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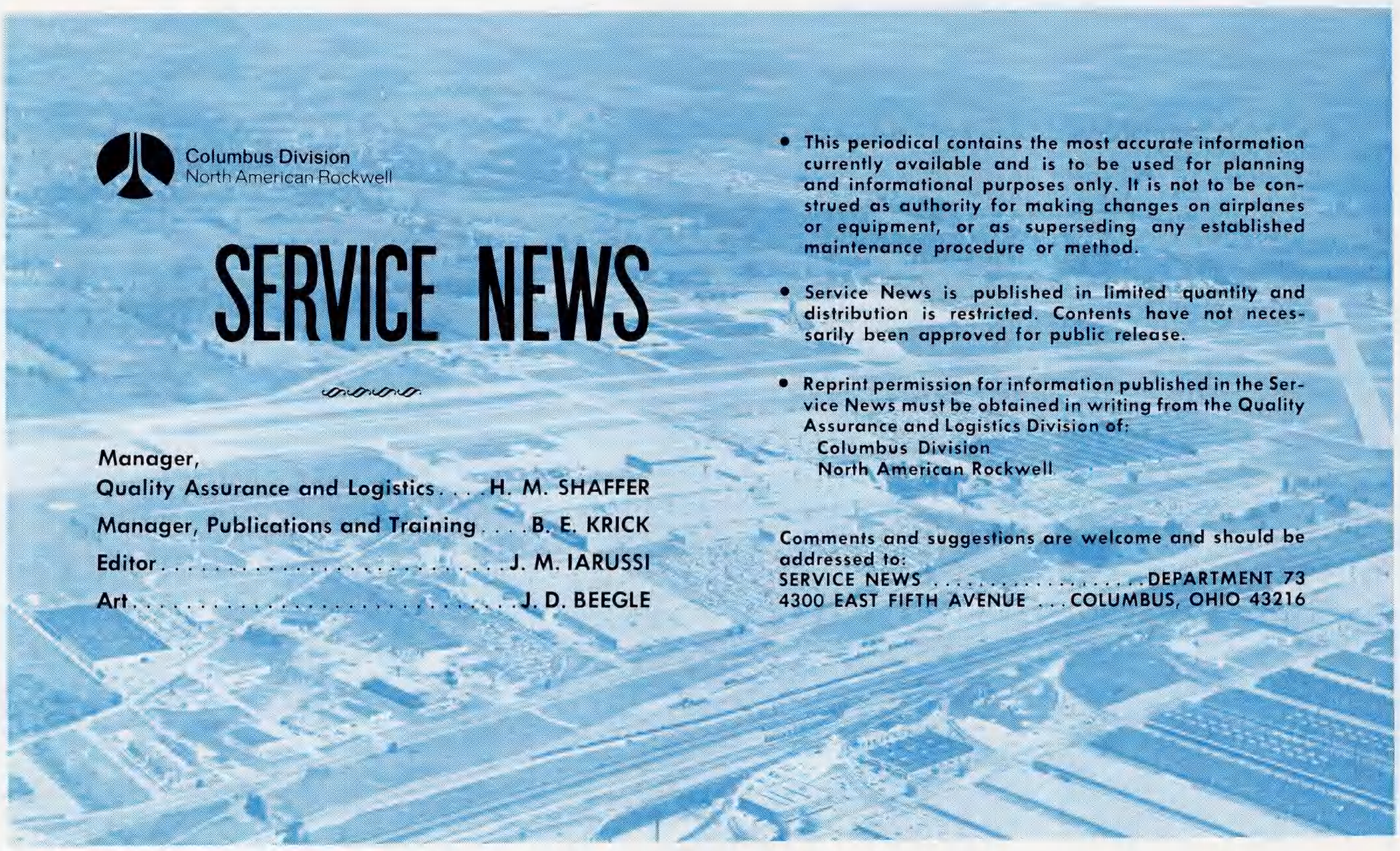
Columbus Division
North American Rockwell

SERVICE NEWS

Feature Issue . . .

OV-10A "Bronco"

U.S. AIR FORCE
U.S. NAVY
U.S. MARINE CORPS



Columbus Division
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SERVICE NEWS

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From the Editor -

This Service News feature issue is dedicated to Navy, Marine, and Air Force personnel who fly and maintain the OV-10A Bronco. The skills and dedication of the pilots and of the men maintaining the Bronco have given the airplane a truly outstanding record. An airplane manufacturer may produce a fine product, but without the efforts and contributions of many service personnel, an airplane such as the Bronco could not have achieved the results it has over the past 3 years.

NOTICE

With this issue the Columbus Division Service News will temporarily cease publication. From the first issue dated 1 May 1952 to the present, the Service News has provided the most current information in support of our products in the field. It is hoped that the Service News has been an asset to our readers. Comments and suggestions from both field representatives and service activities were greatly appreciated and surely contributed to the long standing success of this publication.

Table of Contents-

OV-10A "Bronco"

The first of 271 OV-10A Broncos rolled off the production line at the Columbus Division of North American Rockwell in June 1967. During these past 3 years, the Bronco has seen service with the U.S. Navy, U.S. Marine Corps, and the U.S. Air Force and has proven itself as a counterinsurgency and limited warfare aircraft.

The development of the Bronco, from design to combat operations, is shown in Table 1.

Table 1.

Navy designation	OV-10A
NR designation	NA-305
Descriptive designation	Bronco
Mock-up	Jan. 1965
Contract approval	Oct. 1966
First flight prototype No. 1	Mar. 1967
Preliminary NPE	Apr. 1967
First production aircraft	June 1967
First Flight prototype No. 2	July 1967
Phase II preliminary NPE	Sept. 1967
First combat mission	July 1968
BIS trials	Aug. 1968
Number of aircraft manufactured	USN/USMC 114 USAF 157

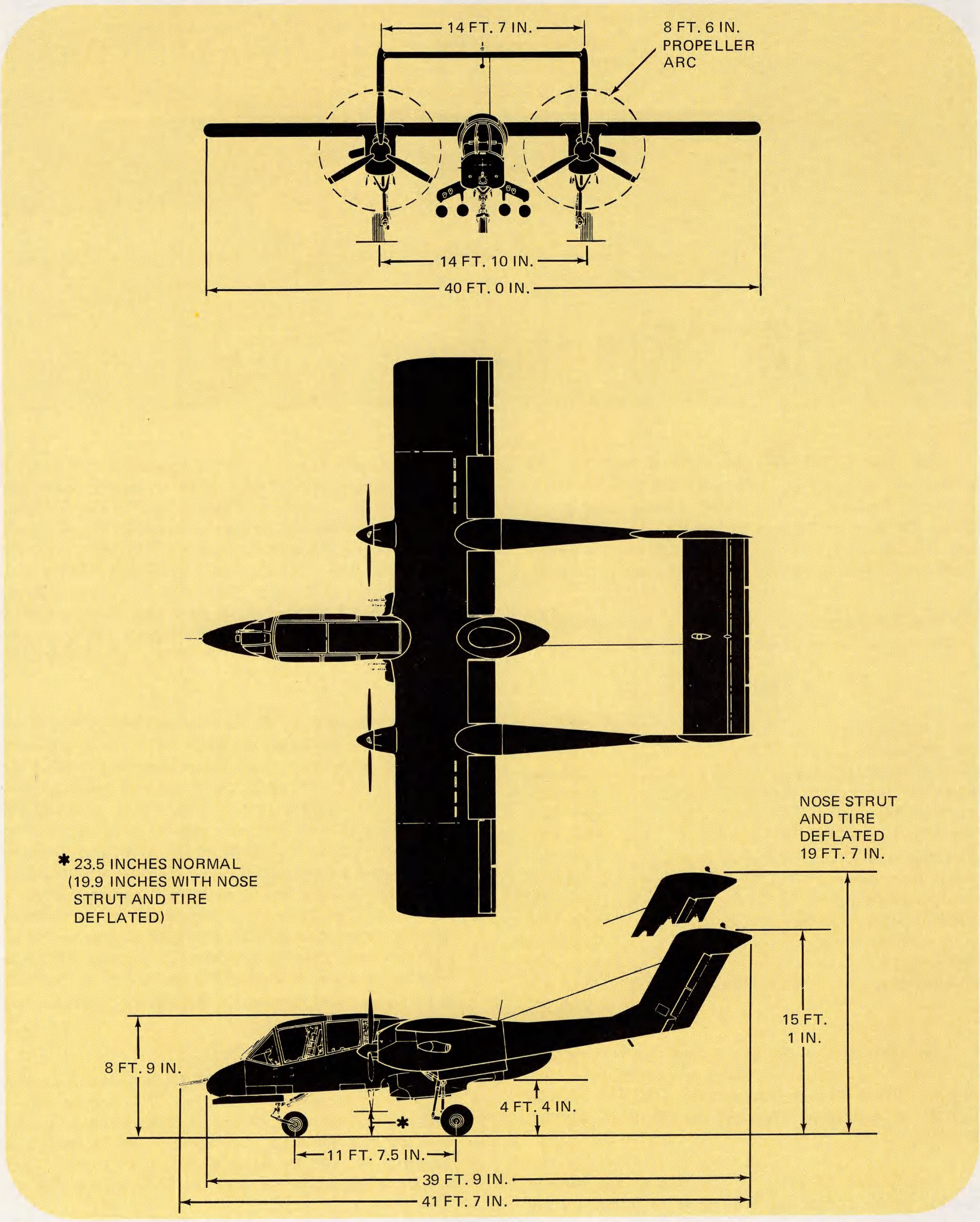
The capabilities of the aircraft have also been realized by foreign countries. West Germany and Thailand have ordered 18 and 16 aircraft respectively. The West German aircraft is designated OV-10B; the Thailand aircraft, OV-10C.

As depicted in Table 1, the Bronco was used in combat before completing BIS (Board of Inspection and Survey) trials. This is unusual because a new aircraft usually completes BIS trials prior to service induction. The need for aircraft in Vietnam such as the OV-10A, however, necessitated sending it overseas. The Bronco's first combat mission, following a ferry flight from the Philippines, was flown on 6 July 1968, just 2 hours after landing in South Vietnam. Since that first mission, Navy, Marine, and Air Force pilots have logged thousands of hours in the Bronco and their reports attest to the capability, ruggedness, and flexibility of this unique aircraft.

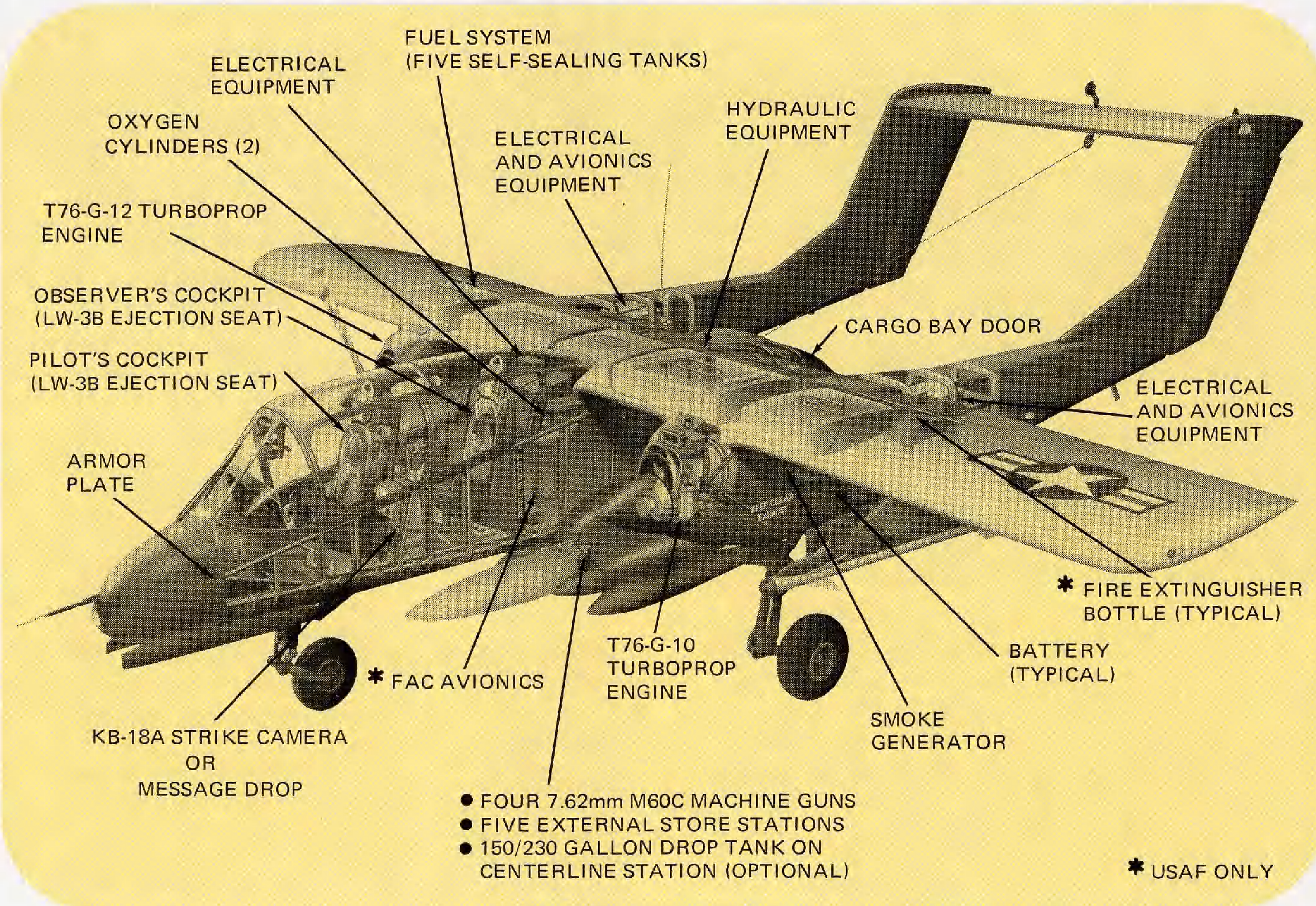
The versatility of the Bronco has been proven by its capability to perform a variety of military missions, including observation and reconnaissance, forward air control (FAC), helicopter escort, ground attack, target marking, artillery spotting, liaison, utility, training, and light transport. The Bronco is capable of operating from rough clearings and primitive roads, as well as prepared airfields and aircraft carriers. The performance capability of the aircraft was further exemplified when a Bronco, enroute to the 1969 Paris Air Show, set an Atlantic crossing record for turboprop aircraft in the 13,000 to 17,000 pounds gross weight class. The crossing was made from Stephenville, Newfoundland, to Mildenhall, England, in 11 hours and 49 minutes, a distance of approximately 2522 statute miles.

The August 1967 issue of Service News was dedicated to the debut of the OV-10A Bronco. This feature issue is dedicated to the Navy, Marine, and Air Force personnel who fly and maintain the Bronco. The information presented reflects the latest aircraft configurations and changes incorporated on both the Navy/Marine and Air Force aircraft.

OV-10A AIRCRAFT



GENERAL ARRANGEMENT



System simplicity, accessibility, and ease of maintenance were prime objectives in designing the OV-10A. Most of the systems are manually operated, thereby providing high system effectiveness with minimum complexity. While the number of components has been held to a minimum, identical and interchanageable items are used wherever possible. Main landing gear, propellers, and engine gearboxes are the only major components requiring right- and left-hand configurations.

Main identification features of the OV-10A include a rectangular (constant chord), shoulder-mounted wing, a large canopy, and high vertical stabilizers with a high set horizontal stabilizer. The color scheme of the U. S. Navy and U. S. Marine Corps OV-10A aircraft is field green with a gull gray underside and white on the upper surface of the wing. The U.S. Air Force version is completely gull gray with white on the upper surface of the wing. See cover.

Both pilot and observer are positioned well forward of the engines and wings for maximum visibility. A 90-percent visibility overlap between crewmen assures close coordination during visual surveillance missions.

Each cockpit is equipped with an LW-3B ejection seat system capable of zero altitude and zero velocity ejections.

The ejection seat, instruments, and primary flight and engine controls in the aft cockpit can be readily removed, thereby enlarging the 75-cubic foot cargo compartment to 110 cubic feet. The cargo compartment can accommodate either: (1) five fully-equipped paratroopers, (2) two litter patients and a medical attendant, or (3) a maximum of 3200 pounds of cargo. The cargo compartment door swings open 180 degrees for unobstructed loading and can be removed for air drop operations.

In addition to four 7.62 mm M60C machine guns mounted in the sponsons, a variety of external stores and munitions can be carried on the sponson and centerline stations. Either a 150- or 230-gallon drop tank can be carried on the centerline station, and provisions are provided for mounting missiles and rockets under the wings.

"RIDING the BRONCO"

A Pilot's Viewpoint

by

ED GILLESPIE

COLUMBUS DIVISION
NORTH AMERICAN ROCKWELL
CHIEF TEST PILOT

Regardless of rumors or appearances, this airplane does not fly quite as easily as a "double-breasted cub" and does demand more of the pilot than merely reading the manual. Throughout the "Bronco" development period, we tried to optimize the flying qualities of the airplane for the operational missions that the airplane will be performing. This means short, low-speed take-offs and landings, lengthy cruise flight periods, tight and fast maneuverability for forward air control and armed reconnaissance missions, and a stable, but responsive weapons platform for delivering ordnance on target.

The cockpit layout is functional and displays Air Force, Army, and USN commonality. Engine instruments are on the right side of the instrument panel and the UHF transceiver controls are on the left side of the instrument panel. The "basic six" flight instruments are grouped in the center. The cockpit reflects the best efforts of tri-service pilots and mock-up board members to integrate all of the requirements and practices of the individual services into one layout acceptable to all—in itself, no easy trick.

Though the airplane is of simple and proven construction, it behooves future "Bronco Busters" to thoroughly acquaint themselves with the operating characteristics of solid shaft turboprop engines, the flying qualities and performance, particularly in the areas of take-off and landing, and single-engine control and flyaway speed characteristics.

PREFLIGHT, START, and TAXI

A walkaround preflight inspection can be quickly conducted. Primarily check conditions of canopy and access doors for security, tires and brakes for wear, intakes and exhaust for plugs removed and cleanliness, wings for fuel leaks, cargo compartment for loose gear, hydraulic reservoir level, and angle-of-attack and pitot-static covers off. Entrance into the cockpit is awkward, but once in, the pilot's sitting position is comfortable and easily adjusted. After strapping in properly and arming the seat, starting is simple. Either battery or external power starts are available. With the battery switch on, condition levers at "FUEL SHUT-OFF," and power control levers at the "FLIGHT IDLE" position, only advancement of the condition levers to "NORMAL FLIGHT" and monitoring of engine temperature is required after the start switch is actuated. Following the start, it is necessary to reverse each prop to ensure that prop locks have been retracted prior to taxi. The airplane taxies moderately fast on the level with power control levers at about the "FLIGHT IDLE" position. Reverse thrust is available for braking and maneuvering very sharp turns. Nose wheel steering is also available, but is generally utilized only when maneuvering across unprepared terrain. Taxiing is usually performed with the condition levers in the "NORMAL FLIGHT" position to provide the lowest noise level.

TAKE-OFF and CLIMB

Prior to moving into the take-off position on the runway, double check all canopies locked (both fore and aft edges) and all trims at zero. Condition levers should be in the "take-off and land" mode (T.O./LAND) and throttles advanced to limit engine temperature or limit torque depending on pre-take-off calculations. The airplane can be maintained statically with MRT applied by holding brakes. Engine temperature is slow to rise and the airplane will probably be allowed to roll before engine temperature stabilizes. Rudder effectiveness is available almost immediately upon brake release. Direct cross winds of up to 20 knots can be tolerated although lateral effectiveness will be low during the initial take-off roll. In this case, just let the airplane assume a list and maintain directional control utilizing rudder until the airplane is airborne. Good lateral effectiveness is immediately available upon main gear lift-off. Normal take-offs on adequate runways will be performed with zero flaps as this enables the airplane to attain a safe single-engine climb (flyaway) speed more quickly. For short field take-offs, half flaps will be used. Rotate the airplane briskly once the minimum single-engine speed is obtained and retract the gear by depressing the gear handle latch and firmly punching the handle upward. The gear will come up in about 10 seconds and lock home with a firm "klunk."

CRUISE

Reconnaissance cruise will probably be conducted at altitudes from 500 to 1000 feet with power settings of 90% to 92% rpm which will provide approximately 180 KIAS. A typical cross-country cruise will be at 5000 to 8000 feet with power settings of 89% to 91% providing a true airspeed of approximately 200 knots. Long-range (ferry) flights will be performed at the oxygen altitudes at lower power settings and true airspeeds of approximately 170 knots. In all cases, the engines will be in the "normal" mode to provide best miles per pound of fuel and the lowest noise levels. Trimmability is outstanding and the airplane can be maintained in wings level flight utilizing the rudders for directional and roll control while the pilot is studying the necessary navigation paraphernalia. The view from the airplane is outstanding under any flight condition. In the cruise region, especially at low altitude, an almost panoramic view is presented to the pilot. The field of view is equal to or better than most bubble-type helicopters.

MANEUVERABILITY

The "Bronco" has a design load factor range from +8.0 to -3.0 "g's" within the allowable speed envelope and the flight characteristics displayed in this wide range during maneuvering flight with a normal cg show the airplane to its best advantage. Relatively light control forces and high response are exhibited during maneuvering at normal maneuvering speeds (160 to 350 KIAS). The light forces enable the airplane to be turned continuously as would be the case during recco or foward air control missions without causing excessive pilot fatigue. Control displacement requirements are relatively low, again reducing the workload of the pilot. Lateral response is good at normal approach speed (75–100 knots), and is very good above 250 knots. Adverse yaw is present in the landing configuration, but is easily corrected by the very effective rudders. Moderate pitch excursions are noticeable with large lateral deflections during high-speed rolls, but are not noticeable during normal corrective control movements. The yaw damper effectively presents small amplitude directional snaking during tracking runs in turbulence. It is recommended the damper be turned off for other flight conditions. The turning radius of the airplane is remarkably small and a 360-degree turn could be completed within the confines of the average college football stadium, although this is not recommended on Homecoming Day.

The "Bronco" displays no unusual characteristics during high-speed flight, although steep dive angles are required to obtain speeds in excess of 350 KIAS. Control forces laterally and longitudinally, remain light at high speed. Rudder forces increase, but are still moderate. With no external stores, airframe buffet is negligible. Engine torques increase significantly with a decrease in altitude and/or an increase in airspeed; consequently, in high-speed flight, especially in cold weather, attention to engine limits is absolutely required, or the engine will be unacceptably overtorqued.

STALLS and SPINS

Normal stall characteristics of the "Bronco" are about the only similarity it has to a "cub." Artificial stall warning is provided by a rudder pedal shaker 3–10 knots above stall depending on power setting (the higher the thrust, the lower the stall warning). In addition, cruise and landing configuration stalls are characterized by natural airframe shake 5 to 7 knots before stall occurs with full aft stick. Stall breaks are not finite and the wings can be maintained level, fully stalled, by judicious use of rudders; however, a high sink rate develops. Take-off stalls occur with less stall warning, but in an abnormally steep attitude. This stall is characterized by an increase in sink rate, moderate directional wandering, and if continued, the nose will slice either left or right until recovery is made. In all cases, recovery is immediate with relaxation of aft stick and application of aileron and rudder to control any roll or yaw tendencies. Because of the lack of a finite stall break, actual stall speeds are nebulous, but at nominal gross weights (9500 pounds) minimum speeds are about 55 KIAS in the take-off configuration, 64 KIAS in the landing configuration, 60 KIAS in the power approach configuration, and 70 KIAS in the cruise configuration.

Because of the high maneuverability and the operational requirement for pilots (particularly FAC) to maintain their attention outside of the cockpit, it is reasonable to expect that accelerated stalls will be encountered more often in the "Bronco" than in other types. Accelerated stalls are easily recognized and stall and recovery characteristics are excellent. As "g" is increased and/or airspeed is decreased during turning flight or symmetrical pullups, moderate to heavy airframe and rudder pedal shake occurs 5 to 8 knots prior to stall. Stall occurs with a moderate but firm pitch-down and a mild tendency to roll either left or right, which can easily be stopped with lateral control. Recovery is effected by relaxation of aft stick and the airplane is immediately under full control.

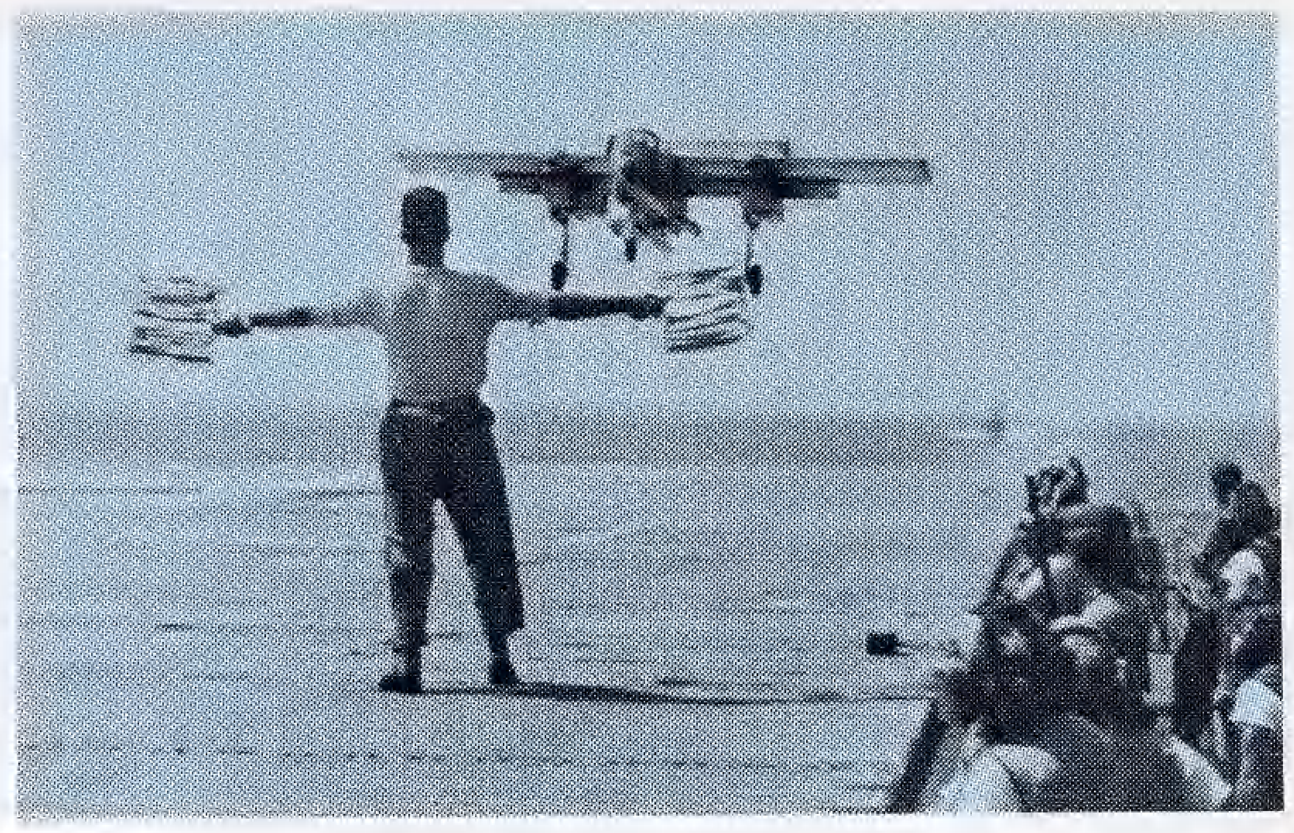
Because of mild stall characteristics and strong rudder effectiveness, the airplane resists spinning in any configuration. If desired, the airplane can be made to spin to the left or right and recovered quickly. Spins are characterized by pitch oscillations during the first turns from about 60–80 degrees, then becoming steadier at the third turn. After the third turn, the spin usually slows of its own accord for one-half turn, then speeds up and repeats the cycle if pro spin controls are maintained full. Recovery can be effected within one-fourth turn by application of opposite rudder and neutral stick. The only difference between normal 1.0 "g" and accelerated entry spins is that the airplane will perform a couple of snap rolls in the direction of applied rudder following an accelerated entry prior to entering the normal upright spin.

SINGLE-ENGINE CHARACTERISTICS

Intentional shutdown or loss of an engine in the normal flight envelope of the airplane is easily handled. The windmilling propeller automatically seeks essentially a no-thrust blade position which varies according to the flight speed. In the cruise configuration, it is normal for the airplane to yaw and roll slightly into the failed engine. The pilot will instinctively apply corrective roll and yaw controls generally requiring less than half of the total control available. The problem may then be sorted out and the propeller feathered without undue hurry on the pilot's part. The airplane can be trimmed up hands-off in single-engine flight. Loss of an engine in the take-off configuration will result in greater yaw and roll toward the failed engine, but recovery may be made to wings level flight at and above 80 KIAS. The airplane must be cleaned up by retraction of gear and flaps and speed increased above 90 knots to achieve flyaway. Loss of an engine in the landing approach configuration results in very mild roll and yaw toward the failed engine which are very easily controlled. Power should be added smoothly to the operative engine, flaps retracted, and speed increased to at least single-engine flyaway in case a wave-off is necessary. The airplane does not have single-engine flyaway capabilities with the gear and flaps down.

Air start procedures are simple requiring only actuation of the air start switch, replacement of the condition lever to the "NORMAL FLIGHT" position, and monitoring of the engine temperature. Power control levers should be set between "FLIGHT IDLE" and half-way to "MILITARY." Drag pulses from the starting engine may be expected as rpm increases above 80%.

APPROACH and LANDING



Gear limits are 158 KIAS and operation provides no trim changes. Full flap (40°) limit is 130 KIAS and will require about one unit nose-down trim to compensate. Normal field landings can be made at any approach airspeed above single-engine minimum, but 85 to 90 KIAS is recommended with 20° flap selected. A "seat of the pants" instinct should be utilized to determine if power is symmetric during the approach. Due to the rapid thrust response available, small throttle changes will produce considerable thrust variances and if they are not symmetrical, it will quickly be apparent to the pilot by sideslip angle or a loss of lift on one side. Therefore, throttle movements during approach should be made smoothly and simultaneously correcting any change in asymmetry by advancing or retarding either or both throttles to maintain balanced flight. Because of the large percentage of lift generated by the propellers, it is recommended that the throttles not be retarded quickly as the airplane may yaw unsymmetrically and commence a high sink rate at low approach speeds. Gentle flared landings are possible during landings on normal length runways. Short field approaches should be conducted with full flap at the minimum single-engine approach speed (dependent on gross weight) and as the desired landing spot is reached, the airplane should be firmly "planted" by symmetric throttle reduction with no attempt to flare. The rugged landing gear enables landings of this type to be made safely though somewhat unnaturally. Reverse thrust can be selected during either normal or short field landings immediately upon main gear touchdown. Adequate directional control is available through use of brakes or rudders during reverse thrust operation. Heavy braking should be avoided until the full weight of the airplane is on the landing gear as brake power is high enough to cause the tires to skid if landings are made with even light brake pressure applied.

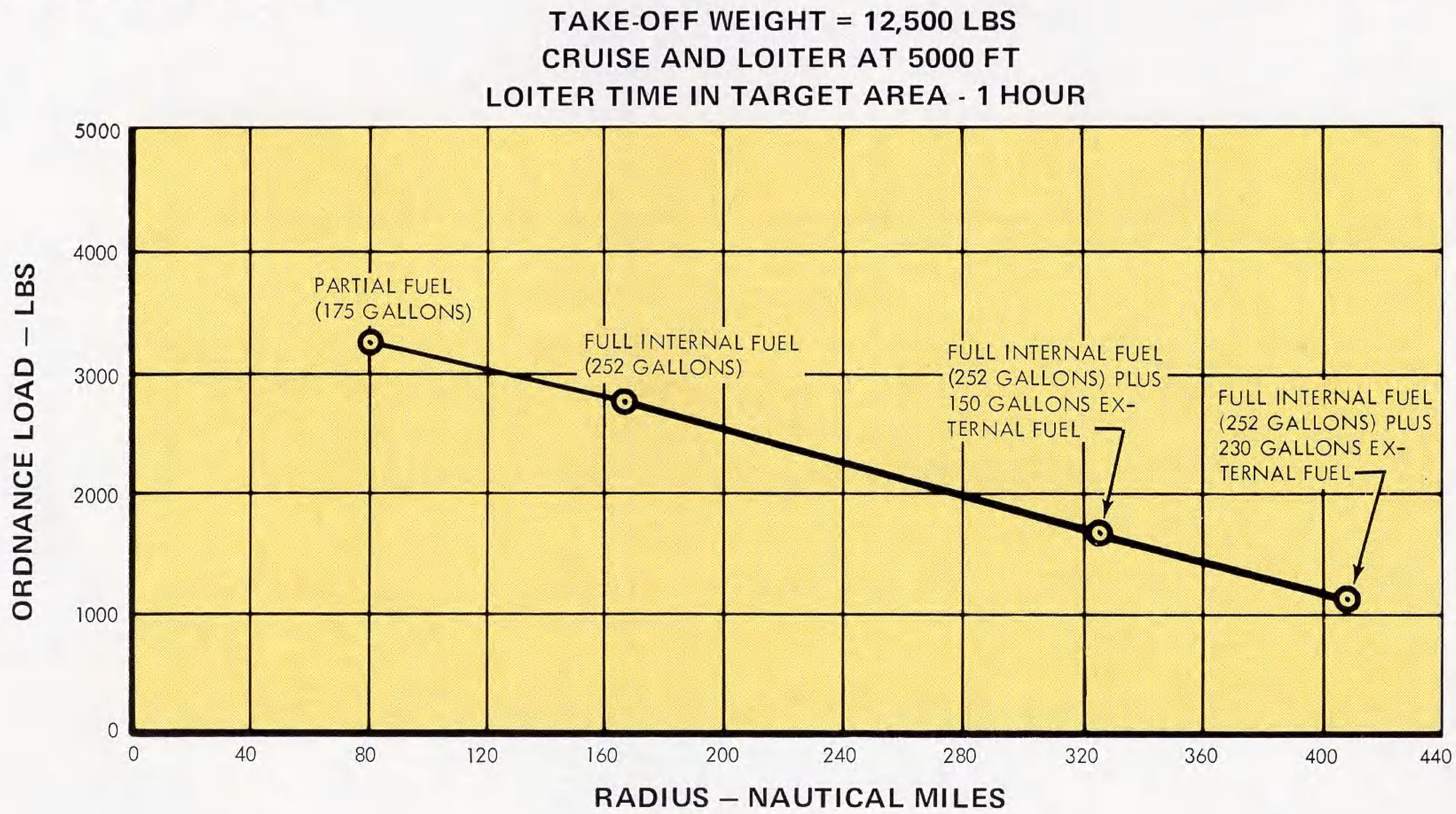
When not being shot at in combat or on GCA final at night in thunderstorms, pilots will find the "Bronco" a fun airplane to fly because of its wide speed range, rugged structure, crisp maneuverability, and outstanding visibility. These characteristics and the airframe component arrangement enable the "Bronco" to do a multitude of jobs with the workload on the pilot eased due to stable, responsive, and safe flight characteristics.

FLIGHT CHARACTERISTICS

The OV-10A is one of the first aircraft specifically designed for close-in battlefield conditions and is capable of supporting all requirements of air-ground operations. Designed for operation in the medium-to-lower end of the performance spectrum, the OV-10A is faster and more tactically versatile than helicopters and slower but more maneuverable than jets. The OV-10A can perform many missions which previously required several different types of aircraft. The following charts have been prepared to illustrate the flight characteristics and capabilities of the OV-10A:

- Mission Capability
- Take-off
- Landing
- Performance
- Operational Flight Envelope
- Sustained Turn Capability
- Dive Capability
- Carrier Suitability

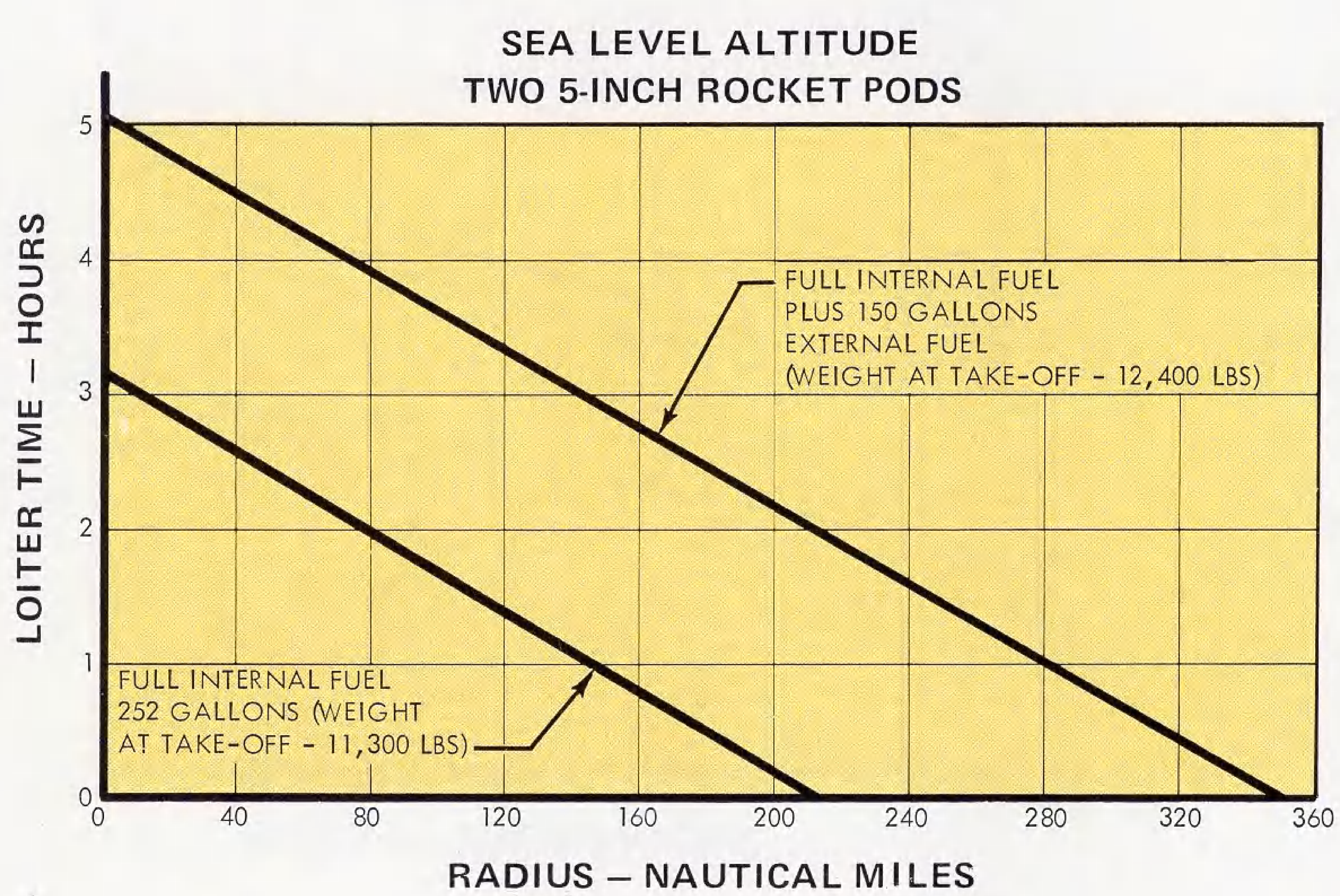
● MISSION CAPABILITY



▲ **Close Support—Strike Mission**

The OV-10A is capable of carrying a large amount of external stores and munitions over a wide range. A cargo bay also makes it possible to carry litter cases, cargo, and paratroops.

The effect of loiter time on the radius is similar to that shown for FAC missions.

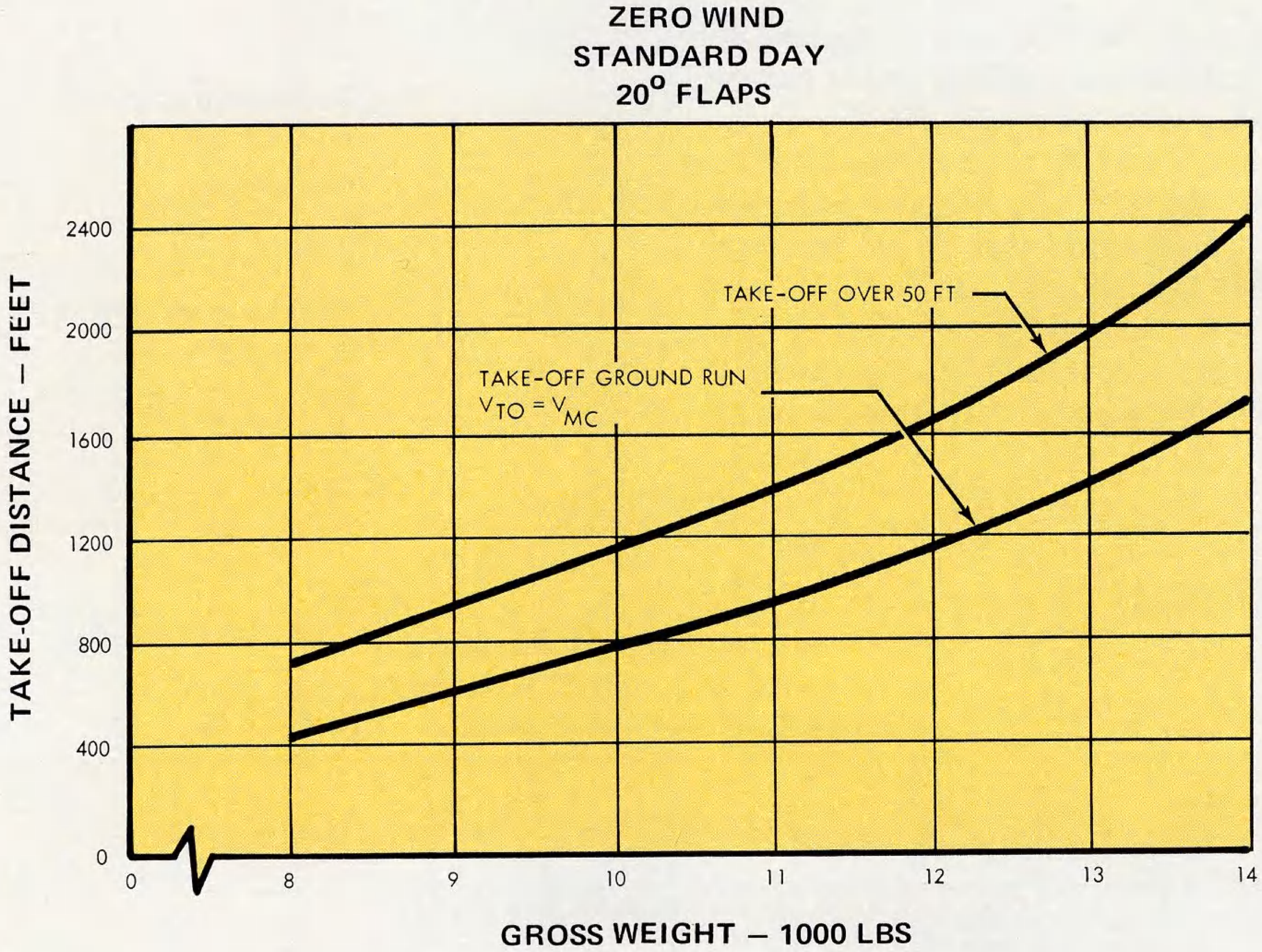


◀ **Forward Air Control (FAC) Mission**

Excellent visibility for both crewmembers, coupled with the range and loiter characteristics of turboprops, make the OV-10A well-suited for FAC, helicopter escort, and reconnaissance-type missions.

Flight Characteristics (Cont.)

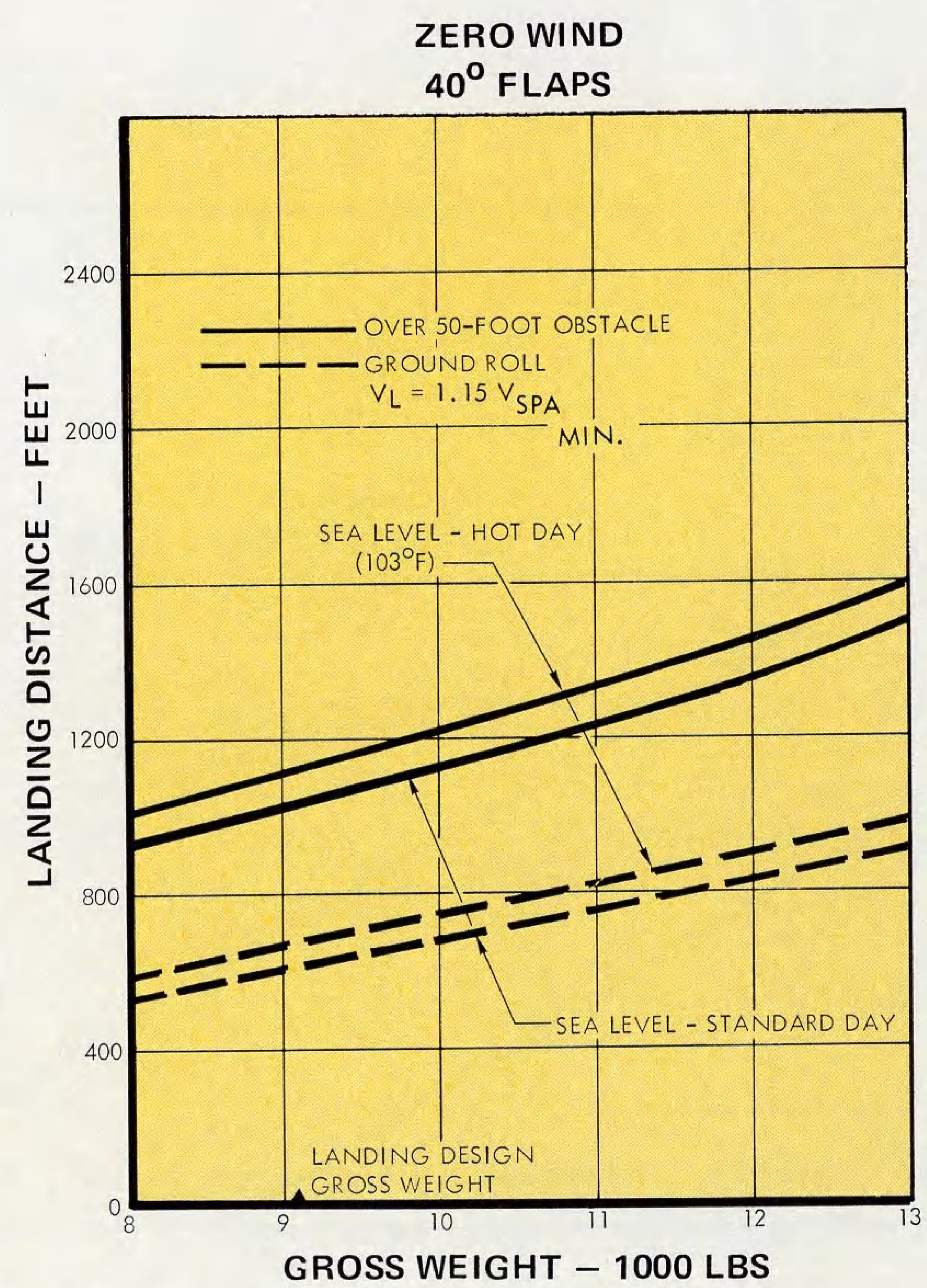
● TAKE-OFF



A "washed wing" combined with double-slotted flaps make the OV-10A a truly STOL aircraft. The counterrotating propellers eliminate any swing on take-off and provide better single-engine operating characteristics.

● LANDING

The excellent landing characteristics of the OV-10A are achieved by combining an efficient high-lift system, a rugged landing gear which is capable of absorbing high impact loads, and a fast-acting reverse thrust system. Able to land within a ground roll of approximately 600 feet, the aircraft has a minimum of bounce back and the reverse thrust, being well-balanced, presents no problems to the pilot in keeping the aircraft in line.



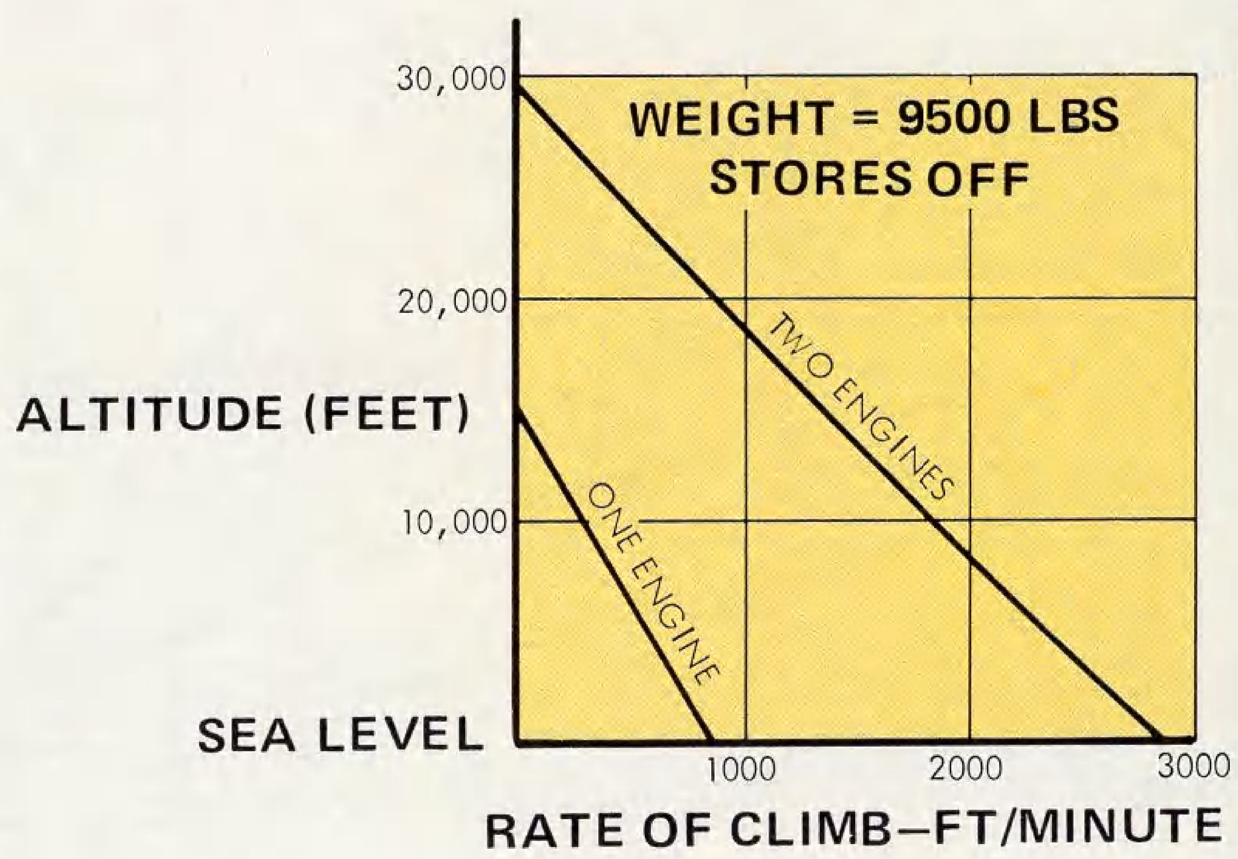
Flight Characteristics (Cont.)

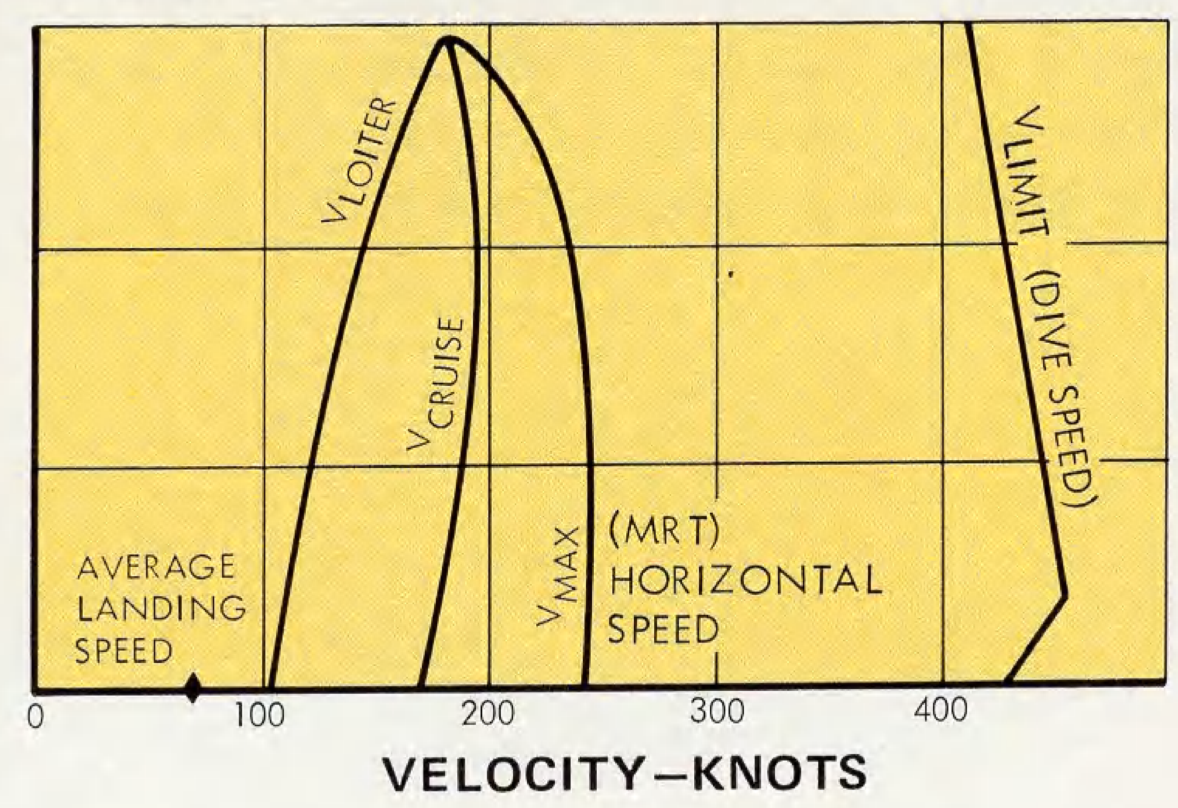
● PERFORMANCE

The speed range of the OV-10A is well-suited for close support, visual reconnaissance, and changing battlefield environments. Low, slow, close-in search is possible in rugged terrain and, if the situation warrants, high-speed dives and zooms to safe altitudes are available.

The single-engine characteristics of the aircraft improve its survivability. The only single-engine limitations are altitude and speed, with range actually increased at low weights and altitudes.

STANDARD DAY





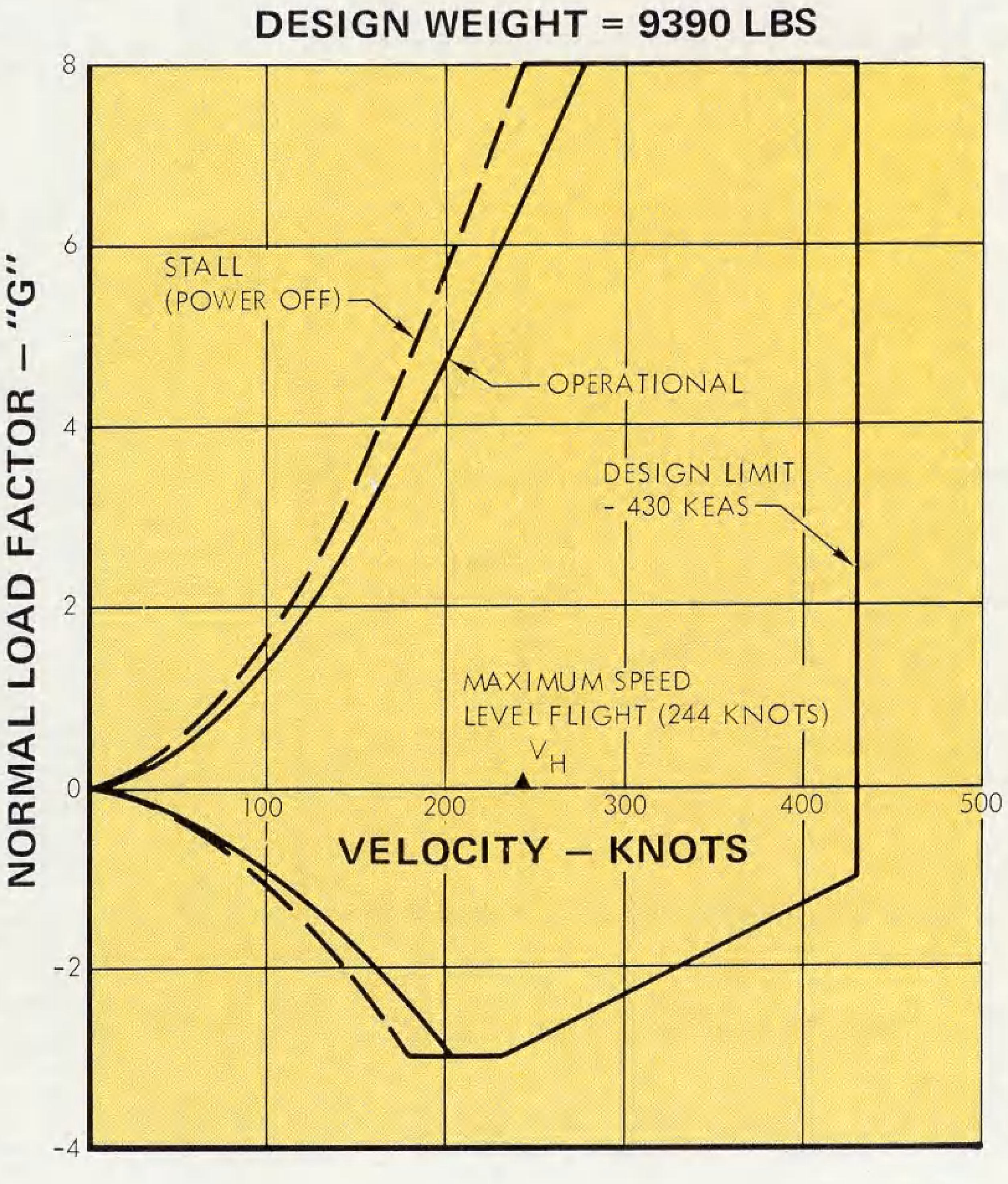
● SUSTAINED TURN CAPABILITY

The turning capability of the OV-10A indicates its ability to operate over any type of terrain (valleys, etc) and to remain close to the target for visual observation purposes. Because of their structural integrity, the flaps can be used to increase aircraft maneuverability below 120 knots. Flap deflections up to 20 degrees only increase the drag a small amount, but because lift and maneuverability are improved, partial flaps are recommended for slow speed searches below 100 knots.

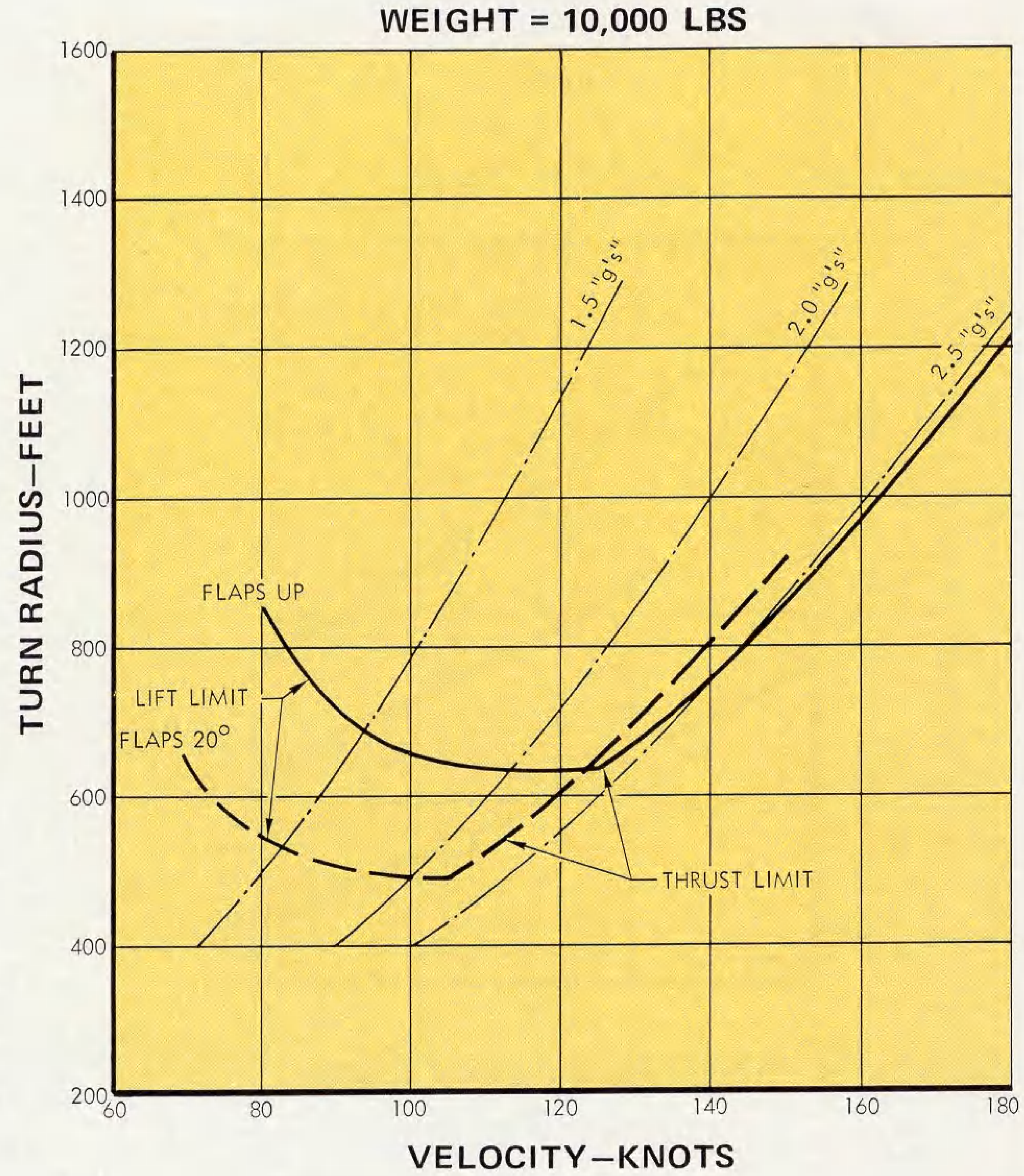
● OPERATIONAL FLIGHT ENVELOPE

Effectiveness studies have shown the advantages of maneuverability, both in killing and survivability. Maneuverability requires high lift, high strength, and good control. The OV-10A has all three. The operational envelope shown is applicable for stores on or off.

SEA LEVEL
STANDARD DAY
DESIGN WEIGHT = 9390 LBS



SEA LEVEL
STANDARD DAY
WEIGHT = 10,000 LBS

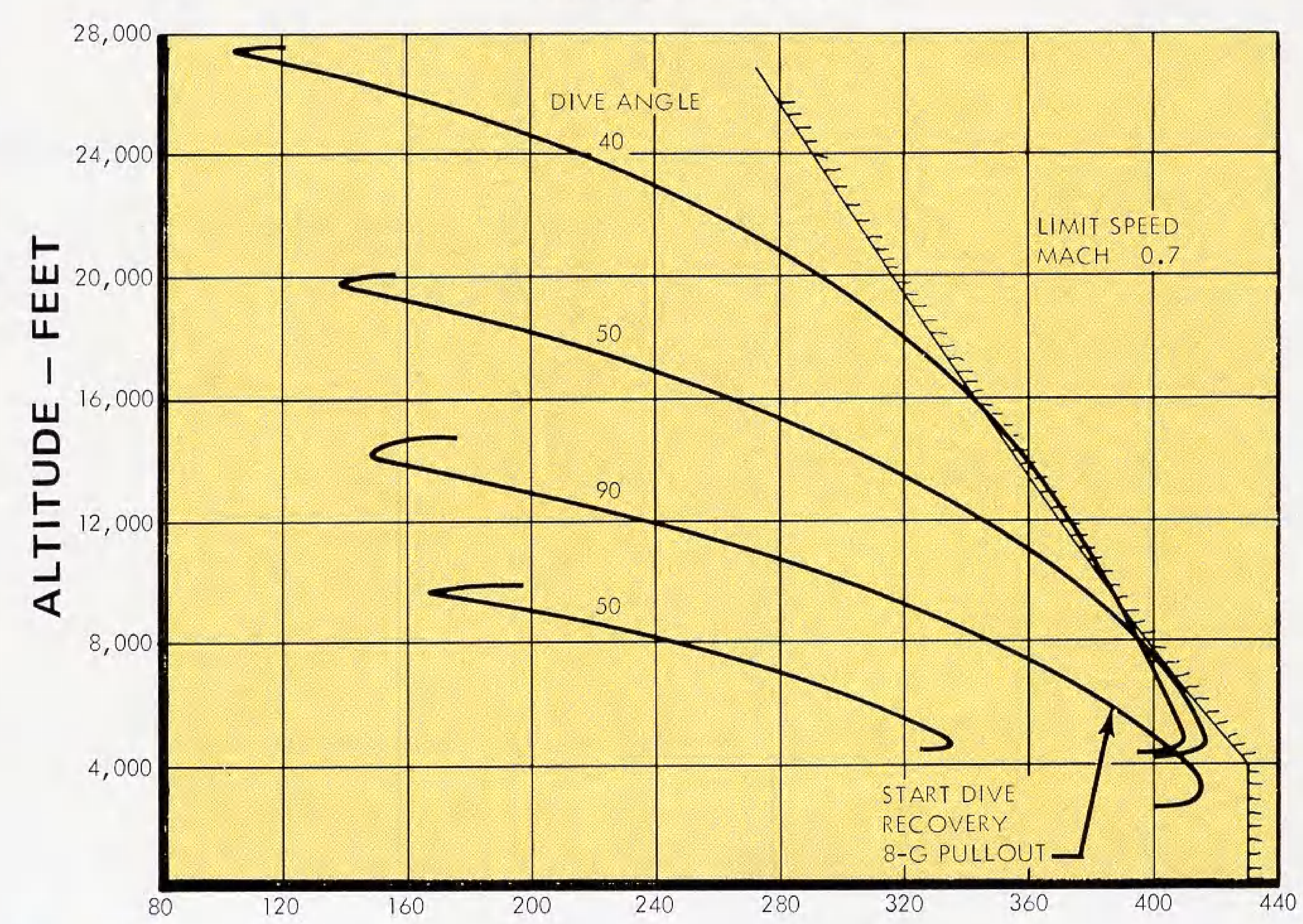


Flight Characteristics (Cont.)

● DIVE CAPABILITY

The dive profiles shown are typical of a wide range of loadings. The curves represent maximum power but power has only a small effect in steep dives. Below 15,000 feet, the pilot can put the aircraft in a 90-degree dive and hold it as long as he desires without exceeding the design speed. It is also interesting to note that the combination of high lift and strength makes it possible to recover from a vertical dive at 400 knots with only a 2500-foot loss in altitude.

TYPICAL HIGH SPEED DIVE CONDITIONS
FOUR MK 81 BOMBS
WEIGHT = 9390 LBS
STANDARD DAY

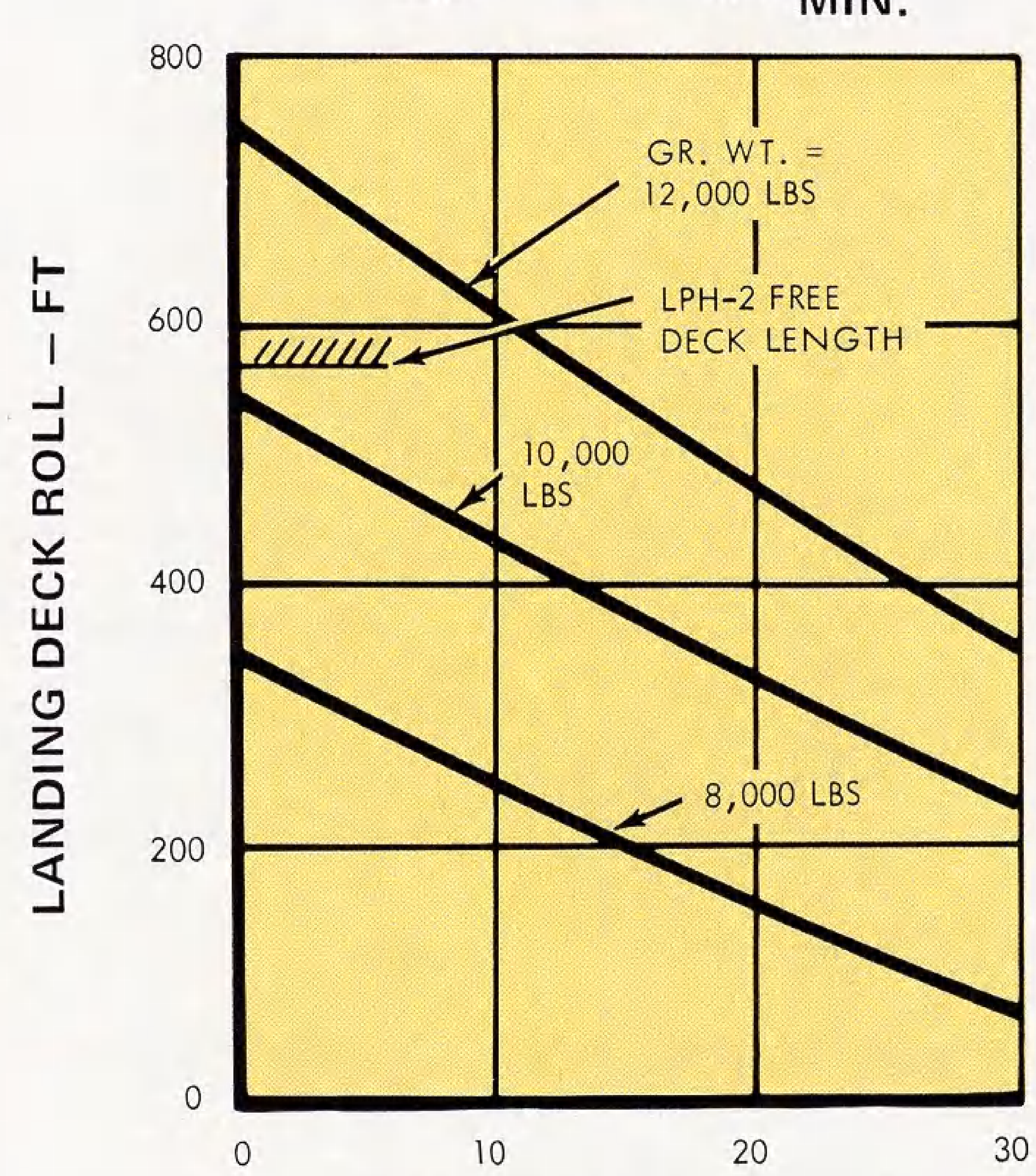


EQUIVALENT AIRSPEED – KNOTS

● CARRIER SUITABILITY

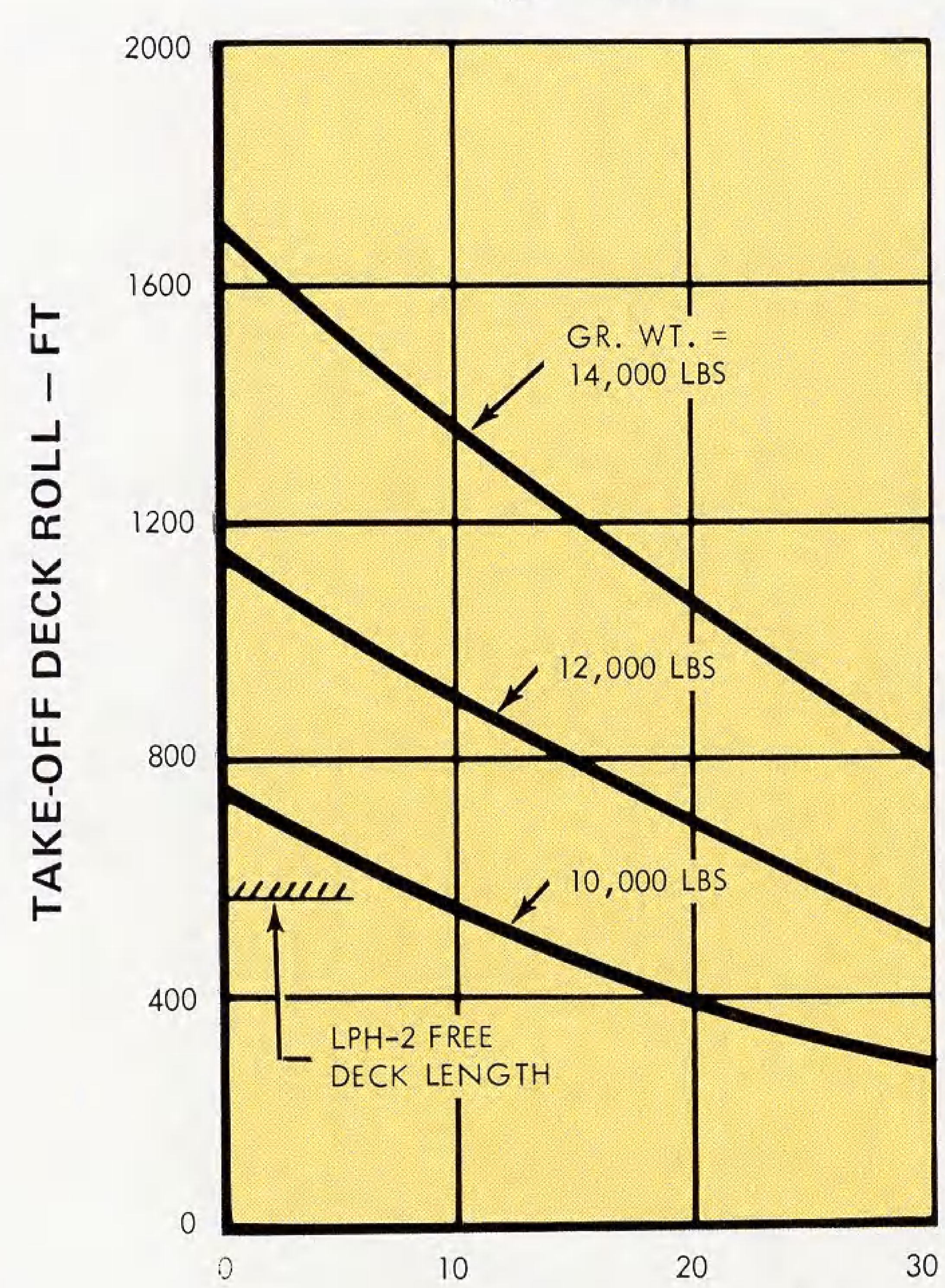
The OV-10A, without catapult equipment and arresting gear, can take off and land aboard aircraft carriers with various configurations of fuel tanks and external stores. During carrier suitability tests, take-off roll averaged less than 700 feet.

LANDING
40° FLAPS
$V_{APP} = 1.15\ V_{SPA_{MIN.}}$



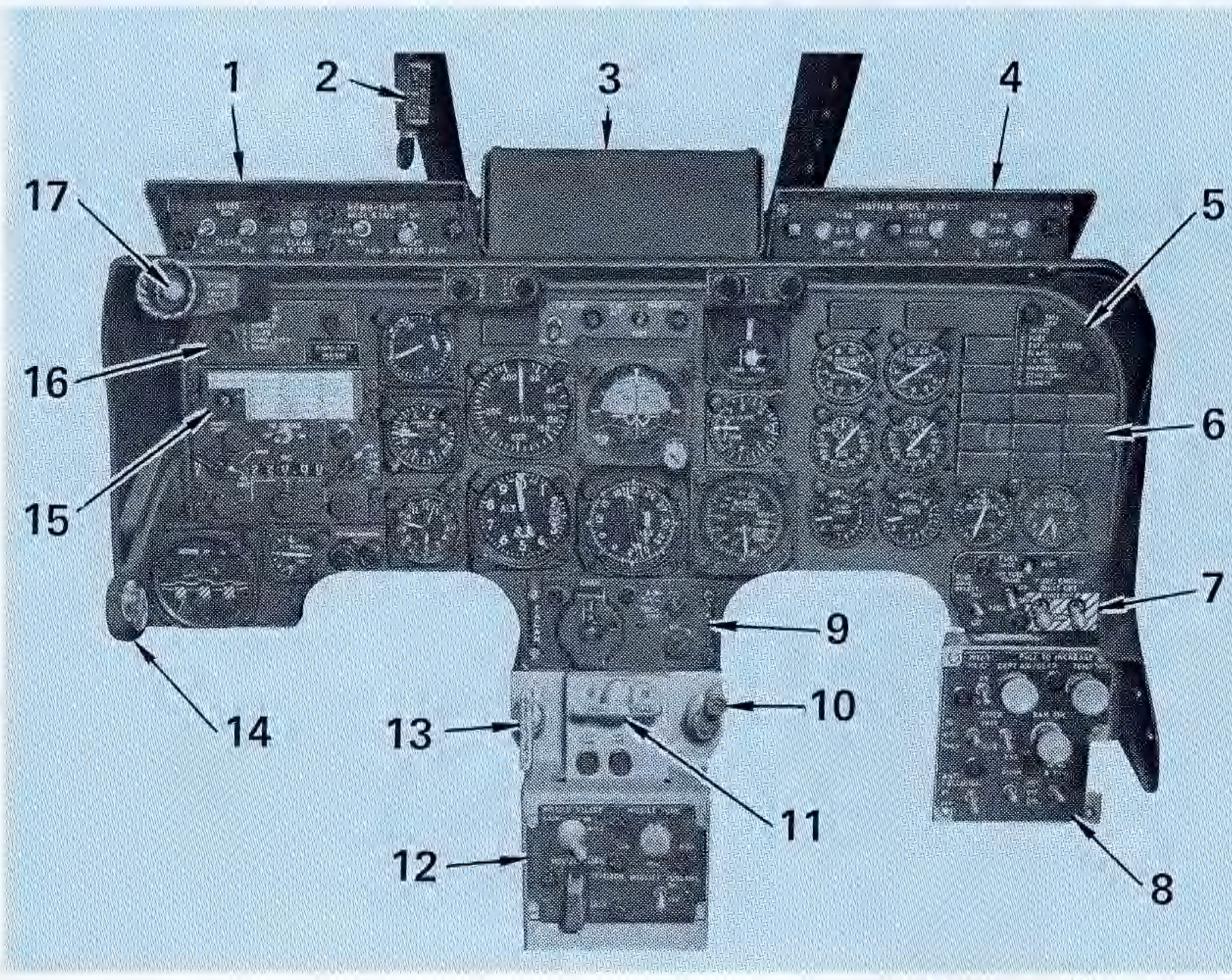
WIND OVER DECK – KTS.

TAKE-OFF
20° FLAPS
$V_{TO} = V_{MC}$

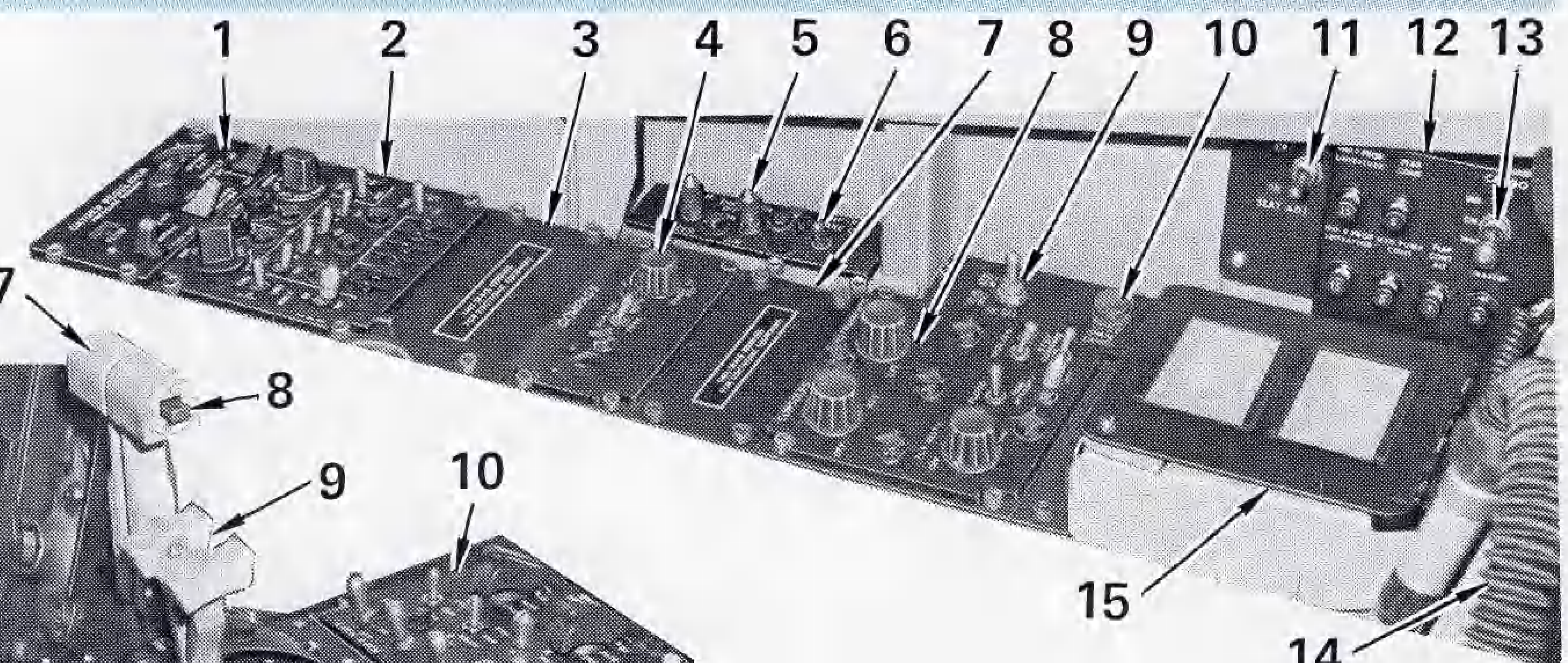


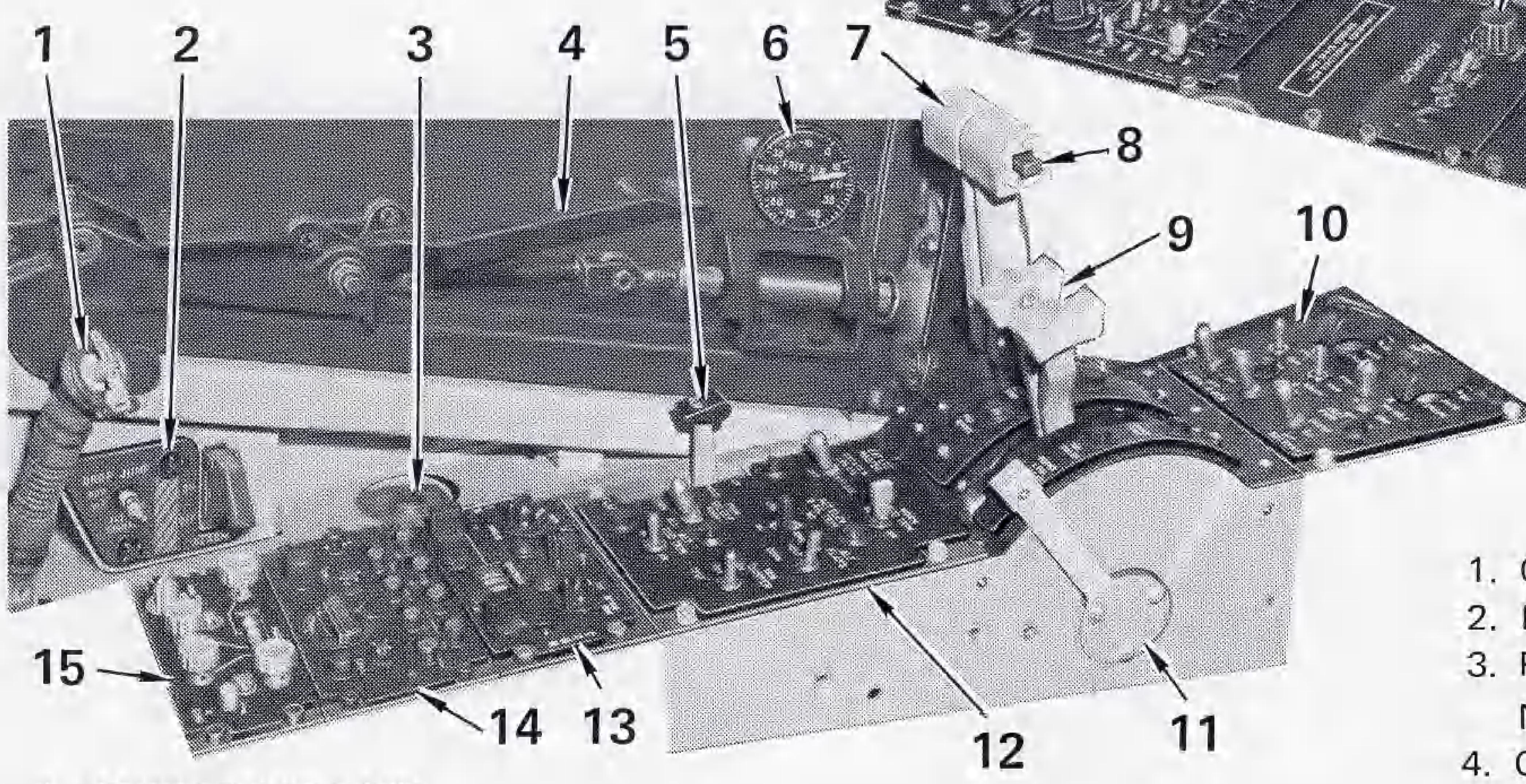
WIND OVER DECK – KTS.

PILOT'S COCKPIT (USN/USMC)



1. LEFT WEAPONS CONTROL PANEL
2. APPROACH INDEXER
3. MAP CASE
4. RIGHT WEAPONS CONTROL PANEL
5. TAKE-OFF CHECKLIST
6. WARNING AND CAUTION LIGHTS
7. FUEL SYSTEM CONTROLS
8. HEAT-VENT-DEFROST AND EXTERIOR LIGHTS CONTROL PANEL
9. TACAN [AN/ARN-52(V)] CONTROL PANEL
10. PEDAL ADJUST CRANK
11. PARKING BRAKE HANDLE
12. MISSILE CONTROL PANEL
13. EMERGENCY STORES JETTISON HANDLE
14. LANDING GEAR CONTROL HANDLE
15. UHF-AM (AN/ARC-51AX) COMM CONTROL PANEL
16. LANDING CHECKLIST
17. STORES EMERGENCY RELEASE BUTTON



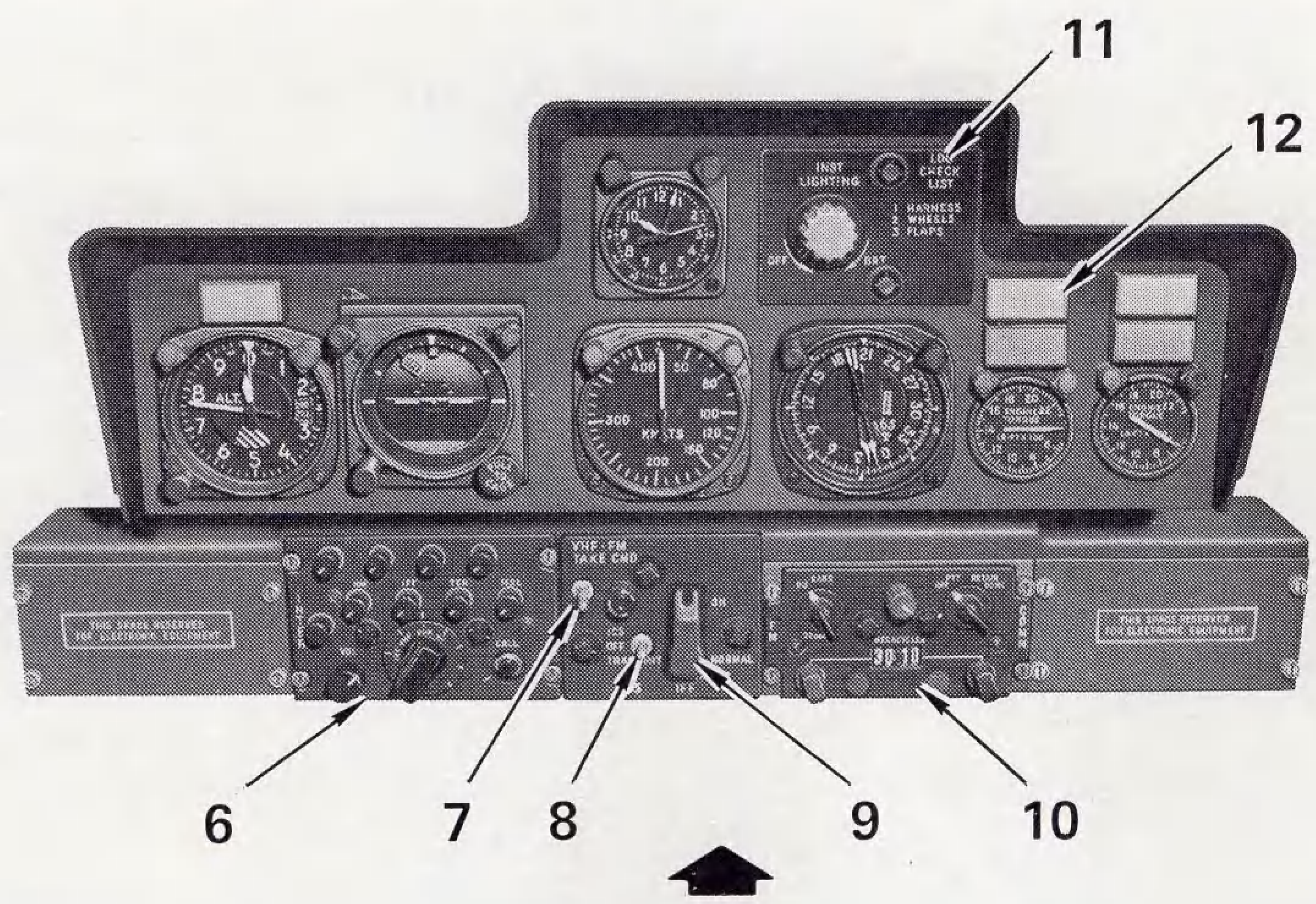


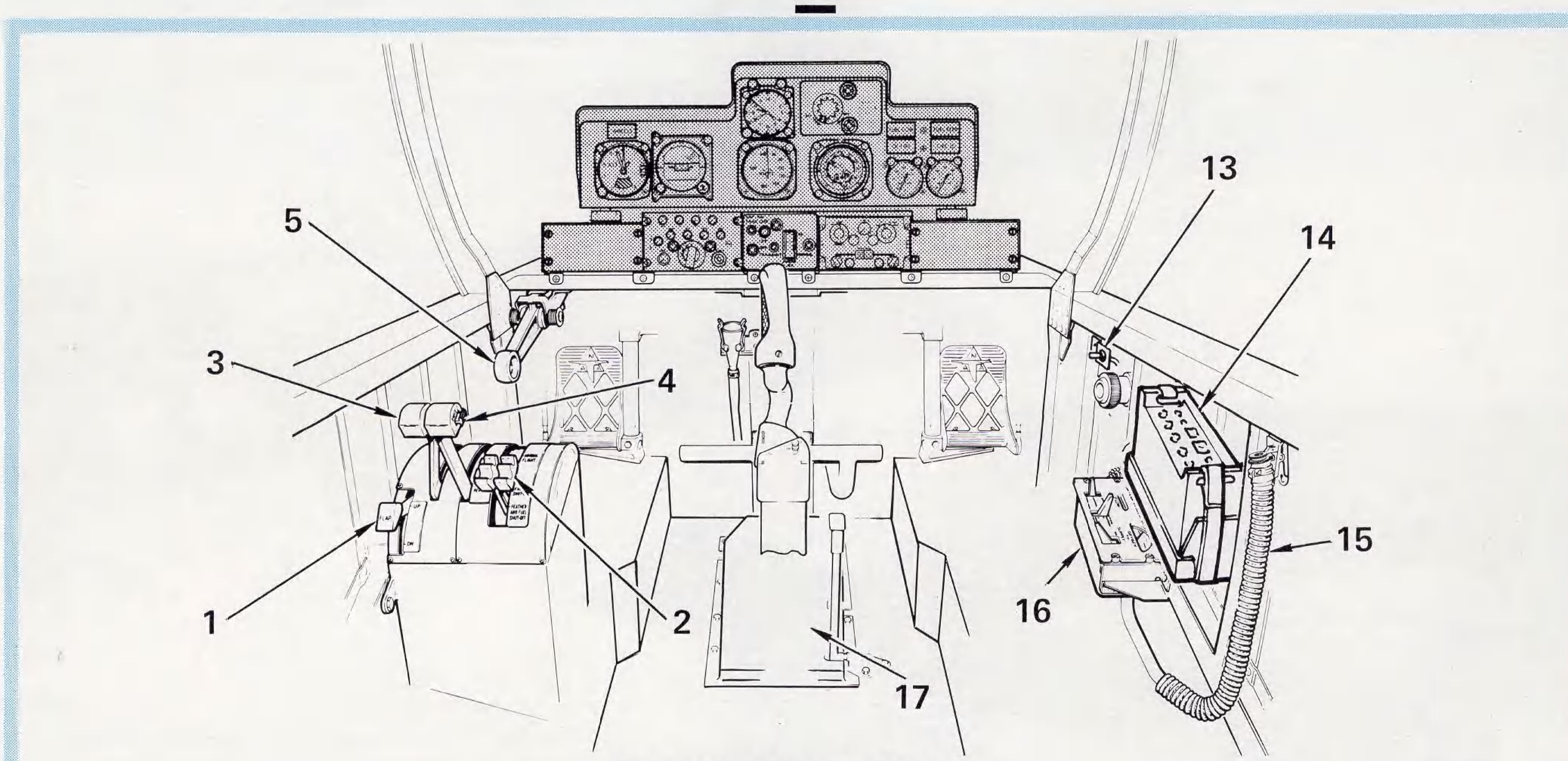
1. ANTI-G SUIT HOSE
2. DROP/JUMP SIGNAL CONTROLS
3. ANTI-G VALVE
4. CANOPY DOOR LOCK HANDLE
5. FLAP CONTROL HANDLE
6. FREE AIR TEMPERATURE INDICATOR
7. ENGINE POWER LEVERS
8. MIC SWITCH
9. ENGINE CONDITION LEVERS
10. ENGINE START AND ELECTRICAL CONTROL PANEL
11. ENGINE CONTROLS FRICTION LEVER
12. FLAP-TRIM CONTROL PANEL
13. VHF-FM (AN/ARC-54) COMM CONTROL PANEL
14. ICS (AN/AIC-18) CONTROL PANEL
15. HF-SSB (AN/ARC-120) COMM CONTROL PANEL

1. OXYGEN REGULATOR
2. IFF-SIF [AN/APX-64(V)] CONTROL PANEL
3. PROVISIONS FOR JULIET - 28 SYSTEM NO. 2 CONTROL PANEL
4. COMPASS (AN/ASN-75) CONTROL PANEL
5. ENGINE BLEED AIR SWITCHES
6. VHF-FM TAKE COMMAND SWITCH AND LIGHT
7. PROVISIONS FOR JULIET - 28 SYSTEM NO. 1 CONTROL PANEL
8. INTERIOR LIGHTS CONTROL PANEL
9. AMMETER SELECT SWITCH
10. SPARE LAMPS
11. SEAT ADJUST SWITCH
12. CIRCUIT BREAKER PANEL
13. CARGO BAY LIGHTS SWITCH
14. OXYGEN HOSE
15. MAP CASE

NOTE – COCKPIT VIEWS REFLECT AFC'S 24 AND 39

OBSERVER'S COCKPIT (USN/USMC)





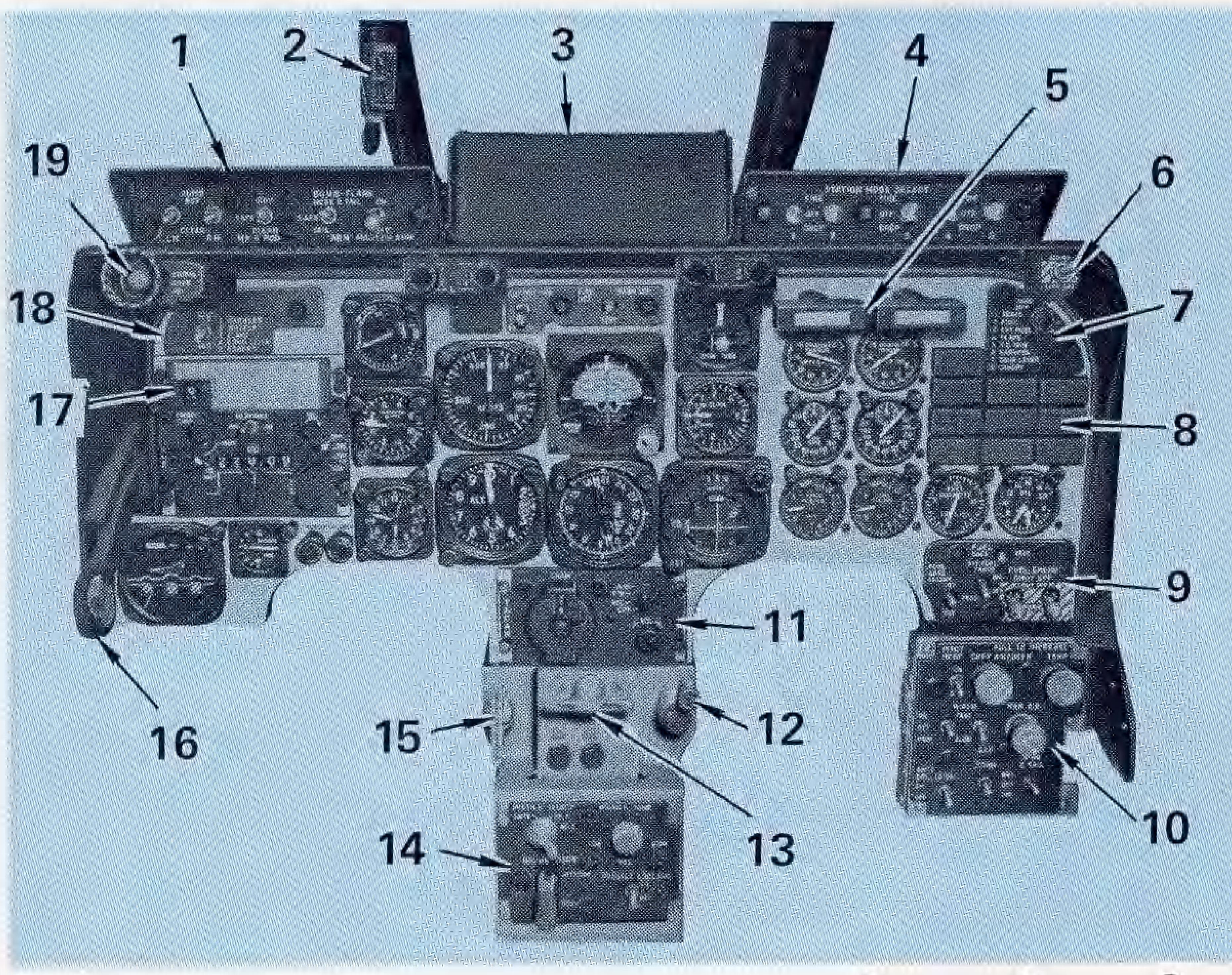
OBSERVER'S COCKPIT

1. FLAP CONTROL HANDLE
2. ENGINE CONDITION LEVERS
3. ENGINE POWER LEVERS
4. MIC SWITCH
5. LANDING GEAR CONTROL HANDLE
6. ICS (AN/AIC-18) CONTROL PANEL
7. VHF-FM TAKE COMMAND SWITCH AND LIGHT
8. MIC SELECT SWITCH
9. EMERGENCY IFF SWITCH

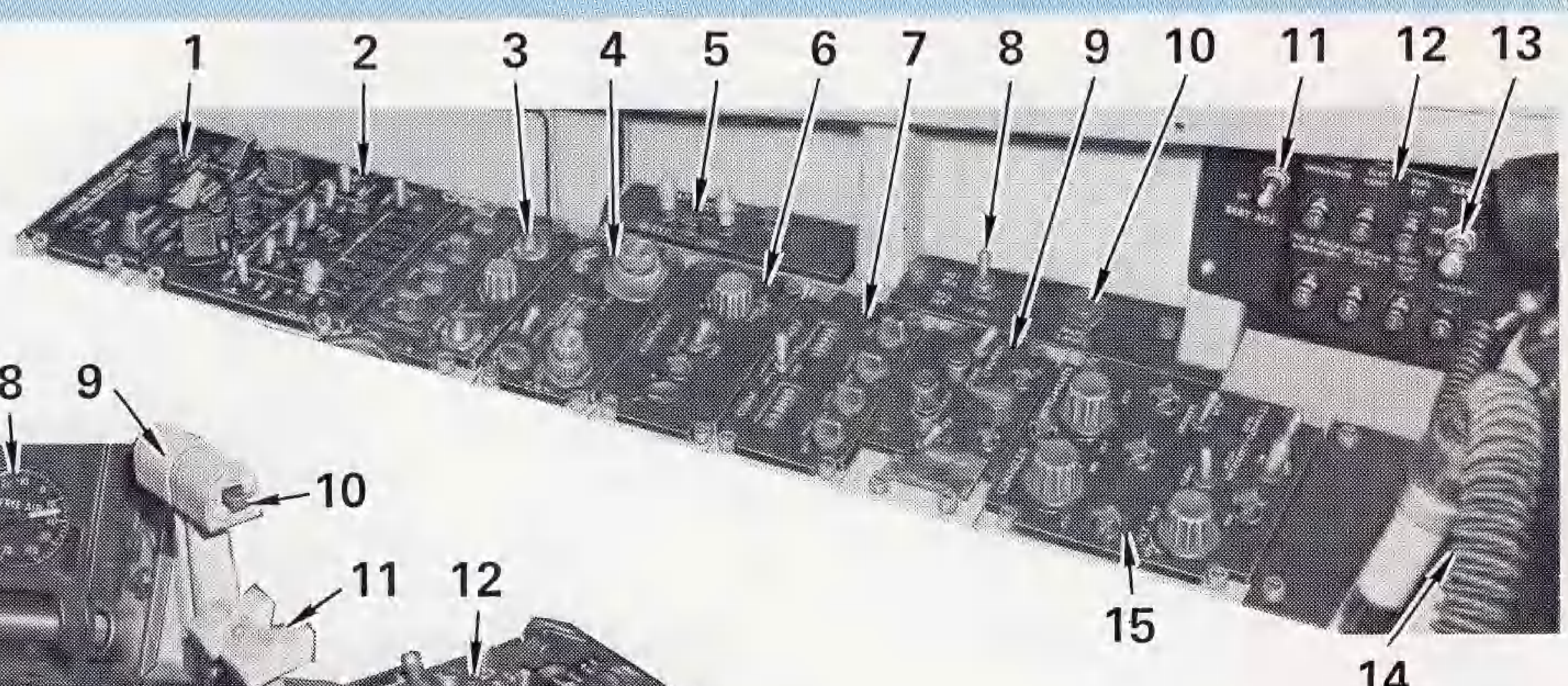
NOTE—COCKPIT VIEWS REFLECT AFC 20

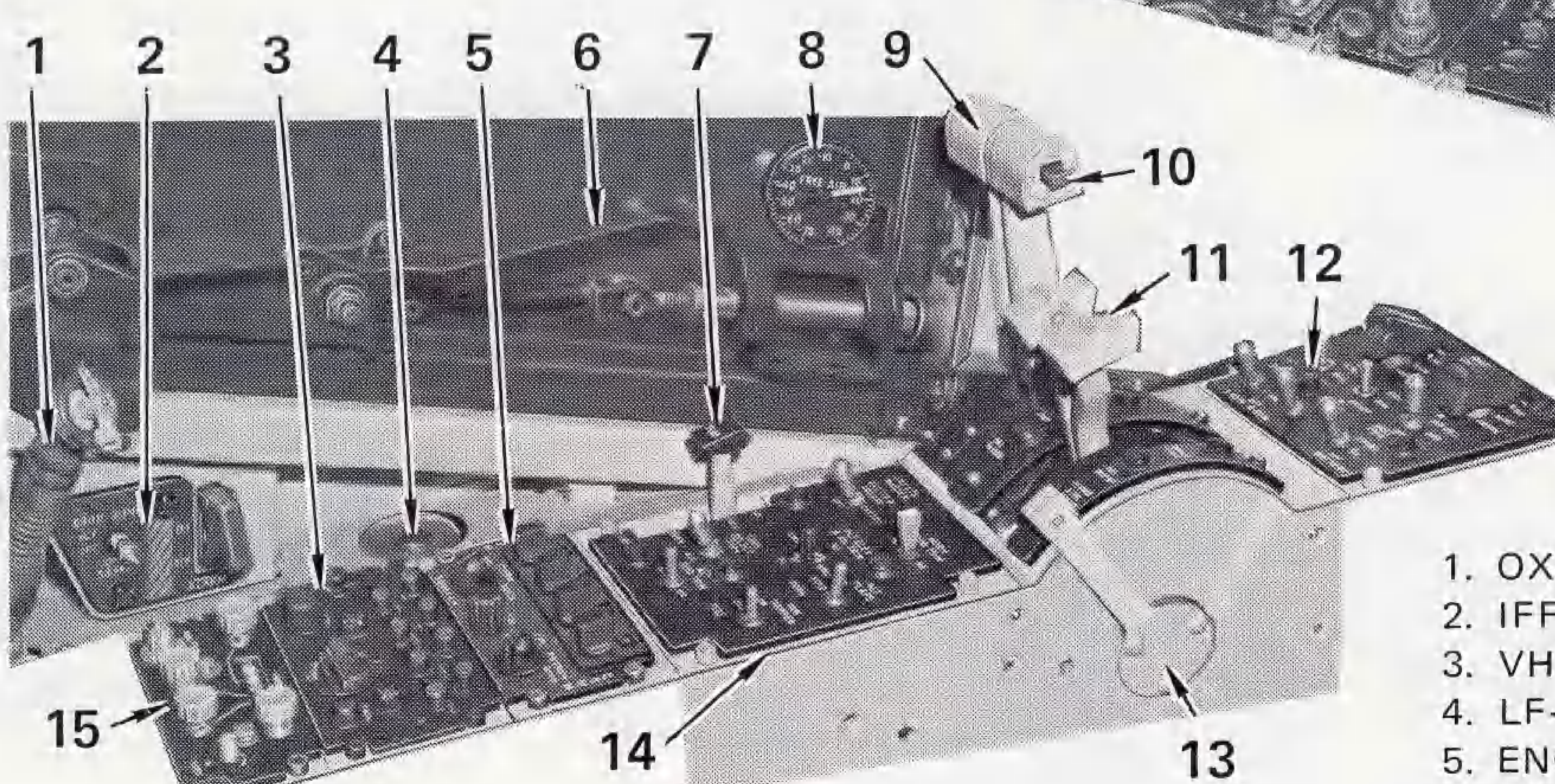
10. VHF-FM (AN/ARC-54) COMM CONTROL PANEL
11. INSTRUMENT LIGHTS CONTROL AND LANDING CHECK LIST
12. WARNING AND CAUTION LIGHTS
13. SEAT ADJUST SWITCH
14. RADIO FREQUENCY MONITOR SET, AN/USQ-42
15. OXYGEN HOSE
16. OXYGEN REGULATOR
17. KB-18A STRIKE CAMERA OR MESSAGE DROP DOOR

PILOT'S COCKPIT (USAF)



1. LEFT WEAPONS CONTROL PANEL
2. APPROACH INDEXER
3. MAP CASE
4. RIGHT WEAPONS CONTROL PANEL
5. FIRE WARNING - PULL HANDLES
6. FIRE EXTINGUISHER AGENT SWITCH
7. TAKE-OFF CHECKLIST
8. WARNING AND CAUTION LIGHTS
9. FUEL SYSTEM CONTROLS
10. HEAT-VENT-DEFROST AND EXTERIOR LIGHTS CONTROL PANEL
11. TACAN [AN/ARN-52(V)] CONTROL PANEL
12. PEDAL ADJUST CRANK
13. PARKING BRAKE HANDLE
14. MISSILE CONTROL PANEL
15. EMERGENCY STORES JETTISON HANDLE
16. LANDING GEAR CONTROL HANDLE
17. UHF-AM(AN/ARC-51BX) COMM CONTROL PANEL
18. LANDING CHECKLIST
19. STORES EMERGENCY RELEASE BUTTON



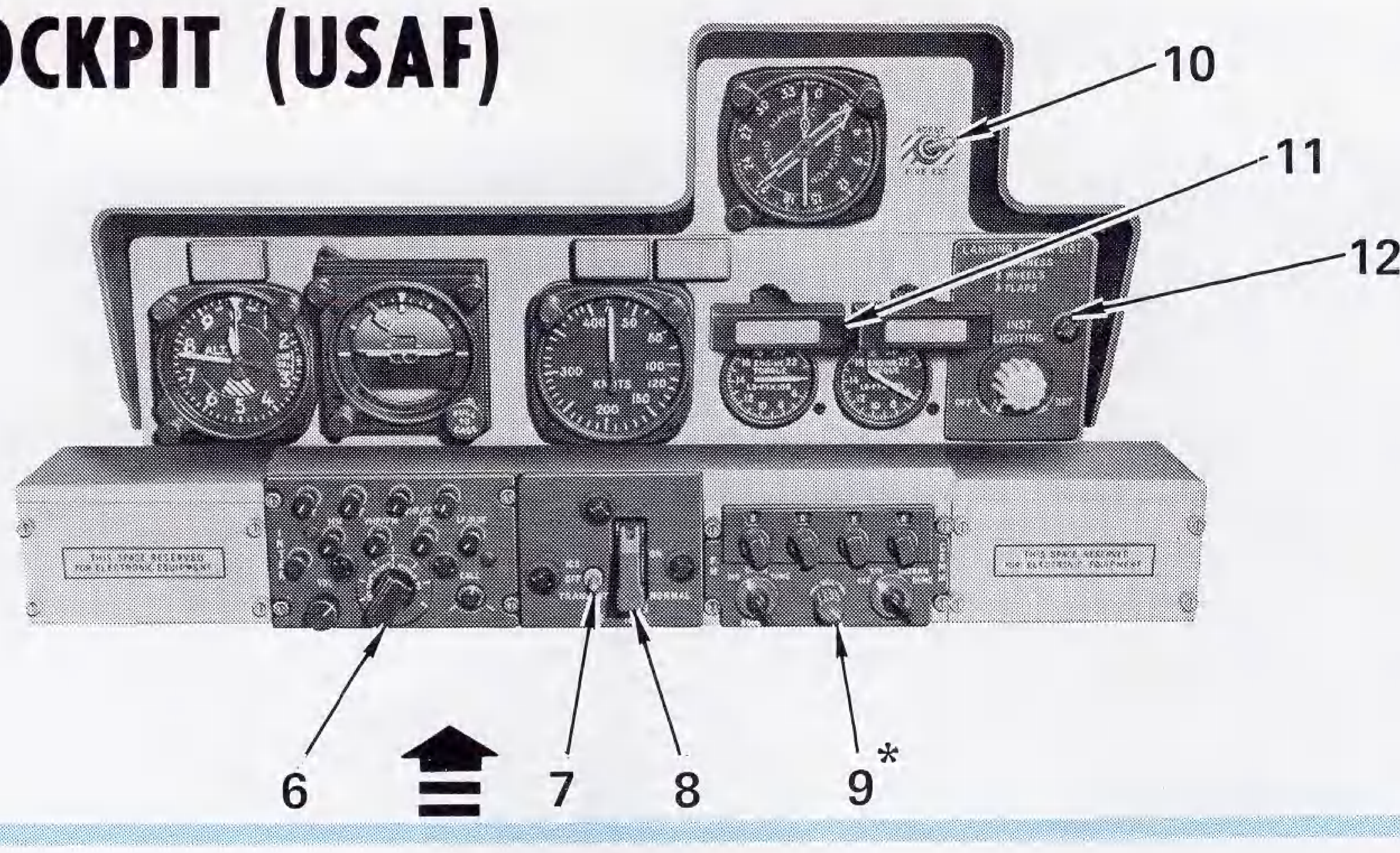


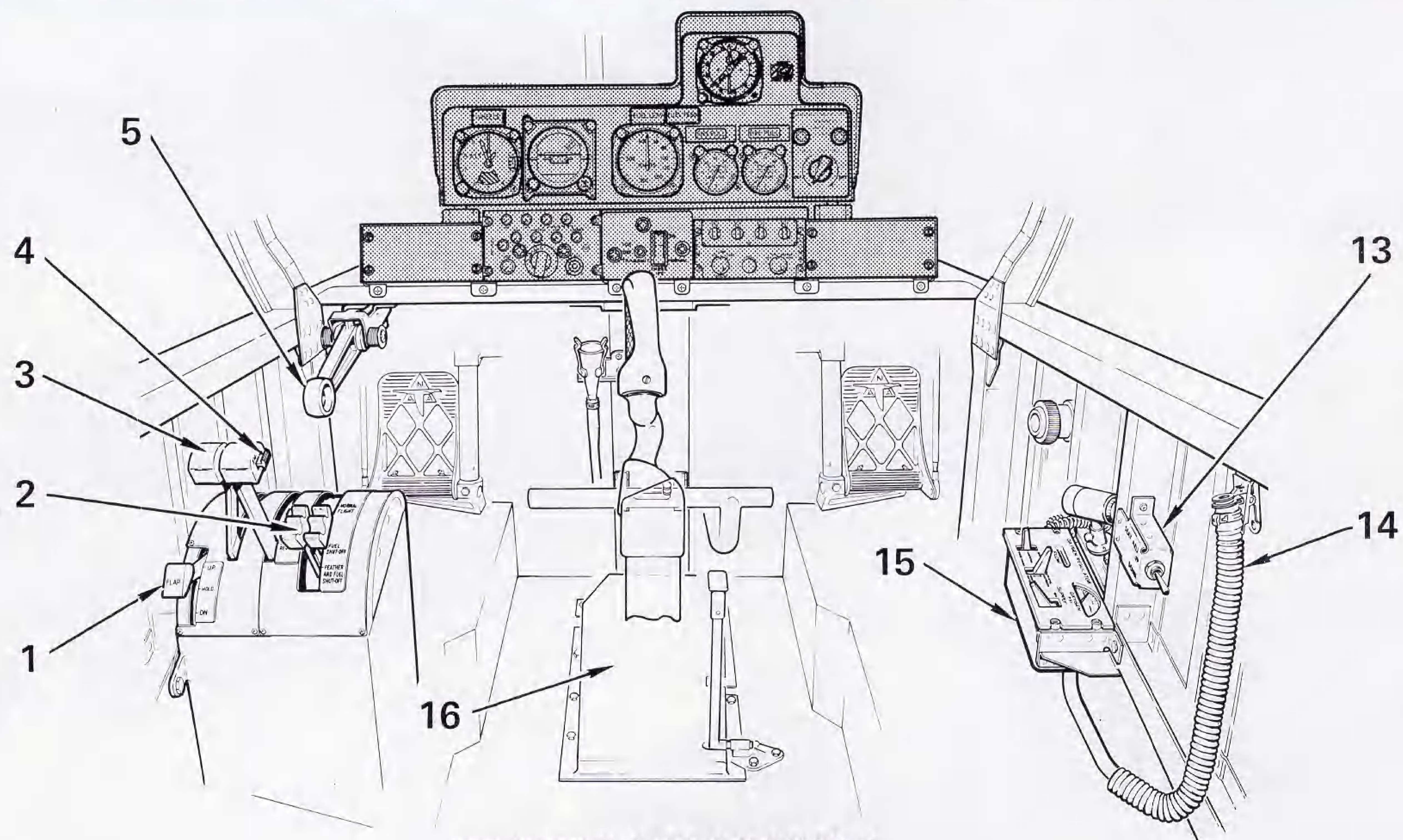
1. OXYGEN REGULATOR
2. IFF-SIF [AN/APX-64(V)] CONTROL PANEL
3. VHF-FM (FM-622A) COMM CONTROL PANEL (NO. 2)
4. LF-ADF (AN/ARN-83) ADF CONTROL PANEL
5. ENGINE BLEED AIR SWITCHES
6. COMPASS (AN/ASN-75) CONTROL PANEL
7. VHF-AM (WILCOX 807A) - VOR/ILS (COMM-NAV) CONTROL PANEL
8. AMMETER SELECT SWITCH
9. JULIET - 28 (KY-28) CONTROL PANEL
10. SPARE LAMPS
11. SEAT ADJUST SWITCH
12. CIRCUIT BREAKER PANEL
13. CARGO BAY LIGHTS SWITCH
14. OXYGEN HOSE
15. INTERIOR LIGHTS CONTROL PANEL

1. ANTI-G SUIT HOSE
2. PARATROOP SIGNAL CONTROLS
3. ICS (AN/AIC-18) CONTROL PANEL
4. ANTI-G VALVE
5. VHF-FM (FM-622A) COMM CONTROL PANEL (NO. 1)
6. CANOPY DOOR LOCK HANDLE
7. FLAP CONTROL HANDLE
8. FREE AIR TEMPERATURE INDICATOR
9. ENGINE POWER LEVERS
10. MIC SWITCH
11. ENGINE CONDITION LEVERS
12. ENGINE START AND ELECTRICAL CONTROL PANEL
13. ENGINE CONTROLS FRICTION LEVER
14. FLAP-TRIM CONTROL PANEL
15. HF-SSB (HF-103) COMM CONTROL PANEL

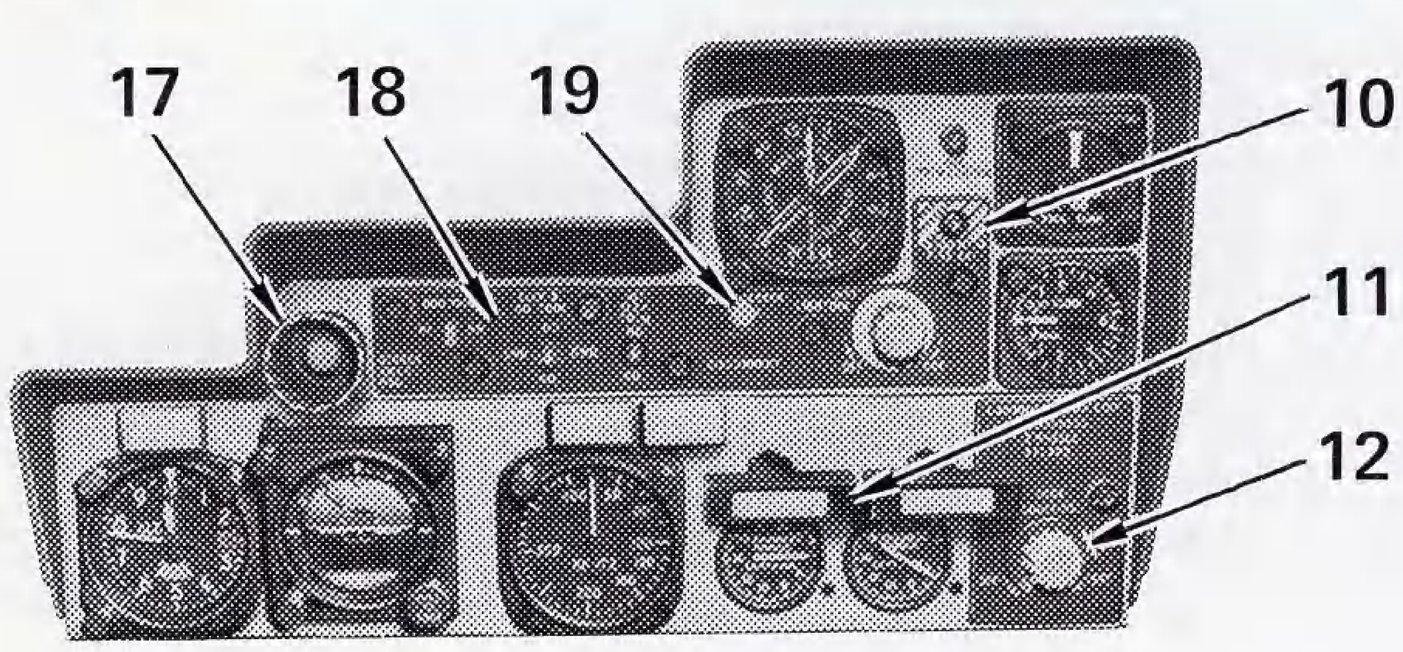
NOTE – COCKPIT VIEWS REFLECT TCTO 1L-10A-536, TCTO 1L-10A-538, AND TCTO 1L-10A-595

OBSERVER'S COCKPIT (USAF)





OBSERVER'S COCKPIT

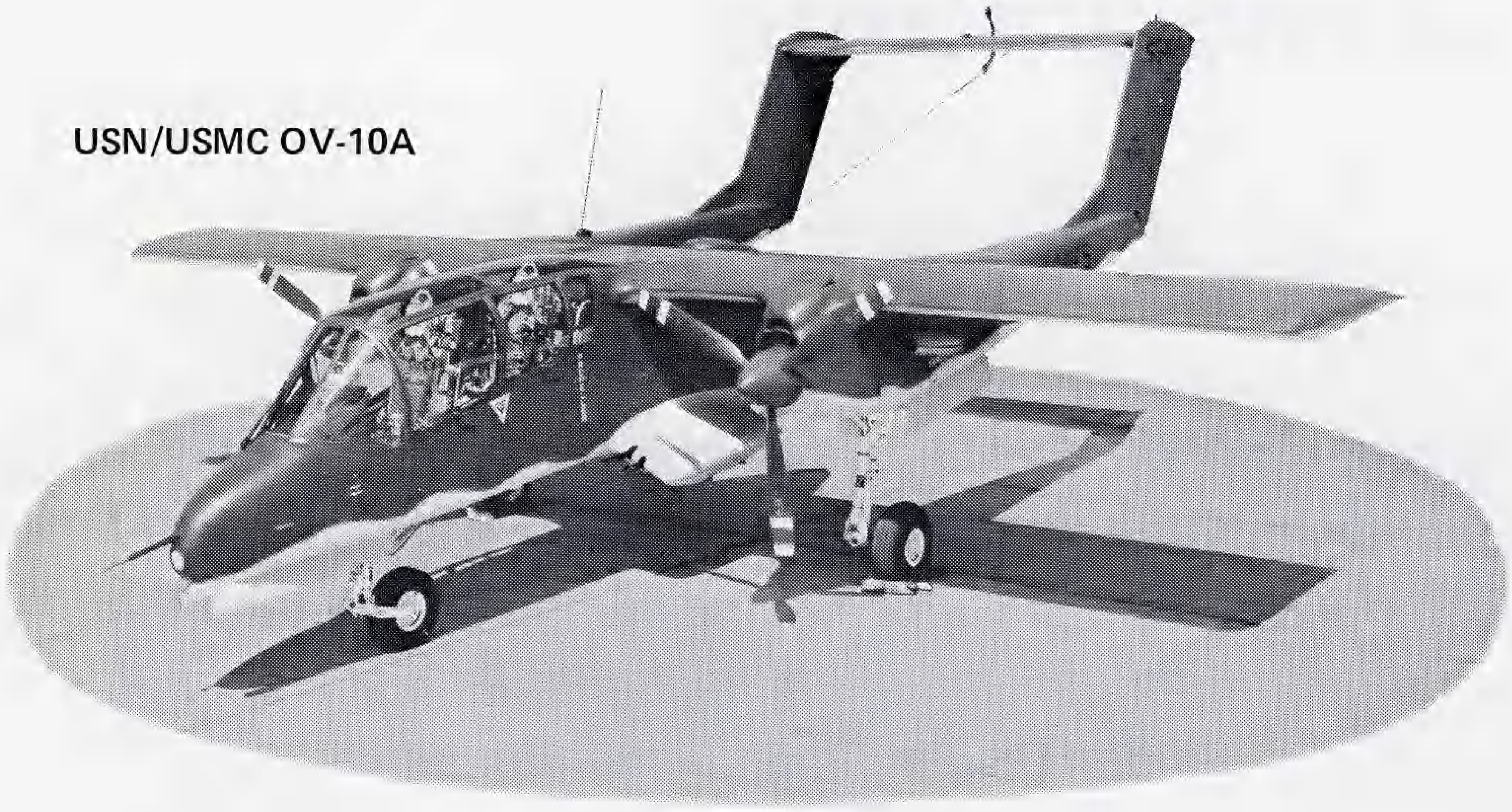


OBSERVER'S INSTRUMENT PANEL ON AIRCRAFT HAVING TCTO 1L-10A-510 INCORPORATED

* TCTO 1L-10A-536 INSTALLS PROVISIONS FOR MOUNTING PANEL IN PILOT'S RIGHT-HAND CONSOLE

1. FLAP CONTROL HANDLE
2. ENGINE CONDITION LEVERS
3. ENGINE POWER LEVERS
4. MIC SWITCH
5. LANDING GEAR CONTROL HANDLE
6. ICS (AN/AIC-18) CONTROL PANEL
7. MIC SELECT SWITCH
8. EMERGENCY IFF SWITCH
9. VHF-FM (FM-622A) COMM CONTROL PANEL
10. FIRE EXTINGUISHER AGENT SWITCH
11. FIRE WARNING - PULL HANDLES
12. INSTRUMENT LIGHTS CONTROL AND LANDING CHECKLIST
13. SEAT ADJUST SWITCH
14. OXYGEN HOSE
15. OXYGEN REGULATOR
16. KB-18A STRIKE CAMERA
17. STORES EMERGENCY RELEASE BUTTON
18. FLIGHT CONTROL TRIM SWITCHES
19. ARMAMENT MASTER SWITCH

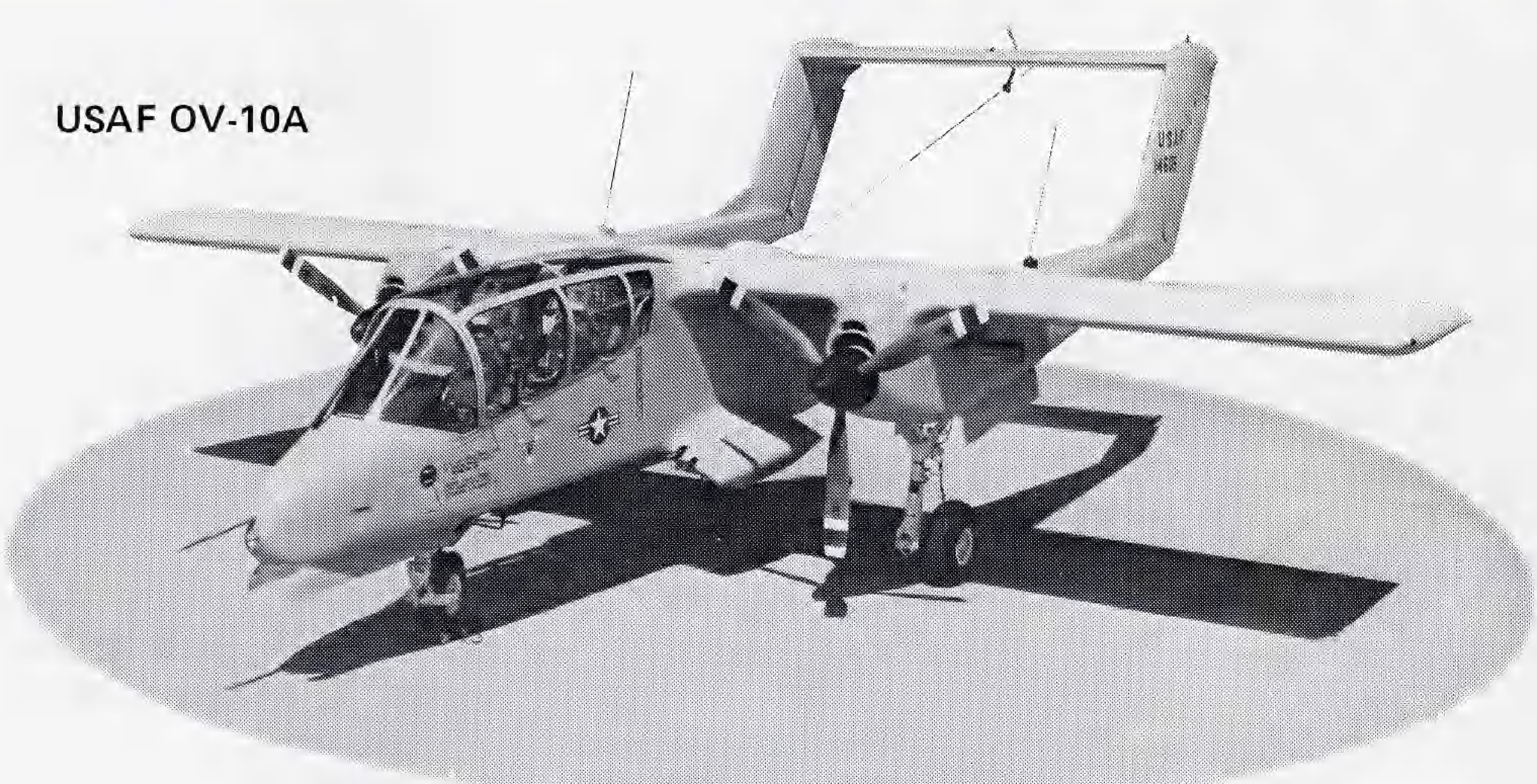
USN/USMC OV-10A



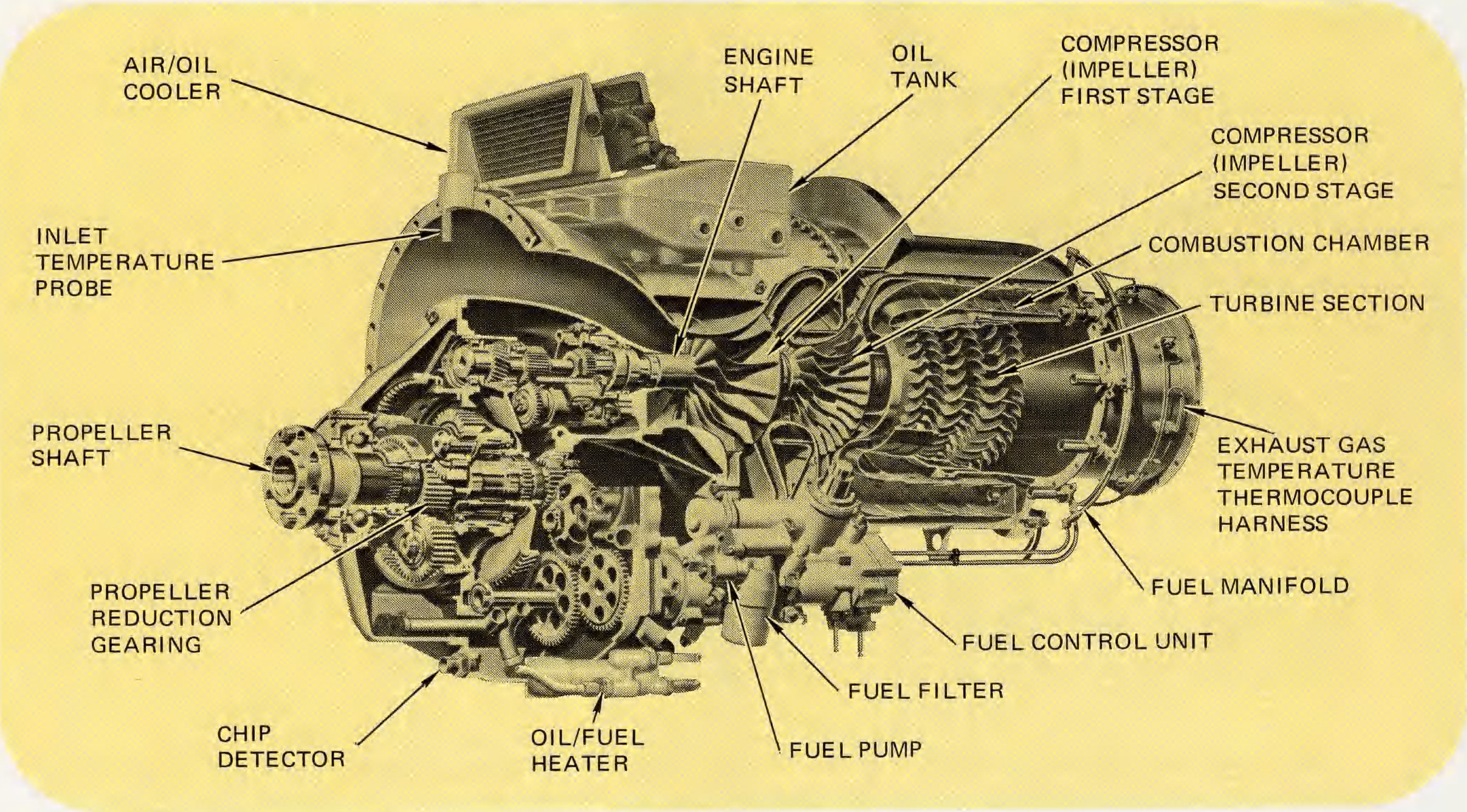
AIRCRAFT SYSTEMS

Descriptions of the various systems of the OV-10A aircraft are provided on pages 68 through 92. Also included are locations of system components and servicing information (page 95). Following is a listing of the aircraft systems.

USAF OV-10A



POWER PLANTS and ASSOCIATED SYSTEMS



ENGINES AND PROPELLERS

The OV-10A is powered by two Garrett-AiResearch T76-G-10 (left) and -12 (right), fixed shaft, turbo-prop engines, each rated at 715-shaft horsepower. The centrifugal flow engines, each weighing 325 pounds, employ a two-stage compressor and a three-stage turbine. Rotating on a common shaft, the compressor and turbine units drive a gear reduction system which powers an 8-1/2-foot, full-reversible, full-feathering, three-bladed aluminum propeller. At military engine rpm (41,730), the propeller rotates at 2000 rpm. To reduce engine-propeller torque effects, the propellers are counter-rotating (left propeller rotates clockwise and the right propeller rotates counter-clockwise). Counter-rotation of the propellers is accomplished through gearing as both engine turbines rotate in the same direction. Engine rpm and propeller blade angle are regulated, through the cockpit condition and power levers, by an integrated power management control system. The power management control system simplifies power/thrust management by automatic control and correlation of all functions of the engine and propeller into a single input to the condition lever. A separate power lever and condition lever are provided for each engine/propeller. Each engine has: (1) an independent ignition system consisting of an engine-mounted ignition unit, rpm sensing switches, and an igniter plug; (2) a dry sump oil system which provides both engine lubrication and propeller control medium; and (3) an air-oil cooler to maintain oil temperature limits. Descriptions of these systems and components, in addition to the engine fuel, fire warning and fire extinguishing systems, are provided in the following paragraphs:

FUEL SYSTEM

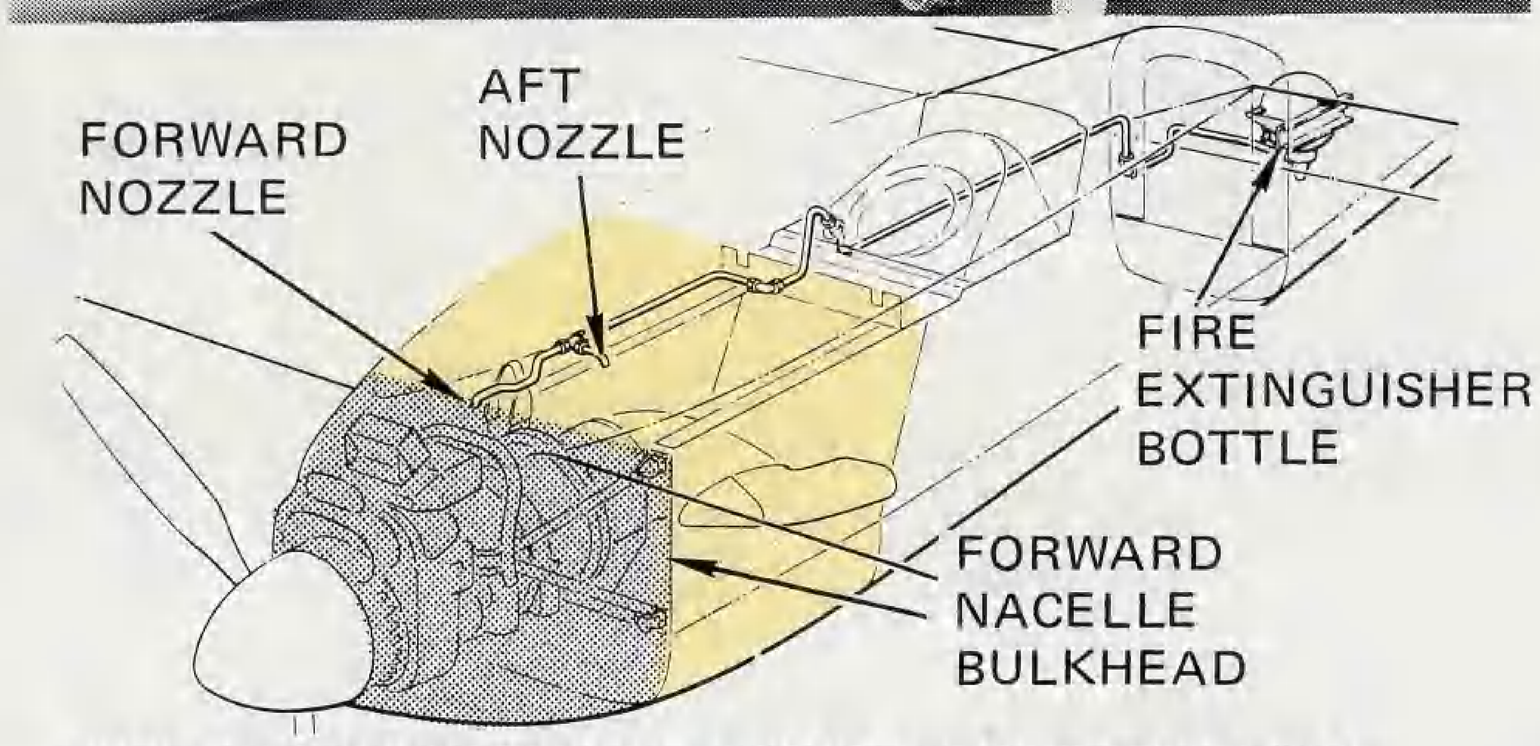
Fuel is supplied by gravity from the wing center/feed tank to the engine-driven boost pumps. Fuel at low pressure is then directed to the combination low-/high-pressure fuel pumps, which supply fuel at high pressure (through a 10-micron filter) to the fuel control units. The fuel control units provide engine overspeed protection through an automatic flow limiting feature set at 104% rpm. An underspeed governor on each engine sets minimum propeller rpm for selected flight conditions. During engine starts, extra starting fuel bypasses the fuel control and fuel shutoff valve and is fed directly into the engine. Flow of this starting fuel is cut off automatically by an EGT sensing switch or upon attaining approximately 52% rpm.

IGNITION SYSTEM

Each engine has an independent ignition system consisting of an ignition unit, rpm sensing switches, and an igniter plug mounted in the engine combustor. During normal ground starts, the system is energized by the speed sensing switches as rpm passes approximately 8%. The rpm sensing switches cut off igniter operation as rpm

Power Plants and Associated Systems (Cont.)

SWING-OPEN COWLING PROVIDES ACCESS TO ENGINE COMPONENTS



FIRE EXTINGUISHER AGENT DISTRIBUTION

passes approximately 52%, discontinuing the start cycle and preventing the ignition unit duty cycle from being exceeded. For air starts, the ignition system is manually turned on bypassing the rpm sensing switch. The system operates continuously until manually turned off following the start.

OIL SYSTEM

An independent, dry sump oil system is provided for each engine. These systems provide both engine lubrication and propeller control system supply. Oil is stored in a 1.5-gallon tank on each engine, 1.25 gallons of which are usable. At idle (65% rpm), minimum oil pressure is 50 psi. Above approximately 91% rpm, oil pressure is regulated at 105 (±15) psi (by the return of excess oil from the engine-driven oil pump back to the inlet side of the oil pump). Each system includes an air-oil cooler and oil cooler door system to maintain oil temperature at approximately 190°F. The air-oil cooler incorporates a thermostatic valve and a pressure relief valve to direct scavenge oil to the cooler core or directly to the oil tank. An air-oil cooler door, located on the wing leading edge above each nacelle, opens when the landing gear extends to ensure airflow through the air-oil cooler during ground operations. Both engine accessory gearcases are equipped with a magnetic drain plug which attracts any ferrous particles present in the lower area of the sump. The plugs provide the electrical ground for operation of the engine chip warning lights.

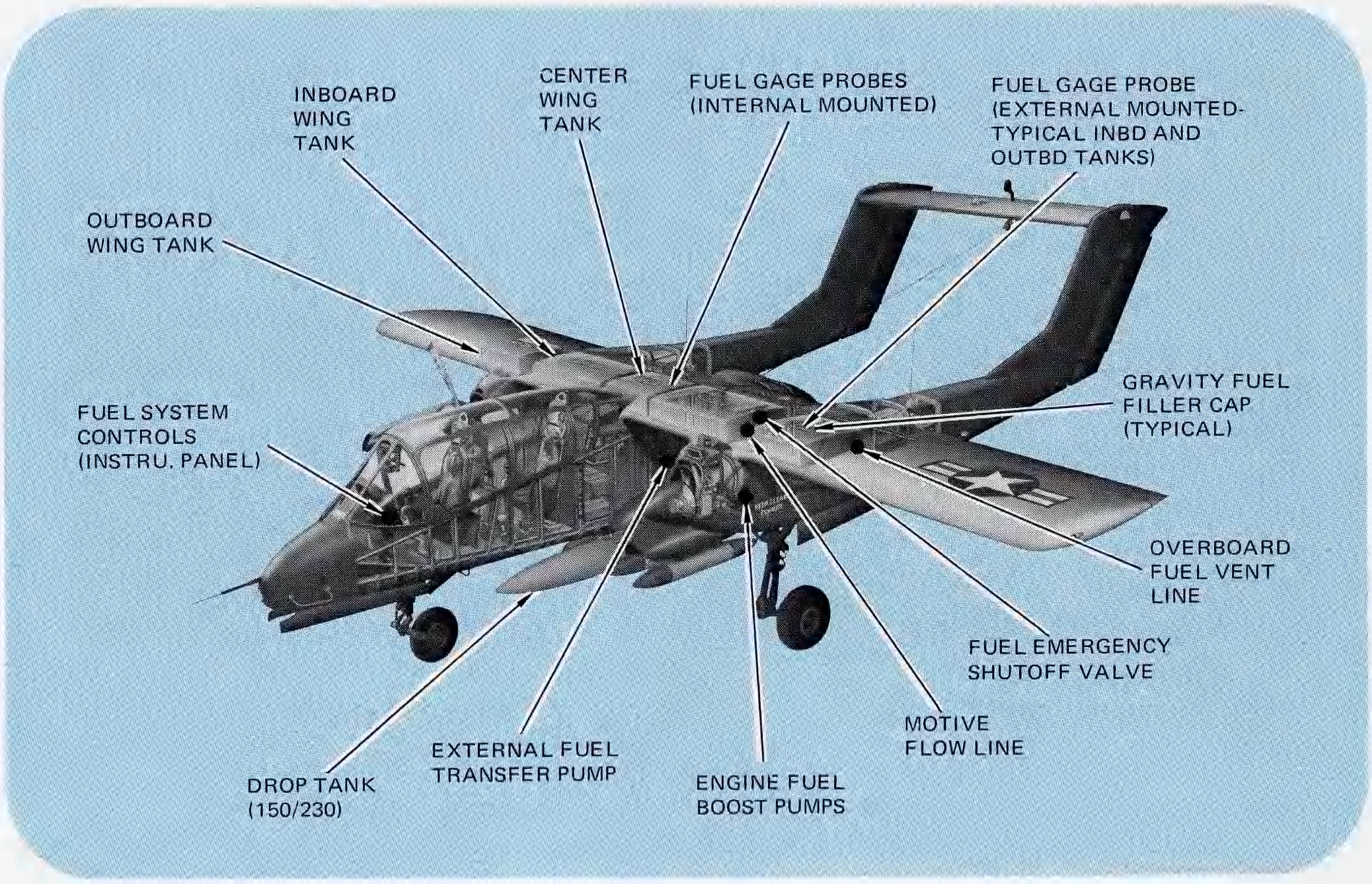
FIRE WARNING SYSTEM

The engine fire warning system for each engine consists of an independent fire detector control assembly in each boom, a continuous-sensing element routed throughout each engine compartment, the engine FIRE warning lights, and a system test switch. The fire warning system normally operates on 115-volt a-c power to provide a ground isolated system to prevent false warnings, but will automatically switch to 28-volt d-c power in the event of a-c power failure. As engine compartment temperature rises, the resistance of the sensing element lowers and is monitored by the control assembly. This signal energizes a relay to illuminate the FIRE warning light.

FIRE EXTINGUISHING SYSTEM (USAF AIRCRAFT ONLY)

An electrically-fired, squib-activated fire extinguisher system is installed in each engine nacelle. The fire extinguisher systems are not interconnected and operate independently. Each extinguisher bottle contains 86 cubic inches of monotrifluoromethane (CF_3Br) at a nominal 600-psi gage pressure. The agent is odorless, nontoxic, and noncorrosive. Each system is armed by the respective FIRE PULL handle, and is completely discharged when the FIRE EXT switch is placed to AGENT. (Each fire extinguisher system is "one shot" and must be recharged prior to further use.) Two nozzles in each engine nacelle direct the agent to flood the engine bay.

FUEL SYSTEM



INTERNAL FUEL

The OV-10A internal fuel system consists of five fuel tanks (two inboard and two outboard wing tanks and a center wing tank), two engine-driven boost pumps (one per engine), an ejector transfer pump in each tank, and associated filters, valves, switches, and plumbing. The system is vented to the atmosphere by a vent valve in each outboard wing tank. The fuel quantity indicating system is a self-balancing, capacitance-type system consisting of a fuel quantity indicator in the pilot's cockpit and a fuel probe in each tank. Various controls and indicators are used to control and monitor system operation.

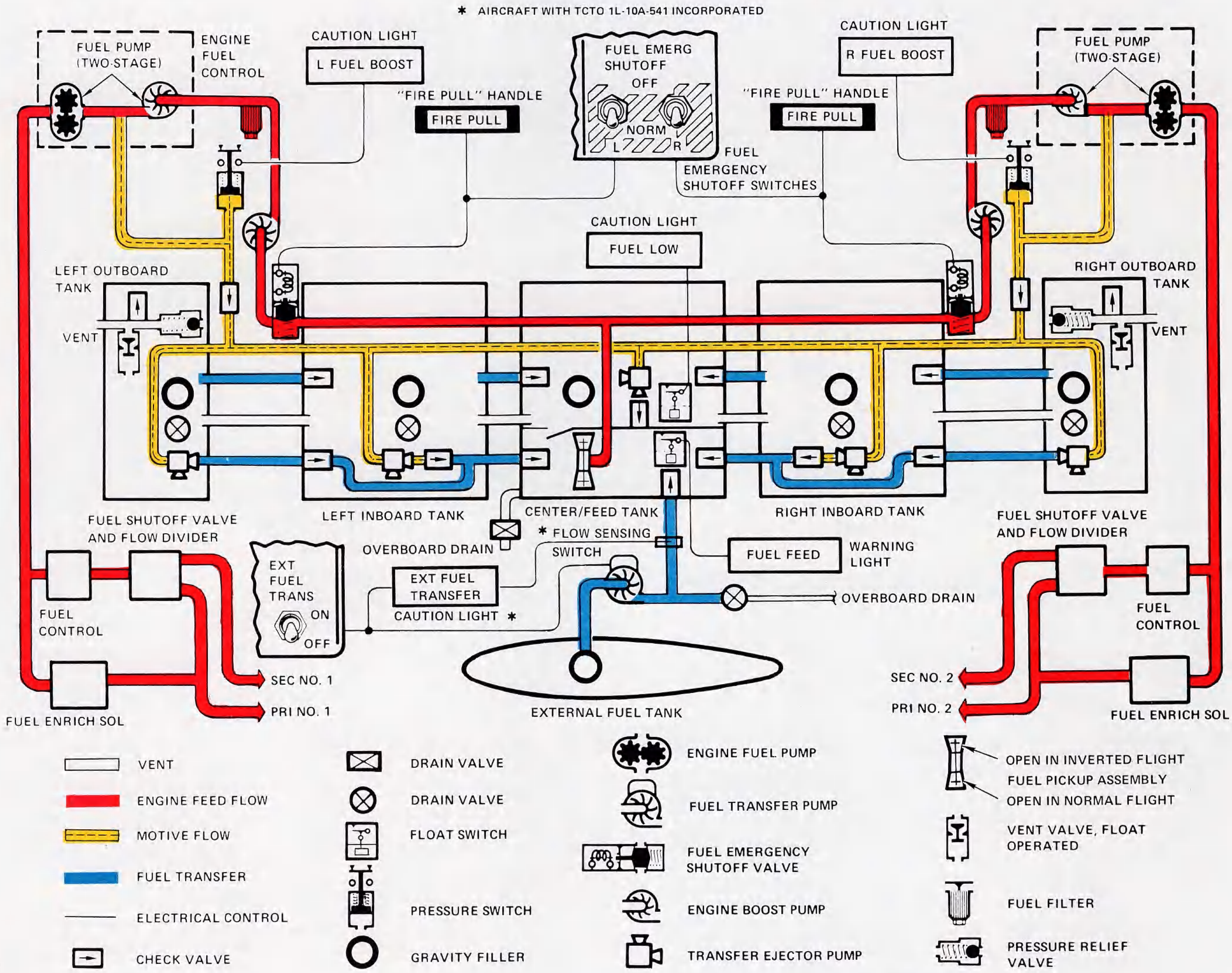
The two outboard wing tanks are rated at 40 gallons each and the two inboard tanks are rated at 69 gallons each. The center tank, also rated at 40 gallons, includes a sump portion which acts as an engine feed tank. All wing tanks are self-sealing, unpressurized, bladder-type cells, filled with explosion and fire suppressing reticulated foam. The tanks contain approximately 250 gallons of usable fuel during normal fuel transfer operation. The center tank receives all fuel from the inboard and outboard tanks. The engine feed portion of the center tank has limited inverted flight capability and receives all fuel before it is distributed to the engines. Wing and center tank fuel is transferred by gravity and ejector-type transfer pumps which are operated by motive flow (fuel flow returned from the low-pressure port of the engine-driven fuel pumps). Fuel from the feed tank is supplied by gravity to engine-driven boost pumps in the engine fuel lines. Should wing or center tank ejector pump action fail, fuel will continue to flow into the feed tank by gravity. Electrically-operated fuel shutoff valves are provided, one in each wing, for the emergency shutoff of fuel. Refueling is accomplished manually through five filler points on top of the wing.

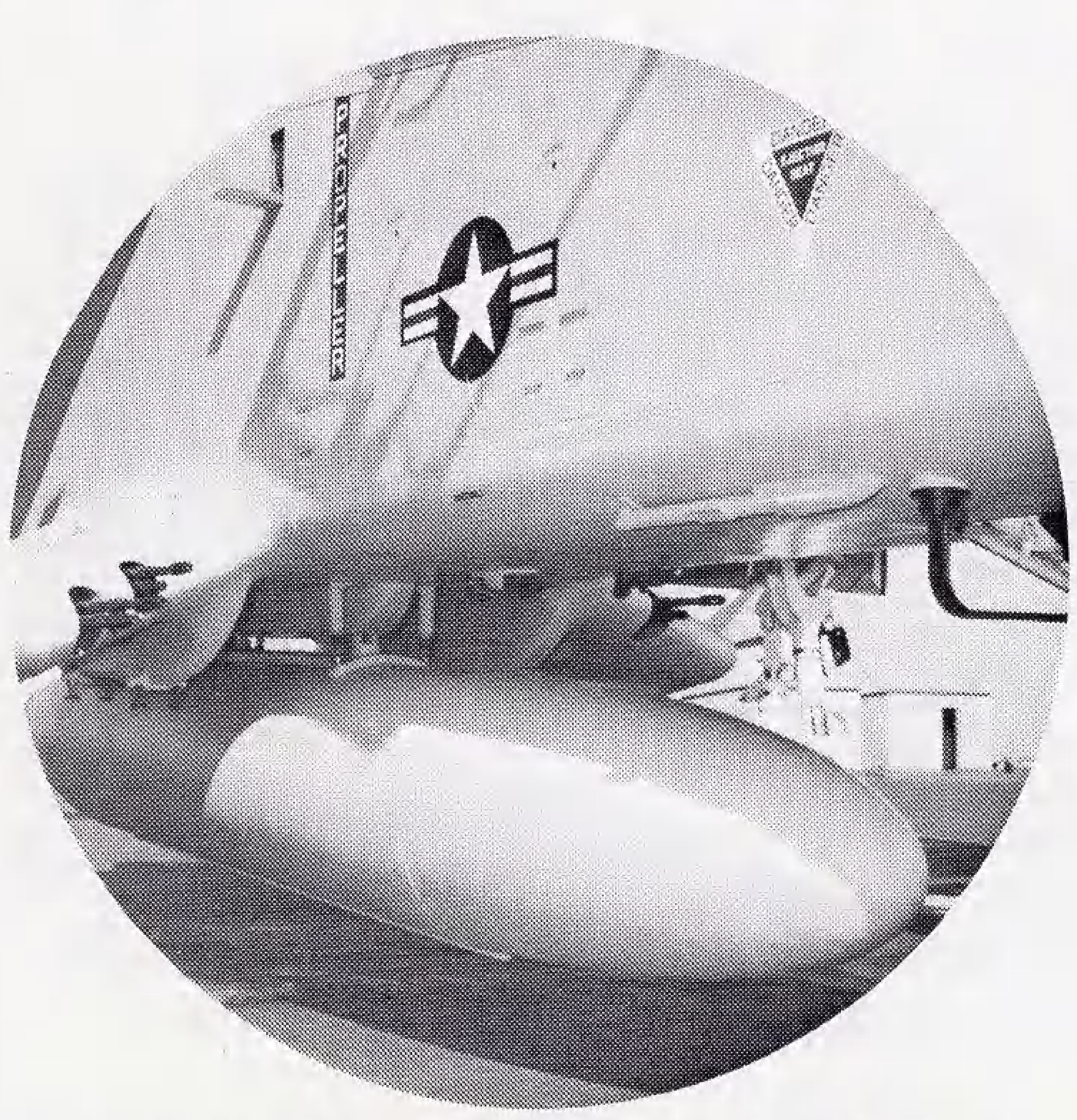
EXTERNAL FUEL

External fuel can be carried in a single 150- or 230-gallon tank installed at the centerline fuselage station. Fuel is transferred from the external tank to the wing-center/feed tank by an electrically-driven transfer pump in the external fuel transfer line. The normal rate of transfer from the external tank is 750 pounds per hour (115 GPH). It is to be noted that the 150-gallon external fuel tank will accept only 122 gallons of fuel unless special procedures are used to elevate the aircraft nose to level the tank for filling. The 230-gallon tank incorporates reticulated foam and will accept 229 gallons of fuel using standard filling procedures.

Fuel System (Cont.)

FUEL SYSTEM DIAGRAM





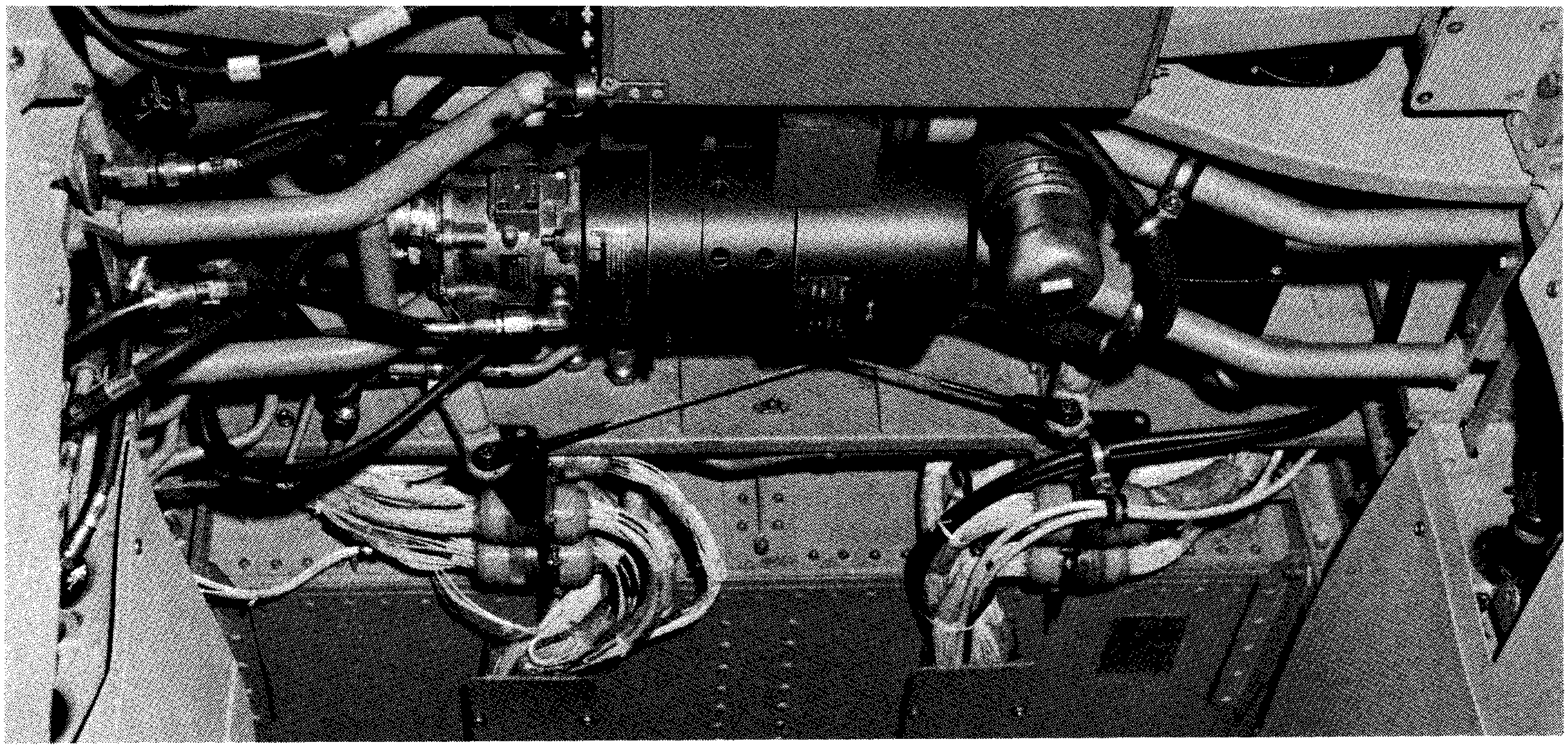
230 GALLON EXTERNAL TANK (USAF INSTALLATION)

FUEL QUANTITY DATA

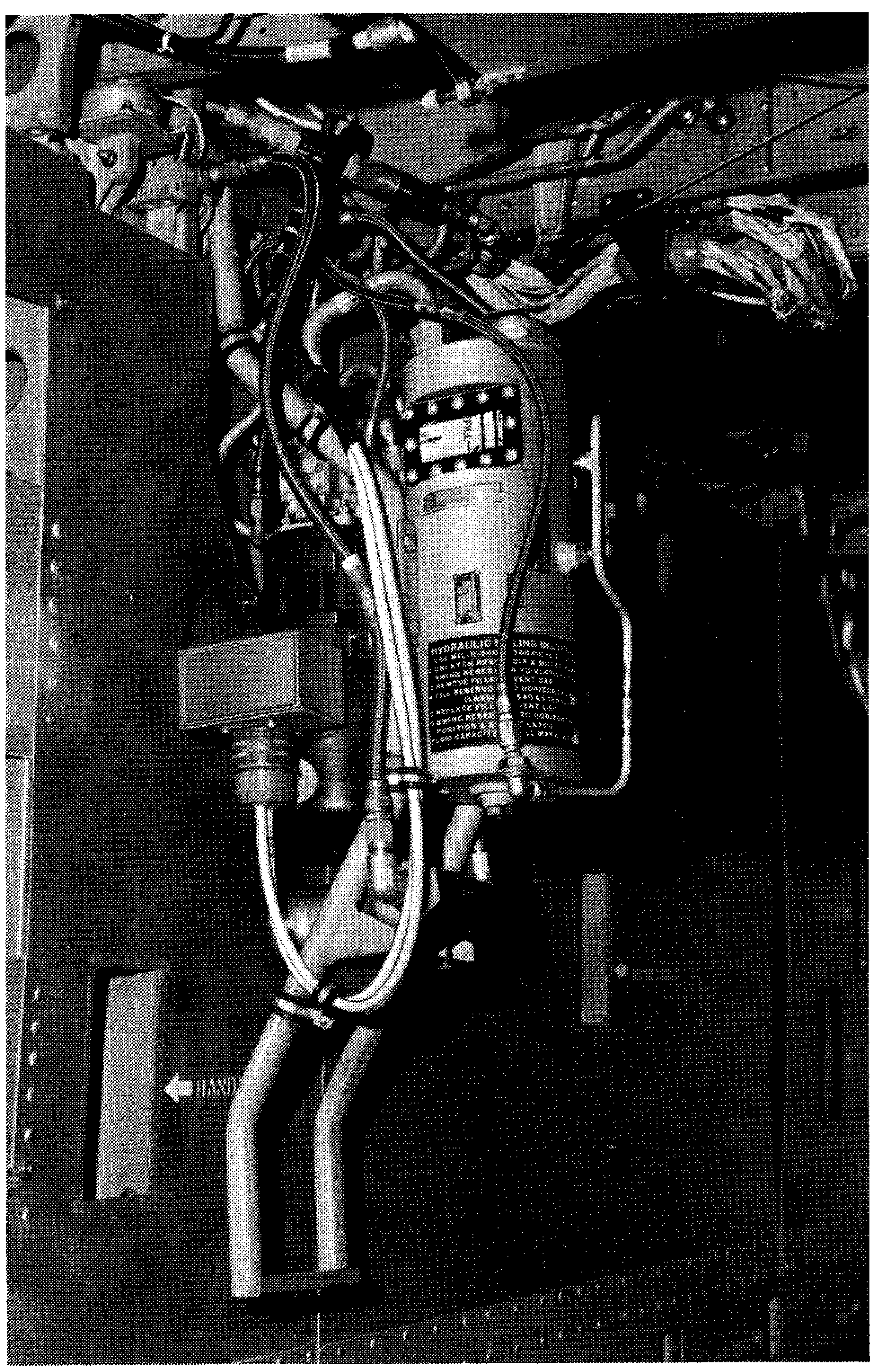
	TANK CAPACITY			USABLE		
		JP-5	JP-4		JP-5	JP-4
	GALLONS	POUNDS	POUNDS	GALLONS	POUNDS	POUNDS
WING OUTBOARD (2)	80	544	520	77	523.6	500
WING INBOARD (2)	138	938.4	897	135	918	878
CENTER/FEED	40	272	260	40	272	260
TOTAL INTERNAL	258	1754.4	1677	252	1713.6	1638
1 INTERNAL TOTAL	258	1754.4	1677	252	1713.6	1638
150 GAL. EXT. TANK	122	829.6	793	122	829.6	793
TOTAL	380	2584.0	2470	374	2543.2	2431
2 INTERNAL TOTAL	258	1754.4	1677	252	1713.6	1638
150 GAL. EXT. TANK	150	1020	975	150	1020	975
TOTAL	408	2774.4	2652	402	2733.6	2613
1 INTERNAL TOTAL	258	1754.4	1677	252	1713.6	1638
230 GAL. EXT. TANK	229	1557.2	1488.5	223	1516.4	1449.5
TOTAL	487	3311.6	3165.5	475	3230.0	3087.5

JP-4 = 6.5 LBS/GAL
JP-5 = 6.8 LBS/GAL

1 TANK REFUELED IN NORMAL ATTITUDE
2 TANK "PACKED" (NOSE RAISED 4 DEGREES)



Hydraulic System Power Package



Power Package Swings Down for Servicing Convenience

HYDRAULIC SYSTEM

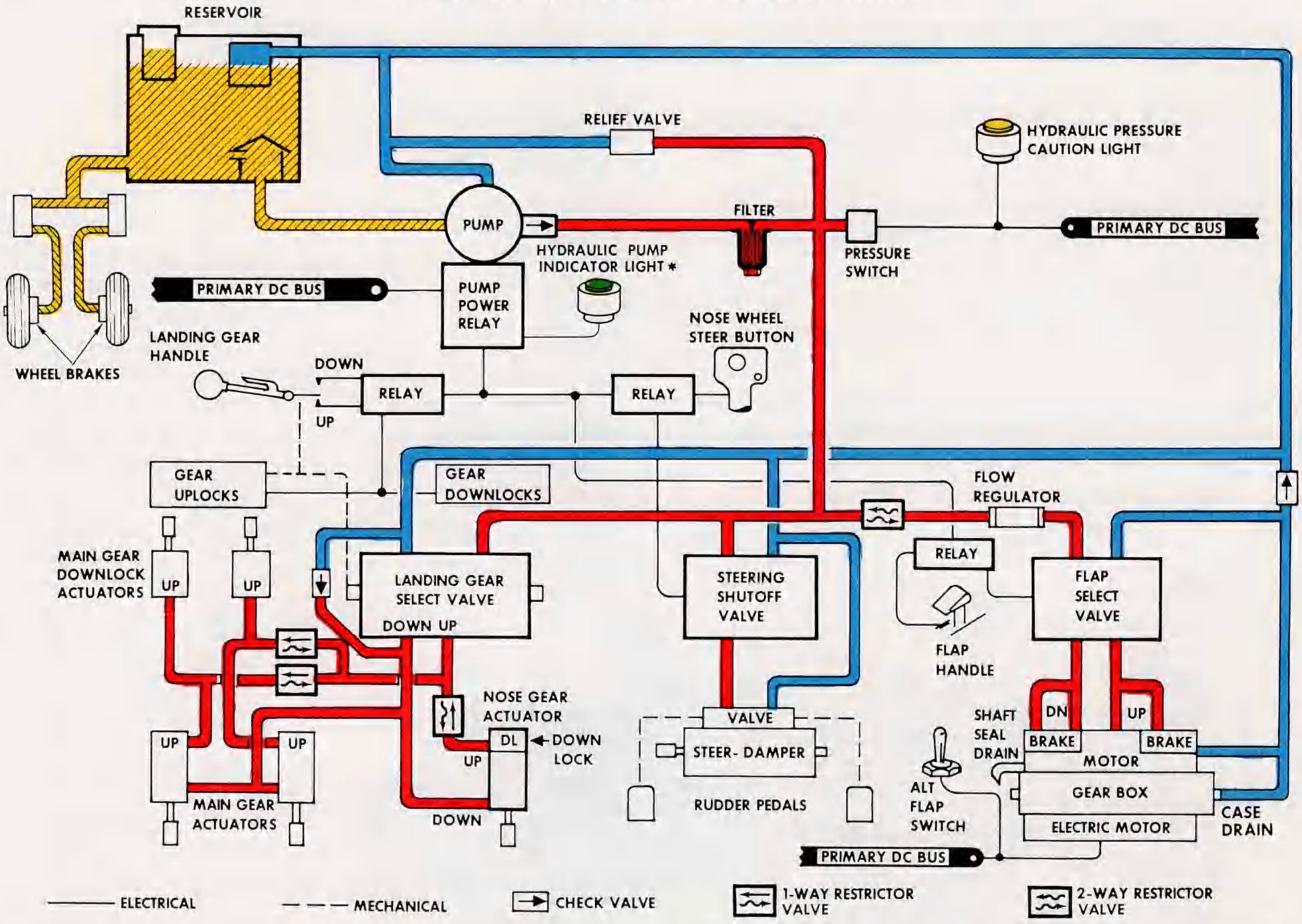
The hydraulic system is a closed-center, intermittent-duty type system that supplies hydraulic power at 1500 psi to operate the wing flaps, landing gear, and nose wheel steering. Hydraulic fluid for wheel brake operation is obtained directly from the hydraulic system reservoir by gravity flow. The wheel brake system consists of two independent, manually operated hydraulic brake units.

The hydraulic system power package consists of a reservoir, filter, and an electric motor-driven hydraulic pump unit installed in a swingdown assembly in the upper area of the cargo bay aft of the wing. Two indicating lights, located on the pilot's center pedestal, provide indications of system pressure and hydraulic pump operation. The hydraulic pump functions only during operation of the flaps, landing gear, or nose wheel steering systems. The nose wheel steering button may be used to operate the hydraulic pump at any time to provide positive operation in event the pump fails to operate through normal circuits. The hydraulic pump has a flow rate of 4.0 gpm at 850 psi and pressure is maintained at 1500 psi under no-flow conditions.

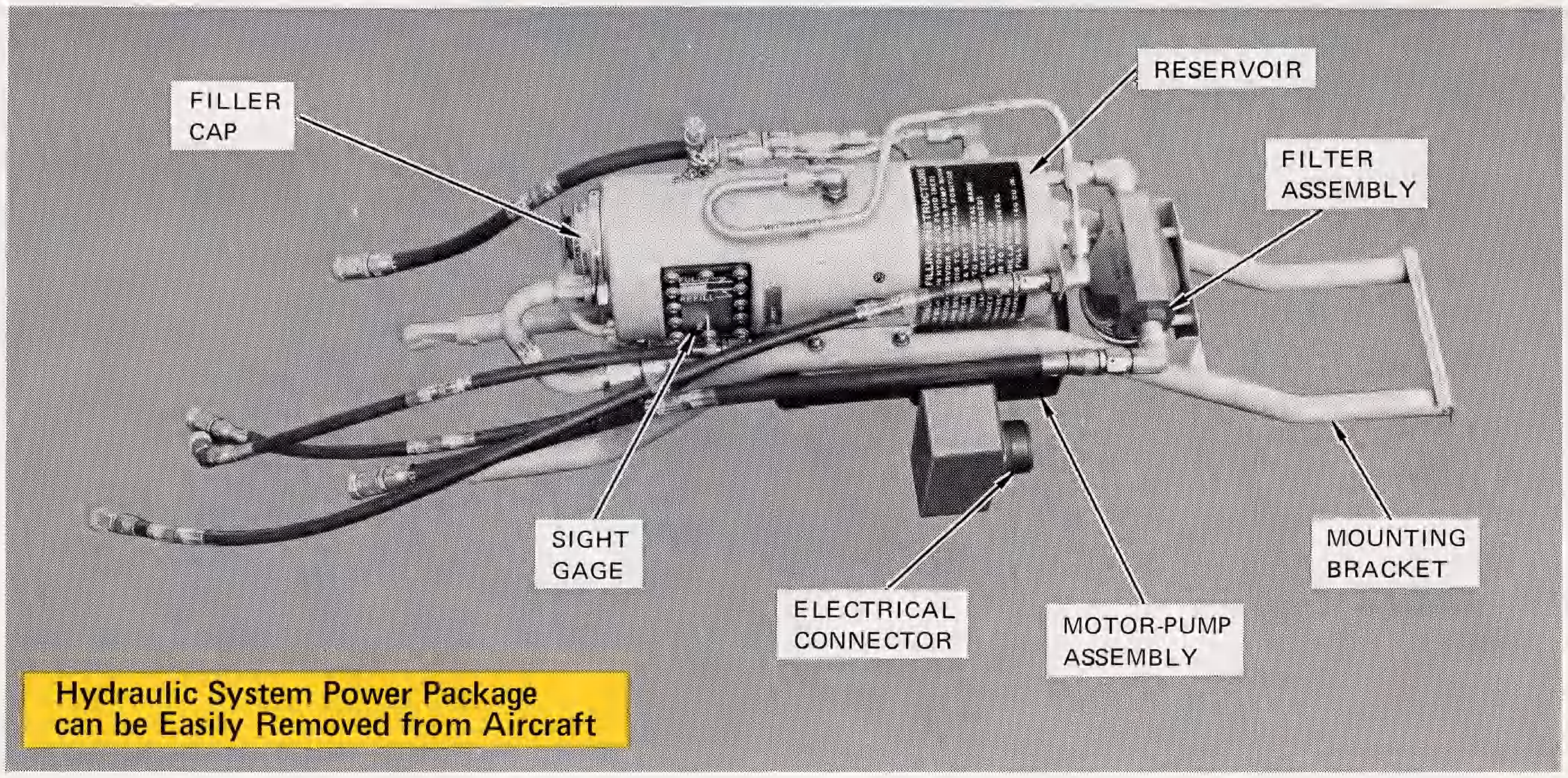
In the event of a hydraulic system malfunction, the landing gear can free-fall to the down position; the wing flaps can be operated electrically; and, because of the design of the hydraulic reservoir, sufficient fluid is always available for operation of the wheel brakes.

Hydraulic System (Cont.)

HYDRAULIC SYSTEM FLOW DIAGRAM



*AFC 24/TCTO 1L-10A-538 INCORPORATED



Hydraulic System Power Package can be Easily Removed from Aircraft

LANDING GEAR and WHEEL BRAKE SYSTEM

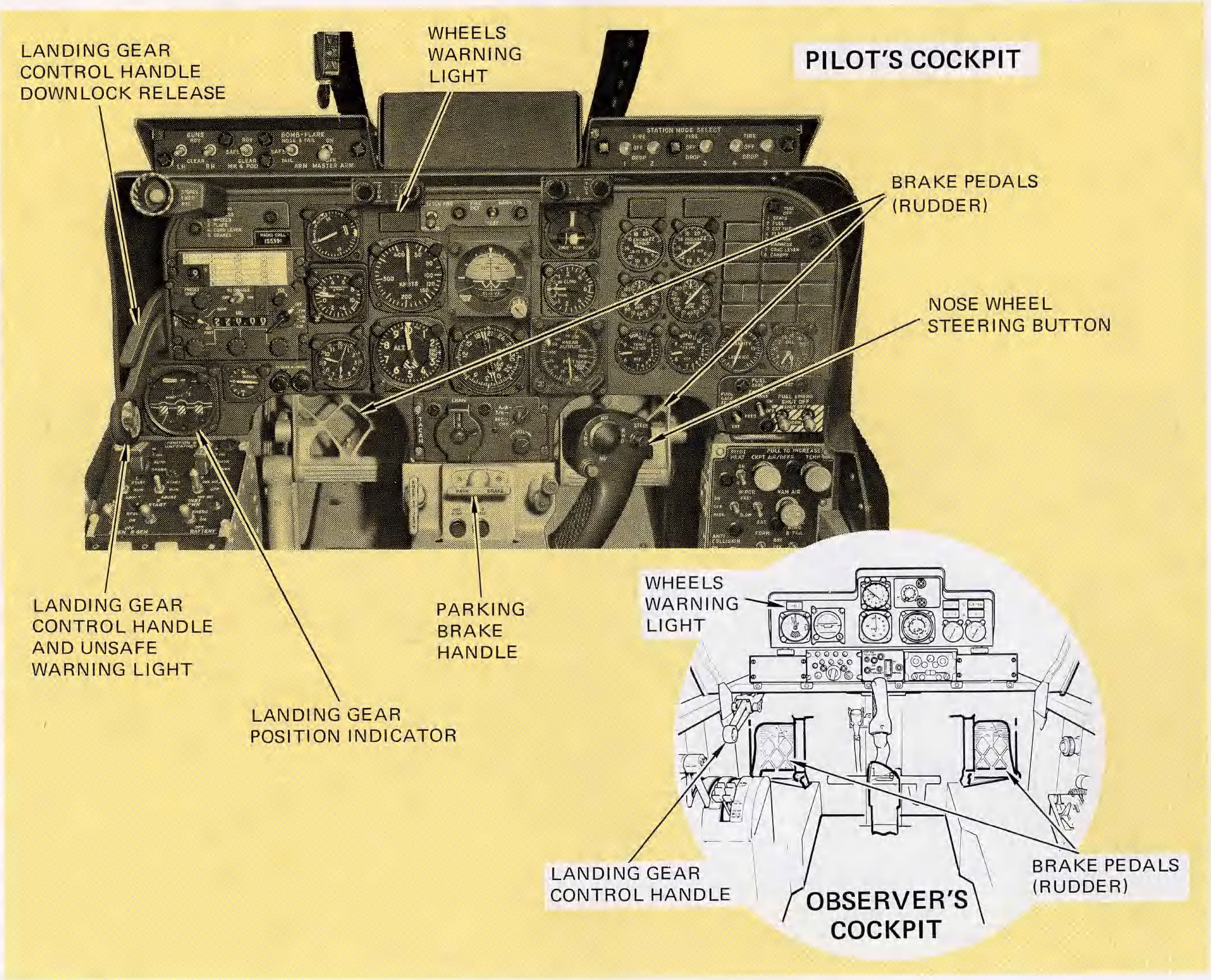
Hydraulically-operated, tricycle landing gear of the folding drag link, trailing-arm type, provide the Bronco with the capability to operate from unimproved areas at high sink rates (up to 20 feet per second). Although the system is controlled by mechanical linkage, gear retraction is hydraulically powered, with the mains retracting upward and aft, and the nose gear retracting forward. Emergency extension is accomplished by gravity, with the main gear assisted by spring bungees. Normal retraction requires approximately 10 seconds and extension requires approximately 7 seconds. Landing gear system controls and indicators, located in both cockpits, are shown in the accompanying illustrations.

Braking of the Bronco is accomplished through manually-operated brake systems which incorporate a separate master brake cylinder for each system. Parking brake provisions are also provided by means of a handle located on the center pedestal.

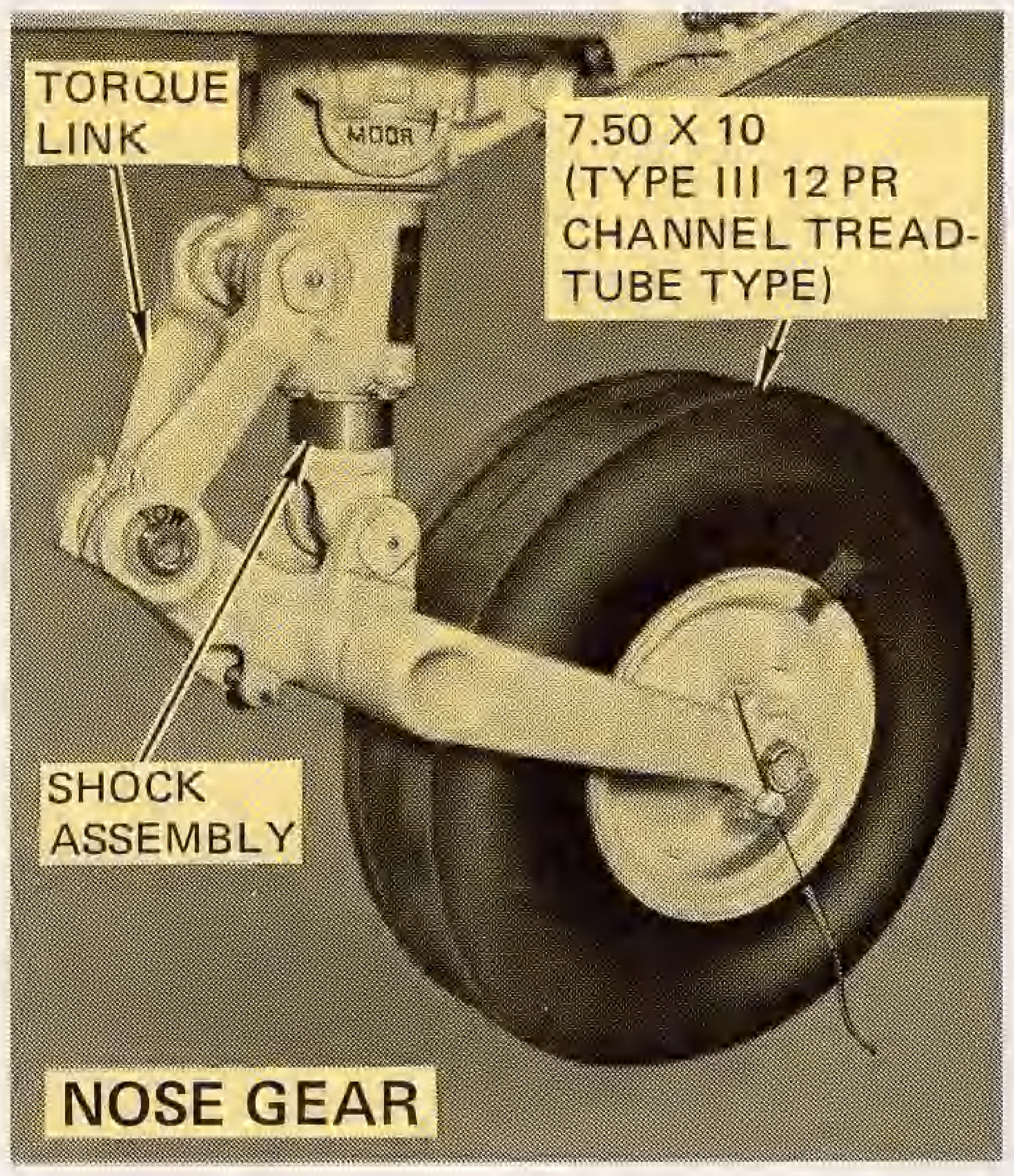
Nose wheel steering is available, up to 55 degrees left or right of center, through a hydraulically-operated nose wheel steer damper system.

WHEEL BRAKES

Manually-operated, hydraulically independent wheel brakes are installed on the Bronco. Pressure applied at the rudder pedals in either cockpit operates a separate brake master cylinder for each wheel. The brakes include integral parking brake provisions, utilizing pedal pressure by a valve mechanism which traps pressure generated in the master cylinders. Brake hydraulic fluid is supplied by the main aircraft hydraulic power system reservoir. The reservoir is designed to maintain a sufficient amount of fluid for the brakes in the event of a leak in the main hydraulic system.

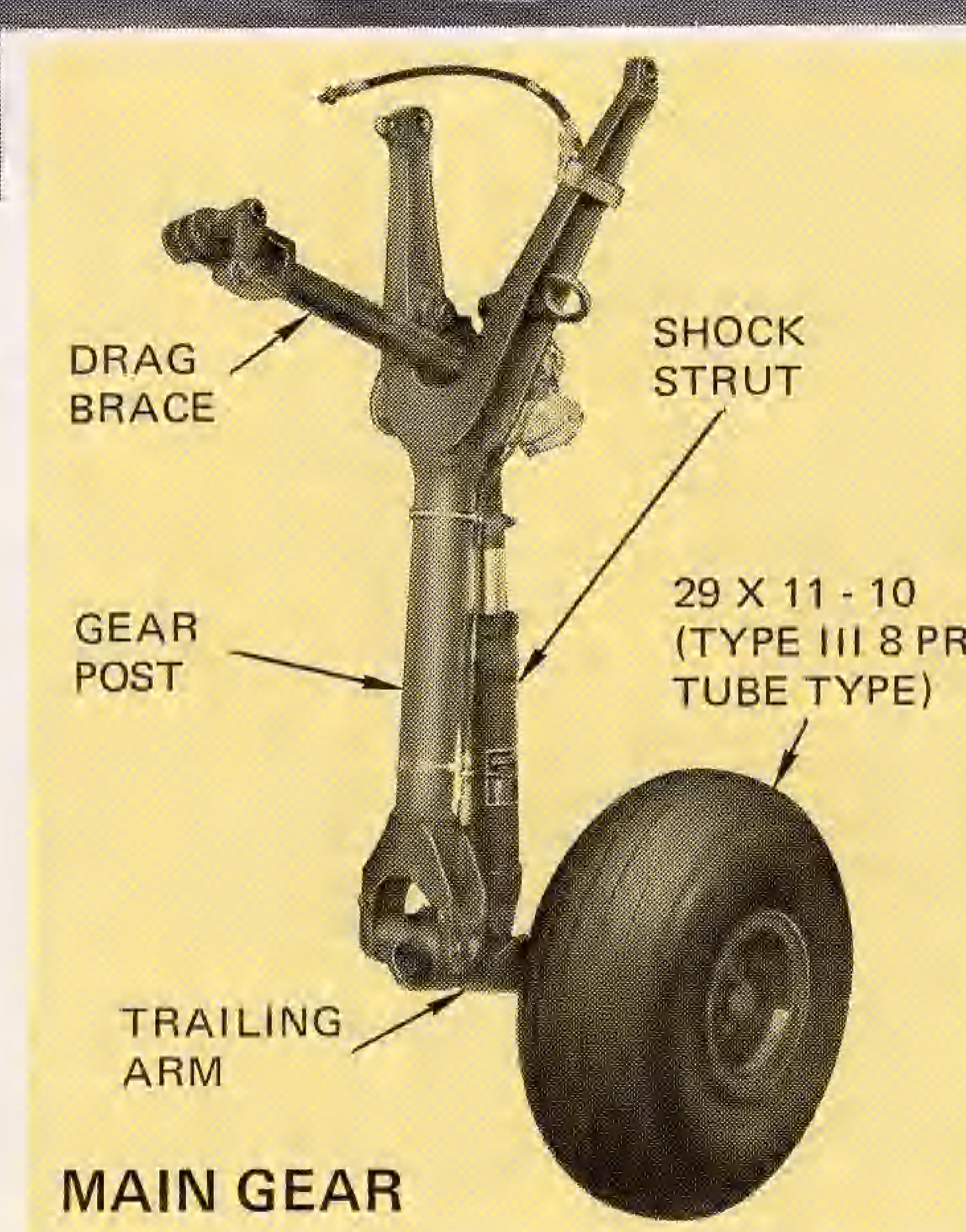


Landing Gear and Wheel Brake System (Cont.)



PARKING BRAKE

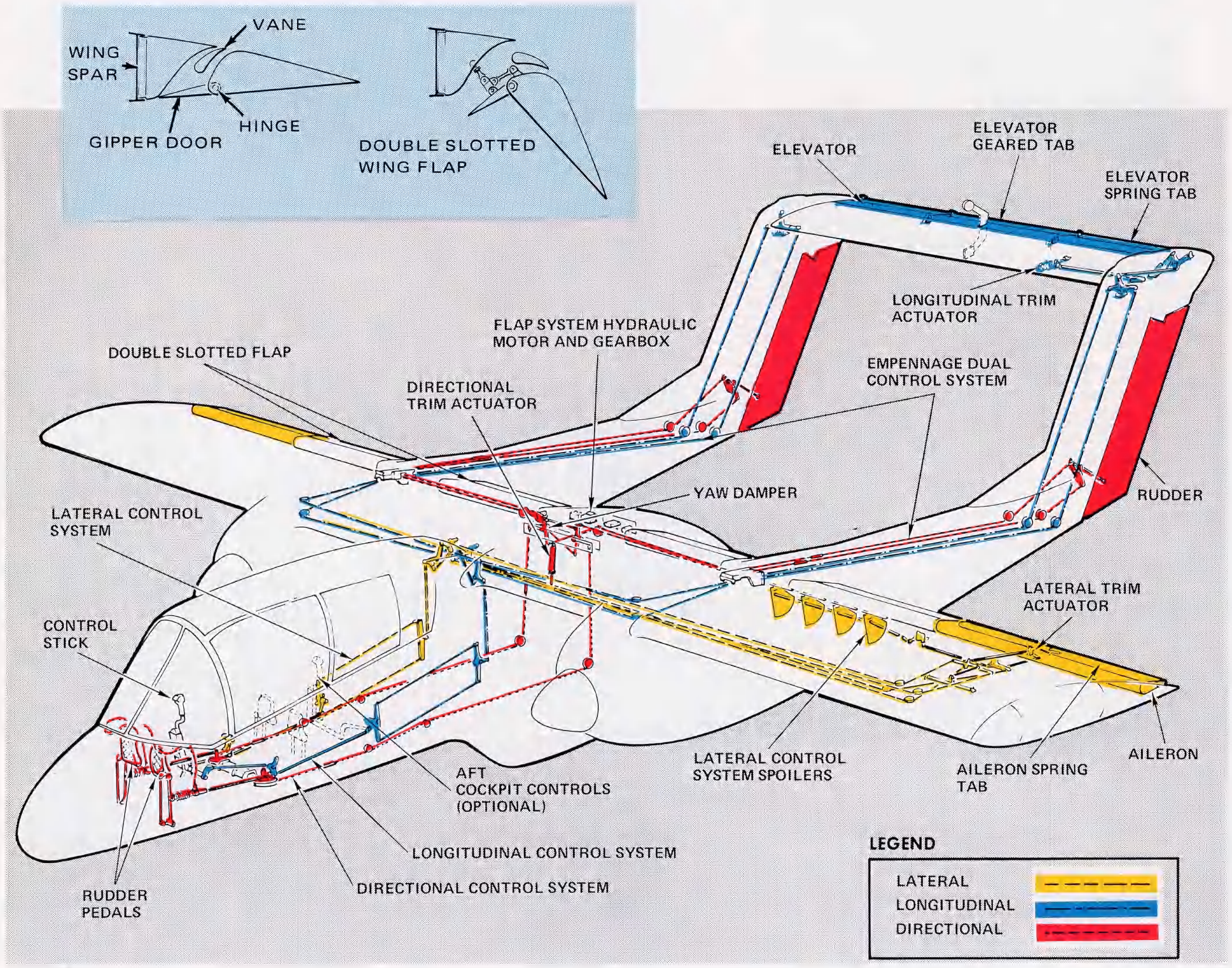
The PARK BRAKE handle is installed on the pilot's center pedestal. Brakes are set for parking by applying pedal pressure as desired, then pulling the handle out and releasing pedal pressure. The parking brakes are released by applying sufficient pedal pressure to exceed the level of trapped pressure.



NOSE WHEEL STEERING

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

FLIGHT CONTROL SYSTEMS



GENERAL

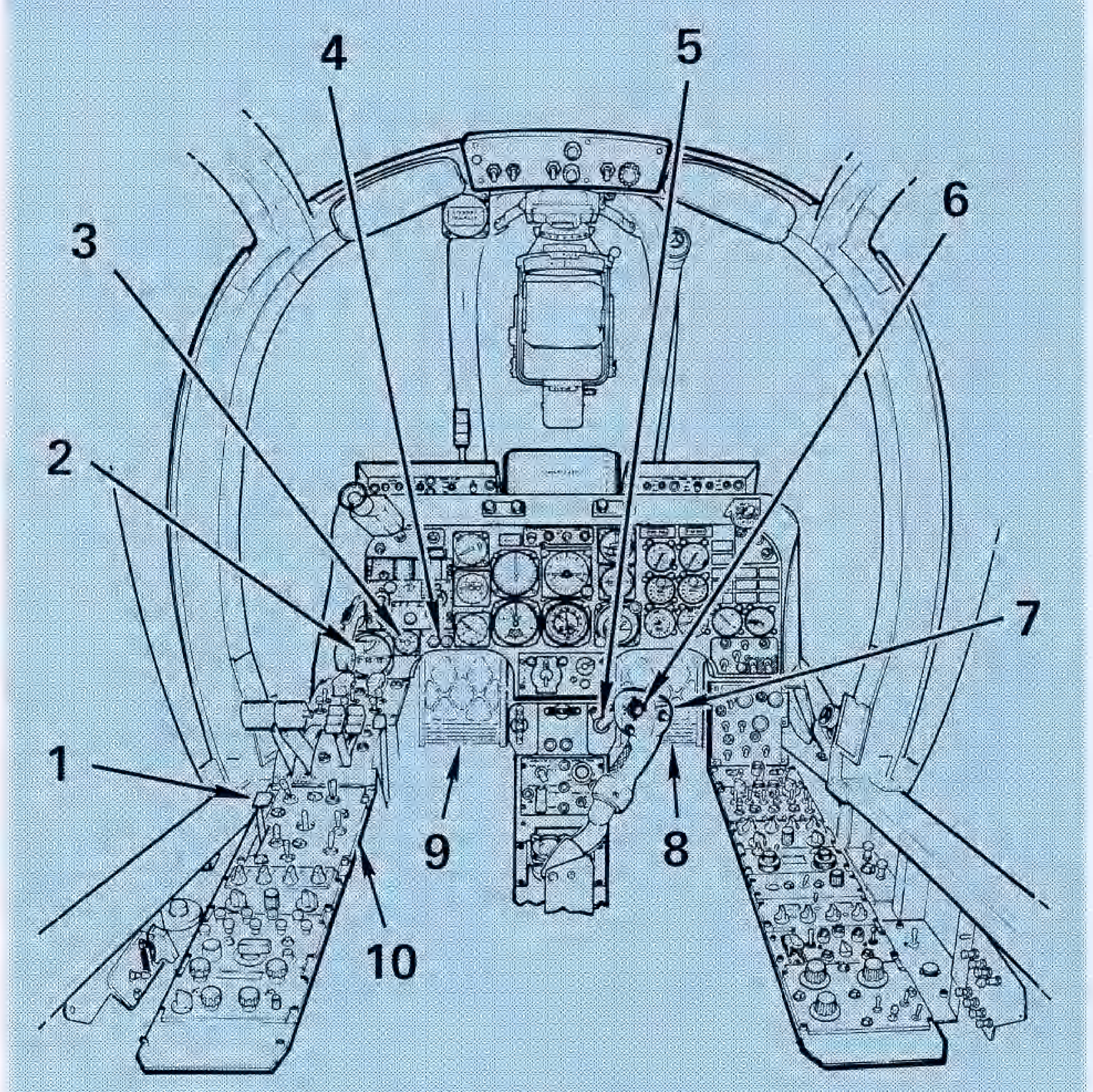
The flight control systems consist of the longitudinal, lateral, and directional control systems, the associated trim systems, and the trailing edge flap system. The longitudinal, lateral, and directional systems are push-pull rod/cable-type systems which provide control through the elevator, aileron/spoilers and the twin rudders. Bungee-type trim systems are operated by trimming the no-force stick and rudder pedal position through electrically-operated torsion bungee assemblies. An electrically-controlled yaw damper system is incorporated in the directional control system to dampen directional oscillations of the aircraft.

Aircraft provisions are provided for the installation of a flight control system package in the observer's cockpit. When installed, the components operate in parallel with the basic aircraft controls.

LONGITUDINAL SYSTEM

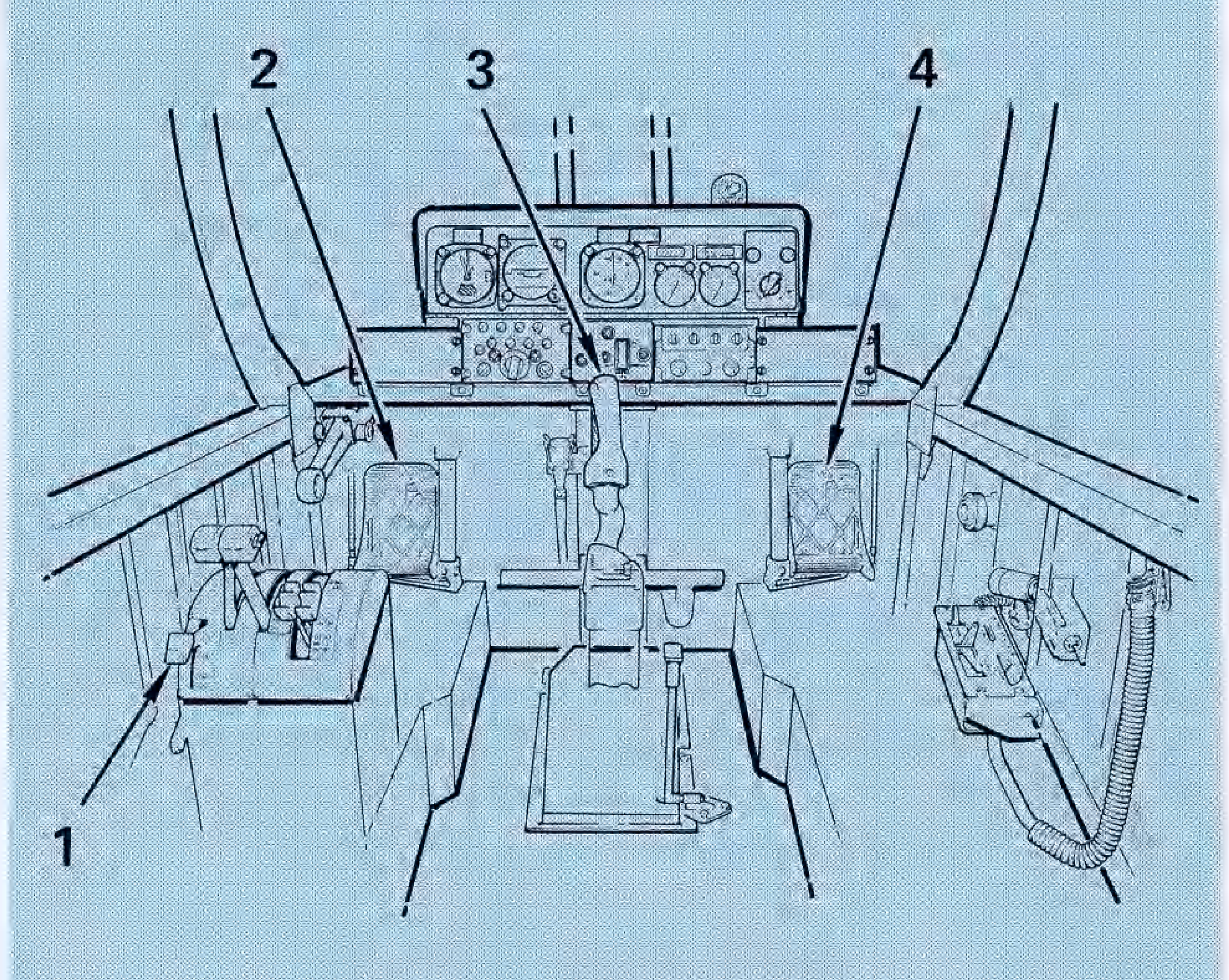
The longitudinal system consists of a horizontal stabilizer and a tab-boosted, mechanically dampened, overbalanced elevator. The tab system consists of four trailing edge segments extending the entire span of the elevator. In flight, the spring (outboard) tabs are driven by the control stick in the direction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

Flight Control Systems (Cont.)



PILOT'S COCKPIT

1. FLAP HANDLE
2. FLAP POSITION INDICATOR
3. ELEVATOR TRIM INDICATOR
4. RUDDER AND AILERON TRIM NEUTRAL INDICATORS
5. RUDDER PEDAL ADJUST CRANK
6. ELEVATOR AND AILERON TRIM SWITCH
7. CONTROL STICK
8. RH RUDDER PEDAL
9. LH RUDDER PEDAL
10. FLAP-TRIM CONTROL PANEL



OBSERVER'S COCKPIT

1. FLAP HANDLE
2. LH RUDDER PEDAL
3. CONTROL STICK
4. RH RUDDER PEDAL

LATERAL SYSTEM

The lateral system consists of spring and gear tab-boosted ailerons, augmented by spoilers. Operation of the outboard (spring) tabs is similar to that of the elevator spring tabs, in that in-flight control stick initial movement displaces the tabs, driving the ailerons by aerodynamic reaction until spring tab stops are contacted. Further lateral movement of the control stick then drives the ailerons directly. Lateral trim is achieved through the action of a trim actuator/torsion bar assembly which adjusts the no-load position of the system (including the control stick) as required.

The spoiler system consists of four rotating spoiler plates located in each wing inboard of each aileron. The spoilers are linked to the ailerons and rotate out of the wing when the trailing edge of the respective aileron is deflected upward by stick movement. Roll rate is increased by spoiler rotation into the air stream on the "down-going" wing; thereby creating additional rolling reaction due to lift loss.

DIRECTIONAL SYSTEM

The directional system consists of twin vertical stabilizers, twin rudders, and an electromechanical yaw damper system. The rudders are controlled by direct mechanical action through the rudder pedals. Rudder trim is provided by an electrical actuator/bungee assembly which displaces the control linkage, adjusting the directional system to no-load position as required. The yaw damper system supplies a control torque to the rudders proportional to aircraft yaw rate and oscillation frequency and in the opposite direction of the yaw motion.

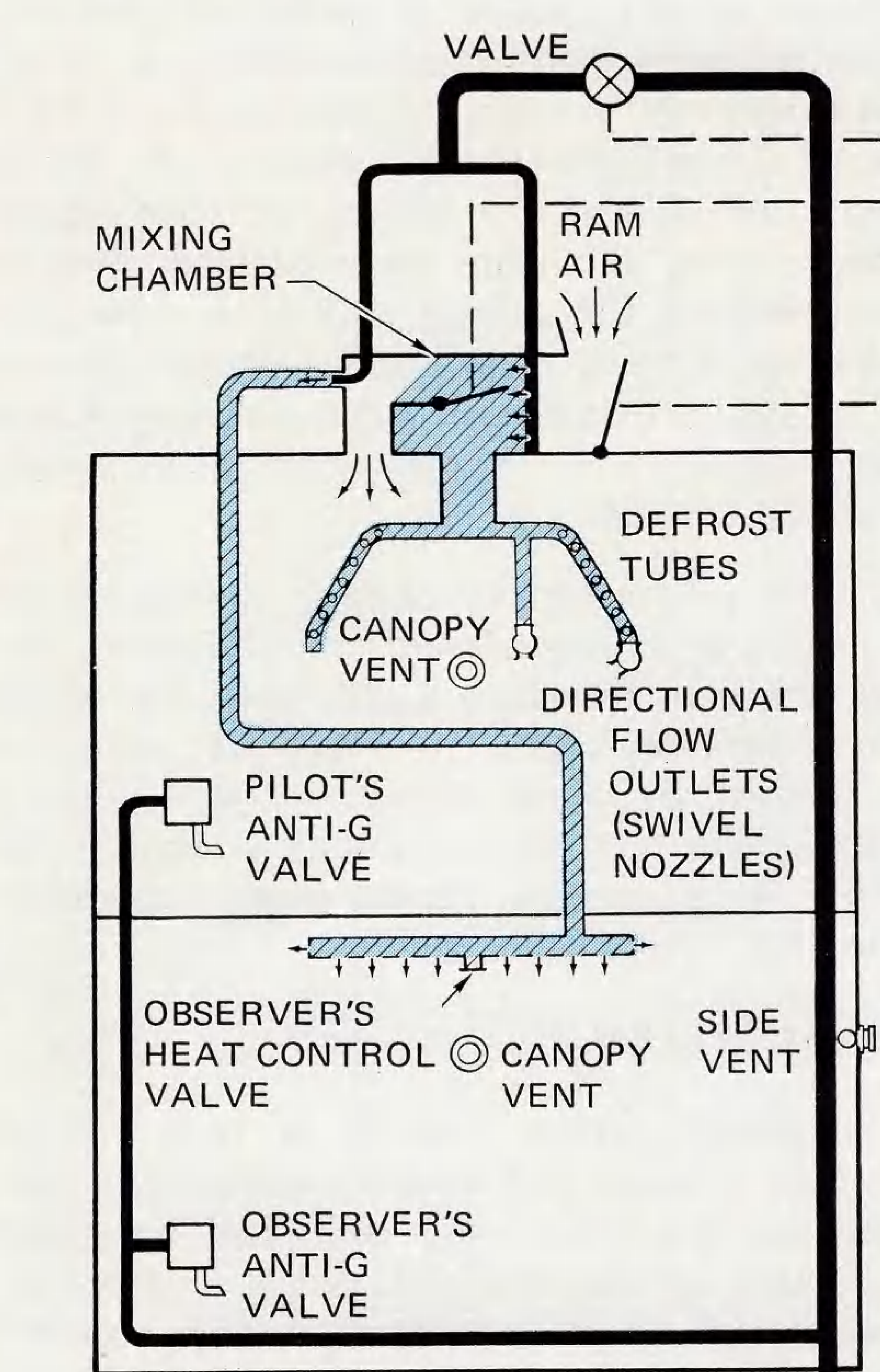
FLAP SYSTEM

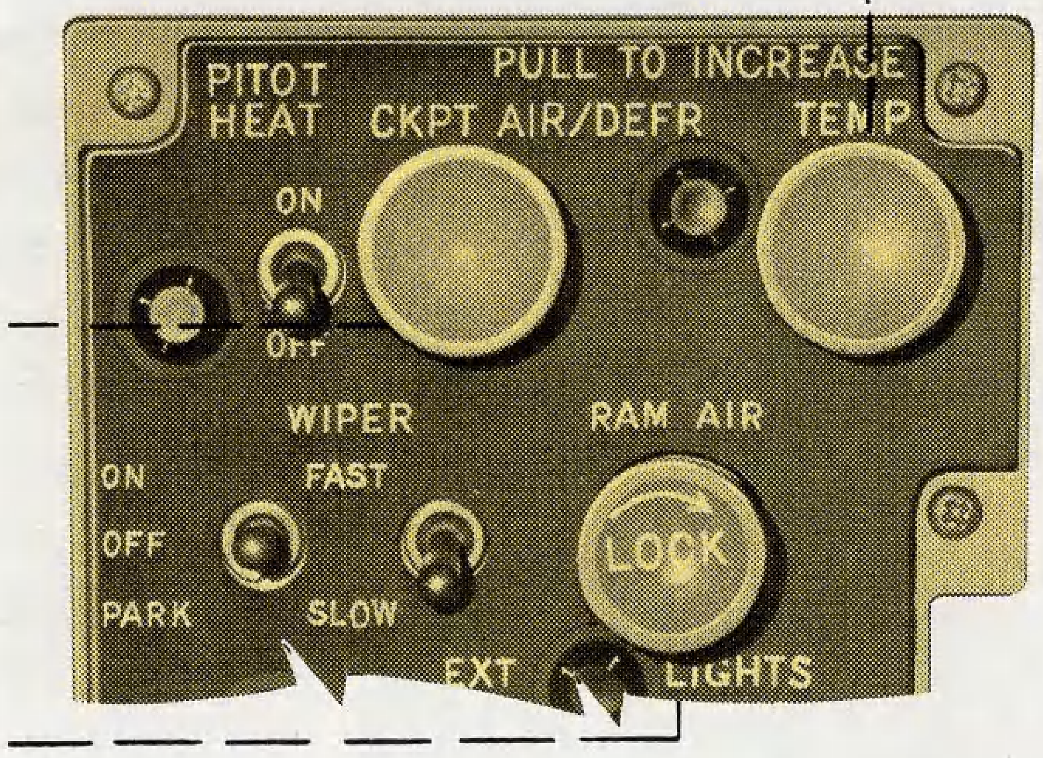
The high-lift capability of the aircraft is increased by the installation of double-slotted flaps in each wing. The slot feature of the flaps is obtained by positioning a vane slightly above each main flap. The airflow over the slotted flaps is augmented by gipper (deflector) doors located in the lower portion of the wing forward of the flaps. These doors extend mechanically with the flaps. The flaps consist of four sections, one inboard of each aileron, and one inboard of each boom. Normal extension and retraction are provided by hydraulic system power through operation of a separate mechanical actuator (jackscrew) in each wing. An emergency flap switch, located on the pilot's right-hand console, is provided to extend the flaps electrically in event of hydraulic failure.

OBSERVER'S EQUIPMENT PACKAGE

An observer's flight control equipment package may be installed in the observer's cockpit to provide for alternate control of the aircraft. This package consists of an observer's flight control equipment package and an observer's instrument panel package.

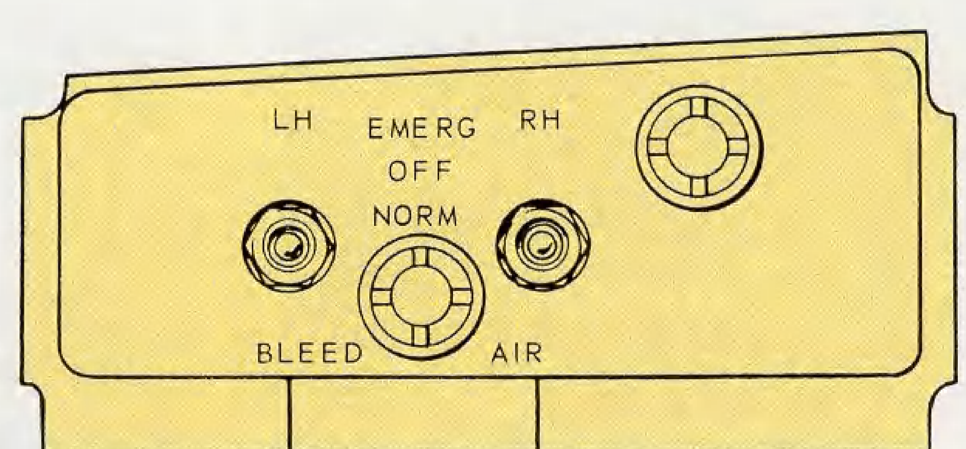
HEAT and VENT SYSTEM



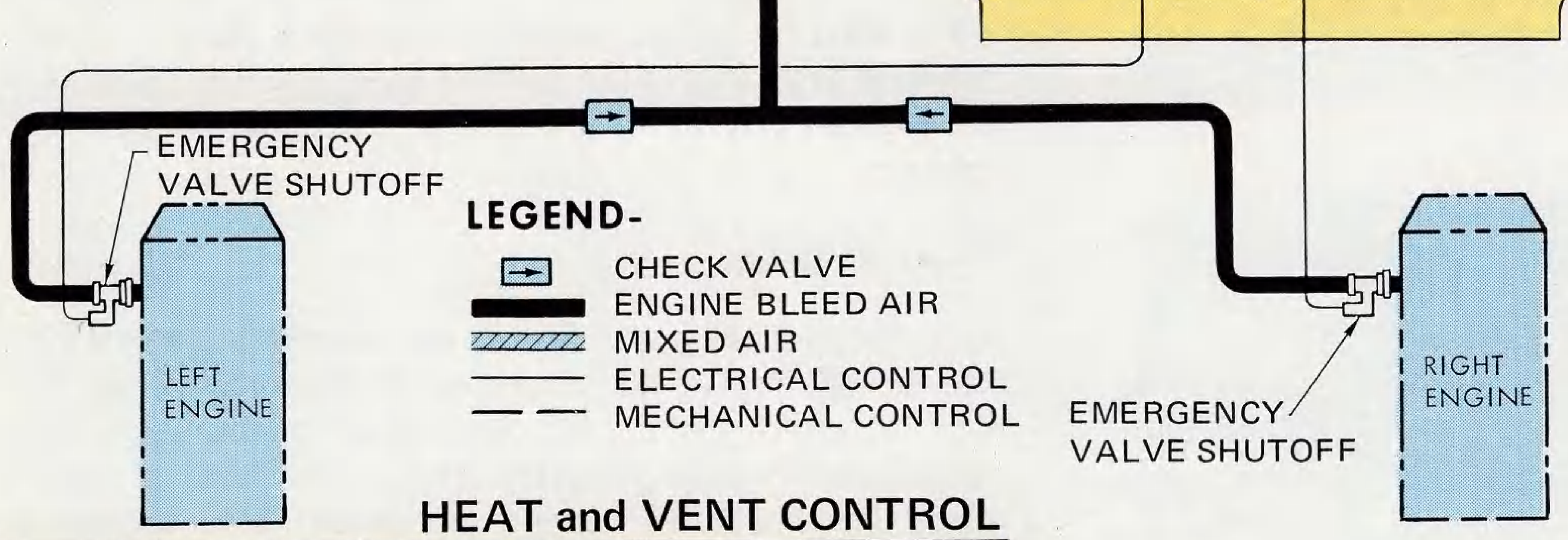


HEAT-VENT CONTROL PANEL (Pilot's RH Console)

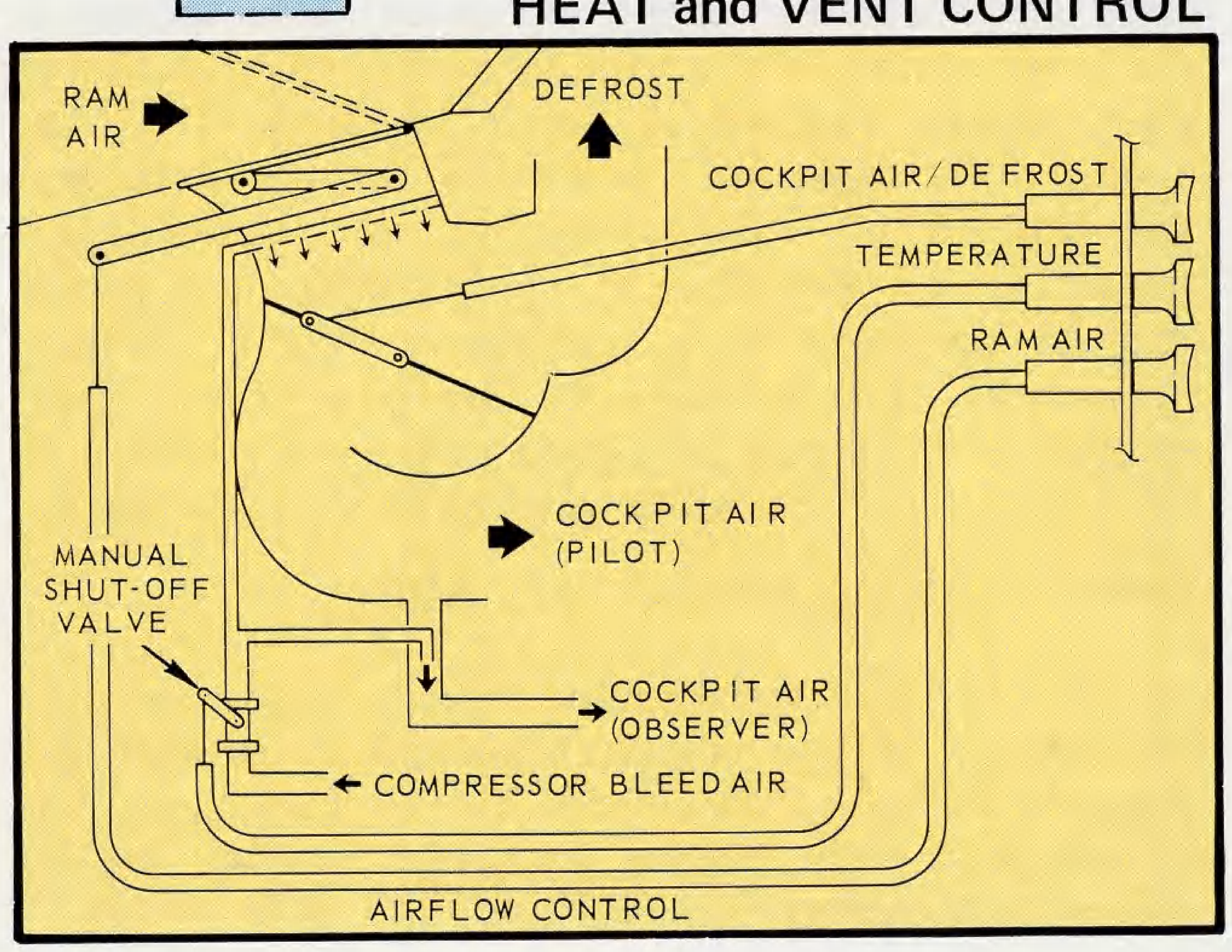
The heat and vent system provides air to both cockpits and the windshield at operator-controlled temperatures. Air inputs are routed through a mixing chamber which incorporates manually-operated butterfly valves. Push-pull knobs in the pilot's cockpit control the valves to select ram–air, temperature, and cockpit air/defrost.



BLEED AIR SHUTOFF SWITCHES (Pilot's RH Console)



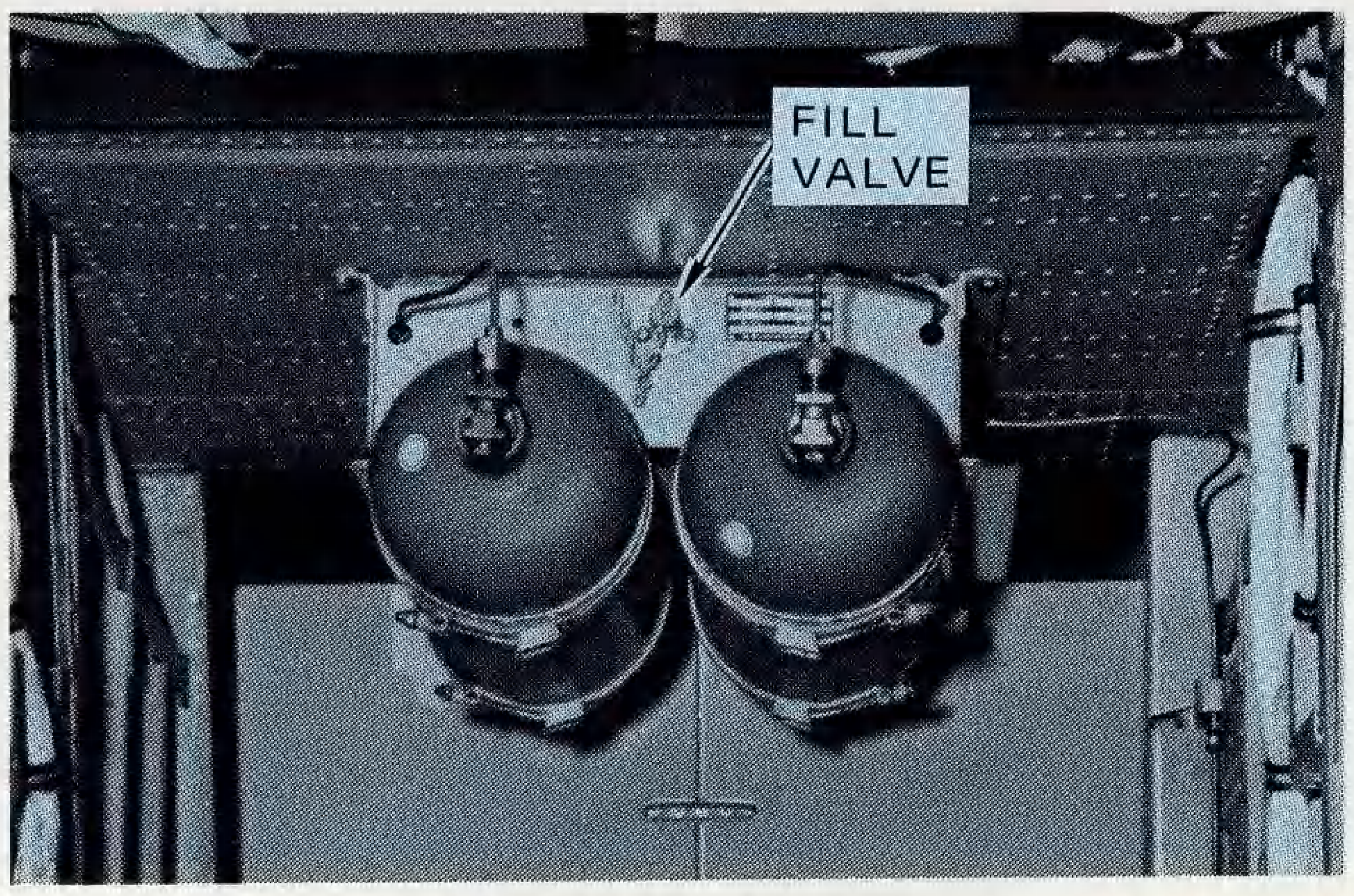
HEAT and VENT CONTROL



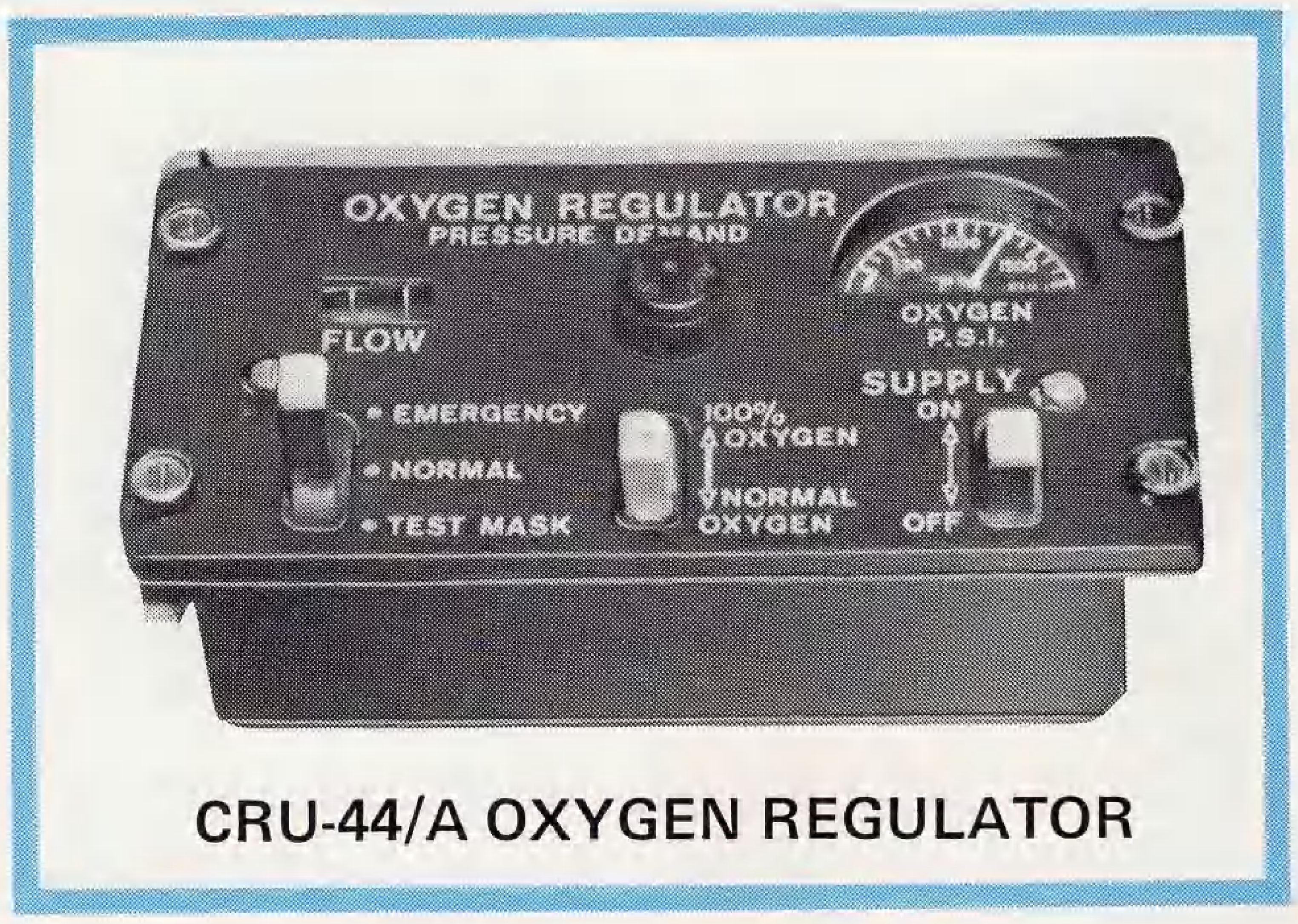
Hot air from the engine compressors is used in combination with ram air to regulate cockpit temperature and to provide defrosting of the windshield. Engine compressor bleed air is routed to the air mixing chamber forward of the pilot's instrument panel, and to the anti-G suit valves on the left side of both cockpits. Controlled to the desired temperature, chamber air is then ducted into both the pilot's and observer's cockpits. Defrost air is selected as desired. Electrical switches are provided for emergency shutoff of the engine bleed air valves.

OXYGEN SYSTEM

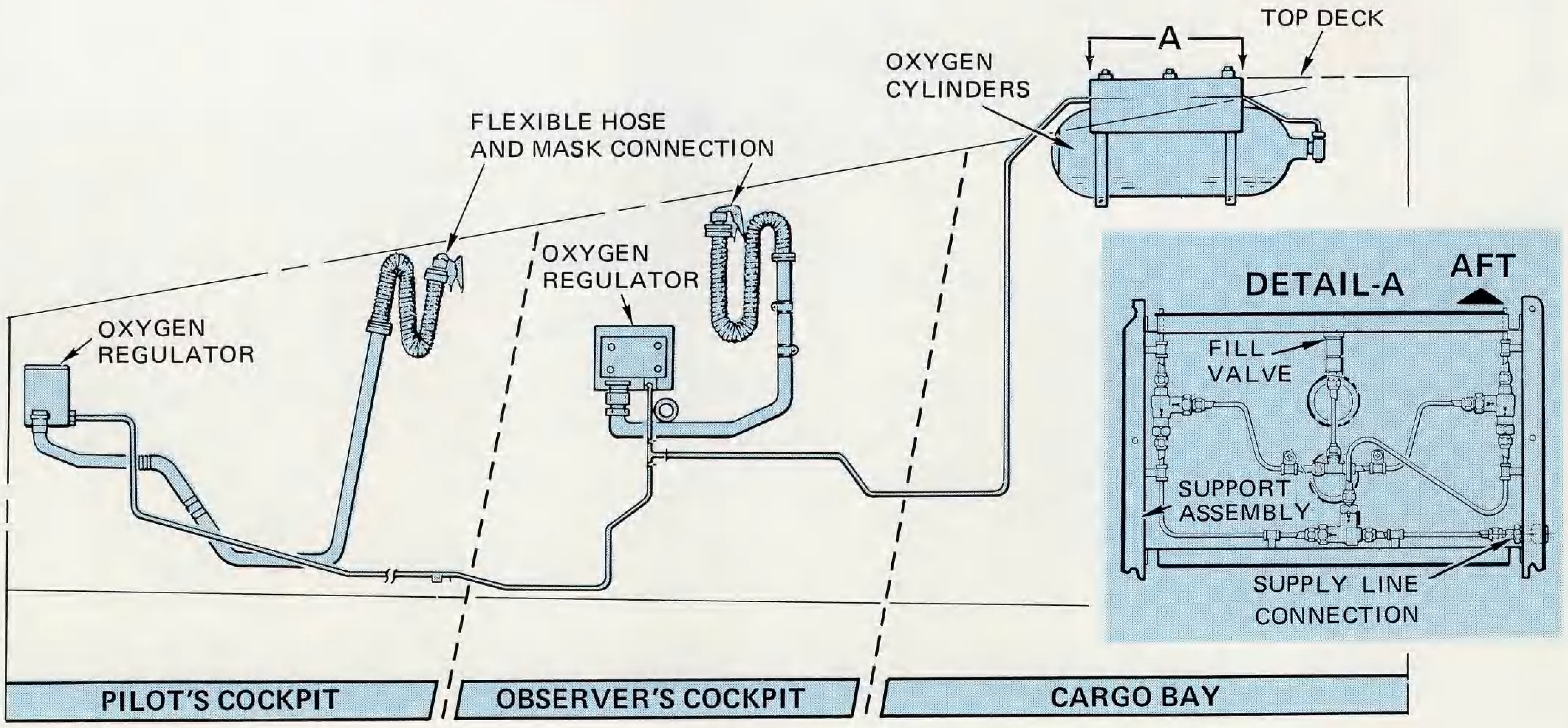
The high-pressure, diluter-demand, gaseous oxygen system consists of two 514-cubic-inch capacity cylinders, check and shuttle valves, a filler valve, and two regulator panels. The system consists of a package which may be removed or installed as desired. A CRU-44/A oxygen regulator panel is installed on the right-hand side of each cockpit and the two 514-cubic-inch oxygen cylinders are mounted in the upper forward end of the cargo bay. The oxygen cylinders are serviced to 1800 (±50) psi.



OXYGEN CYLINDERS
(Cargo Bay-View Looking Forward)



CRU-44/A OXYGEN REGULATOR

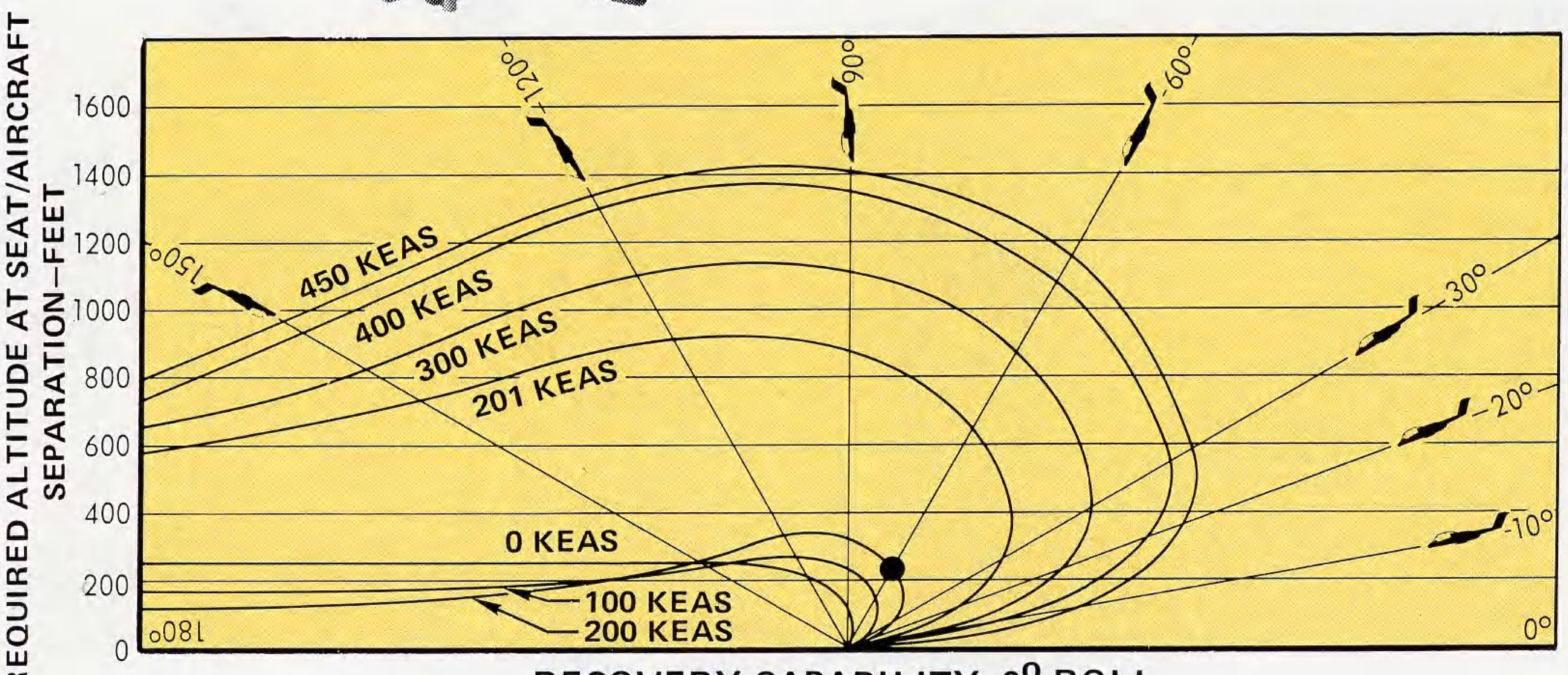


ESCAPE SYSTEM

A zero-speed—zero-altitude LW-3B ejection seat is installed in the pilot's cockpit and in the aft cockpit when the observer's package is installed. The seats eject through the cockpit enclosure; the entire sequence being automatic after "D" ring initiation.

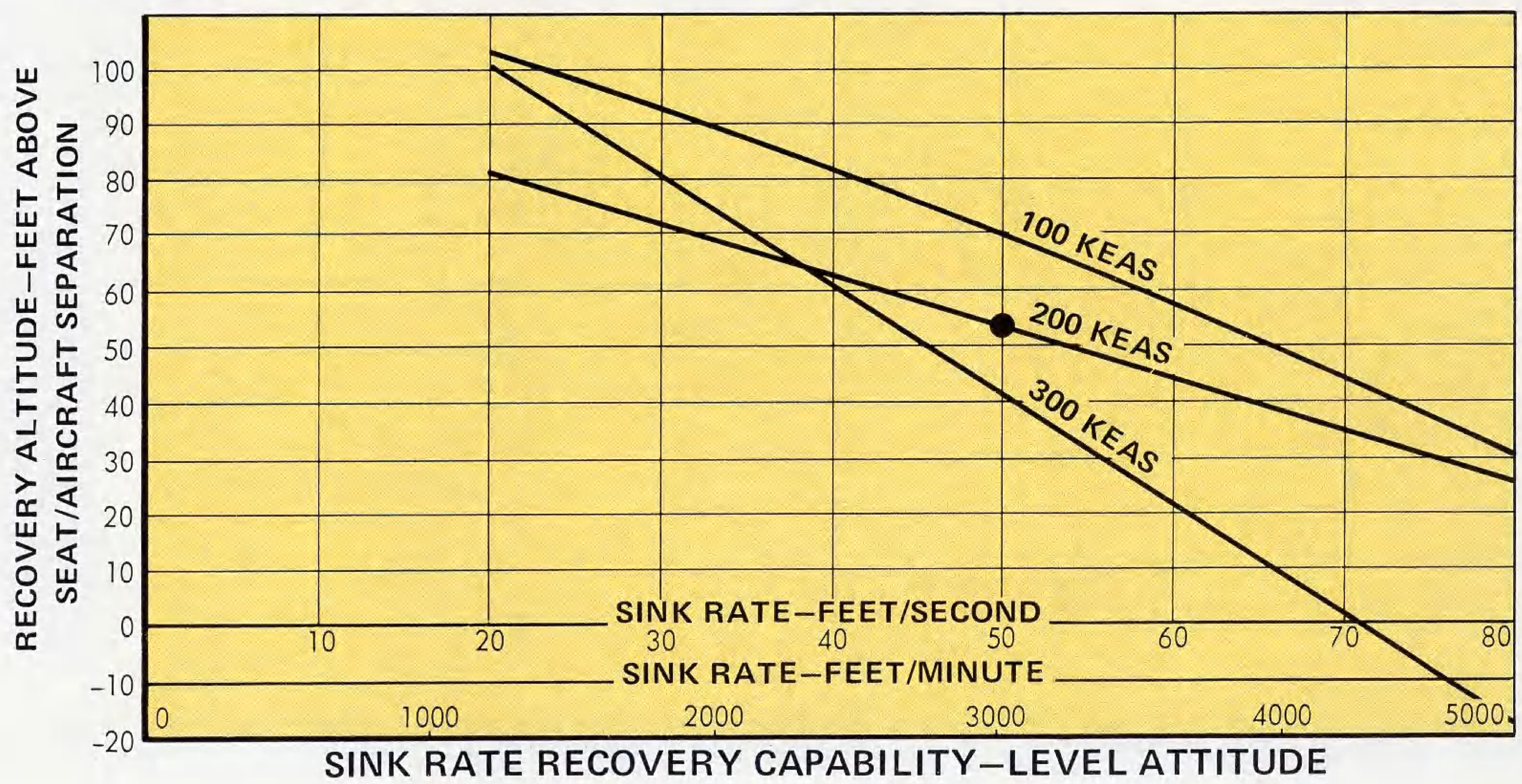
At altitudes below 10,000 feet and/or at speeds less than 200 knots, the recovery parachute is ballistically deployed immediately after the seat leaves the aircraft. At speeds greater than 200 knots and/or altitudes above 10,000 feet, a delay in the chute thruster allows the seat to decelerate to a velocity safe for recovery chute deployment. In both the low- and high-speed modes, seat-man separation is effected by inflation of the recovery parachute.

CHARTS ARE BASED ON AVERAGE VALUES FOR EJECTED WEIGHT, ROCKET THRUST MOMENT ARM, AND PARACHUTE INFLATION TIME.



RECOVERY CAPABILITY, 0° ROLL

EXAMPLE: Aircraft in 60° dive at 200 KEAS-Seat/Aircraft separation above 230 feet will provide safe recovery.



SINK RATE RECOVERY CAPABILITY–LEVEL ATTITUDE

EXAMPLE: Aircraft at 200 KEAS with a 3000 feet/minute sink rate-Seat-Aircraft separation just prior to ground impact provides a 53-foot recovery altitude.

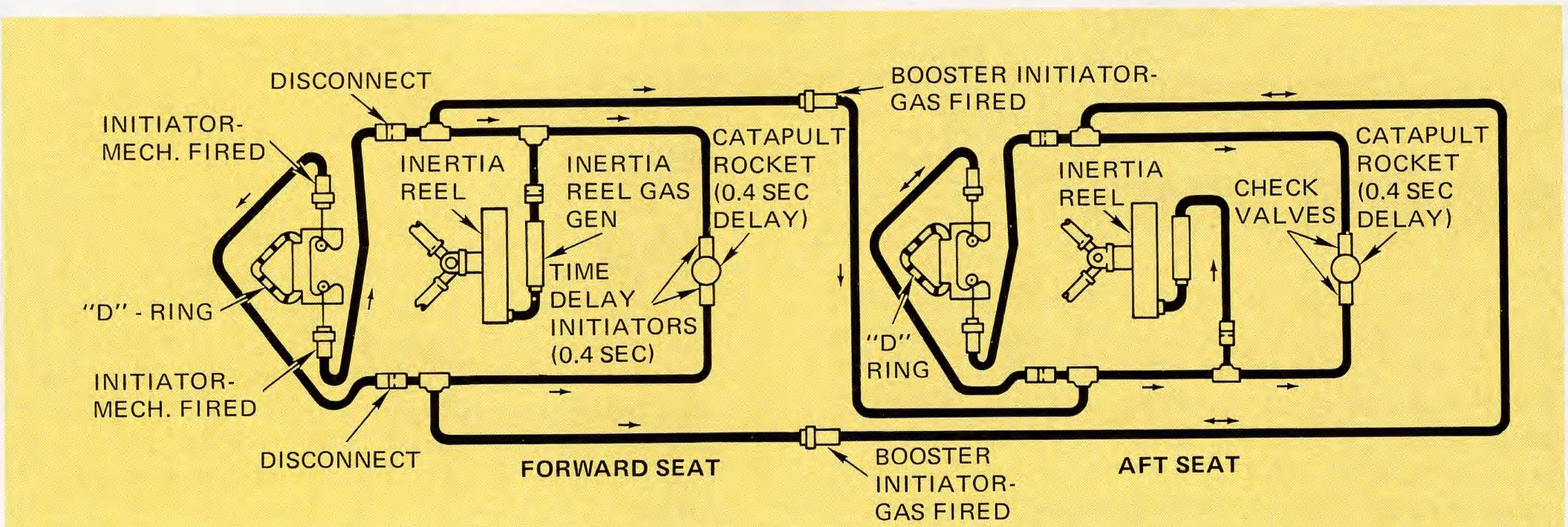
Escape System (Cont.)

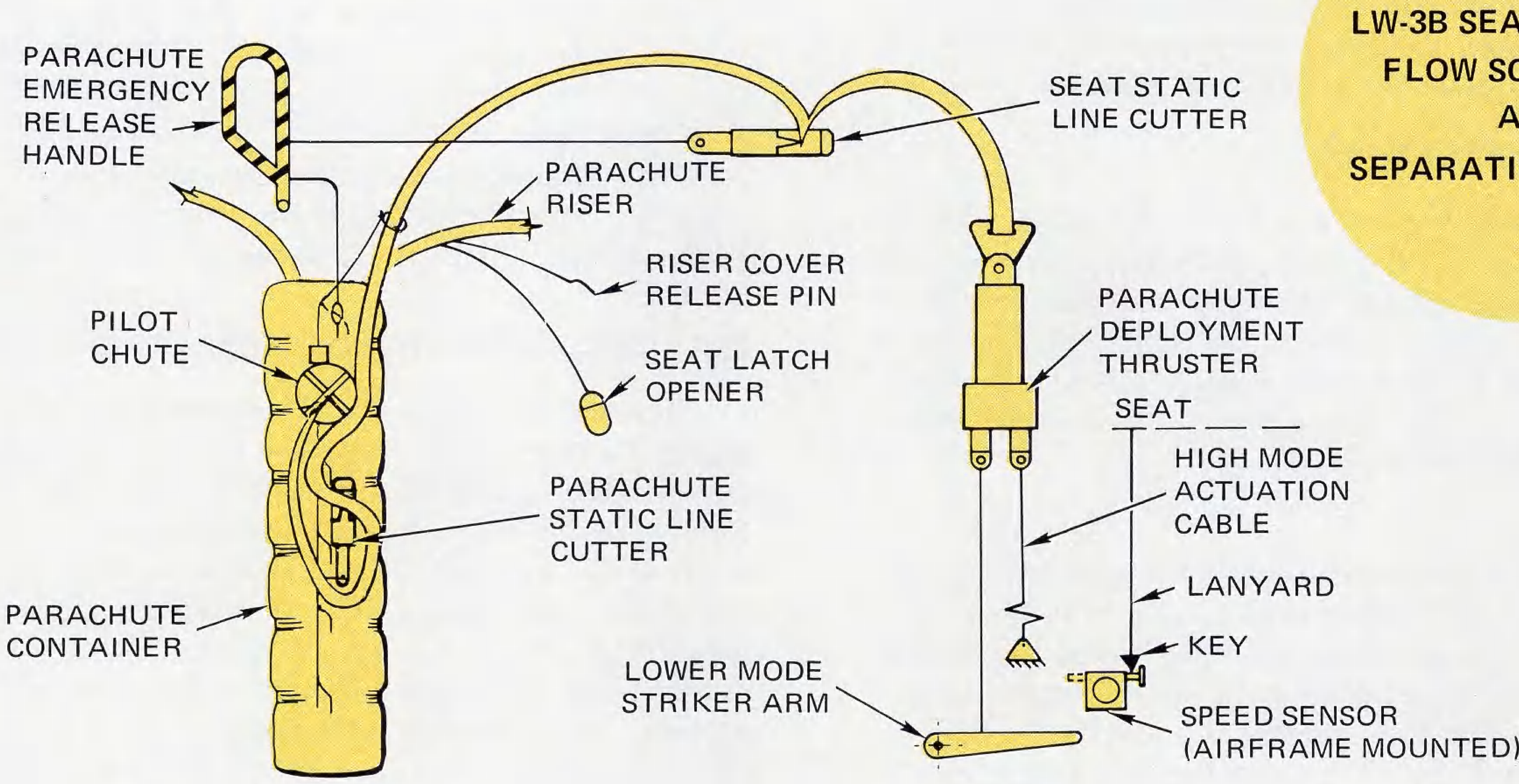
SEAT SEQUENCING

The OV-10A, with a tandem seating arrangement, utilizes an aft-fore seat sequencing system. The system has the capability that enables the pilot to eject both the observer and himself. In the event of a pilot-initiated ejection, the observer is always ejected first.

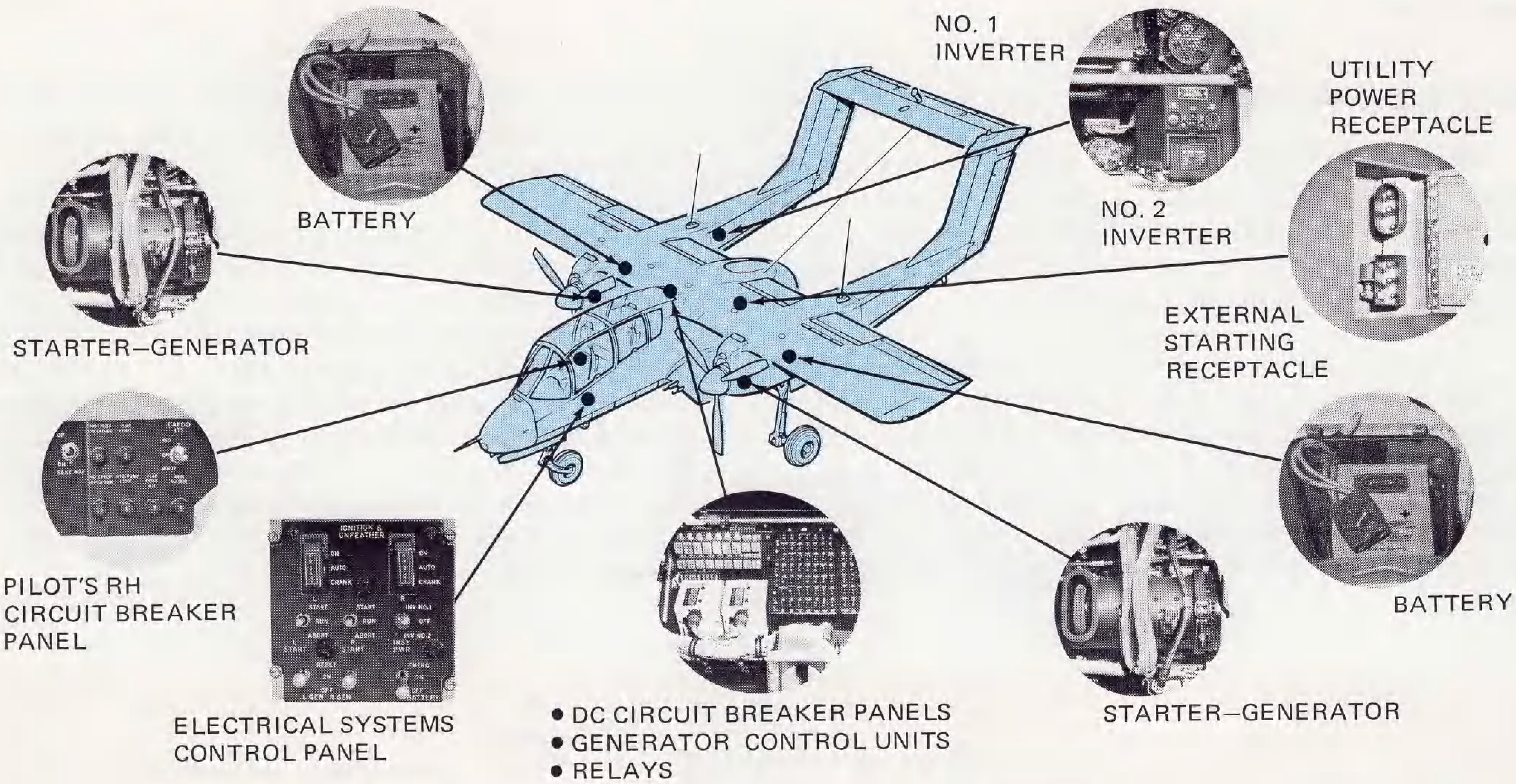
When the ejection sequence is initiated by the pilot, he simultaneously fires both his and the observer's ballistic inertia reel, the observer's catapult-rocket, and the 0.4-second time delay, incorporated externally of his catapult-rocket. This time-delay sequence allows the observer to eject before the pilot. The observer also has the capability to eject himself at any time. In the event this should occur, the booster initiators between the two seats serve as check valves, thus preventing initiation of the pilot's seat.

The pilot's and observer's ejection seats are identical in design with the exception of the recovery parachute location. A parachute is located on the left-hand side of the pilot's seat and on the right-hand side of the observer's seat. Parachute location plays an important role during an ejection. As the seats are ejected, the parachutes cause an asymmetrical load with respect to the rocket thrust line. The load on the pilot's seat induces an arc to the left of the aircraft and the load on the observer's seat induces an arc to the right. These trajectories preclude collision between the two seats.





LW-3B SEAT EJECTION FLOW SCHEMATIC AND SEPARATION SYSTEM



ELECTRICAL SYSTEM

The aircraft electrical system provides both a-c and d-c electrical power. The d-c generating system consists of two 30-volt starter-generators, two 24-volt (22 amperes/hour) nickel-cadmium batteries, and two generator control units (consisting of voltage regulators and associated control and protective devices). A-C electrical power is provided by two 750-volt-ampere inverters which supply 115-volt, 400-cycle a-c power. Two external power receptacles located on the aft right-hand side of the fuselage provide a means of supplying electrical power for engine starting or energizing the d-c power system for maintenance purposes and interaircraft servicing.

STARTER–GENERATORS

Each d-c starter-generator is a self-excited, 30-volt, 300-ampere, shunt field unit. The starter-generator is self-cooled during ground operation and blast-cooled in flight. During engine starting, the unit functions as a starter until the engine reaches approximately 52% engine rpm, at which time, the unit converts to generator operation until engine shutdown.

Power for engine starting can be provided by the aircraft batteries (to 0°F) or external power. If one engine is running, starting power for the other engine is provided by the operating starter-generator and the batteries, all in parallel. The starter-generators are connected in parallel to supply the 28-volt d-c electrical power bus system. Single generator operation is capable of supplying sufficient power for present aircraft electrical loads.

BATTERIES

Two 24-volt, 22-ampere-hour nickel-cadmium batteries are installed for engine starting and emergency electrical power. Fully charged batteries are capable of providing sufficient power for three unsuccessful engine ground start attempts and a fourth (successful) start without recharge under all conditions from 0° to 160°F. The batteries can be charged with external utility power applied or with generator power. The batteries are also used for emergency power in the event of dual generator failure.

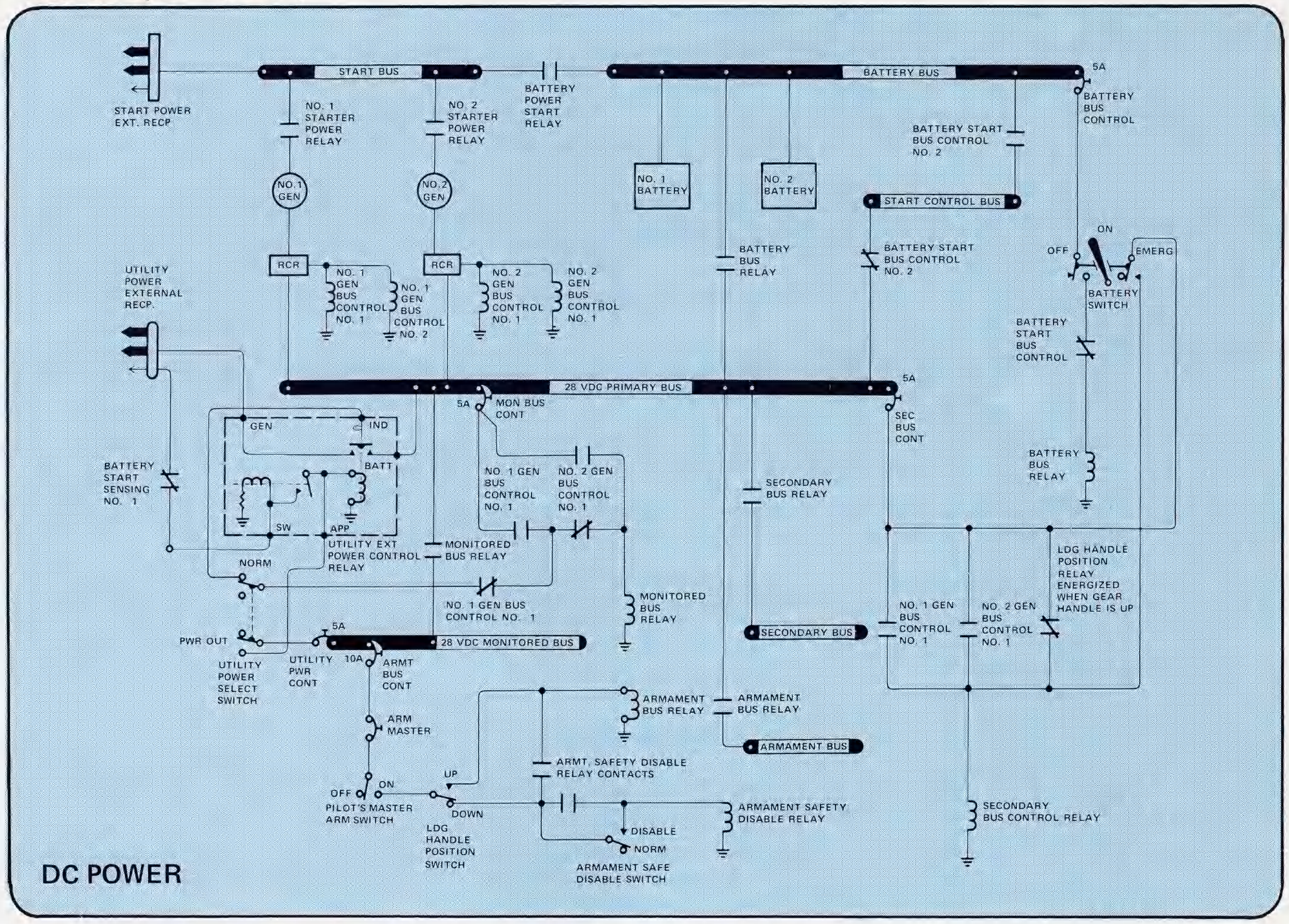
INVERTERS

A-C electrical power is provided by two 750-volt-ampere, three-phase, 115/200-volt, 400-cycle inverters located in the right-hand boom electronics bay. The No. 1 inverter provides instrument and IFF power, and the No. 2 inverter supplies a-c electrical power to all remaining 115-volt a-c equipment. If the No. 1 inverter fails, the No. 2 inverter can be selected to restore power for instrument functions.

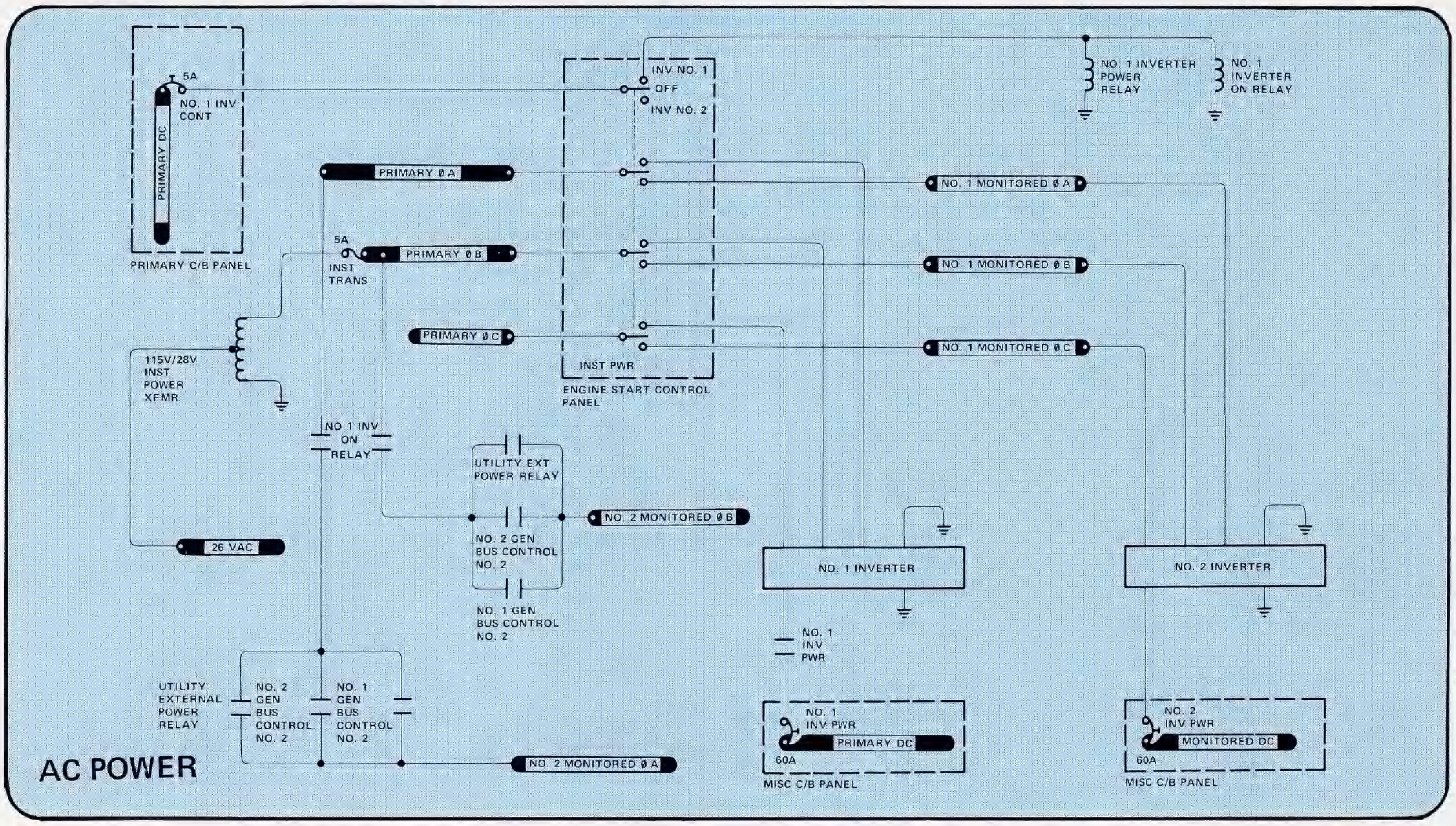
EXTERNAL/INTERAIRCRAFT STARTING POWER

External d-c power can be supplied to the aircraft for engine starting and maintenance purposes. The external power access is located on the right side of the fuselage, forward of the cargo door. Two receptacles are provided: a START receptacle (rectangular), and a UTILITY receptacle (oval). The utility electrical receptacle may be used as a 28-volt d-c power output. With an engine running and the utility power select switch (in the external power receptacle access) positioned to "PWR OUT," a jumper cable may be used to supply power to another aircraft. The utility power select switch must be in "NORM" (guard closed) position at all other times.

Electrical System (Cont.)



DC POWER



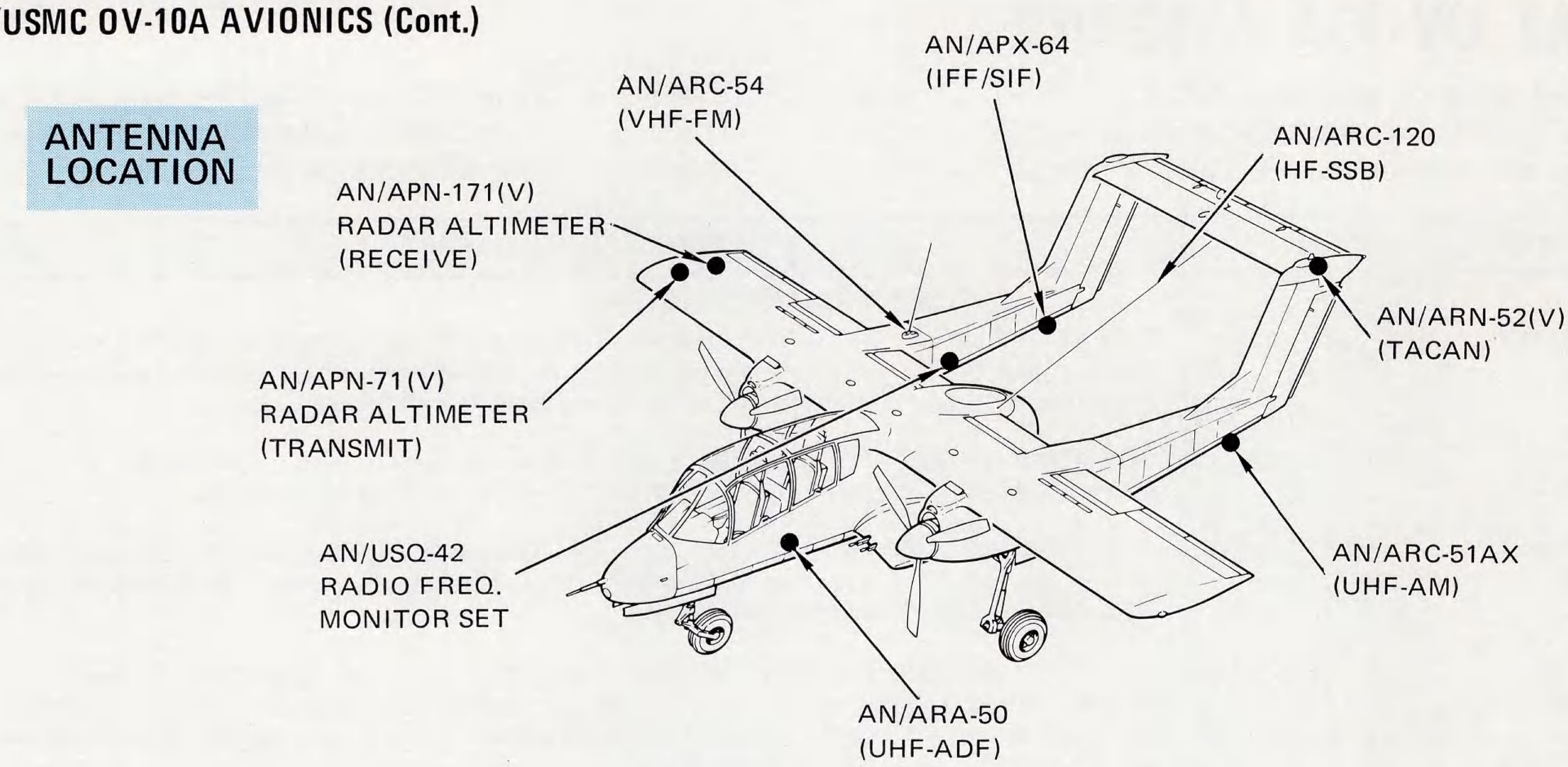
AC POWER

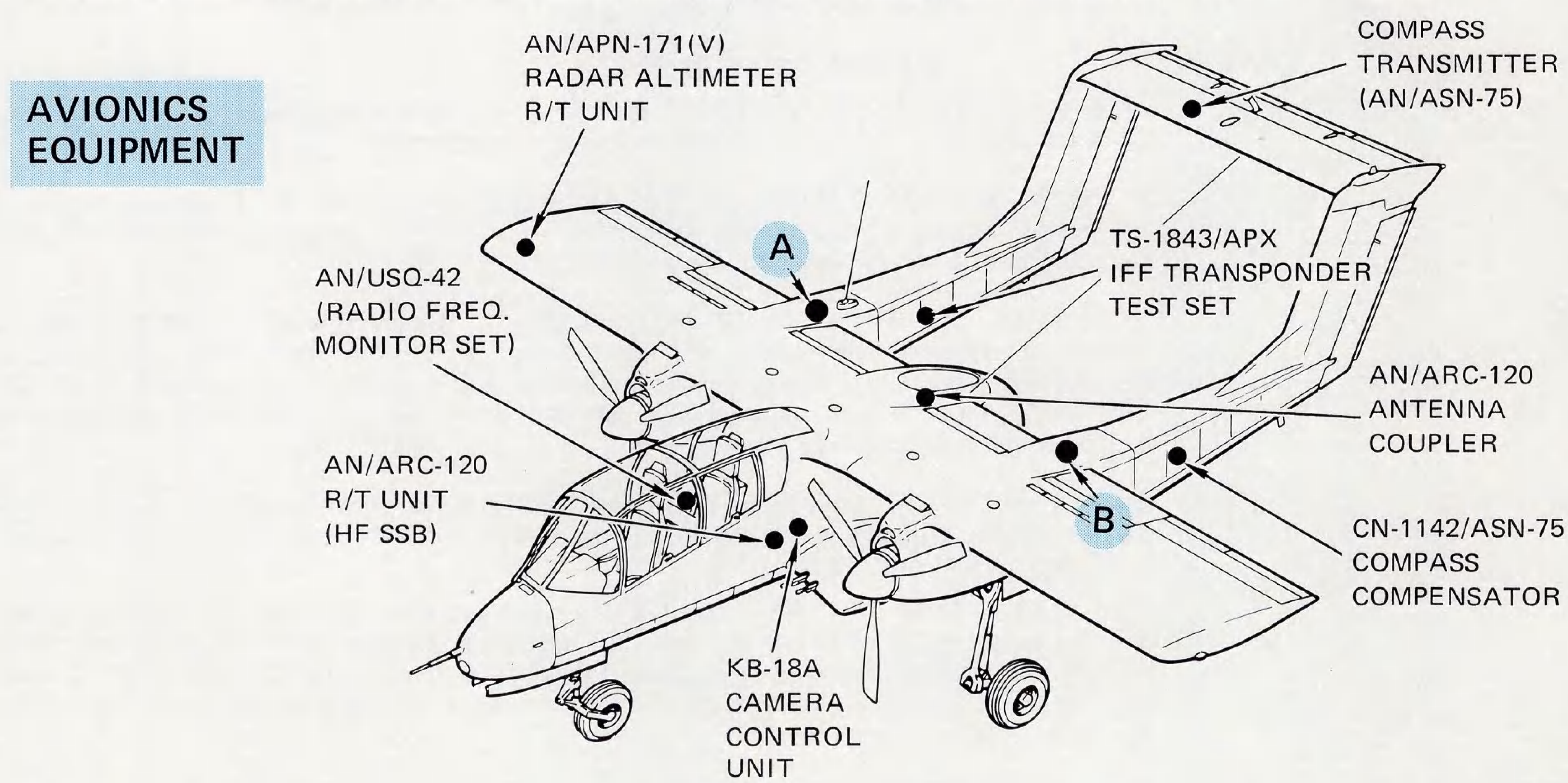
USN/USMC OV-10A AVIONICS

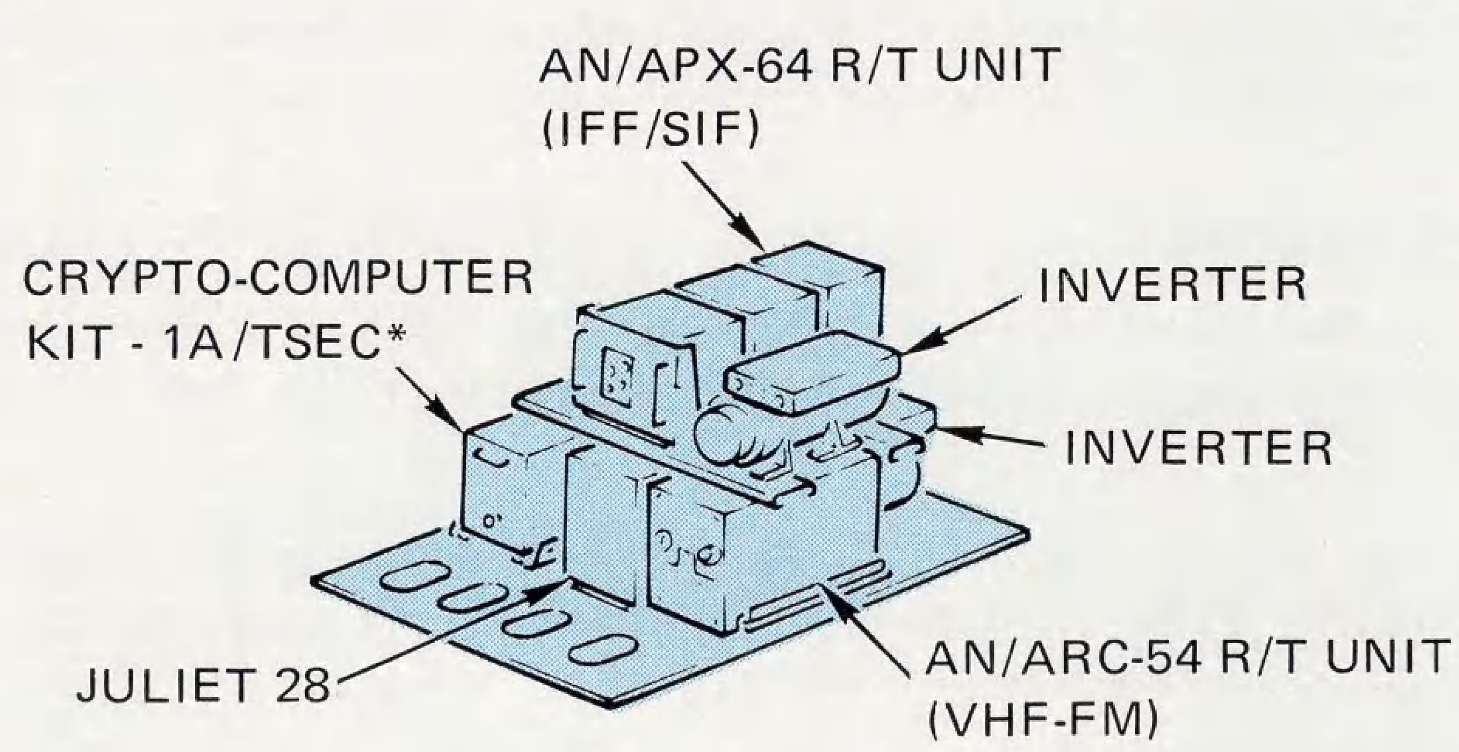
The avionics systems installed on USN and USMC OV-10A aircraft consist of communications, navigation, identification, and security systems. The following table provides a listing of the avionics equipment by type, designation, function, and operating frequencies. Equipment and antenna locations are shown on the adjacent page.

SYSTEM	DESIGNATION	FUNCTION/FREQUENCY
		COMMUNICATONS SYSTEMS
INTERCOM	AN/AIC-18	INTERCOMMUNICATIONS–The intercommunications system provides intercrew communication, selection and modulation of communication system transmitters, and selection and volume control of communication system receivers and other avionic systems audio signals.
UHF-AM RADIO	AN/ARC-51AX	COMMUNICATIONS–The UHF-AM radio communications system is used for air-to-air and air-to-ground voice communications within the 225- to 400-MHz frequency band.
VHF-FM RADIO	AN/ARC-54	COMMUNICATIONS–The VHF-FM radio communications system is used for voice communications with portable and mobile ground systems within the 30- to 70-MHz frequency band.
HF-SSB RADIO	AN/ARC-120	COMMUNICATIONS–The HF-SSB radio communications system is used for both short and long range voice communications with mobile and fixed ground sites within the 2- to 30-MHz frequency band.
		NAVIGATION SYSTEMS
COMPASS	AN/ASN-75	COMPASS SYSTEM–The AN/ASN-75 gyroscope reference navigational compass set provides a stabilized aircraft heading signal through 360 degrees of azimuth.
TACAN	AN/ARN-52(V)	TACTICAL AIR NAVIGATION–The TACAN navigation system provides range and magnetic bearing to selected military or civil ground installations. The TACAN equipped aircraft can also operate in conjunction with another similarly equipped aircraft.
UHF-ADF	AN/ARA-50	AUTOMATIC DIRECTION FINDING–The UHF-ADF system is used for indicating the magnetic bearing of received UHF signals and for homing on received signals from ground or airborne transmitters. The signals received by the direction-finding antenna are processed by the UHF-AM (AN/ARC-51AX) communications system, operating within the 225- to 400-MHz frequency band, and applied to the direction-finding system.
RADAR ALTIMETER	AN/APN-171(V)	ELECTRONIC ALTIMETER SET–The electronic altimeter set, AN/APN-171(V) is an airborne low-altitude terrain tracking and altitude sensing radar system that provides a continuous indication of aircraft altitude within a range of 0 to 5000 feet. This set is installed on aircraft having AFC 27 incorporated.
		IDENTIFICATION SYSTEMS
IFF/SIF	AN/APX-64(V)	IDENTIFICATION, Friend or Foe/Selective Identification Feature–The IFF/SIF system automatically provides coded replies to interrogating radar sites (airborne or ground), and is used for aircraft identification and traffic control.
RADIO FREQUENCY MONITOR	AN/USQ-42	RADIO FREQUENCY MONITOR SET–The radio frequency monitor set, AN/USQ-42 (aircraft having AFC 20 incorporated) is a frequency modulated receiver used to monitor signals from as many as 27 remote sensors on any one of 31 channels.
		SPEECH-SECURITY SYSTMES
JULIET-28 (Two)	KY-28	JULIET-28 SYSTEM–The Juliet-28 system functions in conjunction with the UHF-AM (AN/ARC-51AX), VHF-FM (AN/ARC-54), and HF-SSB (AN/ARC-120) radio communications systems on the aircraft to provide secure voice communications. The aircraft has provisions for the installation of two Juliet-28 systems.

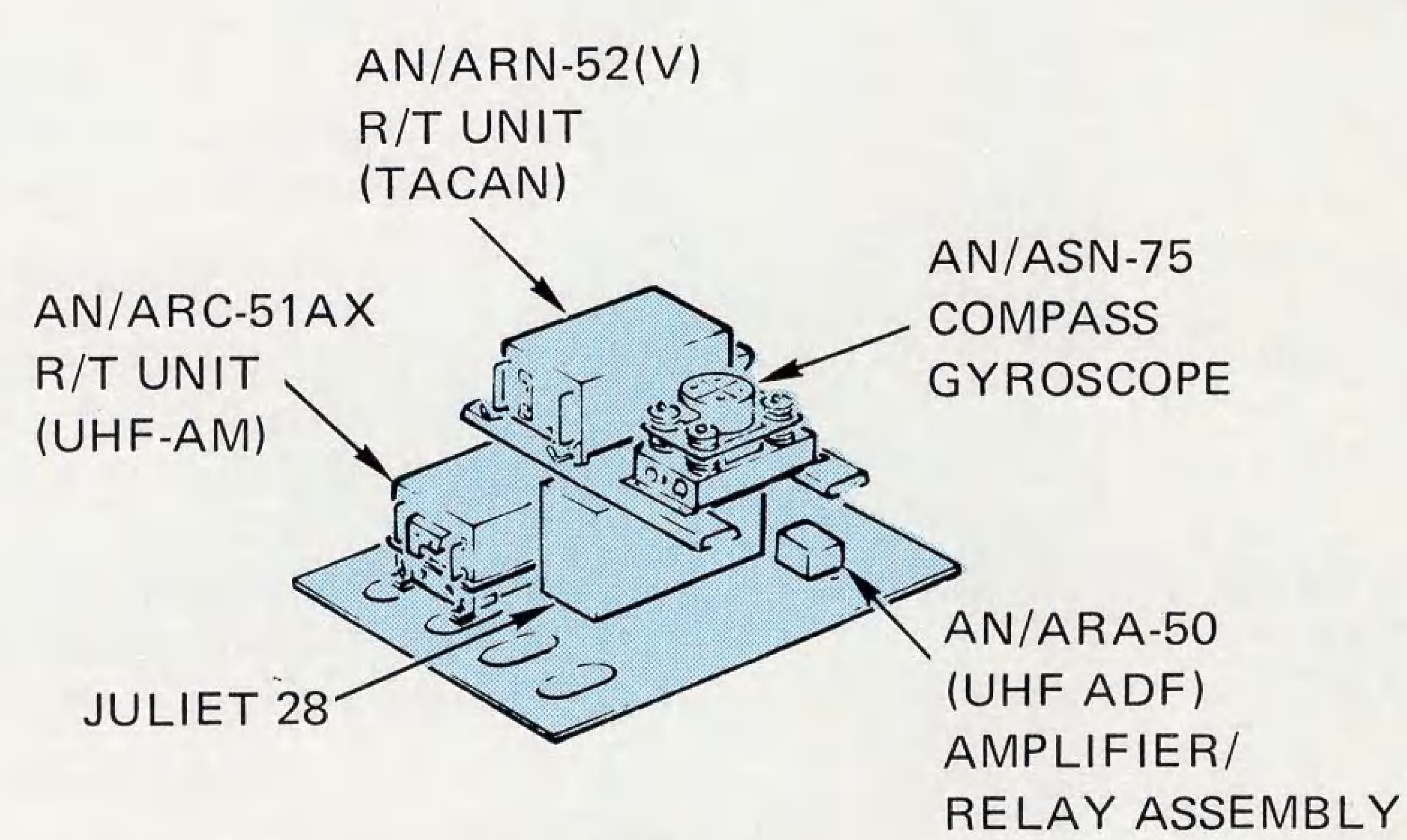
USN/USMC OV-10A AVIONICS (Cont.)







DETAIL "A"

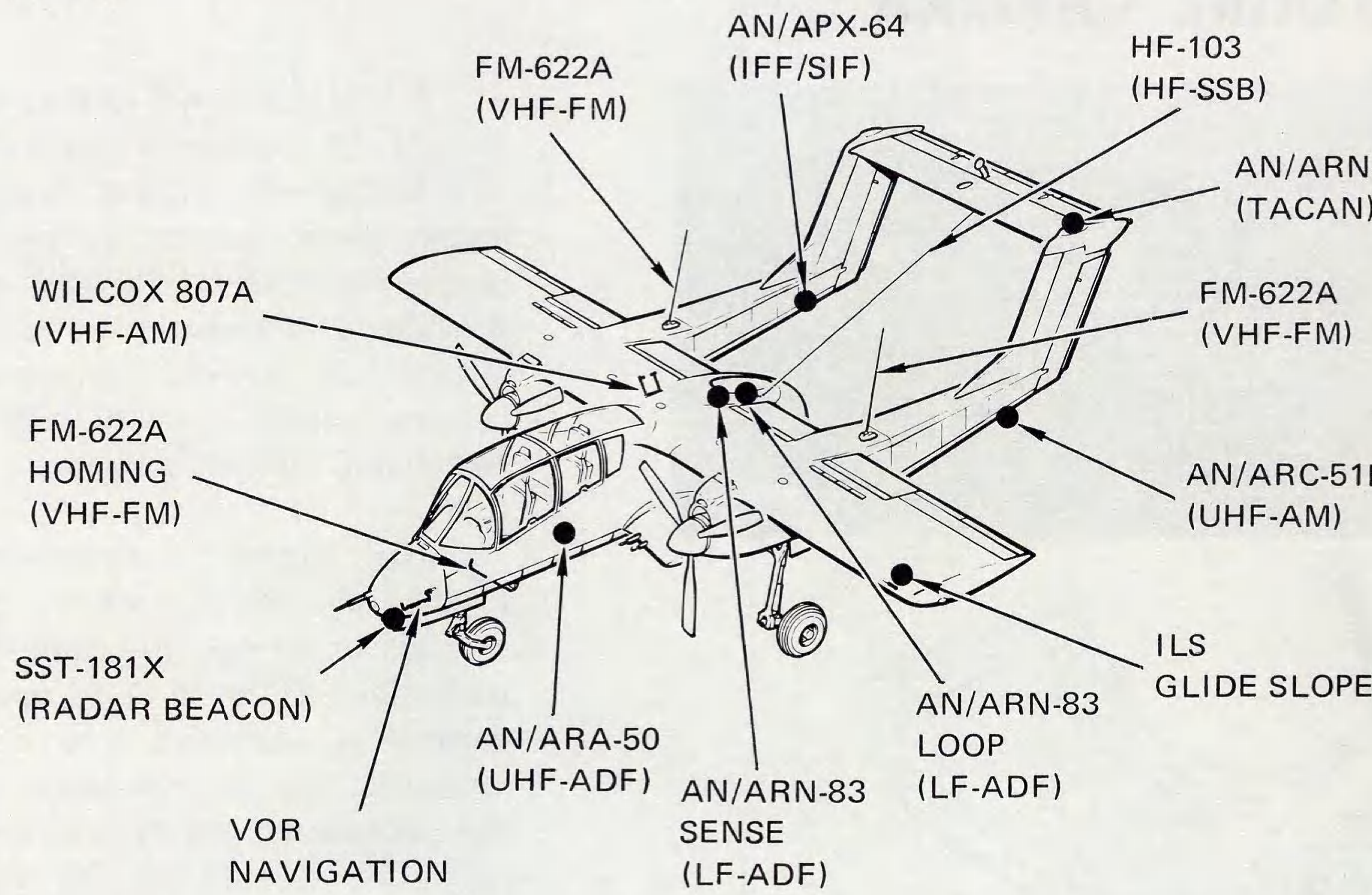


DETAIL "B"

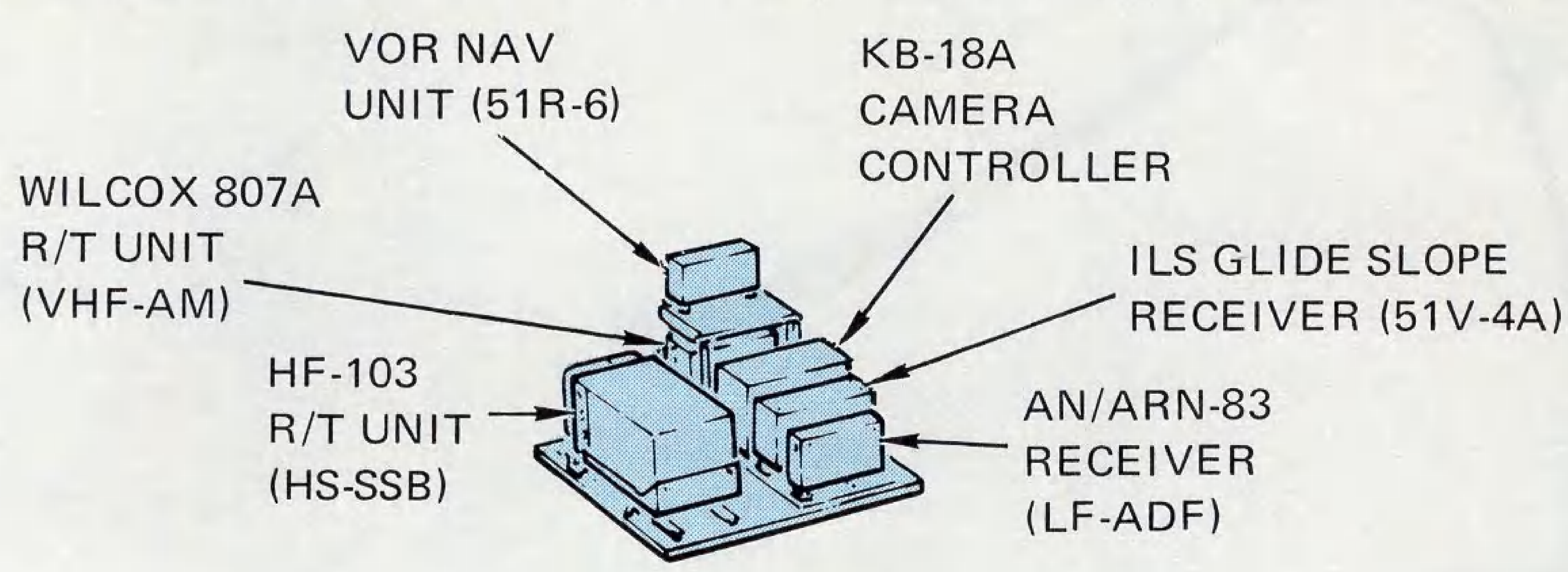
*PROVISIONS ONLY

USAF OV-10A AVIONICS (Cont.)

ANTENNA LOCATION



AVIONICS EQUIPMENT



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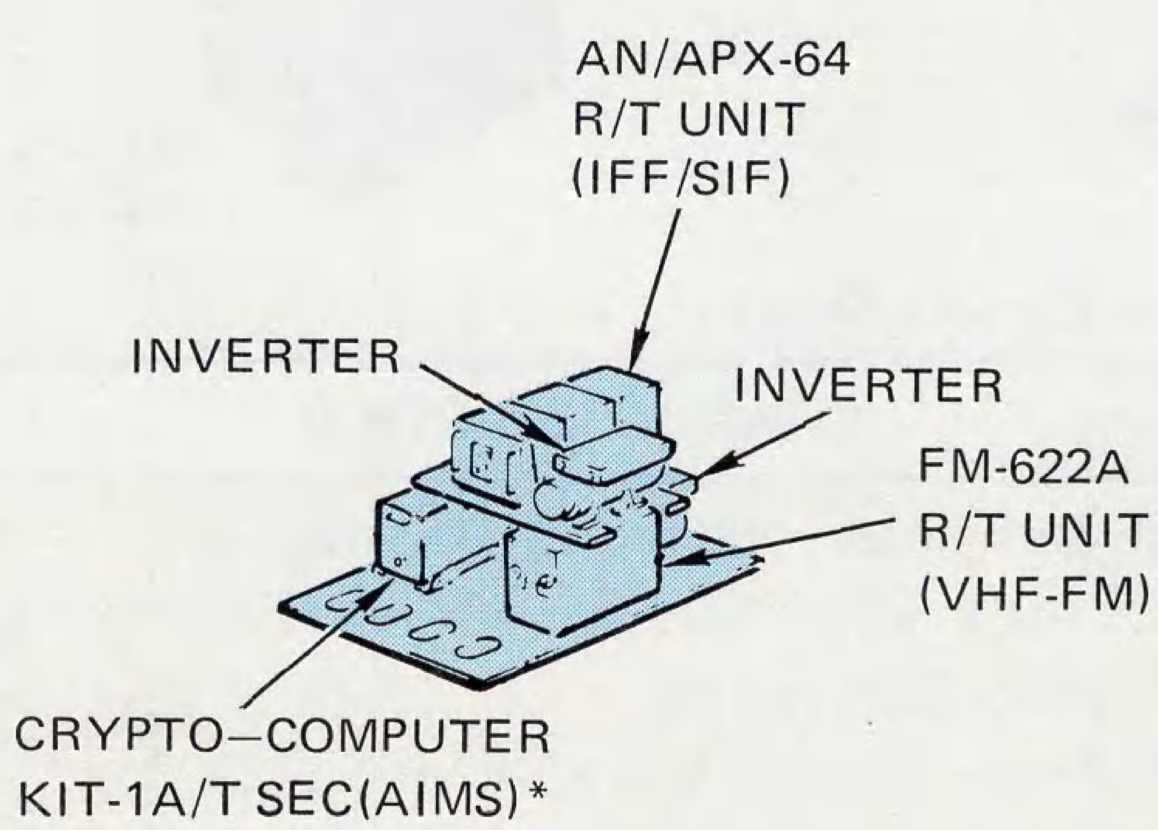

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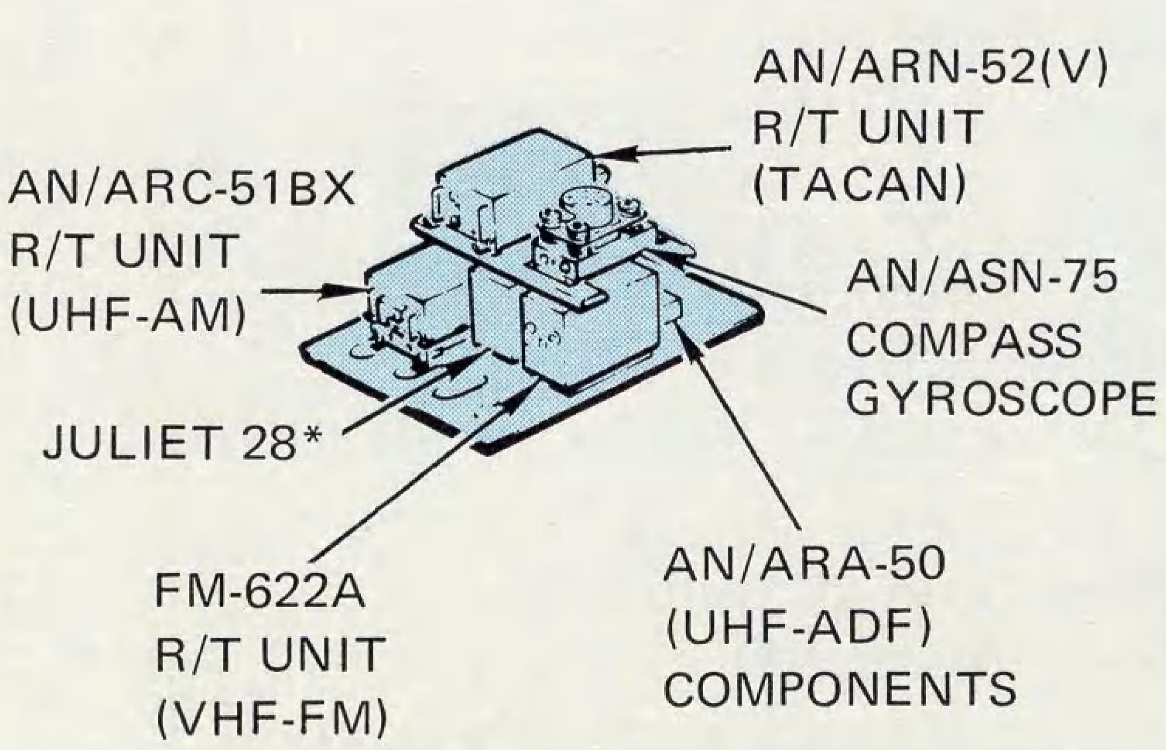

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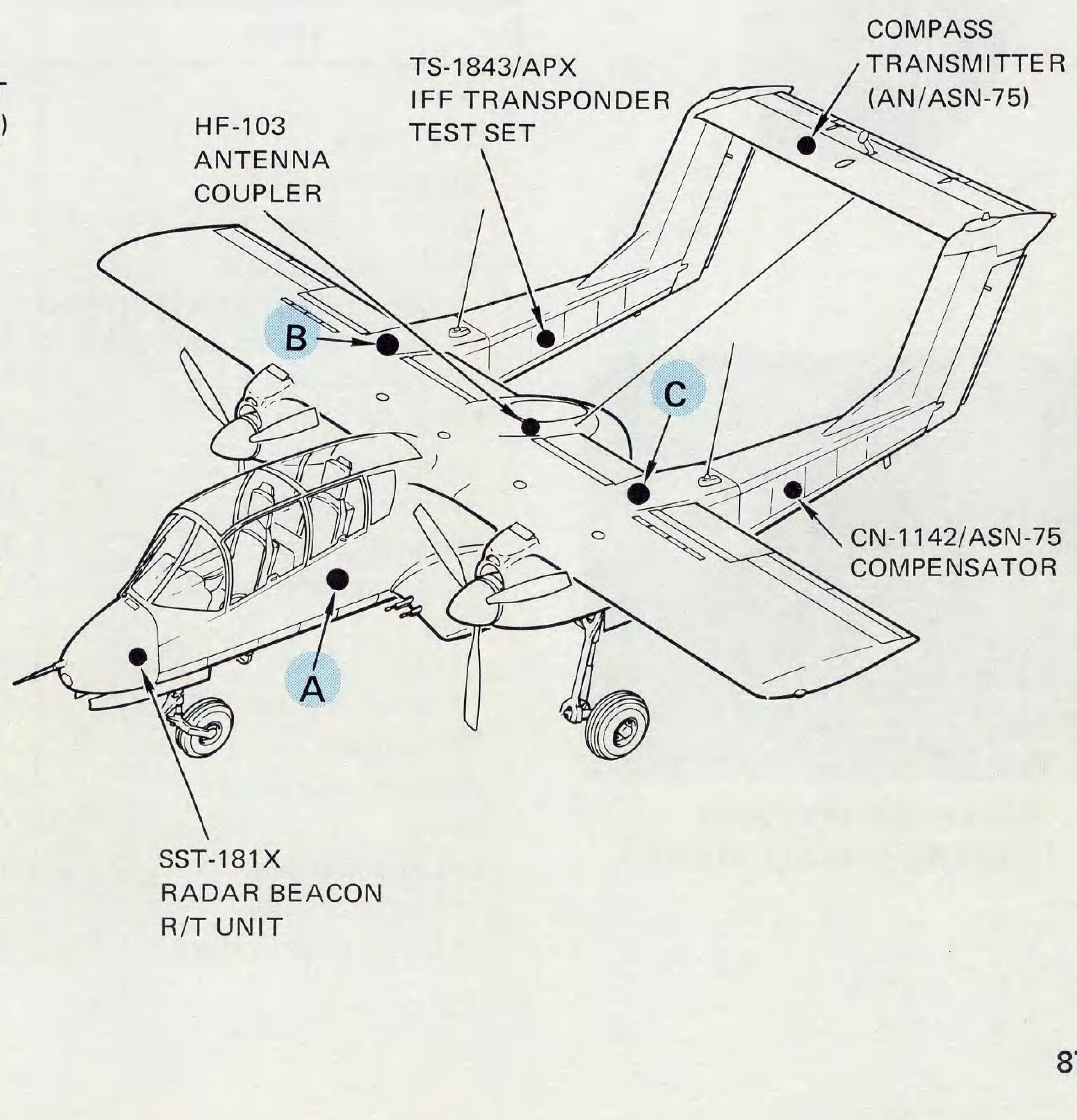
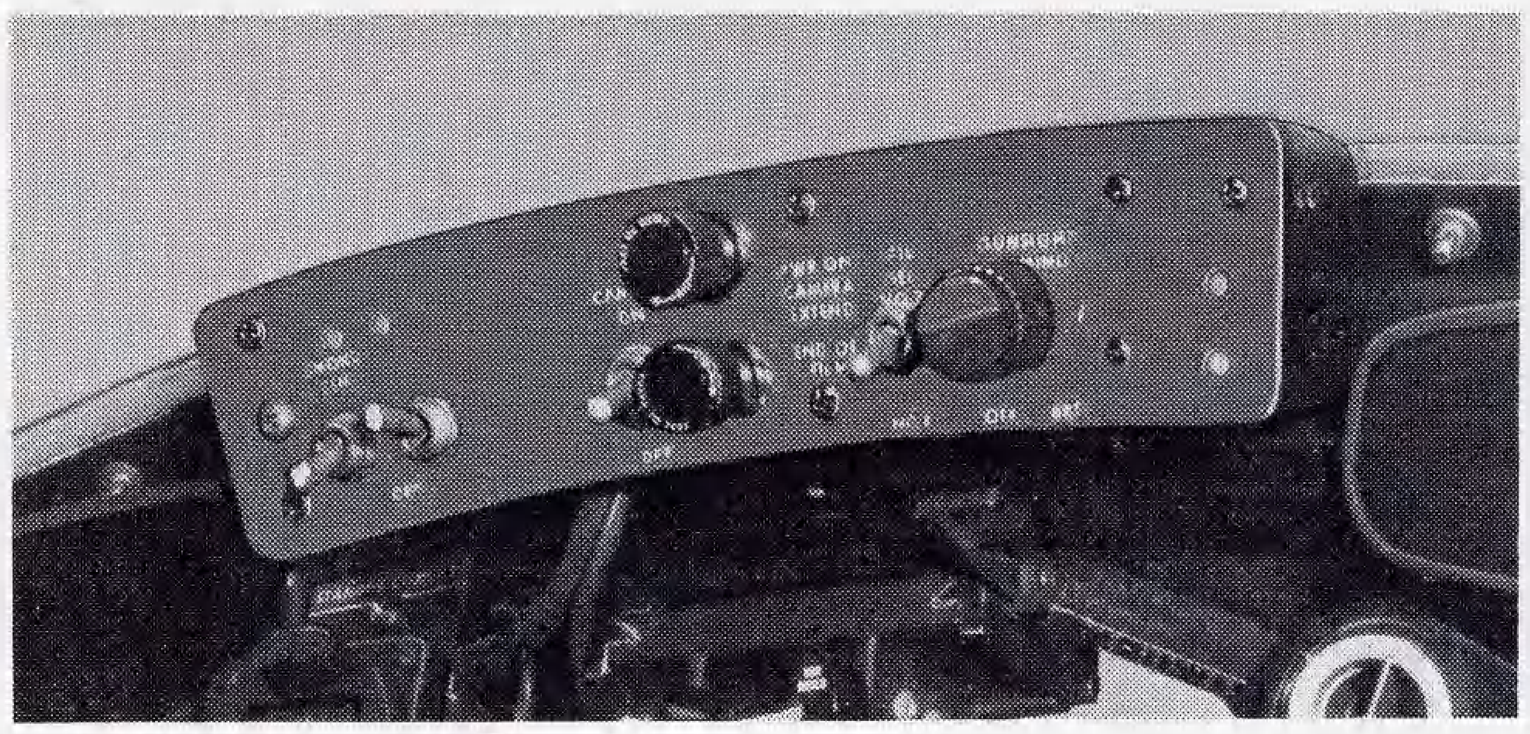
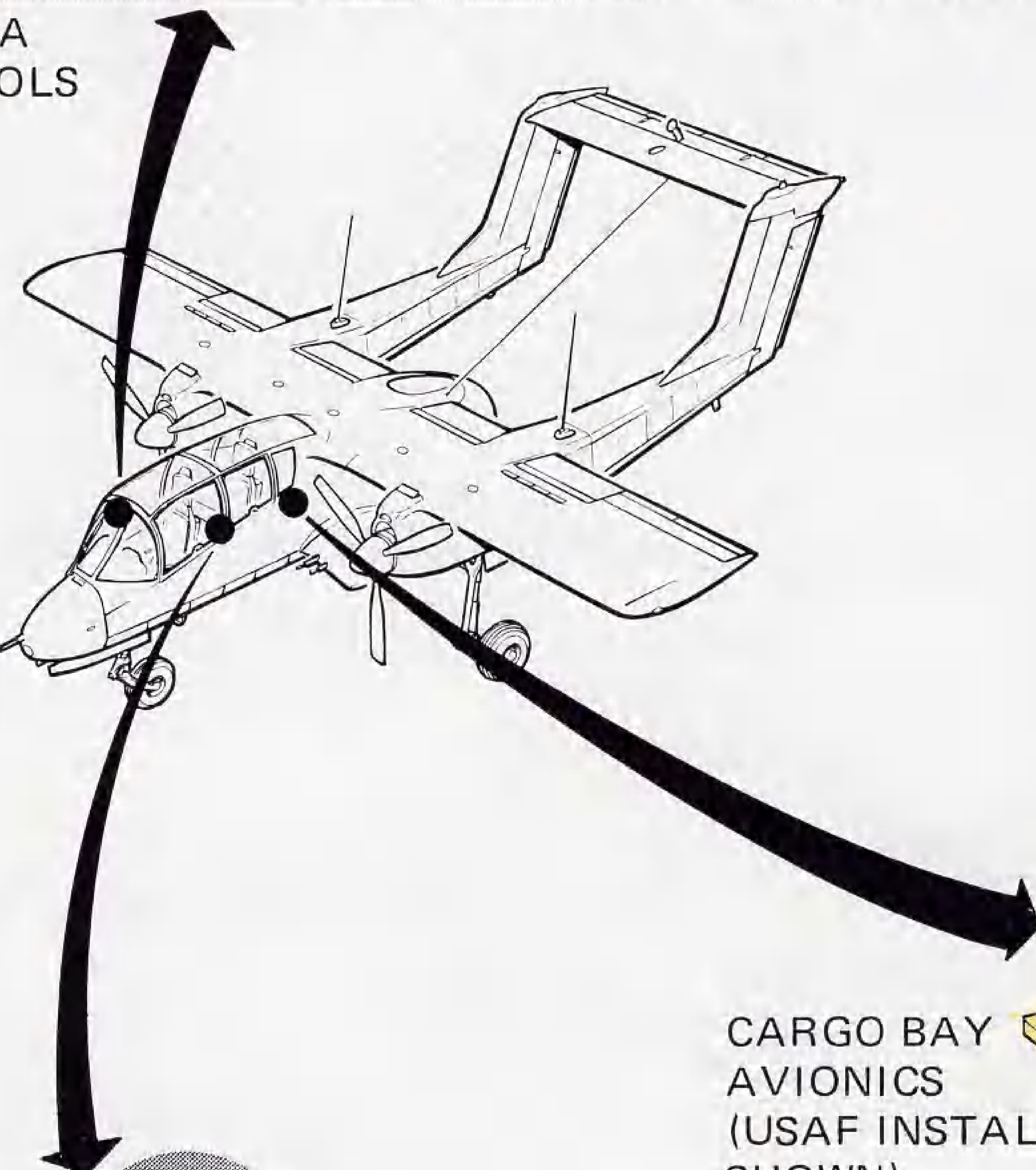


*PROVISIONS ONLY

KB-18A STRIKE CAMERA

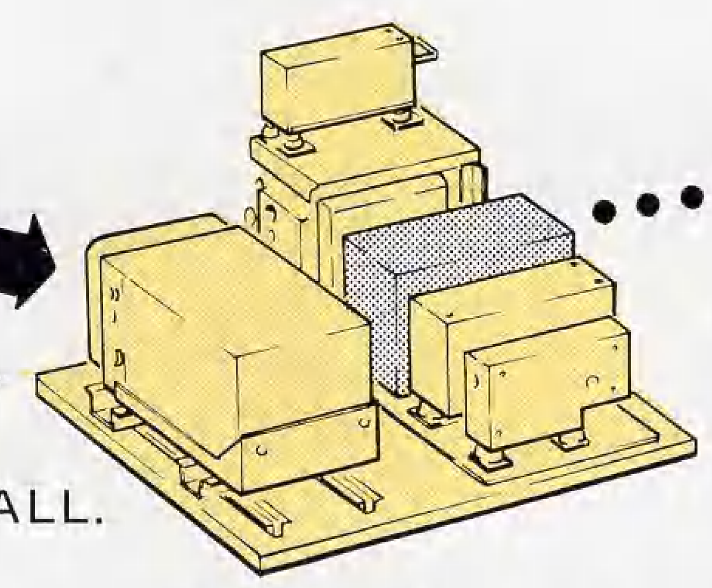


CAMERA CONTROLS



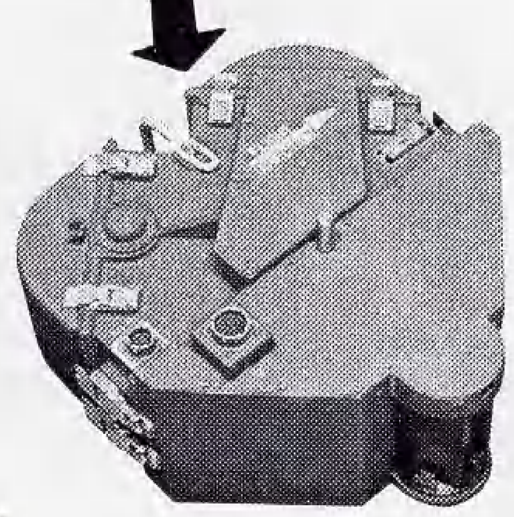
A KB-18A strike camera is installed in most OV-10A aircraft. (A message drop door is installed in those aircraft not having the camera installation.) The 3-inch focal length strike camera is located on the floor of the observer's cockpit forward of the control stick and provides 180-degree panoramic film coverage along the line-of-flight. System components consists of the KB-18A camera, camera control unit, and the camera operate switch and indicating lights.

The camera is mounted vertically in a cradle mechanism which, when operated by the observer, extends or retracts the camera. The camera doors on the underside of the aircraft open automatically when the camera is extended and close when the camera is retracted. The control unit is located in the cargo bay and the pilot-controlled camera operate switch and indicating lights are located on the pilot's windshield bow. The control unit contains various switches, electronics, and protective devices for control and operation of the camera system.

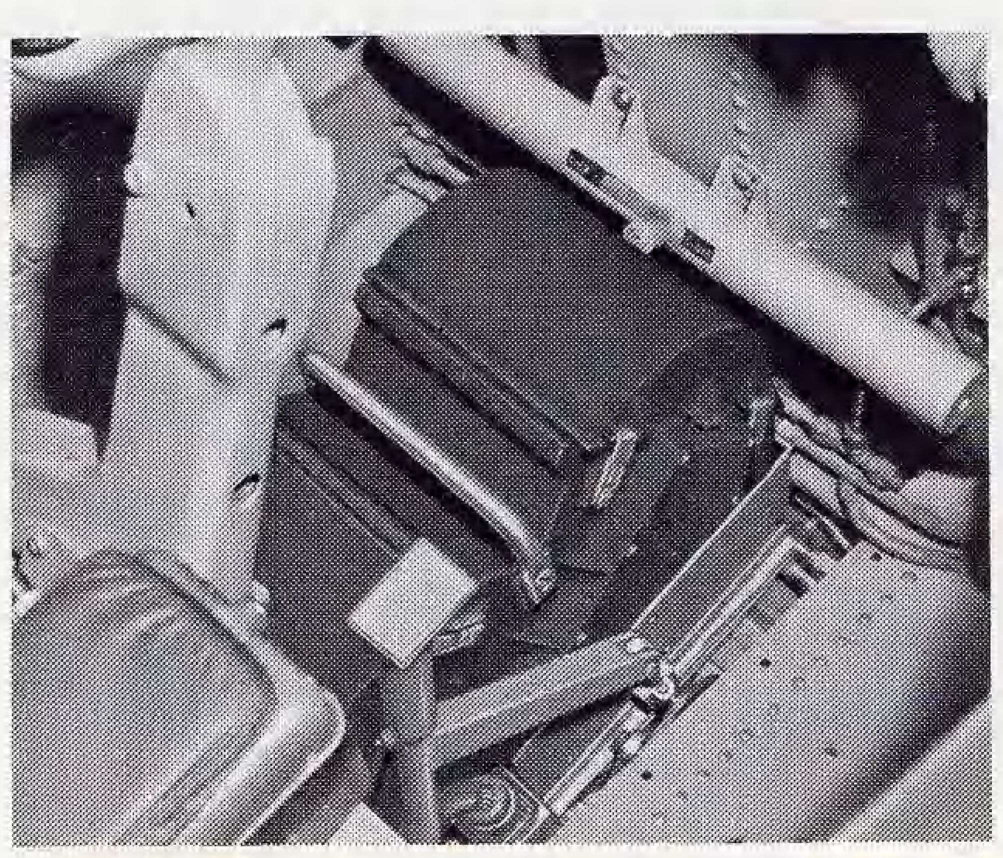


CARGO BAY AVIONICS (USAF INSTALL. SHOWN)

CAMERA CONTROL UNIT



KB-18A STRIKE CAMERA



OBSERVER'S COCKPIT CAMERA INSTALLATION

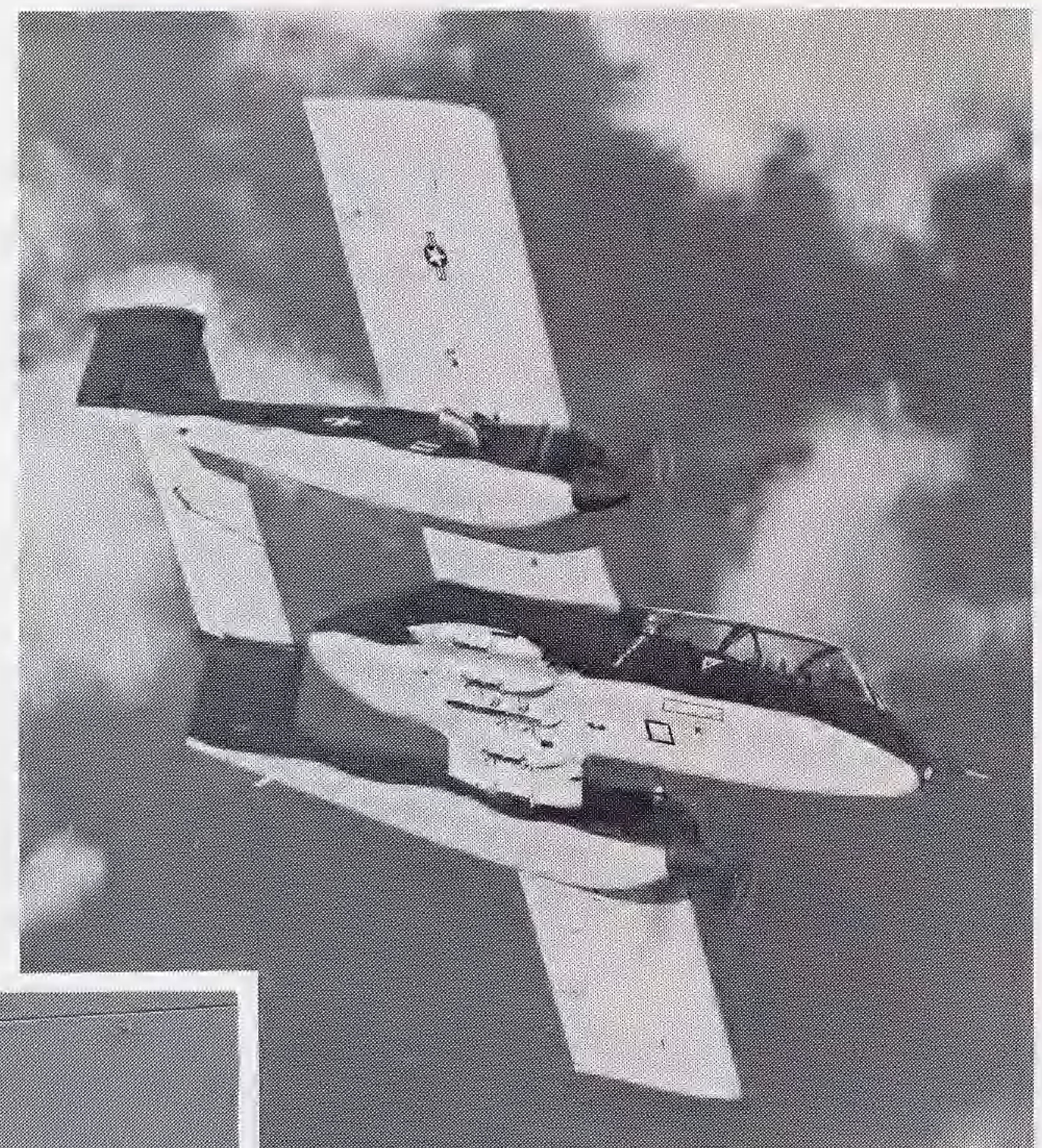
Leading Particulars–Camera System, KB-18A

ITEM	CHARACTERISTICS
Type	Rotary prism, panoramic, moving film
Scan angle	180 degrees forward and aft, 40 degrees lateral
Film format size	9.40 by 2.25 inches
Operating voltages	115 volts ac, 400 Hz, +28 volts dc
Modes of operation	
• Autocycle or remote operate	1, 2, or 4 cycles per second
• Aerial exposure index (AEI)	40, 64, 80, 200
• Overrun time	Inoperative
Prism	Double dove
Lens	3-inch, f/2.8
Aperture range	f/2.8 through f/22
Slit width range	0.02 to 0.20-inch
Relative shutter speeds	Approximately 1/400 to 1/4000 second
Film	
• Type	70mm, Type II, perforated
• Aerial exposure index	40, 64, 80, or 200
Film Capacity	250 feet (approximately 300 exposures)
Altitude, operating	0 to 50,000 feet
Weight	
• Camera body	16.0 pounds
• Magazine/film	12.5 pounds
• Camera control unit	5.0 pounds

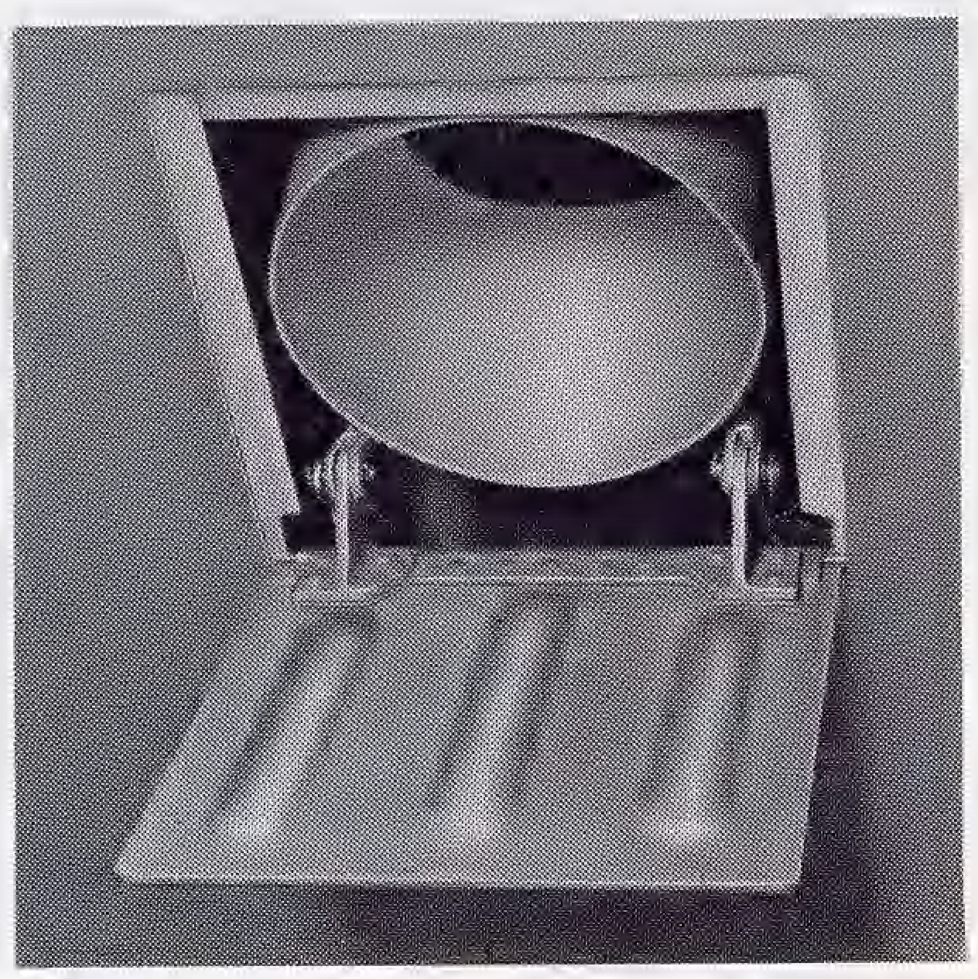
MESSAGE DROP INSTALLATION

A foot-operated, spring-loaded message drop door is installed in the aft cockpit on some OV-10A aircraft. The door and its foot pedal control are located on the cockpit floor forward of the observer's control stick. (Most aircraft have a KB-18A strike camera installed in this same area. Refer to page 88.)

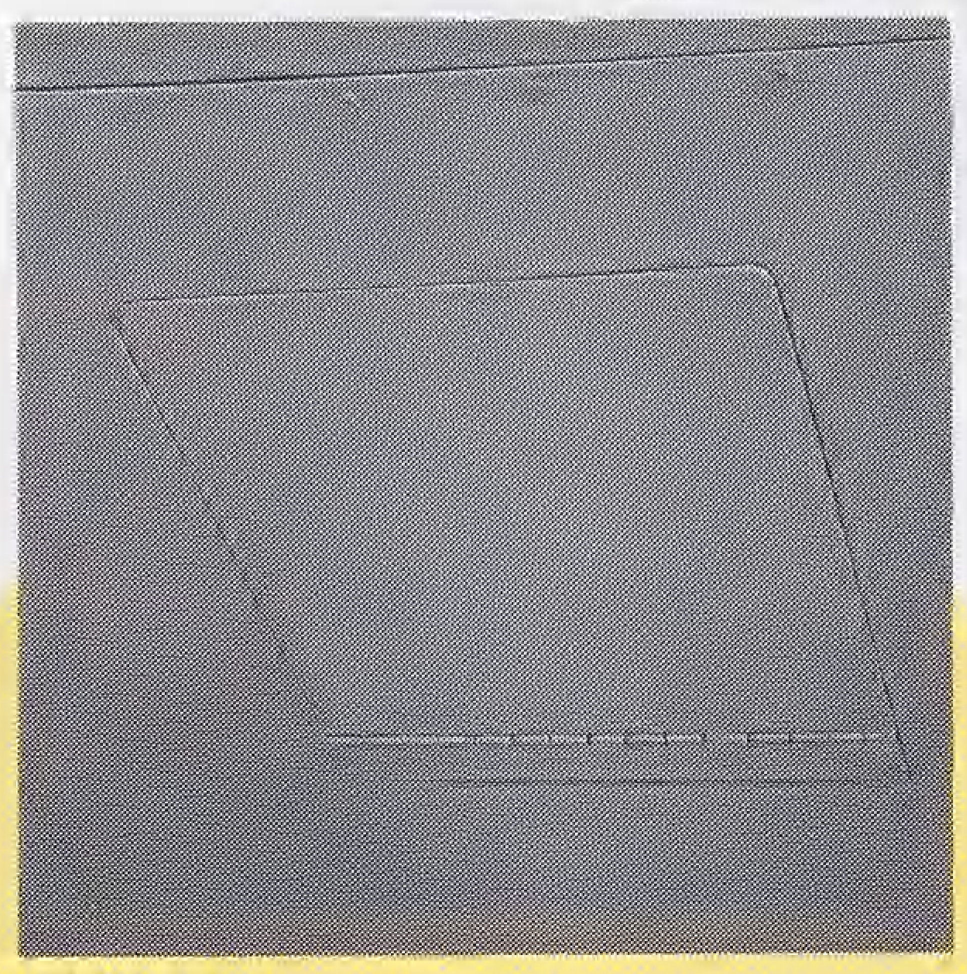
The message drop door is operated by depressing the pedal lever forward with the left foot, which simultaneously opens the inner and outer doors. When the pedal is depressed full forward, an overcenter mechanism overrides the spring-closing feature and holds the doors open.



OUTER DOOR

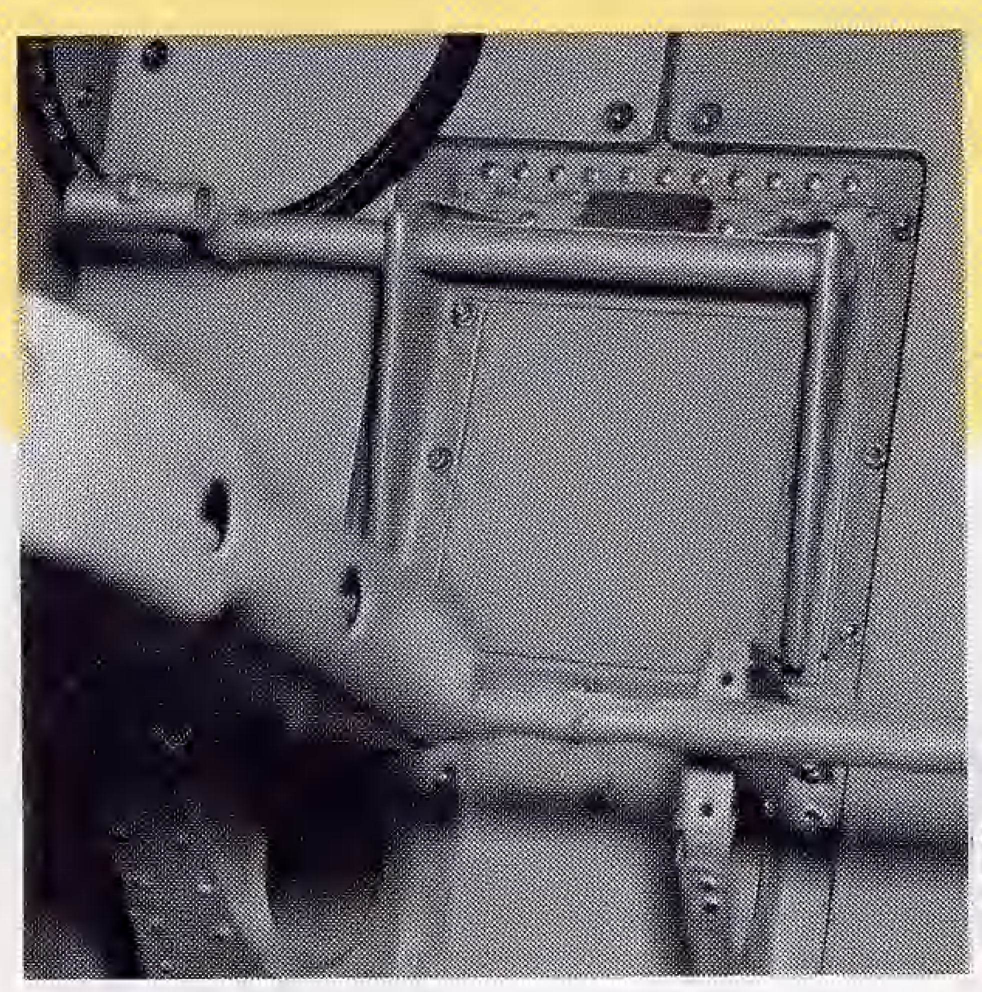


Open

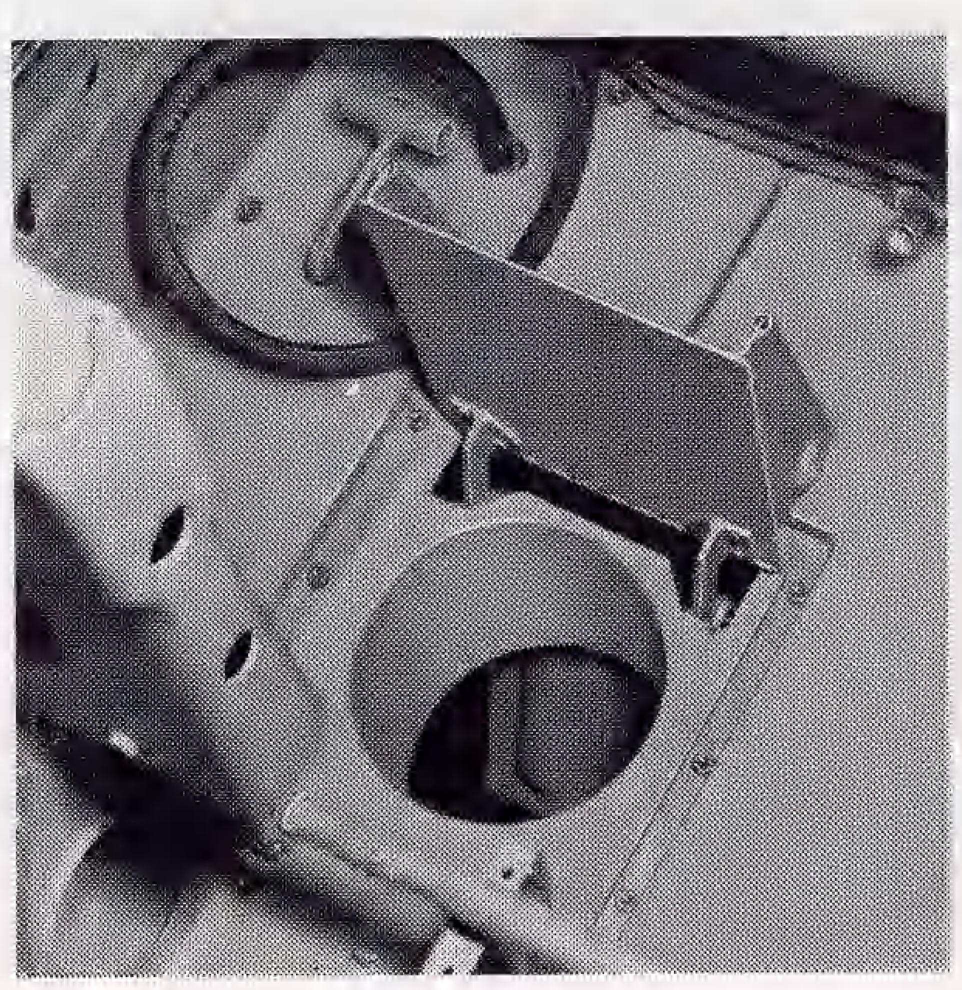


Closed

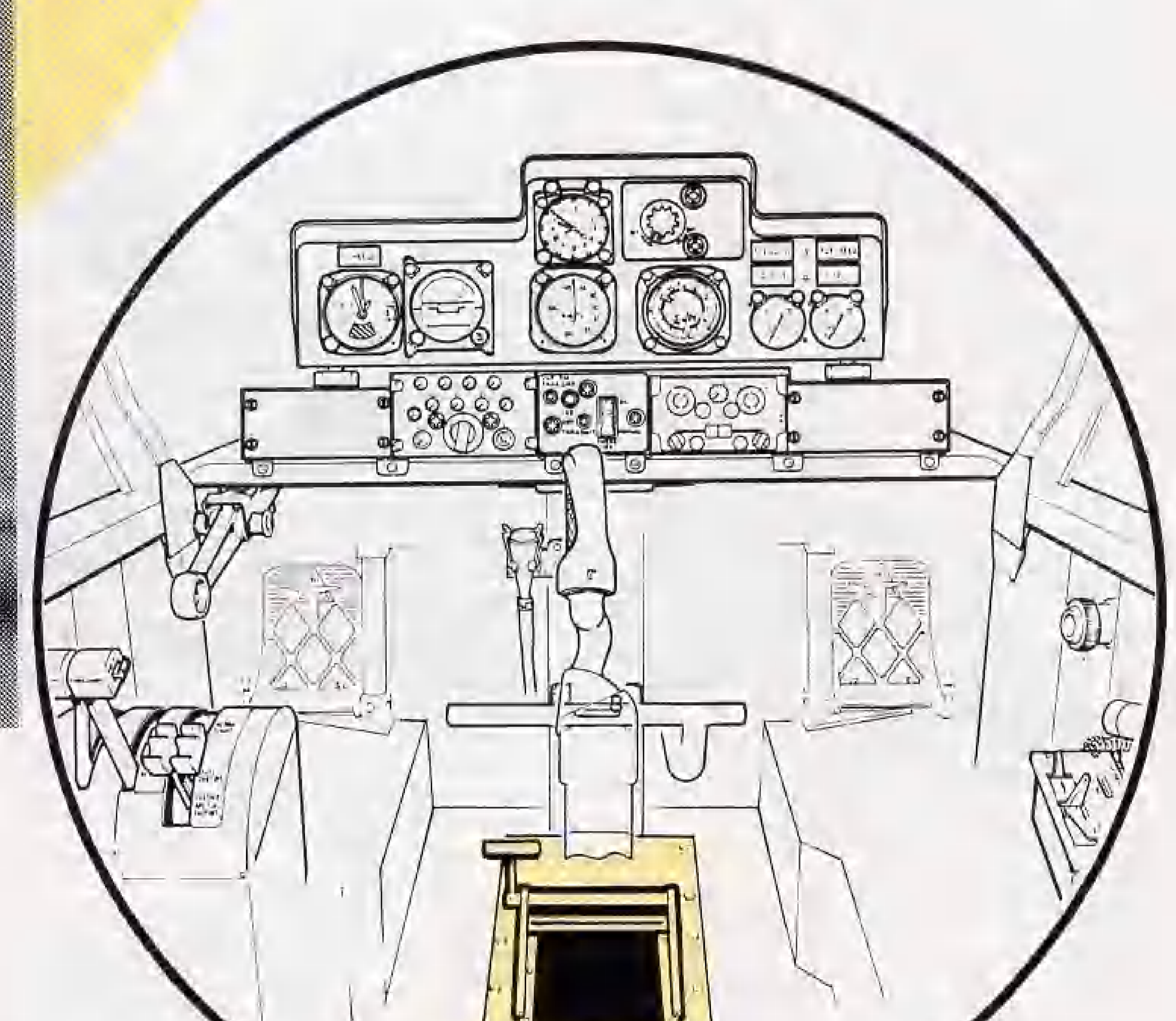
INNER DOOR



Closed

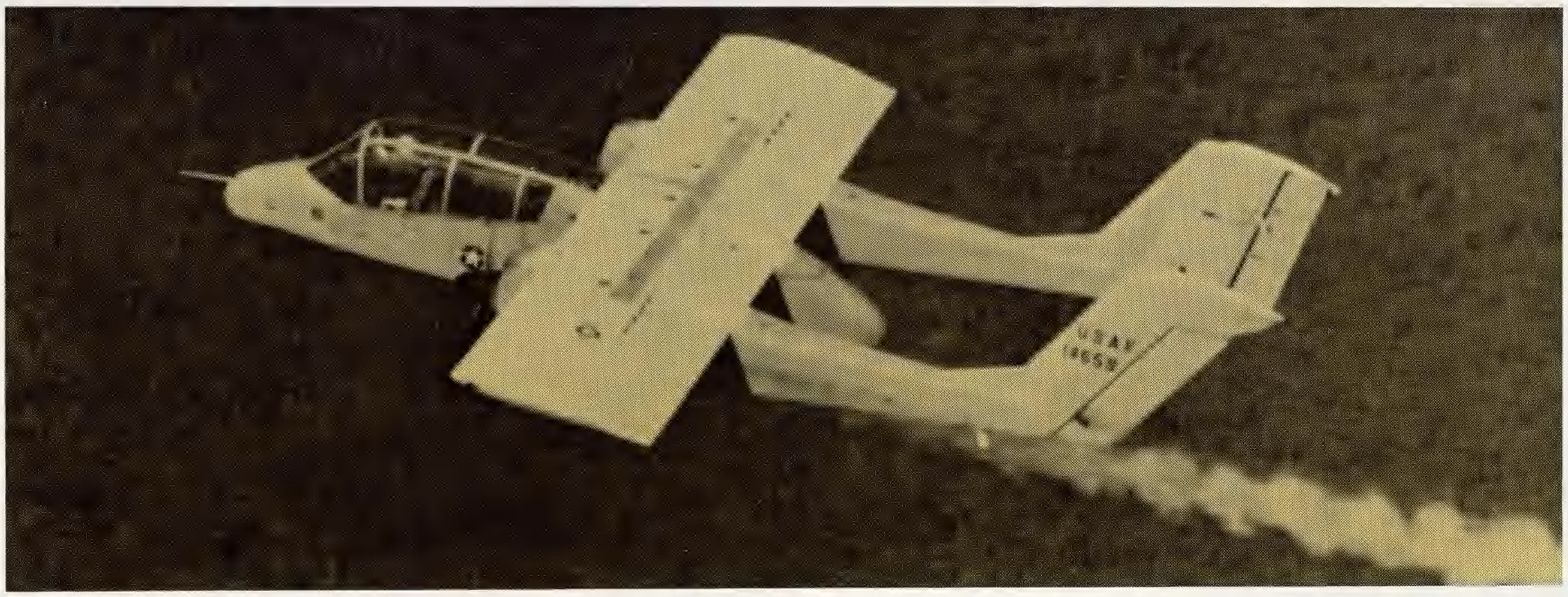


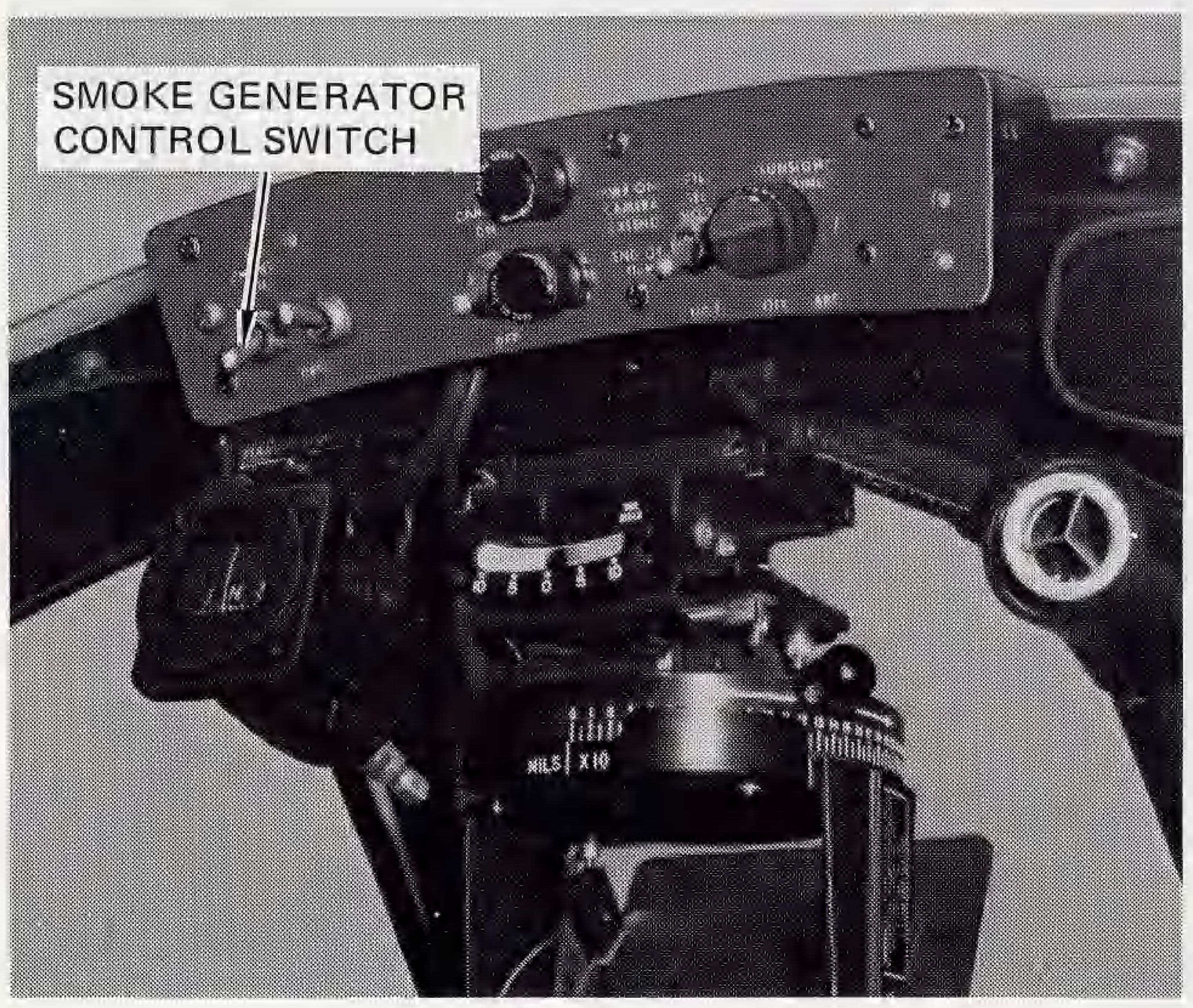
Open



OBSERVER'S COCKPIT

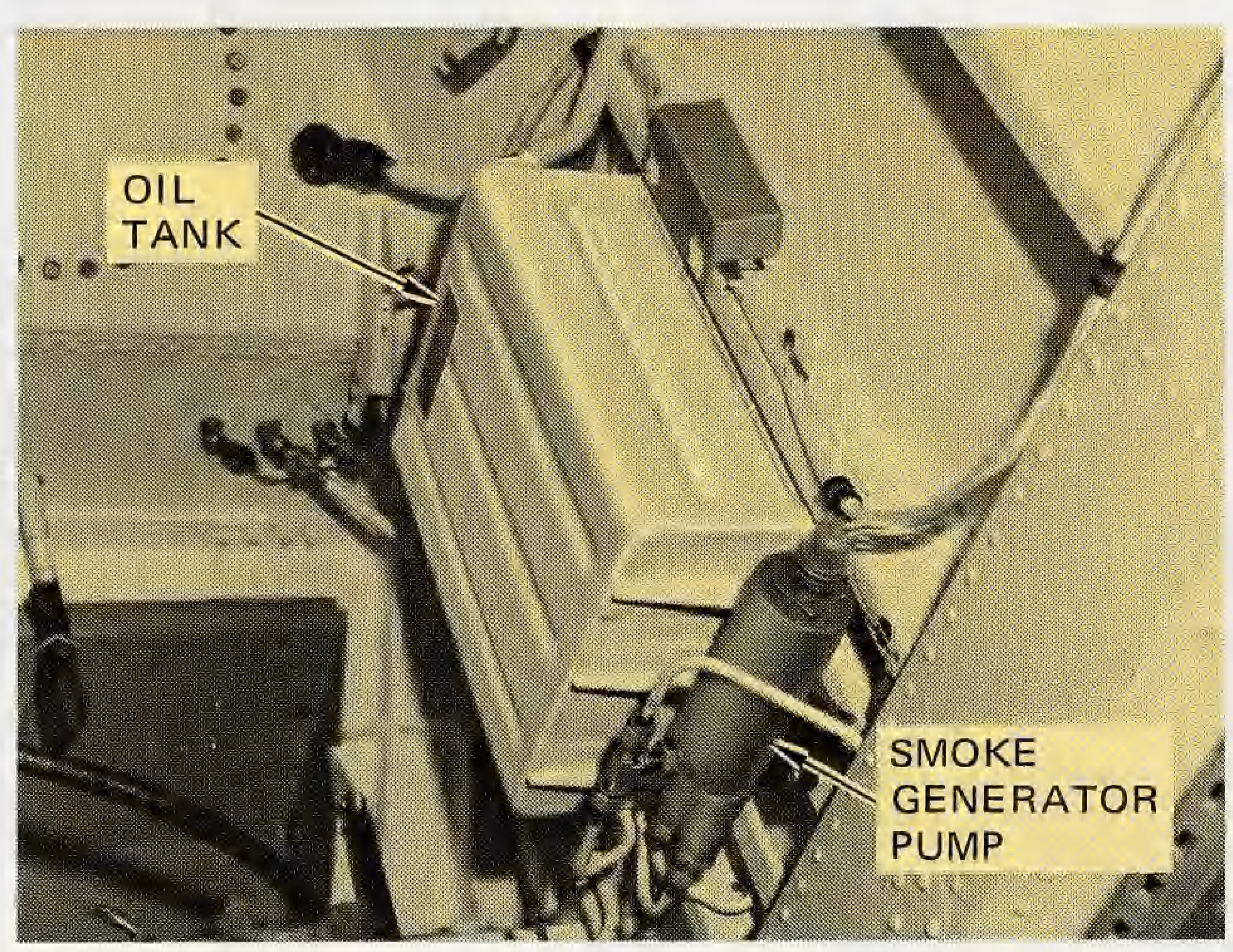
SMOKE GENERATOR SYSTEM





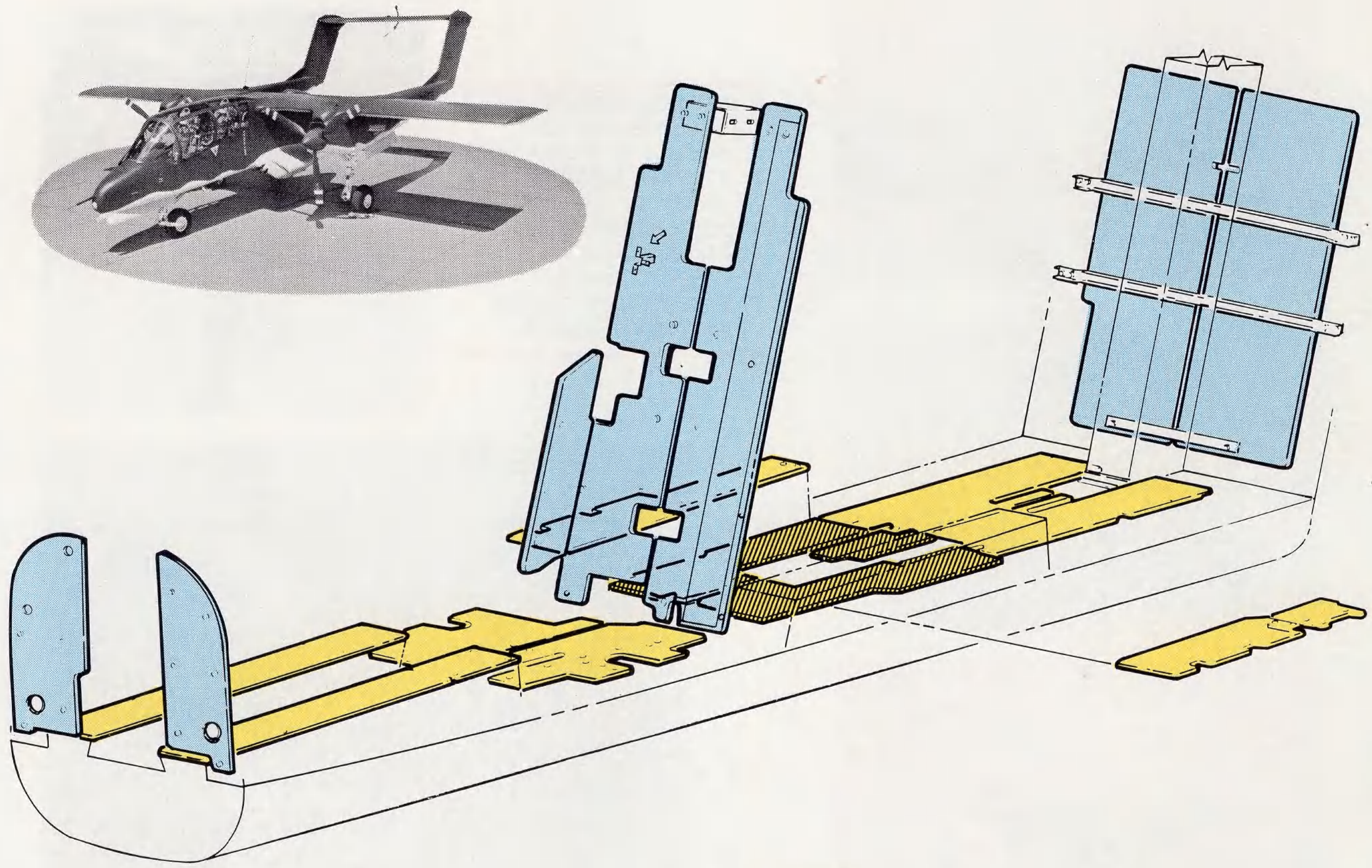
The smoke generator system is designed to assist ground and airborne personnel in making visual contact with the aircraft and to locate target areas for attack aircraft. The system consists of an oil tank, pump, engine exhaust stack generator nozzle, and a cockpit control switch. The oil tank has a 2.3-gallon capacity and is serviced through the filler cap located on top of the tank (MIL-F-12070 fog oil). The electrically-driven smoke generator pump is a low-flow, high-pressure, vane-type unit identical to the propeller unfeather pump. During normal operation, the system can provide smoke for approximately 4 minutes.

Location of system components provides easy access for servicing and maintenance. The oil tank and smoke generator pump are located on the right side of the left main landing gear wheel well and the smoke generator control switch is located on the pilot's windshield bow.



LH WHEEL WELL (View Looking Forward)

PILOT and OBSERVER ARMOR INSTALLATION



- USN/USMC ARMOR PLATE PACKAGE (305-865015)
- USAF ARMOR PLATE PACKAGE (305-865016)

ALUMINUM ALLOY

STEEL

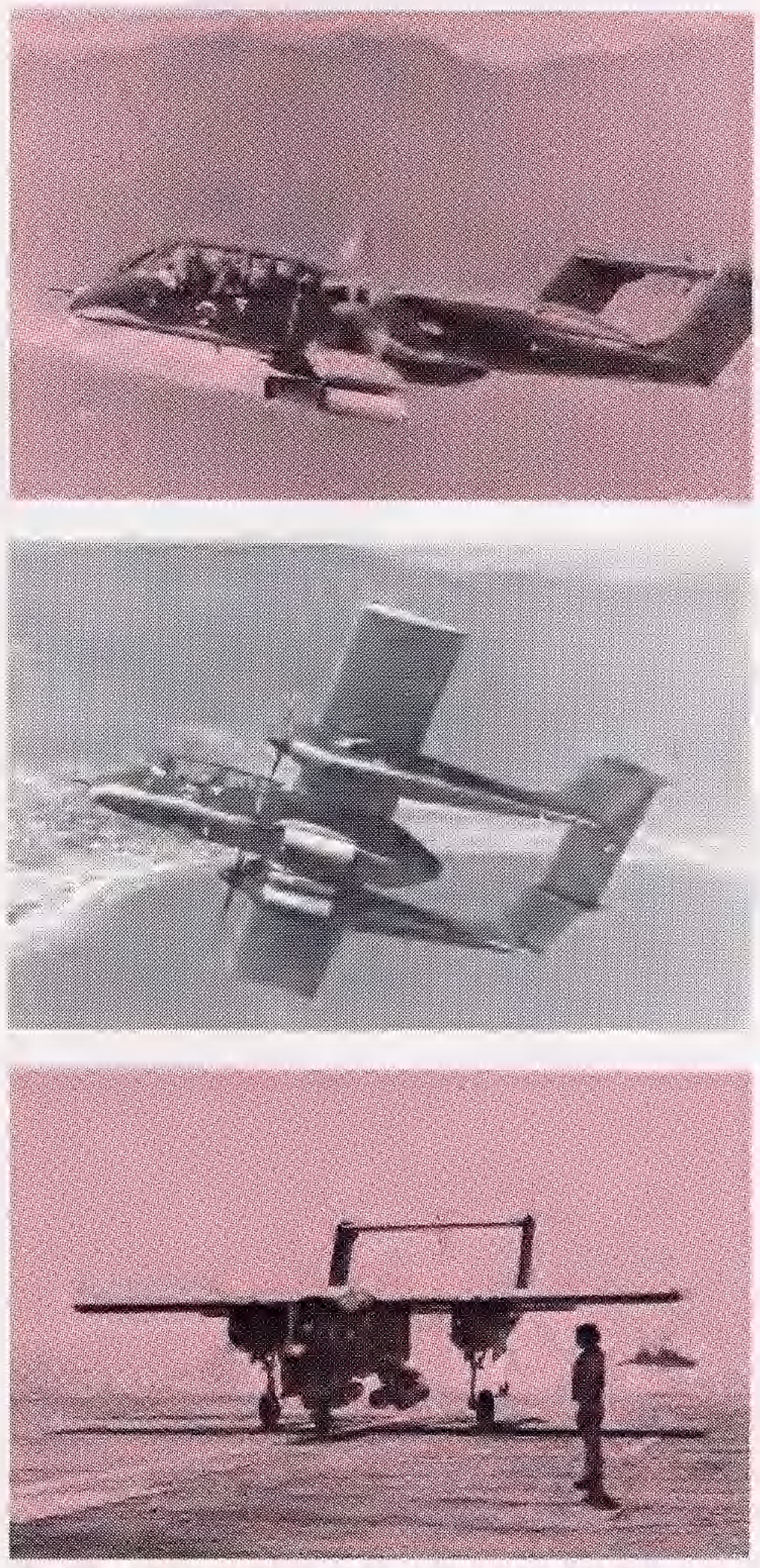
ALUMINUM ALLOY (USN/USMC ONLY)

Protection of the pilot and observer against small arms ground fire is provided by armor plates located throughout the cockpit areas. The pilot also has 1-1/4-inch thick bullet resistant windshield glass. The types and specific locations of the armor plates are shown in the accompanying illustration.

Vertical or near vertical-installed armor plate consists of 3/8-inch face hardened steel and horizontal or floor-mounted armor plate consists of 1/2-inch face hardened aluminum alloy. Both types of armor plates are installed with the hardened surface exposed to projectiles. The surfaces of the armor plate are appropriately identified for installation purposes.

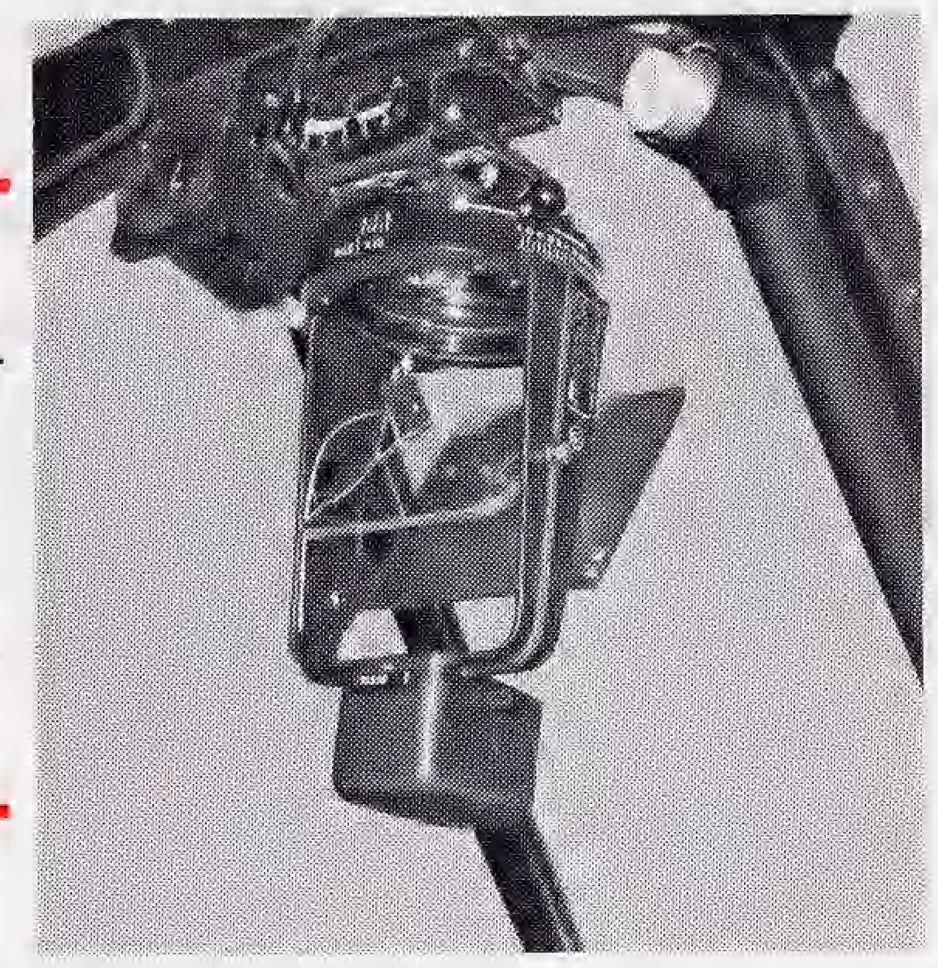
The weight of the armor plate in USN and USMC OV-10A aircraft is 325 pounds and in USAF aircraft, 307 pounds. The difference in weight results from the elimination of armor plate in the area of the strike camera (page 88) in the aft cockpit of USAF aircraft. On USN and USMC aircraft, a message drop door (page 89) is installed in lieu of the strike camera and the area surrounding the door is protected with armor plate. Some USN and USMC aircraft, however, have the strike camera installed and a section of the armor plate has been removed.

ARMAMENT

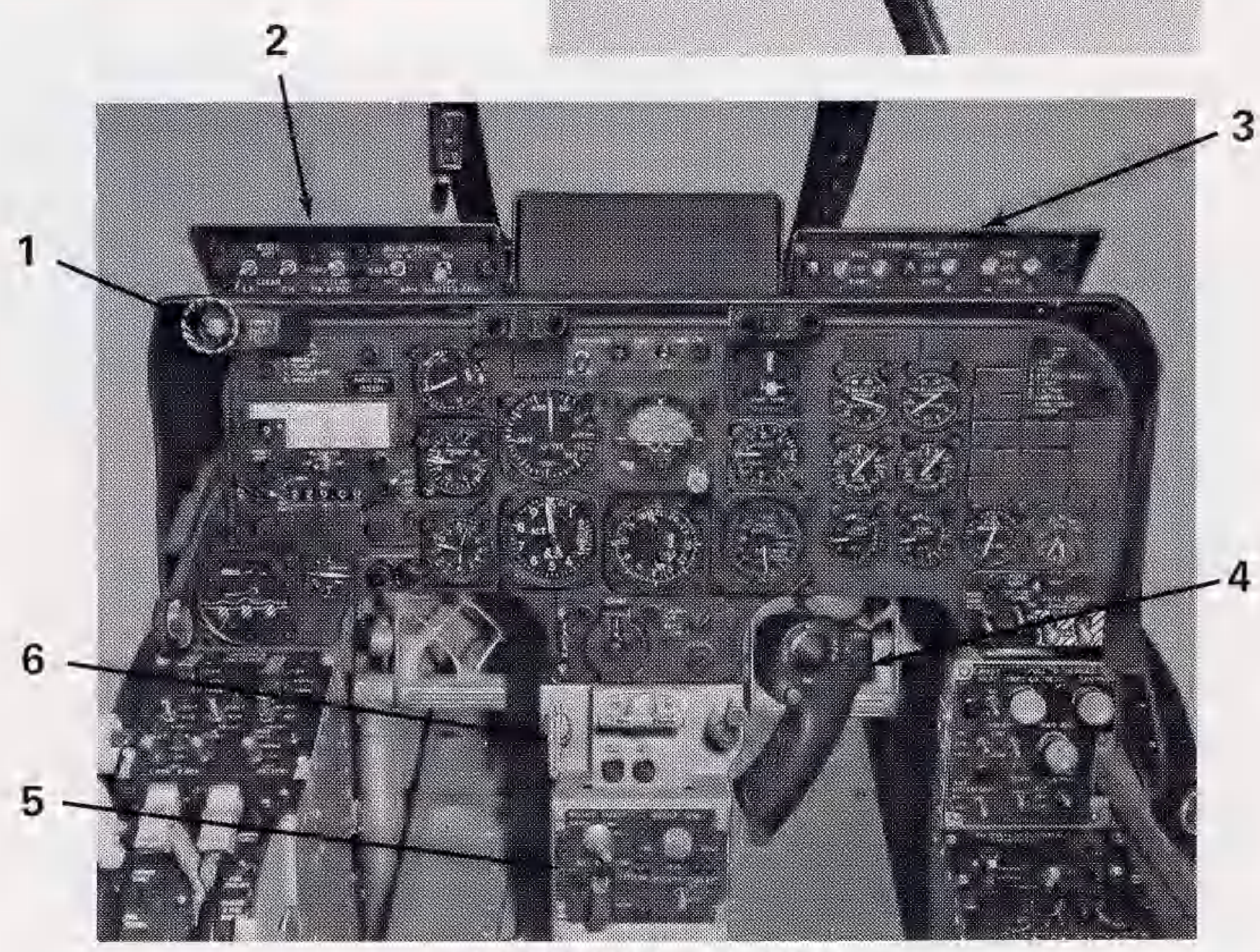


SPONSON ACCESSIBILITY PROVIDES RAPID LOADING OF STORES AND AMMUNITION

OPTICAL SIGHT



1. STORES EMERGENCY RELEASE BUTTON
2. WEAPON CONTROL PANEL
3. STATION MODE SELECT PANEL
4. BOMB RELEASE BUTTON AND TRIGGER
5. MISSILE CONTROL PANEL
6. EMERGENCY STORES JETTISON HANDLE



PILOT'S COCKPIT

The OV-10A is equipped with seven external store stations and four 7.62 mm guns installed in the sponsons. A variety of conventional ordnance can be delivered in addition to 2000 rounds of ammunition. Included in the ordnance loads are general-purpose bombs, fire bombs, rockets, gun pods, missiles, cluster bomb units, search stores, and flares/markers. The seven external store stations consist of four sponson store stations, one centerline station, and two external wing stations. Sponson accessibility provides rapid loading of stores and ammunition. The wing stations can carry the LAU-7/A launcher for mounting either rocket packages or missiles. The centerline store station also has the capability of carrying either a 150- or 230-gallon external fuel tank.

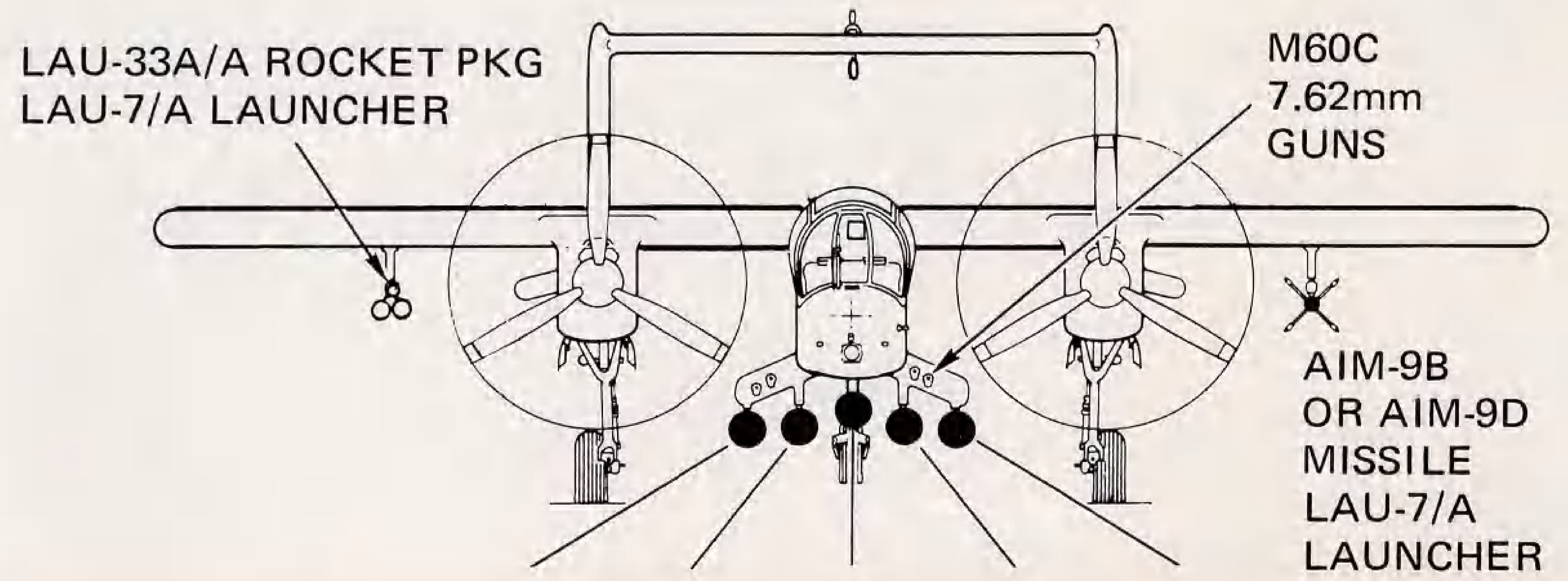
Internal armament consists of four fixed, forward-firing, 7.62 mm (M60C) machine guns. The guns, two on each side of the fuselage, are located in sponsons which extend outboard and down from the lower shoulders of the fuselage. A total of 1000 rounds of standard NATO ammunition may be carried in each sponson, providing 500 rounds per gun.

Gun pods, such as the SUU11( )/A 7.62 mm minigun, can be attached to the external store stations with the centerline store station capable of carrying a MK 4 MOD 0 20 mm gun pod.

An illuminated, reflecting, noncomputing optical sight is installed in the pilot's cockpit for delivery of bombs and rockets and for directing air-to-ground gunfire. The sight reticle may be depressed up to 270 mils, through tilting of the reflecting glass, to provide proper sight angles for release slant range or lead angles for all types of weapons.

All armament controls are located in the pilot's cockpit, including the manual emergency stores jettison handle. On some USAF aircraft, an armament master switch and stores emergency release button are located on the observer's instrument panel.

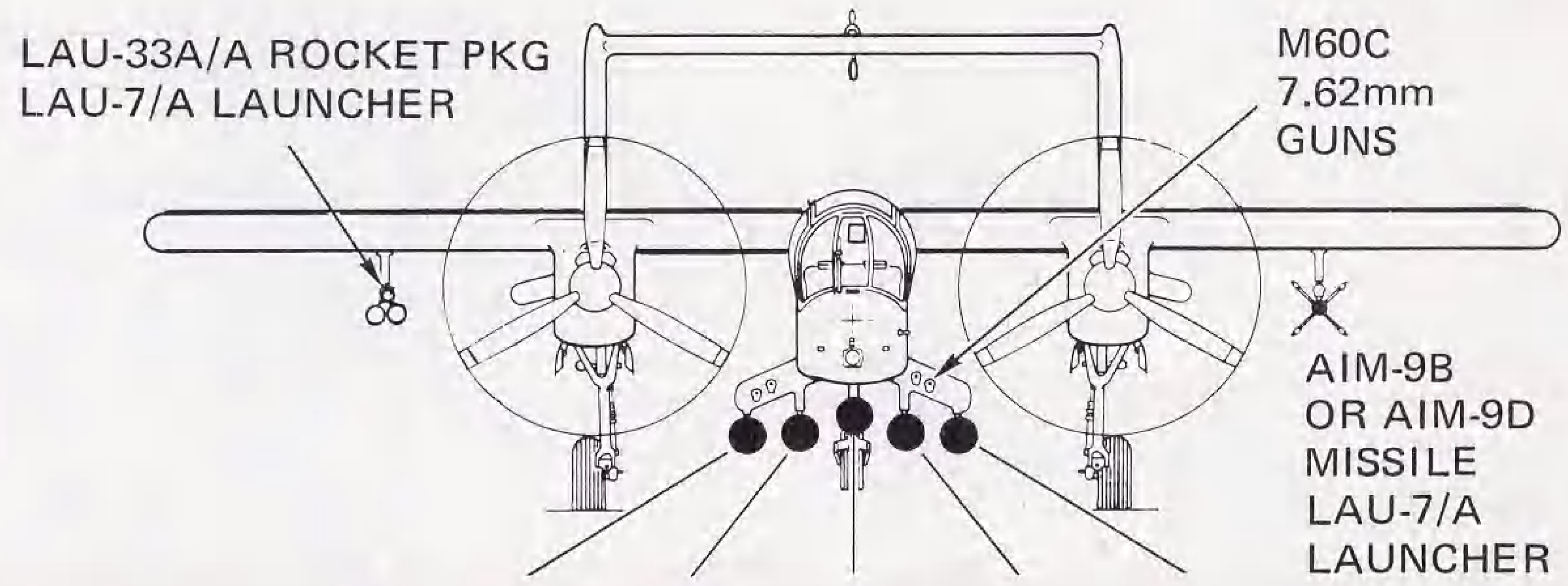
Armament (Cont.)



1 - USAF ONLY
2 - USN/USMC ONLY

CODE	WEAPON/MUNITION	STA 5	STA 4	STA 3	STA 2	STA 1	WEIGHT (POUNDS)
	● General-purpose, Low Drag (GPLD) Bombs						
	MK 81	●	●	●	●	●	260
1	MK 82	●	●	●	●	●	572
1	M 117			●			823
	● General-purpose, Snakeye/Retarded Bombs						
2	MK 81 (Snakeye 1)	●	●	●	●	●	305
1	MK 82 (Snakeye 1)	●	●	●	●	●	572
1	M 117 (Retarded)			●			857
	● Guns/Gun Pods						
	M60C (four mounted in sponsons)						
	SUU-11A/A, -11B/A (minigun)	●	●	●	●	●	325
2	MK 4 Mod (20mm)			●			1390
	● Rocket Packages						
	LAU-3/A, -3A/A	●	●		●	●	427
	LAU-32A/A, -32B/A	●	●		●	●	175
	LAU-10/A, -10A/A	●	●		●	●	533
2	LAU-33A/A (wing stations only)						262
	LAU-59/A	●	●		●	●	174
2	LAU-60/A	●	●		●	●	474
2	LAU-61/A	●	●		●	●	542
2	LAU-68/A	●	●		●	●	217
2	LAU-69/A	●	●		●	●	506
	● Missiles (Provisions for)						
	AIM-9B (Wing Stations Only) or AIM-9D						
	● Flare Dispensers/Flares/Markers						
1	SUU-25B/A (eight MK 24 flares)	●	●		●	●	360
1	SUU-25B/A (eight LUU-1/B markers)	●	●		●	●	360
2	SUU-40/A (eight MK 24/45 flares)	●	●	●	●	●	350
2	SUU-44/A (eight MK 24/25 flares)	●	●	●	●	●	350
1	AF/B37K-1, -2 (four MK 24 flares)	●	●		●	●	188
1	AF/B37K-1, -2 (four LUU-1/B markers)	●	●		●	●	188
1	AF/B37K-1, -2 (four LUU-2/B flares)	●	●		●	●	196

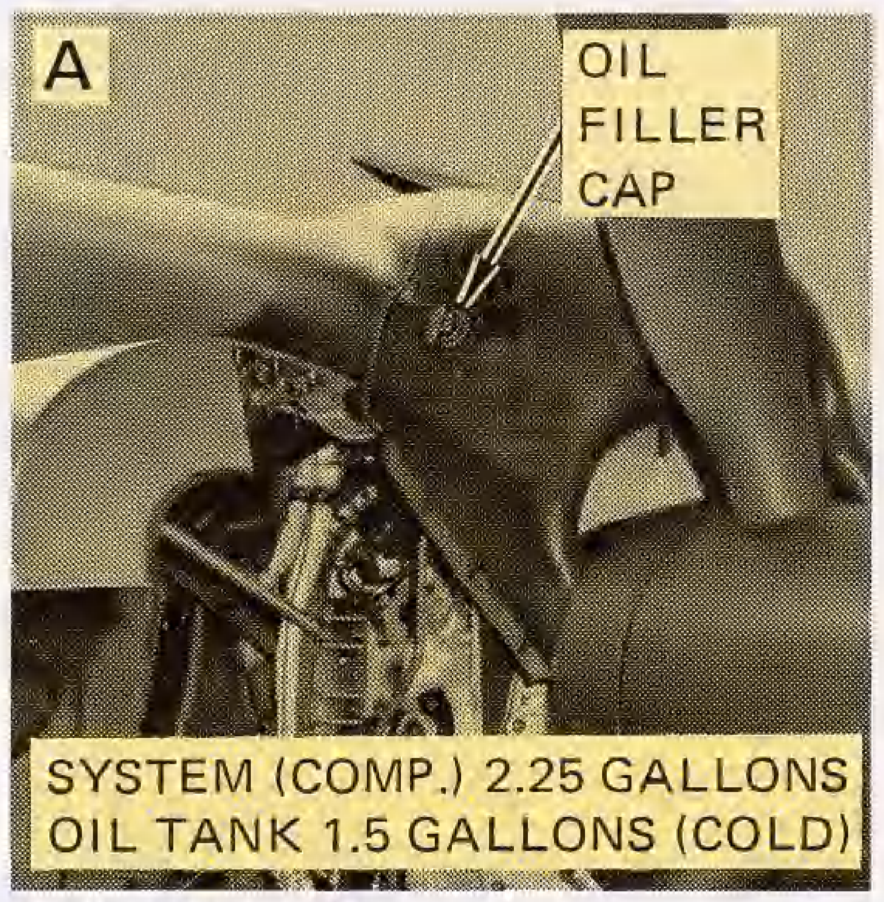
Armament (Cont.)



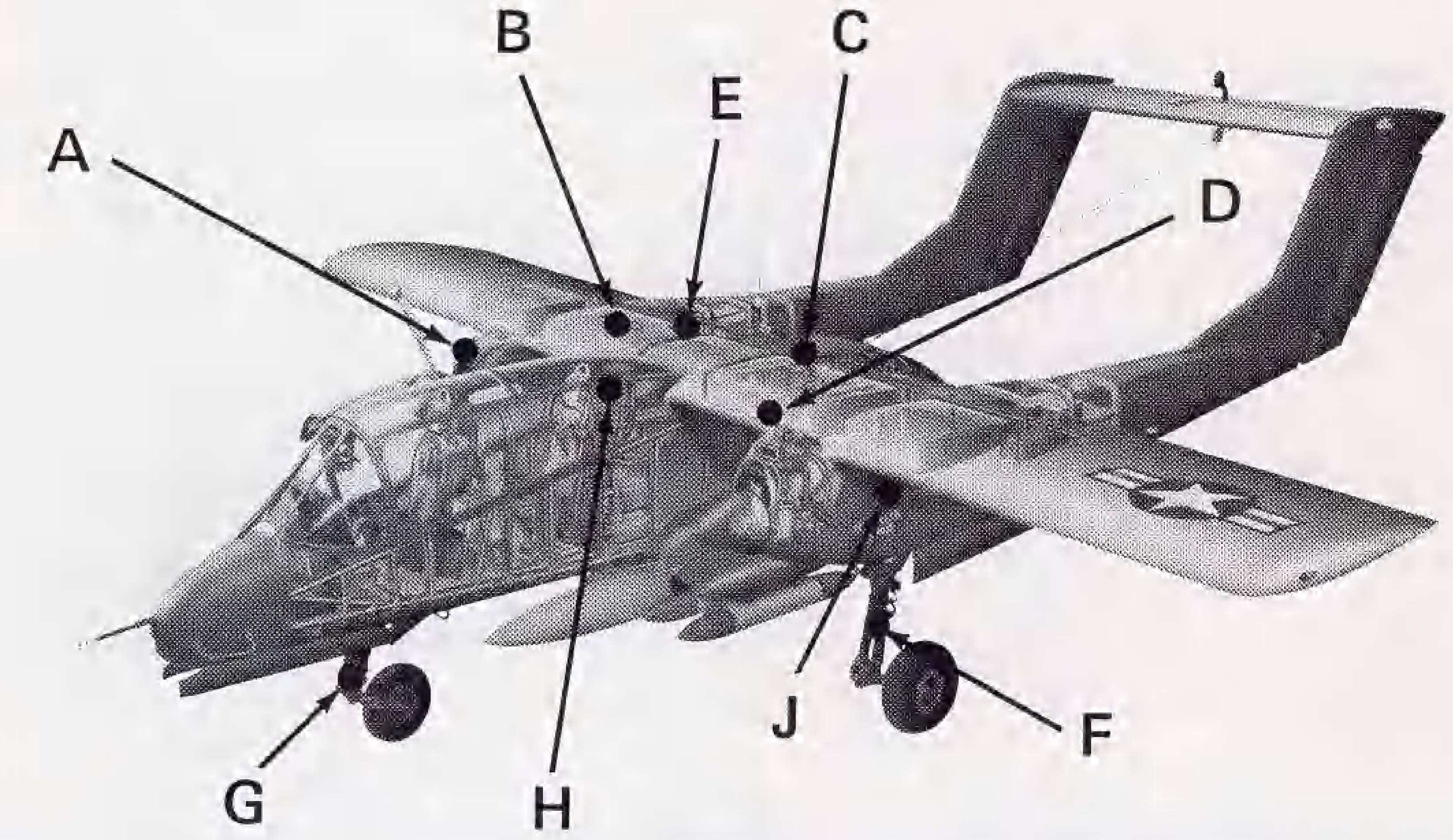
1 - USAF ONLY
2 - USN/USMC ONLY

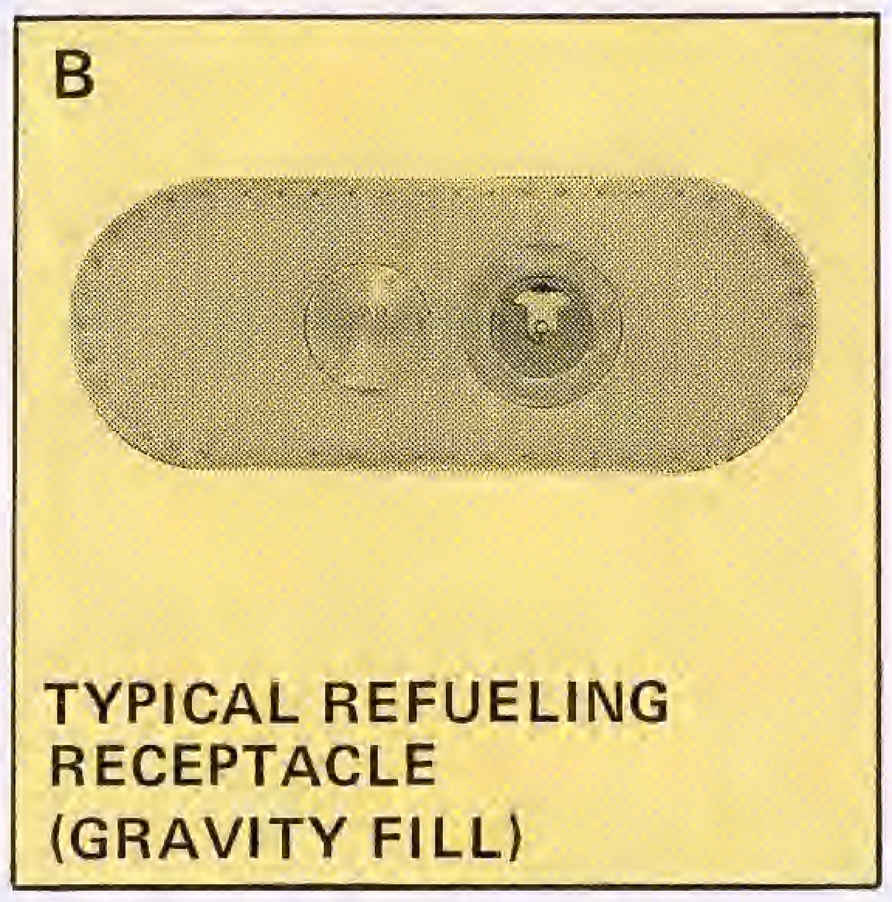
CODE	WEAPON/MUNITION	STA 5	STA 4	STA 3	STA 2	STA 1	WEIGHT (POUNDS)
	Flare Dispensers/Flares/Markers (Cont.)						
1	AF/B37K-1, -2 (four MK 6 signals)	●	●		●	●	144
2	A/A37B-3 (six MK 24/25 flares)	●	●	●	●	●	249
2	A/A37B-3 (six MK 6 signals)	●	●	●	●	●	183
	● External Fuel Tanks						
	150-gallon (Aero 1C)			●			1106
1	230-gallon (Modified)			●			1698
	● Fire Bombs						
2	MK 77 Mod 2	●	●	●	●	●	520
2	MK 77 Mod 4	●	●	●	●	●	593
1	BLU-1C/B (unfinned)	●				●	700–850
1	BLU-10/B (unfinned)	●	●		●	●	250
1	BLU-23/B (unfinned)	●	●		●	●	490
1	BLU-27/B (unfinned)	●				●	870
1	BLU-32/B (unfinned)	●	●		●	●	540
	● Cluster Bomb Units						
1	CBU-14A/A	●	●		●	●	250
1	CBU-22A/A	●	●		●	●	226
1	CBU-24B/B	●				●	830
1	CBU-25A/A	●	●		●	●	264
1	CBU-29B/B	●				●	830
	● Search Stores						
2	SUU-40/A (GSQ-117/117LS/141)	●	●	●	●	●	267–328
2	SUU-44/A (GSQ-117/117LS/141)	●	●	●	●	●	267–328
2	A/A37B-3 (ADSID-1/3)	●	●	●	●	●	237
2	A/A37B-3 (ADSID-three short)	●	●	●	●	●	237
	● Practice Bombs						
1	AF/B37K-1 (four MK 106)	●	●		●	●	100
1	AF/B37K-1 (four BDU-33/B)	●	●		●	●	176
1	AF/B37K-1 (four BDU-33A/B)	●	●		●	●	176
2	A/A37B-3 (six MK 76)	●	●	●	●	●	237
2	A/A37B-3 (six MK 106)	●	●	●	●	●	117
2	MK 86	●	●	●	●	●	141–217

SERVICING



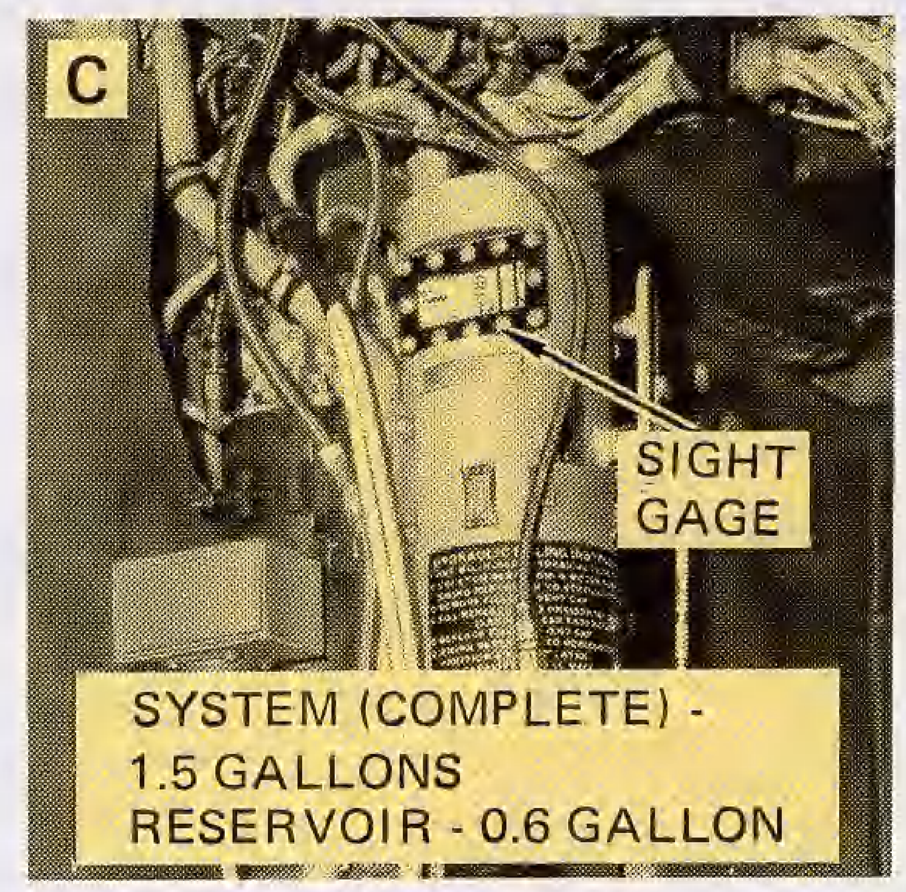
OIL SYSTEM



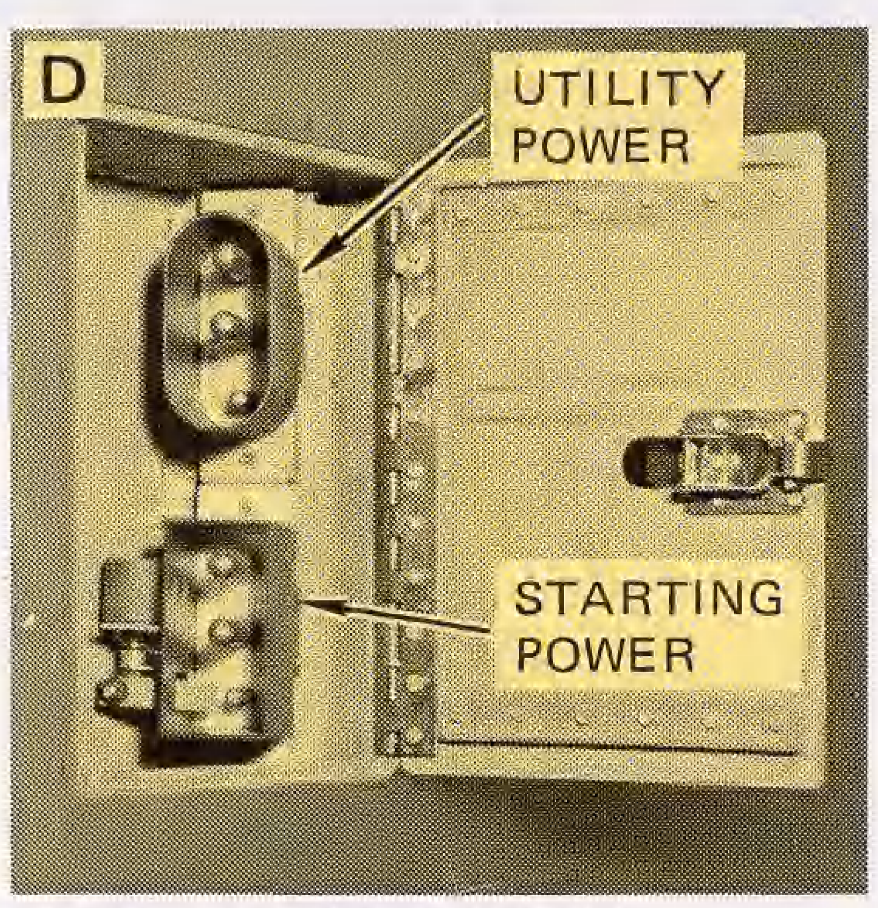


TANK CAPACITIES	GALS
CTR WING TANK	40
LH OUTBD WING TANK	40
RH OUTBD WING TANK	40
LH INBD WING TANK	69
RH INBD WING TANK	69
TOTAL INTERNAL	258
DROP TANK (150)	150
DROP TANK (230)	229
TOTAL FUEL CAP.*	408
(WITH 230 GAL TANK)	487

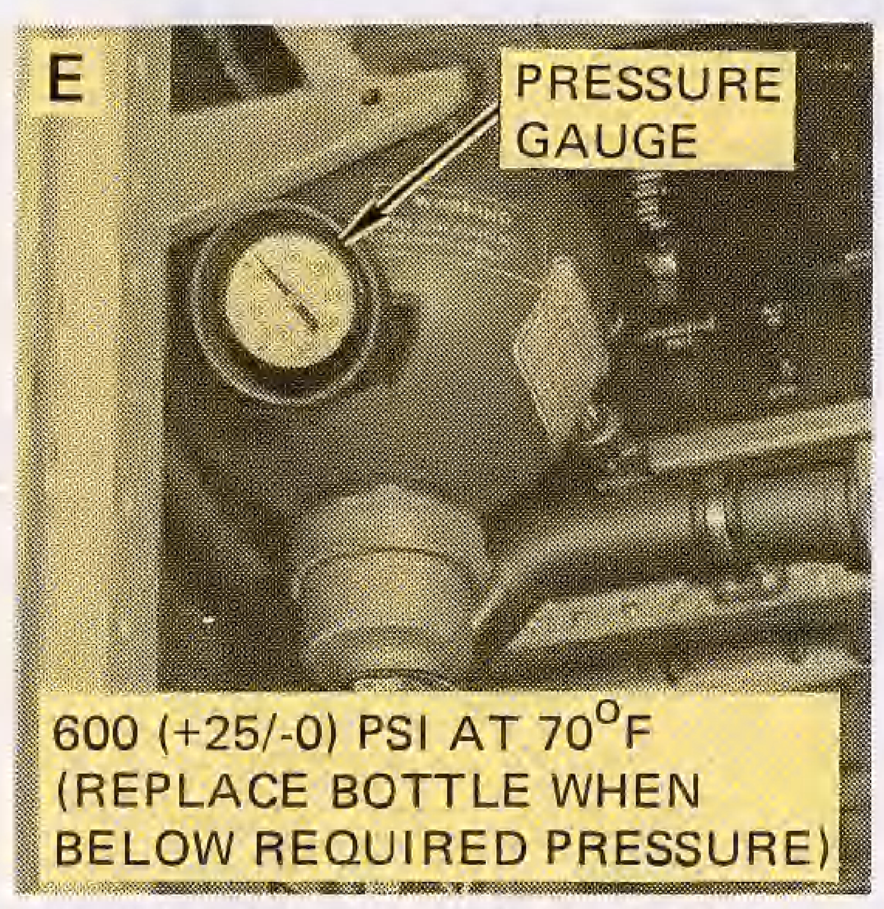
*REFER TO PAGE 71



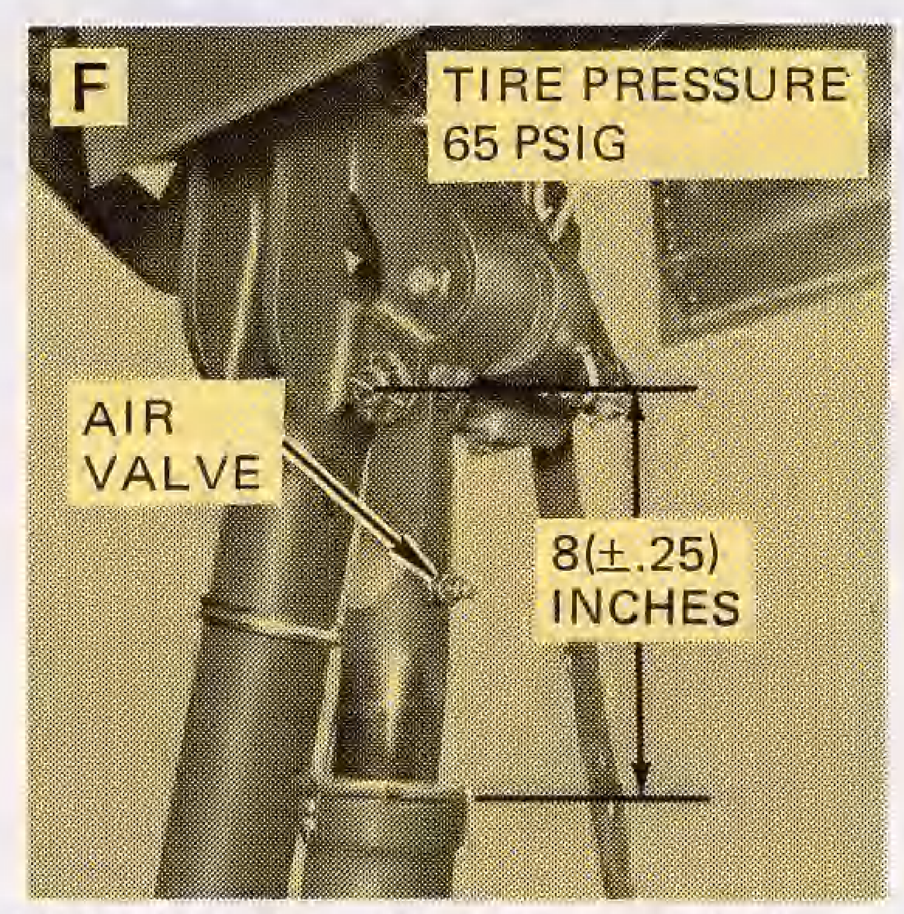
HYDRAULIC SYSTEM



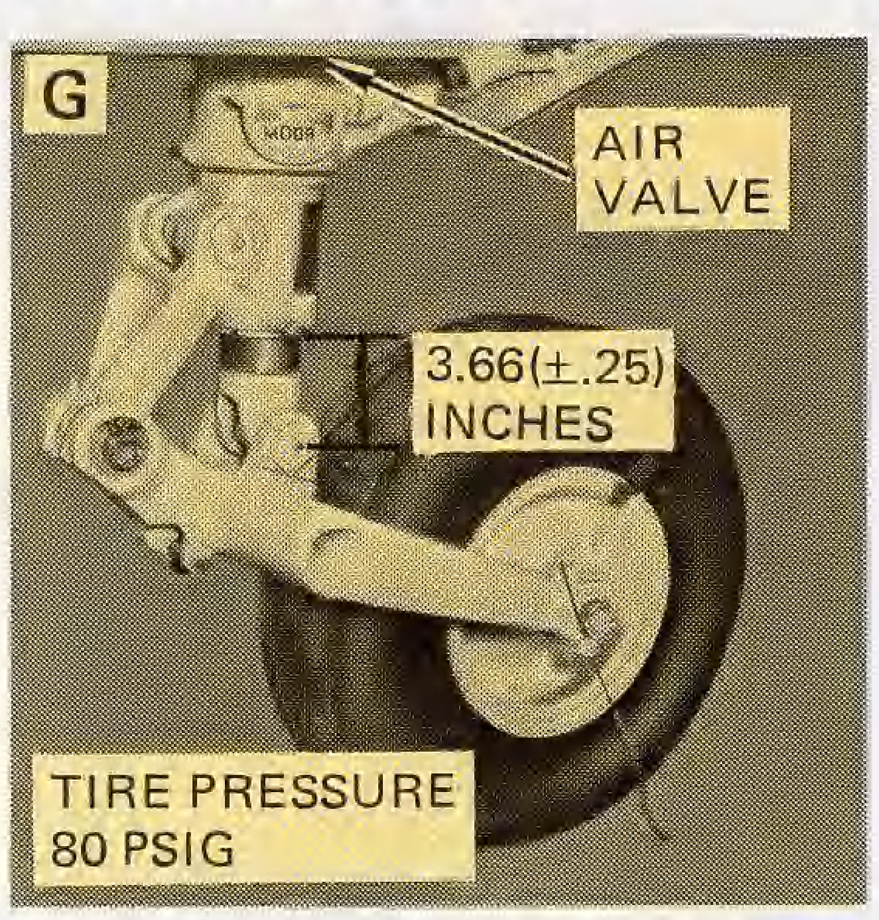
ELECTRICAL SYSTEM



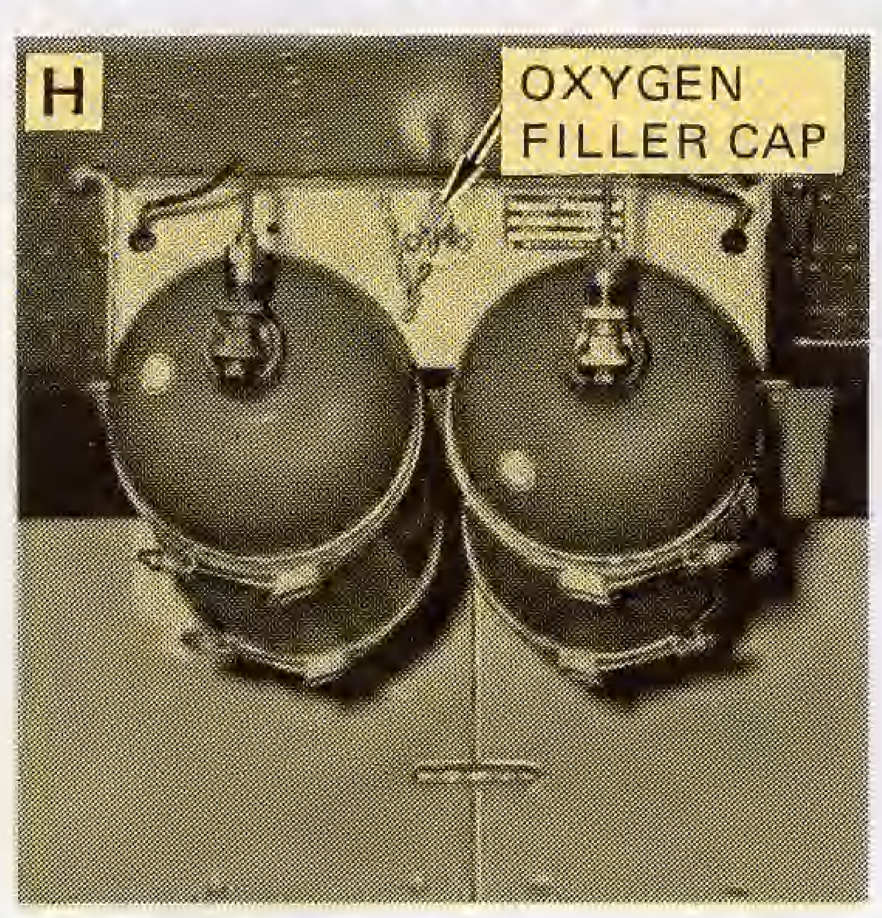
USAF FIRE EXTINGUISHER



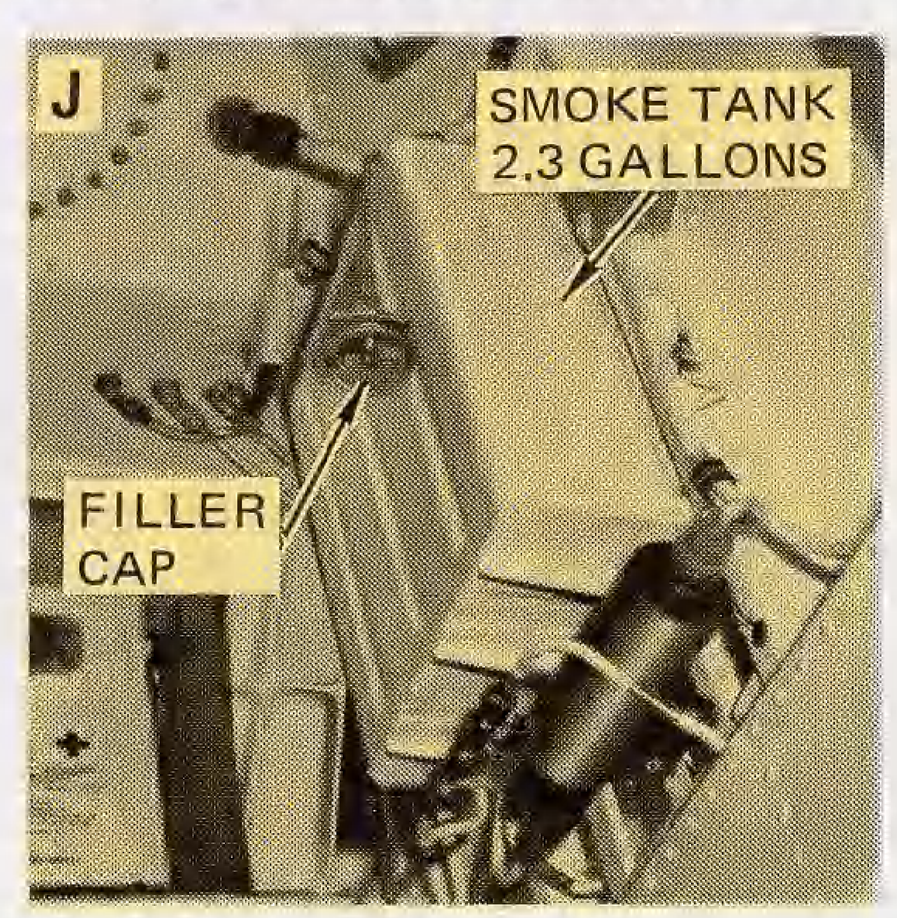
FILLING MAIN GEAR STRUT



FILLING NOSE GEAR STRUT



OXYGEN



SMOKE GENERATOR

PUBLICATION LISTINGS

The following tables provide a listing of publications applicable to the U.S. Navy, U.S. Marine Corps and U.S. Air Force OV-10A aircraft. For a listing of depot maintenance publications applicable to aircraft components, refer to the respective maintenance instructions manual.

USAF MANUALS

T.O.	TITLE
1L-10A-01	List of Applicable Publications
1L-10A-1	Flight Manual
1L-10A-1CL-1	Pilot's Abbreviated Flight Crew Checklist
1L-10A-2 Series	Maintenance Instructions Manuals
-2-1	General Information and Servicing
-2-2	Airframe Systems
-2-3	Environmental Systems
-2-4	Power Plants and Fuel Systems
-2-5	Avionics Systems
-2-6	Armament Systems
-2-7	Wiring Data
1L-10A-3	Structural Repair Manual
1L-10A-4	Illustrated Parts Breakdown
1L-10A-5	Basic Weight Checklist and Loading Data
1L-10A-06	Work Unit Code Manual
6	Inspection Requirement Manual
-6CF-1	Functional Check Flight (FCF) Procedures
-6CL-1	Functional Check Flight (FCF) Checklist

T.O.	TITLE
1L-10A-6WC-2	Phased Inspection Work Cards
1L-10A-6WC-1	Preflight/Basic Postflight Inspection Work Cards
1L-10A-10	Power Package Buildup Manual
1L-10A-17	Storage of Weapons Requirements
1L-10A-21	Aircraft Inventory Record Master Guide
1L-10A-33-1-1	Nonnuclear Munitions Basic Information
1L-10A-33-1-2	Nonnuclear Munitions Loading Procedures
1L-10A-33-1-2CL Series	Nonnuclear Munitions Loading Checklists
1L-10A-34-1-1	Nonnuclear Munitions Delivery Manual
1L-10A-34-1-1A	Nonnuclear Munitions Delivery Manual (Confidential)
1L-10A-34-1-1CL-1	Nonnuclear Munitions Delivery Checklist
1L-10A-36	Nondestructive Inspection Manual
00-25-113-LV10	Critical Alloys and Precious Metals Parts List

USN/USMC MANUALS

NAVAIR	TITLE
01-60GCB-1	NATOPS Flight Manual
01-60GCB-1B	NATOPS Pilot's Pocket Checklist
01-60GCB-1T	Tactical Manual
01-60GCB-1TB	Tactical Manual Pocket Guide
01-60GCB-2 Series	Maintenance Instructions Manuals
-2-1	General Information and Servicing
-2-2	Airframe Systems
-2-3	Environmental Systems
-2-4	Power Plants and Fuel Systems
-2-5	Avionics Systems
-2-6	Armament Systems
-2-7	Wiring Data
01-60GCB-3	Structural Repair Manual
01-60GCB-4	Illustrated Parts Breakdown
01-60GCB-6	Periodic Maintenance Requirements Manual

NAVAIR	TITLE
01-60GCB-6-1	Preflight Maintenance Requirements Cards
-6-2	Postflight/Servicing/Conditional Maintenance Requirements Cards
-6-3	Daily/Special Maintenance Requirements Cards
-6-4	Calendar Maintenance Requirements Cards
-6-5	Calendar Sequence Control Chart
-6-6	Functional Test Flight Checklist
-6-7	Preoperational SSE Maintenance Requirements Cards
-6-8	Periodic SSE Maintenance Requirements Cards
01-60GCB-75	Conventional Weapons Loading Manual
01-60GCB-N2	Cross-Servicing Schedule