OF-1 (AO-1) MOHAWK
3/1956

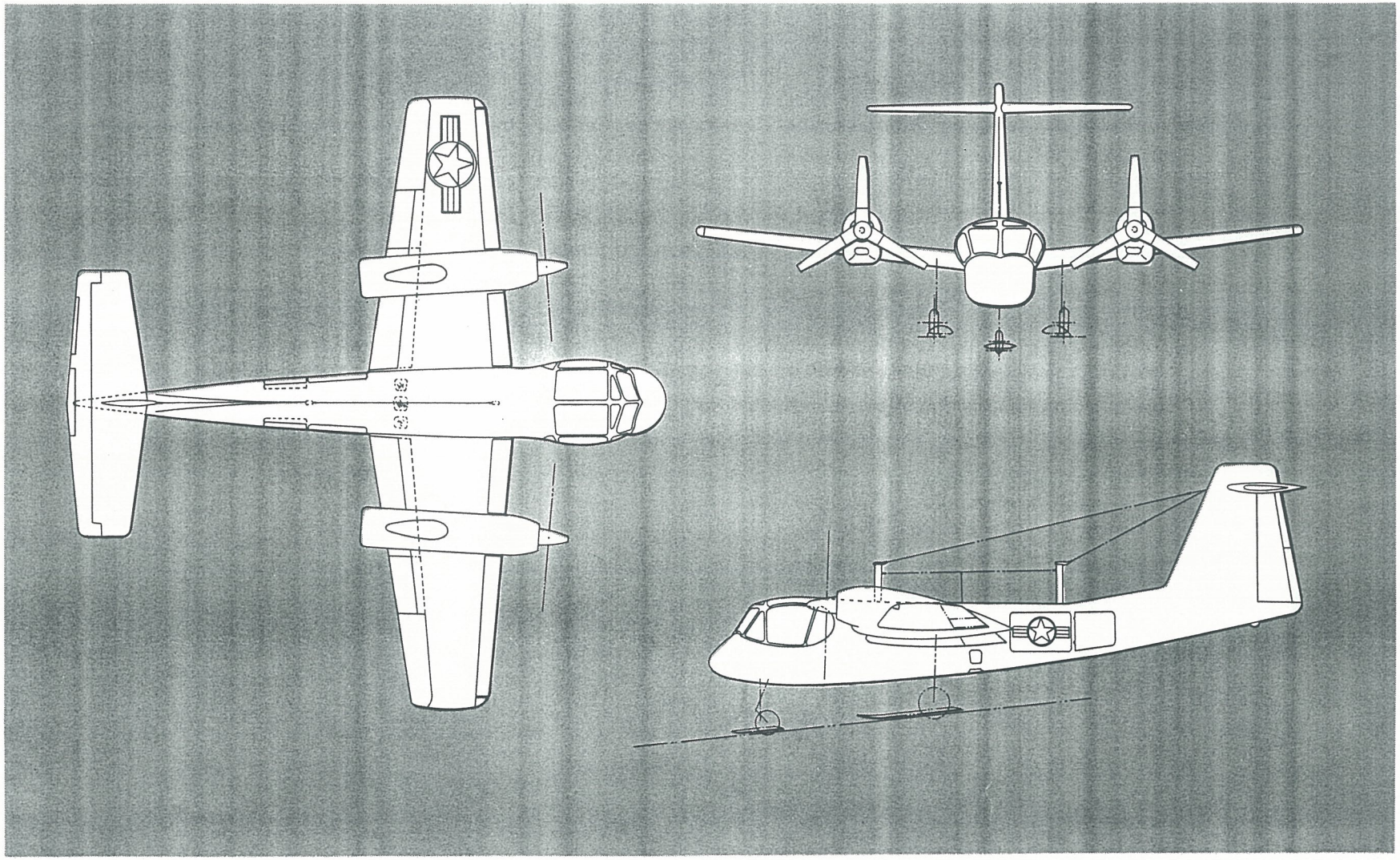
• INTRODUCTION •

The Grumman OF-1 Mohawk is a two-place, twin turbo-prop aircraft designed to operate from small, unimproved fields, water, snow and mud for purposes of tactical observation and reconnaissance. The airplane configuration consists of a mid-wing, single fuselage, high tail, and utilizes Lycoming T-53-L-3 engines mounted in nacelles above the wing. Each engine is fitted with a three-bladed, full-feathering, reversible pitch Hamilton Standard Hydromatic propeller. Primary control surfaces consist of conventional, manually-operated ailerons, elevator, and rudder. Six store stations are incorporated in the wing to permit the carrying of various combinations of external stores. A camera compartment with provisions for mounting any of 5 different cameras is also provided.

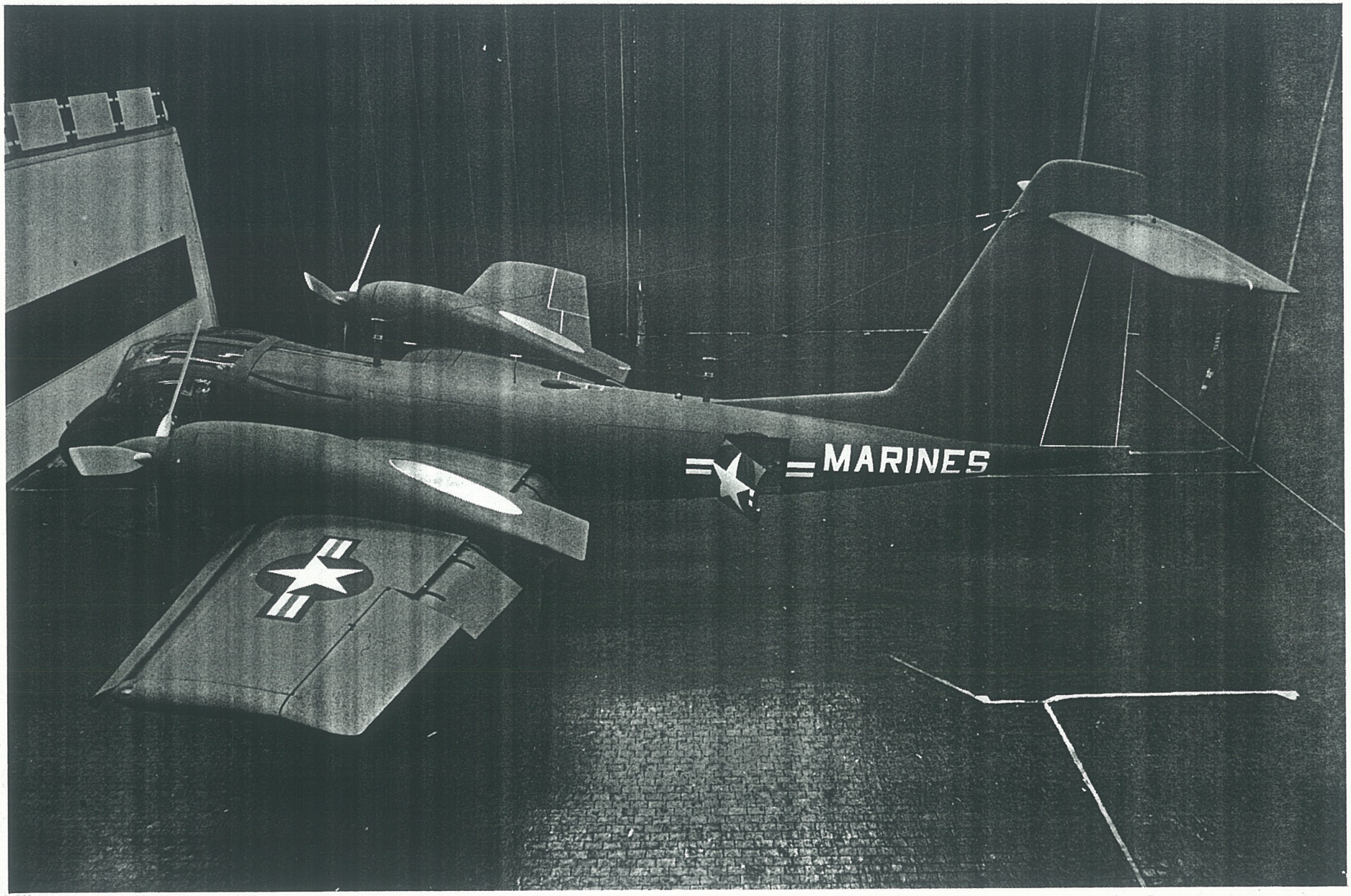
Descriptive information regarding the OF-1 aircraft structure, systems, equipment, crew compartment and armament provisions are presented in this brochure in accordance with the requirements of Military Specification MIL-M-8650(Aer), "Mockups: Aircraft, Construction of," dated 1 July 1955.

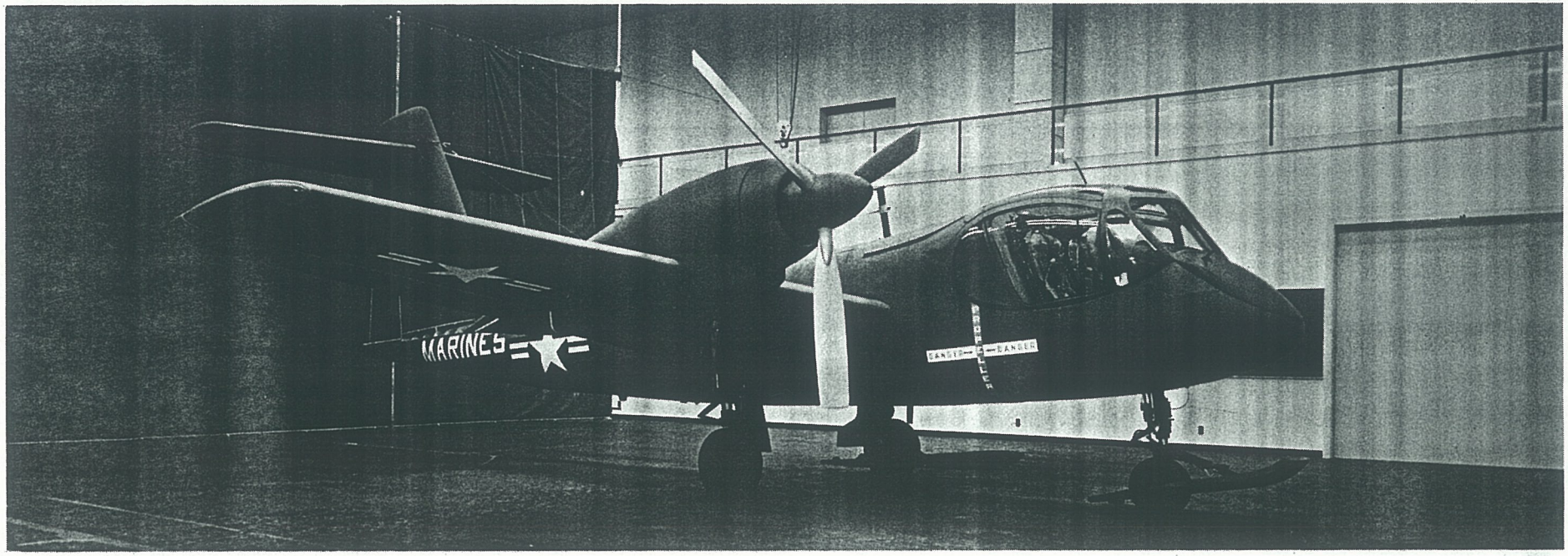
Wing Span	42 feet 0 inches
Overall Length	42 feet 9-1/2 inches
Tail Height	15 feet 7 inches
Wing Area	330 square feet
Aspect Ratio	5.35

Take-off Gross Weight	10423 pounds
Weight Empty	7772 pounds
Fuel	1666 pounds
Power Plant (2)	Lycoming T-53-L-3
Take-off Power	1005 ESHP each



OF-1 (AO-1) MOCK-UP





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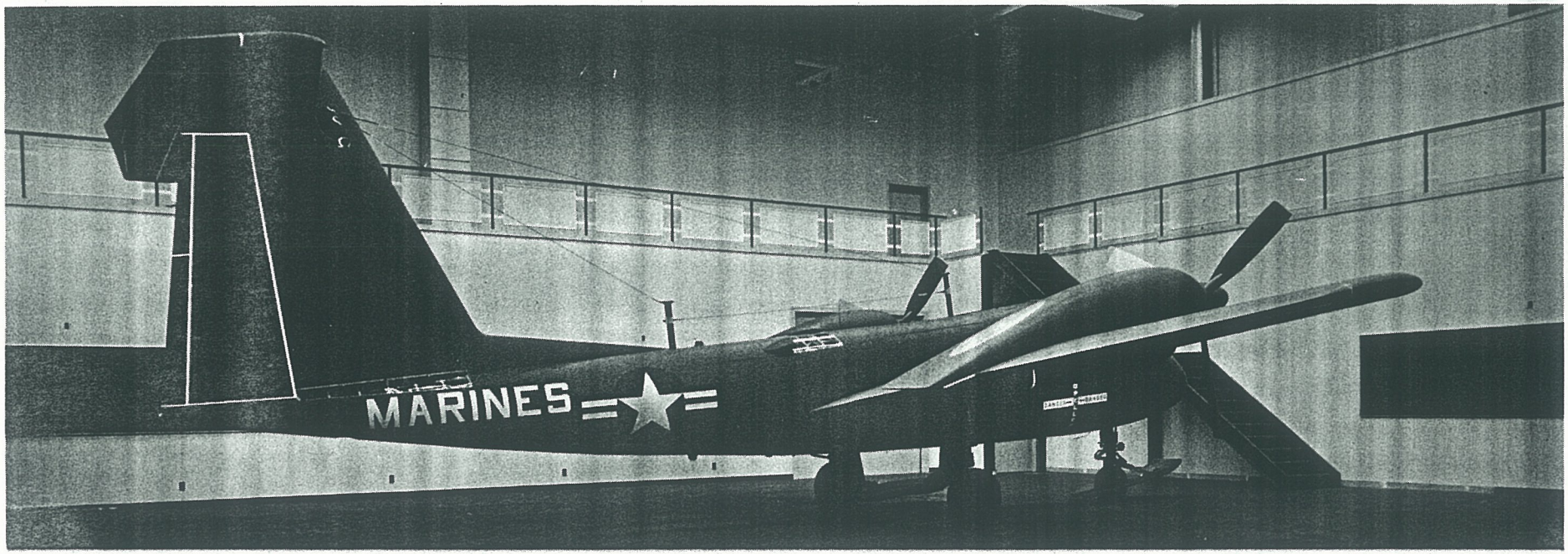


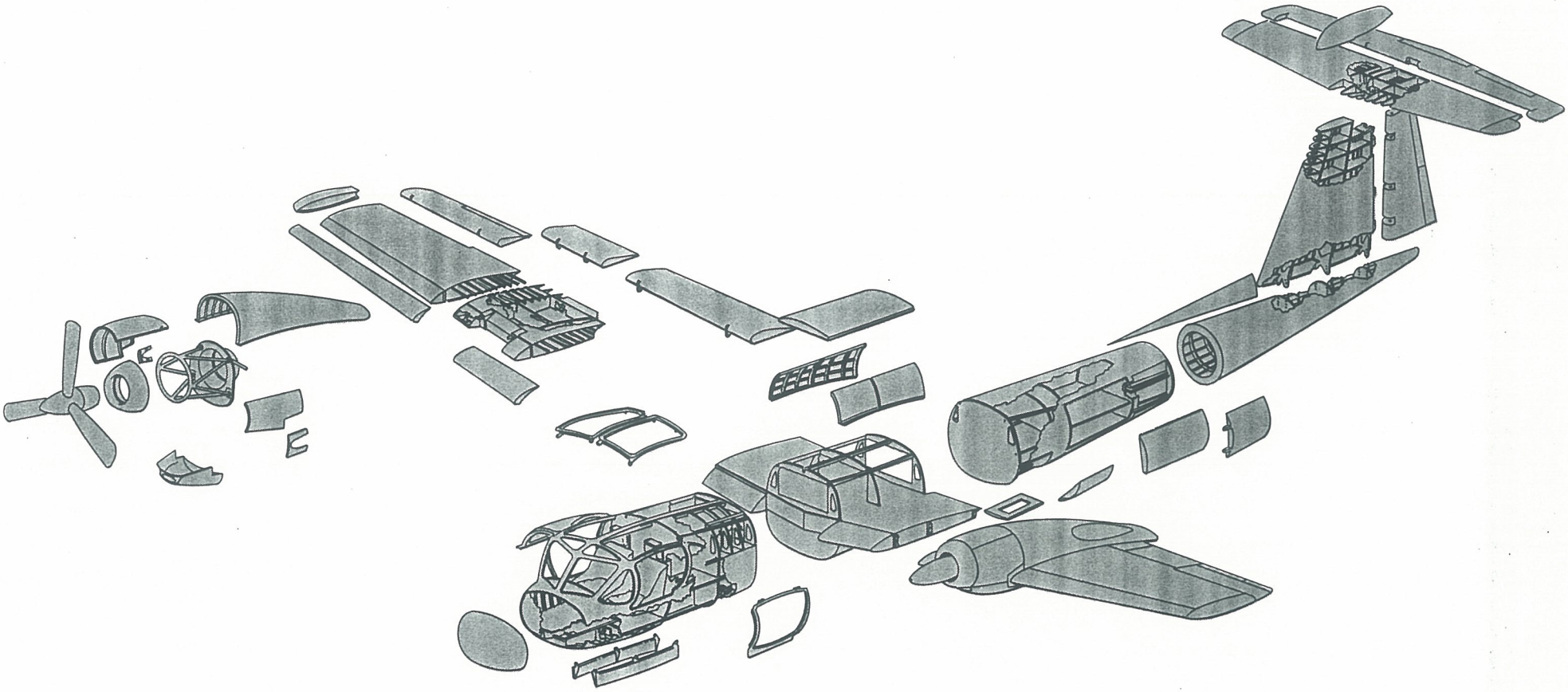
Structure (wing, tail, body, landing gear and nacelles)	3532 lbs.	
Propulsion Group	2056 lbs.	
Electronics Group	391 lbs.	
Passive Defense (armor plate, bullet resistant glass and flak curtains)	372 lbs.	
Fixed Equipment (flight controls, instruments, hydraulics, electrical, furnishings, air conditioning and photographic)	1371 lbs.	
TOTAL WEIGHT EMPTY		**7722 lbs.**
Crew (2)	400 lbs.	
Fuel (Usable) (256.3 Gallons)	1666 lbs.	
5" Target Marking Rockets and Launchers (2)	314 lbs.	
Photographic Equipment (K-17 Type Camera and Accessories)	121 lbs.	
Oxygen Installation	45 lbs.	
Observer's Pack	25 lbs.	
Miscellaneous Useful Load (pararafts, seat pans, oil, unusable fuel, etc.)	130 lbs.	
TOTAL USEFUL LOAD		**2701 lbs.**
Take-off Gross Weight (Tactical Air Observation Mission)		**10423 lbs.**

Alternate External Stores	**Stores**	**Racks and Pylons**	**Total Installation**
Re-supply Containers (2)	1500 lbs.	102 lbs.	1602 lbs.
150 Gallon Drop Tanks (2) (includes 1950# fuel)	2210 lbs.	102 lbs.	2312 lbs.
5" Target Marking Rockets (2)	270 lbs.	44 lbs.	314 lbs.
Night Photographic Accessories	300 lbs.	102 lbs.	402 lbs.

Special Equipment (not included in weights above)

Planing Ski Installation	355 lbs.
AN/APN-78 Doppler Radar Installation	125 lbs.
F-5 Autopilot Installation	79 lbs.

STRUCTURAL ARRANGEMENT

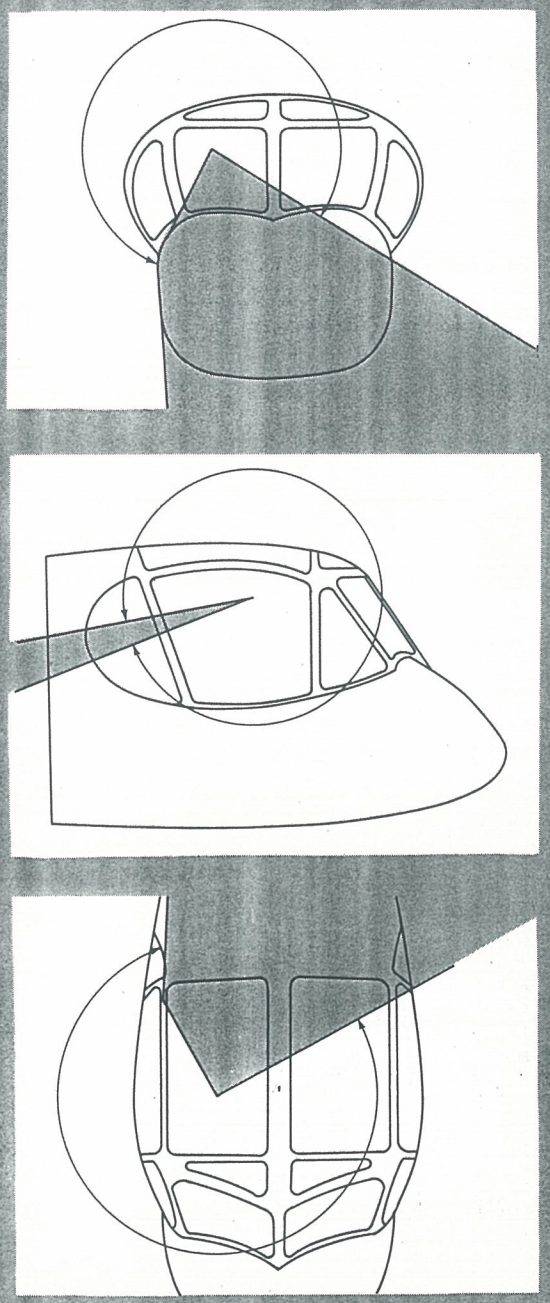


Functions

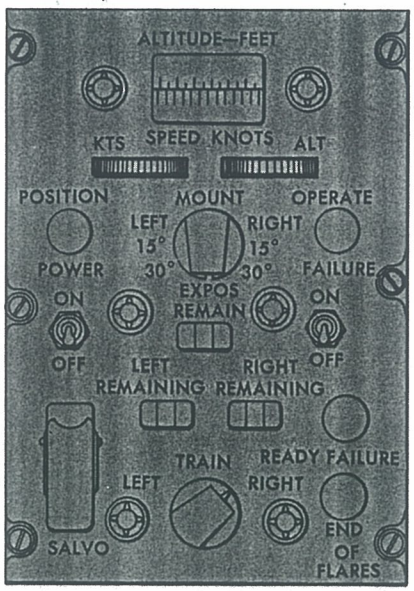
OBSERVATION

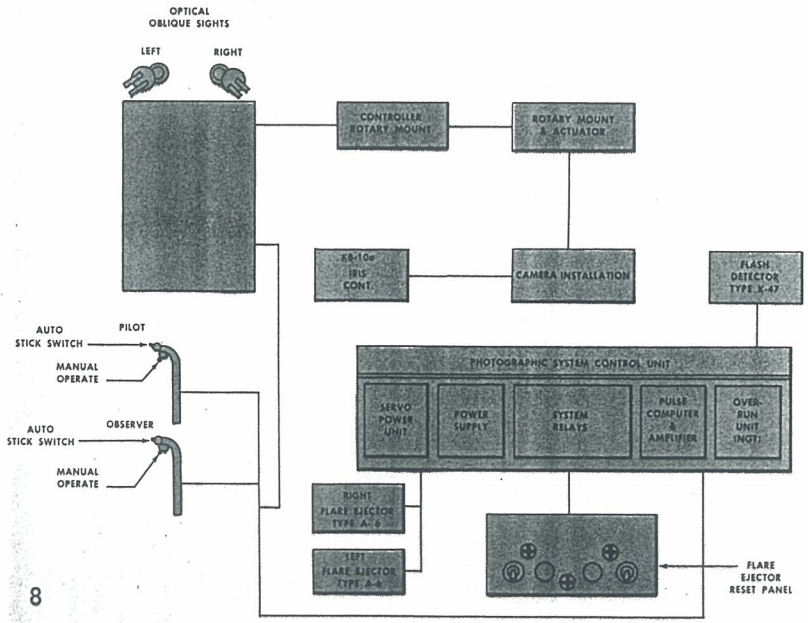
The principal function of the OF-1 aircraft is observation. Maximum visibility has been achieved by the use of a bubble canopy. Either crewman has unobstructed vision 22° down over the nose of the aircraft along the centerline of the seats. By moving the line of vision outboard, the visibility afforded the pilot and observer is expanded as shown in the accompanying figures. The resulting increase in the downward visibility over the nose is due to the employment of a low instrument panel and a nose section which falls away at a sharp angle.

Maximum side and rearward visibility is obtained by bubbled side hatches and a low main supporting longeron. Eleven degrees of rearward visibility is obstructed by the wing. The bubbled side hatches increase downward visibility by the extent that the lines of sight of the pilot and observer converge at a point thirty-six feet below the aircraft. Transparent sliding hatches, which provide necessary clearance for ejection, also allow complete vision directly overhead.



CLEAR AREAS REPRESENT OBSERVER'S VISIBILITY





The OF-1 photographic installation consists of a photographic control system which remotely operates any one of a variety of cameras located in the fuselage mid-section.

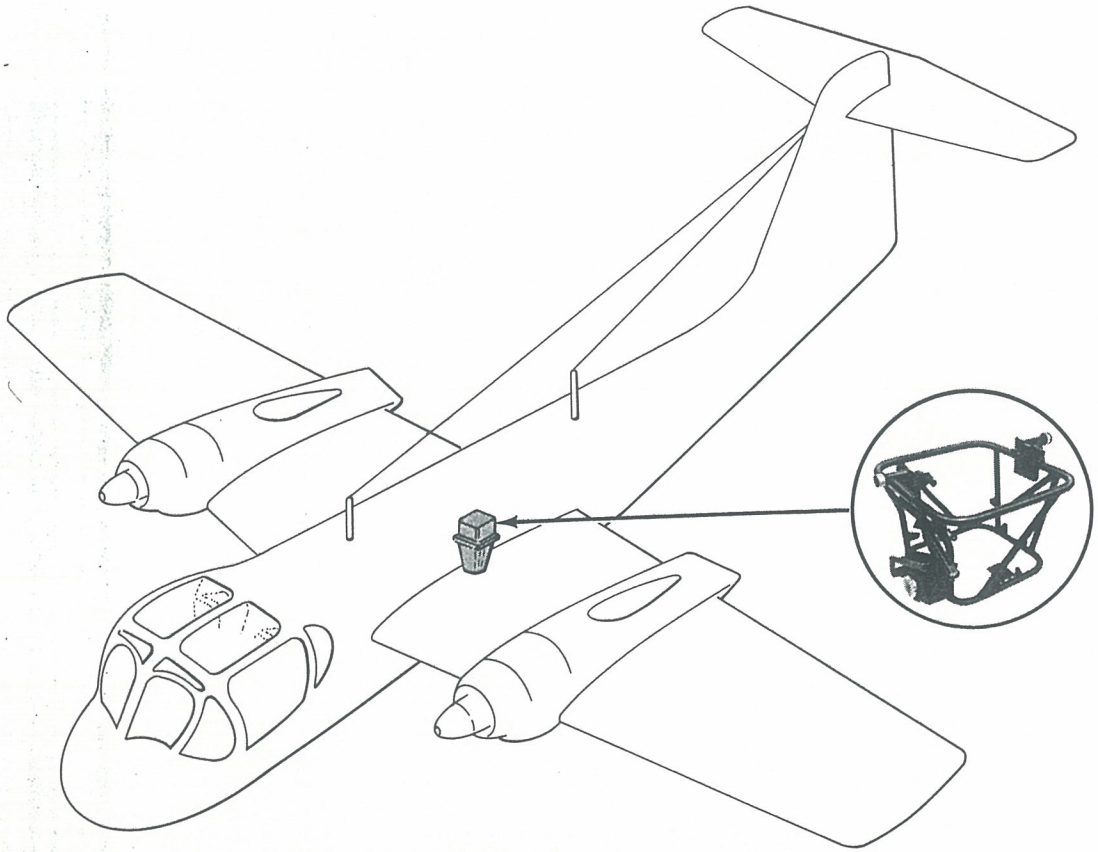
The photographic control system is composed of a cockpit console control panel, system control unit, actuator control unit, flare detector unit and flare reset panel.

The control panel is available to both the pilot and observer and includes the master station and flare control. By means of manual controls on the panel, altitude and speed data is provided to image motion compensation and pulse circuits. These circuits provide signals to the camera system to give 60% overlap of vertical photographs. Also provided on the panel are remote indicators which show the proper operation of the cameras, amount of film and flares remaining, film failure, mount position, flares ready and end of flares.

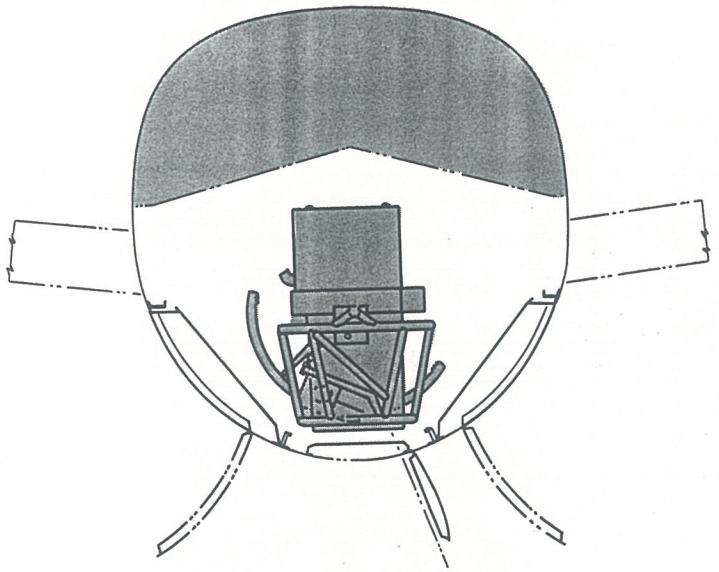
When preparing to photograph, the control panel power "on-off" switch is "on", at which time the cameras operate either by turning the control panel auto master switch to "on" or by squeezing the auto stick switch on either the pilot's or operator's control column. A stick switch is also available for manually pulsing the cameras for day photography or pulsing individual flares for night photography.

The camera mount can be rotated remotely to left or right, 15° or 30° oblique and vertical positions by the use of the control panel mount selector switch. Any one of the cameras tabulated on page 9 may be installed. However, the KA-9 and KB-10A cameras each require a separate adapter which may be stored if required.

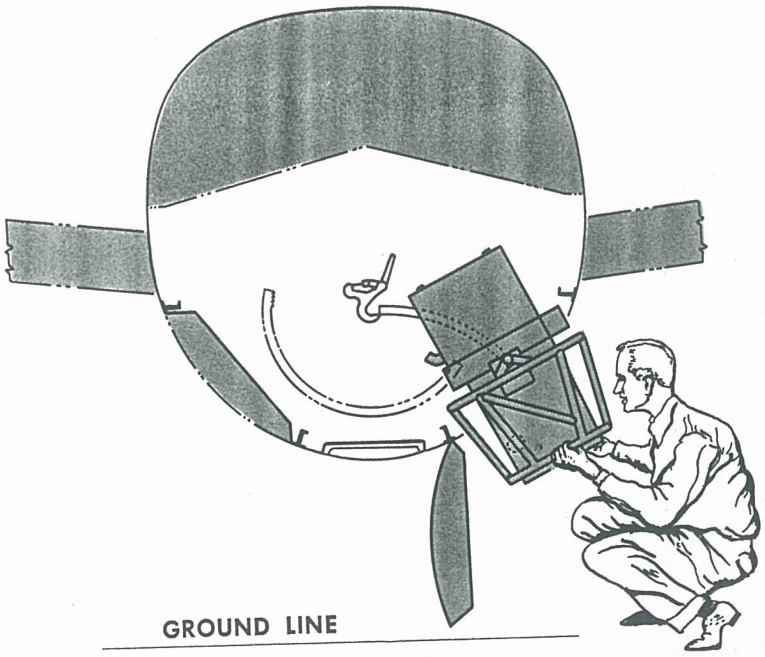
The left, right and vertical camera window doors open only when the corresponding mount position is selected. During ground handling, the mount selector switch is inoperative when a momentary override switch in the camera bay is depressed and locked with a pin attached to a red streamer.

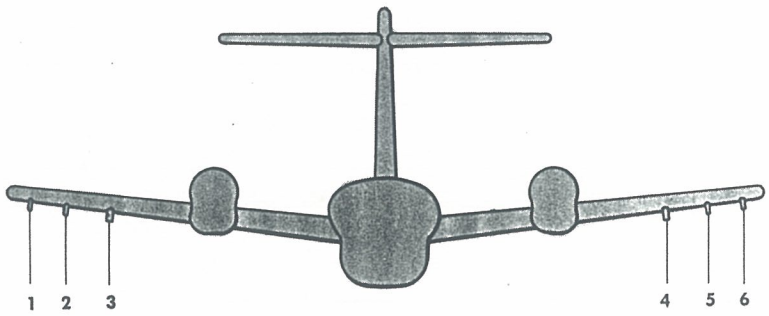


CAMERA STATION ALTERNATIVES		
CAMERA	LENS CONE	MAGAZINE
CA-3-2 (K17C)	CIL-7	MA-2 (A5A), MA-2a (A5A MOD) MA-9a (A9B) or MA-10a
CA-3-2b (K 47)	CIL-7a	MA-2 (A5A), MA-2a (A5A MOD), MA-9a (A9B) or MA-10a
KB-10a	3"	INTEGRAL
KA-9	6" or 12"	INTEGRAL
CA-17a	12"	MA-10a



INSTALLATION OF CAMERA





All external stores installed on the OF-1 are mounted on six pylons, three under each wing. The two inboard pylons are equipped with Aero 65A bomb racks and are capable of carrying loads up to their individual capacity of 1105 pounds. The four outboard pylons consist of Aero 15 or Aero 25 combination bomb rack and rocket launchers attached to the wing. The racks and supporting wing structure are designed to carry stores up to 500 pounds each or to fire 5″ target marking rockets. These stations are capable of carrying all the stores, as tabulated, to equip the airplane not only for visual observation missions, but also for its secondary missions of utility, re-supply and day or night photography.

Two fuel tanks and four target marking rockets constitute the basic external store arrangement for the OF-1 observation mission.

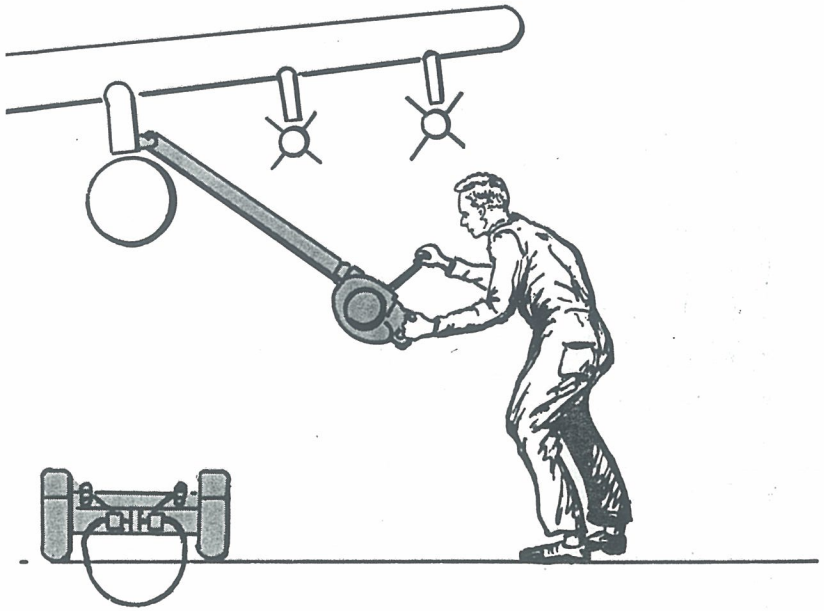
	STATION					
STORE	1	2	3	4	5	6
Target Marketing Rocket	X	X			X	X
150 Gallon Fuel Tank			X	X		
750# Re-supply Package			X	X		
Wire Dispenser			X	X		
500# Bomb	X	X	X	X	X	X
1000# Bomb			X	X		

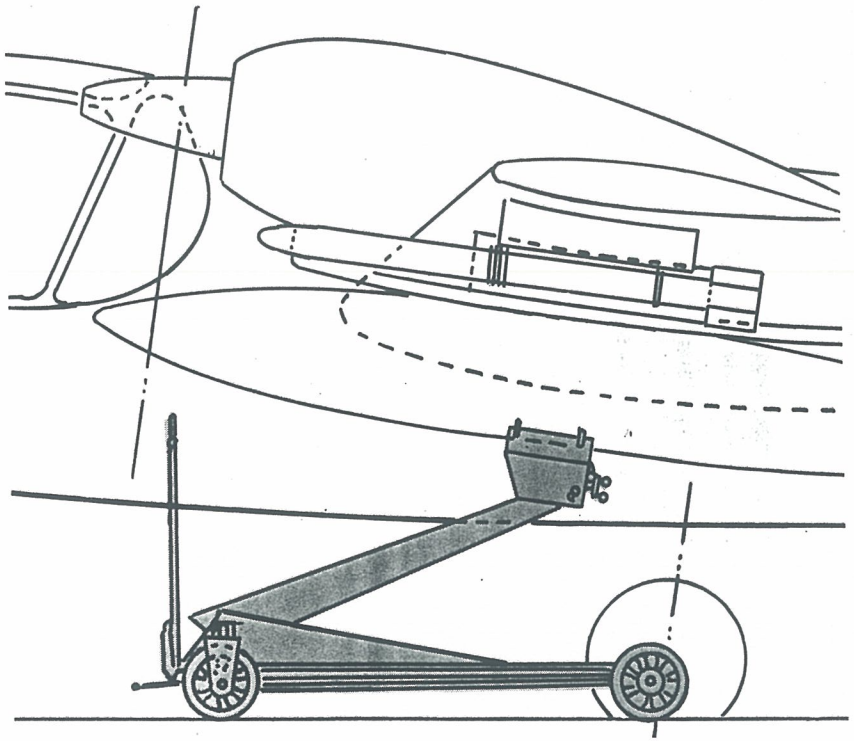
External store release is manually controlled by the pilot by use of a release button on the control column. The sight unit is a MK-17 Mod. 0 into which lead angle is pre-set.

All stores are selected and armed from the armament control panel in the cockpit for normal operations. The emergency release handle opens the Aero 65A bomb rack hooks mechanically and simultaneously fires the Aero 15 or Aero 25 racks electrically.

During photo reconnaissance missions, flare drops are controlled from the camera control panel in the cockpit. Flares may be pulse dropped individually or salvoed using the cockpit controls.

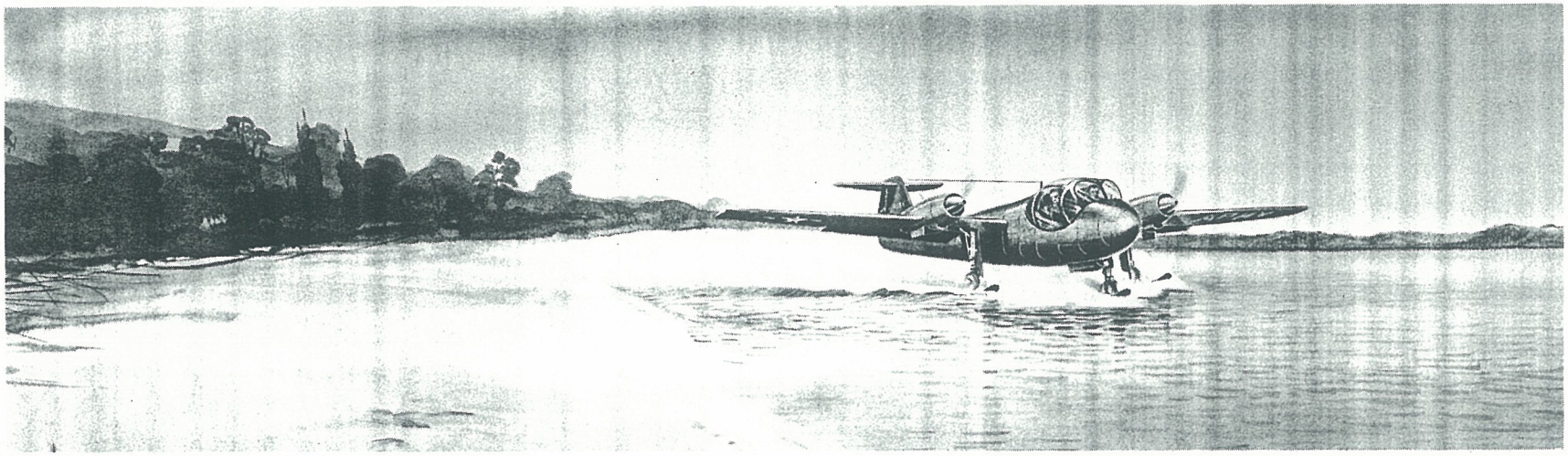
Any specified store can be installed on any station with a MK-8 Mod. 0 Portable Bomb Hoist or a MK-6 Mod. 0 Bomb Lift Truck. The Aero 23B or Aero 33A lift trucks can also be used.





Pantobase operations are facilitated by skis which enable the OF-1 to land and take-off from unprepared fields, mud, snow, and water. With the exception of water operations, the technique for landing on all surfaces is the same. At initial touchdown, the skis trim from 10 degrees bow up to whatever angle the ground line makes with the airplane. A small rubber wheel on the trailing edge of the skis protects the ski bottom when landing on hard surfaces. If the terrain consists of mud or snow, the skis bear the load of the airplane and the tires protrude through the bottom, permitting a certain amount of wheel braking. Freezedown on snow can be combated by a combination of asymmetric thrust and manual rocking of the airplane. Piling up of snow and mud on the top of the main skis is limited by deadrise and forebody warpage on the skis. Low speed maneuvering on snow and mud is performed with asymmetric thrust and aided by transverse curvature on the bottom of the nose ski which lets it slide laterally over the snow.

To effect a water take-off from a beach or ramp of any slope up to the maximum of 6 to 1, the pilot enters the water at a speed in excess of 20 knots. The skis move to the full up-trim position because of the center of pressure location, and lock there automatically. The pilot then accelerates and takes off. Maneuvering on the water should be done at a speed greater than 30 knots to assure adequate propeller water clearance. To land, the skis are locked in up-trim, and a normal touchdown is made. The airplane is taxied close to the beach and the skis moved to free-to-trim for the water exit. If water stall or engine failure causes the airplane to settle into the water, adequate buoyancy is provided in the fuselage and wing to float the airplane in sheltered water until salvage can be accomplished.



Space provisions have been made for the following:

Doppler Navigation System AN/APN-78

The APN-78 is a small lightweight automatic Doppler Navigation System. Present position, course to destination, and distance to destination are available automatically. This relieves the pilot of the task of continually navigating. The system operates from zero altitude and zero velocity to the full capabilities of the aircraft. A single, fixed, dielectric lens antenna is used for transmitting and receiving. The transmitter is an interrupted C-W type providing the principal advantages of both the C-W and pulse type systems.

F-5 Automatic Pilot

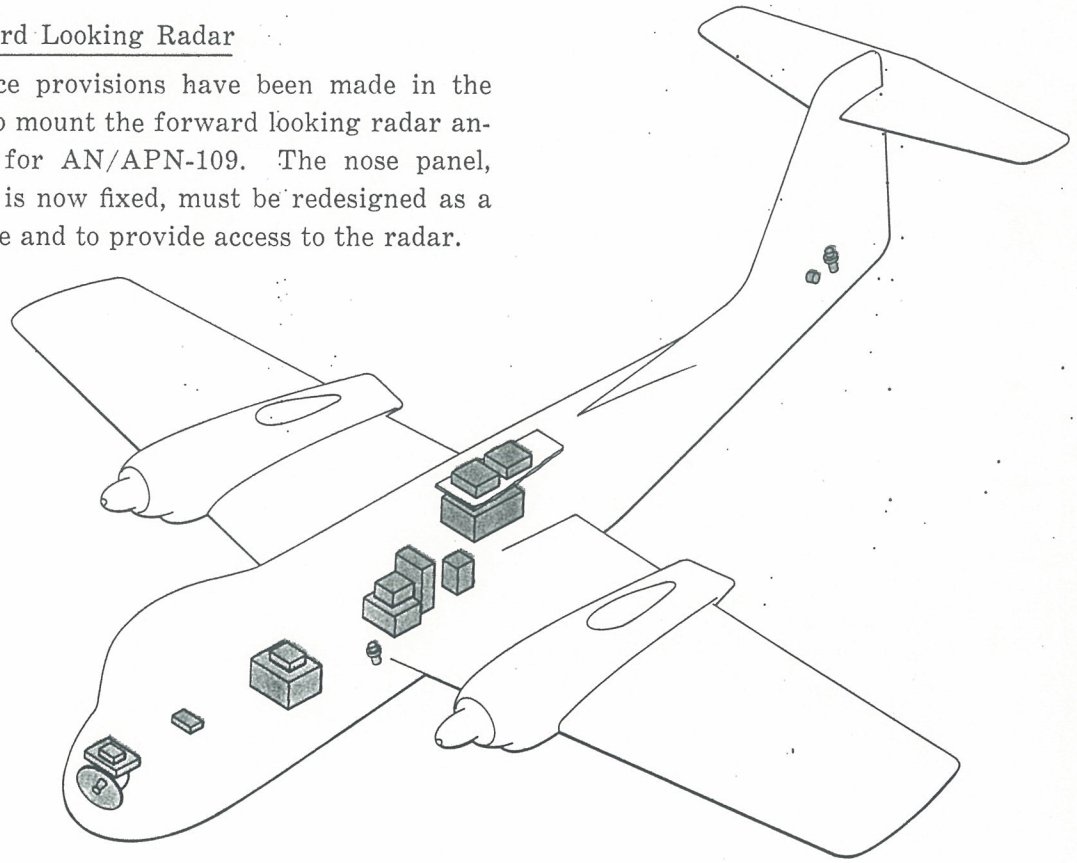
The Lear F-5 automatic pilot is an electromechanical servo mechanism providing three-axis attitude stabilization and command maneuvers. Operational features are: automatic pitch trim, automatic heading control, command maneuvering control in pitch and turn, roll attitude trim, and substantially coordinated turns in all flight conditions. Space provisions for the various auto-pilot components, such as servos, amplifiers and cockpit control panel, have been made in the basic design of the OF-1.

Television Camera and Recording Equipment

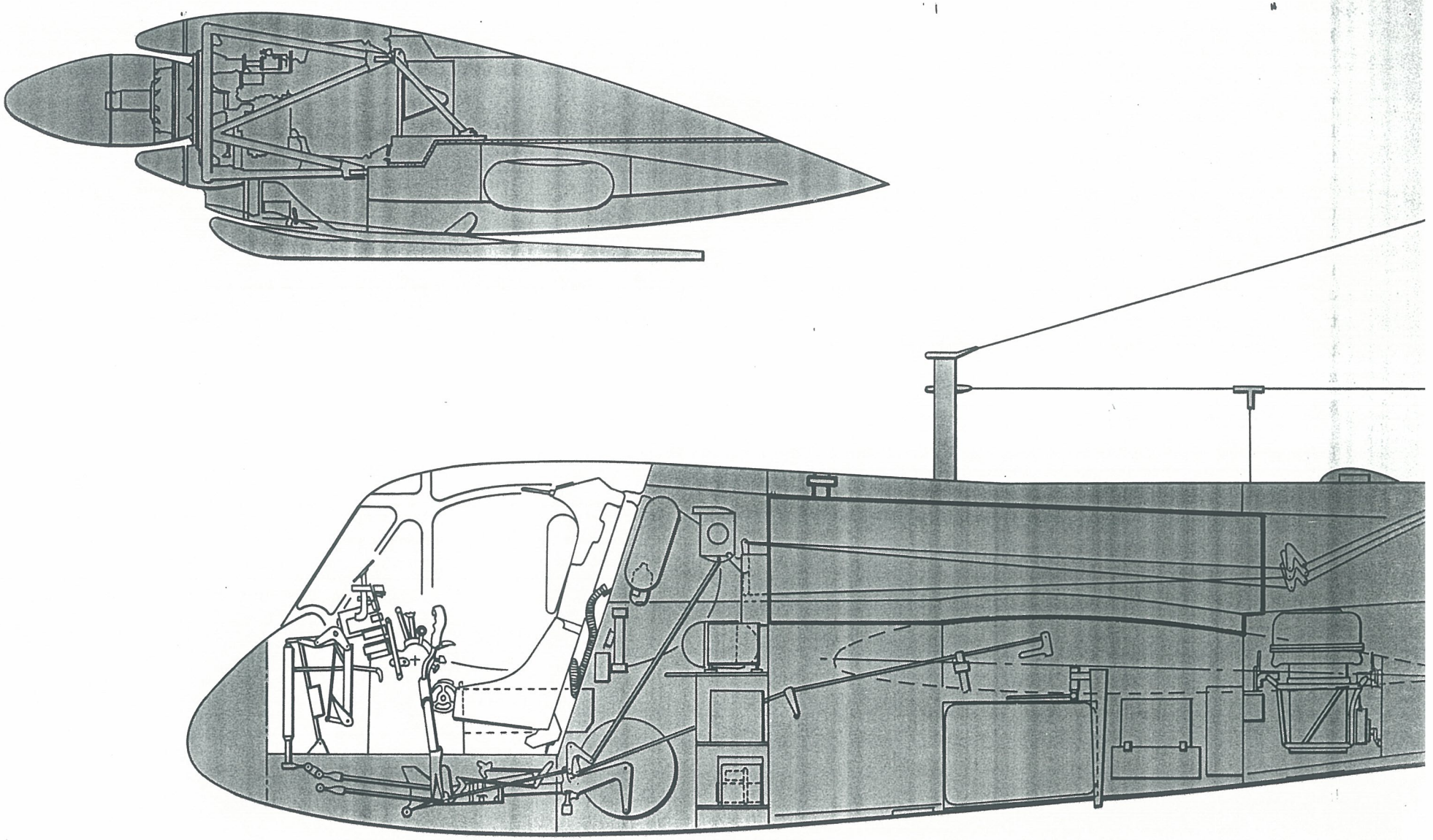
Space provisions have been made in the lower fuselage mid-section for a television camera, recorder, and transmitter.

Forward Looking Radar

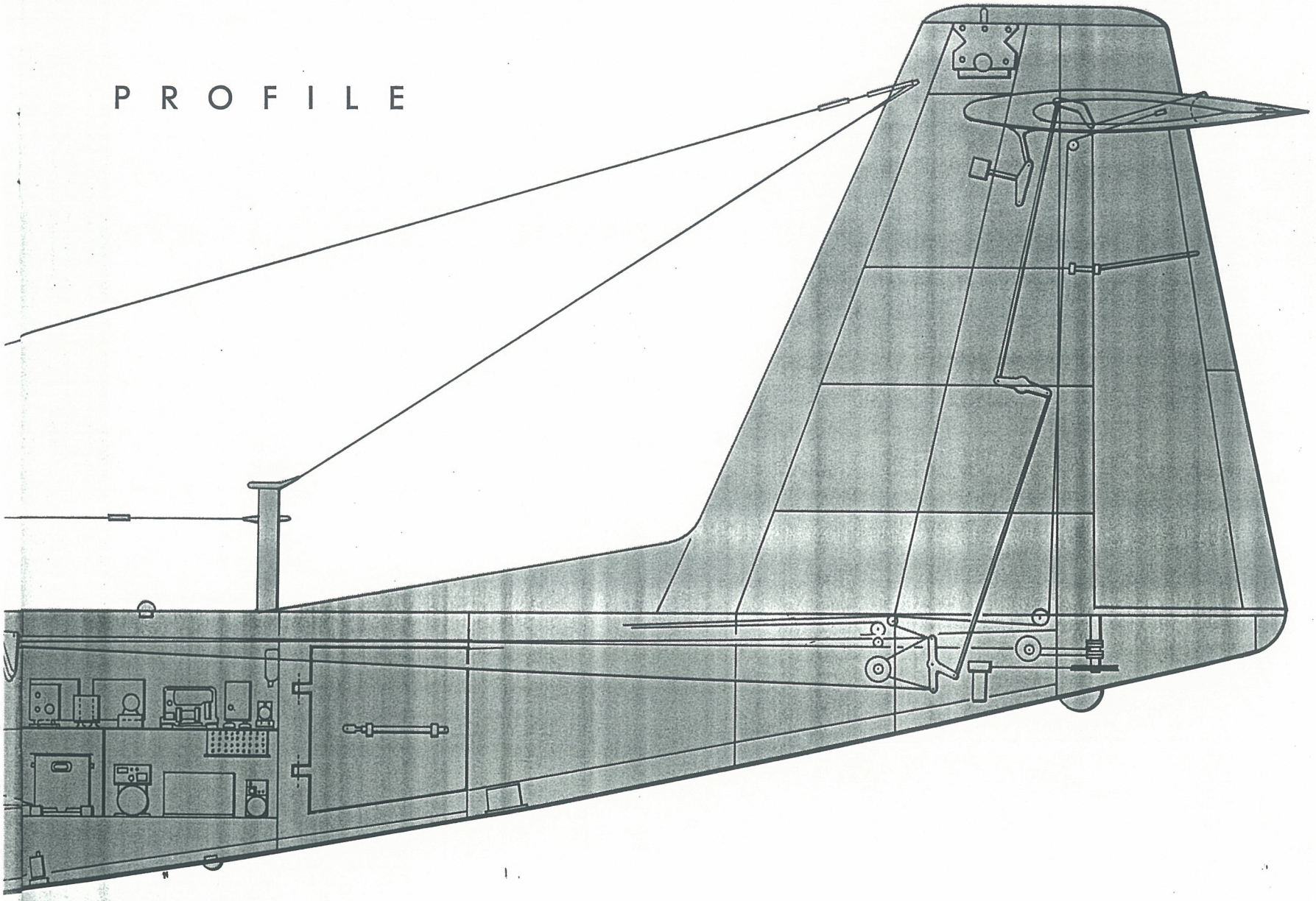
Space provisions have been made in the nose to mount the forward looking radar antenna for AN/APN-109. The nose panel, which is now fixed, must be redesigned as a radome and to provide access to the radar.



INBOARD



PROFILE



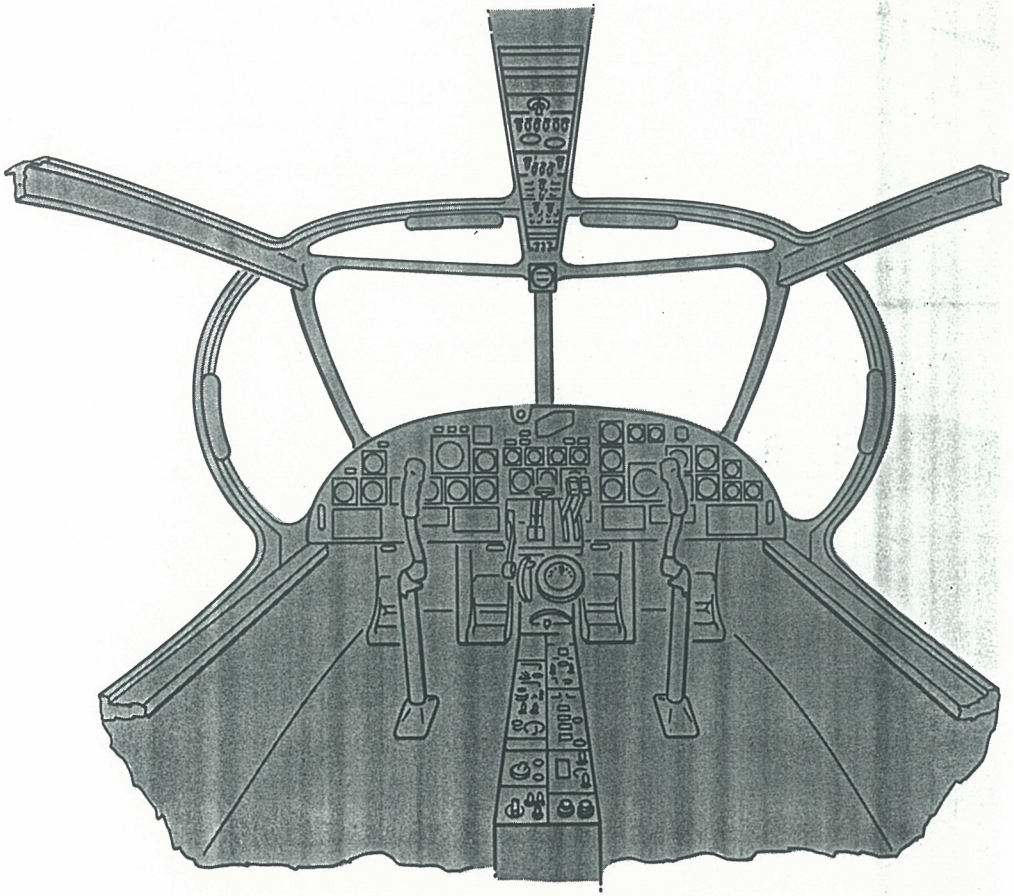
Crew Compartment

Maximum utilization of available cockpit space has been obtained by adhering to recommended human factor considerations for both efficiency and comfort. A low profile instrument panel (made up of the pilot's, center, and observer's panels) is sloped 15° forward of vertical. The tilt eliminates partial blocking of the instrument faces by their own bezels and improves pilot instrument visibility. Flight instruments are duplicated for the pilot and observer and have been arranged to conform as closely as possible to the recommendations of the Aircraft Station Standardization Panel. Engine control instruments are grouped in the center panel. This allows both pilot and observer to monitor the engine instruments with ease. Regulators for the gaseous oxygen system are located on the outboard side of the pilot's and observer's instrument panels. This system is composed of two 514 cu. in. O_2 bottles and the two instrument panel regulators with the associated piping.

A central pedestal provides one set of control levers equally accessible to both pilot and co-pilot. The location of the levers allows a man of any stature down to the 5 percentile man, as defined in WADC TR52-321, to reach them comfortably. All trim controls may be readily reached by either the pilot or observer. The arrangement of the control pedestal also enables the pilot to fly the aircraft solo. A newly designed stick grip allows for interchangeability between the left and right control sticks.

Two adjacent standard consoles between the pilot and observer house the necessary communications, navigation and photographic panels. The overhead console provides for all the engine, fuel and electrical master panels with special consideration given to the location of the engine emergency panel which contains the engine fire extinguishing switches.

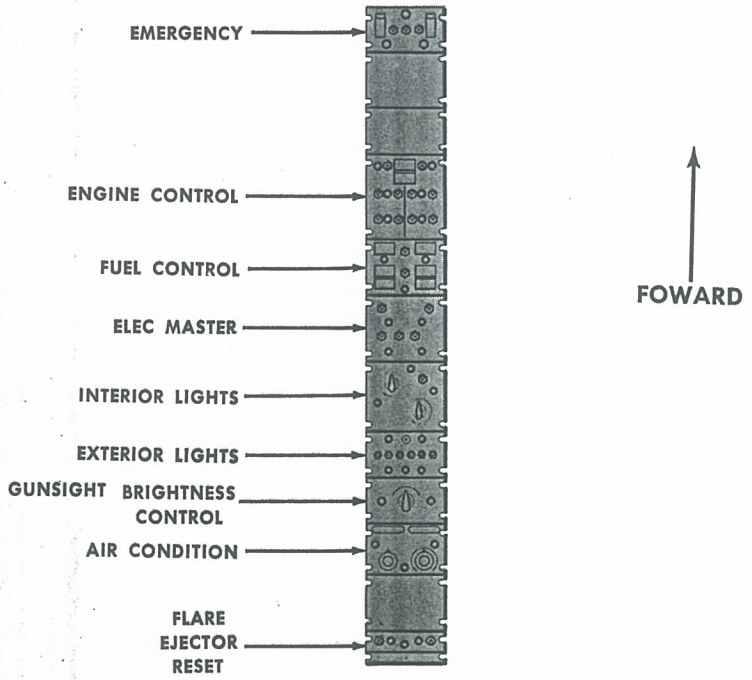
In the event of a casualty, a first aid kit is mounted on the sloping bulkhead and is readily accessible to the pilot. The bulkhead also supplies stowage for the pyrotechnic pistol, binoculars, a spot light, and mounting of important circuit breakers.



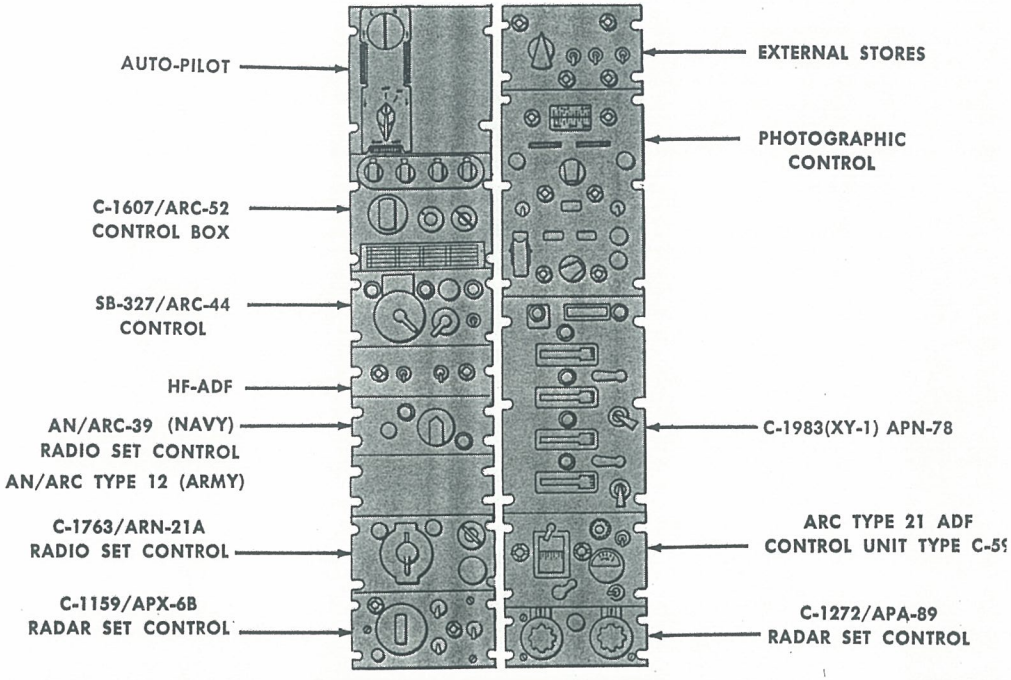
COCKPIT ARRANGEMENT

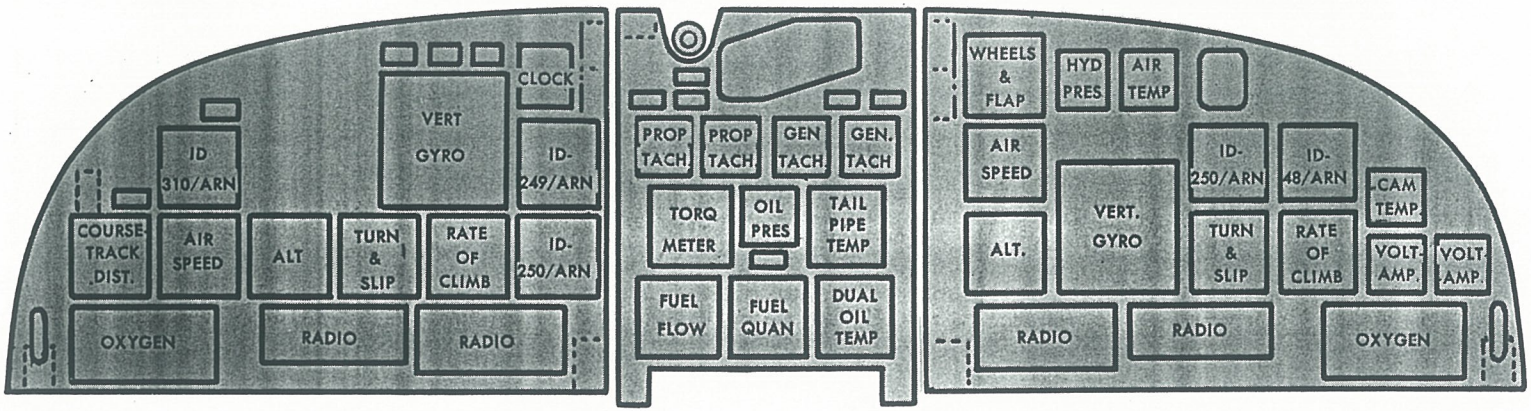
Crew Compartment

OVERHEAD CONSOLE



LOWER CONSOLE

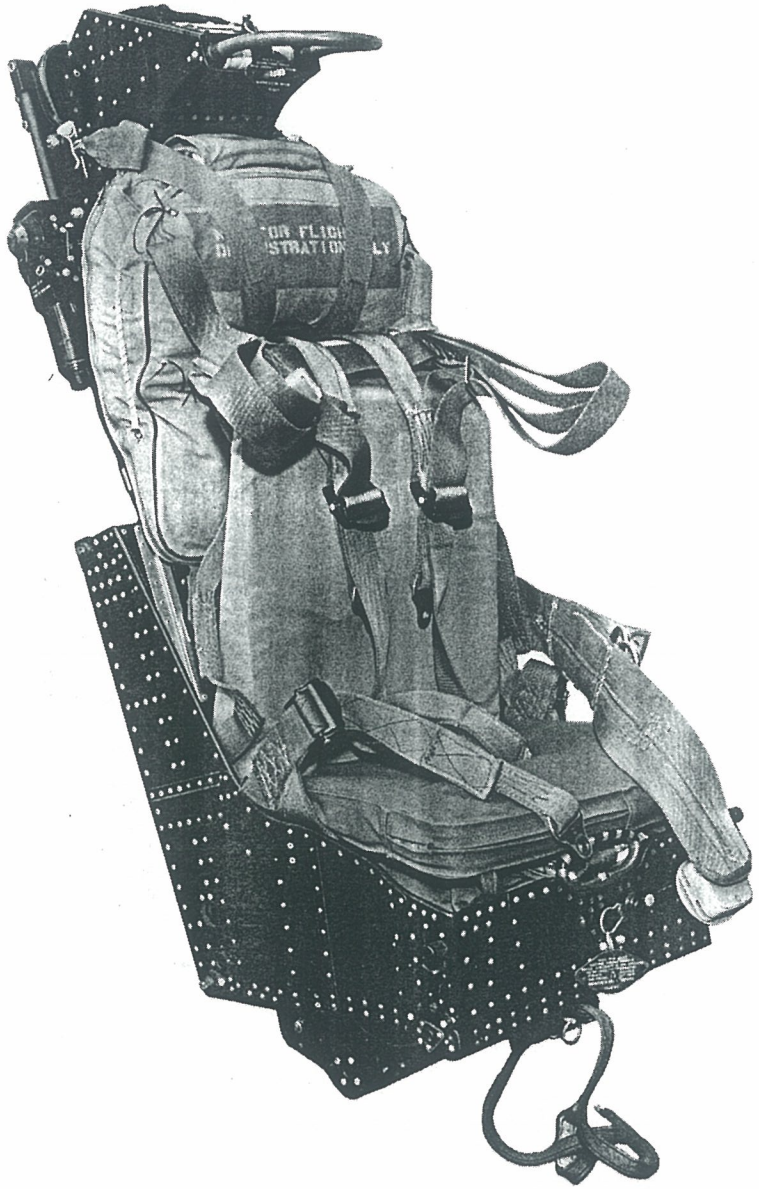




INSTRUMENT PANEL ARRANGEMENT

Crew Compartment

MARTIN BAKER SEAT



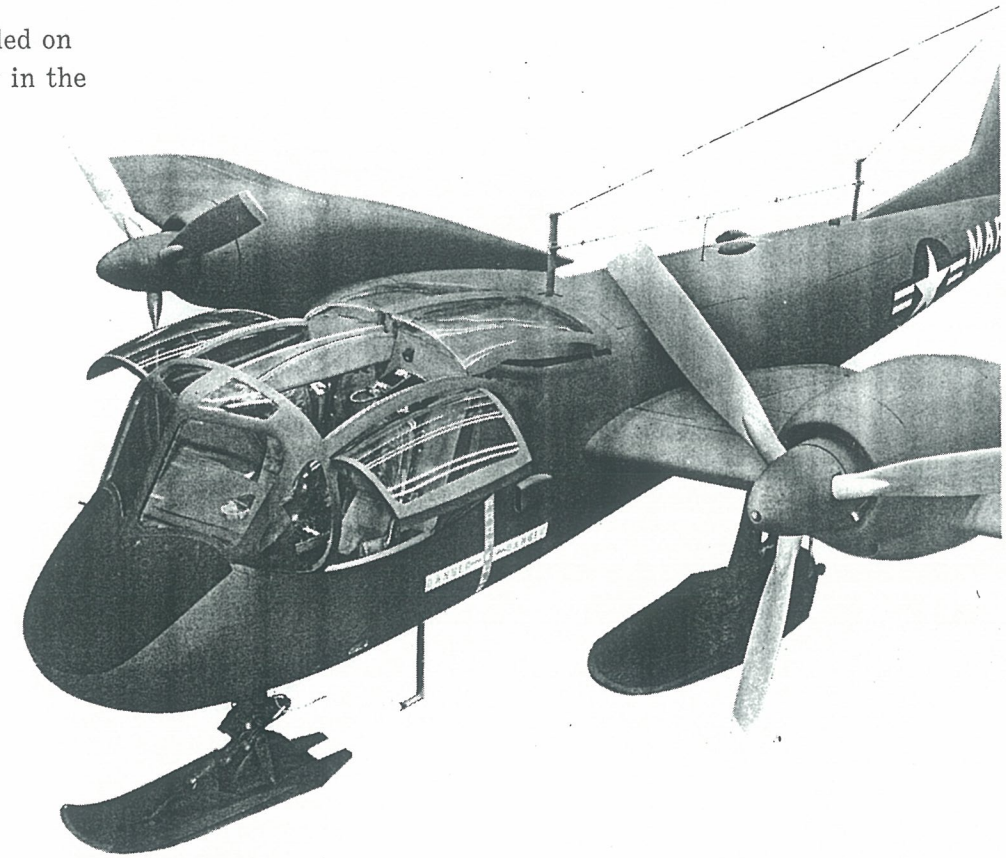
A Martin Baker designed seat is provided to give safe escape at altitudes within the range of the aircraft and speeds ranging from 60 knots to 450 knots. After ejection, the parachute will deploy automatically and lift the occupant from the seat. If an ejection is made at high altitude, a barostatic control, attached to the seat, delays the opening of the main parachute and separation of the occupant from the seat. This is in order that the occupant may descend quickly through the cold rarified atmosphere, strapped in his seat and steadied by the duplex drogue parachute, to a more tolerable altitude where the automatic mechanism operates. At very high ejection speeds the opening of the parachute is delayed by a "G" switch until safe deployment speed is reached. Although the seat is fitted primarily with face curtain firing control, an alternative firing handle is also positioned in the leading edge of the seat pan. A well proven time fired drogue gun and harness release mechanism with barostatic monitor is employed. A low peak acceleration and an exceptionally high trajectory are obtained through use of a telescopic ejection gun. The main parachute is stowed in a "horseshoe wedge" shaped pack behind the occupant's shoulders and is combined with a back pad and harness system compatible with an integrated torso suit. Bail-out oxygen is automatically actuated on ejection with the supply bottle mounted on the seat structure. Vertical adjustment of 5 inches as required by Specification MIL-S-18471(Aer) is accomplished by electrical actuation of the seat bucket. The seat is designed to accept a high speed PK-2 container and an energy absorbing type seat pan.

NORMAL, EMERGENCY AND JETTISONING PROCEDURES

To eject, the occupant need only pull the face curtain or the alternate firing handle on the leading edge of the bucket. This action pulls two sears, one on a cartridge actuated device for initiating the canopy emergency opening system and the other on the catapult gun. An interlock system prevents firing of the catapult gun until the canopy is clear of the ejection envelope. In event that the canopy is damaged and will not open, an emergency arming handle will allow ejection through the canopy. A frangible bow has been provided on the overhead hatch to permit safe ejection through the canopy in the event it becomes jammed in a partially open position.

Normal access to the cockpit is obtained from either side of the aircraft, through the hinged side hatches. An extensible step, automatically actuated by a covered foot hole, is installed on each side of the fuselage.

Both sliding overhead hatches are manually operated and may be opened independently. Each slides aft a distance of 18 inches. For ejection, the hatches are power driven clear of the ejection envelope.

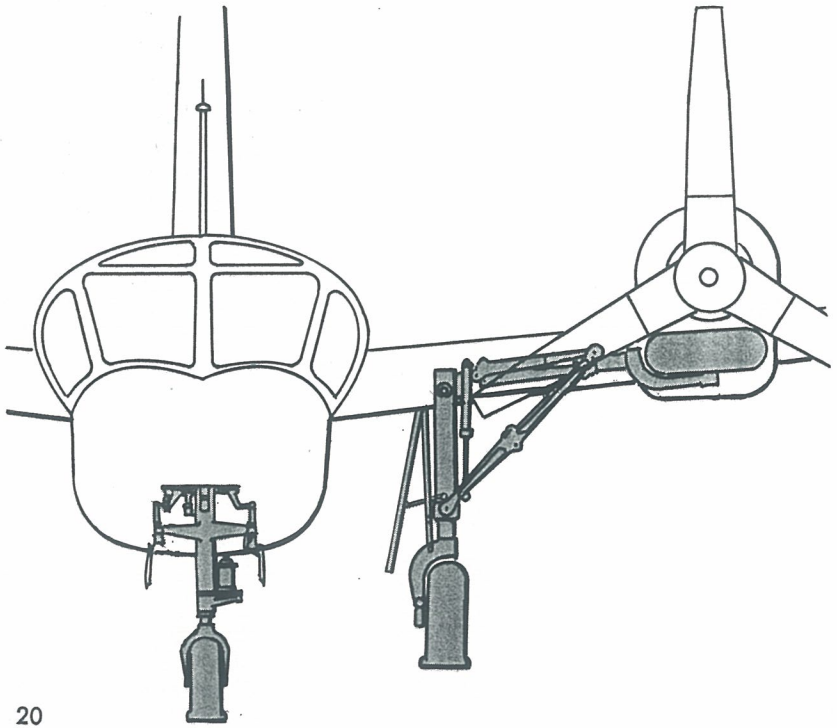


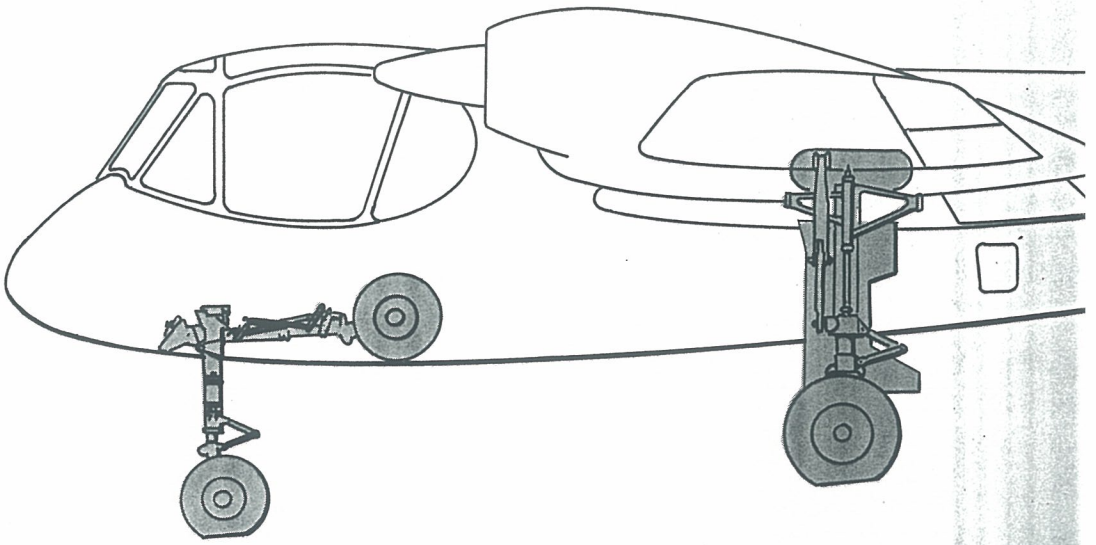
WHEELS

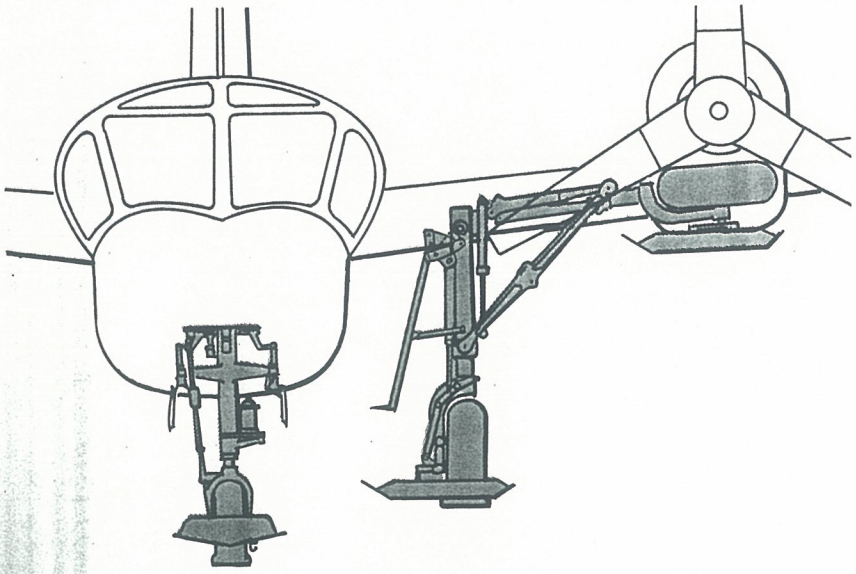
The OF-1 has a conventional tricycle landing gear with pneudraulic shock struts. A rubber bumper tail skid is also provided. Both nose and main gear struts are fitted with low pressure tires which provide excellent ground flotation characteristics for operation from unprepared fields. U.C.I. (Unit Construction Index) values of 10 or lower have been calculated for static rolling loads without skis.

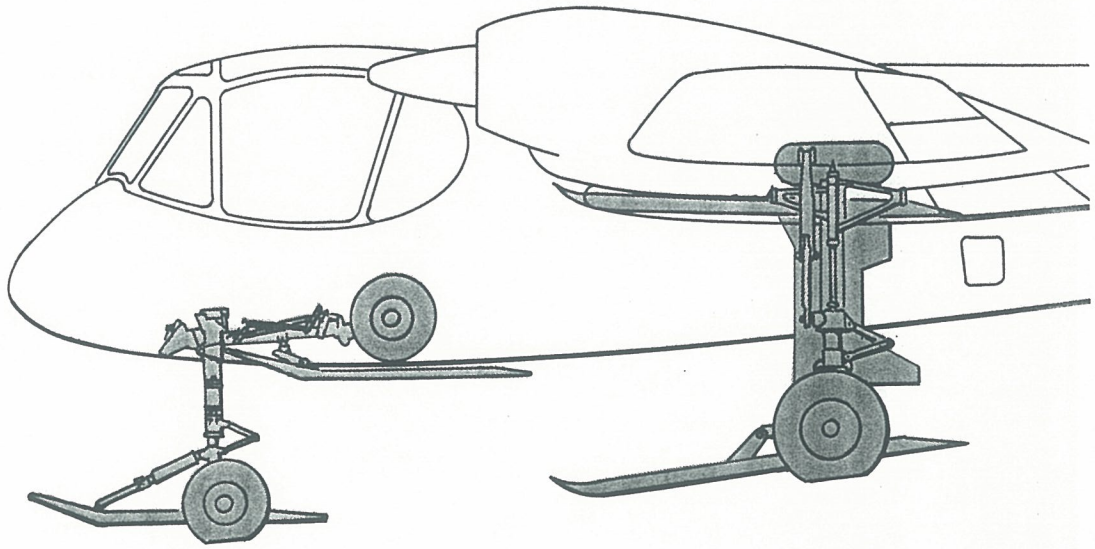
The main gear consists of a simple, cantilevered pneudraulic shock strut which is supported between the center and rear beams in the wing center section. This arrangement permits the fuselage to be rolled about on the gear when the outer wing panels and nacelles are removed. Both left and right hand shock struts are interchangeable. An oleo shrink rod is provided for shortening the gear during retraction, permitting the gear to be housed within the wing in the engine nacelle. The nose wheel is mounted on a fork and spindle which may swivel through 360°, thus facilitating ground handling of the airplane.

Nose and main gear retraction and extension are accomplished hydraulically with mechanical up and down locks.

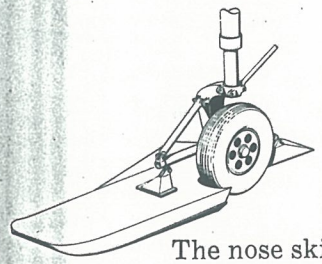








SKIS



Both nose and main landing gear have provisions for mounting planing skis, which will permit operation from sheltered water, snow, ice, mud, and soft natural terrain, as well as from prepared runways.

The nose ski installation consists of a planing ski, a hydraulic trim cylinder and a synchronizing retracting cylinder. All components are readily installed. The ski is hydraulically locked nose up for a water landing and is free-to-trim when landing on other surfaces. The synchronizing cylinder maintains the ski in a streamwise attitude while the gear is being retracted or extended and properly fairs the ski to the fuselage contour when the gear is fully up. The ski closes the nose wheel well opening. When the ski is removed, nose gear doors must be installed.

Each main gear ski installation consists of a planing ski, a hydraulic trim cylinder and a ski support scissors linkage operated by a slide tube. When the ski installation is used, the main gear doors must be replaced by another door and fairing. All these components are readily removable.

For water landings, the ski is hydraulically locked nose up and is free-to-trim when landing on other surfaces.

As the gear retracts, the strut shrinkage operation simultaneously imparts motion to the ski scissors linkage and rotates the ski so that it remains essentially horizontal. It is raised with the gear and fairs into the nacelle contour when the gear reaches the full up position.

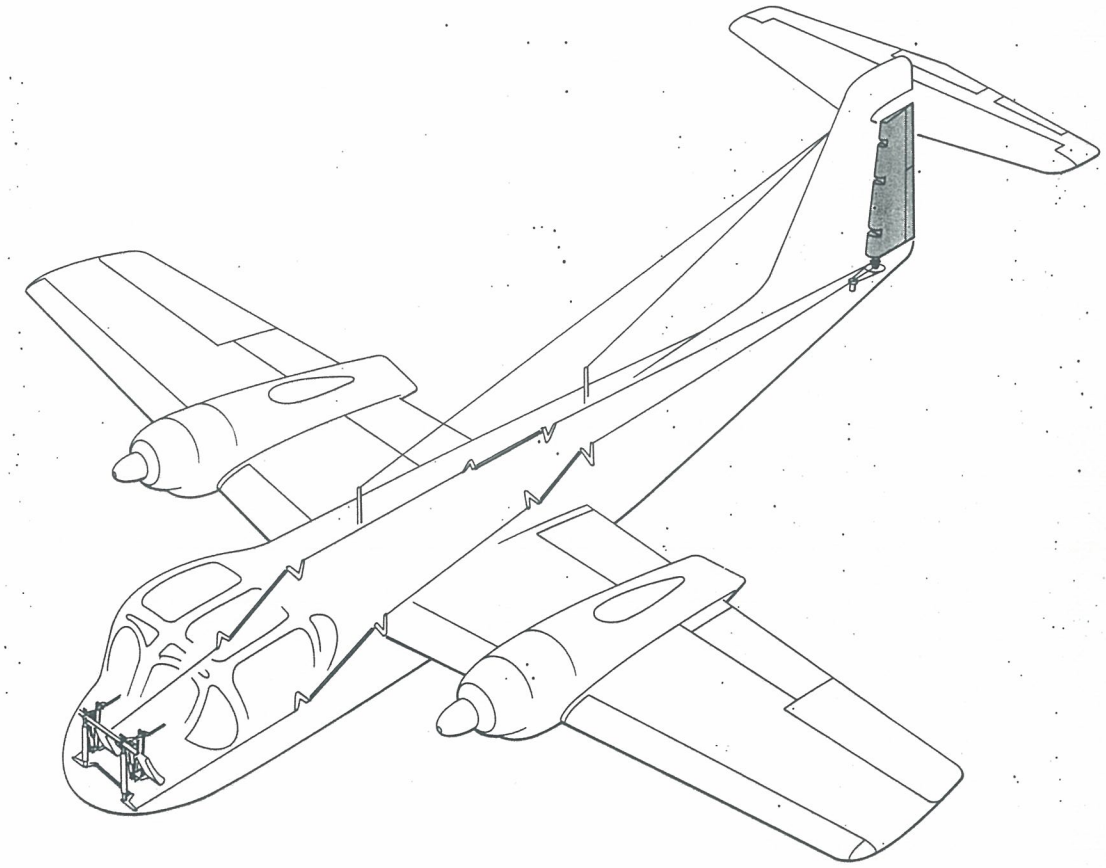
DIRECTIONAL

Conventional pedals at the pilot and co-pilot stations control the rudder through a simple mechanical system consisting mainly of cables used as tension members between cranks. Each set of pedals incorporates a mechanism for adjusting both pedals simultaneously.

Pilot control forces are reduced by the use of a geared tab on the rudder.

Movable rudder stops, mechanically operated by the flap actuating mechanism, are used to obtain additional surface deflection for single engine conditions.

A built-in gust lock system, controlled by a handle in the cockpit, is provided. When engaged, the handle blocks the throttle levers to prevent take-off with the gust lock engaged. Locking is accomplished at the rudder torque tube through a latch which engages a pin on the torque tube arm. Duplicate safety springs will disengage the latch in the event of failure of any system component.



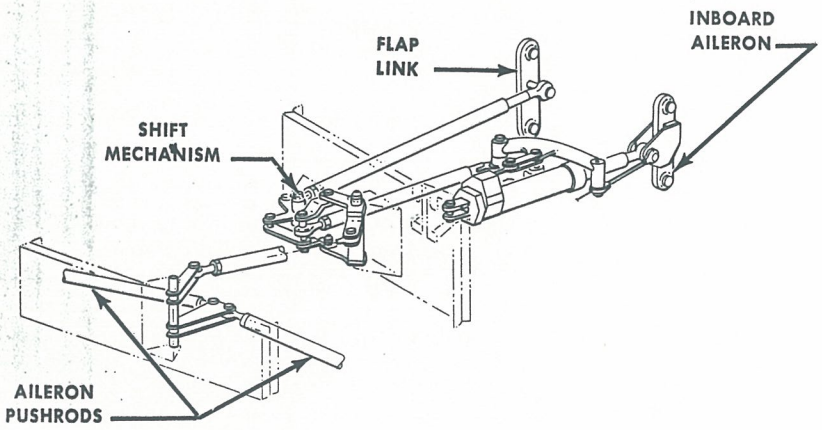
LATERAL

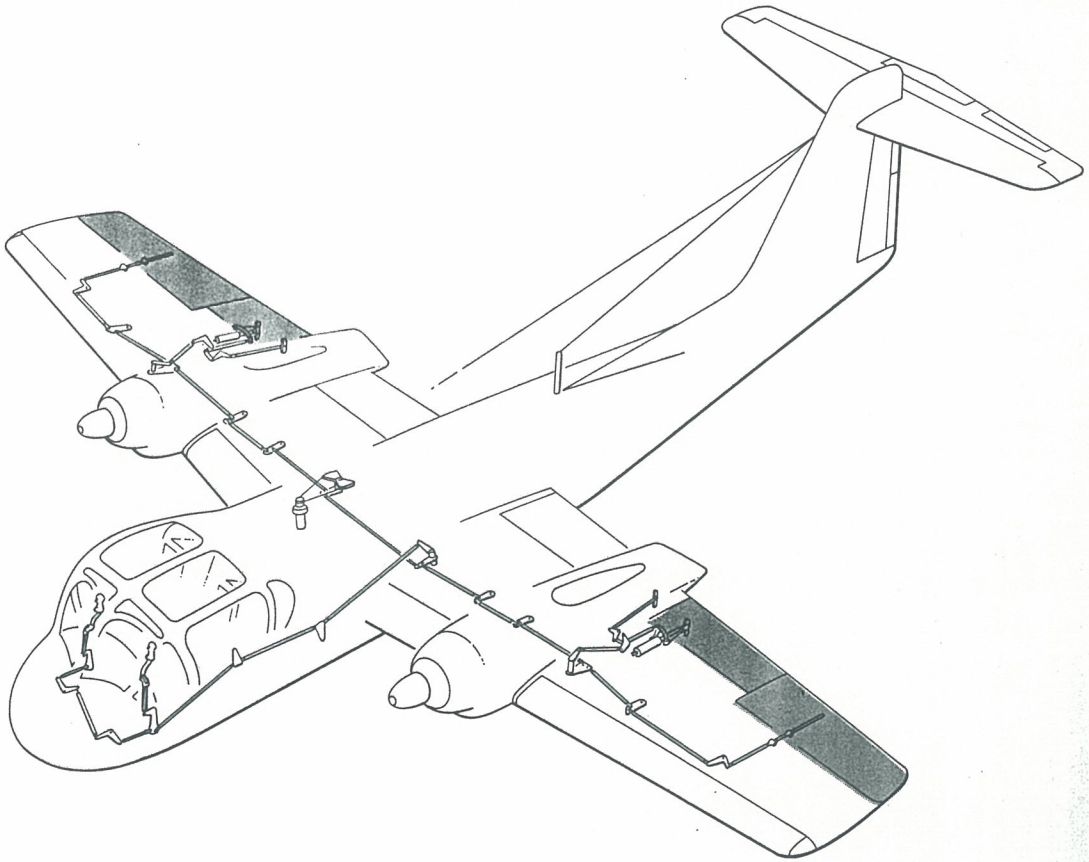
Control sticks at the pilot and co-pilot stations are mechanically connected to aileron spring tabs through a pushrod system arranged to provide a direct mechanical connection between both ailerons.

Separate auxiliary surfaces (inboard ailerons) on each wing are used to provide additional power for single engine conditions. Irreversible power systems are used to drive these surfaces, the power systems being linked to the basic control system only when flaps are extended. Flap motion is used mechanically to shift these power systems out of the basic control system when the flaps retract. Failure of the power actuators does not in any way limit aileron motion.

Trim control is accomplished by a manual cable and drum system controlling a tab on the left aileron only.

A built-in gust lock similar to that for the directional system is provided.





LONGITUDINAL

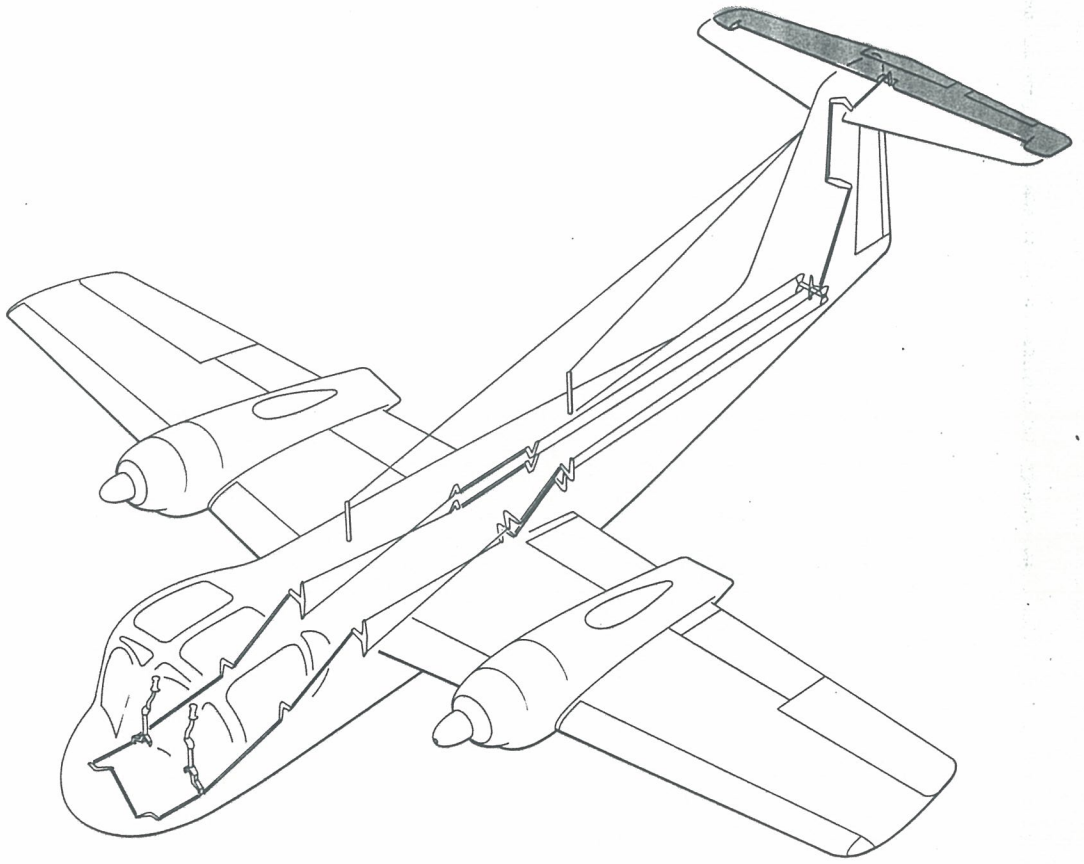
Conventional control sticks at the pilot and co-pilot stations control the elevator through a simple mechanical system, consisting mainly of cables used as tension members between cranks. Pulleys and sectors are avoided to keep friction to a minimum. Two independent systems are run the full length of the fuselage.

Pilot control forces are reduced by the use of aerodynamic balance and a geared tab on the elevator.

Trim change from flap operation is held to a minimum by varying the stabilizer angle of attack by means of an irreversible screw-jack actuated by a cable system driven by the flap actuating mechanism.

Trim control is accomplished by a manual cable-and-drum system controlling a trim tab in the elevator.

A built-in gust lock similar to that for the directional system is provided, locking the basic control system at the aft end of the fuselage.



WING SLAT ACTUATING MECHANISM

The wing slats are arranged in four mechanically interconnected sections along the wing span. Equipped with integral tracks (two tracks on each inboard section and three on each outboard) the slats move on fixed supporting rollers in the wing. Motion from a hydraulically actuated mechanical linkage, located along the forward wing beam, is transmitted through right angle gear boxes to the slats. Each slat section has two gear boxes located at track stations near its ends.

Control for the slats is integral with the wing flap control and the slats are operated through their full range of motion with flap travel from 0° to 25°.

WING FLAP ACTUATING MECHANISM

Each flap is supported and guided in motion by two pairs of swing links situated near the flap ends. Motion is imparted by a torque tube extending from one inboard link to a hydraulically actuated linkage in the fuselage This linkage both drives and interconnects the flaps.

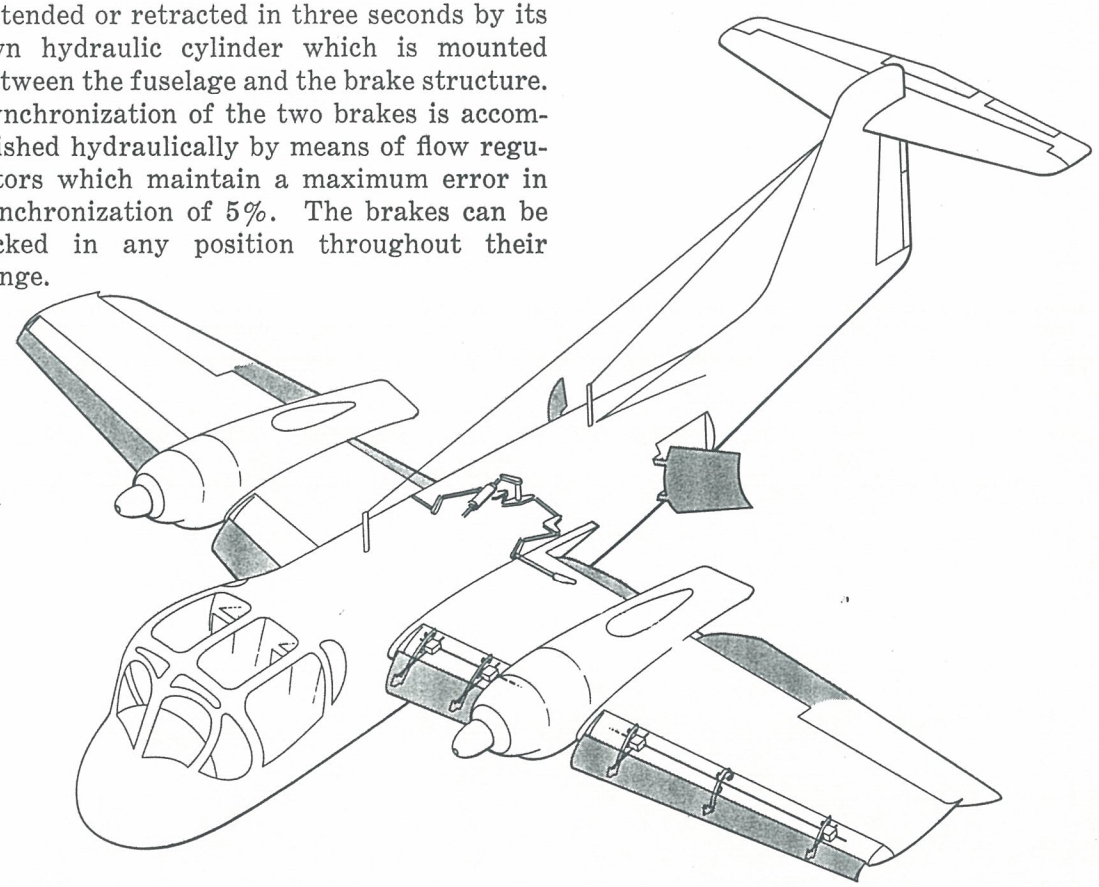
At the outboard end of each flap, a pushrod is attached to operate the inboard aileron shift mechanism.

Three positions of flap extension (0°, 25°, 45°) may be selected through a follow-up system between the pilot's control and actuating cylinder. A lock for the 0° position is incorporated in the cylinder.

The flap mechanism provides a sector driven through a jack shaft by the flap actuating cylinder for stabilizer trim and positioning of the rudder stops. The sector drives, by means of cables, rudder stop cams and an irreversible actuator for stabilizer trim. Both are fully operated within the first 25° of flap extension.

SPEED BRAKE ACTUATING MECHANISM

The two speed brakes are located in the aft section on the side of the fuselage and swing around vertical hinge lines. Each is extended or retracted in three seconds by its own hydraulic cylinder which is mounted between the fuselage and the brake structure. Synchronization of the two brakes is accomplished hydraulically by means of flow regulators which maintain a maximum error in synchronization of 5%. The brakes can be locked in any position throughout their range.



The power plant of the OF-1 airplane consists of two Lycoming T-53-L-3 turbo prop engines installed in nacelles above the wings.

The Lycoming T-53-L-3 features a single stage free-type power turbine, combination axial-centrifugal compressor driven by a single stage turbine, and an external annular vaporizing combuster.

The propellers installed on the OF-1 are C.F.E. Hamilton Standard Hydromatic propellers, three-bladed, 10 feet in diameter. These propellers have the features of variable pitch, full feathering, reverse pitch and synchronizing and synchrophasing.

The engines each have a take-off rating of 960 shaft horsepower and approximately 100 pounds of jet thrust at a gas producer speed of 26,390 RPM and a propeller shaft speed of approximately 1678 RPM. The gear ratio between the power turbine and propeller drive is 12.46:1.

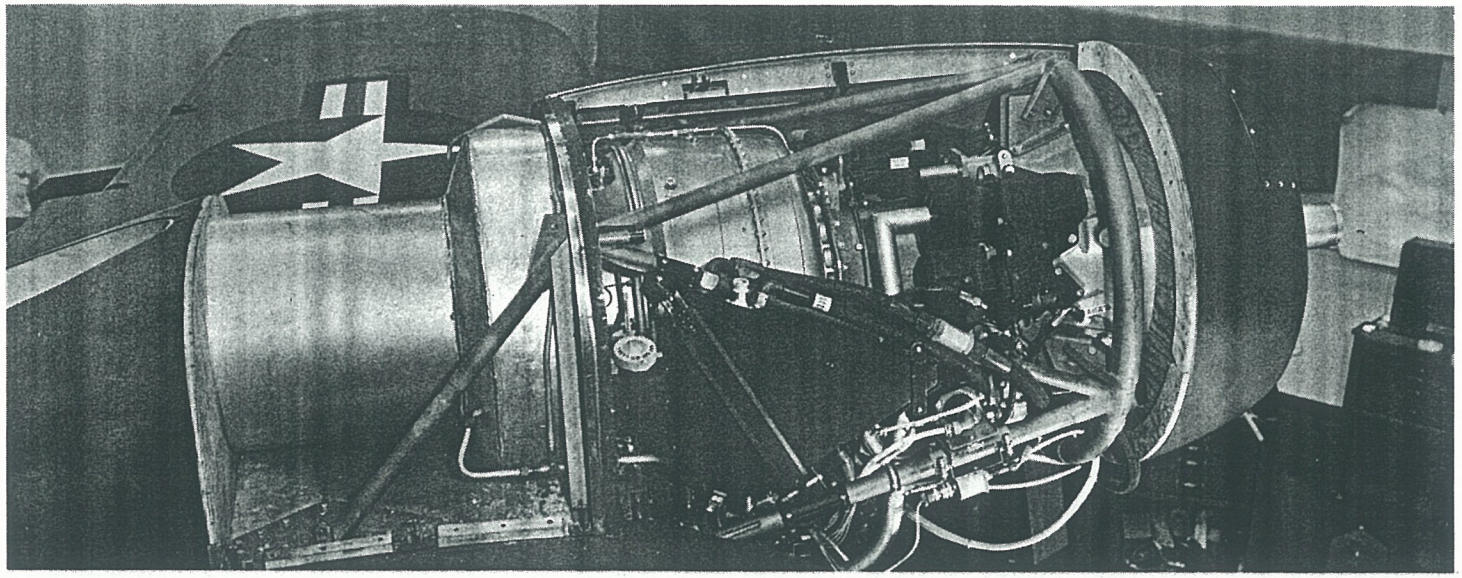
Anti-icing of the engine is accomplished by passing hot compressor bleed air through the engine inlet struts and inlet guide vanes.

The engine nacelle is arranged to provide easy access to the engine, controls and accessories. The two side cowl panels will hinge up and the lower panel will hinge forward, thus providing 360° of accessibility. The lower panel contains the oil cooler, oil cooler ducts and the thermostatically controlled oil cooler flap.

The fireseal and shroud have been designed to permit inspection of the hot section of the engine without removal of the engine from the aircraft. All fuel control adjustments are easily accessible. Although screens are not shown in the installation, space is available for screen installation if necessary.

The whole power plant package, which includes propeller, engine accessories and engine mount with vibration isolators, can be moved as one unit if desired and is inter-changeable between left and right wings.

In addition to the gear box, which mounts a starter-generator on the lower portion of the engine, a contractor furnished gear box is provided in the upper right-hand quadrant, mounting a hydraulic pump and an air turbine starter.



STARTER

There are two methods for starting the engines in the OF-1 airplane. These are an air turbine starter, supplied with low pressure air from a ground gas turbine compressor, and a starter-generator used with aircraft contained batteries or ground external power. The starter-generator starting is only for starting the engine in the event of flame-out during flight. The air turbine starter is used for all normal ground starting.

The installation of both the air turbine starter and starter generator is being studied and, at some time in the future, it may be possible to eliminate the air turbine starter and use only the starter-generator for all starting requirements.

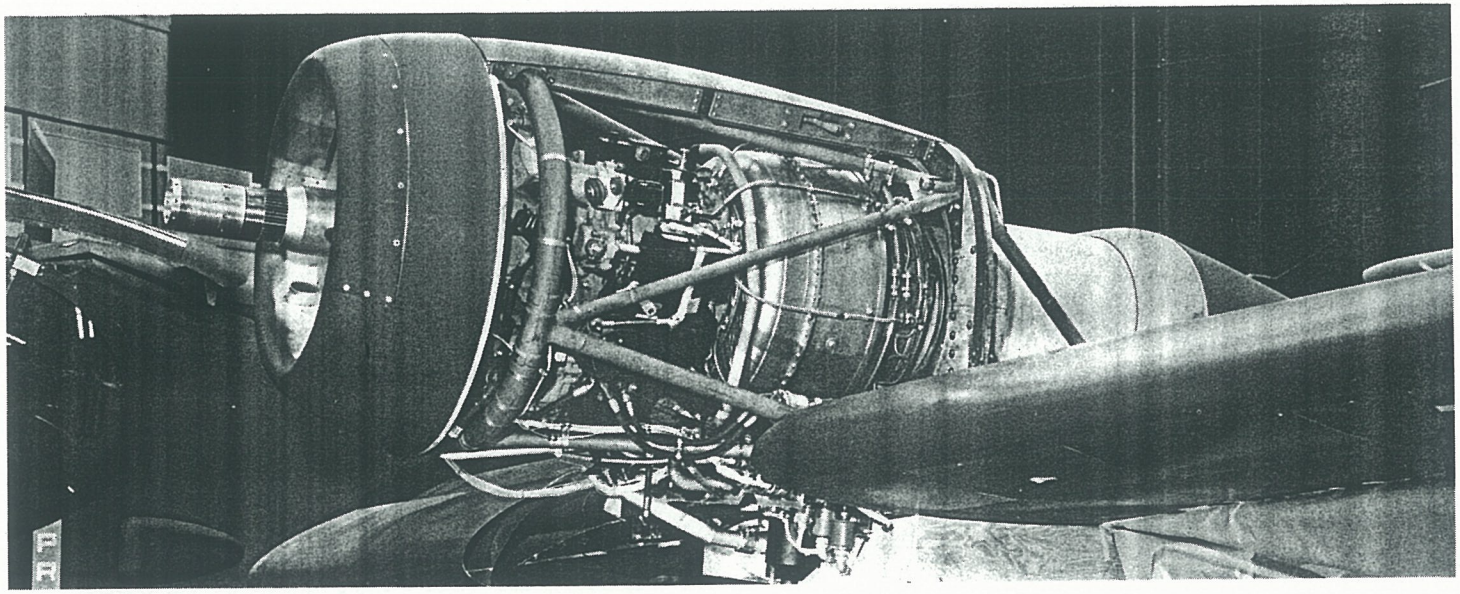
TEST STAND

Installed Engine Test Program

Before first flight on the OF-1 aircraft, tests will be conducted on a complete operating engine nacelle. This nacelle, with engine and propeller, will be mounted on a wing section simulating the actual aircraft installation. The test program will establish the engine environmental conditions, determine the adequacy of the engine oil cooler, nacelle vents, and the magnitude of any structural heating during ground run up.

Since the tests will be run with an operating propeller and spinner installed, the effects of these components and the inlet on engine operation can be determined. Distortions of the engine inlet pressure profiles, determined from inlet wind tunnel tests, can be simulated on the test rig by partial blockage of the inlet. Dynamic tests of engine acceleration will determine if any adverse operational problems of the engine/propeller control exist.

This test program will enable Grumman shop personnel to become acquainted with the aircraft propulsion system.



FUEL SYSTEM

The fuel system on the OF-1 aircraft is designed for simplicity and reliability. All fuel is contained in one internal 256 gallon tank and two external 150 gallon tanks. The main tank is self-sealing. The external tanks are standard Douglas drop tanks.

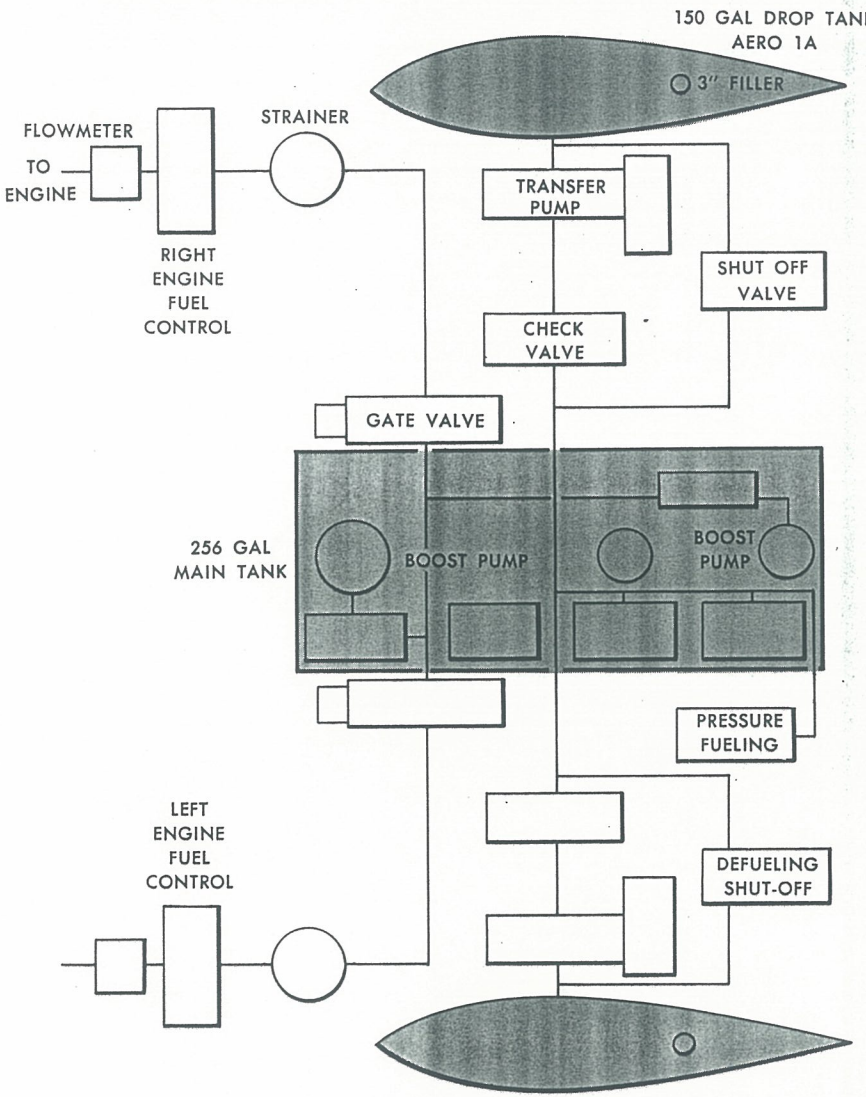
All tanks may be fueled through 3 inch gravity filler units, one at each tank, or by single point pressure fueling. Complete operation of the pressure fueling system, including selective filling or shut-off pre-check on all tanks, can be accomplished at the pressure fueling station. Float switches in the drop tanks and a pilot valve in the main tank control automatic shut-off in all tanks. The pressure fueling adapter provides for defueling of all tanks. For drop tank defueling, fuel must be first transferred to the main tank. This can be done selectively at the fueling station by switching on either or both wing tank transfer pumps.

Fuel feed to both engines is provided by two centrifugal pumps located forward and aft in the main tank. Two pumps are necessary to provide positive fuel flow for all conditions of aircraft attitude and fuel quantity. Both pumps charge the main fuel line which feeds both engines. Each pump is capable of meeting the fuel flow requirements of both engines. Two electrically driven vane type pumps in the wings provide fuel transfer from the drop tanks to the main tank. The pilot and shut-off valves in the main tank control the flow of fuel from the wing tanks. Thus, when the transfer switch is on, the main tank remains full until both drop tanks are empty.

Cockpit control of the fuel system is provided by left and right engine master switches which control the nacelle fuel gate valves, and a fuel master switch which controls the main tank pumps and energizes the drop tank transfer system. A drop tank transfer switch is also provided. Warning lights are installed to show low pressure entering either the left or right engine high pressure pump, high pressure across either engine fuel pump and zero fuel flow when the fuel transfer switch is on.

Fuel quantity is measured by a capacitance type system indicating total fuel or fuel in each tank individually. Flow-meters indicate the rate of fuel to each engine. A cockpit reading low fuel level indicator device is contained in the main tank.

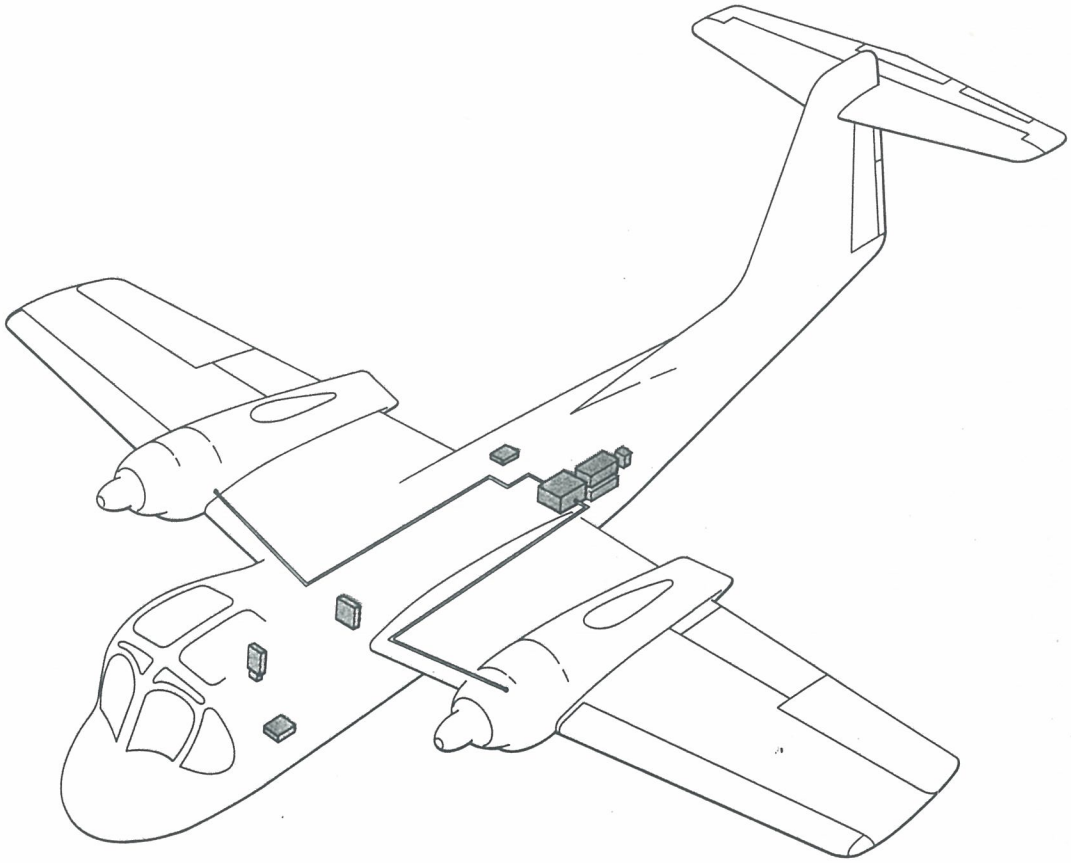
Due to the simplicity of the fuel system, pressure switches, float valves, etc., the electrical portion is not shown in the schematic drawing.



ELECTRICAL SYSTEM

The 28 volt D.C. electrical system consists of two parallel-connected 300 amp starter-generators (1 driven by each engine), two voltage regulators, two reverse current cut-outs, two overvoltage and field relay assemblies, a 24 volt 36 ampere-hour nickel-cadmium battery, and assorted relays and switches. An external D.C. power receptacle with reverse polarity protection is also included. Either generator is capable of carrying the entire load. The battery provides emergency power in the event of a double generator failure in addition to providing power for engine starting. There is a battery bus, primary bus, secondary bus and monitored bus.

The 115/200 volt, 400 cycle A.C. electrical system is supplied by 2 inverters. For normal operation, the instruments are supplied by a 250 VA inverter. All other A.C. is supplied by a 2500 VA inverter. If the 250 VA machine should fail, instrument power is supplied by the 2500 VA inverter.



Communications:

Ultra High Frequency Receiver-Transmitter AN/ARC-52

This equipment provides for operation in the frequency range of 225.0 to 399.9 MCS on any of 1750 crystal controlled channels. Remote selection of any one of 18 pre-set channels or guard channel operation thru the frequency range of 238 to 248 MCS is provided. Tone modulation of the transmitter at 920 to 1120 CPS for emergency or rendezvous purposes is also provided. Minimum transmitter power is 18 watts. Modular construction is utilized in this latest development to attain a compact lightweight replacement for the AN/ARC-27.

Very High Frequency Receiver-Transmitter AN/ARC-44

The ARC-44 equipment provides two-way voice communication over the frequency range of 24.0 to 51.9 MCS. The equipment is frequency modulated. The receiver may be used in conjunction with antenna group AN/ARA-31 to provide a homing function. Transmitter power output is 6 watts.

High Frequency Receiver-Transmitter AN/ARC-39 (Navy and Marine Corps Airplanes)

The ARC-39 equipment provides two way voice communication over the frequency range of 2 to 9.1 MCS. This band is covered by twelve crystal controlled channels. The power output is 17 watts under optimum conditions of load and frequency. A fixed antenna will be used to attain optimum system performance. Operational ranges are not limited to line-of-sight but only affected by frequency, weather and atmospheric conditions.

Very High Frequency Receiver-Transmitter Aircraft Radio Corporation Type 12 (Alternate—Army Airplanes only)

Aircraft Radio Corporation Type 12 equipment is the designation assigned to a group of radio components which may be employed to provide a variety of communication facilities. The components chosen for the OF-1 provide transmission for the range of frequencies of 116 to 132 MCS and reception for the range of frequencies from 118 to 148 MCS. The transmitter provides 5 channels in any 2 MC bands between 116 and 132 MCS The equipment is crystal controlled and voice amplitude modulated. Transmitter power output is 2 watts.

Inter Communication System	The Inter Communication System is proposed as a CFE item and will basically be of the AN/AIC-14 type. Both pilots will have two control boxes. One control box contains transistorized ICS and radio amplifiers while the other control contains the receiver and transmitter selector switch box. The system is designed to provide internal aircraft communications and selection of three transmitters and associated receivers. Switches are also provided for the navigational equipment. One system will function normally as a "Hot" mike for internal aircraft communications; however, operation of a transmitter will require keying of a thumb or foot operated switch.

Navigation

Tactical Aerial Navigation (TACAN) AN/ARN-21	This equipment provides range and bearing to fly to any selected AN/URN-3 station. Bearing is determined from a signal transmitted by the URN-3 and received by the ARN-21. The bearing is an indication of the heading the aircraft must take from any particular point, independent of its present heading. Range is determined by the time interval between an ARN-21 transmitted pulse and the reception of a URN-3 acknowledging pulse. The range of the system is limited to line-of-sight for distance and bearing and will indicate to 195 nautical miles for distance. Bearing is indicated on the #2 needles of the pilot's and observer's ID-250 indicators.
Marker Beacon Receiver AN/ARN-32	This lightweight equipment is designed to receive signals from ground marker stations. Reception of the marker signal is indicated by energizing lights on the pilot's and observer's instrument panels.
Low Frequency Direction Finder AN/ARN-59 Aircraft Radio Corporation Type 21A	This lightweight equipment, requiring a low power input, is designed to operate over the range of 190 to 1750 KC in three bands. It will receive and produce a bearing to the above radio signals. Bearings are displayed on the #1 needles of the pilot's and observer's ID-250 indicators.

VHF Homing
AN/ARA-31

Antenna group AN/ARA-31 is used in conjunction with AN/ARC-44 to provide a homing function. The equipment consists of two phase sensitive dipoles for D-U sector coding and a keyer box. The system provides an aural D-U indicator of homing.

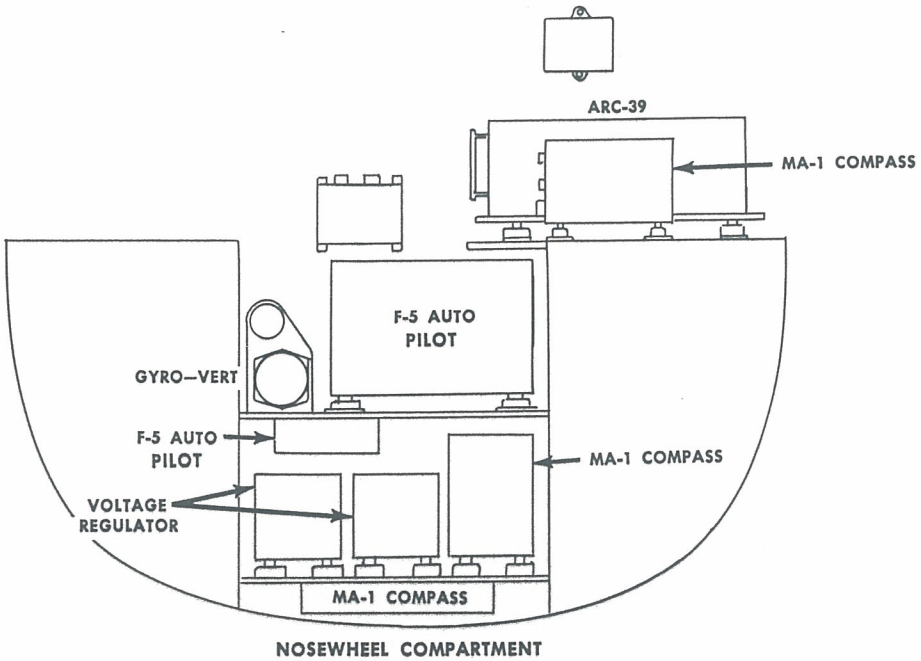
Identification

Transponder AN/APX-6B

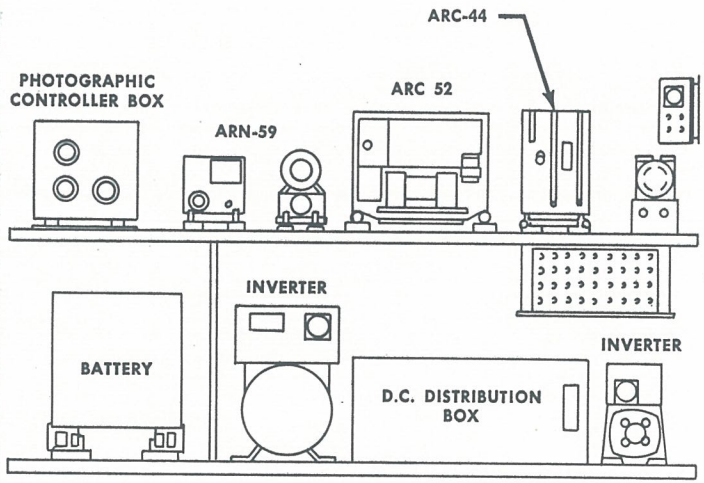
Identification System. (IFF) This equipment is designed to operate over a frequency range of 950 to 1150 MCS and is controlled by the pilot or co-pilot. The equipment receives coded interrogation pulses and automatically replies with a coded pulse train. Range of operation is limited to line-of-sight.

Coder Group AN/APA-89

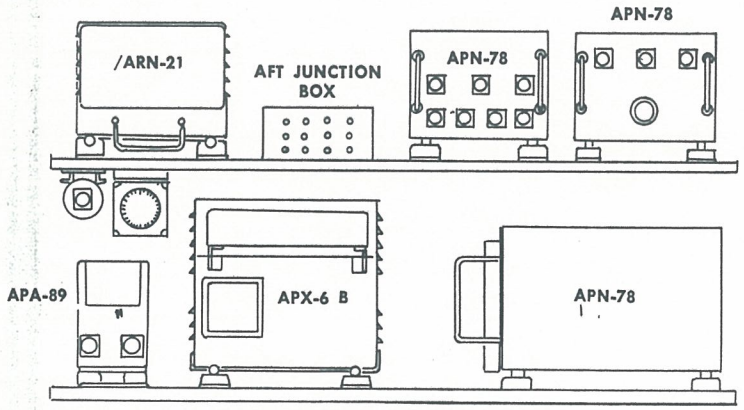
This item is combined with the APX-6B to give that equipment greater versatility in coding. This feature is known as "Selective Identification Feature." (SIF)



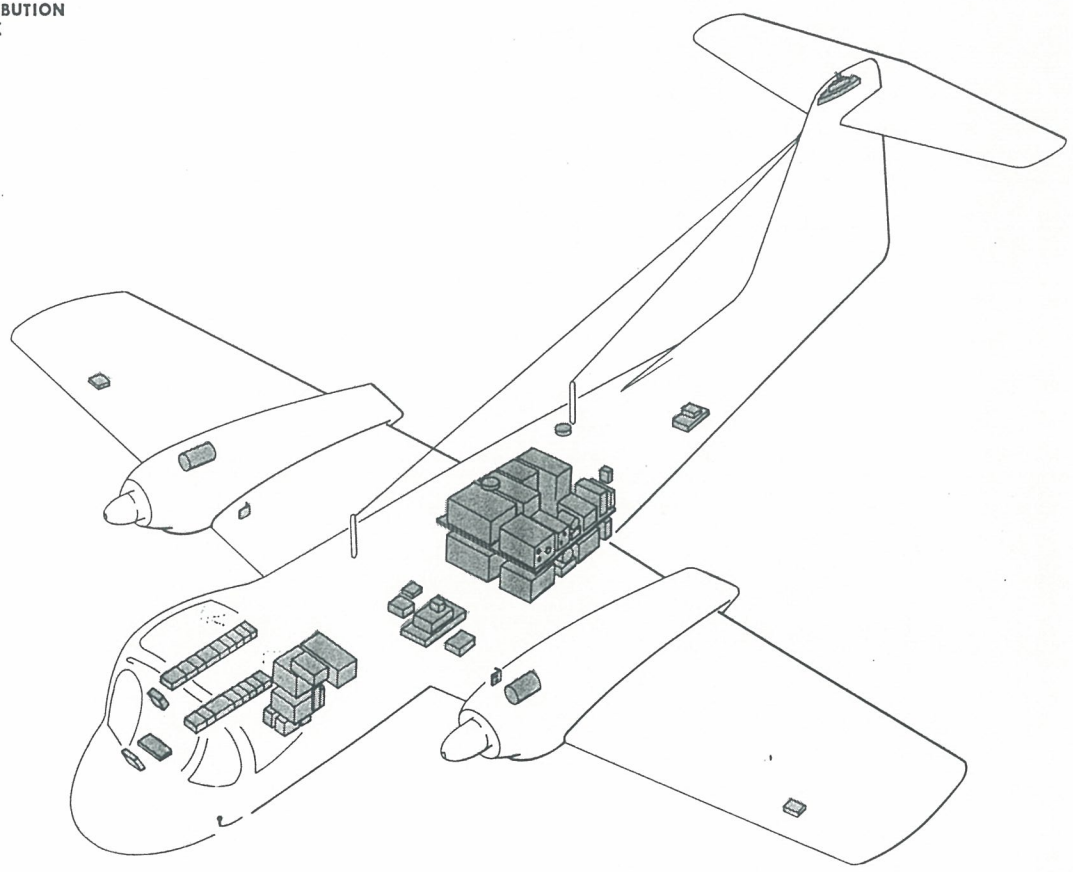
CNI AND ELECTRICAL ARRANGEMENT



EQUIPMENT BAY—LEFT HAND SIDE



EQUIPMENT BAY—RIGHT HAND SIDE



The hydraulic system is a Type I 3000 psi variable volume pump system in accordance with MIL-H-5440B.

The hydraulic system provides power for normal operation of the following sub-systems:

1. Alighting Gear
2. Ski Trim and Nose Gear Synchronization
3. Speed Brakes
4. Inboard Aileron (Landing and Take-Off only)
5. Slats
6. Flaps, Stabilizer Shift and Rudder Stops
7. Windshield Wipers

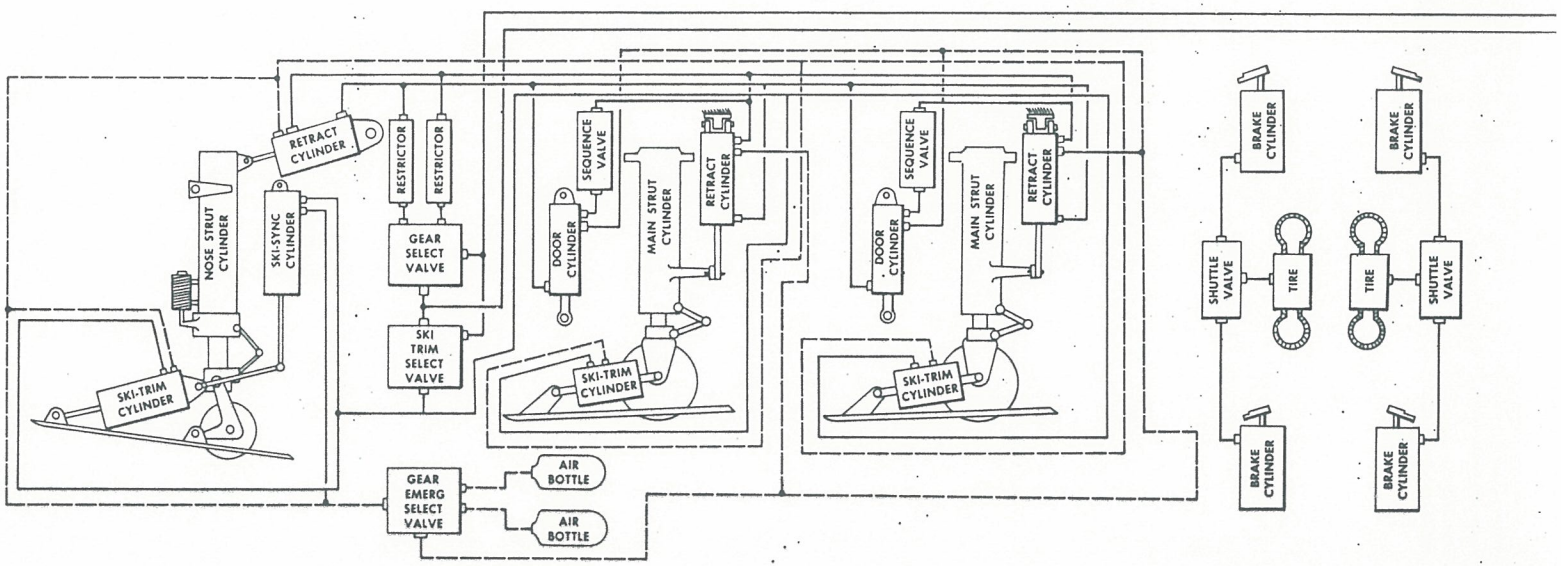
Wheel brakes are simple master cylinder type with independent reservoirs. Parking provisions consist of a mechanical control to lock the pedals in the "brakes on" position.

Hydraulic power is supplied by two engine driven variable volume pumps, one on each engine, which draw fluid from a common reservoir located in the fuselage. The reservoir is pressurized by engine bleed air to maintain proper pump inlet pressure at altitude.

1. The alighting gear system consists of a single nose gear cylinder and two cylinders for each main gear. The main gear retracting cylinder and door cylinder are mechanically sequenced during extension and hydraulically sequenced for retraction.

Emergency gear extension is accomplished by a single shot stored air system.

2. The ski system consists of a trim cylinder for each ski and a manual control valve which controls the trim cylinders. Ski control is accomplished by moving the normal gear



selector to one of three positions: "Gear Up", "Gear Down Land" and "Gear Down Water".

A fully automatic nose gear ski synchronizing system is provided which maintains the nose ski approximately parallel to the flight path during gear extension and retraction. This system consists of a synchronizing cylinder and solenoid control valves.

Emergency operation of ski trim and ski synchronizing systems is by stored air.

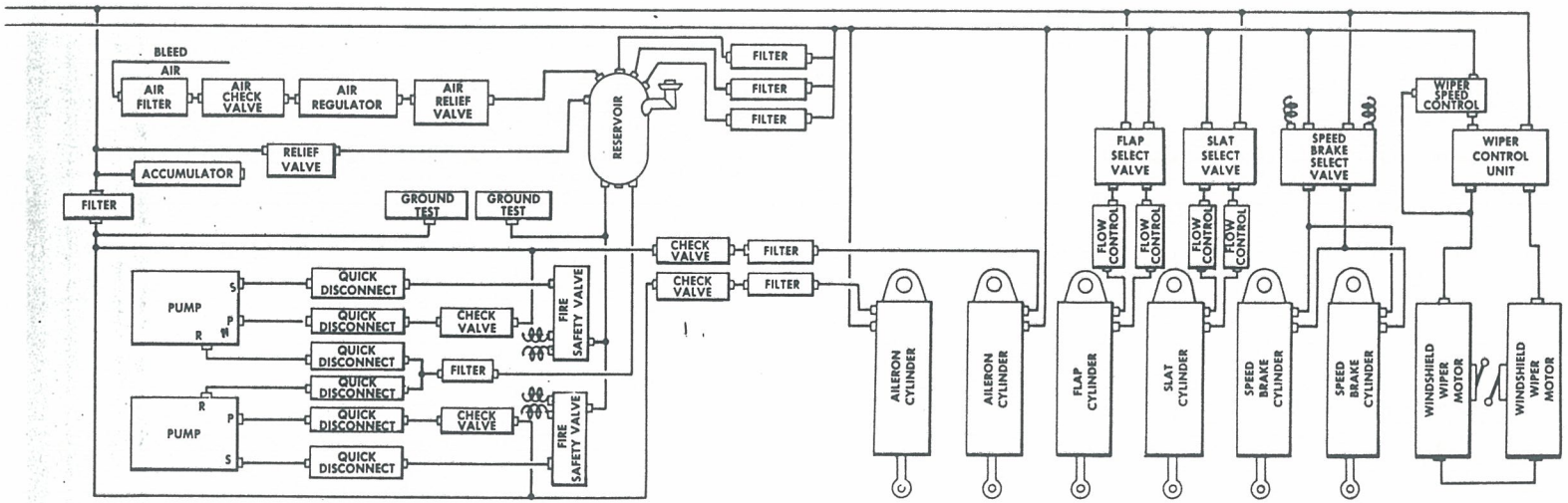
3. Speed brakes are operated by two simple cylinders synchronized by flow regulators and controlled by a pilot operated selector valve. Infinite positioning of the speed brakes is possible by trapping fluid in the lines.

4. The inboard ailerons are power operated by an actuator consisting of a cylinder with an internal ball lock and an integral slide control valve. The inboard aileron is operated only when the flaps are down.

5. Slats are operated by a single double acting cylinder with an internal ball lock by means of mechanical linkage. A manual valve, operated by linkage attached to the cockpit flap selector, controls slat position.

6. A single cylinder with an internal ball lock operates both flaps through a mechanical linkage. A manual slide valve, operated by a position follow-up linkage, controls flap position. The flap cylinder provides power for positioning the stabilizer and rudder stops, in addition to shifting into operation the powered inboard aileron.

7. Windshield wiper system is conventional with two wiper units and a single speed control valve.



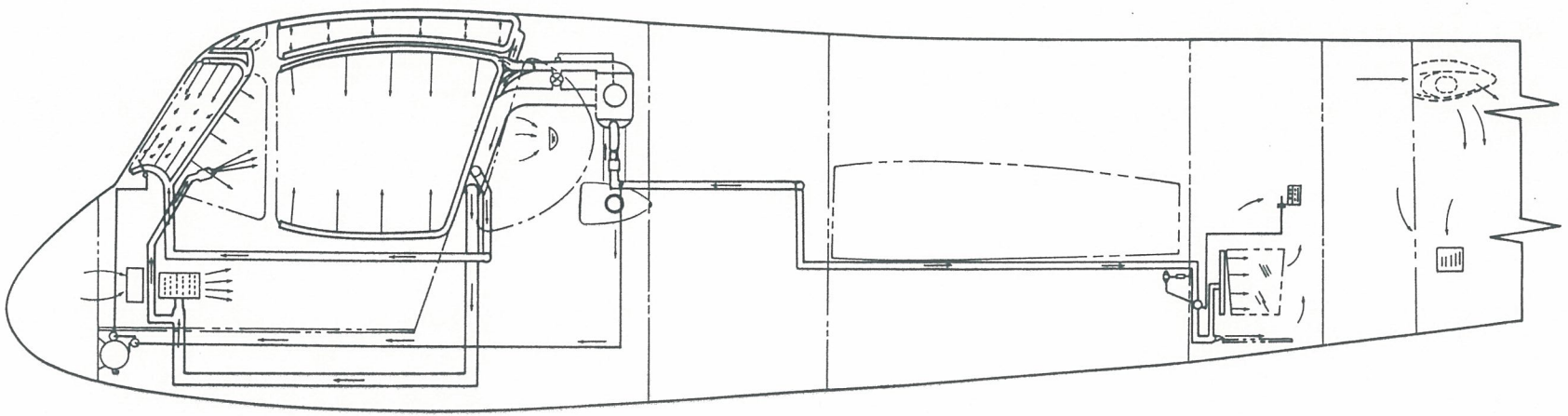
The OF-1 air conditioning systems provide for cockpit heating and ventilating, air blast defogging of all transparent areas, camera compartment heating and ram air cooling of the electronic compartment.

Cockpit heating is accomplished by introducing engine bleed air into the cabin after cooling it in a heat exchanger located in the equipment compartment. Ventilation is provided by diverting to the cabin air distribution system the ram air which is used to cool engine bleed air. The transparent area defogging nozzles, together with foot air diffusers and face nozzles for each pilot, comprise the cockpit air distribution system. A control panel located on the upper center console permits selection of various heating, venting, and defogging combinations together with automatic control of the temperature of heating and defogging air. Controls are provided to shut-off any or all air diffusers. A cabin temperature sensing thermostat is used.

A separate automatic temperature sensing control system has been provided for the camera compartment. This system regulates the flow of bleed air to the camera window defogging nozzles.

The electronic compartment is cooled with ram air from a scoop at the front of the compartment, exiting through louvers at the rear.

A windshield fluid anti-icing and washing system with a capacity of six quarts is provided, and is actuated by a momentary on-off switch located in the center of the instrument panel. This actuates solenoid valves which permit engine bleed air to force fluid to the distribution system. A tank filler is located in the nose of the airplane.



HOISTING EQUIPMENT

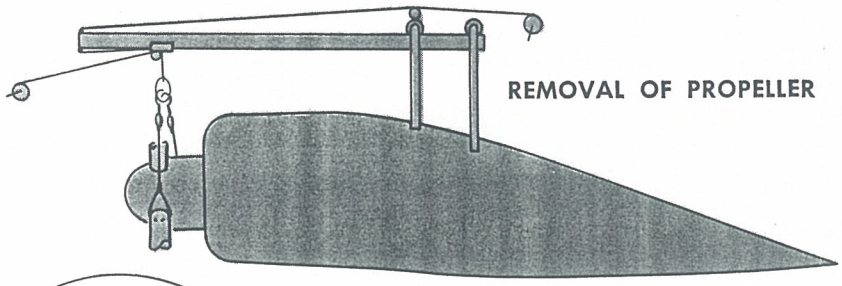
The hoisting equipment for support of the OF-1 airplane is designed to provide a mobile and lightweight propeller and engine handling system for use in remote areas. The system consists of a hoisting davit, propeller sling, propeller stand, engine sling and engine stand. The hoisting davit attaches to pickup fittings in the airplane nacelle and is secured in place with quick release pins. Two portable Mark 8 hoists attach to the davit and provide fore and aft and up and down motion.

A) *Propeller Handling*—The propeller sling loops around two blades of the propeller with snap hooks fastening into the sling hoisting ring. The davit forward hoist attaches to the same ring and lowers the propeller onto the propeller stand.

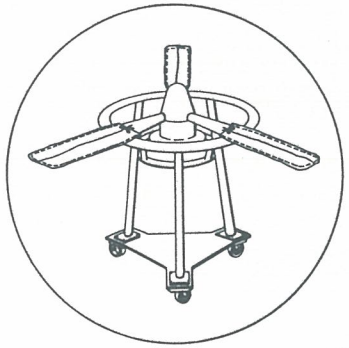
B) *T-53 Engine Handling*—The engine sling attaches to hoist fittings provided at the top of the engine. For handling the engine, less propeller, the davit forward hoist fastens to the engine sling. (Engine plus propeller may also be handled by attaching the hoist further forward on the sling.) The removed engine, with or without propeller, may be supported on the engine stand by securing the engine mount to the stand with fastening bolts provided. The engine stand folds flat for stowage.

SPECIAL EQUIPMENT

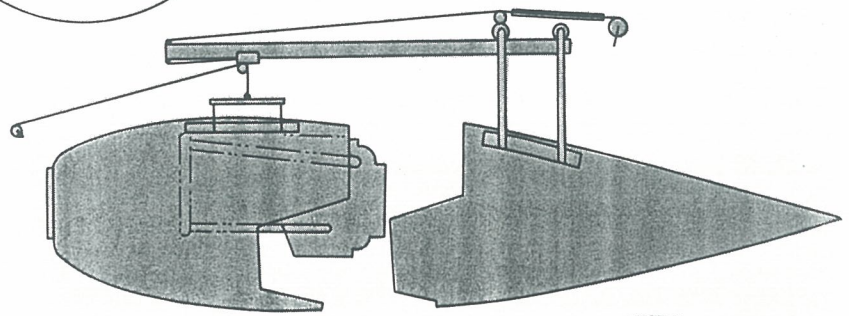
Additional equipment anticipated for ground handling would include aircraft jacks, protective covers for camera windows, and ground safety locks for the landing gear.



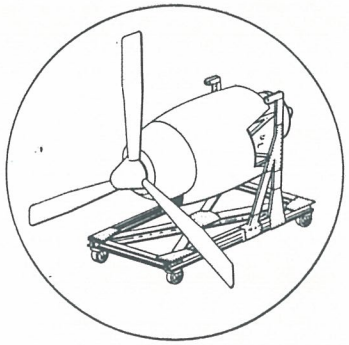
REMOVAL OF PROPELLER



PROPELLER ON STAND



REMOVAL OF ENGINE

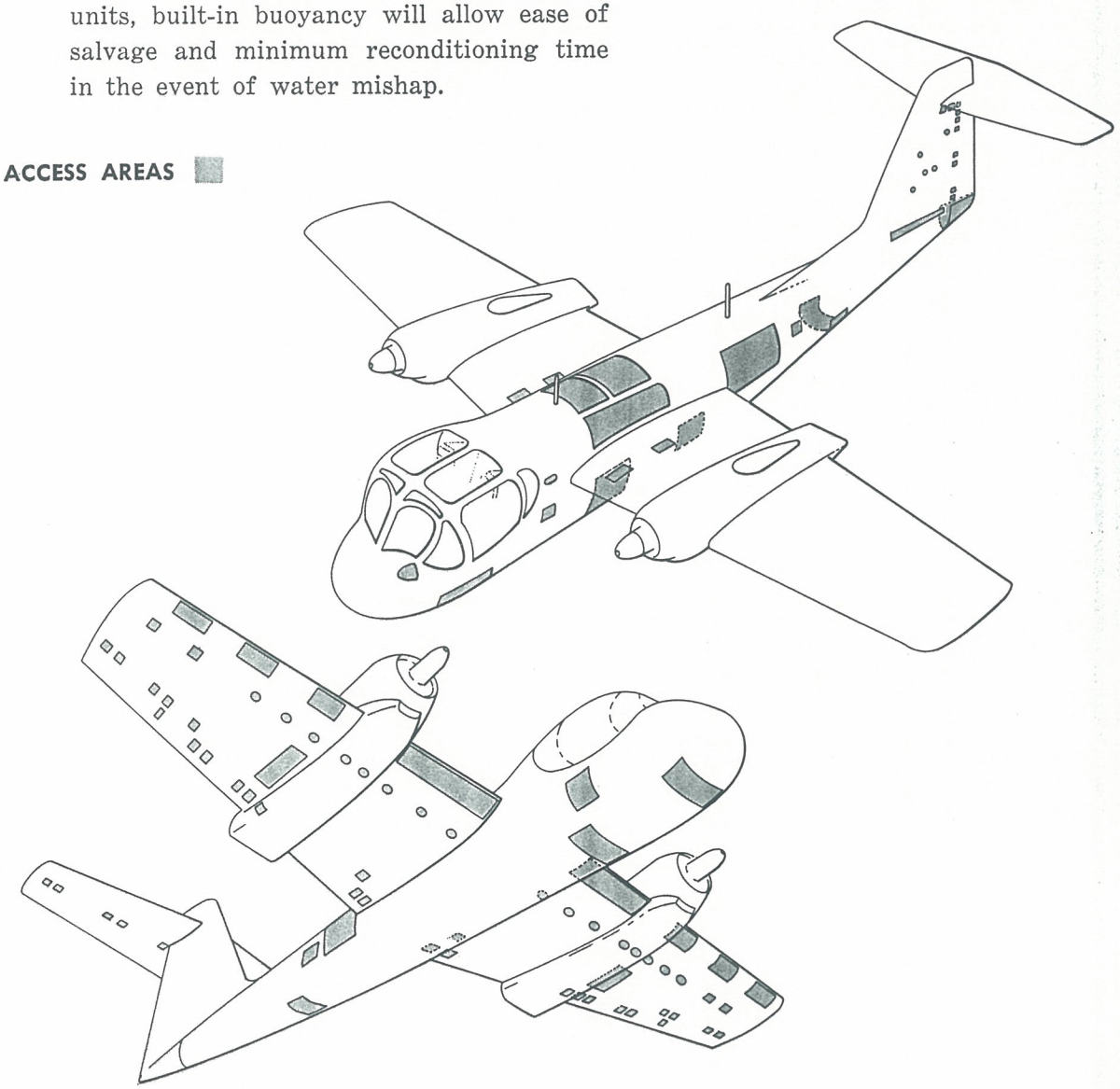


ENGINE ON STAND

For maximum serviceability and maintenance, quick access has been provided to all equipment items on the airplane. Wherever possible, this access is obtained directly from the ground with a minimum use of work stands. Access to the electronic compartment is achieved by the opening of a latched door on either side of the airplane. Access to the oxygen bottles, hydraulic reservoir, radio, and air conditioning equipment is achieved through the nose wheel doors. Access to the camera compartment is directly from the ground through two side doors under the wing trailing edge. A single fuel cell is readily replaceable through two removable panels on the top of the fuselage. Additional openings for servicing the airplane are indicated on the accompanying sketches.

In addition to providing ease of access, all major assemblies have been made interchangeable. A single power plant assembly fits either the left or right wing. Major landing gear components are interchangeable, left and right. The complete wing panel, including engine nacelle, is quickly replaceable. The wing tips, horizontal and vertical tails, and fuselage nose and tail sections are all readily replaceable as units. In addition to this quick replacement of major units, built-in buoyancy will allow ease of salvage and minimum reconditioning time in the event of water mishap.

ACCESS AREAS

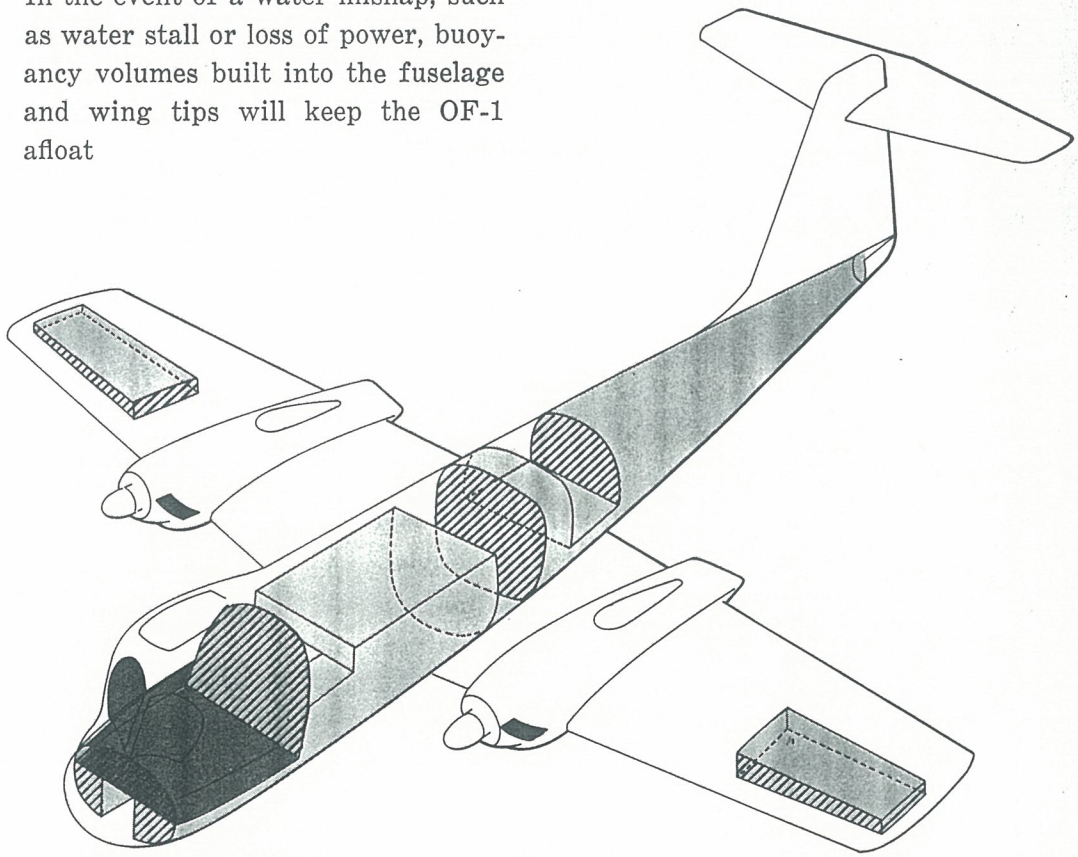


The design philosophy incorporated in the OF-1 will assure maximum protection from ground fire and decreased vulnerability. Features included are:

1. 372 lbs. of armor protection installed in the basic aircraft.
   - 1" thick bullet proof windshield for pilot and co-pilot
   - 1/2" thick aluminum floor—the full width of the cockpit
   - 1/4" thick aluminum cockpit side panel
   - Removable flak curtains above the cockpit floor on the fore and aft cockpit bulkheads
   - 1/4" aluminum plate below the oil cooler
2. Basic configuration established to allow the structure to protect critical items on the airplane.
   - Self-sealing fuel cell mounted above the wing structure and beams
   - Engines located above the wing
3. Dual longitudinal control runs, separated as much as possible, are provided throughout the fuselage.

SAFETY

- Cockpit area is designed for 20 "g's" vertically and 40 "g's" fore and aft
- Overhead hatch is designed to remain open under crash loads
- In the event of a water mishap, such as water stall or loss of power, buoyancy volumes built into the fuselage and wing tips will keep the OF-1 afloat



FLOTATION

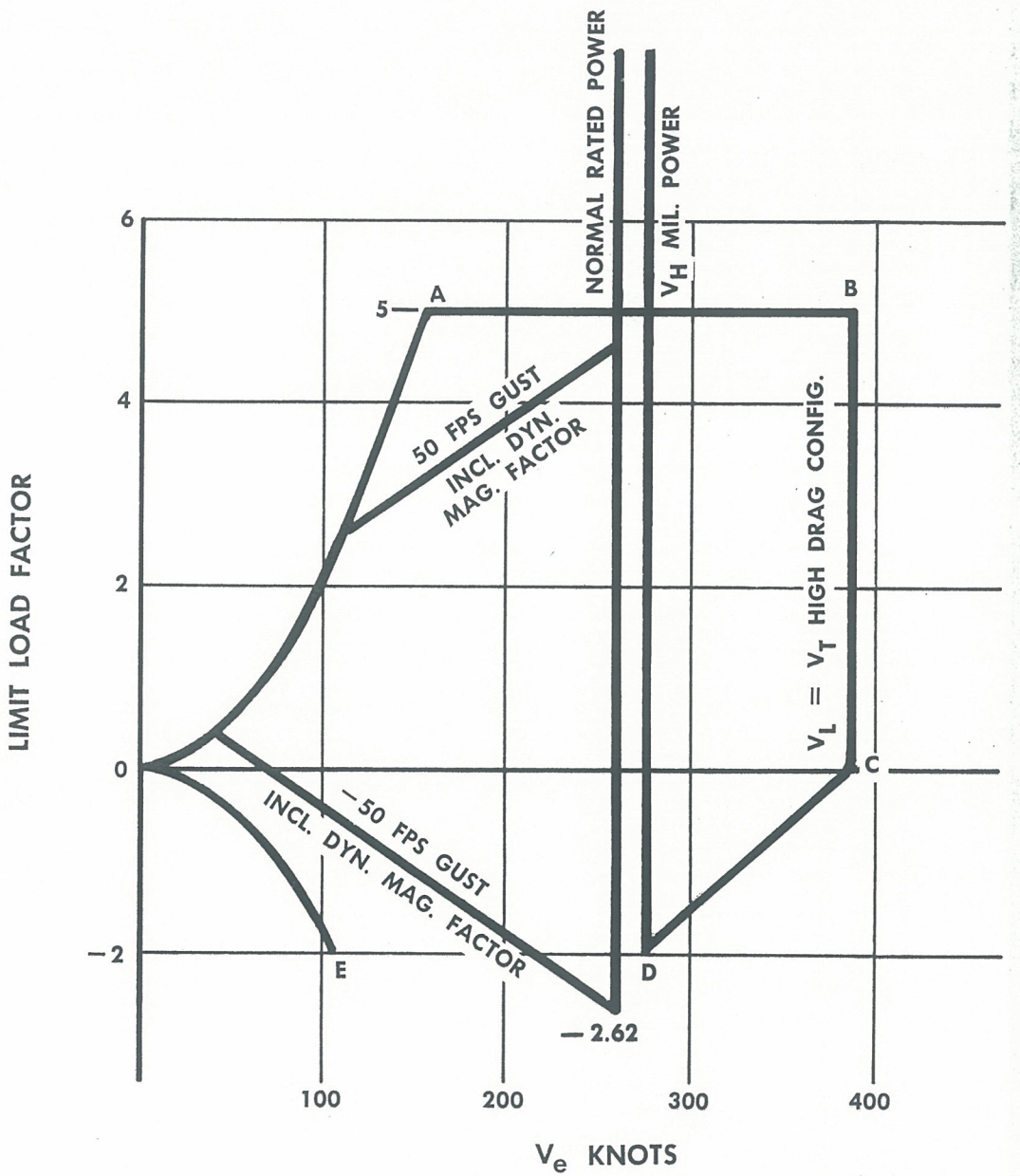
FLAK CURTAIN

ARMOR PLATE, BULLET RESISTANT WINDSHIELD

Structure

The symmetrical maneuver and gust envelope for the OF-1 is shown on the right. The design limit load factor is +5.0 and is applicable up to the limit speed of 390 knots. For unsymmetrical maneuvers, the design load factor is +4.0. The landing gear is designed for a limit sink speed of 17 feet per second, 20.8 feet per second ultimate.

The airplane is designed to meet the strength requirements of Specification MIL-A-8629 (Aer) and the Detail Specification, SD-532-1. These specifications require a design factor of safety of at least 1.5 as well as proof of strength by static tests to failure of all major structural components. In addition, fatigue tests to failure are required for the wing, tail surfaces, control surfaces and control system. The fatigue loading schedules are designed to duplicate, as nearly as possible, the many repetitions of loads of various magnitudes which are predicted to occur during the planned service life of the airplane.



Maximum speed at 5000 ft., military power, level flight	275 kts.
Stall speed at sea level, landing configuration, 10% NRP	55 kts.
Take-off distance, over 50 ft. obstacle	655 ft.
Landing distance, over 50 ft. obstacle	776 ft.
Service ceiling, military power T. O. wt. less 20% fuel (1)	32,500 ft.
Rate of climb, 2 engines, NRP, sea level, T. O. wt. less 20% fuel	3000 f.p.m.
Rate of climb, 1 engine, military power, sea level T. O. wt. less 20%	1050 f.p.m.
Endurance at 200 kts., 5000 ft.	2 hrs.

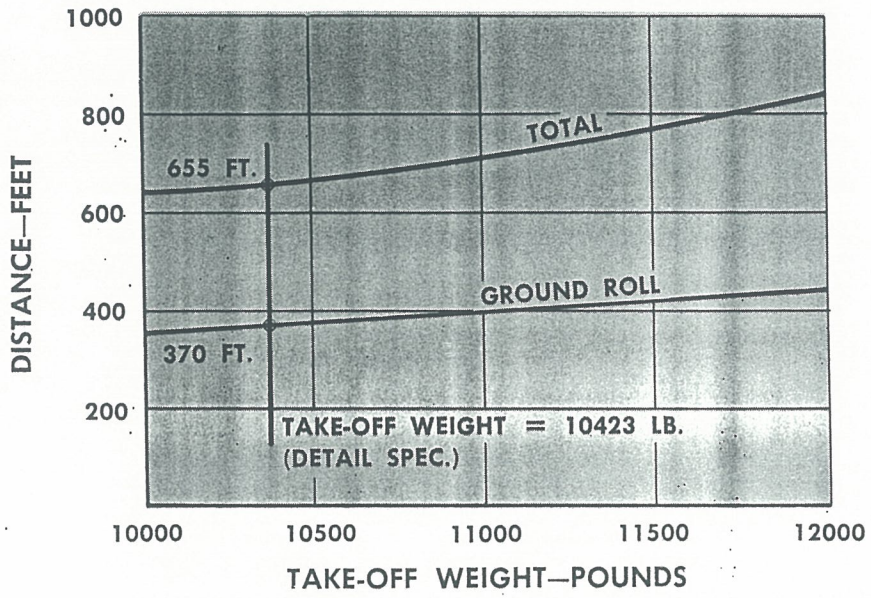
Ferry Mission: (2)

Range	1453 N. mi.
Time	6.96 hrs.
Avg. Speed	208 kts.
Cruise altitude	25,000 ft.

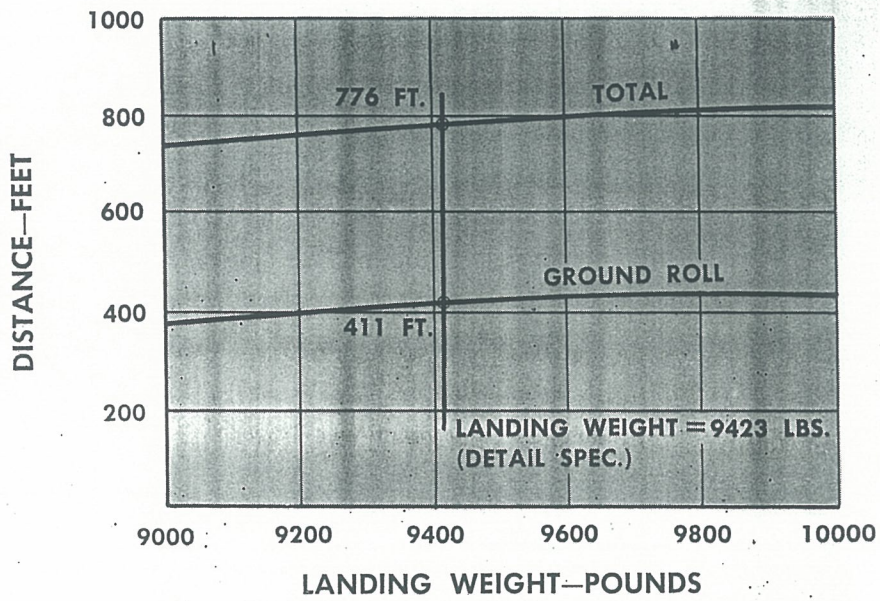
Notes: (1) Engine data extrapolated over 25,000 ft.
(2) With two 150 gal. external tanks, no rockets

Performance

TAKE-OFF DISTANCE



LANDING DISTANCE



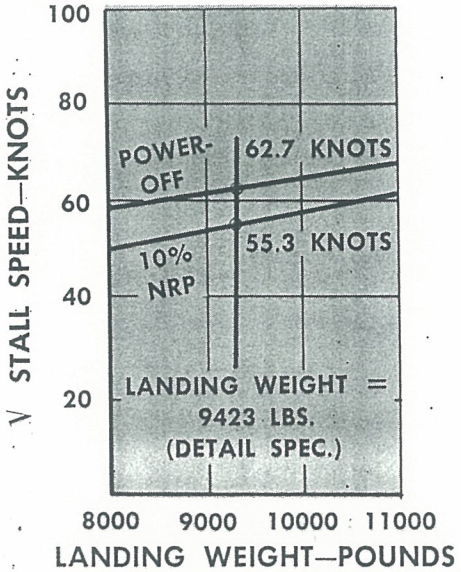
TAKE-OFF-OVER 50 FT. OBSTACLE

Take-off Power
Take-off Speed = 60 knots

Greater than:

(1) Single engine control speed
(2) Single engine positive rate of climb speed

STALL SPEED



LANDING-OVER 50 FT. OBSTACLE

Straight-in approach with:

(1) 6-10% Normal Rated Power
(2) Speed over obstacle greater than 1.10 V_{stall} (10% NRP)
(3) Rate of sink = 14 ft./sec

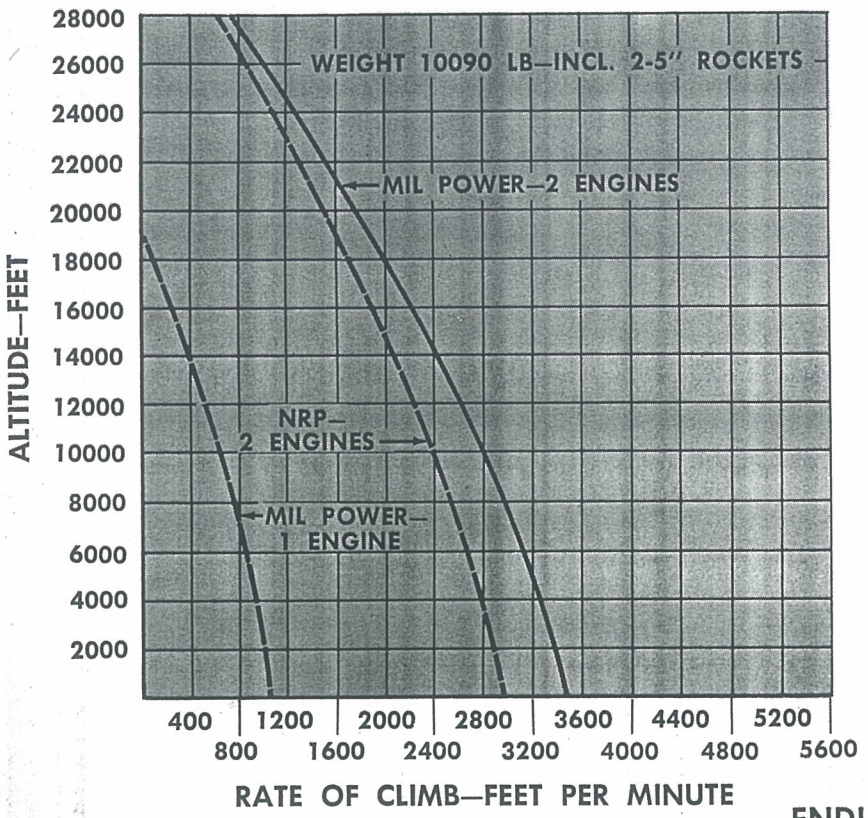
Unflared touchdown with rate of sink = 14 ft./sec.

At touchdown:

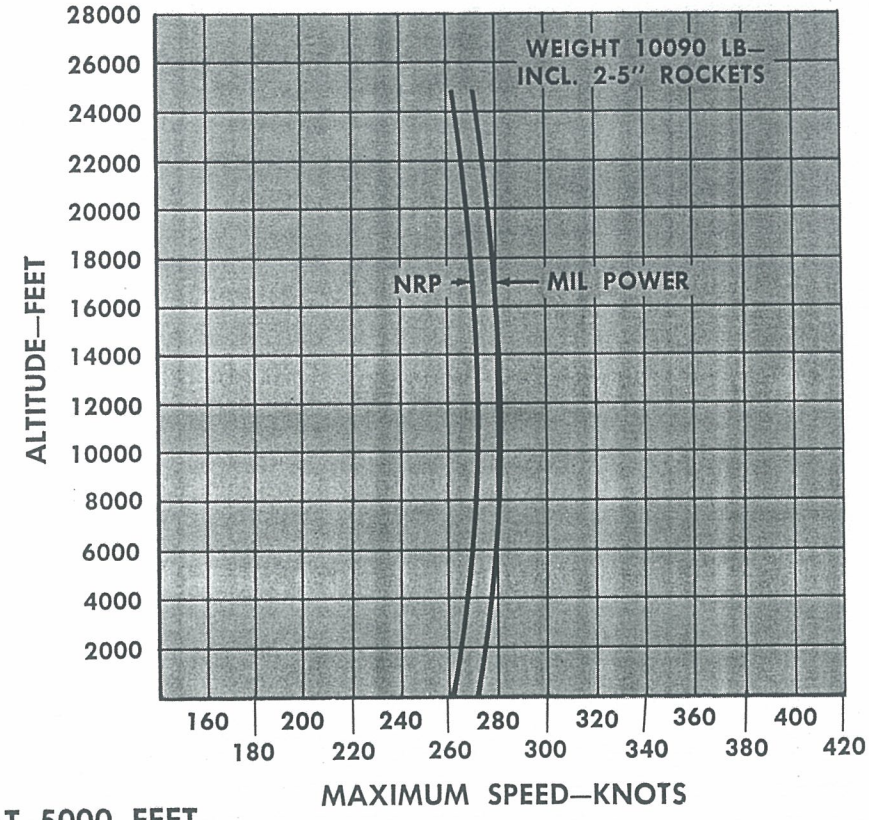
(1) Actuate reverse thrust
(2) Apply full braking

Performance

CLIMB



SPEED



ENDURANCE AT 5000 FEET