PHANTOM II

The United States' All-Service Fighter

MCDONNELL

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The appearance in 1958, of a new U.S. Naval fighter, the McDonnell Phantom II, has erased the performance limitations long associated with carrier-based aircraft.

Thirty years ago, performance of land and carrier-based service fighters was comparable. Sometimes both the U.S. Navy and Army used the same design. The Navy airplanes suffered little if any performance penalty due to the weight of increased equipment and structure for carrier operations.

However, in recent years, attempts to produce Navy fighters have almost always resulted in aircraft whose performance was compromised by carrier operation limitations. With the great strides made during the past decade in both airplane design features and the development of jet engines, high-strength low-weight alloys, and carrier catapult and arresting gear designs, the challenge to provide equivalent performance has been met in the Phantom II – an airplane with unrivaled performance and firepower.

Never before has one aircraft so indelibly marked the pages of military aviation history. It is appropriate that the Phantom II will now serve all three air arms of our nation.

Designated the F4H–1, the Phantom II is now in service as an air defense interceptor for the United States Navy. With the same designation, the Phantom II has been assigned to the United States Marines for the conduct of close support and air superiority missions. Designated the F–110A and the RF–110 by the United States Air Force, the Phantom II is now being built to perform long range attack and photo reconnaissance missions for that service.

The combination of speed, range, weapon-carrying capability and a dual purpose all-weather radar system qualifies the McDonnell Phantom II for its multiple mission assignments.


NAVY

Airborne before strike, the Phantom II demonstrated the capability of delivering multi-ton loads of bombs. The pilot has the option for a variety of bomb delivery combinations – one at a time, in clusters, or all at one time. The aircraft can also carry rockets, napalm, missiles or nuclear weapons in addition to providing its own self-protective armament in the form of Sparrow III missiles.

The McDonnell Phantom II is a supersonic, two-place, twin-jet, multiple mission, all-weather fighter. Built to operate from a carrier deck, it is equally suited for land-based operations, capitalizing on its ability to lift multi-ton loads of air-to-ground weapons from minimum length runways.

The Phantom II was, in its early development, designed as a long-range all-weather attack fighter; however, fleet requirements changed the basic mission to that of a long range high altitude interceptor using missiles as principal armament. As an interceptor, it can carry six Sparrow III missiles – one under each wing and four semi-recessed in the fuselage or, as an alternative, two heat-seeking Sidewinders under each wing and four Sparrow III's under the fuselage.

Retaining much of the original attack-design structure (especially at external attach points) along with the capability of low-speed flying, it was soon evident the Phantom II was equally well qualified for long range air-to-ground strikes. As an attack aircraft, the Phantom II is capable of carrying a multi-ton load of conventional bombs, rockets, missiles, napalm or nuclear ground strike weapons. in addition, it retains its own self-protective Sparrow III armament.

The unrefueled range of the Phantom II operating from carriers or existing suitable friendly land base allows the aircraft to carry its payload of ground strike weapons over 92% of the earth's surface. As an air superiority fighter, its combat range extends over 96% of the earth's surface.

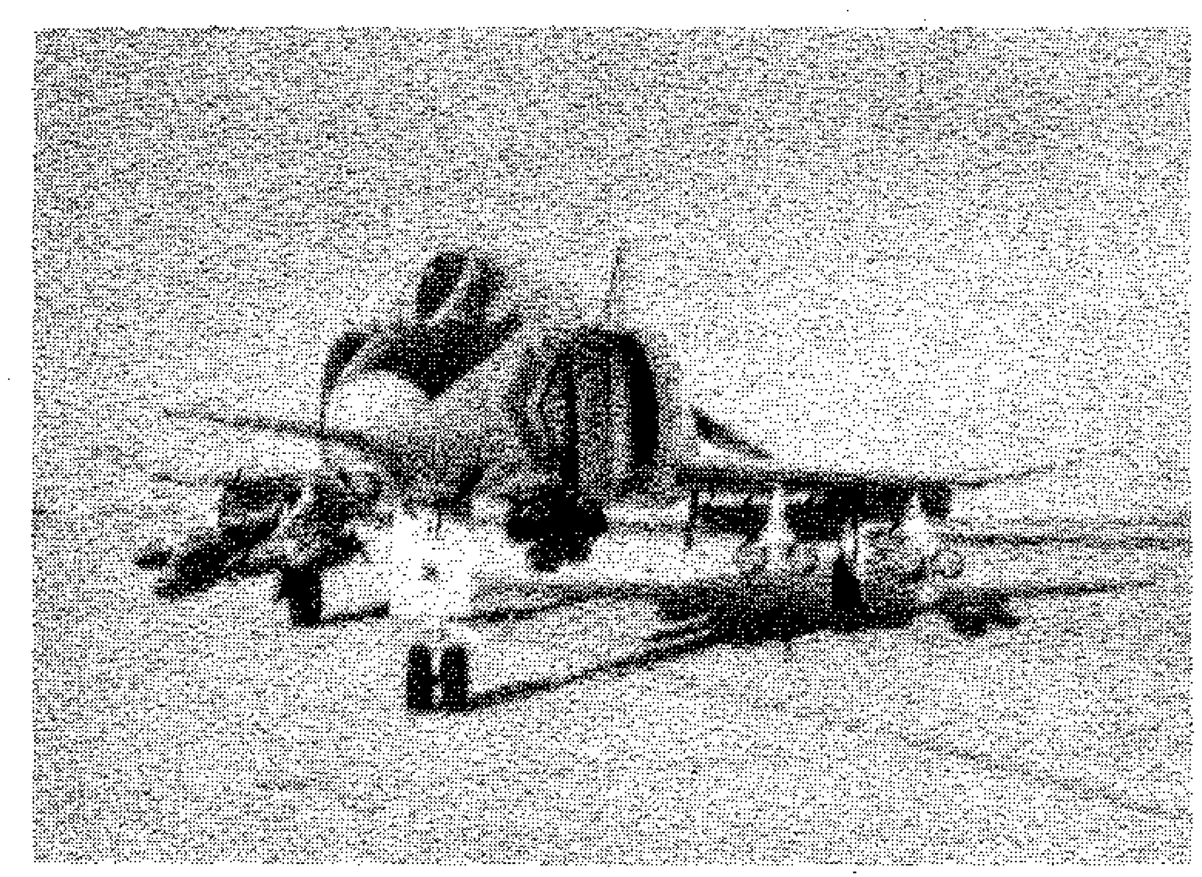
The Phantom II's outstanding performance was demonstrated even before it became operational in the service. During pre-service preparations, the airplane established its place in aviation history by zoom-climbing to a then record 98,557 feet. It is currently holder of the world's class record for horizontal flight as sustained altitude, maintaining 66,443.8 feet over a measured 15/25 kilometer course.

Another measure of the Phantom II aircraft lies in its ability to maneuver at high speeds. On September 5, 1960 a Phantom II set a 500-kilometer closed-course record of 1216 mph and 20 days later it established a 100-kilometer world closed-course record of 1390 mph. Flying a circular path less than 20 miles in diameter, the Phantom II sustained a continuous centrifugal load of more than 3 g throughout the Mach 2 turn.

On 28 August 1961, a McDonnell Phantom II swept 4 times through a measured 3 kilometer course. At times less than 50 feet above the ground, the Phantom II slammed through the hot desert air at an average speed of 902.77 mph to capture the world record and attest its low altitude attack and re-attack capability.

On May 24, 1961 a Phantom II, crossing the North American continent at the rate of a mile every four seconds set a new transcontinental speed record for the 2421.42 statute miles from Los Angeles to New York.

The Phantom II's intercept capability was exhibited in setting the world's absolute speed record of 1606.3 mph (Mach 2.5+). During this record flight the Phantom II reached peak speeds in excess of 1650 mph.



During the months of February – April 1962, the Phantom II set eight official world time-to-climb records. The records, for 3, 6, 9, 12, 15, 20, 25 and 30 thousand meters, emphasized the Phantom II's outstanding reaction capability to reach any altitude in record time from a standing start. It is significant to note, that in establishing the 30,000 meter time-to-climb record, the airplane eclipsed its own peak altitude mark of 98,557 feet by zooming to an altitude of over 100,000 feet.

Time to Climb (in meters):

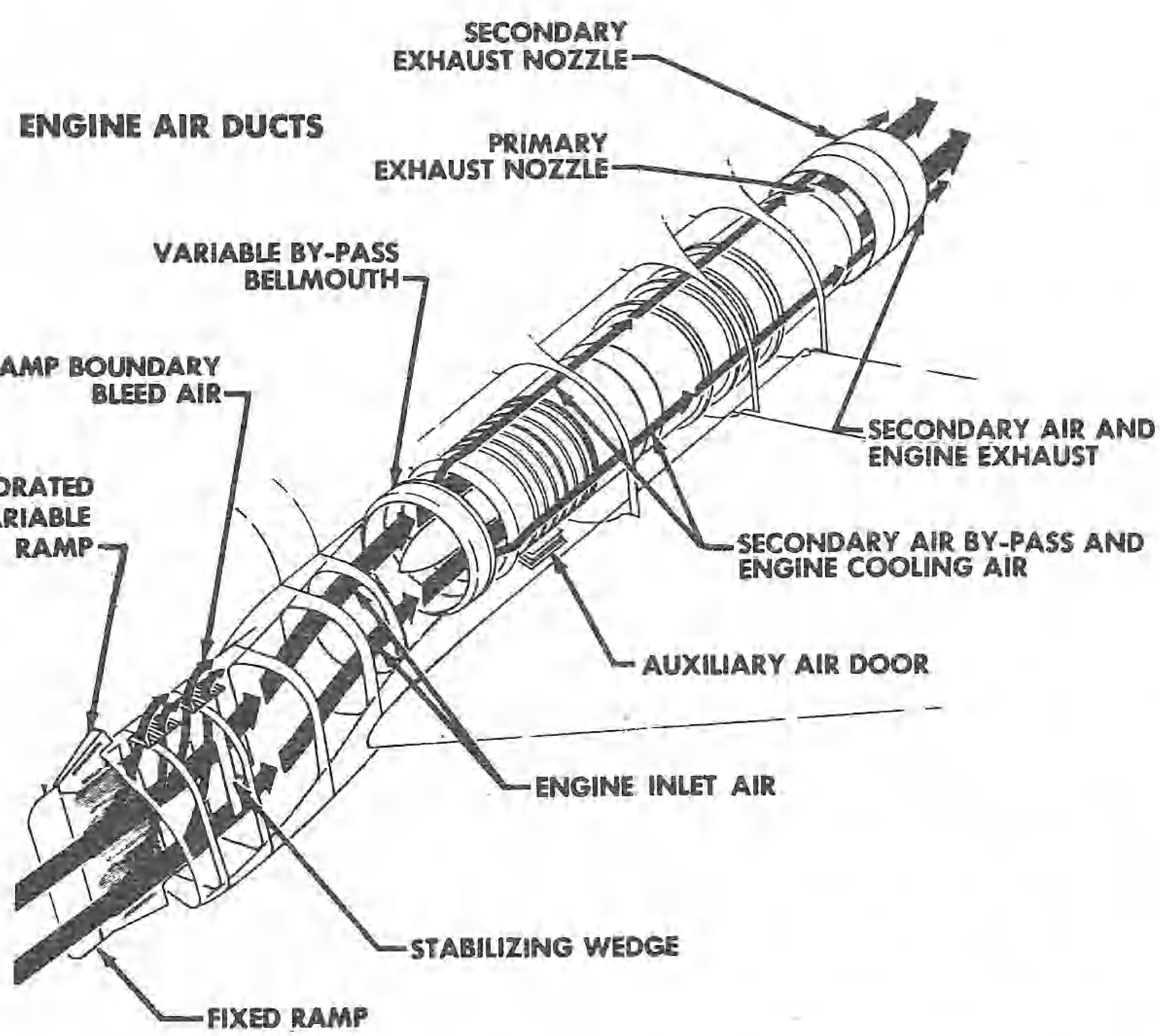
3,000	34.52 seconds
6,000	48.78 seconds
9,000	61.62 seconds
12,000	77.15 seconds
15,000	114.54 seconds
20,000	178.50 seconds
25,000	230.44 seconds
30,000	371.43 seconds

Power Plant

The Phantom II has exceptionally long range and outstanding power supplied by two General Electric J79 axial flow turbojet engines equipped with afterburners for thrust augmentation. At military power the engines develop 21,800 pounds thrust and with complete afterburner, maximum thrust is well above 30,000 pounds. The safety inherent in a twin-engine design is provided in addition to added performance and strike capability.

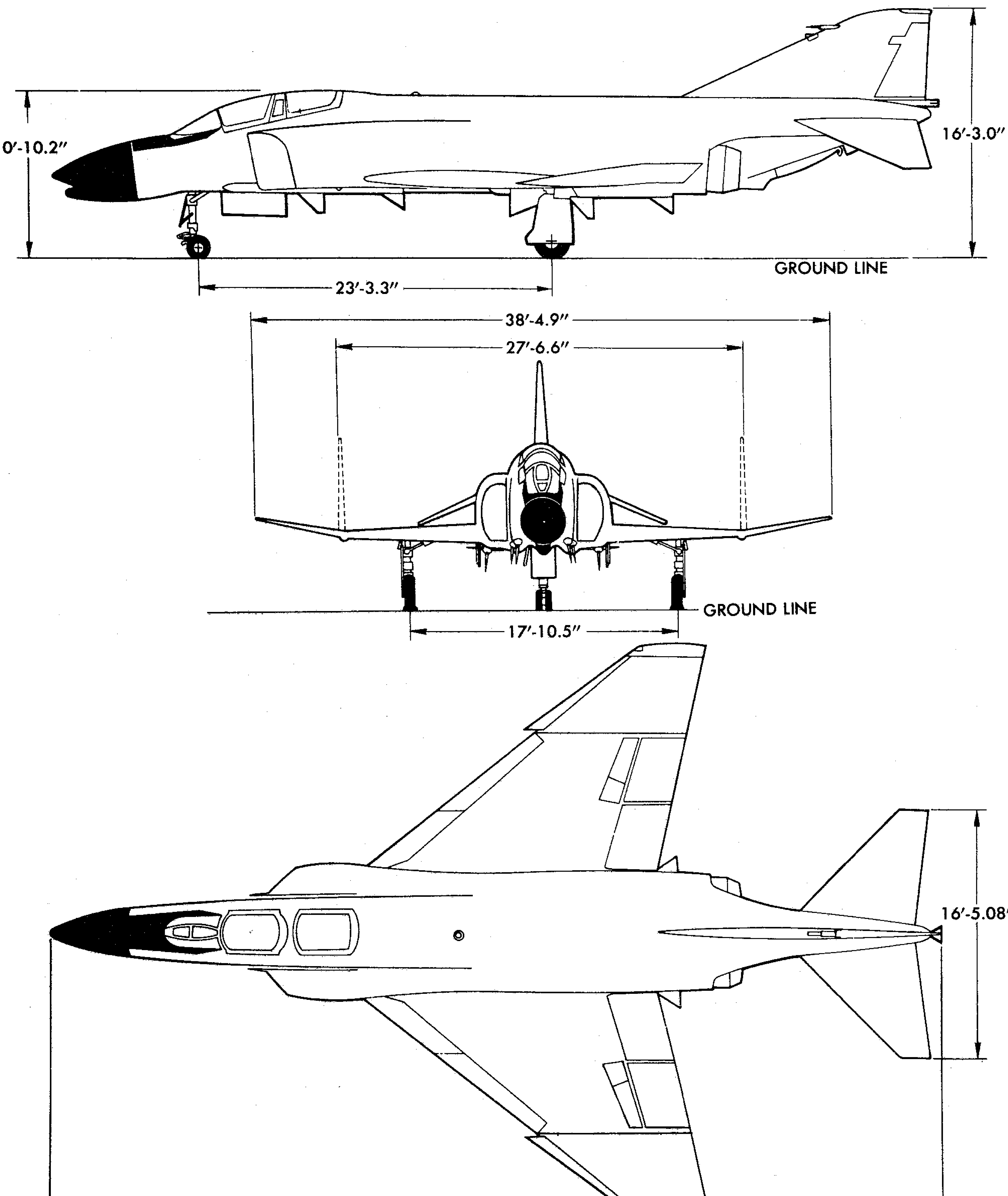
One of the outstanding features of the J79-GE-8 engine is its thrust response to throttle movement. The variable exhaust nozzles allow a maximum rate thrust build-up within the allowable temperature limits of the engine. When a wave-off is given, the pilot advances the throttle and in about four seconds the engines are producing full thrust. During carrier suitability trials, wave-offs were accomplished on one engine – without using afterburner.

The J79-GE-8 engines have the highest thrust-to-weight ratio in their class and provide low specific fuel consumption rates. Each engine produces more than 16,000 pounds of thrust, yet weighs only 3630 pounds.



The thrust potential of the two engines is fully realized through the operation of the unique air induction systems. The engine air inlets, located on the sides of the fuselage are mounted two inches out from the fuselage to avoid slow moving boundary layer air next to the surface. Each inlet system employs a variable inlet ramp, a by-pass bellmouth and auxiliary air doors. Variable ramp operation is programmed to control the inlet airflow capacity by changing the inlet area and positioning the shock wave in the area of the duct inlet. The amount of air admitted to the engine inlet is controlled by the by-pass bellmouth which opens and closes to maintain desired airflow by spilling air into the engine compartment. Holes, drilled in the by-pass ring, assure minimum flow cooling air to the engine compartment when the bellmouth is fully closed. The air by-passed by the bellmouth is the source of air for the secondary air system, which in addition to acting as a cooling medium for the engine compartment, is directed over and around the afterburner section and is channeled into the exhaust gases from between the primary and secondary nozzles. The expansion of the air, as it cushions the hot exhaust, increases the thrust in all power ranges. The opening of the primary nozzle flaps, along with the secondary air, forms a convergent-divergent nozzle, causing the exhaust flow to increase to high supersonic velocities. There is no excess flow to create drag, no insufficient flow to compromise power. The auxiliary air doors are used to introduce cooling air during ground operation and low speed flying and, in addition, to relieve excess engine compartment pressure.

Piloting the Phantom II in its first launch and recovery during carrier trials at sea was LCdr. Paul Spencer of the Naval Air Test Center. Describing the Phantom II's performance aboard the U.S.S. Independence, LCdr. Spencer said: "The F4H is a big airplane. It is twice the weight of the F11F and nearly three times the weight of the A4D. Yet with all this bulk, it handles better than any of our modern Navy fighters."


10′-10.2″
16′-3.0″
GROUND LINE
23′-3.3″
38′-4.9″
27′-6.6″
GROUND LINE
17′-10.5″
16′-5.08″
58′-3.1″ STATIC LENGTH

Profile of a Phantom

The unique aerodynamic styling employed in the design of the Phantom II succeeds in providing maximum performance per pound of aircraft. The tail of a Phantom; thin, swept, highly tapered and completely movable, has approximately 23 degrees of negative dihedral. Mounting the tail in this manner aligns it properly with the swirling airstream which exists at moderate angles of attack in this region and eliminates pitch-up characteristics. A negative dihedral configuration also provides the weight saving and ground clearance advantages inherent in an overhanging aft fuselage design.

The wings of a Phantom are tapered sharply both in chord, thickness and thickness ratio. There is a discontinuity in the leading edge at the wingfold where the outer panel chord has been increased 10 per cent over the basic planform. This interruption in the leading edge creates a swirl of air on the upper surface at moderate angles of attack which inhibits complete stalling of airflow on the outer panel. This, in turn, maintains longitudinal stability in this angle of attack range by distributing the lift more evenly. The main part of the wing structure carries straight through the fuselage for greater strength and for ease of assembly. The wing, set low on the fuselage, permits a short landing gear and yet provides enough clearance to carry a centerline fuselage tank, two wing-mounted tanks, and armament. The outer wing panels sweep up at a dihedral of 12 degrees for aerodynamic stability above Mach 2. Only the outer panels are bent up to preserve the straight-through wing structure configuration. This bend is made at the wing fold so that no additional structural support is required.

Leading and trailing edge flaps, augmented by boundary layer control, *allow slower than commercial jet transport* landing approach speeds. Spoilers and ailerons are employed to provide good lateral control at both low and high speeds. The ailerons deflect down 30 degrees and up one degree. The spoilers deflect up 45 degrees. The airplane features aileron-rudder-interconnect which is effective at low-speed flying, to provide the pilot with more uniform handling and aircraft control characteristics. Three axis dampers are available to improve static stability and dynamic damping; however, stability and control characteristics are such that the entire flight envelope can be covered without stability augmentation. The movable surfaces mounted under the wing ahead of the trailing edge flaps are speed brakes and produce more drag per square foot than the more common aft-fuselage types.

Although aerodynamic theory would dictate a long, slim fuselage with a needle-like nose, actually the fuselage is shorter by one foot than that of its predecessor, the F3H Demon, allowing improved deck handling. The necessity for housing two large engines, together with the air inlet ducts, semi-recessed missiles, electronic gear and large quantities of fuel results in a fuselage that appears short and stubby for a supersonic fighter. To reduce drag due to skin friction, a minimum of openings and proturbances mar the Phantom II surface. Although the sides of the fuselage are visibly reflexed, "area rule" as such was not an important factor in the design.

The nose houses the radar gear. Just underneath the nose, a small blunt bulge contains the infra-red or heat-seeking equipment which "looks" through a hemispherical head. The two-man cockpit, equipped with Martin Baker ejection seats to provide ground level and high altitude escape capability, is depressed as much as possible since the shape of the forward part of the fuselage ("nose fineness ratio") is very important at supersonic speeds. A look at the fuselage aft of the jet nozzle reveals an arresting hook faired into the centerline keel. At the very end of the fuselage, just below the rudder, is the drag chute compartment.

The aircraft utilizes a fully retractable tricycle landing gear completely covered by flush doors when retracted. The gear is electrically controlled by the 28 volt d-c bus, and hydraulically actuated by the basic utility system. Emergency gear extension is accomplished pneumatically. The nose gear is equipped with an integral self-centering mechanism, a catapult extension feature and dual nose wheels. Nose gear steering, incorporating shimmy damping features, is also provided.

Systems

The fuel system comprises six interconnected fuselage fuel cells and two integral "wet wing" cells located in the wing torque boxes. Provisions are made for two externally mounted 370-gallon jettisonable wing tanks and a 600-gallon jettisonable fuselage centerline external tank, which is interchangeable with a refueling tanker store (buddy tank). It should be noted that these external stores can be jettisoned even while the airplane is flying at supersonic speeds. A complete in-flight mission may be carried out without the pilot moving a single fuel transfer switch. The transfer system provides for transfer of fuel from the wing and external tanks to the fuselage cells. Hydraulic and electrically driven transfer pumps plus gravity feed are used to transfer fuel from fuselage cells to the engine feed tank. Under normal operation, all external fuel is transferred by air pressure to fuselage tanks before being pumped to the engine feed tank; however, if the engine feed tank fuel supply drops below a certain level, the wing or external fuel is automatically fed directly to the engine feed tank. The Phantom II is equipped for in-flight re-fueling.

The electrical power supply system consists of an a-c generator power supply, transformer-rectifier d-c power supply and a power distribution system. There are no batteries. The a-c generator power supply is the primary source of electrical energy. The two 20,000 volt-ampere a-c generators, located in the forward engine compartment and mounted one on each engine, are driven by constant speed drive units. All d-c power is supplied by two 60-ampere transformer-rectifiers which are connected in parallel through a current limiter to inhibit loss of d-c power.

An emergency ram air turbine driven generator supplies power to the essential loads if the main generators are not functioning.

Three independent 3000 psi closed-center hydraulic systems are used to supply power to airplane components which require heavy force application. The No. 1 and No. 2 power control systems supply power to the ailerons, spoilers and stabilator; and, the utility system supplies power to the rest of the hydraulically operated systems. Each power control system, in addition to having a relief valve, accumulator, pressure transmitter and heat exchanger, utilizes an airless, pressure loaded, piston type reservoir to supply fluid to a variable delivery pump. This type of reservoir insures necessary positive pump pressure at the suction port regardless of altitude or flight attitude. The utility system utilizes similar (except for size) reservoirs to supply fluid to each of two variable delivery pumps mounted respectively on the right and left engine. Emergency hydraulic power is also provided, and will be delivered to power control system No. 1 by a ram air emergency hydraulic pump in the event of engine or pump failure.

The airplane can be equipped with dual controls without altering the primary airplane or engine control system operation or rigging. Dual controls permit pilot transition training without sacrificing mission-readiness capability. The airplane can be reconverted for full radar-observer capability in minutes without removing any major dual control kit installation components.

The pneumatic power supply system provides high pressure air for canopy operation, nose gear strut catapult extension, ram air turbine extension and certain emergency operations. Air is supplied from air bottles, whose pressure is maintained by a hydraulic motor driven compressor.

For ease of manufacture and accessibility during fabrication, the Phantom II is made up of essentially four major assemblies: the wings, the forward, the center and the aft fuselages. The forward fuselage is fabricated in left and right halves ("half-shell construction"), and the cockpit areas are almost completely wired and finished before the halves are joined.

Fire Control System and Electronic Equipment

The airplane fire control system provides radar and IR search, target acquisition and tracking, attack phase steering information, CW target illumination and signals required for missile guidance. Major system components are: (1) Search and Track Radar, (2) Missile Control Radar, (3) Missile Firing Circuits, and (4) IR.

The Search and Track Radar, utilizing a hydraulically-driven dish antenna provides for airborne and surface search. It is equipped with anti-jamming devices and has a ground mapping mode. The Missile Control Radar serves to illuminate tracked targets for homing guidance and also acts as a missile computer. The Infra-Red Search and Track Set complements the Search and Track Radar and serves to facilitate detection and tracking of airborne targets.

In addition to the Fire Control System, the Phantom II carries the following electronic equipment:

Communication-Navigation-Identification Set (Collins Radio) which is an integrated Electronic Central that provides: (1) UHF Communications, (2) TACAN, (3) UHF ADF, (4) Auxiliary UHF Receiver, (5) IFF, (6) SIF, and (7) Intercom.

Central Air Data Computer (Airesearch – Division of Garrett Corp.) which furnishes data for automatic flight control subsystems, missile control subsystems, navigation computer, engine air inlet duct control system and some flight instruments.

Navigation Computer (Eclipse Pioneer Division of Bendix) which is a dead-reckoning ground position indicator.

Attitude Indicating and Loft Bombing System (Lear) providing attitude indicating system and gyro compass presentation.

Radar Altimeter (Raytheon) providing accurate altitude indication over land or water.

Autopilot (General Electric) providing attitude, altitude and Mach hold functions.

Data Link (RCA) providing a two-way system of high speed communication for automatic attack and carrier approaches.

The CNI (Communications-Navigation-Identification) was developed under the weapons system concept by McDonnell and Collins Radio Company. This was the first time that a prime contractor played a large role in determining the system objectives based on specifications agreed on between the prime contractor and the Navy.

The design goals for the system were: modularization, economies of space and weight integration (exemplified by common power supplies), shelf space mounting and a reliable operational system prior to the first Phantom II flight.

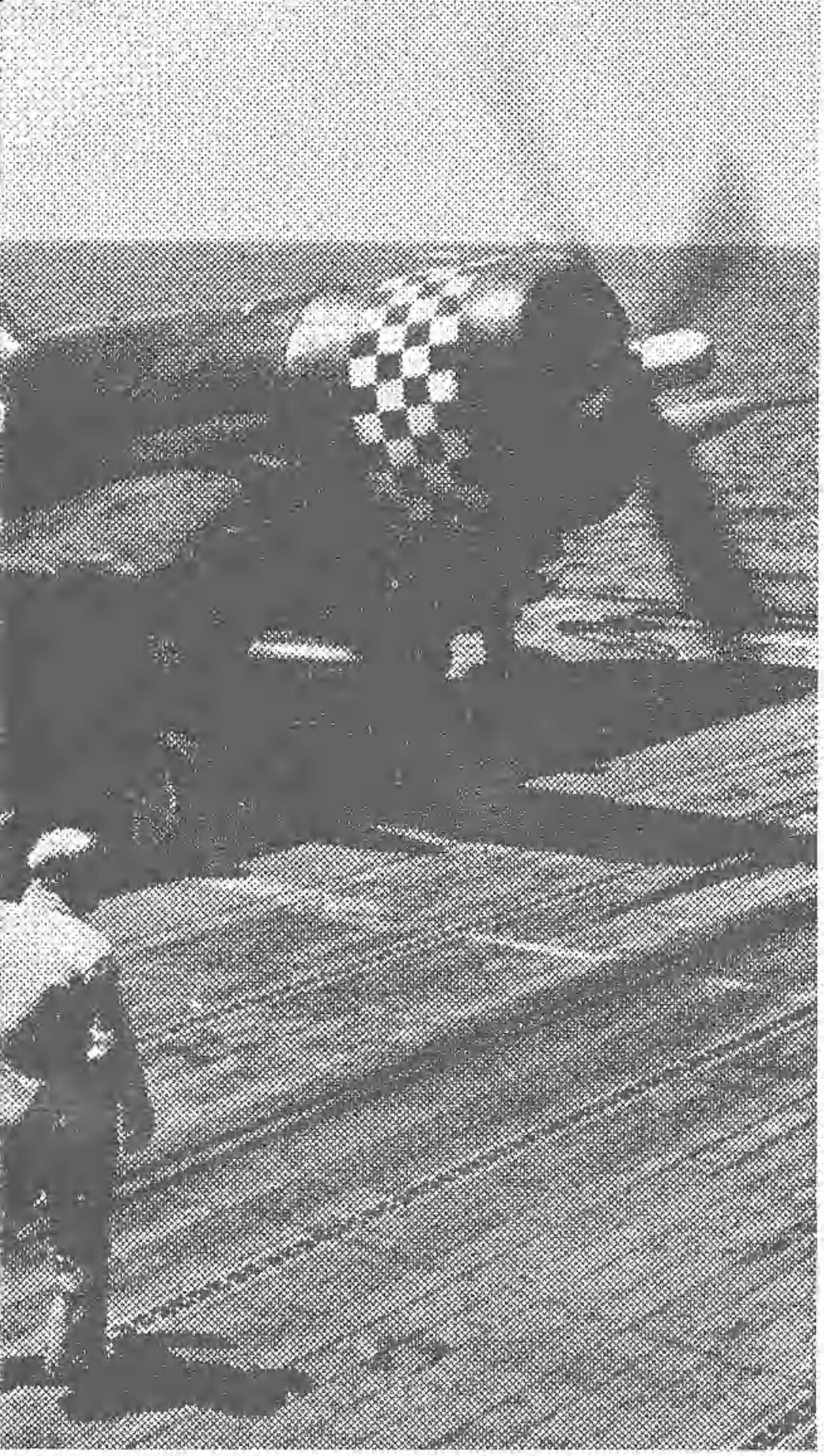
To be certain that the system would function soundly when installed in a Phantom II, a prototype package was installed in a McDonnell F3H Demon, where direct comparisons could be made between existing equipment and the CNI during flight.

Semi-submerged in the fuselage and slung beneath the wings are six Sparrow III air-to-air missiles. The Sparrow III missile is 12 feet long and weighs approximately 400 pounds. The airplane utilizes a cartridge-type ejection system which supersedes the older and more cumbersome rail launcher. Firing range is indicated to the pilot by a red "in range" light at the proper time, and missile guidance is by radar.

Twenty Years of Aircraft Maintenance

The time was 1943 on a U.S. Carrier in the South Pacific. A plane captain signaled to the line chief. His 10,000 pound fighter aircraft was in the up-status ready for a 100-mile mission. This was 10,000 pounds of mechanical devices. No radar, no electronic computers and the only hydraulics was in the landing gear oleo and brakes. A straightforward transmitter and receiver for communication were the only little black boxes. This airplane was in the up-status most of the time, like all others. Because it was a simple airplane, the plane captain knew every detail about it. He did all the flight deck maintenance, gassed it, oiled it, serviced the oxygen, kicked the tires and performed a general integrity pre-flight inspection. He even flew the airplane on non-combat missions. The only special support equipment required was a crank for the inertia starter. The availability of this airplane was great, but as a fighter, time soon made it ineffectual.

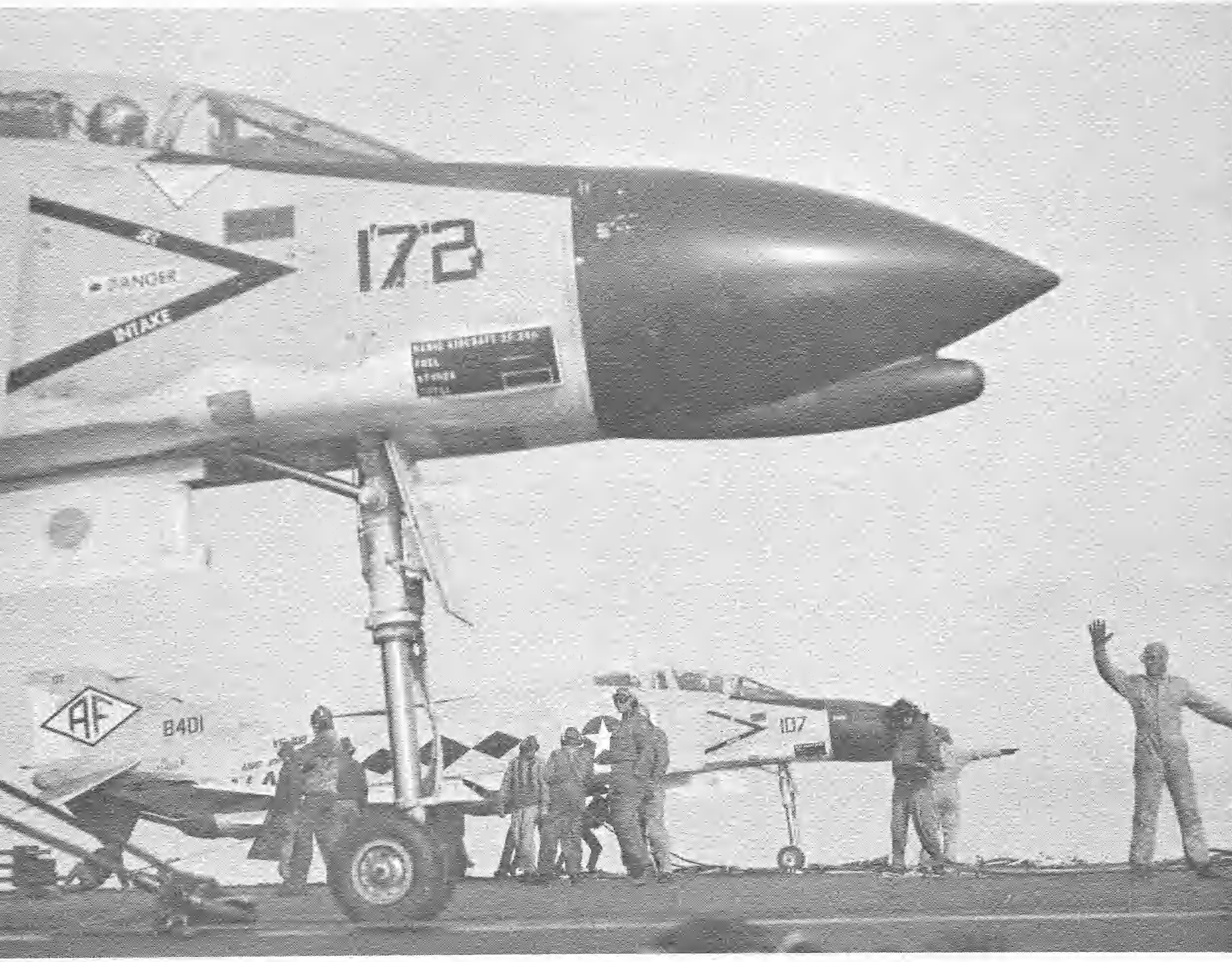
Ten years later in the Sea of Japan, a plane captain on the U.S.S. Essex CV-9 signaled to the line chief. His 25,000 pound jet fighter was in the up-status ready for a 500-mile mission. This plane captain needed help to place his airplane in the up-status – but not much help. He still knew most of the details. A basic radar system was installed and some electronics, but since this equipment was not integrated into a weapons system it was possible to fly an intercept mission, engage in combat, destroy the enemy and return to a carrier or a land base without utilizing these electronic systems. The support equipment consisted of a few



special wrenches and standard off-the-shelf test equipment. The mechanic could walk up to the airplane with a handcarried tool box, work on it, and then say, "It's ready to fly." It was not uncommon for this airplane to go a dozen straight hops without a squawk. Major inspections were performed many times just for the books. The line mechanics did not require special jet training – reciprocating engine experience was adequate. The engine major inspection was aboveboard – remove a few inspection plates, file out a few nicks in the compressor and turbine blades, and run it up. If it didn't shake, rattle or roll, it was ready to go. This was the rule of thumb with each system in the early jet fighters. These airplanes were adequate in their day but would have an unavailing effect in the fleet now.

The year is 1961. A plane captain on the U.S.S. Independence (CVA–62) signaled to his line chief. His 40,000 + lb. twin-engine, supersonic jet fighter was in the up-status, ready for an 800-mile, Mach 2 +, high altitude mission.

The servicing and preflight checkout procedures were carried out by a specially trained crew who worked with precision and speed. This airplane was packed with more integrated electronic components and systems than any previous Naval fighter aircraft and carried more firepower than a thousand World War II bombers. No taking anything for granted before this airplane hooked up to the steam catapult. Kicking the tires may have been a good way to see if a "Yellow Peril's" wings were well glued, but in this case you're dealing with some 20 tons of potent weapon which might resent it if you didn't give it the world's best service.



Today, maintaining a modern supersonic airplane is a specialist's job requiring from 18 to 24 men. In the case of the Phantom II, this job is simplified by the airplane's built-in maintainability but, compared to the fighters of 10 to 20 years ago, maintenance is an enormous task. The price paid for unrivaled performance and firepower is high, but it's not expensive when you consider the comparative return on the investment.

Phantom II Maintenance

The Phantom II represents the latest concept in Naval Aviation; that of a long range, Mach 2 +, all-weather interceptor and attack fighter. To fulfill these operational requirements, the aircraft had to be provided with more fuel, radar, electronics, navigational aids and a tougher structure than any previous Naval fighter aircraft. Reliability requirements and delicacy of electronic components dictate that they be shock mounted and installed in areas environmentally controlled with respect to pressure, temperature and humidity – yet operational requirements dictate that these components be readily accessible for maintenance – all this within a structure whose external size is dramatically limited by carrier operation. The Phantom II is one foot shorter than its single-engine carrier-based predecessor, the F3H Demon, and yet in operational squadrons will require less maintenance manhours per flight-hour (mmh/fh) than the F–101B, which has the lowest mmh/fh ratio of any century series aircraft.

The designer built maintenance accessibility into the airplane – 199 external access doors, as compared to 152 on the McDonnell F–101B. Major structural considerations which facilitate maintenance assessibility are: swing-up doors which expose both engines and attached hydraulic pumps and electrical equipment; top fuselage removable cover which provides accessibility to the fuselage fuel tanks and associated plumbing; and hinged radome and rail-installed radar, which permit the radar to slide out for maintenance without removal from the airplane.

Electronic Equipment – Interchangeability and modularization, employed throughout the electronic system and component installations, coupled with good accessibility, reduce maintenance time. Basically, the electronic equipment is housed in three main areas.

Most of the major Communication, Navigation and Identification units are shock mounted on a rack just behind and accessible from the nose wheel well. The compartment panel is quickly and easily opened by removing seven thumb screw type Dzus fasteners. These units can be removed easily. Test points labeled on the front panels of most of this equipment, aid in pinpointing trouble.

The radar set group, electrical synchronizer, radar set power supply-control and target intercept computer, radar transmitter and missile control radar magnetron cooling system are mounted on an electrical equipment rack in the nose equipment compartment. The support assembly slides forward for easy access and maintenance. (The IR is mounted in the bottom of the radome.)

Other electronic gear, mostly communication equipment, is located in the R.I.O. (Radar Intercept Officer) cockpit alongside the seat. Removal of electronic components from the R.I.O. cockpit can be accomplished without removing the complete seat since the installation features a removable seat bucket. Bucket removal is accomplished by two men in 5 minutes. This arrangement, in addition to providing good accessibility, affords maintenance personnel more room when performing minor cockpit repairs. cockpit repairs.

In addition to accessibility, the airplane provides many safety devices and maintenance aids, such as a manual switch which must be energized before external power can reach the CNI system. This feature precludes the possibility of damaging the CNI if the system is inadvertently turned on without ground cooling.

A maintenance intercom station (permitting personnel on the ground to keep in contact with personnel working in the cockpits) is of special value during engine operation. Safety is inherent in the high engine inlet air ducts, which reduce the possibility of injury to ground personnel during engine runs.

Control Systems – The control system bellcranks have rigging pin holes that provide a method of holding the bellcranks in the neutral position during rigging operations. This feature, in addition to enabling maintenance personnel to determine whether or not a component replacement or rework causes a dimensional change in the system, provides an easy and accurate method of determining the bellcrank neutral position and eliminates time-consuming measuring or guesswork.

Hydraulic Systems – System/Reservoir servicing is accomplished through quick disconnect fittings located in the left and right wheel wells for each flight control system and behind an access door for the Utility Hydraulic System. Use of quick disconnect fittings eliminates oil spillage, contamination, and manhandling of oil containers. Air bleeding for the flight control hydraulic systems is accomplished through a bleed valve located in the main landing gear wheel wells and Utility System air bleed is accomplished through a bleed valve located behind an access door.

Airless type reservoirs eliminate the need for an air pressurization system and piston fluid level indicators give the correct reservoir fluid level, regardless of airplane attitude.

Pneumatic System – The entire pneumatic system is air charged through one filler (air charge valve) point. Flap, Landing Gear, Ram Air Turbine and Wheel Brake Emergency Pneumatic Pressure Gages are visible from the ground without opening access doors.

Pneumatic subsystem air pressure gages, located in the nose gear wheel well, minimize the time required to trouble shoot the individual pneumatic subsystems. The gage faces are calibrated to compensate for temperature versus pressure variation.

Landing Gear – The Main and Nose Landing Gear Actuators employ integral down locks, which in addition to eliminating a complicated external mechanism, provide a more positive and safer down lock. The Main Gear shock upper chamber pressure may be checked quickly by inspecting a gage that is readily visible at the top of the strut. Main and Nose Landing Gear rigging is greatly simplified by rigging tools which are of the "go, no-go" type. Nose wheel steering reduces brake wear in addition to affording better airplane control on the ground. Jacking points on each gear permit tire changes in less than five minutes without jacking the entire airplane.

The wheel Brake System comprises a standard hydraulic system, accumulator and a completely separate pneumatic (emergency) system. Redundant systems provide a definite safety feature and eliminate normal hydraulic brake system bleeding every time the emergency (pneumatic) system is used. The wheel brake accumulator and its gage are readily visible from the nose gear wheel well and the wheel brakes may be bled without jacking the airplane.

Power Plant – The twin J79–GE–8 engines can be removed without jacking or removing the tail section from the aircraft. Large swing-up doors provide access to both engines and since a majority of the engine accessories are bottom mounted, they can be removed from the engine while it is installed. Servicing and/or removal of hydraulic pumps and electrical equipment can be easily accomplished.

The engine is built up neutrally and then converted to a right or left installation in 30 minutes. Heat shrouds and fire detector sensing elements are mounted on the airframe, not on the engine. Impingement engine starting directs air tangentially to the turbine blades eliminating the need for a separate air driven starter for each engine.

Engine Controls – Several features incorporated into the twin-air induction system reduce maintenance manhours. Mechanical rigging of the ramps will not change without disassembly or component changes. Easily accessible ramp amplifiers provide for changes in ramp travel through amplifier adjustments for exact ramp linear travel distances. Normally open engine auxiliary air doors (ground operating engine) permit access to the engine compartment for inspection and servicing.

The variable ramp system and bypass bellmouth system can be checked by attaching a test unit to the test connections underneath the airplane (ramp system) or to ports in the inlet duct (bypass bellmouth system). An access door is provided for bypass bellmouth controller adjustment; and, a removable inlet duct top and bottom louvers permit access for ramp components inspection.

Fuel System – The right wheel well fuel panel contains all switches necessary to control fueling and defueling operations, and permits one man to fuel or defuel the airplane. The panel contains switches for precheck of fuel level control valves and permits defective valve isolation if a valve malfunctions in the system. The left wheel well transfer pump check panel contains check switches and indicator lights which indicate if operation of the two hydraulic and two electrically driven fuel transfer pumps is satisfactory. The pilot's fuel system control panel contains "Fuel Boost Pump Check Switches" which permit the pilot and/or maintenance personnel to check each fuel boost pump's actual output pressure prior to flight.

Fittings, similar to tire valves, are located on the utility hydraulic service panel and in the right and left wheel wells. Using a low pressure air gage, tank pressures are easily checked to determine if tank pressure regulators and vent valves are maintaining correct tank pressures.

Fuselage fuel tank transfer pumps and fuel level control valves are mounted on the tank access covers. This arrangement permits removal and installation of components without defueling the fuselage tanks. The fuel quantity tank units are top mounted in the fuselage tanks. Each unit has individual access holes which eliminates large access door removal for maintenance. In addition, top-mounting reduces the possibility of fuel contamination damage.

A pressure fueling adapter is used to permit single point pressure refueling and defueling without use of additional ground support equipment. Two point ground pressure fueling can be accomplished by using the inflight refueling probe in addition to the underside fuel service inlet.

The fuel quantity indicating system is one completely transistorized unit containing indicator and amplifier. The only system adjustments are conveniently located at the rear of the indicator.

External fuel tanks are attached to the aircraft with a minimum of effort. The external wing tank sway braces are integral with the tank pylon and the sway braces do not have to be adjusted separately when installing a tank. As the tank is installed, the sway braces are automatically seated. In addition, external fuel tank installation automatically conditions the fuel system. As the tank is installed the quick disconnects are automatically coupled and when the electrical quick disconnect is attached, the required shutoff valve and relays are energized.

Airborne Missile Control System (AMCS) Two features of the missile fire control system that greatly reduce maintenance time are the single package test equipment unit that isolates a trouble to a particular black box or plug-in unit, and the built-in-test provided for rapid system checks. The latter feature, primarily for ground maintenance purposes, may also be used by the RIO after the airplane is airborne.

Armament – The missile launcher is engineered so that mechanical adjustments are not required during normal service life. In addition, dry film lubrication of all critical internal wear points eliminates internal linkage mechanism lubrication during normal service life. Missile launcher installation and removal from the airplane is fast because of a simple four (4) bolt attachment to the airplane structure. Launcher cleaning and lubrication is accomplished by flushing the gas tube system using a special cleaning and flushing kit.

The bomb rack is adjustable in pitch to permit easy centerline stores loading; and, the bomb rack breech and ejector mechanism can be easily removed for cleaning and lubrication without removing the bomb rack from the airplane.

Built-in stray voltage test receptacles on each missile launcher and each wing missile pylon help insure ordnance personnel and equipment safety. The rack cartridge ground test panel, located in the forward cockpit, permits continuity checks of all missile launcher, wing pylon, external wing fuel tanks and centerline bomb rack cartridge firing circuits from one location.

Sparrow III missiles can be loaded manually in two (2) minutes, each by a single crew. As a special weapons carrier, the Phantom II does not require the addition of any conversion kits.

General – The Phantom II utilizes the air logistic trailer system for removal and installation of major components. This trailer and its adapters may be used for installation and repair of the following items:

1. External Wing Tank
2. External Centerline Tank
3. Stabilator
4. Each Engine
5. Auxiliary Power Unit

General Maintenance features which speed up daily and preflight inspections are: look-through windows for gage indications, engine oil filling gages, cockpit access steps built into the fuselage, color coded lube points, and the fact that work stands are not required. A composite servicing pod which can be carried by the airplane on the centerline stores rack provides the airplane with its own hydraulic, electrical, pneumatic and cooling supplies for ground maintenance. Special attention is called to the special quick change provisions of high-usage items, such as tires, replaceable liquid oxygen converter, IRR coolant bottle, and drag chute, which can all be replaced in a matter of minutes. Rolling stock requirements are minimized since d-c power, LOX and IRR carts are not needed. This is especially desirable for advanced base/carrier operations where space is at a premium.

Corrosion maintenance has been greatly reduced on this airplane by the elimination of magnesium panels on the outer mold line skin. Chemical treatment and painting of dissimilar metals eliminates galvanic effects.

Servicing and maintenance is carried out in accordance with a scheduled maintenance program tailored to the needs of the Phantom II. In addition to providing the essential information on what, when and how to carry out maintenance, this program establishes a complete organization of men, equipment and materials. The program, all-inclusive from flight line up through the overhaul maintenance level, not only establishes an engineering methodological approach to the establishment of minimum maintenance requirements, but, in addition, provides for effective maintenance operation through the use of cards, sequence charts and other visual aids. Updating the maintenance requirements is accomplished by a continuous surveillance of field operational data utilizing an electronic data processing system.

Naval Air Mobile (Maintenance) Trainer – The Phantom II is the first U.S. Naval fighter to employ the integrated weapons system concept. The pilot and radar operator are, in effect, coordinators of the weapons system which, in turn, provides all of the capabilities necessary for mission accomplishment. It is important that operating and maintenance personnel of the Phantom II receive adequate training to ensure that the weapons system will be utilized to maximum effectiveness. To meet this need, the Naval Air Mobile (Maintenance) Trainer has been developed, produced and made available in the field.

The Naval Air Mobile Trainer consists of fourteen units, or individual system trainers, and the associated support equipment, such as power carts, handling devices and tools. Each individual trainer may be used to demonstrate single system functions or they may be interconnected to demonstrate the integrated operation of related systems as installed in the airplane. These trainers can be divided into three basic categories: (1) Aircraft System and Maintenance Trainer consisting of Surface Controls Trainer, Fuel System Trainer, Hydraulic System Trainer, Air Conditioning and Pressurization Trainer, Armament System Trainer, Electrical System Trainer, Landing Gear, Arresting Gear and Parabrake Trainer, Ejection Seat Trainer and the Jet Engine Trainer; (2) Weapon System Operation and Maintenance Trainers consisting of Weapon Control System Trainer, Automatic Flight Control Trainer, Communication, Navigation and Identification Trainer and the Central Air Data Computer Trainer; and, (3) the Cockpit Orientation Trainer.

The trainers and associated equipment may be compared to a non-flying operational aircraft. The training device and all of the support equipment supplied provide a system by which group instruction can be given by actual demonstration of both operation and maintenance procedures. Detection and elimination of mistakes in early training expedite and reduce the cost of early airplane fleet operation.

movable inlet duct top and bottom louvers permit access for ramp components inspection.

Fuel System – The right wheel well fuel panel contains all switches necessary to control fueling and defueling operations, and permits one man to fuel or defuel the airplane. The panel contains switches for precheck of fuel level control valves and permits defective valve isolation if a valve malfunctions in the system. The left wheel well transfer pump check panel contains check switches and indicator lights which indicate if operation of the two hydraulic and two electrically driven fuel transfer pumps is satisfactory. The pilot's fuel system control panel contains "Fuel Boost Pump Check Switches" which permit the pilot and/or maintenance personnel to check each fuel boost pump's actual output pressure prior to flight.

Fittings, similar to tire valves, are located on the utility hydraulic service panel and in the right and left wheel wells. Using a low pressure air gage, tank pressures are easily checked to determine if tank pressure regulators and vent valves are maintaining correct tank pressures.

Fuselage fuel tank transfer pumps and fuel level control valves are mounted on the tank access covers. This arrangement permits removal and installation of components without defueling the fuselage tanks. The fuel quantity tank units are top mounted in the fuselage tanks. Each unit has individual access holes which eliminates large access door removal for maintenance. In addition, top-mounting reduces the possibility of fuel contamination damage.

A pressure fueling adapter is used to permit single point pressure refueling and defueling without use of additional ground support equipment. Two point ground pressure fueling can be accomplished by using the inflight refueling probe in addition to the underside fuel service inlet.

The fuel quantity indicating system is one completely transistorized unit containing indicator and amplifier. The only system adjustments are conveniently located at the rear of the indicator.

External fuel tanks are attached to the aircraft with a minimum of effort. The external wing tank sway braces are integral with the tank pylon and the sway braces do not have to be adjusted separately when installing a tank. As the tank is installed, the sway braces are automatically seated. In addition, external fuel tank installation automatically conditions the fuel system. As the tank is installed the quick disconnects are automatically coupled and when the electrical quick disconnect is attached, the required shutoff valve and relays are energized.

Airborne Missile Control System (AMCS) Two features of the missile fire control system that greatly reduce maintenance time are the single package test equipment unit that isolates a trouble to a particular black box or plug-in unit, and the built-in-test provided for rapid system checks. The latter feature, primarily for ground maintenance purposes, may also be used by the RIO after the airplane is airborne.

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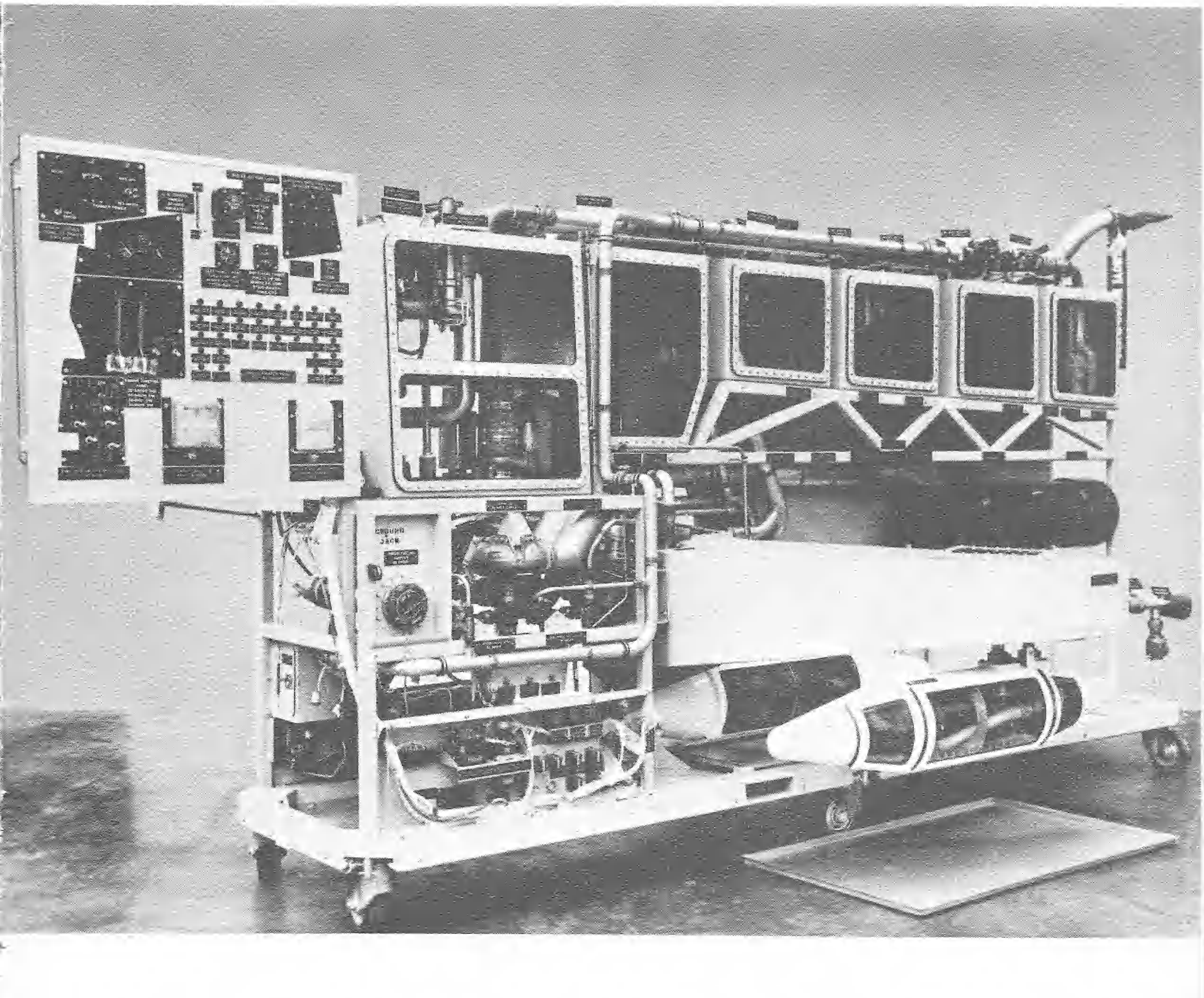


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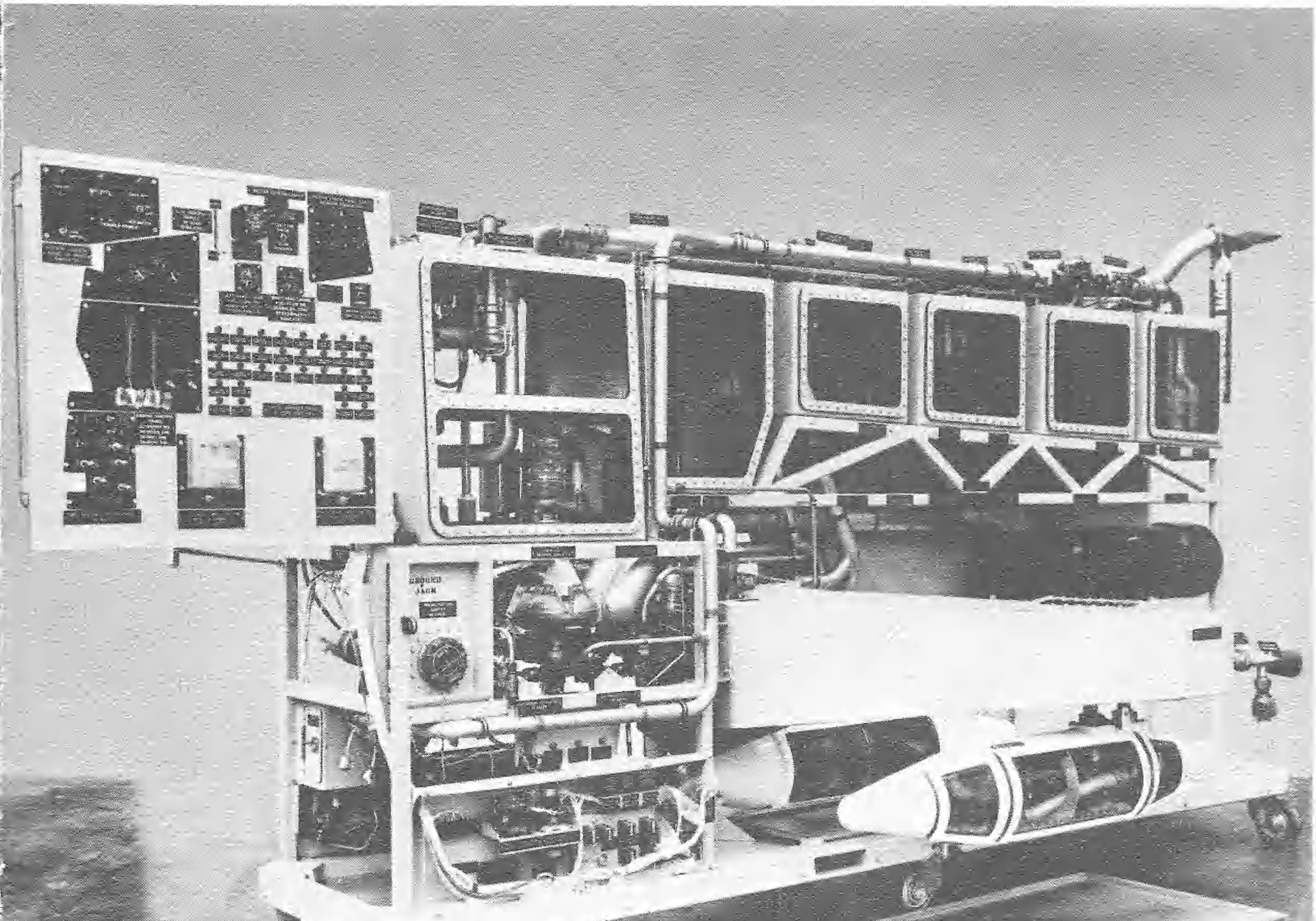


FLYING THE PHANTOM II by Commander William A. Mackey, United States Navy

The Phantom II is the first airplane that I have ever had the pleasure of flying which is always capable of performing as well as, if not better than, the Contractor advertises in his sales brochures. For example, when a pilot tells this machine to go Mach 2, he will never have it apologizing or making excuses because of such things as the upper air temperature being too hot that day or because there is still too much fuel aboard. Plain and simply, this bird is loaded with the performance capable of exceeding its published performance envelope at any time. It is truly a perfect tool for our Navy pilots intrusted with the fleet's air defense mission.

Before I begin to sound completely like a McDonnell rather than Navy pilot, let's discuss actually flying the Phantom II. My association with the F4H has been in the role of a Navy production test pilot at the McDonnell Aircraft Corporation for the past two-and-a-half years. It required only a few hours flying in this twin engine interceptor for me to realize that it is a real pilot's airplane – comfortable, honest, straightforward and very easy to fly throughout the speed range.

Since even the production version is capable of attaining near-record altitudes on every flight, the pilot will want to be prepared and wear a pressure suit. In fact, wearing the suit on every flight is an excellent way for the pilot to become fully acquainted with it. In a very few hours he will be feeling completely at home. The pressure suit used with the Phantom is the Navy's Mk IV Mod I Light Weight Full Pressure Suit made by the B.F. Goodrich Company. The suit is both comfortable and mobile, and will become immediately pressurized if airplane cabin pressurization drops below 3.4 psia. It offers protection against rapid decompression, wind blast and cold, and gives complete protection from the hazards of extreme altitudes. It is automatic and operates under all conditions, including ejection.

For the period while pilot and RIO are being transported to the airplane from the ready-room they carry small, light portable air conditioning units that afford ventilation air to their suits.

Despite the plane's complexity and density, walk-around inspection of the F4H can be accomplished in a few minutes and is as simple and routine as the inspection of any modern jet interceptor. I usually have my RIO accompany me on this brief tour and follow recommended procedures set forth in the pilot's handbook, checking mainly for fuel or hydraulic leaks, removal of protective covers, and proper pressure gauge readings.

External canopy operation is accomplished pneumatically by depressing individual buttons on the left exterior of the fuselage just below each canopy. Normal access to the cockpit is made via a built-in boarding ladder and two kick-in steps located on the left side of the forward fuselage. The boarding ladder release button is located in the bottom kick-in step. This convenient feature eliminates the necessity of a separate ladder which is always a hazard during carrier operations where high winds across the deck are routine and a loose object blowing down the flight deck could result in injury to personnel

Naturally, this up-to-date fighter is equipped with the latest in ejection seats, the Martin Baker, which provides both low level and high altitude escape capability. Getting strapped into the seat is accomplished easily and rapidly by use of a pilot's integrated flight harness designed for use with the seat.

Cockpit arrangement is good — a real pilot's cockpit. The RIO's are equally pleased with their workshop, but since I am more familiar with the front cockpit and the pilot's tasks, I will refrain from further discussion of the rear cockpit.

The pilot's right console contains an orderly arrangement of the communication and navigation control switches, external and internal light controls, wing folding control, generator switches, and cabin temperature and pressurization controls.

The left console contains the throttles, fuel control panel, AFCS (Automatic Flight Control System) panel, engine control panels, radio inter-communications control panel; emergency handles for canopy, flaps, and hydraulic/generators; and the drag chute handle.

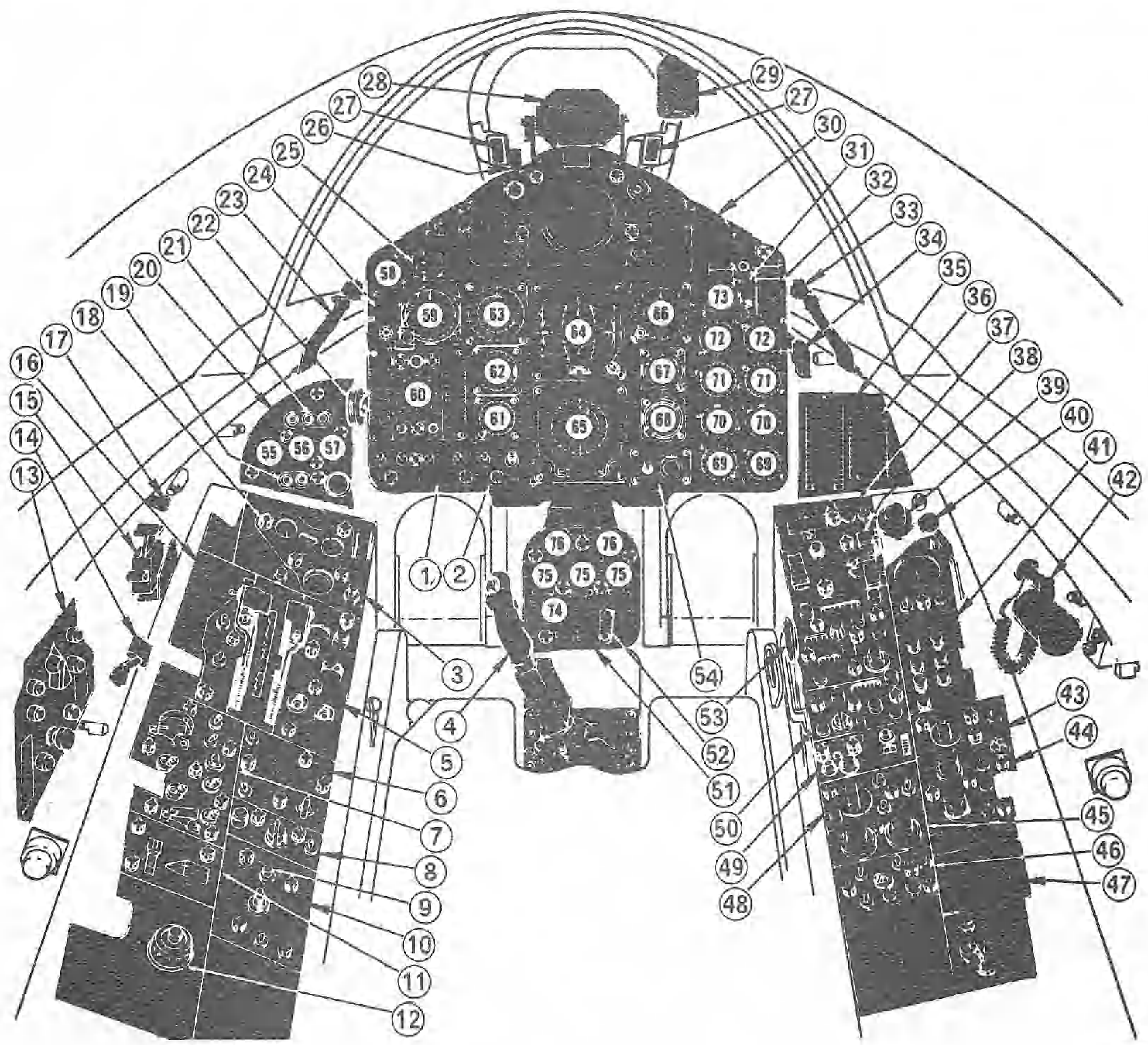
The right vertical panel contains a grouping of all warning lights. When a malfunction occurs, a master caution light illuminates on the main instrument panel simultaneously with the proper one on the warning light panel. This reduces the amount of instrument surveillance required by the pilot since he need only watch the Master Caution light for an indication of trouble and then refer to the warning light panel for a definition of his problem.

The left vertical panel provides indication of wheel and flap position and trim settings.

The main instrument panel is designed for maximum ease of scanning under instrument conditions. The Attitude Director Indicator (ADI) is a very imposing 5 inch diameter instrument located in the center of the panel. It provides attitude and heading information in all three axes simultaneously with flight director indication. Directly below it is the Horizontal Situation Indicator (HSI) which is the same size and provides the horizontal or plan view of the aircraft with respect to the navigation situation.

Forming a T arrangement with the two instruments described above are the Airspeed and Mach number indicator on the left of the ADI and the counter pointer type altimeter on the right.

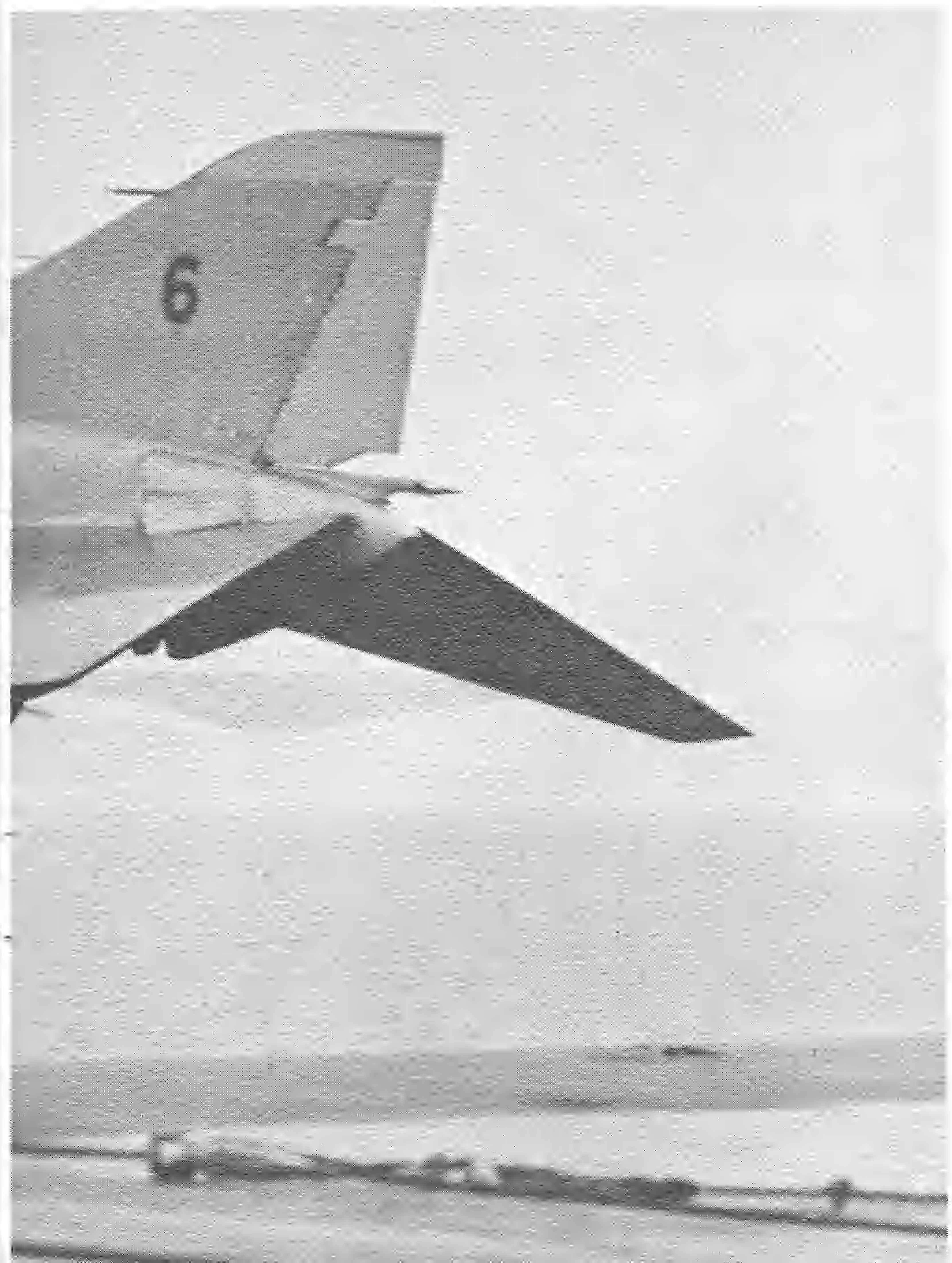
The right side of the main panel holds the fuel quantity gauge and an orderly arrangement of the necessary engine instruments for each engine. The left side of the panel consists mainly of the fire control switches and presentations.



1. MISSILE CONTROL PANEL
2. BOMB CONTROL PANEL
3. LEFT UTILITY PANEL
4. CONTROL STICK GRIP
5. ENGINE CONTROL PANEL (INBOARD)
6. FLIGHT CONTROL PANEL
7. FUEL CONTROL PANEL
8. INTERCOM CONTROL PANEL
9. STEPS POSITION INDICATOR
10. AUXILIARY ARMAMENT CONTROL PANEL
11. PRESSURE SUIT/OXYGEN CONTROL PANEL
12. ANTI "G" SUIT CONTROL VALVE
13. RACK CARTRIDGE GROUND TEST PANEL
14. EMERGENCY HYDRAU IC PUMP HANDLE
15. FLAP CONTROLS
16. ENGINE CONTROL PANEL (OUTBOARD)
17. CANOPY CONTROL HANDLE
18. ENGINE CONTROL PANEL (CENTER)
19. FLAP POSITION INDICATORS
20. LEFT VERTICAL PANEL
21. GEAR POSITION INDICATORS
22. LANDING GEAR CONTROL HANDLE
23. EMERGENCY CANOPY RELEASE HANDLE
24. LANDING CHECK LIST
25. UHF CHANNEL INDICATOR
26. LABS LIGHT
27. APPROACH INDEXER LIGHT
28. AZIMUTH-ELEVATION-RANGE INDICATOR
29. STANDBY COMPASS
30. MAIN INSTRUMENT PANEL
31. FEED TANK CHECK LIST
32. TAKE-OFF CHECK LIST
33. MANUAL CANOPY UNLOCK HANDLE
34. ARRESTING GEAR CONTROL HANDLE
35. RIGHT VERTICAL PANEL
36. CAUTION LIGHT PANELS
37. ELECTRICAL CONTROL PANEL
38. T249A BOMB CONTROL MONITOR PANEL
39. EMERGENCY VENT HANDLE
40. DEFOG-FOOT HEAT HANDLE
41. RIGHT UTILITY PANEL
42. UTILITY SPOT AND FLOOD LIGHT
43. TEMPERATURE CONTROL PANEL
44. COCKPIT LIGHTS CONTROL PANEL
45. SIF CONTROL PANEL
46. EXTERIOR LIGHTS CONTROL PANEL
47. WINGFOLD PANEL
48. IFF CONTROL PANEL
49. COMPASS SYSTEM CONTROLLER
50. COMM-NAV. GROUP CONTROL PANEL
51. PEDESTAL PANEL
52. RUDDER PEDAL ADJUSTMENT CRANK
53. EMERGENCY BRAKE HANDLE
54. MODE-BEARING/DISTANCE SELECTOR PANEL
55. STABILATOR TRIM POSITION INDICATOR
56. WING TRIM POSITION INDICATOR
57. RUDDER POSITION INDICATOR
58. TRUE AIRSPEED INDICATOR
59. RADIO ALTIMETER
60. MISSILE STATUS PANEL
61. ACCELEROMETER
62. ANGLE-OF-ATTACK INDICATOR
63. AIRSPEED AND MACH NUMBER INDICATOR
64. ATTITUDE DIRECTOR INDICATOR
65. HORIZONTAL SITUATION INDICATOR
66. ALTIMETER
67. VERTICAL VELOCITY INDICATOR
68. CLOCK
69. EXHAUST NOZZLE POSITION INDICATORS
70. EXHAUST GAS TEMPERATURE INDICATORS
71. TACHOMETERS
72. ENGINE FUEL FLOW INDICATORS
73. FUEL QUANTITY INDICATOR
74. PNEUMATIC PRESSURE INDICATORS
75. HYDRAULIC PRESSURE INDICATORS
76. OIL PRESSURE INDICATORS

The aircraft's impingement starting system eliminates the need for the usual bulky, heavy starters found in most airplanes. Air from an external source is distributed to the left or right engine, depending on the pilot's selection. The actual start procedure is very simple and straightforward. After the external air and electrical power sources are connected, the pilot turns on the engine master, then the starter switch, waits until the engine reaches 10–11% and then depresses the ignition button on the appropriate throttle and moves the throttle to idle position. The throttles are standard, going forward and inboard from OFF to IDLE and then forward to the stop for full military power. For afterburner (A/B), the throttle is moved outboard and forward from full military.

The Phantom II has a high acceleration off the catapult. With its two J79 engines, the Phantom II has an excess of power at low altitudes, and carrier wave-offs are very easily accomplished.



For taxiing and ground control, the Phantom II is provided with nose wheel steering (or if the pilot so desires he can steer the bird by differential braking of the main wheels). To engage the steering control, the pilot simply presses a button on the control stick and then guides the airplane directionally with the rudder pedals. Steering is disengaged by letting up on the button. Once the plane is rolling, idle power is usually adequate to keep it rolling at the proper taxi speed. Taxiing the Phantom is when the pilot first begins to feel this is the airplane for him. There is none of the "shake, rattle and roll" associated with some of the other jets I have flown. The machine moves along smoothly and with a very solid feel. When brakes are applied to bring it to a stop, it comes to rest easily without vibration.

Checking of the engines prior to take-off must be done individually since running them up simultaneously above 85% RPM while holding brakes could result in skidding or tire rotation on the wheels. Although full flap take-offs are acceptable for normal field use, half-flaps are preferred since there is a reduction in drag, increased power (less bleed air being used for Boundary Layer Control), only a small loss of lateral control, increased stabilator effectiveness, best configuration for single engine, and less trim change while cleaning up. No-flap field take-offs are permissible if the situation warrants it. Full flap take-offs are necessary for shipboard catapult launches.

My procedure for taking off in the F4H is as follows: After the engines have been checked individually and the airplane lined up on the runway with take-off clearance received from the tower, I advance throttles to about 80% and release brakes. Power is then advanced to full military and a rapid check of engine instruments is made prior to moving into afterburner. After the afterburners are lighted another check is made of the engine gauges, especially the EGT (Exhaust Gas Temperature) and nozzle position indicators. The rudder becomes effective for directional control at about 80 knots and the nose strut can be extended at about 110–115 knots with light back pressure on the stick. This enables the use of only moderate back stick to lift off at about 145 knots. A good rule-of-thumb trim setting for any take-off flap configuration is neutral for rudder, stabilator, and ailerons.

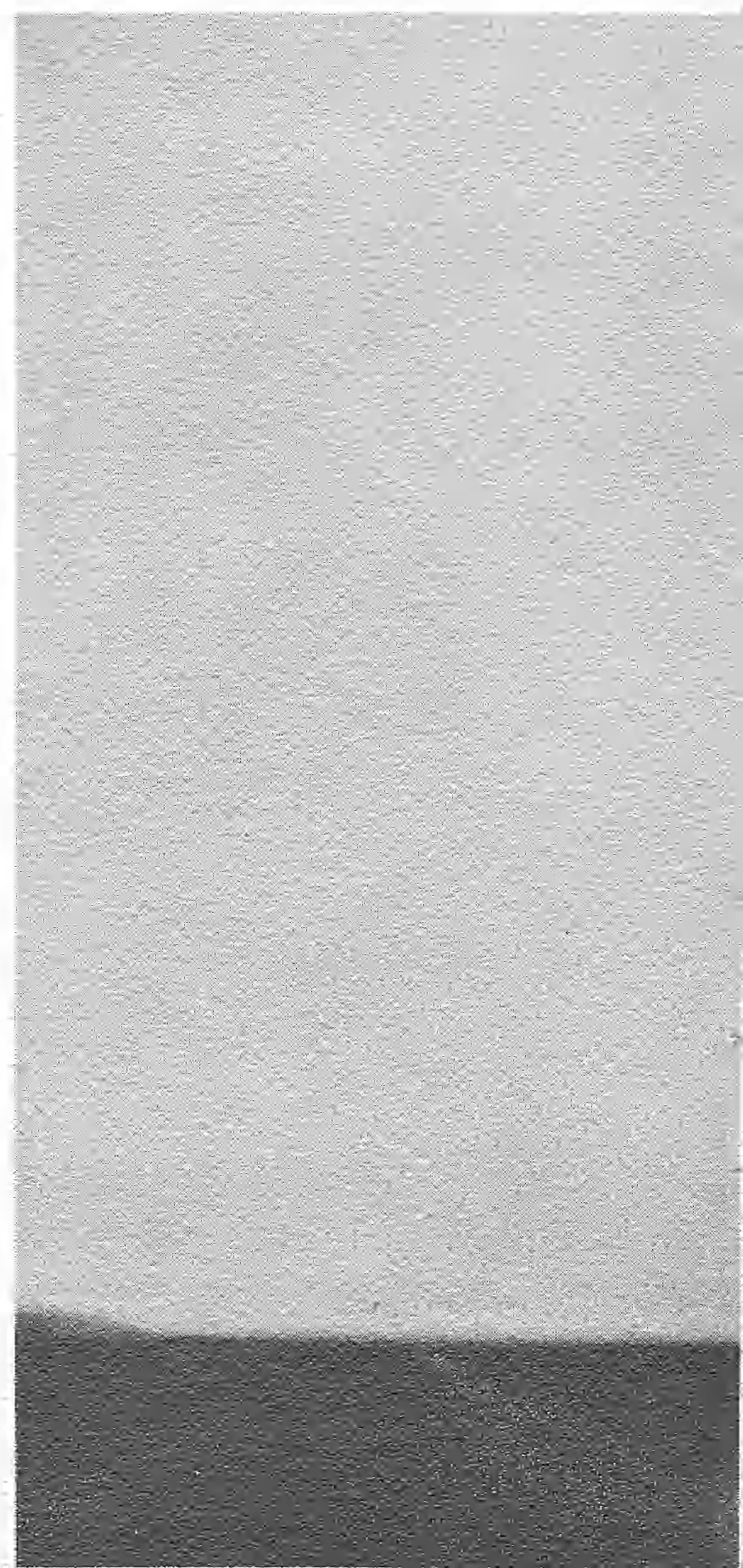
In my brief description of the take-off, I note that I failed to emphasize sufficiently the phenomenal acceleration of the F4H when using A/B. To even an experienced pilot familiar with the normal accelerating jet interceptors in service today, take-off acceleration with afterburner in this bird is going to be breath-taking to say the least. It is so rapid that even if he is prepared for it, the first couple of take-offs will find him having a difficult time absorbing much of what happened and asking himself how he got to 40,000 feet when he wanted to stop at 30,000. So to make sure that on the first few rides pilot and Phantom know who's flying whom, I recommend only full military power be used for take-offs.

When the airplane is positively airborne, raise the landing gear. Since even a clean take-off can be made at 160 knots, flaps can be started up at this speed which will easily be attained by the time the pilot has put the gear handle in "up" position.

Immediately after getting airborne with gear and flaps retracting, there will be a noticeable nose-up tendency which is readily controllable and easily trimmed out. In A/B quite a nose-up attitude is required to hold down acceleration enough for gear and flaps to clean up prior to reaching limit speeds.

Needless to say an A/B climb to forty or fifty thousand feet is quite impressive and must be experienced to believe. When operating around a field or area that has considerable traffic, it is best to get a "high performance take-off" clearance and radar control since the nose attitude becomes quite high. The Phantom II's time-to-climb performance is also of the record breaking variety.

On reaching an altitude of 35 to 40 thousand feet the pilot will find the airplane handles very well in subsonic flight regimes. Three axis dampers are available and he will feel quite comfortable orbiting and conserving fuel while awaiting assignment of an intercept mission. Longitudinally, in the area of transonic flight, the machine becomes even more stable in both static and maneuvering stability. Lateral control system and rudder remain effective in this range with little noticeable change. Over-all, the plane remains highly maneuverable in the transonic

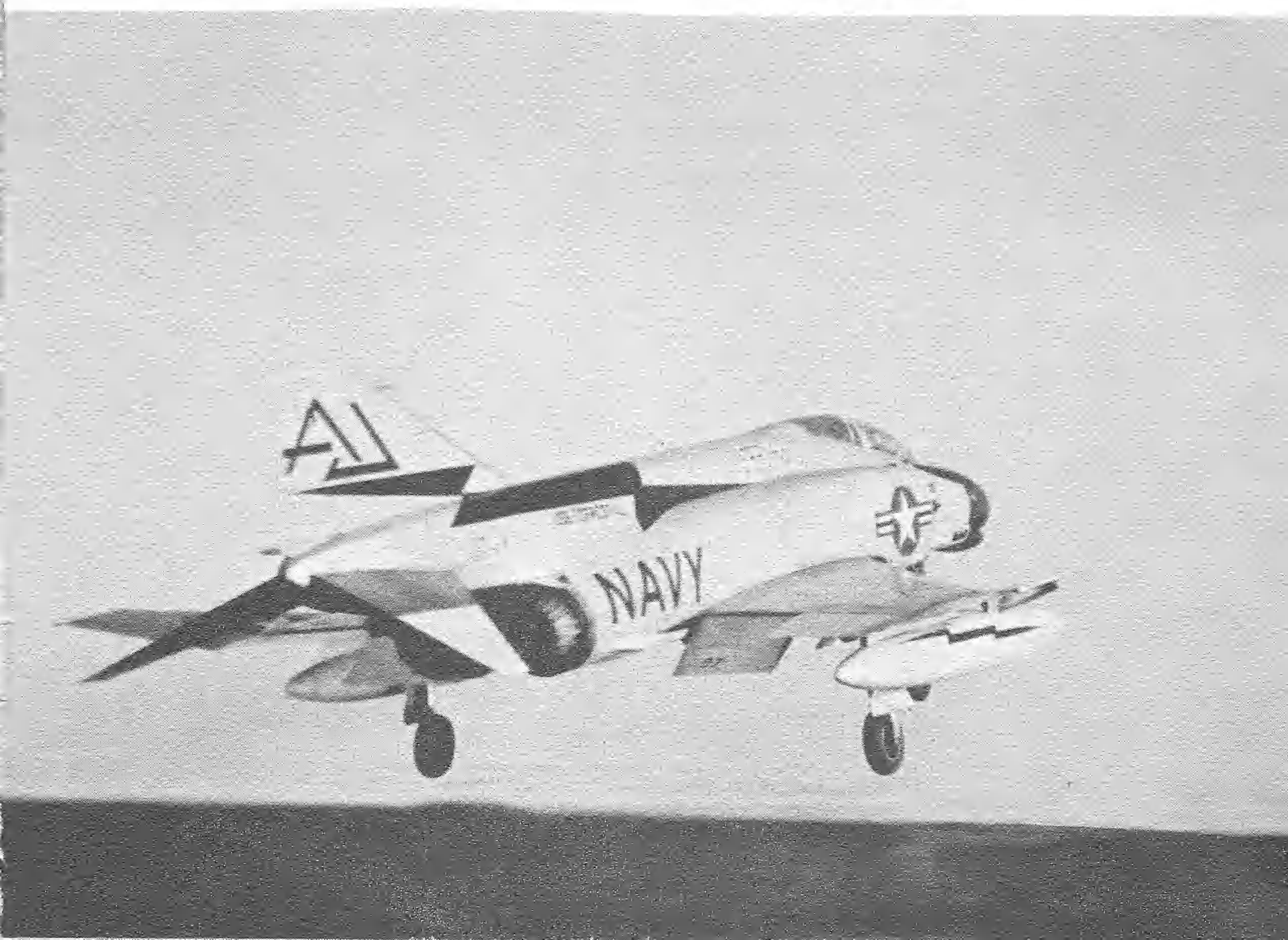


speed range. In the supersonic region stabilator effectiveness is reduced as Mach number increases; however, the airplane still maneuvers quite well out to Mach 2+ speeds. Longitudinal damping is highly positive at all supersonic speeds. Roll rate and response is reduced at high supersonic speeds, but remains sufficiently high to permit rapid maneuvering at all speeds. The rudder remains effective but is reduced considerably in yawing power at high mach numbers.

The Phantom II provides the pilot with a very fine AFCS which is an electro-hydraulic autopilot system capable of performing two modes of operation, damper and autopilot. The damper improves stability in pitch, roll and yaw and can be used while the plane is being flown manually. The autopilot mode maintains any heading and/or attitude selected by the pilot within autopilot limits. It is also capable of holding any altitude or Mach number selected. For a change in heading or attitude, movement of the normal flight control stick will effect the change without the necessity of disengagement and reengagement of the autopilot. Normal disengagement is simply the reverse of the engagement sequence, but an emergency or rapid disconnect feature is provided on the control stick which disengages the entire autopilot.

Despite the Phantom II's amazing take-off performance the pilot is in for an even more pleasant surprise when he receives an order to abandon his subsonic orbit station and intercept an inbound target as soon as possible. The time required to accelerate from about .85 Mach to a speed in excess of Mach 2 is truly remarkable and in my opinion places the Phantom II foremost among the world's fighters.

Hydraulically operated speed brakes, mounted on the underside of the inboard wing panels, are very effective in slowing the aircraft and can be extended at any speed. Pitch trim change required during extension is surprisingly small.



The final phases to be discussed are slow flight and landing, and here the Phantom II gives the Navy pilot final proof that it meets the full requirements of an outstanding carrier-based interceptor.

The pilot is provided with angle-of-attack indexers which are installed on each side of the windshield. The indexers present angle-of-attack information during a landing approach by illuminating symbolic cutouts. They are located so as to be readily seen at all times during a carrier or field landing. This permits the pilot to devote more of his attention to line-up and rate-of-descent.

For an airplane which has better than a twelve-to-one ratio of top speed to landing approach speed, it is probably surprising to read that the Phantom II is completely free of any unusual or tricky landing characteristics. Its handling during approach, landing and roll-out is as comfortable and unrestricted as the best handling jet trainers. In fact, it is probably more comfortable to the pilot, mentally, because of the abundance of power available for wave-off or recovery from a sagging approach. The only noticeable difference is weight. This bird weighs more during landing than most of the latest Navy fighters weigh at take-off. Still it has comparable approach speeds.

Entry to the break for a normal landing can be made at any airspeed dictated by local course rules. Speed brake extension and a tight turn will always reduce speed to the landing gear maximum by the time the 180° position is reached. For my own standardization purposes I usually hit the break at about 350 knots. Extending the landing gear and flaps produces a negligible attitude and trim change. The noise and buffet that comes from the nose gear wheel well during gear extension smooths out and disappears as approach speeds are reached. Full flaps are used for normal landings, but ½ flaps are recommended for single engine approaches for obvious reasons. At about the 180° position I recheck the gear and flap indicators for a down indication and retract speed brakes to decrease buffet. Here I usually also check the Aileron Rudder Interconnect (ARI) System. This is a special system that the Phantom has which causes rudder displacement proportional to aileron displacement and provides coordinated turns at low airspeeds. The limits of the system are 15° of rudder displacement when the damper is engaged and 10° rudder when the damper switch is OFF. As I roll into the base leg with a moderate rate of descent, I continue to reduce speed so that about the time I hit the 90° position I am about 10–15 knots above final approach speed. I am paying very close attention to the approach indexer to insure that I don't get slower than the "on-speed" indication. When on the final approach (I try to plan the base leg to allow for about a one-mile straightaway final), I attempt to establish a 700 feet-a-minute descent aiming for a touchdown point within the first 1000 feet of runway. I do not attempt to flare or chop power prior to crossing the end of the runway, because when making a power approach in this bird, deceleration with throttles retarded is rapid due to power response and it is going to start settling very fast. Immediately after touchdown I retard throttles to idle, deploy drag chute and hold the nose wheel off as long as possible to take advantage of aerodynamic braking. Frankly, there is very little aerodynamic braking available in the F4H when comparing it to the F3H Demon or F–101 Voodoo. The nose wheel will fall through to the runway after the plane has slowed only about 20–25 knots. Worth mentioning is the fact that I never deploy the drag chute prior to touchdown. To do this will result in the landing being accomplished much shorter and harder than expected.

Crosswind characteristics are good and no special techniques are necessary to accomplish the approach and touchdown except that no effort should be made to hold the nose wheel off after landing. The pilot should also feel free to engage nose gear steering at any time after touchdown to assist in directional control.

The landing roll technique is straightforward. Maintain directional control with rudder until nose wheel rocks forward to the three-point attitude; directional control is then maintained by slight brake pressures and/or nose gear steering. Despite its lack of good aerodynamic braking, the airplane requires less runway for landing than most jets because of the very slow approach and touchdown speed combined with drag chute effectiveness.

Single-engine landings? Actually, they can be considered basically the same as a normal landing. The single-engine flight characteristics are essentially the same as normal flight characteristics due to the proximity of thrust lines to center of the airplane. Slight rudder deflection is required to prevent yaw toward the failed engine. The aircraft design is such that no one safety of flight requirement is dependent on a specific engine. Thus, loss of an engine will not affect safe aircraft operation. The landing pattern is expanded to avoid steep turns and the final approach speeds are increased slightly for better lateral control and more stall margin. As mentioned before, wing flap position would be one-half in this case. If the necessity for a single-engine wave-off should occur, the Phantom II will have the situation well under control. It has ample thrust to accomplish the wave-off snappily without having to resort to afterburner. The afterburner is available, however, and should be used when the pilot so desires.

Because of its relatively low approach speed and its rugged construction (which permits a high engaging speed) the Phantom II wind-over-deck requirement is very low for carrier landings. Excellent stability and controllability in the approach result in lower than average carrier arrested landing sink rates, although the airplane's main and nose landing gear can withstand sink rates of 24 fps and 25.4 fps (for a free flight engagement), respectively.

This has been an effort to hit the high points of flying the Phantom II. I hope that I have adequately described those features which I personally find exciting about the bird. In closing, let me say to any pilots reading this that I wish for them the same good fortune that I have had – that of "Flying the Phantom II."