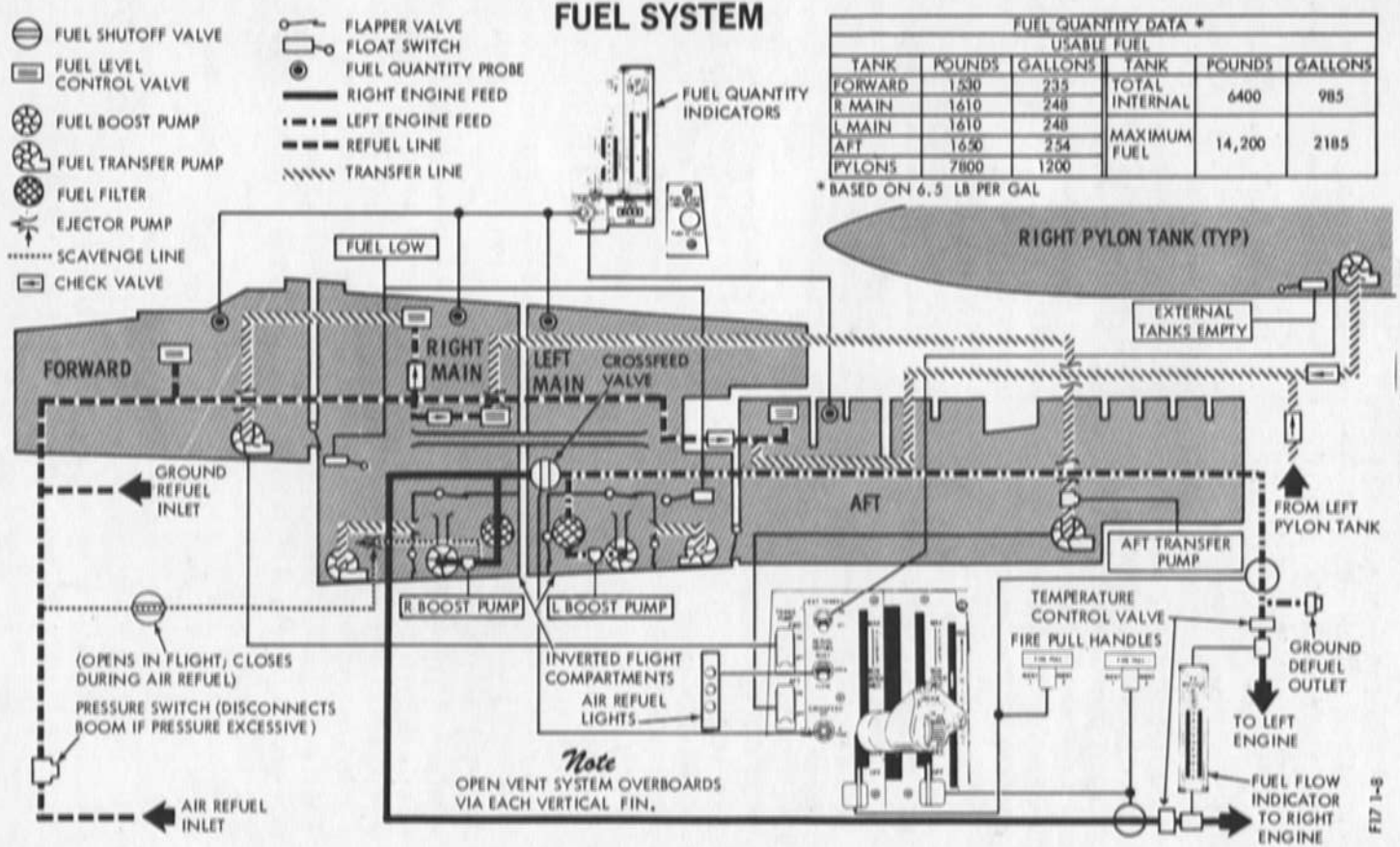
FIRE WARNING AND EXTINGUISH SYSTEM

The fire warning and extinguish system provides engine and accessory gearbox compartment fire detection and extinguishing capability. Two pneumatic heat sensing elements attached to each engine (forward and aft) and one element mounted in each gearbox compartment can detect a fire signal from any element to illuminate fire warning lights (red) in respective FIRE PULL handles on the instrument panel (figure 1-3). Pulling the handle closes the fuel shutoff valve to the engine and arms the extinguishing system. Two fire extinguisher agent bottles provide a "two-shot" capability to the compartments on one side or "one-shot" for each side. When the FIRE PULL handle is pulled, the agent discharge switch under each handle is accessible. AGENT 1 position under either handle fires the left bottle; AGENT 2 fires the right bottle. If a fire in one engine and accessory compartment is not extinguished by using the first bottle, then the second bottle can be used to extinguish a fire in the same compartment; however, once both bottles are expended, no fire protection is available. Momentary positioning of an agent discharge switch to either bottle will discharge the entire contents.

FUEL SYSTEM

Approximately 6400 lb of usable internal fuel is carried in four fuselage bladder type tanks. See figure 1-9 for location and capacities. External tanks (600 gal each), are carried on the inboard wing pylons. JP-4 fuel is supplied to each engine from a respective main tank and feed system consisting of an inverted flight compartment, boost pump, strainer, and shutoff valve. Crossfeed from either the left or right main tanks can be accomplished by use of the crossfeed switch on the left console (figure 1-4). Shutoff valve operation is normally controlled by the throttle(s) during ground operation only. In an emergency (ground or in flight), the valve can be closed by the fire pull handle(s) on the instrument panel (figure 1-3). If both boost pumps are inoperative, sufficient fuel will gravity feed to maintain both engines at intermediate power from sea level to 25,000 ft; flameout may occur above 6000 ft during augmented thrust operation.

FUEL SYSTEM



FUEL QUANTITY DATA *					
USABLE FUEL					
TANK	POUNDS	GALLONS	TANK	POUNDS	GALLONS
FORWARD	1530	235	TOTAL INTERNAL	6400	985
R MAIN	1610	248			
L MAIN	1610	248	MAXIMUM FUEL	14,200	2185
AFT	1650	254			
PYLONS	7800	1200			

*BASED ON 6.5 LB PER GAL

Figure 1-9.

NORTHROP F-17 SENSITIVE

NOTE

Select crossfeed below 40,000 pph fuel flow rate. Flow rates above 40,000 pph will allow possible contaminated fuel strainer bypassed fuel to enter engine fuel control system.

Fuel transfer between internal tanks is automatic during normal operation of the system. Flight test transfer pump switches on the left console (figure 1-4) provide separate control of the forward and aft tank transfer pumps. During automatic transfer, the forward tank transfers first into the main tanks. After the forward tank empties, the aft tank transfers fuel after a 700 lb fuel level drop in the main tanks. The left and right main tanks are interconnected by a transfer tube at the 1800 lb fuel remaining level (900 lb each tank). Final fuel feed is from the individual main tanks.

If the forward transfer pump fails (no caution light), automatic gravity feed to the right main tank will not occur as the fuel level in main tanks decreases due to the gravity flow flapper valve being plugged for initial flight test purposes. However, provision for plug removal during subsequent flight tests will allow gravity flow in the event of transfer pump failure. If the aft transfer pump fails, a caution light on the pedestal (figure 1-6) will illuminate. Gravity feed to the left main tank is delayed until the fuel level in main tanks drops below the interconnect transfer tube. To assist gravity transfer of aft tank fuel, select crossfeed from the left main tank and reduce power to obtain a total fuel flow rate of 6000 pph or less.

A vent inlet-outlet in each vertical tail provides for venting tank pressure during refueling and flight. Total internal usable fuel is displayed in the digital counter on the instrument panel. A fuel quantity selector switch for the left/right main tanks and forward/aft transfer tanks, and a vertical dual-tape quantity indicator are on the instrument panel (figure 1-3). A caution light for a fuel low-level of 375 lb in either main tank and caution lights for either boost pump inoperative are on the pedestal (figure 1-6). A fuel and oxygen push-to-test button on the right console (figure 1-5) provides fuel quantity indicator and fuel remaining counter function check by driving the indicators toward zero. The dual tapes should stop at 1000 lb; counter at 2000 lb. When released, the indications return to onboard quantities. If electrical power is removed from the system, the tapes and counter will display an OFF flag.

Transfer of both wing pylon tank fuel to the aft tank is accomplished by a transfer pump in each external tank. An external tank transfer switch is provided on the left console (figure 1-4). An external tanks empty light on the instrument panel (figure 1-3) will illuminate when the pylon tanks are empty.

AIR REFUELING

Air refueling of the internal fuel system is provided thru a receptacle located forward of the windshield. The receptacle door is retracted when the air refuel switch on the left console is positioned at OPEN. A blue "ready" light in the air refuel indicator panel on the right of the HUD display (figure 1-3) will illuminate when the door is fully opened and the receptacle is ready to receive the refueling boom nozzle. The blue light will go off and a green light will illuminate when the boom nozzle is "latched" in the receptacle. A yellow indicator light will come on and the green will go off to signal "disconnected." Floodlights in the receptacle automatically come on with the door open to provide illumination for cloudy or night operation.

Boom disconnect can occur by various methods during refueling. The receiver can disconnect by normal use of the air refuel disconnect switch on the control stick grip (figure 1-13). The tanker can disconnect the boom by an electrical signal thru the boom nozzle. Automatic disconnect occurs if the boom is displaced outside the tanker/receiver air refuel envelope limits, or if nozzle refueling pressure is too high. Brute force disconnect can be achieved by the receiver advancing position to compress the telescoping boom, then reducing power. When the boom reaches its extension limit, disconnect should occur. The tension force required to achieve brute force disconnect is greater than 4800 lb. To resume refueling after a premature disconnect, momentarily position the air refuel switch at RESET to restore the automatic cycle sequence to the "ready" position. The yellow "disconnect" light will illuminate when the boom nozzle is unlatched from the receptacle and remains on until the door is closed.

The gun bay purge system will be automatically activated whenever the receptacle door is opened to vent any fumes or fuel spillage from the gun compartment. An ejector pump in the system scavenges fuel from the air refuel line into the right main tank. The pump is operated by a small amount of fuel bled from the right system fuel boost pump.

NOTE

External tanks are not capable of being air refueled.

ELECTRICAL SYSTEM

Two 20/24 KVA, 115/200 VAC, 3-phase, 320-500 Hz oil-cooled generators, driven by the accessory gear drivebox of each engine, supply ac power to respective left and right systems. One generator is capable of automatically assuming both ac system power loads if the other generator fails or is turned OFF. External ac power for ground operation is supplied thru an external receptacle. DC power is supplied by two 50-amp, 26-32 VDC transformer-rectifiers (TR) and a 24-VDC, 6 amp-hr rechargeable battery. Each respective TR converts ac power to dc power; if one TR fails, the other will continue to supply all essential dc power requirements. Battery and generator switches are located on the right console (figure 1-5). Each generator switch has a RESET position to allow restoration of generator power if tripped "off-line". Generators cut-in individually when each engine reaches approximately 65% N2 rpm and remain "on-line" at engine idle power. Generator caution lights on the pedestal (figure 1-6) will illuminate if the generators are not operating. See figures 1-10 and 1-11 for system power distribution.

EMERGENCY POWER SUPPLY

Emergency electrical power is supplied by an additional 24-VDC, 3 amp-hr, nonchargeable (in aircraft) battery. This battery provides a direct source of dc power for operation of the hydrazine emergency power unit (EPU).

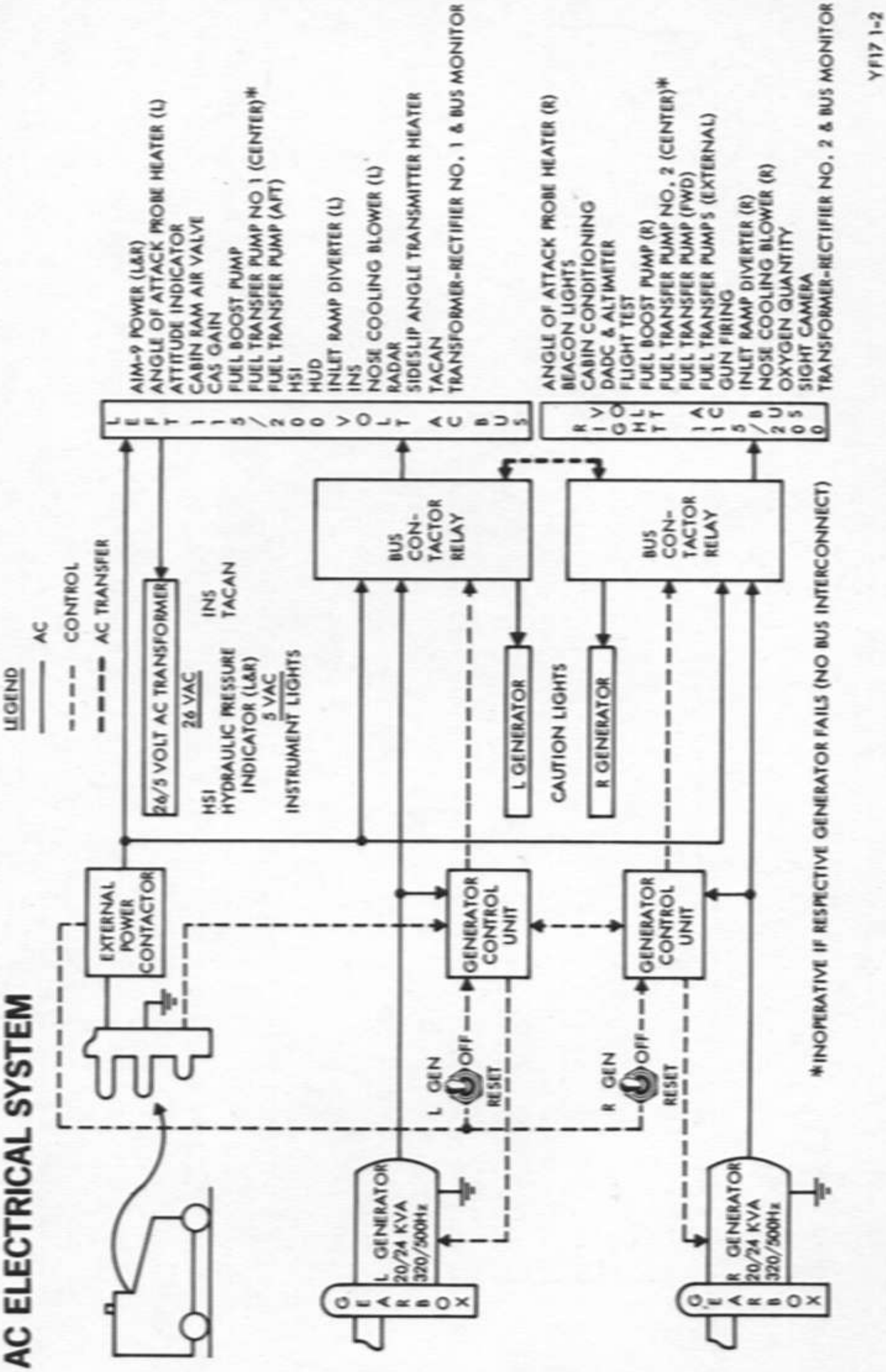

AC ELECTRICAL SYSTEM
LEGEND
AC
CONTROL
AC TRANSFER
26/5 VOLT AC TRANSFORMER
26 VAC
HSI
HYDRAULIC PRESSURE INDICATOR (L&R)
INS
TACAN
5 VAC
INSTRUMENT LIGHTS
EXTERNAL POWER CONTACTOR
GENERATOR CONTROL UNIT
GENERATOR CONTROL UNIT
BUS CON-TACTOR RELAY
BUS CON-TACTOR RELAY
L GENERATOR
CAUTION LIGHTS
R GENERATOR
L GEN
OFF
RESET
R GEN
OFF
RESET
L GENERATOR 20/24 KVA 320/500Hz
R GENERATOR 20/24 KVA 320/500Hz
GEARBOX
GEARBOX
LEFT 115/200 VOLT AC BUS
RIGHT 115/200 VOLT AC BUS
AIM-9 POWER (L&R)
ANGLE OF ATTACK PROBE HEATER (L)
ATTITUDE INDICATOR
CABIN RAM AIR VALVE
CAS GAIN
FUEL BOOST PUMP
FUEL TRANSFER PUMP NO 1 (CENTER)*
FUEL TRANSFER PUMP (AFT)
HSI
HUD
INLET RAMP DIVERTER (L)
INS
NOSE COOLING BLOWER (L)
RADAR
SIDESLIP ANGLE TRANSMITTER HEATER
TACAN
TRANSFORMER-RECTIFIER NO. 1 & BUS MONITOR
ANGLE OF ATTACK PROBE HEATER (R)
BEACON LIGHTS
CABIN CONDITIONING
DADC & ALTIMETER
FLIGHT TEST
FUEL BOOST PUMP (R)
FUEL TRANSFER PUMP NO. 2 (CENTER)*
FUEL TRANSFER PUMP (FWD)
FUEL TRANSFER PUMPS (EXTERNAL)
GUN FIRING
INLET RAMP DIVERTER (R)
NOSE COOLING BLOWER (R)
OXYGEN QUANTITY
SIGHT CAMERA
TRANSFORMER-RECTIFIER NO. 2 & BUS MONITOR
*INOPERATIVE IF RESPECTIVE GENERATOR FAILS (NO BUS INTERCONNECT)
YF17 1-2

Figure 1-10.

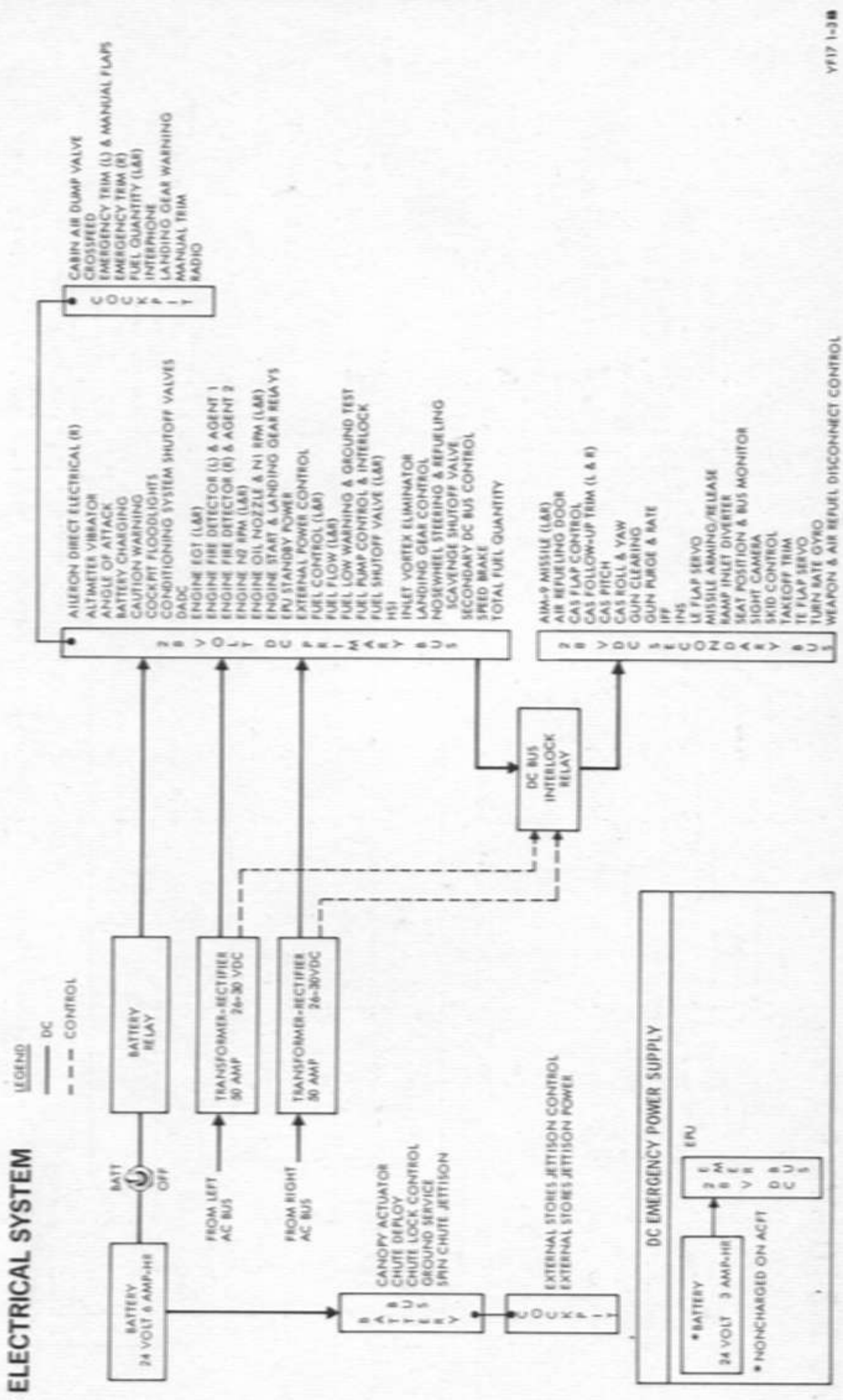

DC ELECTRICAL SYSTEM
LEGEND
DC
CONTROL
BATTERY 24 VOLT 6 AMP-HR
BATT
OFF
BATTERY RELAY
FROM LEFT AC BUS
TRANSFORMER-RECTIFIER 50 AMP 26-30 VDC
FROM RIGHT AC BUS
TRANSFORMER-RECTIFIER 50 AMP 26-30VDC
BATTERY BUS
CANOPY ACTUATOR
CHUTE DEPLOY
CHUTE LOCK CONTROL
GROUND SERVICE
SPIN CHUTE JETTISON
COCKPIT
EXTERNAL STORES JETTISON CONTROL
EXTERNAL STORES JETTISON POWER
DC EMERGENCY POWER SUPPLY
*BATTERY 24 VOLT 3 AMP-HR
EPU
28V EMER DC BUS
* NONCHARGED ON ACFT
DC BUS INTERLOCK RELAY
28 VOLT DC PRIMARY BUS
AILERON DIRECT ELECTRICAL (R)
ALTIMETER VIBRATOR
ANGLE OF ATTACK
BATTERY CHARGING
CAUTION WARNING
COCKPIT FLOODLIGHTS
CONDITIONING SYSTEM SHUTOFF VALVES
DADC
ENGINE EGT (L&R)
ENGINE FIRE DETECTOR (L) & AGENT 1
ENGINE FIRE DETECTOR (R) & AGENT 2
ENGINE N2 RPM (L&R)
ENGINE OIL, NOZZLE & N1 RPM (L&R)
ENGINE START & LANDING GEAR RELAYS
EPU STANDBY POWER
EXTERNAL POWER CONTROL
FUEL CONTROL (L&R)
FUEL FLOW (L&R)
FUEL LOW WARNING & GROUND TEST
FUEL PUMP CONTROL & INTERLOCK
FUEL SHUTOFF VALVE (L&R)
HSI
INLET VORTEX ELIMINATOR
LANDING GEAR CONTROL
NOSEWHEEL STEERING & REFUELING
SCAVENGE SHUTOFF VALVE
SECONDARY DC BUS CONTROL
SPEED BRAKE
TOTAL FUEL QUANTITY
COCKPIT
CABIN AIR DUMP VALVE
CROSSFEED
EMERGENCY TRIM (L) & MANUAL FLAPS
EMERGENCY TRIM (R)
FUEL QUANTITY (L&R)
INTERPHONE
LANDING GEAR WARNING
MANUAL TRIM
RADIO
28 VDC SECONDARY BUS
AIM-9 MISSILE (L&R)
AIR REFUELING DOOR
CAS FLAP CONTROL
CAS FOLLOW-UP TRIM (L & R)
CAS PITCH
CAS ROLL & YAW
GUN CLEARING
GUN PURGE & RATE
IFF
INS
LE FLAP SERVO
MISSILE ARMING/RELEASE
RAMP INLET DIVERTER
SEAT POSITION & BUS MONITOR
SIGHT CAMERA
SKID CONTROL
TAKEOFF TRIM
TE FLAP SERVO
TURN RATE GYRO
WEAPON & AIR REFUEL DISCONNECT CONTROL
YF17 1-38

Figure 1-11.

LIGHTING SYSTEM

Exterior lighting consists of only the rotating beacon light installed in each vertical tail. Interior lighting consists of only two cockpit floodlights mounted aft in the cockpit, and the engine group and hydraulic system indicators. The beacon light switch and cockpit lighting switch are located on the right console (figure 1-5).

WARNING, CAUTION, AND INDICATOR LIGHTS

Warning, caution, and indicator lights provide indication of failures, hazardous conditions, or systems status. A warning test switch on the right console (figure 1-5) when positioned at TEST will lamp check all the following lights.

NOTE

Refer to individual systems description, this section, for analysis operation of lights.

LIGHT	COLOR	LOCATION
ANGLE OF ATTACK INDEXER	RED (High) GREEN (Optimum) YELLOW (Low)	HUD
AERIAL REFUEL	BLUE (Ready) GREEN (Latched) YELLOW (Disconnect)	
IFF (Remote IP (Switch & Monitor)	YELLOW	

LIGHT	COLOR	LOCATION
FIRE WARNING (L & R Engine)	RED	INSTRUMENT PANEL
ARMAMENT POSITION INDICATOR/ SELECTOR SWITCHES (L & R Missile Launchers)	GREEN	
MASTER CAUTION	YELLOW	
CANOPY	RED	
SEAT NOT ARMED	RED	
ANTI-SKID	YELLOW	
EXTERNAL TANKS EMPTY	GREEN	
LANDING GEAR POSITION	GREEN (3)	
LANDING GEAR WARNING (Gear Lever)	RED	
EPU	GREEN	
CAUTION PANEL (21 Word Capsules)	YELLOW	PEDESTAL
ENGINE IGNITERS (L & R)	WHITE	L CONSOLE
CAS INDICATORS	YELLOW (BIT 1) GREEN (Go) RED (No Go)	
	WHITE (BIT 2)	
	GREEN (Takeoff Trim)	

MASTER CAUTION LIGHT

The master caution light will illuminate when a word capsule on the caution light panel comes on and will extinguish if the capsule light goes out. However, the master caution light may be extinguished by pressing the light assembly. This rearms the light to provide warning of subsequent malfunctions.

CAUTION LIGHT PANEL

Each word capsule caution light on the panel, when activated will remain on as long as a malfunction exists or system status remains unchanged. Caution lights will not go out if the master caution light is rearmed.

ENVIRONMENTAL CONTROL SYSTEM

The environmental control system (ECS) provides cockpit air-conditioning and pressurization, avionic equipment compartment cooling, canopy and windshield defogging, canopy seal pressurization, gun breech and gun compartment purging, anti-G suit pressurization, and emergency air ventilation of the cockpit. Fourth stage engine compressor bleed air from each engine is used to supply all conditioning air requirements; however, one engine is capable of operating the complete system. An external bleed air connection permits prolonged ground cooling operation of avionics equipment without the engines operating. Controls on the right console (figure 1-5) are provided for operation of cockpit pressurization, temperature, and defog air distribution. A torso outlet on each side of the cockpit (figure 1-2) provides directional flow of conditioned air and can be adjusted from shutoff to full flow by twisting the knurled outlet fitting. Cockpit pressure altitude is indicated by the cabin altimeter on the pedestal (figure 1-6). The cockpit is unpressurized up to 8000 feet. Cockpit pressure will hold equal to 8000 feet at altitudes up to 23,500 feet. Above 23,500 feet the system will maintain a 5 psig differential. A pressure safety valve in the system automatically protects the cockpit from high and low pressures.

HYDRAULIC SYSTEMS

Hydraulic power is supplied by two independent left and right systems (see figure 1-12 for power distribution). Constant-pressure variable-delivery piston pumps, driven by the respective left and right engine accessory gearbox drive assembly, provide each system with 3000 psi operating pressure. A pressurized reservoir supplies hydraulic fluid to each pump (2.5-gal. Left) (1.25-gal. Right). Both systems normally operate at all times while both engines are in operation. Hydraulic pressure monitoring is accomplished thru the pressure gages on the instrument panel (figure 1-3) and the caution lights on the pedestal (figure 1-6). Caution lights will come on when the respective system pressure drops to 1500 psi or less and will go out when system pressure of approximately 1800 psi is restored. Loss of either engine, either pump, or either fluid system will not cause loss of the powered flight controls; although a reduction of flight control effectiveness will occur.

EMERGENCY POWER UNIT

The hydrazine-fueled emergency power unit (EPU) in the fuselage nose is a self-contained system which operates a variable output (9 gpm) hydraulic pump to provide power to the right hydraulic system for flight control operation should engines flameout in flight. Automatic operation will occur in flight if both generators are "off-line" with the EPU switch on the left console (figure 1-4) positioned at AUTO. Operation is prevented on the ground with switch positioned at AUTO, except when aircraft weight is removed from the wheels. The EPU will operate regardless of generator loss sensing if positioned at ON during flight or on the ground; however, with engines in operation depletion of the hydrazine fuel will occur without affecting the aircraft hydraulic system. When activated, the EPU is capable of instant start and will provide approximately 7 minutes of total operation including multiple restarts. An emergency 28-vdc battery supplies electrical power for EPU operation. An EPU fuel quantity indicator on the instrument panel (figure 1-3) is provided to monitor available fuel supply. An EPU indicator light on the instrument panel (figure 1-3) will illuminate steady to indicate primary mode of operation. A blinking light indicates self-controlled back-up secondary mode of operation. The unit will provide full output power in either mode.

HYDRAULIC SYSTEM

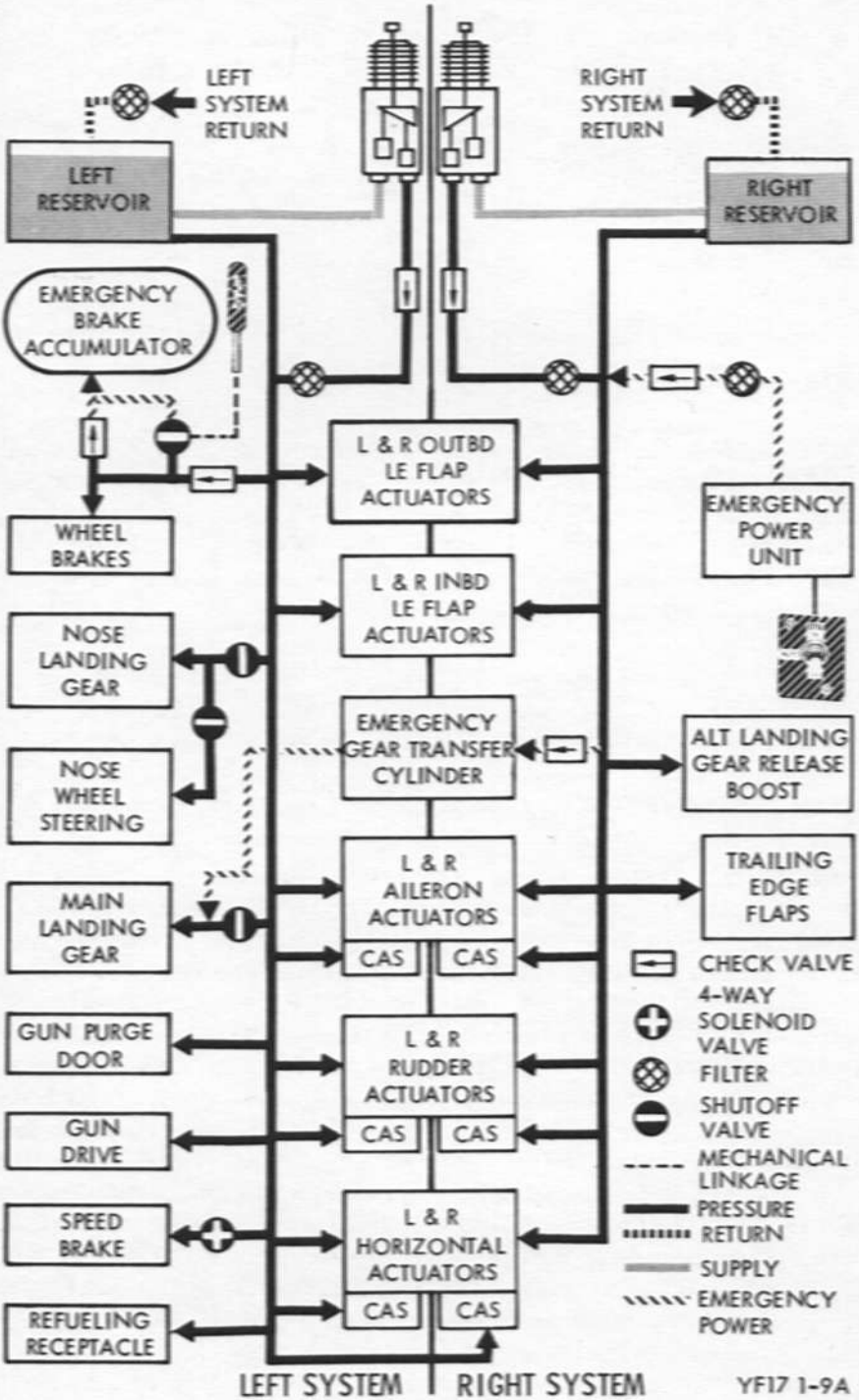


Figure 1-12.

NOTE

- If secondary operation mode is indicated in flight, make appropriate entry on postflight aircraft form for required service of unit before next flight.
- The EPU will provide reduced flight control effectiveness during emergency operation.
- Use of flaps during EPU operation should be avoided.

EMERGENCY HYDRAULIC SYSTEMS

Emergency hydraulic power to boost main landing gear extension is provided thru a transfer cylinder containing stored left system hydraulic fluid. The cylinder is powered by right hydraulic system pressure or the EPU, if in operation. Transfer cylinder activation occurs when the alternate landing gear extension procedure is used.

A separate emergency brake accumulator with stored pressurized left hydraulic system fluid provides alternate wheel braking power and is activated during emergency wheel brake procedure.

LANDING GEAR SYSTEM

The landing gear system provides normal extension and retraction of gear, alternate extension, normal and emergency brake operation, and nosewheel steering. Retraction and extension of gear is accomplished thru left hydraulic system power controlled electrically by the landing gear lever on the instrument panel. Normal braking power is supplied by the left hydraulic system and controlled by the brake pedals. Nosewheel steering is hydraulically powered by the left hydraulic system, electrically engaged by the nosewheel steering button on the control stick (figure 1-13), and directionally controlled by the rudder pedals. Retraction and extension time of the gear is approximately 5 seconds. Main gear are held in retracted position by individual uplocks hydraulically actuated. The nose gear uplock is contained within the gear drag-brace mechanism. All gears are locked in the down position by spring-loaded overcenter downlocks. Three green lights, a red warning light, and an audible signal heard thru the headset are provided to indicate when the landing gear is in a safe or unsafe position.

In flight, the red warning light in the gear lever will come on and an audible warning signal will sound any time the landing gear is not extended and locked, aircraft below 10, 000 ft (±250), airspeed less than 200 KIAS (±5), and either or both throttles below 90% N2 RPM. The warning signal may be silenced by pressing the warning signal silence button adjacent to the gear lever. The three green lights indicate safe extension and locking of the gear and the red light in the lever will go out.

With the weight of the aircraft on the struts and the gear lever in the down position, a locking solenoid is deenergized to prevent the lever from being moved out of LG DOWN position. If the locking solenoid fails to release the gear lever from LG DOWN, as on takeoff, the downlock override button adjacent to the gear lever should be pressed and held to allow the gear lever to be raised to LG UP position.

LANDING GEAR ALTERNATE EXTENSION

The alternate release D-handle to the left of the instrument panel (figure 1-3) permits gear extension with the landing gear control lever up or down. Pulling the handle operates a cable system which opens all the uplocks for gear free fall and opens the main gear emergency power valve. The main gear is forced to the down position by right system hydraulic pressure against stored left hydraulic system fluid. The nose gear is lowered by aerodynamic loads and locked by springs.

EMERGENCY WHEEL BRAKES

Pulling the emergency brake lever on the left console (figure 1-4) opens an emergency brake power valve which allows pressurized hydraulic oil from the emergency brake accumulator to flow to the brake metering valve. Brakes are then controlled in the normal manner by the brake pedals. Approximately 10 full pedal applications are available. Anti-skid control is inoperative when using emergency braking.

ANTI-SKID SYSTEM

The anti-skid control system provides brake pressure control to prevent prolonged wheel skids, tire damage, and anti-skid failure detection. The system operates when the landing gear is on the

ground at ground speeds above 15 kt. Under 15 kt the aircraft is controlled by manual braking only and the anti-skid is inoperative. The system uses wheel deceleration to detect skids; skids on one wheel cause brake pressure to be modulated to both wheels for maximum directional control. To turn off the system, pull the emergency brake lever on the left console (figure 1-4).

NOTE

The emergency brake system will not be affected if the left hydraulic system is functioning.

An anti-skid caution light (yellow) on the instrument panel (figure 1-3) will illuminate if the system is turned off or malfunctions.

FLIGHT CONTROL SYSTEM

Ailerons, horizontal tail, and rudders are positioned by dual-hydraulic closed-loop actuators. All primary flight control surfaces utilize control augmentation system (CAS). CAS hydraulic actuators are integrally attached to the control surface hydraulic actuators. If either hydraulic system malfunctions, hydraulic power to the flight control system will continue to be available. If both hydraulic systems fail, as in dual-engine flameout, EPU operation will power the flight controls. Both rudders, both horizontal tails, rolling tail, and the right aileron will be available under this condition.

WARNING

If left hydraulic system fails, position PITCH CAS switch to OFF.

PITCH CONTROL

Pitch control is thru conventional cable and push-pull rods to the hydraulically-actuated, all-movable horizontal tail which is capable of operation with CAS on or off. CAS provides relatively constant stick force per-g throughout the flight envelope as programmed response to airspeed and altitude based on data computed by the DADC. Control to the surface actuator is a dual-mechanical system. Left and right horizontal tail surfaces are independently controlled to permit differential deflection for rolling tail control. The interface elements in the mechanical system for CAS are the dual command sensor operated directly by the control stick, the CAS servos integrated in each dual hydraulic surface actuator, and the CAS follow-up actuator in series with the control linkage.

CONTROL STICK

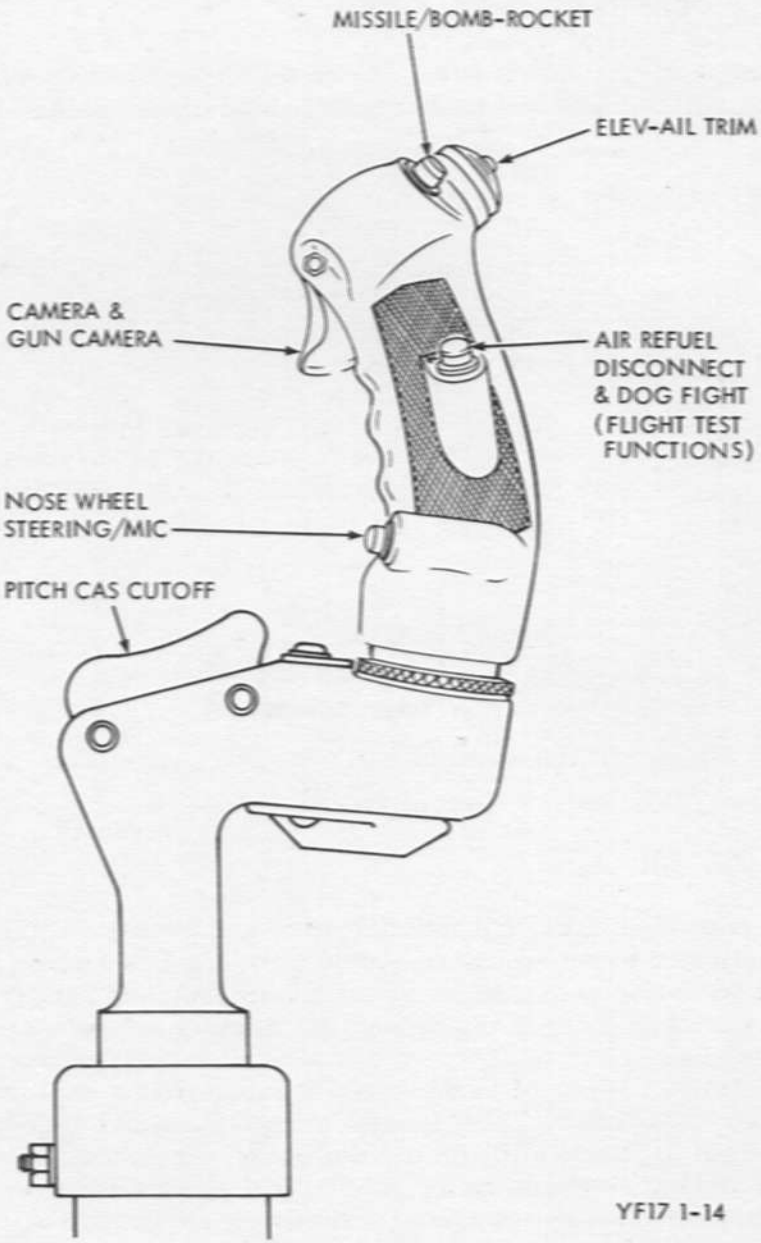


Figure 1-13.

The CAS follow-up actuator functions as an automatic slow speed trim for the system to reduce the steady state error in the CAS command. The CAS follow-up actuator (6° trailing edge up; 3° down) uses dual actuators in series with separate circuits and controls to minimize out-of-trim condition that can occur from a failure. The follow-up actuator is automatically positioned to neutral and deactivated upon extension of the landing gear. Any electrical failure in the pitch system will cause reversion to a degraded CAS mode or an unaugmented, mechanical mode of operation. An automatic series trim input (no stick movement) is effected with the incorporation of a mechanical interconnect between the trailing edge flaps and the pitch control system. Parallel pitch trim during flight is controlled by forward and aft use of the trim button on the control stick grip (figure 1-13). Trim authority is 3° trailing edge up to 2° down.

ROLL CONTROL

Ailerons are controlled by a direct electrical (DE) control signal from the control stick to the aileron CAS actuators and a model-following roll rate command system. The DE control of the roll axis provides a signal from the control stick thru a function generator. The CAS provides a roll rate gyro signal and a signal from the control stick thru the function generator to an electronic model. The difference between the latter two CAS signals provides an error signal. The gain of this error signal is scheduled as a function of compressible dynamic pressure. The DE and CAS drive the respective left and right CAS actuators and actuator models. The input command to each actuator is adjusted by two functions supplied by the DADC which control each side of limiters which limit CAS actuator travel, and in turn, aileron deflection. Maximum travel is 35° up and 25° down.

Failure of the DADC will automatically limit aileron travel to 17° up and 13° down and will switch off the scheduled portion of the error gain, leaving it at a nominal value. Detection of a failure will shut off the CAS leaving the roll axis with the DE control plus the rolling tail. Failure of either the left or right aileron dual-channel DE will shut off the DE to the respective aileron. Monitoring is also provided between the CAS actuators and actuator models to detect a failure in a CAS actuator. Such a failure will cause the actuator to return to neutral. The roll axis uses two electrical power supplies. The roll/yaw power supply provides power to the

roll CAS, one-half the DE, one CAS actuator, and one actuator model. The maneuvering flap control power supply provides power to the other half of DE, the other CAS actuator and other actuator model. A failure in either power supply will affect the respective powered controls.

During dual-engine flameout the aircraft battery will power the secondary (CAS) right aileron actuator and EPU operation will supply right hydraulic system pressure to power the right aileron actuator (left aileron CAS actuator which controls movement of the left aileron actuator is powered only by the left hydraulic system). Aileron trim during flight is controlled by lateral use of the trim button on the control stick grip (figure 1-13).

YAW CONTROL

Dual hydraulically-powered rudders are operated by a single cable system connected from the rudder pedal control mechanism to the aft cable quadrant. This quadrant operates left and right rudder servo valves thru load limiters and pushrod linkages. A centering spring attached to the servo linkage will center the rudder should the linkage become disconnected. Each rudder actuator is a dual hydraulic actuator with an integrated CAS hydraulic actuator. Yaw control augmentation consists of a yaw rate gyro, a lateral accelerometer signal, and a signal from the product of angle of attack and roll rate gyro signals. These signals plus dynamic pressure inputs from the DADC are processed by the CAS system to determine rudder positioning during flight. Failure of the DADC will switch off the schedule portion of the yaw rate gain leaving it a nominal value, and sets the lateral accelerometer and the angle of attack/roll rate signals to zero. Aileron/rudder interconnect (ARI), and stick/rudder interconnect also provide signals from each aileron and lateral control stick to the CAS actuators. These signals are modified by DADC functions of angle of attack and Mach number. In case of DADC failure, a back-up system replaces the DADC functions with functions of horizontal tail and trailing edge flaps. Maximum rudder deflection in manual mode is 30° either side of neutral. In CAS mode, maximum rudder deflection is 15° either side of neutral; however, the amount of deflection during flight is a function of dynamic pressure force (q) on the rudder surface and varies with airspeed, altitude, and angle of attack. Trim control is provided by a rudder trim knob on the CAS control panel in the left console (figure 1-4).

FLIGHT CONTROL CAUTION LIGHTS

The following flight control caution lights on the pedestal (figure 1-6) will illuminate when the respective controls are affected.

PITCH CAS — When significant discrepancy errors between monitored electronic channels of the pitch CAS or CAS servo actuator that a failure exists. The servo actuator will quickly center and the follow-up trim actuator will freeze its position. The TRIM FOLLOW-UP caution light will simultaneously illuminate to indicate that the follow-up trim actuator is inoperative. The system will revert to mechanical operation.

NOTE

With left hydraulic system failure, the pitch CAS actuator will center; however, the PITCH CAS and TRIM FOLLOW-UP caution lights will remain off. The follow-up trim actuator remains inoperative.

TRIM FOLLOW-UP — Indicates failure of follow-up trim actuator system. Actuator will freeze at attained position. The PITCH CAS caution light will not illuminate.

ROLL CAS — Indicates that the roll CAS signal has been switched off to both ailerons. This will result in no roll-rate command-model following and no roll rate damping from the roll rate gyro (dutch roll damping due to yaw CAS will remain in operation). DE aileron control will remain available to provide maximum aileron deflections of 17° up and 13° down. Limits below these maximums are programmed by the DADC dependent upon airspeed. Rolling tail will still be available.

YAW CAS — Indicates that yaw CAS signal has been switched off to both rudders. This will result in no yaw rate damping from yaw rate gyro, no lateral accelerometer signal, and no angle of attack vane times roll rate signal. Manual control of rudders remains available thru the rudder pedals. Rudders will still respond to ARI and SRI signals.

L RUDDER — Indicates left rudder CAS actuator disengaged and centered. Rudder will not respond to yaw CAS, ARI, or SRI. Manual control of rudder remains available thru rudder pedal. All functions thru the right rudder remain operative.

R RUDDER — Indicates same as above for left rudder. Left rudder functions remain operative.

L AILERON — Indicates that the left aileron CAS actuator has disengaged and centered to zero deflection. Control of left aileron is rendered inoperative; however, roll CAS and DE remain available to the right aileron.

R AILERON — Indicates deactivation of right aileron in same manner as that of left aileron, above. Left aileron remains operative in same manner as above.

ARI — Indicates four possible situations, as follows:

1. Either the left or right SRI system has failed. Each SRI system normally goes to both rudders and if the left or right SRI system fails, that SRI system is switched off to both rudders. This leaves one-half of the SRI signals, so the rudders only deflect one-half of what the normal deflection would be due to SRI.

2. Either the left or right channel of the ARI has failed. Normally the ARI signals from each aileron go to both rudders so that if one channel fails, that channel is switched out to both rudders. The aileron CAS actuator in the failed channel (left or right) is disengaged and centered; therefore, DE control to that aileron is lost. The appropriate aileron caution light will illuminate. The aileron not affected remains operational.

3. A DADC no/go condition exists. This will result in the backup ARI being switched on. The air data computer caution light may not illuminate.

4. A failure has occurred in the backup ARI calculation although backup ARI has not been switched on.

FLIGHT CONTROL AUGMENTATION SYSTEM

The CAS automatically dampens pitch, roll, and yaw oscillations during flight to provide smooth control inputs programmed to allow safe and stable flight thru all flight regimes. Functions of the CAS are covered in description of the individual flight controls.

CAS CONTROLS

The CAS PITCH, ROLL, and YAW switches are located on the CAS control panel in the left console (figure 1-4). Each switch will disengage the corresponding CAS. A pitch CAS cutoff switch on the control stick (figure 1-13) when depressed, provides quick disengagement of the pitch CAS actuators in the event of system malfunction.

An EMERGENCY PITCH (follow-up) TRIM double-throw, spring-loaded-to-center switch on the control panel provides nose down (NS DN) or nose up (NS UP) pitch servo trim.

A TAKEOFF TRIM pushbutton indicator light switch on the control panel, when depressed and held while on the ground, will set zero takeoff trim when the light illuminates (green).

Self-Test Procedures (CAS BIT)

A self-test (BIT) capability is provided thru use of pushbutton indicator switches. The BIT 1 push-to-test switch, when depressed, will light (yellow) indicating test in progress. The BIT computer will sequence a programmed procedure until a GO (green) or NO GO (red) instruction on the same switch is encountered. If a "wait" condition occurs, the BIT 2 pushbutton switch will light (white) and remain on until the switch is depressed. If a NO GO condition is encountered during the sequence, the NO GO light (on BIT 1 switch) will illuminate and test will terminate. At the pilot's discretion, BIT may be commanded to proceed by depressing the BIT 2 pushbutton but this will not extinguish the NO GO light. Either the GO or NO GO light must be illuminated at the end of a normal test sequence. Self-test procedure requires approximately 2 minutes to complete. At end of test, depressing BIT 1 switch will turn the system "off."

NOTE

If NO GO light is encountered, ground maintenance check of system for fault analysis should be accomplished before continuing operation.

A typical BIT sequence is as follows:

1. Press BIT 1 pushbutton.

2. In approximately 1.5 minutes the BIT 2 pushbutton indicator light will illuminate. Perform the following functions:

   a. Select EMERG UP position of flaps mode switch.

   b. Engage YAW, ROLL, PITCH CAS switches.

   c. Press BIT 2 pushbutton.

3. The BIT 2 pushbutton will restart BIT sequence. The BIT 2 indicator light will go out, the caution lights associated with CAS will be out, and each control surface will complete two full cycles.

4. The time from depressing the BIT 2 pushbutton until test is complete is less than 20 seconds. At the conclusion of a successful BIT, the GO light on the BIT 2 pushbutton will illuminate.

5. BIT is completed by depressing the BIT 1 pushbutton again. This will deactivate BIT and extinguish all lights.

NOTE

The pilot's attention is not required for BIT except for the operations performed in step 2, above.

6. Should the BIT detect a failure, the NO GO light on the BIT 1 pushbutton will illuminate. This signifies that the control system is not safe to fly and maintenance should be consulted.

7. The BIT system does perform takeoff trim (TOT) function. However, the pilot must verify proper TOT by depressing the TOT pushbutton. If the pitch parallel trim servo, the two pitch series servos, and the roll series trim signal are in their proper condition or state, the TOT pushbutton will illuminate. The light will remain for 2 seconds after the TOT pushbutton is released.

WING FLAP SYSTEM

The leading edge (LE) and trailing edge (TE) flaps may be used for all phases of flight below 450 KIAS and are capable of automatic operation with DADC control as maneuvering flaps as a function of angle of attack and Mach number. The leading edge (LE) flaps are powered by both hydraulic systems; TE flaps by the right system only. In the event of right hydraulic system failure, the TE flaps will lock in a faired position. Mechanical interconnection, between left and right servo valves assure symmetric flap control. The TE flaps are mechanically interconnected with the horizontal tail to minimize trim changes. An asymmetric detection system will shut down the flap drive system if normal asymmetry limit is exceeded. During normal system flap operation, the LE and TE flaps cannot be independently operated.

FLAP CONTROLS/INDICATORS

Flaps Mode Switch

The FLAPS mode switch on the left console (figure 1-4) provides for selection of NORMAL, FLT TEST, or EMERG UP modes of operation of the wing flap system. NORMAL position allows control of the flaps thru use of the flaps thumb switch on the master throttle (figure 1-8). FLT TEST position reverts operation of the flaps to selective test operation; LE and TE switches on the instrument panel (figure 1-3). The EMERG UP position is provided to allow emergency retraction of flaps in the event of systems malfunction. Selection of this position will override either the flap thumb switch or flight test switch positioning of flaps.

Flap Thumb Switch

The flap thumb switch on the master throttle (figure 1-8) provides selection of DOWN, AUTO, and UP positions of the LE and TE flaps. AUTO permits flaps operation to be DADC controlled as maneuvering flaps.

Flap Position Indicator

The flap position indicator on the instrument panel (figure 1-3) provides symbolic position indication during normal mode of operation. The indicator will display a barber pole to indicate the flaps in transition to a newly selected position or DADC failure, DN for full down, UP for full up, and A for automatic maneuvering flap.

Flight Test Flap Switches

The individual LE and TE flap switches on the instrument panel (figure 1-3), when enabled by flap mode switch FLT TEST selection, provide for test positioning of the individual flaps. A dual-pointer indicator above these switches indicates selected flap settings in degrees of travel.

Caution Light

The FLAPS caution light on the pedestal (figure 1-6) will illuminate if the flap electrical system or DADC fails. In case of failure of the DADC or maneuvering flap electrical power supply, the LE flap will be held in the position at which the failure occurred.

SPEED BRAKE

The electrically-controlled variable-position type speed brake located on the upper aft fuselage between the vertical tails is controlled by the speed brake switch on the master throttle (figure 1-8) and is powered by the left hydraulic system. Positioning the switch aft opens the speed brake (OUT); forward closes

speed brake (IN). The center position closes a solenoid valve to permit intermediate speed brake positioning. Full extension is 60°. At high airspeed, air loads will prevent full extension of the speed brake.

NOTE

Speed brake on AF72-1570 will be removed to allow installation of a spin recovery parachute during a scheduled flight test event. Refer to section IV for spin chute description and operation.

EJECTION SEAT

The SIIIS-3 ballistic-initiated, rocket-powered, DART and drogue parachute stabilized ejection seat provides zero-zero and high altitude/airspeed escape capability. The man/seat connections are designed for use of the PCU-15/P pilot torso harness. Incorporated into the seat is a modified survival kit (RALSA) containing a survival package, emergency locator beacon (AN/URT-33), emergency oxygen bottle, safety belt, and contoured seat pad. A non-adjustable headrest contains the main parachute canopy and risers. Barometric and airspeed sensors, mounted on the right side of the seat structure, determine system mode of operation. The modified C-9 canopy parachute is equipped with a pilot chute and ballistic spreader. A drogue chute is housed in a container in the rear of the headrest. The seat features a ground safety control handle prominently located on the right side of the seat to arm or safe the seat. When the safety control handle in extended (safe) position a red warning light on the instrument panel will be illuminated to indicate that the seat is in safe position. Canopy piercers above the aircraft seat supports are designed to pierce upward and then rotate rearward to initiate fractures in the canopy if it fails to jettison. A "spanker" plate across the top of the headrest will propagate canopy glass fractures as the seat rises.

A D-ring handle on the front of the seat bucket between the pilot's legs is used to initiate ejection. An emergency release handle on the right panel is used for manual override of the automatic sequencing systems to release the drogue and main parachute after ejection. Manual actuation of the survival kit deployment handle on the right side of the kit after man/seat separation will deploy the survival package. See figure 1-14 for location of all seat controls and equipment.

EJECTION SEAT

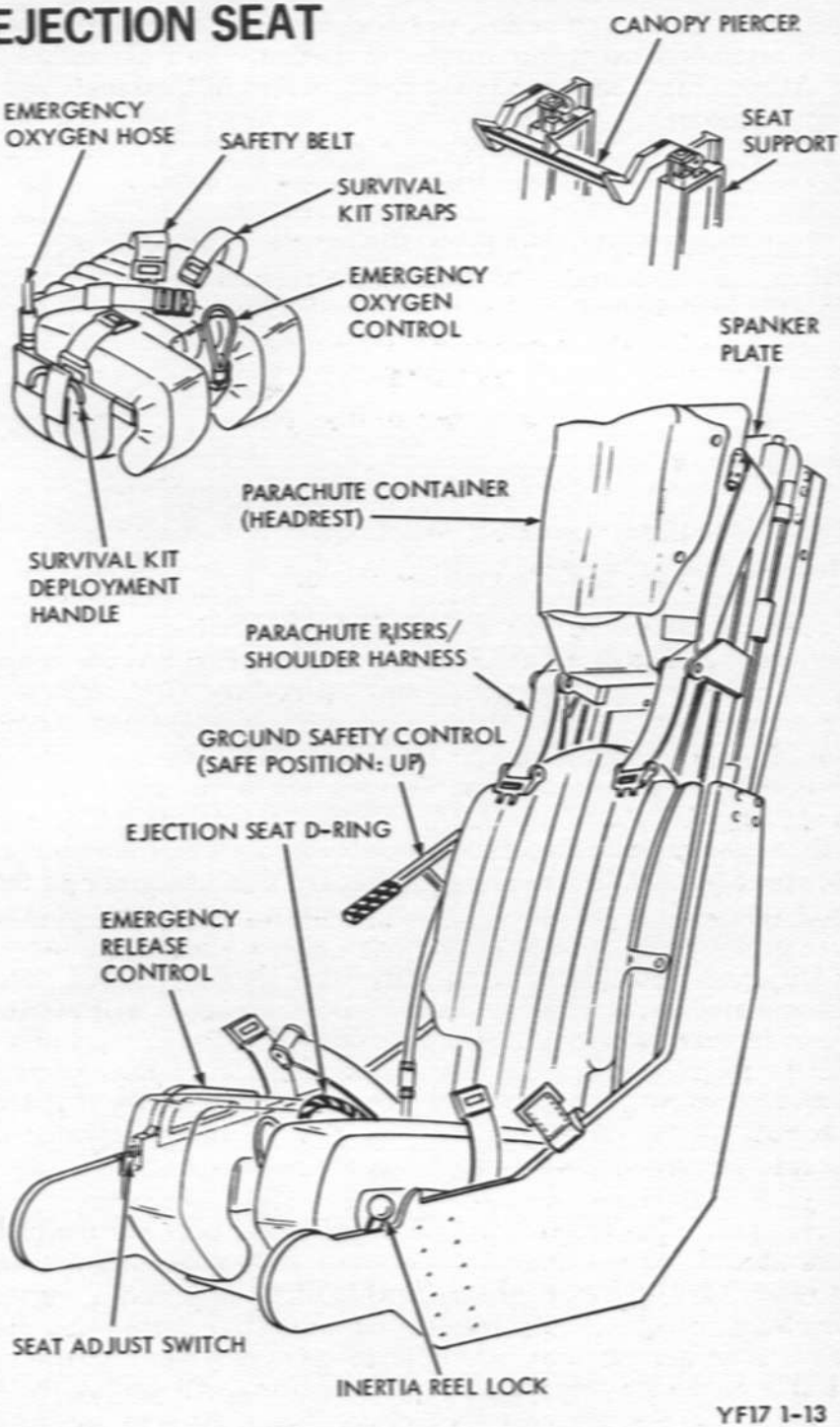


Figure 1-14.

OPERATION

Manual Egress

Over-the-side emergency egress while on the ground requires manual disconnect of all personal connections (parachute risers, survival kit, seat belt, G-suit, oxygen, and communication leads). The emergency release handle on the right seat brace when squeezed and pulled will only cut the shoulder harness reel strap and release the survival kit from the seat.

WARNING

- Do not pull emergency release control handle in flight (seat armed). This action will make it impossible to safely escape from the aircraft.
- If handle is pulled before ejection:
  a. Shoulder harness reel strap is cut.
  b. WORD motor is released and armed.
  c. Parachute container is opened and chute is released.
  d. Survival kit is released.

Automatic Sequence

The following table summarizes the events and times for four operating modes of seat ejection from initiation until the parachute container opens. Time for parachute container opening depends upon airspeed and altitude at the time of escape initiation. Upon parachute line stretch the spreader gun fires and the drag is sufficient to fire the man/seat release initiator. This severs the shoulder retention reel straps and releases the survival kit allowing the man and seat to separate. The four operating modes during seat ejection sequence are:

Mode 1 — Low Speed/Low Altitude; Below 225 ± 20 KT; Below 7000 Ft.

Mode 2 — High Speed/Low Altitude; Above 225 ± 20 KT; Below 7000 Ft.

Mode 3 — Intermediate Altitude; Between 7000 Ft and 14, 000 Ft.

Mode 4 — High Altitude; Above 14, 000 Ft.

EJECTION SEQUENCE

TIME (Sec)	MODE 1	MODE 2	MODE 3	MODE 4
0	Pull D-ring: shoulder harness retracts and locks, canopy jettisons, seat catapult ignition, ballistic time delay starts, airspeed sensing key removed to program seat mode.			
0.43	Emergency oxygen supply and locator beacon activated, drogue chute container projects.			
0.47	Catapult stroke completed. Seat back rockets (SBR) propel seat upward. Directional automatic realignment of trajectory (DART) system controls seat stabilization while leaving aircraft. 3.0, 0.10, and 1.20-sec delays start. (See Note.)			
0.57	0.10-sec delay fired. Drogue chute released. Parachute container opened.			
0.61	Wind Oriented Rocket Deployment (WORD) ignited. Parachute deployed.			
0.75	SRB burnout.			
0.90	WORD burnout. Parachute ballistic spread open.			
1.45	1.20-sec delay fired. If any component in low speed/low altitude mode fails, sequence continues as in Mode 2.	1.20-sec delay fired. 7000 FT aneroid armed and fired. Drogue chute released. Parachute container opened.	1.20 sec delay fires. armed.	7000 FT aneroid
1.47		WORD ignited. Parachute deployed.		
1.80		WORD burnout. Parachute ballistic spread open.		
3.46		3.0-sec delay fires. If any component in high speed/low altitude mode fails, sequence continues as in Mode 3.	3.0-sec delay fires. Drogue chute released. 14,000 FT aneroid armed and fired.	3.0-sec delay fires. Drogue chute released. 14,000 FT, aneroid armed.
3.48			WORD ignited. Parachute deployed.	WORD ignited. Seat/man re-oriented to "feet-to-wind" attitude.
3.70			WORD burnout. Parachute ballistic spread open.	

TIME (Sec)	MODE 1	MODE 2	MODE 3	MODE 4
----				Seat/man descends by drogue chute. At 14,000 FT, aneroid fires. Parachute container opens and chute deployment begins by pull of drogue chute.
----			If any component in the high altitude mode fails, sequence continues by drogue chute descent to 7000 FT and Mode 2 will operate.	
	NOTE • The 0.10/1.20-second delay initiator is the time base for both the Mode 1 and Mode 2 operation. The 0.10-second delay operates the drogue release and arms the 14,000 FT aneroid in ejections at low speeds. The 1.20-second delay arms the 7000 FT aneroid. • The 3.0-second delay is the time base for Modes 3 and 4 and operates the drogue release, and arms the 14,000 FT aneroid.			

CANOPY

The one-piece jettisonable canopy is electrically powered, automatically locked and unlocked during normal operation. A control handle under the right cockpit rail (figure 1-2) will close the canopy when held forward. When released, the handle will automatically position at LOCK. To open: turn and slide the handle aft to the UNLOCK position, and then hold aft. Releasing the handle from either the full forward or full aft positions will stop the canopy in any intermediate position. Pulling the handle full aft and turning into the detent will cause the canopy to open without requiring a hand hold on the handle. A warning light (red) on the instrument panel will illuminate when the canopy is unlocked. A gearbox on the right cockpit interior trim panel (figure 1-2) and a handcrank stowed in the right console map case are provided to manually open or close the canopy if the electrical system fails. A switch in the nosewheel well (right side) is provided for external electrical operation of the canopy. This switch is inoperative unless the cockpit control handle is in the unlocked position.

EMERGENCY OPERATION

A canopy jettison T-handle to the right of the instrument panel (figure 1-3) when pulled, will jettison the canopy. Automatic jettison occurs during seat ejection. A canopy breaker tool on the right console is used to break the canopy glass if all canopy opening methods fail. Two D-handles, within an access door on each fuselage side, are provided for emergency jettison from outside the cockpit.

DIGITAL AIR DATA COMPUTER

The digital air data computer (DADC) provides analog-to-digital conversion, air data computation, and auxiliary functions which include monitoring of flight test data and system failure. Inputs to the DADC and outputs to the various systems and indicators are shown below.

INPUTS

1. Pitot Static Boom — Pitot and Static Pressure.
2. L and R Angle of Attack Transmitters — Local Angles of Attack.
3. Sideslip Angle Transmitter — Local Sideslip Angle.
4. Total Temperature Probe — Local Total Temperature.
5. Ammunition Drum Temperature Sensor — Local Temperature.
6. EPU — When activated.

NOTE

Operation of EPU will cause DADC to signal a freeze of maneuvering flap position. Flap position should not be manually controlled because excessive hydraulic power would be required.

7. Electrical Power — 28 VDC, 28VDC/14VAC, 115VAC ØA.

OUTPUTS

1. HUD Sight (Data Bus No. 2) — Air Density, True Angle of Attack, Ammunition Temperature, KTAS, True Mach, True Sideslip Angle.
2. Flight Test Recorder (Data Bus No. 3) — Local and Corrected Dynamic Pressure Local Pitot and Static Pressures, Corrected Pressure Altitude.
3. IFF/SIF (Mode C) — Corrected Pressure Altitude.
4. Altimeter — Corrected Pressure Altitude.
5. Landing Gear Warning — Corrected Pressure Altitude, KTAS.
6. AIR DATA COMPUTER (Caution Light) — DADC Failure.
7. TEMP LIMIT (Caution Light) — Skin Friction Temperature.
8. Angle of Attack Indicator — True Angle of Attack.
9. Control Augmentation System (CAS) — True Angle of Attack, Corrected Compressible Dynamic Pressure, True Mach.
10. Boundary Layer Control — True Mach.
11. Maneuvering Flap Control — True Angle of Attack, Corrected Compressible Dynamic Pressure, True Mach.

ANGLE OF ATTACK SYSTEM

The angle of attack (AOA) system provides a display indication of optimum AOA for landing approach and flight modes of operation. The system consists of left and right AOA probe type transmitters on each side of the fuselage forward of the cockpit, a sideslip angle transmitter on the lower fuselage centerline below the cockpit, an electronics unit in the avionics compartment, an approach indexer light on the HUD gunsight and an AOA indicator on the instrument panel (figure 1-3). Electrical heaters in the transmitters are provided for anti-ice protection. The heaters are energized when the weight of the aircraft is off the landing gear.

AOA INDICATOR

The AOA indicator is calibrated in degrees from -20 to +60. Optimum angle readout will be positioned at 9-o'clock on the indicator face as determined by flight test calibration. The indicator will read true AOA from all transmitters as computed by the DADC or local AOA from the right transmitter vane corrected by the electronics unit, if the DADC is nonfunctioning. When electrical power is removed from the AOA system, an OFF flag will appear on the face of the indicator.

AOA INDEXER

The AOA indexer remotes the data from the AOA indicator to present a heads-up-display in the form of three vertically-aligned lighted symbols. The symbols include: an upper chevron (red), a center circle (green), and a bottom inverted chevron (yellow). Indexer light operation during landing and inflight operation is shown below.

INDEXER LIGHT OPERATION

<table>
<tr><th rowspan="3">SWITCHING POINT TRUE AOA (DEGREES)</th><th colspan="6">INDEXER LIGHTS</th></tr>
<tr><th colspan="3">LANDING APPROACH</th><th colspan="3">NORMAL INFLIGHT</th></tr>
<tr><th>^</th><th>○</th><th>v</th><th>^</th><th>○</th><th>v</th></tr>
<tr><td rowspan="2">+30.0</td><td rowspan="5">OFF</td><td rowspan="2">OFF</td><td rowspan="3">ON</td><td rowspan="4">OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td rowspan="4">ON</td><td rowspan="4">OFF</td></tr>
<tr><td>+11.75</td><td rowspan="3">ON</td></tr>
<tr><td>+10.75</td><td rowspan="3">OFF</td></tr>
<tr><td>+ 9.25</td><td rowspan="2">ON</td><td rowspan="2">OFF</td><td rowspan="2">ON</td></tr>
<tr><td>+ 8.25</td><td rowspan="2">OFF</td><td rowspan="2">ON</td><td rowspan="2">OFF</td></tr>
<tr><td>0</td></tr>
</table>

NOTE

Optimum landing approach angle of on-speed indexer based on AOA of 10°; adjustable ±10° pending results of flight test.

COMMUNICATION AND NAVIGATION EQUIPMENT

UHF RADIO

The AN/ARC-150(V)9 UHF radio on the left console (figure 1-4) provides transmission and reception within the 225.000 to 399.975 MHz range with voice and tone, and ADF controls. Twenty preset channels plus guard channel (243.000 MHz) can be selected. Manual selection of any frequency (spaced 25 kHz apart) can be accomplished without disturbing the preset channels by use of the frequency selector knobs.

NOTE

When operating under emergency conditions, position the slide switch to GUARD and function switch at MAIN. Do not use BOTH, since feedback noise from the two receivers may make the incoming signal unintelligible.

An antenna switch on the left console (figure 1-4) provides L, R, or AUTO antenna selection.

INTERCOM

The AN/AIC-18 intercom system provides headset amplification for the UHF radio, IFF, TACAN, landing gear audible warning, AIM-9E missile tone, and cockpit-to-ground crew communication. There are no controls provided for system operation. Individual volume controls on associated equipment are used to control audio level.

IFF/SIF

The AN/APX-101 IFF/SIF transponder system, controlled by a standard type C-6280 control panel on the right console (figure 1-5), provides automatic identification pulse-coded response to interrogations of ground and airborne radar stations. Operation is possible in any one of three pulse-coded modes, as selected on the control panel, with capability of IDENT (Identification) position and Emergency identification. Mode 1 (Security Ident), Mode 2 (Personal Ident), Mode 3/A (Air Traffic Ident) and Mode C (Altitude Report) are operational. Mode 4 (Security Ident - Classified) is inactive. Modes 1 and 3/A are capable of manual variable selection of required codes in flight. Mode 2 code is preset into the system before flight. Emergency mode of operation can be manually selected on the control panel. An optional low-power setting (LOW) on the control panel selector restricts transponder sensitivity so that replies are made only to local interrogations. A remote IFF IDENT indicator light/reply switch is provided for convenient use on the HUD sight control panel (figure 1-3).

NOTE

If ground station indicates loss of signal, position appropriate mode selector switch to TEST position to determine if transponder has failed.

TACAN

The ANS-100(V6A) TACAN system provides bearing, distance, course deviation, aural and visual channel indication, and transponds to other aircraft interrogations. The TACAN control panel on the right console (figure 1-5) provides selection of 126 channels in Mode X and an additional 126 channels in Mode Y with frequencies spaced 1 MHz apart in receive (REC), transmit-receive (T/R), or air-to-air (A/A) function modes of operation. In REC, the set receives identity signals of selected ground stations and gives bearing only. In T/R the set functions as in REC and also transmits and receives pulsed signals for distance indication. In A/A, the set receives and transponds only to air-to-air interrogations for bearing and distance. Bearing, distance, and deviation is displayed in the HSI on the instrument panel. If TACAN is inoperative, bearing signals weak, or unreliable the bearing pointer in the HSI will search aimlessly or the course warning (DEV) flag, or the distance flag warning will appear. A TEST pushbutton on the panel, when pressed and held with function selector in REC or T/R will self-test the TACAN by causing the bearing pointer to rotate to 180° and 0 distance will appear in the HSI.

INERTIAL NAVIGATION SYSTEM

The LN-33 (modified) self-contained inertial navigation system (INS) continuously determines aircraft position by sensing accelerations for erection of gyros referenced to true north, and provides precision attitude/heading reference and navigational display information. System components are the computer and inertial platform (inertial navigation unit — INU) in the fuselage aft avionics compartment, and the control display unit (CDU) on the right console (figure 1-5). Geographic position data programmed into the CDU provides magnetic heading for the TACAN and HSI, and true heading for the HUD sight. Pitch, roll, and attitude warning data is supplied to the attitude indicator. Pitch and roll data is also supplied to the HUD sight. The system is capable of storing the present position (point-of-departure) and nine preselected geographic navigation points in the CDU. These navigation points may be changed either on the ground or in flight. Visual update of enroute positions may be accomplished in flight. Digital readout data is displayed on the CDU. Refer to section II for ground alignment and inflight operating procedures.

Control Display Unit

The INS is controlled by the CDU which is used to turn on and align gyros before takeoff, and program and display navigational data. Refer to figure 1-15 for locations of key numbered controls/indicators as functionally described below.

(1) MODE SELECTOR

TEST or GB — Maintenance ground test.

NOTE

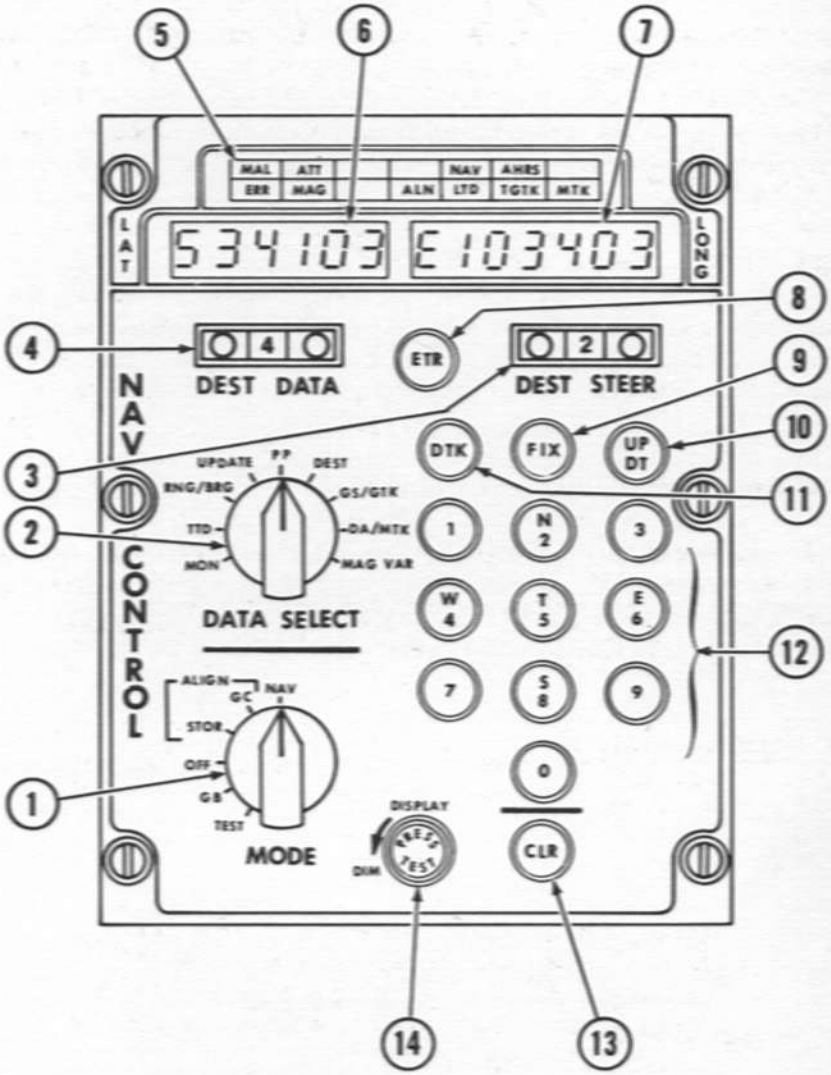
Alignment will be lost if TEST or GB positions are selected during flight.

OFF — Turns system off.

INS CONTROL DISPLAY UNIT

Note

SEE INERTIAL NAVIGATION SYSTEM TEST FOR KEY NO. CONTROL/FUNCTION.



YF17 1-4

Figure 1-15.

ALIGN STORE — Aligns system in 3 minutes to a previously stored gyrocompass alignment.

NOTE

Requires previous gyrocompass alignment before last turnoff and aircraft not moved.

ALIGN GC — Computes new gyrocompass alignment data from keyboard entry. Requires minimum of 10 minutes.

NAV — Initiates navigation mode and must be selected before taxi.

CAUTION

If selector is moved from NAV during flight, navigation capability is lost for remainder of flight.

NOTE

- If NAV selected before 6 minutes of GC alignment is completed, only attitude and heading information will be provided.
- If selected after 6 minutes and before 10 minutes of GC alignment, navigational accuracy will be degraded.

(2) DATA SELECT — Provides computer data entry and display.

NOTE

Reference to DEST DATA and DEST STEER in the following selector positions refer to the digital readout in the left and right numeric displays for respective thumbwheel positions of selected destinations.

MON — Ground test

TTD — Time-to-destination (minutes) in right display (use with DEST STEER). Left display blank.

RNG/BRG — Destination range (nm) in left display; bearing in right display (use with DEST STEER).

UPDATE — Destination distance (nm) N or S in left display; E or W in right display (use with DEST DATA). Fix push button must be activated.

PP — Present position (point-of-departure) data insert of coordinates (use with DEST DATA position 1 only). Also permits inertially derived readout of LAT and LONG coordinates of DEST DATA position 1, and 2 thru 10.

DEST — Destination data insert and/or readout of LAT and LONG coordinates (use with DEST DATA).

NOTE

DEST DATA position 1 reserved for home base (point-of-departure) and is protected. It can be data entered only thru PP in ALIGN mode.

GS/GTK — Groundspeed in left display and actual magnetic or true groundtrack in right display depending on steering mode selected by DTK pushbutton.

DA/MTK — Drift angle in left display; desired inbound magnetic track entered and/or displayed in right display (use with DEST DATA).

MAG VAR — Enter or display local magnetic variation in right display. Left display blank.

(3) DEST STEER Pushbuttons and Thumbwheel. Provides selection of one of 10 stored destinations for steer data. Right pushbutton advances thumbwheel position each push; left decreases.

(4) DEST DATA Pushbuttons and Thumbwheel. Provides insert or readout of data (as selected on DATA SELECT) for 10 destinations (positions T1 thru T6 not used). Advance and decrease of positions same as above.

(5) Status/Mode Lights

Status Lights (Yellow)

MAL — Computer failure.

ATT — Attitude information unreliable.

ERR — Error in procedure or wrong data entered.

MAG — (Inoperative).

Mode Lights (Green)

ALN — On steady when gyros at operating rpm. Flashes when gyro alignment complete and ready for NAV mode.

NAV — Mode selector at NAV.

LTD — Navigational accuracy of system is limited.

AHRS — Attitude and heading information is available.

TGTK — True ground track desired direct or waypoint steering mode of operation (inoperative).

MTK — Magnetic desired track mode of operation (inoperative).

(6) Left Numeric Display (LAT). Digital display of selected or computed latitude coordinates, drift angle, range to destination, and groundspeed.

(7) Right Numeric Display (LONG). Digital display of selected or computed longitude coordinates, time to destination, bearing, magnetic desired track, and magnetic variation.

(8) ETR Pushbutton. Momentary push to enter original or new data into computer. Activated and illuminated only after keyboard entry. Light will go out when entry completed.

(9) FIX Pushbutton. When pushed will illuminate and compare computed position at activation with selected position on DEST DATA. Stores computed position and variance in memory. Repushing will unfreeze the display data and deactivate the process.

(10) UP DT Pushbutton. Illuminates when FIX pushbutton activated and DATA SELECT control is at UPDATE position. When pushed, commands computer to update correct position by the amount shown in left and right displays.

NOTE

To reject update data, do not push UP DT button; instead, repush FIX button to cancel update procedure.

(11) DTK Pushbutton. Illuminates when pushed. Selects steering mode according to position of DATA SELECT (inoperative).

(12) Data Entry Keyboard (10 pushbuttons). Used in conjunction with DEST DATA and DEST STEER selected position and DATA SELECT to enter data in left and right displays. Buttons illuminate when pushed.

NOTE

- Keyboard activated for entry by first pushing either N2, S8, E6, W4 or T5 pushbutton; as desired.
- Initial push will blank display. N or S will appear in left display; E or W in right display. T5 will blank only the right display.
- Later push of same button will enter the number of the button. First number entered will appear in extreme right of display and step to left as succeeding numbers are entered.

(13) CLR Pushbutton. Illuminates when pushed. Clears keyboard entry data before computer entry and restores previous numeric displays.

(14) DISPLAY/DIM Press-to-Test. Rotate to control light intensity of keyboard and displays. Press to test digital readout segmented lighting (displays all 8's).

WEAPONS SYSTEM

Basic armament consists of the 20mm Vulcan gun in the nose and two AIM-9E type missiles on the wingtips. The fire control system consists of a range-only radar and a head-up display (HUD) sight system. External stores are carried on four wing pylons. The pylon bomb racks contain electrically-initiated impulse cartridges to force eject stores. There is no provision for fuze arming. The master armament switch on the instrument panel must be positioned at ARM to fire the gun or missiles, and release external stores.

GUN SYSTEM M61A1

The M61A1, 20mm Vulcan gun system is pallet mounted as a unit on the centerline in the nose section. The complete system consists of the rotating cluster of six gun barrels, the modified ammunition drum with a capacity of 500 rounds of linkless 20mm ammunition, the feed chutes, and the hydraulically-powered drive. Access for gun servicing is provided thru doors in the bottom and right side of the fuselage. The gun is electrically controlled and fired. Empty cases and cleared rounds are returned to storage in the drum. Although capable of high (6000) and low (4000) rounds-per-minute rate of fire, the gun is electrically wired to provide only high rate continuous fire. A cumulative rounds indicator on the gun records the total rounds fired and/or cycled thru the gun. A shot port is provided thru the upper nose section skin. During firing, a deflector at the muzzle end deflects the gun gas away from the aircraft. Gun breech purge provides air circulation throughout the gun housing and ammunition transfer unit. Air is drawn thru by an ejector pump system using engine bleed air. The gun compartment is also scavenged by ram air directed over the gun components. Scavenge and purge air starts to flow after the gun arm switch on the instrument panel is positioned at GUN/CAMR, the master arm switch positioned at ARM, and when the trigger is squeezed thru the first detent; and continues for 10 seconds after trigger release. The gun will not fire if the purge door fails to open or the ejector pressure switch on the gun is not closed. Gun compartment gas is evacuated thru exhaust louvers in the lower fuselage access door. The gun compartment is automatically purged following air-to-air refueling.

WARNING

- Ensure that right fuel boost pump operative at least 5 minutes prior to firing gun.
- Fuel boost pump operation assures fuel scavenged from gun bay routed fuel line.

PYLONS

The inboard nonjettisonable pylons contain MAU-12C/A bomb racks with 14- and 30-inch hook suspension. The outboard nonjettisonable pylons contain MAU-50/A bomb racks with 14-inch hook spacing. The outboard pylon armament station selector/indicator switches on the instrument panel (figure 1-3) are used to select normal release only of external stores loaded on these pylons. To select either or both outboard stations, press the appropriate armament selector/indicator switch. With a store on the pylon bomb rack and the master armament switch at ARM, the selector/indicator will illuminate (green). The light will go off when the store is released by the bomb-rocket button on the control stick grip (figure 1-13), or if the selected station is deselected. To deselect the station, before or after release, repress the armament selector/indicator switch. The centerline pylon armament station selector/indicator switch is inactive.

WINGTIP LAUNCHERS

The wingtip launchers are equipped to carry the AIM-9 series missiles. To select loaded launcher(s) stations, press the appropriate armament selector/indicator switch on the instrument panel (L TIP). With a missile on the launcher and the master armament switch at ARM, the selector/indicator switch will illuminate (green). The light will go off when the missile is fired or if the selected station is deselected. To deselect the wingtip station, before or after firing, repress the armament selector/indicator switch.

MISSILE FIRING CONTROLS

A missile volume control knob on the instrument panel provides missile tone control to the pilot's headset. A missile uncage button on the master throttle (figure 1-8) when pressed and held uncages the IR seeker head. The IR head will cage to missile boresight line if the uncage button is released. Firing occurs when the missile firing button on the control stick grip (figure 1-13) is pressed.

STORES JETTISON

The emergency jettison pushbutton on the instrument panel (figure 1-3) provides nondelay salvo force ejection of all pylon stores from the bomb racks, regardless of armament selector/indicator switch selections. Jettison can be accomplished while on the ground or in flight with landing gear down or up.

NOTE

- Wingtip missiles are not capable of emergency jettison.
- Missiles may be electrically fired (unguided) thru use of normal missile firing controls.

HEAD-UP DISPLAY GUNSIGHT SYSTEM

The head-up display (HUD) gunsight system consists of a display unit (DU) centered above the instrument panel (figure 1-3) and an acceleration and rate converter (ARC) unit in the aft avionics compartment. Symbolic display of data (figure 1-16) is projected on the combining glass from a cathode-ray tube within the DU and appears superimposed on the forward view thru the windshield. A fire control computer within the DU provides solutions to computations based on digital inputs of range, range rate, true airspeed, angle of attack, angle of slip, relative air density; and motion inputs of vertical and lateral acceleration, roll and pitch attitude; and angular rates of turn in roll, pitch and yaw as required for positioning of the symbology. In addition, the system provides boresight and self-test (BIT) displays. Input data is received from the Fire Control Radar, DADC, INS, Armament Controls, and CAS.

SIGHT CONTROLS

Mode Selector

The mode selector (figure 1-3) operating positions and functions are as follows. Refer to figure 1-16 (sheets 1 thru 5) for symbology examples.

OFF — All power removed from HUD (other system controls on sight not affected).

SBY (Standby) — All components in operation except no symbol displays.

AA1 (Historic) — Displays will include an aiming symbol that indicates the immediate angular position of bullets that were fired a time of flight ago. Preselected displays may be:

WITH RADAR	WITHOUT RADAR
a. Two-Circle Display	a. Two-Circle Display
b. Two-Cross Display	b. Three-Cross Display
c. Tracer-Line Display (with reticle and 2 range bars)	c. Tracer-Line Display (3 range bars)

In AA1 mode with radar lock-on the aiming symbol is positioned, at all times, symmetrically about the angular position of the bullet at target range. If the correct position is outside the total field of view, the symbol will remain at the edge of the field of view on a line from the center of the field of view to the correct position. When the tracer line display is selected, the points on the line represent the immediate angular positions of bullets from 400 ft to at least 3000 ft with respect to the corresponding range. Without radar lock-on, stadiametric range bars for ranges of 500 ft, 1500 ft, and 3000 ft are positioned parallel

to the aircraft wing position and are bisected by the points on the tracer line at these ranges. Length of the range bar in milliradians (mr) equals the target wing span at the corresponding range and can be varied by the target wing span selector control. When the radar has achieved a lock-on condition, the aiming symbol will be superimposed on the tracer line, and the 1500 ft range bar will be omitted.

AA2 (Lead Computing) — Calculates the lead angle and positions the aiming symbols based on time derivatives of target range and aircraft rotation to determine the probable target location after a future time of flight. Displays include:

a. Two-Circle Display — Symbols are identical to the two-circle display of AA1 mode. Without radar lock-on the symbols are unchanged and the aiming symbol is positioned for a target fixed at a 1500 ft range.

b. Two-Cross Display — Symbols are identical to the two-cross display of AA1 mode except that a boresight cross is displayed instead of a 500 ft cross.

MSL (Missile) — Provides missile boresight accounting for wing flexure with an indication of target detection, minimum launch range, excess G-turn rate, and range to target up to 6000 ft. Display symbols include boresight circle, rangebar, target detection intensity symbol, a broken boresight circle indicating excess G, and minimum range symbol. The intensity symbol originates at the center of the circle and extends toward both sides, providing an indication of missile tone strength even though the missile volume control knob is turned off, the length being dependent on signal strength.

A/G (Air-to-Ground) — Display includes a depressible bomb release circle, a bomb fall line, and depression numerics. The bomb fall line remains perpendicular to the real world horizon. The uppermost tip of the line indicates the velocity vector position and is determined with respect to the aircraft by the angle of attack mr measured from the horizontal reference line (HRL), and the sideslip angle mr to either side of the centerline. The

reticle is centered along the roll-stabilized bomb fall line at a point corresponding to the selected depression angle from the velocity vector. The reticle wingtabs on the bomb release circle remain fixed to the aircraft lateral axis.

MAN (Manual) — Display includes a fixed depressible aiming reticle, a boresight cross, and the depression numerics. The reticle is positioned manually by the sight depression control with zero depression positioned at the armament reference line (ARL).

BST (Boresight) — Boresight mode reserved for HUD calibration.

Reticle Depression Knob

The five-position reticle depression knob (normally at off when centered in detent at index mark) allows manual raise and lower of the fixed reticle in MAN and A/G modes of operation, as indicated by arrow positions. The first momentary position either side of center will slew setting at approximately 4 mr per second; the second momentary position either side will slew setting at approximately 40 mr per second.

Target Wing Span Control Knob

The target wing span control knob provides stadiametric range control for four selectable positions: TGT (tow target), 30', 60', and 120'.

BIT Control

The BIT momentary pushbutton switch provides interrogation response of the sight system circuitry and will display GO/NO-GO symbols. Activation will override all modes, except OFF.

Auto/Manual Brightness Control

Automatic and manual brightness of symbol displays is controlled by a rotary switch on the left side of the sight. The switch incorporates a center action push-push feature which activates and deactivates automatic control of brightness contrast with real world background. When the switch is activated for manual control of brightness, increase is accomplished by counterclockwise rotation.

DOGFIGHT OVERRIDE

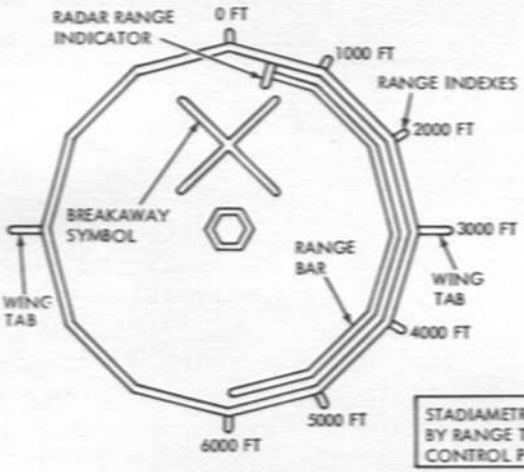
A dogfight override capability provides a quick method of going from SBY, MSL, A/G, or MAN modes of sight operation to the AA1 mode. Pressing the dogfight button on the control stick grip (figure 1-13) will instantly and automatically override the mode selector control and cause the AA1 display to appear. Repressing the button will resume the previously selected mode.

BREAKAWAY SYMBOL

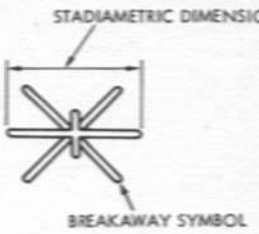
In the AA1, AA2, or MSL modes, a breakaway symbol will appear in the aiming symbol to indicate a radar range signal of less than approximately 1000 ft. If closure time to target at any range is less than 3 seconds, the cross will flash on and off.

HUD SYMBOLS (TYPICAL)

AA1 MODE (HISTORIC) AIMING SYMBOLS



TWO-CIRCLE DISPLAY AIMING SYMBOL



TWO-CROSS DISPLAY AIMING SYMBOL

Note

STADIAMETRIC DIMENSIONS ARE DETERMINED BY RANGE TO TARGET AND WINGSPAN SELECTOR CONTROL POSITION.

Note

RADAR RANGE BAR ORIGINATES AT 6000 FT AND INCREASES LENGTH IN 100 FT INCREMENTS AS RANGE DECREASES.

TRACER LINE DISPLAY AIMING SYMBOL

Note

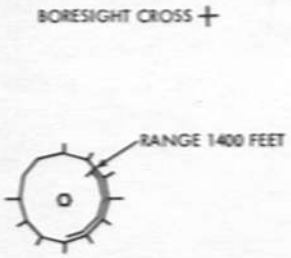
WITH RADAR LOCKED-ON IN MODES AA1, AA2, MSL, AND MAN THE BREAKAWAY SYMBOL WILL APPEAR AT RANGES BELOW 1000 FEET, AND WILL FLASH ON-OFF WHENEVER TIME TO COLLISION IS LESS THAN 3 SECONDS.

Figure 1-16. (Sheet 1)

YF17 1-18(1)

HUD SYMBOLS (TYPICAL)

AA1 MODE (HISTORIC) DISPLAY FORMATS

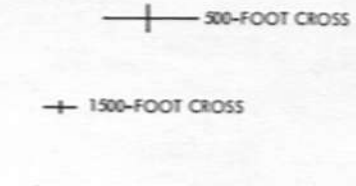


TWO-CIRCLE DISPLAY FORMAT
WITH RADAR LOCKON

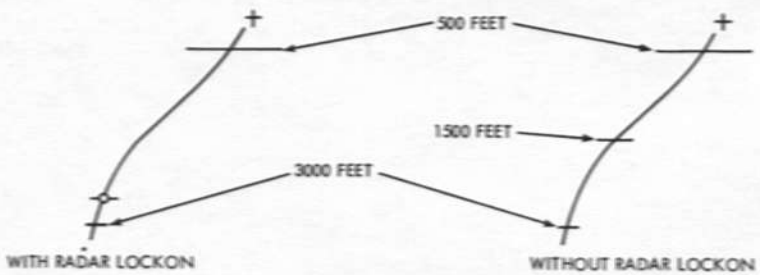
TWO-CROSS DISPLAY FORMAT
WITH RADAR LOCKON

Note

APPEARS AS A BACKUP DISPLAY FOR THE TWO-CROSS DISPLAY WITHOUT RADAR LOCKON.



THREE-CROSS
DISPLAY FORMAT



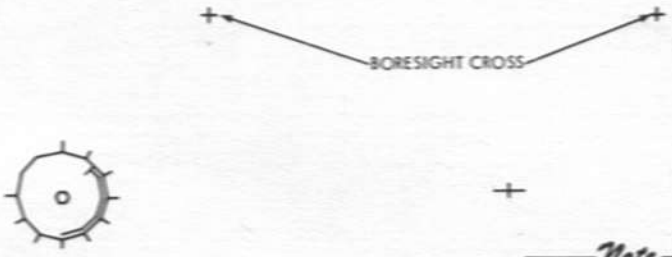
TRACER LINE
DISPLAY FORMAT

Figure 1-16. (Sheet 2)

YF17 1-18(2)B

HUD SYMBOLS (TYPICAL)

AA2 MODE (LEAD COMPUTING) SYMBOLS AND DISPLAY



Note

HORIZONTAL BAR IS STADIAMETRICALLY DIMENSIONED.

Note

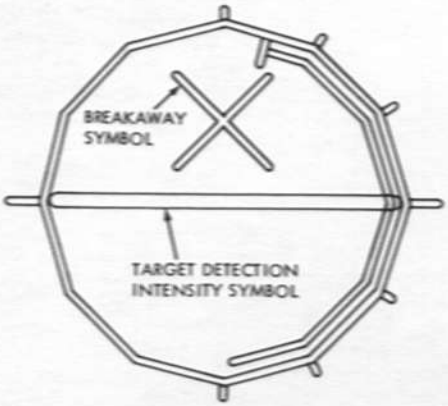
WITHOUT RADAR LOCKON RANGE INPUT IS SET AT 1500 FEET. SYMBOLS ARE UNCHANGED.

YF17 1-18(3)

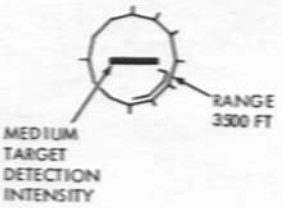
Figure 1-16. (Sheet 3)

HUD SYMBOLS (TYPICAL)

MSL (MISSILE) MODE



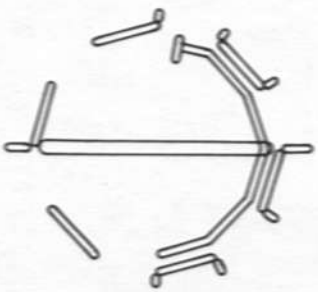
MISSILE BORESIGHT SYMBOL



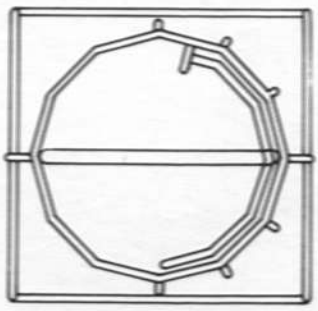
MISSILE MODE DISPLAY (RANGE 3500 FT AND MEDIUM TARGET INTENSITY)

Note

THE TARGET DETECTION INTENSITY SYMBOL ORIGIINATES AT THE CENTER AND INCREASES AT BOTH ENDS AS THE MISSILE OUTPUT SIGNAL INCREASES.



EXCESS "G" INDICATION (DO NOT LAUNCH MISSILE)



MINIMUM LAUNCH RANGE INDICATION (DO NOT LAUNCH MISSILE)

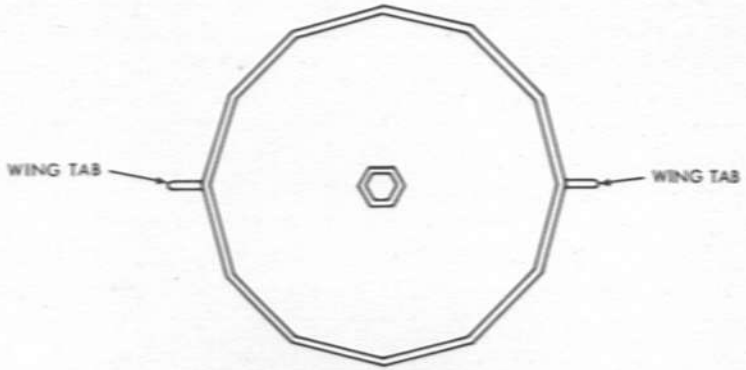
MISSILE MODE SYMBOLS

Figure 1-16. (Sheet 4)

YF17 1-18(4)

HUD SYMBOLS (TYPICAL)

MAN (MANUAL) AND A/G (AIR-TO-GROUND) MODES



MANUAL AND AIR-TO-GROUND
DEPRESSIBLE SYMBOL

Note

MANUAL MODE DEPRESSION ANGLE MEASURED FROM THE BORESIGHT CROSS TO THE AIMING SYMBOL CENTER.

Note

- AIRCRAFT IN RIGHT BANK (ROLL ANGLE).
- BOMB FALL LINE IS ROLL STABILIZED.
- AIR-TO-GROUND DEPRESSION ANGLE MEASURED FROM VELOCITY VECTOR TO AIMING SYMBOL CENTER.

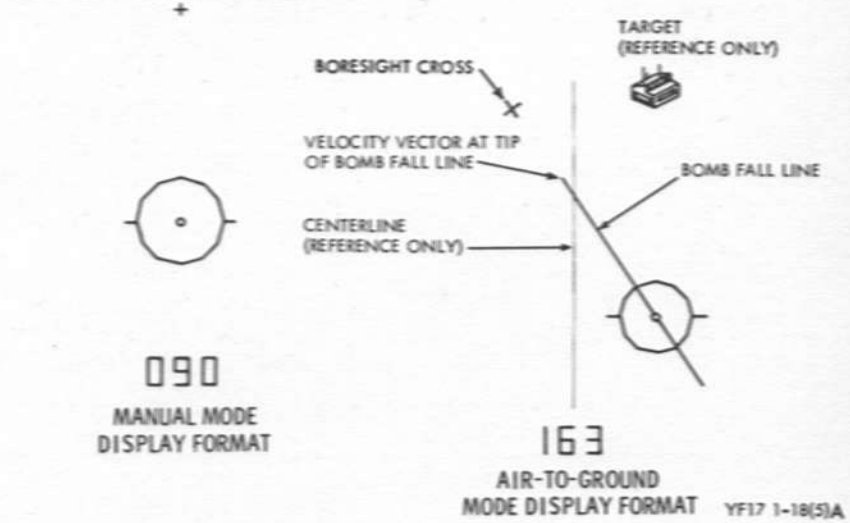


Figure 1-16. (Sheet 5)

FIRE CONTROL RADAR

The X-band radar provides range and range rate only data to the HUD sight system. Components are the flush surface wave antenna in the bottom of the forward nose section and the transmitter-receiver in the forward nose section. The set operates in standby (STBY) and range-only modes (ON) as selected by the RADAR switch on the left console (figure 1-4). Standby operation permits warm-up of the radar circuitry but does not allow transmission of radar wave signals. Minimum required warm-up time is 3 1/2 minutes. In the ON position, the radar will search, detect, lock on, and range track in accordance with selected operation of the sight system controls. Acquisition range is approximately 5000 ft over a beam section of ± 10° azimuth, and +6° to -20° in elevation. Search range is limited to 6000 ft to avoid ground clutter. Range tracking accuracy is ± 25 ft from 400 ft to 2500 ft and ± 1% from 2500 ft to 5000 ft. With the radar locked on to target, a range rate signal of 1000 ft/sec opening to 3000 ft/sec closing is supplied to the sight displays.

SIGHT CAMERA

The KB-26A sight camera (figure 1-3) provides photorecording of the reticle and target during air-to-air and air-to-ground attacks. Camera controls permit the setting of frame rates, overrun exposure time, and lens aperture. The film magazine can be readily changed during flight. Selecting GUN/CAMR or CAMR on the gun arm switch, or selecting mode C with the flight test data control switch on the left console positioned at DATA, will operate the camera. An event marker within the camera marks the film frames when the trigger is squeezed to the second detent. The camera will continue to operate for the preselected 0, 3, 10, or 20 second overrun after control release.

OXYGEN SYSTEM

The oxygen system supplies gaseous oxygen from a 5-liter liquid oxygen converter thru a regulator on the right console. Regulator controls provide selection of normal and emergency flow, and increased flow for testing mask and hose. A liquid oxygen quantity indicator on the right console (figure 1-5) and a gaseous oxygen pressure gage on the regulator indicate system status. An emergency supply of gaseous oxygen is carried in the survival kit. A caution light on the pedestal, when illuminated, indicates oxygen quantity in the converter is 0.5 liter or less, or that supply pressure is 40 psi or less.

WARNING

It is possible to position supply lever at an intermediate position between OFF and ON. Before flight, ensure lever is at ON and visually check flow indicator blinker for proper functioning.

SECTION II

NORMAL PROCEDURES

Table of Contents

FLIGHT PLANNING

Determine mission requirements for fuel, airspeed, and cruise control data from flight test data sheets.

WEIGHT AND BALANCE

Refer to flight test loading sheet.

PREFLIGHT CHECK

1. AIRCRAFT FORMS — CHECK.
2. EXTERNAL POWER — AS REQUIRED.
3. CANOPY JETTISON T-HANDLE SAFETY PIN — INSTALLED.
4. SEAT SAFETY HANDLE — UP.
5. BATTERY SWITCH — OFF.
6. GEAR LEVER — LG DOWN.
7. ARMAMENT SWITCHES — OFF & SAFE.
8. PUBLICATIONS — AS REQUIRED (per flight test card).

EXTERIOR INSPECTION

Duplicate inspection requirements performed by maintenance personnel are eliminated except for items required in the interest of flight safety.

1. AOA ± YAW VANES — CHECK.
2. EPU N2 PRESSURE GAGE — CHECK (3000 psi minimum).
3. PITOT BOOM AND STATIC PORTS — CLEAR.
4. EPU EXHAUST PORT — CLEAR.

5. EMERGENCY BRAKE PRESSURE GAGE — CHECK (2800 to 3200 psi).

6. NOSE GEAR TORQUE LINKS — CONNECTED.

7. NOSE & MAIN GEAR STRUTS & TIRES — PROPER INFLATION.

8. INTAKE DUCTS — CLEAR.

9. ACCESS DOORS — CLOSED & LATCHED.

10. AREA — CHECK FOR FLUID LEAKAGE: LOOSE EQUIPMENT.

11. ARMAMENT — CHECK (as necessary).

INTERIOR INSPECTION

1. SAFETY BELT, SHOULDER HARNESS, SURVIVAL KIT, & PERSONAL EQUIPMENT – SECURE.
2. TORSO HARNESS, SAFETY BELT, & PERSONAL LEADS – ATTACH & CONNECT.
3. SEAT SAFETY HANDLE – DOWN (stow).
4. CANOPY JETTISON T-HANDLE SAFETY PIN – REMOVE.
5. RUDDER PEDALS – ADJUST.

LEFT CONSOLE

1. CIRCUIT BREAKERS – CHECK
2. FLIGHT TEST INSTRUMENTATION CONTROLS – SET (Per flight test card).
3. CAS PANEL – CHECK SWITCHES OFF.
4. RUDDER TRIM KNOB – CENTER.
5. FLAP MODE SWITCH – NORMAL.
6. L & R THROTTLES – OFF.
7. MASTER THROTTLE – STOW.
8. FUEL CROSSFEED SWITCH – OFF.
9. FUEL TRANSFER PUMP SWITCHES – ON.
10. AIR REFUEL SWITCH – CLOSE.

11. EXTERNAL TANKS SWITCH — AS REQUIRED.
12. EMERGENCY BRAKE LEVER — FORWARD.
13. EPU SWITCH — OFF.

WARNING

- Do not position EPU switch at ON to preclude operation of EPU while on the ground.
- EPU exhaust fumes are a toxic hazard to personnel.

14. RADAR SWITCH — OFF.
15. ANTENNA SELECTOR — AUTO.
16. UHF RADIO — AS REQUIRED.

INSTRUMENT PANEL

1. GEAR ALTERNATE RELEASE D-HANDLE — IN.
2. GEAR LEVER — LG DOWN.
3. FLIGHT TEST FLAP SWITCHES — OFF.
4. ARMAMENT CONTROLS & SWITCHES — OFF & SAFE.
5. FIRE PULL HANDLES — IN.
6. HUD GUNSIGHT MODE SELECTOR — SBY.
7. AIRSPEED/MACH INDICATOR — SET.
8. ACCELEROMETER & CLOCK — SET.
9. EPU FUEL QUANTITY INDICATOR — CHECK (110%).

PEDESTAL

1. FLIGHT TEST INSTRUMENTATION SWITCHES — SET (per flight test card).

RIGHT CONSOLE

1. BATTERY SWITCH — BATT.
2. GENERATOR SWITCHES — L & R ON.
3. FUEL/OXYGEN CHECK BUTTON — PUSH.

Check L/R and F/A fuel quantity gage levels and total fuel quantity 6400 lb (minimum). Total fuel quantity does not include external tanks fuel quantity (7800 lb).

Recheck EPU fuel quantity. Indication verifies EPU battery is connected.

4. TACAN — T/R.
5. IFF/SIF — STBY.
6. INS — CHECK ALIGNMENT.

Check alignment and DEST DATA as required. Prealignment check normally accomplished by groundcrew.

7. ROTATING BEACON — AS REQUIRED.
8. CABIN PRESSURE SWITCH — RAM/DUMP.
9. CANOPY BREAKER TOOL — SECURED.

STARTING ENGINES

1. L ENGINE — SIGNAL GROUNDCREW (intercom).
2. L TACHOMETER (N2) — INDICATION (approx. 30%).
3. L THROTTLE — IDLE.

Engine ignition circuit automatically activated below 40% N1 rpm. Ignition button(s) will illuminate automatically to indicate ignition.

CAUTION

- If lightoff does not occur within 5 seconds after fuel flow indication (300 pph minimum), retard throttle to OFF. Wait 3 minutes before restart.
- If egt reaches 760°C during start cycle, retard throttle to OFF.

4. HYDRAULIC PRESSURE — 2800 — 3200 psi.
5. ENGINE INDICATORS — CHECK WITHIN LIMITS
6. R ENGINE — REPEAT STEPS 1 THRU 5.
7. HYDRAULIC & GENERATOR CAUTION LIGHTS — OUT.
8. CABIN PRESSURE SWITCH — CABIN PRESS.
9. EXTERNAL AIR & POWER — DISCONNECT.

BEFORE TAXI

1. INS — ALIGN & SET.
2. CIRCUIT BREAKERS — CHECK.
3. CAS SWITCHES (YAW/ROLL/PITCH) — ENGAGE.
4. PITCH CAS CUTOFF SWITCH — CHECK.
5. CAS PITCH SWITCH — CYCLE TO RE-ENGAGE.
6. CAS BIT 1 BUTTON — PUSH.
7. FLAP MODE SWITCH — EMERG UP.
8. CAS SWITCHES (YAW/ROLL/PITCH) — CYCLE TO RE-ENGAGE.

9. CAS BIT 2 BUTTON — PUSH (check GO indication, approx. 15 seconds).

10. TAKEOFF TRIM PUSHBUTTON — SET (check green light).

11. FLAP MODE SWITCH — NORMAL.

12. SPEED BRAKE — CHECK & IN.

13. FLAP THUMB SWITCH — DOWN.

NOTE

- Check flap indicator for barber pole/A/UP/DN.
- Check for horizontal tail interconnect movement.

14. FLIGHT CONTROLS — CHECK.

15. RADAR SWITCH — STBY.

WARNING

Do not position Radar Switch at ON while on ground in the vicinity of ground personnel (radiation hazard).

16. HUD GUNSIGHT BIT SWITCH — PUSH (check for GO symbol).

17. ATTITUDE INDICATOR & HSI — CHECK.

18. ALTIMETER — CHECK.

19. IFF/SIF — AS REQUIRED.

20. WARNING & CAUTION LIGHTS — CHECK.

21. INS CHECK ALIGNMENT — COMPLETE.

22. INS MODE SELECTOR — NAV.

23. THROTTLES — SLAVE.

24. WHEEL BRAKES — APPLY.

25. WHEEL CHOCKS — REMOVED.

TAXI

1. WHEEL BRAKES — RELEASE.
2. NOSEWHEEL STEERING — ENGAGE.
3. FLIGHT INSTRUMENTS — CHECK.

BEFORE TAKEOFF

TAKEOFF/ARMING AREA

WARNING

Park aircraft headed into safe direction when firing weapons are loaded.

1. ARMAMENT SWITCHES — OFF & SAFE
2. PILOT — HANDS IN VIEW.
3. ARMAMENT SAFETY PINS (live munitions) — REMOVED.
4. SEAT & CANOPY WARNING LIGHTS — OUT.
5. FLAP THUMB SWITCH — DOWN.
6. EPU SWITCH — AS REQUIRED.
7. WARNING & CAUTION LIGHTS — OUT.

LINE-UP CHECK

1. WHEEL BRAKES — APPLY.
2. THROTTLE — ADVANCE.
3. FUEL FLOW & QUANTITY — CHECK.
4. ENGINE INSTRUMENTS — CHECK.

TAKEOFF

1. WHEEL BRAKES — RELEASE.
2. NOSEWHEEL STEERING — AS REQUIRED.

AFTER TAKEOFF

1. GEAR — UP.
2. FLAP THUMB SWITCH — AS REQUIRED.

CLIMB

1. OXYGEN SYSTEM — CHECK.
2. CABIN PRESSURE — CHECK.
3. ALTIMETER — SET AS REQUIRED.

CRUISE

1. LEVEL OFF & OPERATIONAL CHECKS — AS REQUIRED (per flight test card).
2. EXTERNAL FUEL — CHECK FEED.

SUPERSONIC CRUISE

1. THROTTLES INTERMED OR AUGMENT — MACH 1.4 OR ABOVE.

AIR REFUELING

1. RADAR SWITCH — STBY.
2. ARMAMENT SWITCHES — OFF & SAFE.
3. TACAN — REC.
4. IFF/SIF — STBY.
5. AIR REFUEL SWITCH — OPEN: BLUE LIGHT ON.
6. BOOM — ENGAGE; GREEN LIGHT ON.
7. DISCONNECT — YELLOW LIGHT ON.

If Inadvertent Disconnect:

8. AIR REFUEL SWITCH — RESET/OPEN; BLUE LIGHT ON.
9. BOOM — REENGAGE; GREEN LIGHT ON.

Receiver Disconnect:

10. AIR REFUEL DISCONNECT SWITCH (stick) — PRESS; YELLOW LIGHT ON.
11. AIR REFUEL SWITCH — CLOSE; LIGHTS OFF.

NOTE

- Boom operator may unlatch or an automatic unlatch may occur when internal tanks are full.
- External tanks are not capable of being air refueled.

BEFORE LANDING

1. CROSSFEED — DISCONTINUE (if used).
2. RADAR SWITCH — STBY.
3. ARMAMENT SWITCHES — OFF & SAFE.
4. HUD GUNSIGHT MODE SELECTOR — SBY.
5. FLAP THUMB SWITCH — AUTO.
6. GEAR — DOWN.
7. SPEED BRAKE — AS REQUIRED.

LANDING

1. AOA INDICATOR — 10°.
2. APPROACH AIRSPEED — 122 KIAS WITH 1000 LB FUEL REMAINING. Add 3 KIAS for each 1000 LB additional fuel.
3. THROTTLES — IDLE (after touchdown).
4. WHEEL BRAKES — AS REQUIRED.

GO-AROUND

1. THROTTLES — AS REQUIRED.
2. SPEED BRAKE — IN.
3. GEAR — UP (when positive rate of climb established).

AFTER LANDING/DEARMING AREA

1. SPEED BRAKE — IN.
2. FLAP THUMB SWITCH — UP.

3. THROTTLE (R engine) — UNSLAVE & OFF.
4. RADAR SWITCH — OFF.
5. EPU SWITCH — OFF.
6. ARMAMENT SWITCHES — OFF & SAFE.
7. PILOT — HANDS IN VIEW.
8. ARMAMENT SAFETY PINS — INSTALLED.
9. M61A1 GUN POWER — DISCONNECTED.

PARKING AREA

1. THROTTLE — IDLE.
2. UHF RADIO — OFF.
3. HUD GUNSIGHT MODE SELECTOR — OFF.
4. TACAN — OFF.
5. IFF/SIF — OFF.
6. INS MODE SELECTOR — OFF.
7. ROTATING BEACON — OFF.
8. FLIGHT TEST INSTRUMENTATION CONTROLS — SET (per flight test card).
9. THROTTLE — (L engine) — UNSLAVE & OFF.
10. BATTERY & GENERATOR SWITCHES — ON (when engine stopped to maintain flight test data, when APU energized).

BEFORE LEAVING AIRCRAFT

1. CANOPY SAFETY PIN — INSTALLED.
2. SEAT SAFETY HANDLE — UP (safe).

SECTION III

EMERGENCY PROCEDURES

Table of Contents

Table of Contents (Continued)

GROUND OPERATION

MANUAL EGRESS

1. SEAT GROUND SAFETY HANDLE – UP.
2. SAFETY BELT – RELEASE.
3. TORSO HARNESS – REMOVE.

WARNING

Do not use emergency release control handle. Use of handle is not recommended as a primary method during ground egress.

4. OXYGEN MASK – REMOVE.
5. EVACUATE AIRCRAFT.

ENGINE START FIRE

1. THROTTLE – OFF.
2. FIRE HANDLE (affected engine) – PULL.
3. INTERCOM – FIRE WARNING (to ground crew).

NOTE

Ground crew will motor engine.

If Fire Continues:

4. AGENT – DISCHARGE 1 (&2 if necessary).

TAKEOFF

ABORT

1. THROTTLES — IDLE.
2. STORES — JETTISON (if necessary).
3. WHEEL BRAKES — APPLY.

ENGINE FAILURE/FIRE WARNING/FLAMEOUT

If Takeoff Refused:

1. ABORT.

If left engine fails or is shutdown, normal brakes and nosewheel steering will be inoperative. Use emergency brakes for stopping.

If Takeoff Continued:

1. THROTTLES — MAX.
2. STORES — JETTISON (if necessary).
3. ENGINE FIRE — FIRE HANDLE PULL.
4. AGENT — DISCHARGE 1 (& 2 if necessary).
5. THROTTLE (affected engine) — UNSLAVED & OFF.
6. IF FIRE IS CONFIRMED — EJECT.

LOSS OF CANOPY

1. SLOW AIRCRAFT — BELOW 300 KIAS.

TIRE FAILURE

If Takeoff is Refused:

1. ABORT.
2. EMERGENCY BRAKE LEVER — PULL.

If Takeoff Continued:

1. GEAR & FLAPS — DO NOT RETRACT.

UNSAFE GEAR INDICATION (GEAR DOWN OR UP)

1. AIRSPEED — BELOW 240 KIAS.
2. RECYCLE GEAR HANDLE.

If Gear Fails to Move from Down and Locked:

3. ALTERNATE RELEASE D-HANDLE — CHECK FULLY STOWED.

Alternate Gear Extension:

1. AIRSPEED — 200 KIAS.

To avoid "hung-gear" condition caused by reduced hydraulic system pressure and excessive airloads, it is recommended that alternate gear extension not be accomplished above 200 KIAS.

2. GEAR HANDLE — DOWN.
3. ALTERNATE RELEASE D-HANDLE — PULL.
4. LAND AS SOON AS PRACTICAL.

EMERGENCY STORES JETTISON

1. EMERGENCY JETTISON BUTTON — PUSH.

INFLIGHT

ENGINE FAILURE (AFFECTED ENGINE)

1. THROTTLE — AS REQUIRED.
2. EXTERNAL STORES — JETTISON (if necessary).

ENGINE FIRE (AFFECTED ENGINE)

1. THROTTLE — IDLE (UNSLAVED & OFF, if fire warning light remains on).
2. FIRE HANDLE — PULL.
3. AGENT — DISCHARGE 1 (& 2 if necessary).
4. LAND AS SOON AS POSSIBLE.

If Fire Continues:

5. EJECT.

ENGINE AIRSTART

1. THROTTLE – OFF.
2. ALTITUDE — BELOW 25,000 FT (optimum).
3. AIRSPEED — 0.8 MACH (optimum).

NOTE

Airstarts can be expected between 0.8 and 1.0 Mach at 25,000 ft.

If Both Engines Flamed Out:

1. CABIN PRESSURE SWITCH – RAM/DUMP.
2. BATTERY SWITCH – CHECK BATT (instrument power).
3. FLAP THUMB SWITCH – UP.
4. THROTTLES – IDLE.
5. ENGINE INDICATORS – MONITOR.

NOTE

- Minimize flight control use during airstart to reduce accessory load on engine.
- Do not activate manual ignition (pushbuttons) to initiate an airstart at high rotor speeds. Engine airstart capability at rotor speeds greater than steady state within the airstart boundary has yet to be established.

If both engines flame out at low airspeeds, insufficient windmilling rpm may cause loss of sufficient hydraulic pressure to power flight controls. With generators "off-line" the EPU, if in AUTO position, will automatically operate to power flight controls. As airspeed is increased for the required windmilling start envelope, sufficient hydraulic pump pressure may be available for flight control operation. To conserve EPU fuel quantity, turn off EPU if conditions permit. Restart EPU for final landing, if necessary.

ELECTRICAL FAILURE

DUAL GENERATOR FAILURE

1. THROTTLES – REDUCE POWER BELOW INTERMED (if above 25,000 ft).
2. EPU SWITCH – OFF.
3. BATTERY SWITCH – CHECK BATT.
4. GENERATOR SWITCHES – RESET/ON.

With complete electrical failure, all warning, caution, and indicator lights will be inoperative.

If Generators Do Not Reset, Proceed As Follows:

5. DESCEND — BELOW 25,000 FT.
6. OXYGEN — 100%
7. LAND AS SOON AS POSSIBLE.

NOTE

With ac power failure the battery bus will still provide external stores jettison thru JETTISON button if necessary.

ELECTRICAL FIRE

1. BATTERY & GENERATOR SWITCHES — OFF.

NOTE

With fuel boost pumps inoperative, flameout may occur if above 25,000 ft.

2. ALL ELECTRICAL EQUIPMENT — OFF.
3. BATTERY & GENERATOR SWITCH(ES) — ON (as required).
4. ELECTRICAL EQUIPMENT — ON (as required).
5. LAND WHEN PRACTICAL.

FUEL VENTING

1. FUEL TRANSFER PUMP SWITCHES — OFF.
2. EXT TANKS SWITCH — OFF.
3. MAIN & AFT TANK FUEL LEVELS — MONITOR.
4. TRANSFER PUMP SWITCHES — ON (as required to prevent venting).

NOTE

If excessive venting during air refueling occurs, discontinue refueling and monitor fuel system for possible malfunction.

FUEL TRANSFER PUMP FAILURE

1. THROTTLES — CRUISE POWER (6000 total PPH, or less).
2. FUEL QUANTITY — CHECK.
3. CROSSFEED SWITCH — AS REQUIRED (to maintain fuel level balance).

NOTE

- If the forward tank transfer pump fails, automatic gravity flow to the right main tank will be provided as fuel level in main tanks decreases.
- If the aft tank transfer pump fails, gravity feed to the left main tank will be delayed until fuel level in the main tanks drops below 1800 lb. level (interconnect tube).
- To assist gravity transfer of aft tank fuel, select crossfeed from left main while reducing power to maintain fuel flow rate of 6000 pph or less.

SMOKE, FUMES, OR ODOR

1. OXYGEN — 100%.
2. CHECK FOR FIRE.
3. CABIN PRESSURIZATION SWITCH — RAM/DUMP (if necessary).
4. IF CONDITION SEVERE — JETTISON CANOPY (below 300 KIAS).

DUAL HYDRAULIC PUMP FAILURE

1. EPU SWITCH – CHECK ON.
2. FLIGHT ATTITUDE – LEVEL (descending).
3. EPU FUEL QUANTITY – MONITOR.

NOTE

Minimize flight control movements.

4. FLAPS – EMERG UP.
5. LAND AS SOON AS POSSIBLE.
6. IF LANDING CANNOT BE MADE BEFORE EPU FUEL DEPLETION – EJECT (while in positive control).

WARNING

- Decision to lower landing gear thru use of alternate release should be made based on remaining EPU fuel quantity available to continue approach.
- Gear release requires approximately 1.5% EPU fuel and 5 seconds to lower gear to down and locked position.

SINGLE HYDRAULIC FAILURE

LEFT SYSTEM

1. L HYDRAULIC PRESSURE INDICATOR – CHECK.
2. PITCH CAS SWITCH – OFF.

WARNING

Failure to turn the PITCH CAS switch OFF may result in PIO.

NOTE

If left system fails, the following controls will be inoperative: NORMAL LANDING GEAR, NORMAL WHEEL BRAKES, NOSEWHEEL STEERING, GUN PURGE & DRIVE, SPEED BRAKE, AIR REFUEL DOOR, L AILERON PITCH CAS.

Prior to Landing:

3. ALTERNATE GEAR RELEASE D-HANDLE – PULL.

4. EMERGENCY BRAKE LEVER – PULL.

CAUTION

- Anti-skid brake system will be inoperative during emergency brake operation.
- Approximately 10 active pedal applications are available during emergency brake operation.

NOTE

After landing, the landing gear ground safety pins should be installed and the engines should be shut down and the aircraft towed to the parking area.

RIGHT SYSTEM

1. R HYDRAULIC PRESSURE INDICATOR – CHECK.

NOTE

If right system fails, the following controls will be inoperative: ALTERNATE LANDING GEAR RELEASE BOOST, TRAILING EDGE FLAPS, R AILERON.

If Low Pressure:

1. BOTH SYSTEMS – MONITOR.

2. LAND WHEN PRACTICAL.

If High Pressure (Above 3200 psi):

1. THROTTLE (affected engine) — IDLE.
2. FLIGHT CONTROL MOVEMENTS — MINIMIZE.
3. LAND AS SOON AS POSSIBLE.
4. CLEAR OF RUNWAY — SHUT DOWN AFFECTED ENGINE.

NOTE

With left engine shutdown, normal brakes and nosewheel steering will be inoperative. Use emergency brakes for stopping.

If Flight Controls Malfunction or Sluggish:

1. FLIGHT CONTROL MOVEMENTS — MINIMIZE.
2. LAND AS SOON AS POSSIBLE.

If Flight Controls Lock:

1. EPU SWITCH — ON.
2. EJECT (if control impossible).

FLIGHT CONTROL MALFUNCTIONS

If Following Caution Lights Illuminate:

TRIM FOLLOW UP

1. PITCH CAS SWITCH — CYCLE OFF/ON.

NOTE

- If failure still present the caution light will remain illuminated.
- System reverts to mechanical mode operation.

If failure occurs above 1.0 Mach, maintain 1.1 Mach or above and remain in or attempt to return to level flight. If unable, establish level turn.

WARNING

Failure to maintain airspeed above 1.0 Mach can result in PIO during transonic flight.

If Above 1.0 Mach:

1. EMERGENCY PITCH TRIM SWITCH — TRIM IN DIRECTION TO RELIEVE STICK FORCE UNTIL OBTAINING LEVEL FLIGHT WITH NEUTRAL STICK POSITION.
2. AIRSPEED — DECREASE BELOW 0.6 MACH & LAND WHEN PRACTICAL.
3. EMERGENCY PITCH TRIM SWITCH — TRIM FOR MINIMUM PITCH RESPONSE.

NOTE

Ground station can assist in determining optimum trim setting by monitoring the trim follow-up position telemetry data.

4. AIRSPEED — DECREASE BELOW 0.6 MACH & LAND WHEN PRACTICAL.

PITCH CAS

1. PITCH CAS SWITCH — CYCLE OFF/ON.

NOTE

- If failure still present, both PITCH CAS and TRIM FOLLOW UP caution lights will remain illuminated.
- System reverts to mechanical mode operation.
- If failure occurs above 1.0 Mach, proceed as for TRIM FOLLOW UP.
- PITCH CAS FAILURE
  1. AOA --- REDUCE TO LESS THAN 15 DEGREES.
  2. FLAP MODE SWITCH - EMERGENCY UP.

ROLL CAS

1. ROLL CAS SWITCH — CYCLE OFF/ON.

NOTE

- With roll CAS off, both ailerons will return to neutral.
- If failure was due to a transient (spike) rather than failure of a component, the caution light should go out and system roll CAS will remain operative.
- If failure still present the caution light will remain illuminated. Rolling tail will remain available; however, there is no roll rate command model following.

YAW CAS

1. YAW CAS SWITCH — CYCLE OFF/ON.
2. ROLL CAS SWITCH — CYCLE OFF/ON.

NOTE

- With yaw CAS off, both ailerons will return to neutral.
- If failure still present the caution light will remain illuminated and no yaw damping, lateral accelerometer signal, or angle of attack vane signal will be available.
- Manual control of rudders is available and response to ARI and SRI signals will remain operational.

L AILERON or R AILERON

1. ROLL CAS SWITCH — CYCLE OFF/ON.

NOTE

- With roll CAS off, both ailerons will return to neutral.
- If failure still present the respective caution light will remain illuminated.
- The respective aileron will become inoperative; however, the opposite aileron roll CAS and DE will remain operational.

ARI

1. YAW CAS SWITCH — CYCLE OFF/ON.
2. ROLL CAS SWITCH — CYCLE OFF/ON.

NOTE

- With yaw or roll CAS off, both ailerons will return to neutral.
- If ARI caution light remains on, either channel of SRI has failed; thus, only one-half deflection of rudders for SRI signals will be available.
- Or, either channel of ARI has failed causing one-half rudder deflection. In addition, the aileron CAS actuator of failed channel is disengaged and centered.
- Roll control and DE to that aileron are lost resulting in illumination of the respective aileron caution light; remaining aileron remains operational.
- DADC signal will be switched to back up mode of operation. AIR DATA COMPUTER caution light may or may not illuminate.

L RUDDER or R RUDDER

1. YAW CAS SWITCH — CYCLE OFF/ON.
2. ROLL CAS SWITCH — CYCLE OFF/ON.

NOTE

- With yaw or roll CAS off, both ailerons will return to neutral.
- If failure still present the respective caution light will remain illuminated.
- The respective rudder will not respond to yaw CAS, ARI, or SRI; however, manual control of the respective rudder is available thru rudder pedals.
- The opposite rudder to the failed aileron caution light will remain in operation for all functions.

FLAPS

If Conditions Permit:

1. FLAP THUMB SWITCH — UP/DOWN/AUTO.

If No Restoration of Control:

2. FLAP MODE SWITCH — EMERG UP.

NOTE

- Any failure of DADC will cause flaps to "freeze" at last commanded position.
- If failure still present the caution light will remain illuminated; however, override of flaps to up position is obtained thru use of EMER UP operation.

POST-STALL GYRATION

1. CONTROLS — NEUTRALIZE.

NOTE

Post-stall gyration recovery evidenced by increase in airspeed and decrease in angle of attack.

Recovery to normal flight may be accomplished after achieving flying airspeed. Roll motion may be corrected using ailerons to oppose roll. If yaw motion continues, proceed with spin recovery procedures.

SPIN RECOVERY

WARNING

Do not turn YAW CAS or ROLL CAS switches OFF when operating at high attitudes approaching spin entry conditions.

1. CONTROL STICK — SLIGHTLY AFT OF NEUTRAL.
2. AILERONS — INTO DIRECTION OF SPIN TURN.
3. RUDDER — FULL OPPOSITE (until recovery).
4. THROTTLES - IDLE.
5. FLAPS — AUTO.

NOTE

Spin recovery evidenced by nose down pitch attitude, increase in airspeed, and decrease in angle of attack.

Upon Recovery:

6. NEUTRALIZE ALL CONTROLS.

NOTE

This recovery procedure predicated upon engineering analysis and test wind tunnel results.

SPIN CHUTE DEPLOYED (AF72-1570)

After Intentional or Inadvertent Deployment:

1. HOOK SWITCH — UNLOCK/JETTISON.

If Chute Remains Locked:

2. POWER ARM SWITCH — ON.
3. EMERGENCY CHUTE JETTISON SWITCH — EMER CHUTE JETTISON.

If Chute Fails to Jettison:

4. EJECT.

BEFORE EJECTION

If Time and Conditions Permit:

1. IFF MASTER – EMER; MODE 3/A CODE -7700.
2. UHF – GUARD (transmit MAYDAY).
3. AIRCRAFT HEADING – TOWARD UNINHABITED AREA.
4. ATTAIN PROPER AIRSPEED, ALTITUDE, AND ATTITUDE.
5. SEAT – ADJUST (as required).
6. EMERGENCY OXYGEN BOTTLE – ACTIVATE.
7. PERSONAL LEADS – DISCONNECT.
8. HELMET VISOR – LOWER.
9. ASSUME PROPER POSITION.

EJECTION

1. EJECTION SEAT D-RING – PULL WITH BOTH HANDS.

WARNING

- Position arms close to body while pulling D-ring handle to preclude contact with canopy rails during ejection.
- The seat provides escape during level flight conditions from zero altitude and zero airspeed. Maximum safe velocity is limited to 600 KIAS or approximately 0.9 Mach.

LANDING

EMERGENCY BRAKES

1. EMERGENCY BRAKE LEVER — PULL.

NOTE

- Select emergency brakes at or after touchdown to prevent bleed-off of accumulator pressure.
- Normal braking not available if left hydraulic system inoperative.
- Anti-Skid system will be inoperative.
- Approximately 10 full brake applications available.

2. BRAKE PEDALS — APPLY STEADY PRESSURE.

CAUTION

Do not taxi aircraft to parking area if left hydraulic system failed.

SINGLE-ENGINE LANDING

1. GEAR LEVER — DOWN.

NOTE

If left hydraulic system inoperative, use landing gear alternate extension before touchdown and activate emergency brakes after touchdown.

2. FLAP THUMB SWITCH — AUTO.

3. AIRSPEED — MAINTAIN 10 KIAS ABOVE NORMAL UNTIL LANDING ASSURED (disregard AOA indexer).

★

CAUTION

Do not taxi aircraft to parking area if left hydraulic system failed.

DUAL-ENGINE FLAMEOUT LANDING

1. EPU SWITCH — ON (check light on).

WARNING

Limited duration of EPU operation (approximately 7.5 minutes) will require proximity of suitable landing surface for this emergency procedure.

NOTE

If windmilling engine hydraulic power available, leave EPU switch at OFF to conserve EPU fuel for landing.

2. STORES — JETTISON.
3. FLAP MODE SWITCH — EMERG UP.
4. AIRSPEED — 210 KIAS (optimum glide with 2000 lb fuel remaining. Add 5 KIAS for each 1000 lb additional fuel).

NOTE

Optimum airspeed provides for maximum range glide distance and maximum alternate landing gear release limit.

5. EPU SWITCH — ON (if OFF, prior to final).
6. ALTERNATE GEAR RELEASE D-HANDLE — PULL.

WARNING

- Decision to lower landing gear thru use of alternate release should be made based on remaining EPU fuel quantity available to continue approach.
- Gear release requires approximately 1.5% EPU fuel and 5 seconds to lower gear to down and locked position.

7. APPROACH & TOUCHDOWN AIRSPEED — 175 KIAS/ 155 KIAS (with 2000 lb fuel remaining. Add 5 KIAS for each 1000 lb additional fuel).

If Landing Not Assured:

1. EJECT.

On Landing:

1. EMERGENCY BRAKE LEVER — PULL.
2. WHEEL BRAKES — APPLY STEADY PRESSURE.

NO-FLAP LANDING

1. AOA INDICATOR — 10°.
2. AIRSPEED — 155 KIAS WITH 2000 LB FUEL REMAINING. Add 5 KIAS for each 1000 LB additional fuel.

ALTERNATE GEAR EXTENSION

1. AIRSPEED — 200 KIAS (or less).
2. GEAR LEVER — DOWN.
3. ALTERNATE RELEASE D-HANDLE — PULL.
4. GEAR INDICATORS — CHECK.

GEAR EXTENSION FAILURE

Considerations for Landing vs Ejection:

GEAR CONDITION		RECOMMENDED ACTION
NOSE	MAIN	
UP	BOTH DOWN	LAND
DOWN	BOTH UP	Decision to LAND or EJECT to be based on further analysis.
UP	BOTH UP	EJECT (unless carrying empty wing pylon tanks)
UP	ONE DOWN	EJECT
DOWN	ONE DOWN	

LANDING WITH NOSE GEAR UNSAFE

NOTE

Before landing request runway be foamed, expend excess fuel, retain empty wing pylon tanks, and jettison armament.

1. PATTERN — NORMAL.
2. THROTTLES — IDLE (at touchdown).
3. NOSE — LOWER GENTLY (before reaching 115 KIAS).

NOTE

- If nose gear is up, position throttles OFF when nose contacts runway.
- Do not use brakes if a safe stop can be made without them when nose gear is down but indicating unsafe.

4. WHEEL BRAKES — AS REQUIRED.

BELLY LANDING

Without Empty Pylon Tanks:

1. EJECT.

With Empty Pylon Tanks:

1. GEAR — UP.
2. PATTERN — NORMAL.
3. THROTTLES — OFF (at touchdown).
4. BATTERY & GENERATOR SWITCHES — OFF.

LANDING WITH ONE MAIN GEAR NOT EXTENDED

If all Attempts to Lower Gear Fail:

1. EJECT.

If Landing Must be Attempted:

1. PATTERN – NORMAL.

NOTE

With one main gear extended, touchdown in center of runway, hold wings level, nose-wheel steering (if nose gear down), and brake on extended gear to maintain directional control.

2. THROTTLES – IDLE (at touchdown).
3. THROTTLES – OFF.
4. BATTERY & GENERATOR SWITCHES – OFF.

SECTION IV

FLIGHT TEST INSTRUMENTATION

Table of Contents

GENERAL

The inflight test instrumentation concept is based on the requirement for processing numerous measurements with varied characteristics, to data process using computer techniques, to simultaneously record onboard the aircraft, and obtain real-time telemetry data. The installed airborne data acquisition equipment consists of digital data systems using serial pulse-code modulation (PCM) recorded on magnetic tape and telemetered. High frequency data is recorded in analog form. Cameras may be installed to provide specific functions. Discussion of test equipment in this section will be limited to operation of cockpit controls/ indicators.

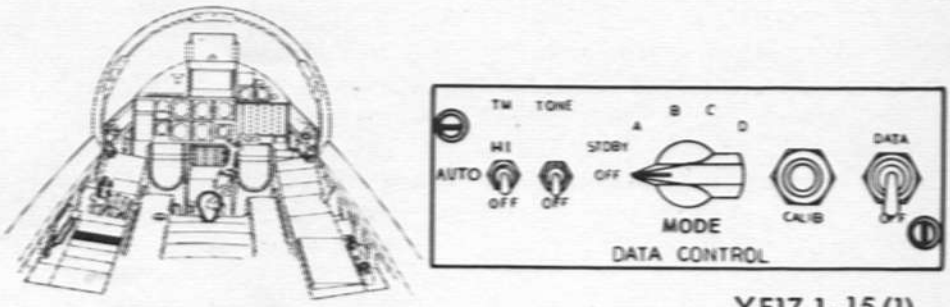
AIRCRAFT DIFFERENCES

Prototype No.1 (AF72-1569) and Prototype No.2 (AF72-1570) will be equipped with different cockpit controls/indicators to facilitate flight test scheduled programmed events. This instrumentation will in some instances temporarily replace previously installed equipment. The following functional descriptions show a cockpit illustration with a heavy black-marked locator to indicate the cockpit installed instrumentation for each aircraft.

NOTE

During scheduled stall/post-stall flight tests of AF72-1570, a 3rd battery will be installed in lieu of the TACAN receiver-transmitter in the avionics equipment bay. This battery provides emergency backup power for spin chute deployment and jettison, UHF radio, INS, telemetry data output, and data recording.

DATA CONTROL PANEL (AF72-1569 & AF72-1570)

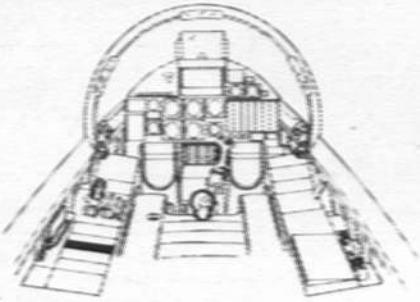


YF17 1-15 (1)

CONTROL/ INDICATOR	FUNCTION	
T/M (Telemetry Switch	HI	— Turns on T/M Transmitter in high power.
	AUTO	— Operates T/M transmitter in high power during flight or low power when on ground.
	OFF	— Turns off T/M transmitter.
TONE Switch	TONE	— Arms for 2-second tone transmission on UHF radio when pilot's event marker button is pressed.
	OFF	— Disables circuit.
Data MODE Selector	OFF	— Removes power from flight test instrumentation.
	STBY	— Provides warmup power without recording.
	A thru D	— Provides selection of data recorder combination as specified on flight test card.

CONTROL/ INDICATOR	FUNCTION	
CALIB (Calibration) Button	Push (Momentary)	— Initiates an automatic instrumentation calibration sequence.
DATA Switch	DATA	— Operates instrumentation recorders according to data mode selected.
	OFF	— Turns off all recorders.

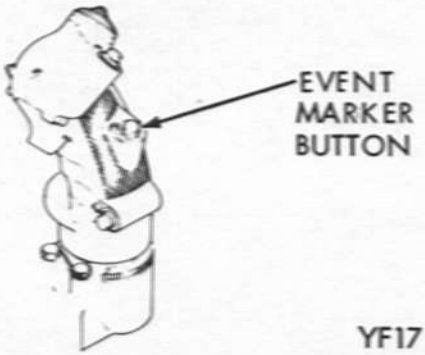
SHAKER CONTROL PANEL (AF72-1569)



YF17 1-15 (2)

CONTROL	FUNCTION	
Phase (between shakers)	IN	— Shaker mass in each wingtip actuates vertically together (in phase).
	OUT	— Shaker mass actuates in opposite vertical direction (at 180° out of phase).
Frequency	FIXED	— Shaker operates at a frequency as set on shaker display panel and adjusted by FINE ADJ.
	SWEEP	— Causes shakers to operate (in or out of phase) from 0 to 100% MAX for selected shakers.
FINE ADJ (Adjust) Frequency	INCREASE	— Used with FREQUENCY RANGE on frequency display panel to operate shakers in or out of phase. Frequency switch (above) must be at FIXED. Observe frequency on display panel digital indicator.
Shaker Switch	RUN	— Turns on shaker system.
	STOP	— Turns off shaker system.

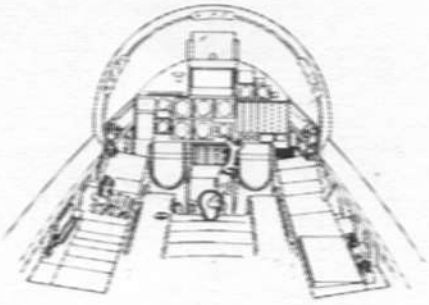
PILOT EVENT MARKER (AF72-1569 & AF72-1570)



YF17 1-15(7)

CONTROL	FUNCTION
AIR REFUEL DISCONNECT/ DOGFIGHT/ FLIGHT TEST FUNCTION (EVENT MARKER) Button	Press — Correlates pilot's observation with recorded and telemetered data.

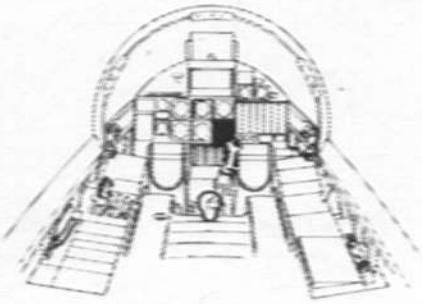
MISSION TIME COUNTER (AF72-1569 & AF72-1570)



YF17 1-15 (3)

INDICATOR	FUNCTION	
MISSION TIME Counter	Normal	— Indicates lapsed mission time, preflight actuated, digitally displayed in hours, minutes, and seconds.
	Optional	— Indicates last recorded lapsed time in hours, minutes, and seconds; updates at start of next recording sequence.

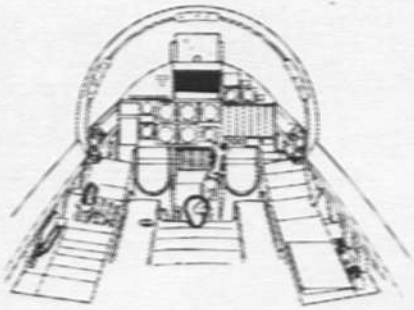
"G" LIGHT ACCELEROMETER (AF72-1569 & AF72-1570)



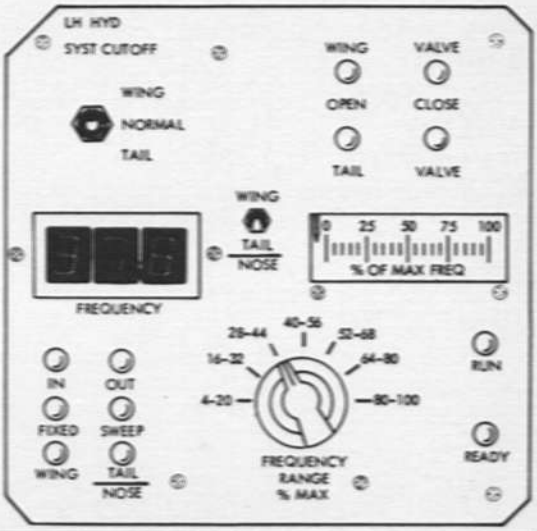
YF17 1-15 (4)

CONTROL/ INDICATOR	FUNCTION
Lights	During flight maneuvers, the maximum "G" will appear as a light on the test accelerometer at 0.5-G intervals.
RESET Button	Press — Turns off light indications.

FREQUENCY DISPLAY PANEL (AF72-1569)



YF17 1-15(5)

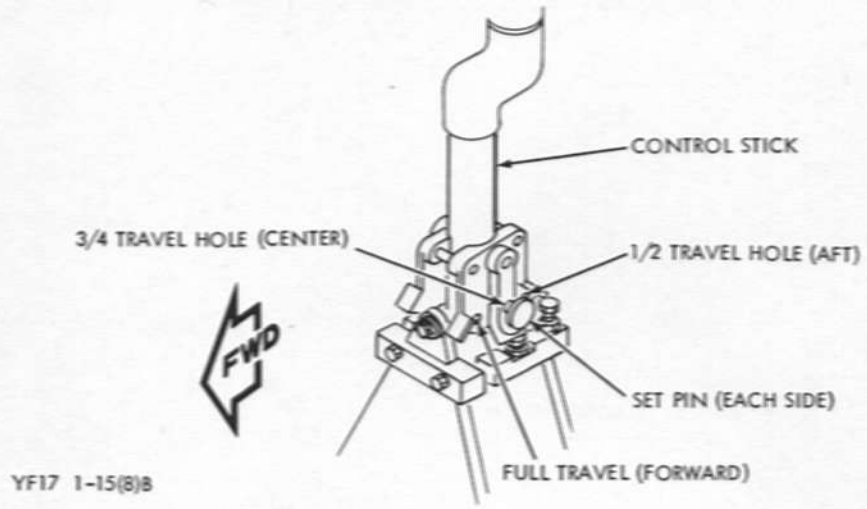


CONTROL/ INDICATOR	FUNCTION
LH HYD SYST CUTOFF Switch (Left hydraulic system)	WING – Cuts off left hydraulic power. Wing right system normal. NORMAL – Normal hydraulic power supplied to left wing and tail. **WARNING** PITCH CAS switch must be positioned to OFF before repositioning LH HYD SYST CUTOFF switch from NORMAL. TAIL – Cuts off left hydraulic power to tail.
LH HYD WING/TAIL VALVE Telights	WING VALVE – OPEN: Indicates left hydraulic power valve in normal position. – CLOSE: Indicates left hydraulic power valve in closed position.

CONTROL/ INDICATOR	FUNCTION
LH HYD WING/TAIL VALVE Telights (Continued)	TAIL VALVE — OPEN: Indicates left hydraulic power valve in normal position. — CLOSE: Indicates left hydraulic power valve in closed position.
Digital FREQUENCY Counter	Indicates actual shaker frequency in cycles/second for selected shaker set.
Shaker Selector Switch	WING — Selects left and right launcher rail shakers for operation. TAIL NOSE — Selects tail or nose shaker depending which was preflight connected.
Analog FREQUENCY Meter	Needle position indicates actual selected shaker frequency in percent of maximum during frequency sweep operation.
FREQUENCY RANGE % MAX Selector	Preselects coarse frequency setting as one of seven ranges, expressed in percent of maximum. For 100% MAX: WING = 22 cps, NOSE = 11 cps, TAIL = 55 cps.
System Status Telights	Operate: RUN — Indicates shakers operating. READY — Indicates system powered and on standby. Selection: WING — Wing shakers selected. TAIL NOSE — Tail or nose shaker selected.

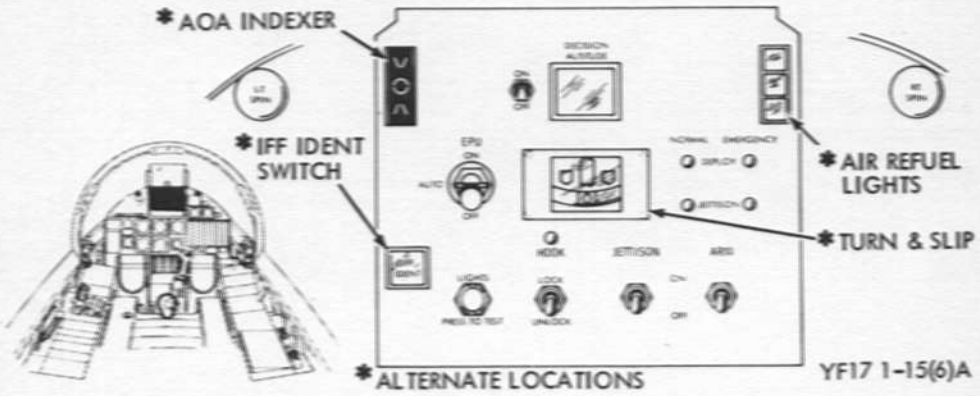
CONTROL/ INDICATOR	FUNCTION
System Status Telights (Continued)	IN — Indicates shaker switch is "in phase" position. OUT — Indicates shaker switch is "out of phase" (180°) position. FIXED — Indicates shaker switch is in "fixed frequency" position. SWEEP — Indicates shaker switch is in "sweep" position.

CONTROL STICK LATERAL LIMITER (AF72-1570)



CONTROL	FUNCTION
Stick Lateral Limiter	NO STOP — Pulling out springloaded set pins and swinging to FORWARD position will permit stick lateral motion to full travel. 3/4 STOP — Setting the pins in CENTER position provides three-quarter stick lateral travel. 1/2 STOP — Setting the pins in AFT position will limit stick lateral motion to one-half full travel.

SPIN CHUTE CONTROL PANEL (AF72-1570)



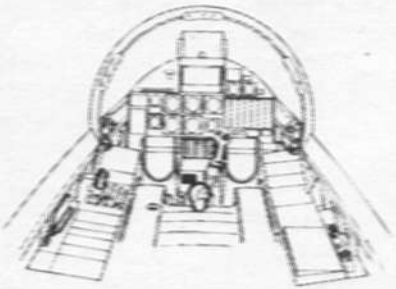
CONTROL/ INDICATOR	FUNCTION	
DECISION ALTITUDE (Altitude Warning) Light	Indicates aircraft has reached critical limit altitude. Pilot must decide if recovery is assured or deployment of spin chute is necessary. The altitude switch is set for 30,000 ft.	
Altitude Caution Light Cutoff Switch	ON	— Enables altitude caution light circuit.
	OFF	— Disables altitude caution light circuit to prevent light operation during normal flight below 30,000 ft.
EPU Switch	ON	— Activates emergency hydraulic power unit supplying hydraulic power to flight controls.
	AUTO	— EPU automatically activated upon loss of generator power from both engines.
	OFF	— EPU is inactivated or turned off.

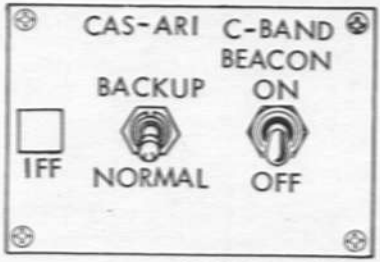
*

CONTROL/ INDICATOR	FUNCTION
PRESS-TO-TEST LIGHTS Button	Press — Supplies power to test all telights on panel.
HOOK Switch	LOCK — Mechanically locks spin recovery chute to airframe (for normal flight leave switch at UNLOCK). UNLOCK — Mechanically unlocks spin recovery chute from airframe and releases chute if it has been deployed.
Hook LOCK Telight (LOCK)	On — Indicates hook is in fully locked position. Off — Indicates that the hook is unlocked or that the explosive bolt has fired.
JETTISON Switch	ON — Fires explosive bolt and jettisons chute from aircraft. OFF — Disables jettison circuit. NOTE Use only if HOOK switch fails to jettison spin chute.
ARM Switch	ON — Supplies normal and emergency power to spin recovery chute DEPLOY and JETTISON circuits (electrically arms system). OFF — No power supplied to DEPLOY and JETTISON circuits.

CONTROL/ INDICATOR	FUNCTION
Power On Telights (DEPLOY) (JETTISON)	NORMAL — Indicates that normal electrical power is supplied to the DEPLOY and JETTISON circuits. Light off — no power. JETTISON — Indicates that emergency electrical power is supplied to DEPLOY and JETTISON circuits. Light off — no power. NOTE If all lights not indicated on during press-to-test preflight check, do not accept aircraft for flight.
Spin Direction (LT SPIN) (RT SPIN) Lights	Indicates direction of spin upon reaching critical yaw rate of 50 degrees per second.
Spin Chute Deploy Switch (Pitch CAS Cutoff Switch on Control Stick).	Press — Activation by pilot hand chop deploys spin chute and starts cameras. **WARNING** Hook LOCK switch must be positioned at LOCK prior to deploying chute.

IFF IDENT, CAS-ARI, & C-BAND BEACON SWITCHES (AF72-1569 & AF72-1570)





YF17 1-15(9)

CONTROL/ INDICATOR	FUNCTION
IFF IDENT SWITCH/ INTERROGATION INDICATOR	Alternate location when SPIN CHUTE PANEL installed. Function identical as previous.
CAS-ARI Switch	BACKUP — Simulates DADC input failure to CAS. NORMAL — Provides normal DADC inputs to CAS.
C-BAND BEACON Switch	ON — Turns C-Band beacon on. OFF — Turns C-Band beacon off.

SECTION V

FLIGHT TEST CONFIGURATIONS

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GENERAL

The objectives, methods, and responsibilities for flight test development and evaluation, and the scheduled program specific test objectives and procedures with various aircraft configurations are fully covered in "USAF/NORTHROP YF-17 Flight Test Program Plan" dated 15 January 1974.

CONFIGURATIONS

The basic aircraft configuration is wingtip launcher rails and no pylons. Launcher rails are equipped to carry AIM-9E missiles. Outboard pylons (when installed), will carry dummy ECM pods. Each inboard pylon (when installed) will carry a 600-gallon fuel tank or inert MK-84 LDGP bomb. Provisions for a dummy centerline pylon with a 300-gallon nonfeeding fuel tank, on AF72-1570, to test drag characteristics, is programmed for a future date. The M61A1 gun is installed in AF72-1569. Ballast equivalent to the gun will be installed in AF72-1570. During spin tests with AF72-1570 the speed brake installation will be removed and a spin-recovery parachute and controls will be installed.

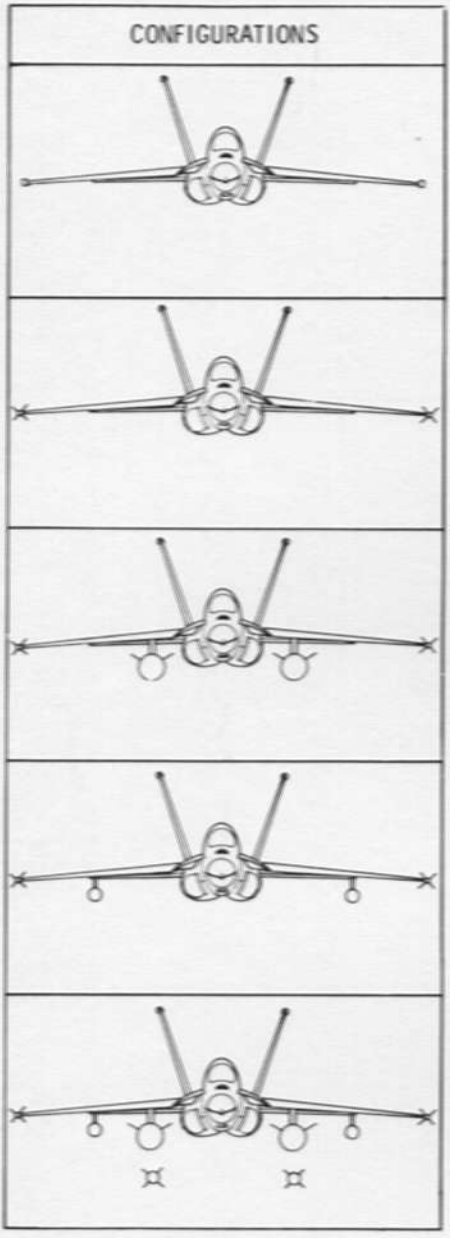

Figure 5-1. YF17 1-19A

SECTION VI

OPERATING LIMITATIONS

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GENERAL

Flight and operating limitations per se are not included within this manual. Refer to "YF-17 Flight and Operating Limitations" for current limitations status.

STALL-RELATED FLIGHT CHARACTERISTICS

The effect on limitations for the following stall-related flight characteristics are applicable.

1. Angle of Attack (AOA) — No limitation on AOA. Stall is characterized by reaching the aft stick stop with no further increase in AOA.

2. Thrust Changes — No limitations on thrust changes insofar as potential loss-of-control is concerned.

3. Aft Stick Application — No limitation on magnitude, duration, or rate of aft stick application.

4. Coordinated Control Inputs — No limitation in application of coordinated lateral and directional control inputs at high AOA with sustained application permissible up to 360° of roll.

ENGINE OPERATING LIMITS

ENGINE OPERATING ENVELOPE

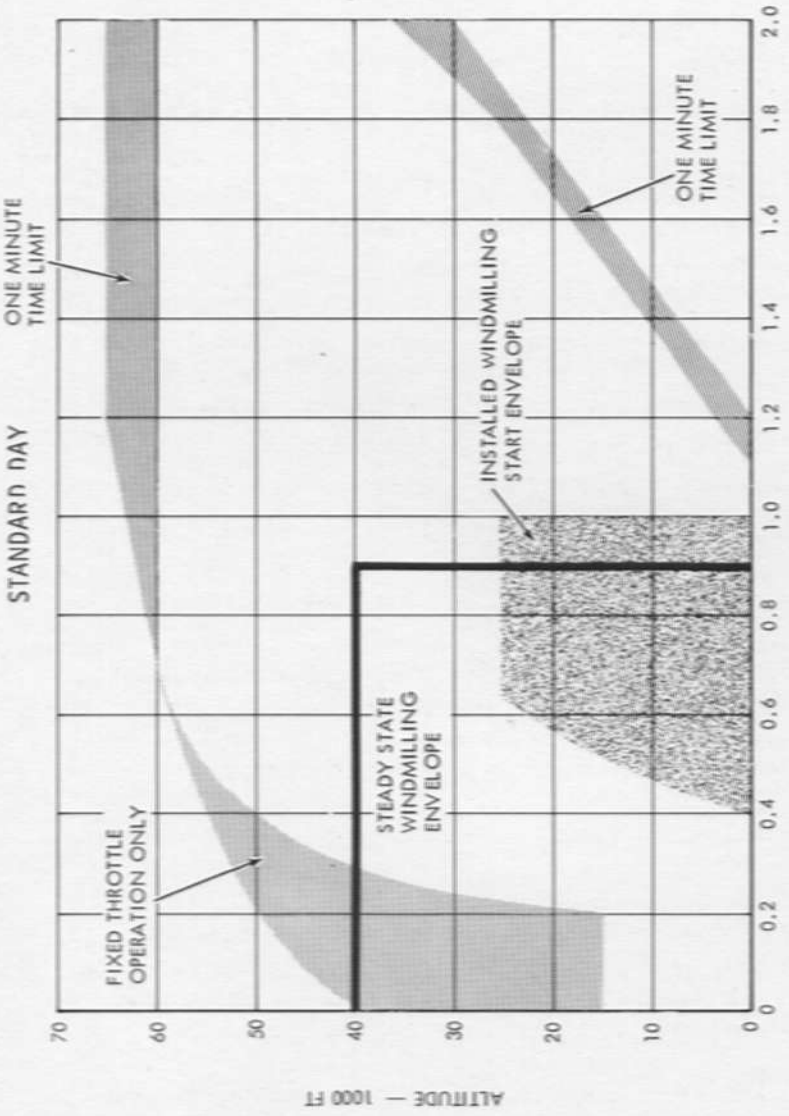

Figure 6-1.

5. Maneuvering — Maneuvering at high load-factors can safely be performed even if the flaps are selected to UP position (the leading edge flaps being automatically extended above 15° AOA regardless of the position selected on the flap thumb switch).

6. Buffet — No limiting conditions.

7. Power Approach — Maneuvering in the power approach configuration should be limited to no more than 20° AOA.

ICING AND LIGHTNING CONDITIONS

Anti-ice equipment for wings, empennage, engine inlet ducts, engine inlet guidevanes, pitot-static system, and canopy and windshield heat is not provided. Therefore, flight in known icing and lightning conditions is prohibited.

ENGINE OPERATING ENVELOPE

The engine operating envelope is presented in figure 6-1.

CONDITION (STEADY STATE)	EGT - °C (MAX)	N1 (% RPM)	N2 (% RPM)	OIL PRESS (PSI)	FUEL FLOW (PPH)	DURATION (MINUTES)	NOZZLE POSITION (%)
Start	760	—	—	10 (min) 200 (max)	300 (min)	—	0 - 3
Idle	415 (Ground) 575 (Flight)	50 (min)	68 (min)	55 - 95	—	—	80 - 95
Max Continuous	780	—	—	80 - 130	—	—	0 - 35
Intermediate	825	102 (max)	100 (max)	80 - 130	—	30	0 - 50
Maximum	825	102 (max)	100 (max)	80 - 130	—	15	45 - 95

NOTE

- Abort start if EGT reaches 760°C (record maximum T6C in Form 781).
- Minimum ground start recycle time is 30 seconds after rotors coast to stop.
- Steady State Windmilling Limits:

  a. Do not exceed 0.9 Mach or 40,000 ft altitude; or N2 rpm of 30%.

  b. Continuous N2 rpm permitted between 15% to 25%.

  c. Limited to 30 minutes at N2 rpm less than 15% (two periods per flight).

  d. Limited to 5 minutes N2 rpm between 25% to 30%.

- Air Turbine Starter Duty Time:

  1 minute ON, 30 seconds OFF
  6 minutes ON, 35 minutes OFF

- Ground Restart Air Motoring Times:

Time Since Shutdown	Minimum Prestart Motoring Time
0–10 minutes	0
10 minutes — 6 hours	One cycle (starts at N2 rpm 24%): 1 minute ON followed by immediate start
Over 6 hours	0

- Engine Transient Limits:

N1 (low pressure) rpm 103% (10 seconds)

N2 (high pressure) rpm 101% (10 seconds)

EGT — 850°C

- Engine Shutdown

Ground Operation — 3 minutes Idle

After Landing — Immediate shutdown if N2 rpm did not exceed 81% for 5 minutes prior to shutdown. (Transients to 84% permitted not to exceed total of 10 seconds.)

SECTION VII

PERFORMANCE DATA

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GENERAL

Specific flight performance data necessary for each flight will be obtained from the Engineering Flight Test Card (NOR 68-131). Program flight performance data is provided in the Performance Data Supplement, Appendix II of NOR-74-101 as issued by YF-17 Aero/Propulsion Integration, Organization 2611, Zone 52. Estimated takeoff and landing airspeeds for representative configurations are outlined below for planning purposes.

TAKEOFF

	HALF INTERNAL FUEL (2) AIM-9 MISSILES	FULL INTERNAL FUEL (2) AIM-9 MISSILES	FULL INTERNAL FUEL (2) FULL EXTERNAL TANKS (2) AIM-9 MISSILES
Weight (lb)	21,910	24,890	33,640
V_{ROT} (KIAS)	115	127	135
$V_{T.O.}$ (KIAS)	128	136	147

LANDING

	1000 LB INTERNAL FUEL (2) AIM-9 MISSILES	FULL INTERNAL FUEL (2) AIM-9 MISSILES
Weight (lb)	19,930	24,890
Approach (KIAS)	122	136
Touchdown (KIAS)	117	130

LANDING

	1000 LB INTERNAL FUEL (2) AIM-9 MISSILES	FULL INTERNAL FUEL (2) AIM-9 MISSILES
Weight (lb)	19,800	24,800
Approach (KIAS)	125	145
Touchdown (KIAS)	120	140

LANDING DISTANCE

IDLE POWER, 2300 FT ASL, CG 30% MAC (Approx)

TEMP		GROUND ROLL DISTANCE – FT	
°C	°F	19,000 LB GROSS WT	24,400 LB GROSS WT
10	50	2500	3100

NOTE

- Distance variation with nonstandard day temperatures is negligible.
- Distances do not include delayed braking.

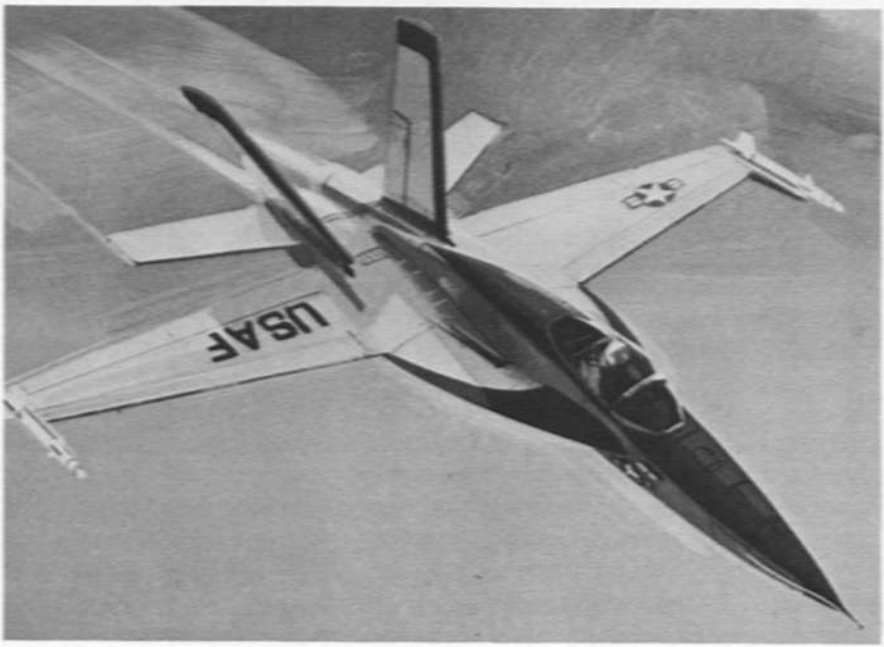
NOR-74-101
APR 1974

APPENDIX I

YF-17

INERTIAL NAVIGATION SYSTEM

OPERATING PROCEDURES



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Northrop Corporation
Aircraft Division

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INERTIAL NAVIGATION SYSTEM OPERATING PROCEDURES

GENERAL

Methods of alignment, data entry and correction, inflight, and system turnoff procedures are consolidated herein for ready reference.

CAUTION

- In normal operation, with ac and dc power available, allow a minimum of 15 seconds in the OFF position for internal shutdown sequence.
- If ac power is interrupted, with dc power available, the INS will operate normally for a period of approximately 3 minutes and then automatically shut down. If the INS automatically shuts down, then the mode selector should be turned to OFF for 5 minutes before initiating the turn-on sequence.
- If both ac and dc power are interrupted, the INS will shut down immediately. After shutdown the mode selector should be turned to OFF for 5 minutes before initiating the turn-on sequence.

PREFLIGHT PROCEDURES

GYROCOMPASS (GC) ALIGNMENT

1. ELECTRICAL POWER — ON.
2. MODE SELECTOR — ALIGN GC.
3. DISPLAY/DIM CONTROL — PRESS & ADJUST.
4. DATA SELECT — PP.

5. DEST DATA — POSITION 1.

NOTE

Entry of departure point LAT and LONG, and magnetic variation should be accomplished within 2 minutes of system turn on.

6. N2 OR S8 (LAT) PUSHBUTTON — PUSH (as appropriate).

7. KEYBOARD NO. PUSHBUTTONS (LAT) — PUSH (deg, min, sec).

NOTE

First significant digits will appear at right end of display and proceed to the left as new digits are entered.

8. ETR PUSHBUTTON — PUSH

9. W4 OR E6 (LONG) PUSHBUTTON — PUSH (as appropriate).

10. KEYBOARD NO. PUSHBUTTONS (LONG) — PUSH (deg, min, sec).

11. ETR PUSHBUTTON — PUSH.

12. DATA SELECT — MAG VAR.

13. W4 OR E6 (variation) — PUSH (as appropriate).

14. KEYBOARD NO. PUSHBUTTONS (variation) — PUSH.

NOTE

Enter variation to nearest tenth of a degree (include .0 if required). Ignore degree symbol (°) in display for entry of variation value. Symbol applies only to LAT and LONG.

15. ETR PUSHBUTTON — PUSH.

16. STATUS/MODE LIGHTS — MONITOR (as follows):

    1 minute — ALN ON.

    3 minutes — AHRS ON; ALN ON.

    5 minutes — AHRS OUT; LTD ON; ALN ON.

    10 minutes — LTD OUT; ALN FLASH.

17. MODE SELECTOR — NAV (ALN out; NAV on).

STORED — HEADING ALIGNMENT

1. ELECTRICAL POWER — ON.
2. MODE SELECTOR — ALIGN STOR.
3. DISPLAY/DIM CONTROL — PRESS & ADJUST.
4. POINT-OF-DEPARTURE DATA — CHECK.

NOTE

- Ensure that system previously gyrocompassed and aircraft not moved since last turnoff.
- Digital readout of LAT and LONG displayed if DATA SELECT positioned at PP or DEST, and DEST DATA at required thumbwheel position.

5. STATUS/MODE LIGHTS — MONITOR (as follows):

   1 minute — ALN ON

   3 minutes — ALN FLASH; LTD ON

NOTE

If procedure continued for 6 minutes, system will begin gyrocompass and will complete gyrocompass at 10 minutes. LTD light will then go out.

6. MODE SELECTOR — NAV (ALN out; NAV on: LTD on, unless system completed gyrocompass time cycle).

DESTINATION DATA ENTRY

Destinations (with exception of DEST DATA position 1) and desired track data may be inserted or changed during any mode of system operation while on ground; NAV mode only in flight.

1. ELECTRICAL POWER — ON.
2. MODE SELECTOR — ALIGN GC OR STOR.
3. DATA SELECT — DEST.
4. DEST DATA — POSITIONS 2 THRU 10 (as desired).

NOTE

Destinations can be stored in computer before takeoff and may be changed at any time in flight.

5. DESTINATION DATA — ENTER.

NOTE

- Use same keyboard procedures as for departure point entry latitude and longitude stored in DEST DATA position 1.
- Repeat procedures for each position.

DESIRED TRACK DATA ENTRY

Insertion of desired magnetic track data for selected destinations is not required due to inoperative HSI interconnect.

CLEARING DATA ENTRY ERROR

If an error is made during keyboard data entry while entering latitude, longitude, magnetic variation, or desired track (ETR pushbutton not activated):

1. CLR PUSHBUTTON — PUSH.

If error not discovered until after computer entry has been made (ETR pushbutton was activated):

1. DATA ENTRY CYCLE (in error) — REPEAT.

INFLIGHT PROCEDURES

During flight while operating in NAV mode, the system will automatically track aircraft movement and will respond with data as selected by the DATA SELECT control (see functions in section I). The following procedures provide the necessary means to change stored data in flight.

CHANGING DESTINATIONS

1. MODE SELECTOR — NAV.
2. DATA SELECT — DEST.
3. DEST DATA — POSITION (as required; except No. 1).
4. DESTINATION DATA — ENTER.

UPDATING POSITION

Inertially derived position being computed during flight can be manually updated. This is accomplished by flying over a known reference point on the ground whose exact coordinates can be compared to the inertially-derived present position coordinates at the instant of flyover. Using a preset destination data point is the best method for accomplishing this procedure.

1. DATA SELECT — DEST.
2. DEST DATA — POSITION (desired).
3. FIX PUSHBUTTON — PUSH (at instant of flyover).

NOTE

- Present position coordinates, as computed, will be stored in memory.
- FIX pushbutton will light and remain depressed.

4. DATA SELECT — UPDATE

NOTE

- Left and right numeric displays will now show difference in distance (nm) between the stored present position and the stored destination position coordinates.
- Changing N/S and E/W distance (nm) to selected destination position is displayed. Displayed distance equals DEST DATA position minus inertial computed position (N&E = plus) (S&W = minus).
- The displayed values represent vectors at right angles and aligned in cardinal directions.

5. UPDATE DATA — ACCEPT OR REJECT.

NOTE

Deciding factors are:

- If either value larger than 5 nm, the ERR light will illuminate.
- Time duration since last update — larger difference due to longer time.
- Accuracy of inertial data — if known.
- Altitude — higher, the less accurate.

If decision to accept:

6. UP DT PUSHBUTTON — PUSH.

NOTE

- FIX pushbutton light will go out.
- Inertially-derived present position coordinates will be corrected by amount which was displayed in update readouts.

If decision to reject:

7. FIX PUSHBUTTON — PUSH.

NOTE

FIX pushbutton light will go out, and inertially-derived coordinates will be computed from previous data.

STEERING

Only magnetic heading is supplied to the heading card in the HSI by the INS; therefore, full capability of the HSI for steering with the INS is nonoperational in the YF-17 prototype. To obtain desired data for display on CDU:

1. DATA SELECT — TTD, RNG/BRG, GS/CRK, DA/MTK (as appropriate).

TURNOFF PROCEDURE

If a stored heading alignment is to be used on the next flight, a gyrocompass alignment must be accomplished. After alignment, the aircraft must not be moved before the INS is again set to NAV for subsequent taxi. To accomplish turnoff:

1. MODE SELECTOR — OFF.