INTERNATIONAL

THE F/A-18 HORNET

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All free-world nations have the sovereign right to take the necessary means to deter potential adversaries; and if deterrence fails, they must be prepared to defend their security interests. To deter potential threats in today's complex and dynamic world means possessing superior capabilities coupled with the demonstrated will to defend national interests. Technology has made the environment we live in more accessible. For those not prepared it has also created a more threatened existence. Weapons systems must keep pace with technology and provide, at the lowest possible cost, the means to defend and protect. To this end, the F/A-18 Hornet strike/fighter sets the free world's standard as the most effective multimission aircraft in production. The following pages tell the remarkable Hornet story.

A World Perspective

The F/A-18 Hornet is one of the most versatile tactical aircraft in the world. After comprehensive evaluations with competing fighters, numerous free-world nations have selected the Hornet as their first line-of-defense aircraft. Specific reasons for choosing the F/A-18 include: superior radar and avionics, considerable growth potential, excellent handling qualities, cockpit designed for unequalled situation awareness, operation and support costs lower than those of competing aircraft, multimission capabilities, and overall safety.

Hornet versatility is demonstrated through its capability to perform multiple missions; air-to-air, air-to-ground and reconnaissance. Since the F/A-18 was designed to operate in the demanding naval environment, it has excellent handling qualities and structural strength needed for carrier operations. The F/A-18 cockpit technology reflects advanced design concepts and systems integration that is unmatched in the world. The high degree of sophistication is reflected in the ease of operation by a single pilot.

The Hornet has the best safety record of any U.S. Naval tactical aircraft. Maintenance requirements are minimized through built-in test systems and accessible self-contained components. A prime example is that an engine has been changed in as little as 25 minutes. The dependable Hornet is consistently ready for the fight.

The Hornet was developed and is produced by the McDonnell Douglas Corporation, an American firm with more that 50 years of experience in designing and building aircraft. The corporation is internationally known for high quality aircraft; advanced technology; and has a reputation for honesty, integrity and fairness. The principal subcontractor for the F/A-18 is the Northrop Corporation, a company also backed by over 50 years of experience in aviation.

Multimission Capability

Because of the Hornet's designed-in mission flexibility, the F/A-18 gives the on-scene battle commander the ability to respond rapidly to varying mission demands by changing the tasking and ordnance loads of the Hornet so that he can support air-to-air, air-to-ground, and anti-shipping requirements. No airframe or avionics conversion is required for the various weapon delivery missions.

Fighter

As a fighter, the Hornet can strike airborne targets that are beyond the pilot's visual range. This tactic is possible because the Hornet's multi-mode radar can detect aircraft over 160 kilometers (100 miles) away. The Hornet can attack airborne targets with the medium-range, highly accurate Sparrow missile system. Both the radar and weapons systems can operate day or night and in fair or foul weather.

The Hornet's twin engines can provide a thrust-to-weight ratio of 1:1. The F/A-18 can accelerate in vertical flight, reach a maximum speed of 1.7 Mach-plus, and fly to a height of more than 15,250 meters (50,000 feet).

The Hornet is armed with a mix of air-to-air weaponry including short-range heat-seeking Sidewinder missiles, medium range radar-guided Sparrow missiles, and a high rate of fire 20 millimeter cannon. Up to eight missiles can be carried including six Sidewinders and two Sparrows. Intercept radius of the Hornet is greater than 640 kilometers (400 miles) using only internal fuel and over 1,045 kilometers (650 miles) with external fuel tanks.

Attack

In the attack mode, the Hornet can accurately strike surface targets with first-pass precision. With its high-resolution radar and Doppler beam sharpening, it can detect ground targets in adverse weather and at night. Both free-fall and guided weapons can be delivered with pinpoint accuracy. The nine payload stations on the wings and fuselage allow the Hornet to carry various combinations of bombs, missiles and external fuel tanks.

Structure

Approximately one-half of the Hornet's airframe is fabricated of aluminum. Steel and titanium are used in heavily loaded or high temperature areas. About 10 percent of the structural weight is carbon/epoxy composite material. This extremely light, corrosion-resistant material is used in the wing skin, horizontal and vertical tail skins, trailing edge flap skins, speed brake, dorsal covers, and in various access doors on the fuselage. Carbon/epoxy composite material has several advantages: it is less costly to produce, can be formed into complex shapes, and it is relatively insensitive to flaws. Fatigue testing of composite structures have demonstrated that they are highly resistant to cracking and fractures generally do not propagate.

Airframe Materials

Aluminum - 50.4%
Steel - 15.5%
Titanium - 13.2%
Carbon/Epoxy - 10.1%
Other - 11.0%
(Percentages in terms of total weight)

Features

Dimensions:

Length: 17.1 meters (56 feet)
Height: 4.6 meters (15.3 feet)
Wingspan: 12.4 meters (37.5 feet)

Speed:

Mach 1.7-plus

Propulsion:

Two, General Electric F404-GE-400 low bypass turbofan engines, each in the 7,200-kilogram (16,000-pound) thrust class. Later model Hornets will be equipped with Enhanced Performance Engines that operate in a higher thrust class and are more reliable.

Range:

The Hornet can ferry more than 3,700 kilometers (1,800 nautical miles) without refueling. Its combat radius is more than 740 kilometers (400 nautical miles) using only internal fuel and carrying a full complement of air-to-air missiles. On the interdiction mission, the Hornet has a radius exceeding 1,000 kilometers (550 nautical miles). The F/A-18 can refuel in-flight and can carry three external fuel tanks.

Combat Ceiling:

Over 15,250 meters (50,000 feet).

Armament:

The Hornet can carry more than 7,700 kilograms (17,000 pounds) of payload. The F/A-18 can accommodate a wide variety of weaponry including air-to-air missiles and conventional or guided weapons. There are two in-board wing stations for fuel tanks or air-to-ground weapons, two nacelle fuselage stations for Sparrows or sensor pods, and one centerline station for fuel or air-to-ground weapons. The internal 20-millimeter gun is mounted in the nose.

Crew:

F/A-18A/C - one
F/A-18B/D - two

Operational Temperatures:

Proven operational in temperatures ranging from well below -50 to well above +50 degrees Celsius.

Growth

Hornet designers integrated critical growth potential into the F/A-18. With minimum modifications, about 12 cubic feet are available for future avionics and new systems.

The Hornet's F404 engines were also developed with growth in mind. Engine upgrades now in development will improve the Hornet's overall performance and reduce fuel consumption.

Taking advantage of the growth potential, Hornet designers are constantly developing new systems to increase the Hornet's effectiveness. Systems unique to each customer's requirements may also be added.

Crew Station

The F/A-18's integrated crew station design emphasizes single-pilot operation. A Head-Up Display (HUD) and the Hands-On-Throttle-And-Stick (HOTAS) concept, with multi-function displays, improves pilot performance and provides him with flexibility.

The HUD is the primary flight instrument providing necessary flight information and guidance for air-to-air and air-to-ground weapons delivery. It is situated directly behind the windscreen, allowing the pilot to determine his flight condition and weapon status without looking inside the cockpit.

The HOTAS capability also reduces the need for the pilot to search the cockpit for information. The radar and FLIR can be operated, weapons fired or release, flares and chaff can be dispensed, communications completed and the speed brake extended, all by the touch of buttons on the throttle and control stick.

Mission data is displayed on two interchangeable cathode ray tubes and the horizontal situation display which are located on the instrument panel. Radar and other sensor information, maintenance data, weapons status, and navigational data are all available at a glance.

Distractions and vertigo are minimized for the pilot by locating the displays on the instrument panel at eye-level. The Hornet's crew station is covered by a bubble canopy which provides the pilot with 360-degree visibility.

Computer System

The Hornet contains more than two dozen computers. Weapon management is handled by two basic types of computers, sensor-related and mission-related. The sensor-related computers are concerned with target detection and navigation, while the mission-related computers concentrate on weapon delivery and display management. Avionics software is essential to the operational capability of the Hornet. Current software is designed to reduce pilot workload as much as possible through the automation of tasks such as airborne target detection and radar lock-on, automatic unguided weapon release, automatic navigation functions, and automatic direction for the sensors such as FLIR or guided weapons.

The F/A-18 was the first tactical aircraft to have a digital fly-by-wire flight control system by which controls are optimized to each flight condition automatically. This fly-by-wire concept gives the Hornet unequalled maneuverability in air combat and the stability required for accurate air-to-ground weapon delivery. In the event of battle damage severe enough to cause total electrical failure, the pilot can use the F/A-18's mechanical flight control system that does not require electrical power to fly home.

The F/A-18 pilot can use the radar-warning receiver to locate and identify threatening radars. This

system gives the pilot an audio warning and a visual indication on his cockpit display. Electronic countermeasures, including jammers and chaff/flare dispensers are also built in and operate both automatically or manually.

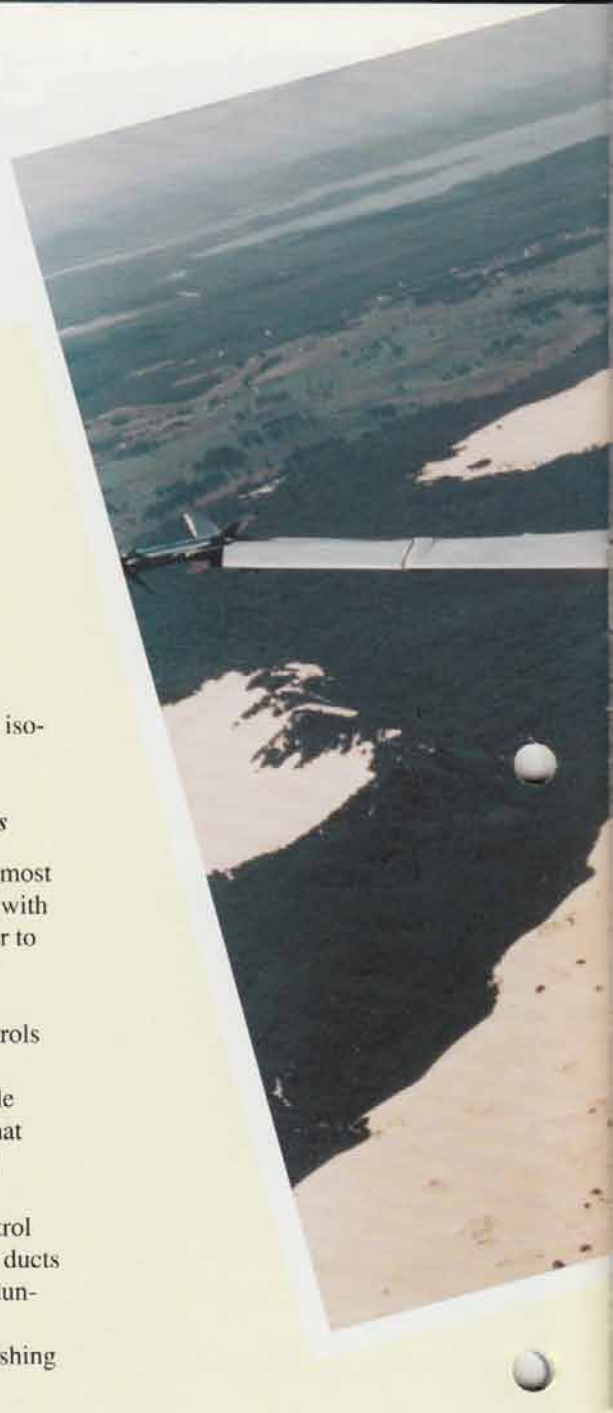
Twin Engines

The Hornet has the safety and the power that comes with having twin engines. These smokeless, low-bypass turbofan F404 engines were developed specifically for the Hornet by General Electric.

The F404s give the Hornet excellent acceleration and deceleration response - idle to full thrust in three seconds. From the outset of design, dependability was a major goal in the development of the F404. The engine was designed with equal emphasis on reliability, power and fuel consumption. The F404 has demonstrated a mean time between failures that is three times better than earlier generation fighter engines.

AMAD

Each of the Hornet's F404 engines have an Airframe Mounted Accessary Drive (AMAD). These AMADs power the fuel pumps, hydraulic pumps, and generators, and have an air turbine starter. By powering this equipment through the AMADs, there are fewer engine connections, thereby facilitating rapid engine removal and improving survivability by not housing combustible fluids in the engine compartment.



Pilot Safety & Aircraft Survivability

The Hornet is an exceptional tactical aircraft by any standard. It is a machine meant to serve men, but is of secondary importance when compared to the lives of the men who fly it. McDonnell Douglas designed the Hornet with pilot safety and aircraft survivability foremost in its goals.

The Hornet quickly became the safest naval fighter aircraft in U.S. history. It is approaching the record for the safest fighter ever built – the McDonnell Douglas F-15 Eagle. This is a remarkable achievement considering the dangerous maritime environment in which many Hornets operate.

Back-Up Systems

All of the Hornet's key systems are equipped with back-up support. Should one of the systems fail, a back-up unit is readily available to resume the function. This principal design criteria is critical in keeping the Hornet flight ready when needed. Other back-up systems include:

- Flight controls that are normally computerized, but can be manipulated through direct electrical connections or mechanical links
- Two mission computers that normally have separate functions, but one can do the work of both with some degradation
- Dual electric generators
- Reservoir-level-sensing for isolating hydraulic system leaks

Safety & Survivability Features

- The Hornet is smaller than most other attack and fighter aircraft with similar capabilities and is harder to detect from either the air or the ground
- Quad-redundant flight controls with mechanical back-up
- Dispersed avionics, multiple back-up and degraded modes that permit mission completion and provide a get-home capability
- A self-sealing damage control system for fuel cells and intake ducts
- Twin engines provide a redundant safety factor
- Fire detection and extinguishing system
- No fuel tanks over or between the engines
- Separate, self-sealing fuel-feed tanks with cross-feed capability
- Explosion and fire-suppression void filler foam

Situation Awareness

Pilot awareness is a key element in the survival of any mission. The more aware a pilot is of the tactical situation, the better he will perform, complete his mission and return home. To aid in pilot awareness, the Hornet is equipped with the following:

- A 360-degree view from the cockpit
- Long-range radar with +/- 70 degree coverage from the plane's nose
- Advanced system integration to reduce pilot workload
- Voice Warning System

Countermeasures

To help protect the Hornet from attack, the following countermeasure equipment is built in:

- Metallic chaff distribution system for radar guided missile defense
- Dispensable flares for heat-seeking missile defense
- Radar-jamming devices

The Reliable Hornet

Readiness and upkeep were just as important design objectives as performance in the creation of the Hornet. In an effort to build an aircraft that is ready to fly when needed, McDonnell Douglas designed the Hornet with advanced features which give the strike/fighter high reliability.

The Hornet's mean flight hours between failures is almost two and one-half times better than any other U.S. Navy and Marine Corps tactical aircraft. The maintenance man-hours per flight hour necessary to keep the Hornet flying are one-half the maintenance needed by other naval tactical fighters. This has shown reduced support requirements for flight operations, improved readiness, and lower life cycle costs.

Built-in Test

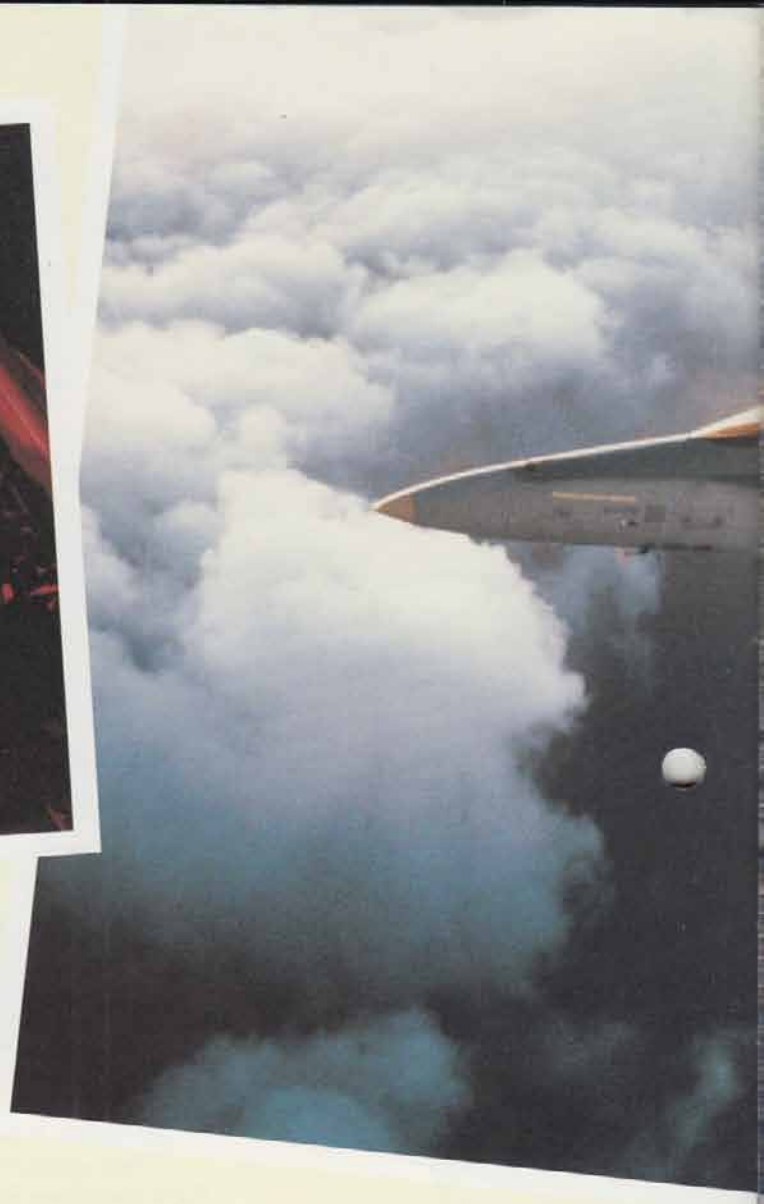
Most functions that require external support equipment for other fighters have been eliminated or are accomplished by equipment built into the F/A-18. The Hornet has a self-contained auxiliary power unit (APU) that eliminates the need for an external power source and provides the means for speedy systems check-out, as well as engine start.

The Built-In Test (BIT) systems allow for rapid fault location and isolation leading to quick repair or replacement of faulty components. About 90 percent of the BIT circuits are automatic and provide the pilot with system status or failures. While on the ground, failures are also displayed on a maintenance monitor panel located in the nose-wheel well. The same panel shows the status of consumables, such as oil, hydraulic fluid, liquid oxygen, etc.

AFTA

With the Avionics Fault Tree analyzer (AFTA), virtually all intermediate maintenance is done at the operational or squadron level. This concept works well for a limited number of aircraft or for squadrons deployed to remote areas. The AFTA reduces the need for large, expensive maintenance equipment and significantly reduces the requirement for technically trained personnel.

The benefits of the design emphasis on maintainability and reliability are paying off handsomely. Hornets are demonstrating a three-fold greater improvement in reliability over the aircraft they are replacing, and up to a 50 percent reduction in maintenance manhours.



New Systems

Night Attack

The Hornet's night attack capabilities substantially enhance the aircraft's effectiveness. Through the addition of several technological enhancements, night will be turned into day for the Hornet pilot.

The F/A-18 pilots will be equipped with night vision goggles which will allow him to see the outside world as if it were daytime by amplifying whatever light is available, such as starlight, moonlight and ground-reflected light.

Because the goggle-wearing pilot would be virtually blinded when he looked at his controls and instruments, the interior lighting is modified to ensure that the lighting is compatible with night vision goggles.

The Hornet's projected moving map navigation display will be replaced by a digital (computer-generated) moving map. The map information is stored in a special memory which is displayed to the pilot electronically, allowing him to determine his exact position.

Color will be added to the Hornet's displays so that items that need the pilot's immediate attention will be highlighted automatically.

The Thermal Imaging Navigation Set (TINS), sometimes called a navigation FLIR, will project real-life infrared images on the Hornet's updated head-up display (HUD), which overlay the images with the appropriate symbology for navigation and/or identification for night navigation. The targeting FLIR can track targets in the air or on the ground.

Reconnaissance

The Hornet's reconnaissance package can include an infrared line scanner and pod-mounted, side-looking radar that can be used day or night. The Hornet reconnaissance sensors will not depend on film photography processing; instead, images can be recorded digitally to be used by the crew or transmitted to a ground station. In the mid-1990s, next generation electro-optical sensors could be installed in the Hornet to further enhance its reconnaissance capabilities.

While on a reconnaissance mission, the Hornet can still perform both air-to-air and air-to-ground missions. The only feature lost will be the use of the 20-millimeter cannon, which is replaced by a sensor pallet in the aircraft's nose.

Other Systems

There are several advancements currently being explored that could readily be incorporated into the Hornet. Among them are the following:

- Integrated fire and flight controls
- Interleaved radar modes
- Radar beacon
- High-resolution synthetic aperture radar
- More internal fuel
- Survivability enhancements

Afterword

The Hornet is a proven aircraft; it is an international aircraft; it is two aircraft in one; and it is the latest advancement in tactical aircraft technology. When it comes to overall performance, readiness, safety, design, materials, dependability and quality, the F/A-18 is unsurpassed.

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