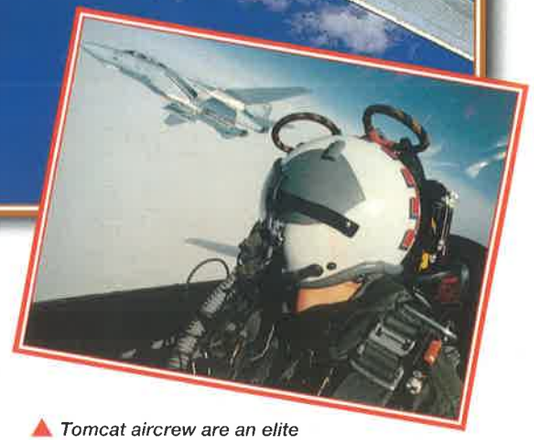
GRUMMAN

F-14A TOMCAT

Long-range fleet interceptor • Recon platform • Fighter bomber

MODERN COMBAT AIRCRAFT



The F-14 Tomcat is the main defender of the U.S. fleet. With its high speed and ultra-long-range weapons, the F-14 can operate hundreds of miles away from its carrier base. The Tomcat AWG-9 radar can engage six targets at once and its Phoenix missiles can kill hostile bombers 90 miles away, before they can launch their attacks. The Tomcat is one of the world's true "Top Guns!"

▲ *Tomcat aircrew are an elite within an elite. Pilot and backseat Naval Flight Officer act as a carefully coordinated team to wring the best from the awesome combination of performance, sophistication and firepower at their command.*

PHOTO FILE

GRUMMAN F-14A TOMCAT

▲ **Fleet defender**
The main threat to U.S. Navy carriers is posed by long-range bombers armed with sea-skimming missiles. Only Tomcat can intercept the bombers before they get within lethal range.

▲ **Power to protect**
The F-14's high-thrust TF-30 turbofans and swing wing allow it to operate from short carrier decks. Takeoffs are made using a powerful steam catapult.

▼ **Detecting the enemy**
As well as its own radar, the F-14 operates with an E-2 Hawkeye, a flying radar station with a huge rotating antenna above the fuselage.

Deadly performer ▶
The F-14 has Mach 2+ performance, a sparkling rate of climb, good maneuverability—all the hallmarks of a great fighter.

▲ **Combat-proven**
The F-14 opened its score on August 19, 1981, when F-14 pilots Lt. Larry Muszynski (above) and Cdr. Hank Kleeman of VF41 "Black Aces" squadron destroyed a pair of marauding Libyan Sukhoi Su-22 "Fitters." Two MiG-23s fell to F-14s in a similar incident during 1989.

FACTS AND FIGURES

- **The Tomcat's AWG-9 radar can detect, track and engage targets at ranges of more than 100 miles.**
- **One Tomcat can engage the same number of targets as three F/A-18 Hornets.**
- **The AIM-54C Phoenix is the world's longest-range air-to-air missile.**
- **The Tomcat's high magnification TV camera enables visual target identification at more than 30 miles.**
- **Forming the outer edge of a battle group's defenses, the Tomcat can engage enemy bombers and missiles more than 500 miles out from its home carrier.**

Defender of the fleet

The F-14's swing wings allow it to combine high-speed performance and supersonic maneuverability with docile low-speed handling.

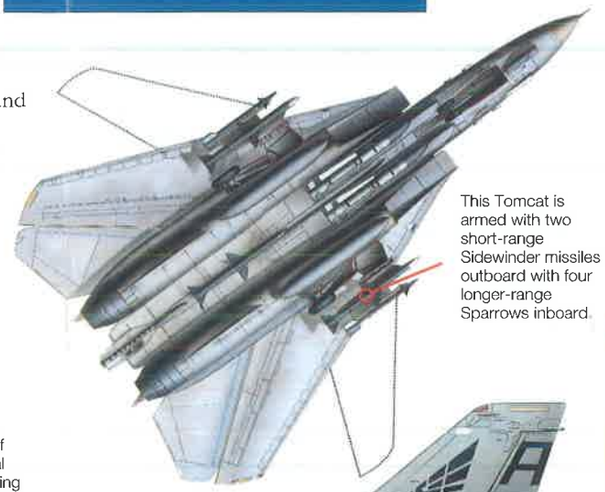
The Tomcat has been one of the great superfighters of the world since its first squadron took to the skies in 1972. It packs a massive punch, performs superbly and is the warplane of choice for many aspiring military pilots. Nothing is more likely to worry an enemy than to know Tomcats are on his track.

And yet this tremendous fighting machine can operate from a 350-foot strip of aircraft carrier deck, in all weather and around the clock.

Working with E-2C Hawkeye radar planes and using air-to-air refueling, a squadron of Tomcats can sanitize the airspace 400 miles out from the carrier battle group. This ensures that no hostile aircraft will threaten the warships below.

Even sea-skimming missiles can be killed by Tomcats using their Phoenix and AMRAAM missiles.

The fact is that Tomcats and their aircrews have to be good—they are protecting a 10-warship, $15-billion battle group manned by 10,000 sailors projecting as much firepower as the United Kingdom's entire armed forces.



This Tomcat is armed with two short-range Sidewinder missiles outboard with four longer-range Sparrows inboard.

SPECIFICATIONS F-14A Tomcat

Type: Two-seat long-range shipboard fleet defense interceptor, tactical reconnaissance aircraft and fighter-bomber.

Powerplant: Two Pratt & Whitney TF-30-P-412As.

Max speed: 1,584 m.p.h. at 40,000 ft.

Combat radius: 378 mi. on internal fuel; 750 mi. with two 130-gal. tanks.

Service ceiling: 68,900 ft.

Weapons: One 20-mm Vulcan cannon. Six AIM-54 Phoenix missiles or six AIM-7 Sparrow plus four AIM-9 Sidewinder missiles. Up to 14,300 lb. of air-to-ground weapons.

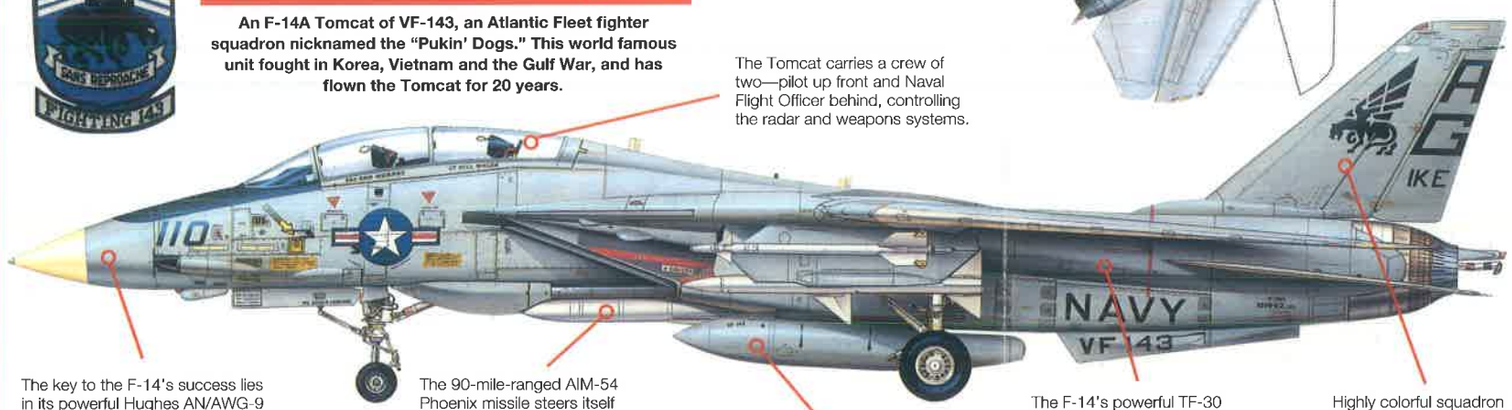
Weight: Maximum takeoff 70,280 lb.

Dimensions:

Span	61 ft. 10 in.
Length	62 ft.
Height	16 ft.
Wing area	565 sq. ft.

F-14A Tomcat "Pukin' Dogs"

An F-14A Tomcat of VF-143, an Atlantic Fleet fighter squadron nicknamed the "Pukin' Dogs." This world famous unit fought in Korea, Vietnam and the Gulf War, and has flown the Tomcat for 20 years.



The Tomcat carries a crew of two—pilot up front and Naval Flight Officer behind, controlling the radar and weapons systems.

The key to the F-14's success lies in its powerful Hughes AN/AWG-9 radar, which can detect fighter-sized targets at very long range, and even allows the F-14 to shoot down cruise missiles.

The 90-mile-ranged AIM-54 Phoenix missile steers itself toward the target using an onboard inertial navigation system, then homes in using its own onboard radar.

The Tomcat can extend its range or endurance by using in-flight refueling or by carrying external fuel tanks.

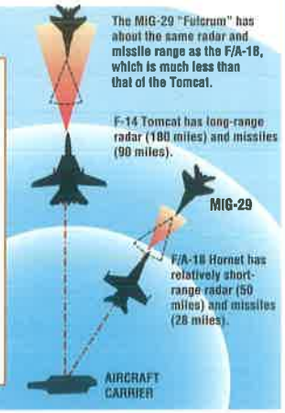
The F-14's powerful TF-30 turbofans give the aircraft superb performance and economy, but have proved troublesome and unreliable.

Highly colorful squadron markings have given way to a subdued low-visibility gray camouflage on all U.S. Navy aircraft.

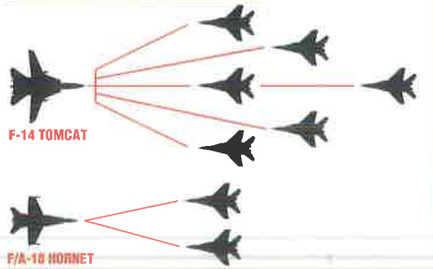
ACTION DATA

REACH

The Tomcat's fuel capacity and highly efficient turbofan engines allow it to operate further out from the carrier than its F/A-18 Hornet counterpart. Once at its patrol station, the Tomcat can see further and reach further with its Phoenix—destroying enemy fighters before they can launch their own missiles against the fleet or the Tomcat itself.



SIMULTANEOUS ENGAGEMENT



The F-14 can simultaneously engage up to six targets, flying at different altitudes, airspeeds and in different directions. Because the Phoenix missile has its own radar, it is independent after launch. The F/A-18 can fire only two Sparrows at a time, against targets which are close together. Unlike the Phoenix, the Sparrow requires the Hornet to continue flying toward the enemy using its radar, making it vulnerable to a return missile shot.

Weapons of the Tomcat

AIM-9 SIDEWINDER: The highly agile Sidewinder is used against maneuvering targets. It homes on heat—for example, from the enemy's jetpipes. **Range 5 miles.**

AIM-7 SPARROW: The Sparrow homes on radar energy reflected from the target, which must be illuminated by the F-14's radar for the whole of its flight. **Range 28 miles.**

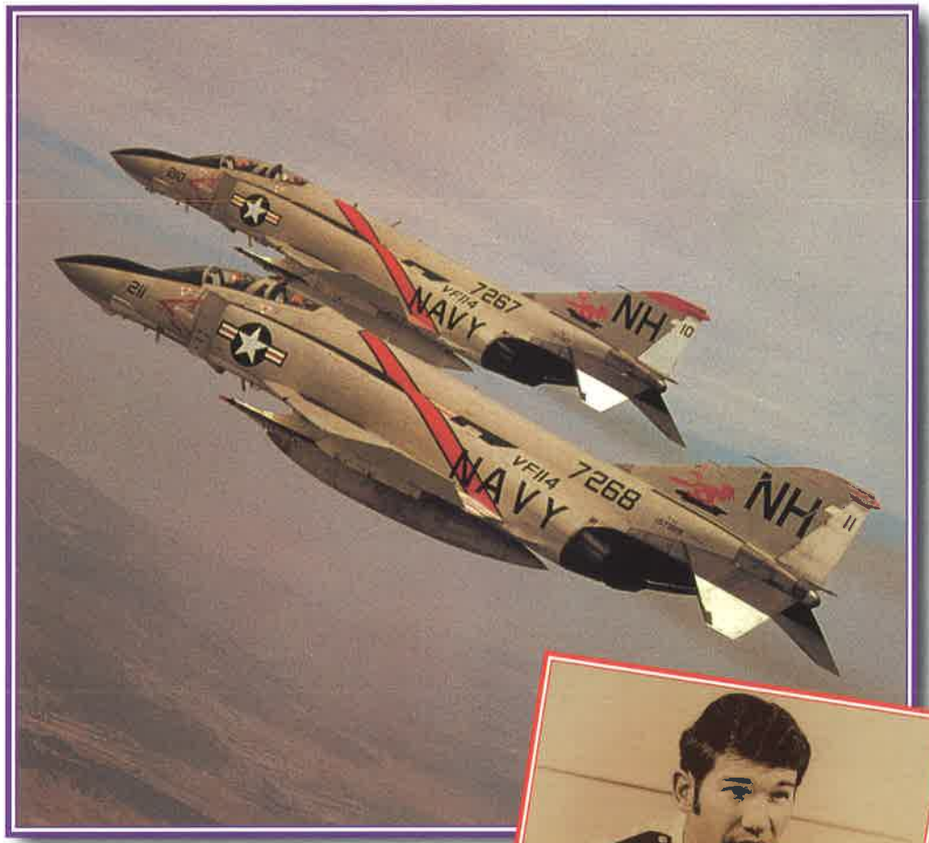
AIM-54 PHOENIX: Weighing in at almost 1,000 lb., costing $2 million and with a range in excess of 90 miles, the AIM-54 is the world's biggest, most costly and longest-range air-to-air missile. Tomcat can launch six AIM-54s simultaneously against separate targets. The missile's onboard radar lets the F-14 turn away after launch. **Range 90 miles.**

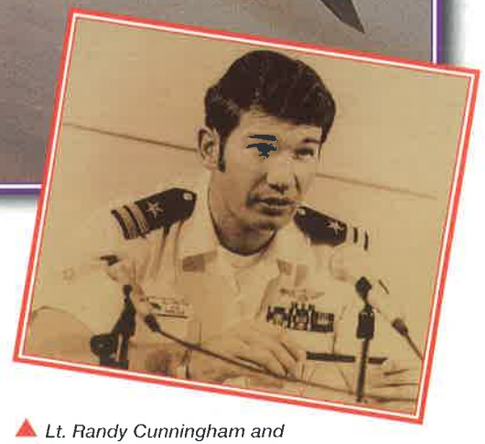
BOMBCAT: The Tomcat can carry a range of dumb (unguided) bombs for use against ground targets. Tomcat squadrons began training in the bombing role in 1991.

NUMBER 6 GROUP 7
ADVENTURES IN FLIGHT

Vietnam Phantom

● Vietnam warrior ● Fighter and bomber ● MiG-killer supreme





▲ *Lt. Randy Cunningham and his RIO Lt. Willie Driscoll scored their third, fourth and fifth kills on May 10, 1972, to become the Navy's only aces of the war in Southeast Asia.*

The Phantom broke all the rules. Fighters were supposed to be small, sleek single-seaters with guns. The Phantom was huge and had bent wings, a two-man crew and missile armament. It looked wrong, but it flew right. Strapped inside Phantom cockpits over Vietnam, naval aviators fought MiGs in raging air combat. Although there were some early problems, the Phantom came out on top almost every time.

PHOTO FILE

McDonnell Douglas F-4 Phantom

▼ **Top Guns of the 1960s**
In the late 1960s the F-4 Phantom crew was considered the elite of the West's air forces. No service trained their crews better than the U.S. Navy.

▲ **Marines at sea**
It wasn't just the Navy that flew the Phantom from aircraft carriers. U.S. Marine Corps squadrons shared the load of shipboard deployments.

▼ **Catapult launch**
An F-4J thunders from the deck on an unarmed training sortie. The undercarriage was incredibly strong to absorb the pounding of carrier operations.

▲ **Fighter-bomber**
The Phantom was best known as a MiG-killer, but it did its fair share of ground attacking as well. These aircraft are seen over Vietnam, dropping 500-lb. bombs from the relative safety of medium altitude.

FACTS AND FIGURES

- Tests showed that pilots in Vietnam were more anxious about landing on the carrier than about fighting MiGs.
- Navy and Marine F-4B and F-4J fighters flew over 100,000 sorties in Vietnam.
- In early Vietnam combat, Phantom pilots were achieving only a 1:1 kill ratio.
- A Phantom weighs 4.68 times as much as the Hellcat carrier fighter of 1944.
- After the introduction of "Top Gun" training, the kill ratio improved to as much as seven MiGs for each F-4 lost.
- On May 10, 1972, Navy F-4s from fighter squadron VF-96 downed six MiGs.

PROFILE

U.S. Navy MiG-killers

Few human exploits compare with fighting in the F-4 Phantom. The big, powerful machine gave both pilot and radar officer the ride of their lives, blasting aloft with twice as much power as other fighters and going into battle armed to the teeth. Designed as a U.S. Navy carrier-based fighter, the Phantom became a jack-of-all-trades, doing many jobs so well that no other warplane met its standard.

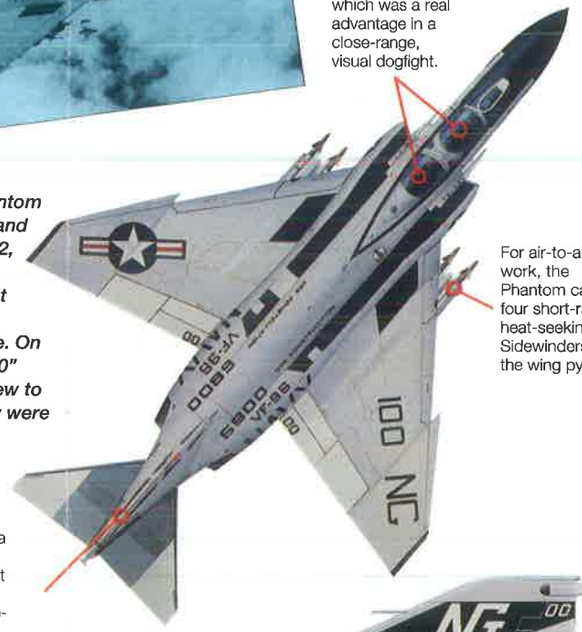
With its far-reaching radar, the Phantom was meant to spot the enemy from a great distance and take him down with a radar-guided missile. It did not always work that way. A small, nimble fighter like the MiG-17 could pose a real danger to the Phantom if it got close enough.

The Phantom was both a fighter and a bomber, capable of unleashing up to 16,000 pounds of bombs. Further, if challenged in the air, the Phantom could fight back. Not surprisingly, the U.S. Navy's air aces in Vietnam flew the Phantom.

"Showtime 100" was the Phantom used by Randy Cunningham and Willie Driscoll on May 10, 1972, to score their three kills. The last was an epic battle against Colonel Tomb, reputedly the leading North Vietnamese ace. On the way home, "Showtime 100" took a SAM hit forcing the crew to bail out over the sea, but they were rescued safely.

Two crewmen meant an extra pair of eyes, which was a real advantage in a close-range, visual dogfight.

For air-to-air work, the Phantom carried four short-range heat-seeking Sidewinders on the wing pylons.



SPECIFICATIONS
F-4J Phantom

Type: Two-seat carrier-based multirole fighter.

Powerplant: Two 17,900-lb.-thrust General Electric J79-GE-10 turbojets with afterburners.

Max speed: Mach 2.25 or 1,500 m.p.h.

Ceiling: 62,000 ft.

Combat radius: 900 mi.

Weights: Empty 29,700 lb.; loaded 54,600 lb.

Weapons: Typically: four AIM-7 Sparrow radar missiles and four AIM-9 Sidewinder infrared missiles. Maximum: up to 3,000 lb. of bombs beneath fuselage and up to 16,000 lb. of bombs under the wings.

Dimensions:

Span	38 ft. 5 in.
Length	58 ft. 5 in.
Height	16 ft. 3 in.
Wing area	530 sq. ft.

F-4J Phantom

By 1972, when Cunningham and Driscoll flew this aircraft to their three MiG victories, the F-4J was the standard shipboard fighter for the U.S. Navy. Because of its size, it could only fly from the larger carriers and could not fit on the small "Essex"-class ships.

In 1965, carrier fighter squadron VF-96 scored the Navy's first MiG kill of the Vietnam War. That was the unit's only success until 1972, when its crews downed a further eight MiGs, including five by the ace team of Cunningham and Driscoll.

For protection, the F-4 was fitted with a radar-homing and warning system that detected enemy-surveillance and fire-control radars. The antennas were housed in the tip of the fin.

The Phantom had a superb radar in the shape of the APG-59. This was the best in the world at the time and could track both low- and high-altitude targets.

To launch, the F-4 was hooked to the catapult with a heavy cable bridle, which fell away when the aircraft left the deck.

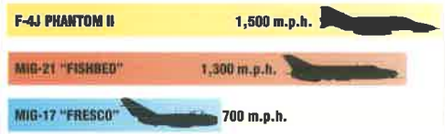
To highlight the secondary attack role of the Phantom, this aircraft carries cluster bombs.

The jetpipes of the Phantom were angled down to give an extra punch for carrier takeoffs. The arrester hook for stopping the aircraft was between the two engines.

ACTION DATA

SPEED

The Phantom's sheer power gave it tremendous speed, but it was very much a straight-line machine. Although by no means a dogfighter, the F-4's climbing, diving and acceleration ability were used to advantage against slower but much more agile opponents.

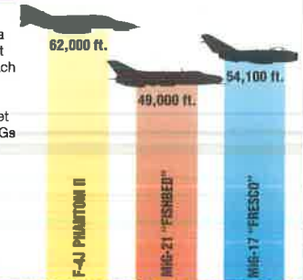


WEAPONS

American rules of engagement in Vietnam meant that F-4 pilots had to visually identify the enemy before firing, negating their long-range missiles. And in a dogfight, the lack of a gun was a severe handicap that only good training could overcome.

SERVICE CEILING

The combination of immense power and a large wing area meant that the F-4 could reach exceptionally high altitudes. Phantom pilots could usually get out of trouble with MiGs by outclimbing their less powerful opponents.



MiG-killers of May 10, 1972

THE NAVY TAKES ON THE MiGs: May 10,1972, was the Navy Phantom's big day over Vietnam. Flying from the USS *Constellation*, sister squadrons VF-92 "Silver Kings" and VF-96 "Fighting Falcons" blasted seven MiGs from the skies between them while a VF-51 crew shot down another for the Navy. To make matters worse for the North Vietnamese, Air Force Phantoms accounted for another three MiGs that day.

FIRST KILL OF THE DAY: Lt. Curt Dose (seen here demonstrating his dogfight) and Lt. James McDevitt from VF-92 scored the first kill of May 10, after blasting their F-4s down the Kep runway to stir up the MiGs.

TWO MiGs IN ONE DAY: RIO Lt. Thomas Blonski looks on as his pilot, Lt. Matt Connelly, relives one of their duels with MiGs on May 10. Two MiGs fell to their AIM-9 Sidewinders that fateful day.

THE FOE: North Vietnamese MiG-17s cower behind bunkers between missions. Although the faster MiG-21 was available, many experienced pilots, such as Colonel Tomb, favored the nimble "Fresco."

LOCKHEED

F-117 NIGHTHAWK

● "Stealth" fighter ● Invisible to radar ● Deadly accurate attacker

NUMBER 5 GROUP 6

CUTTING EDGE

The Lockheed F-117A "Stealth" fighter is one of the most sophisticated warplanes ever built. Almost invisible to radar, the F-117 has revolutionized air warfare. It was operated at first under conditions of total secrecy, but in 1991 the U.S. Air Force deployed it openly to Saudi Arabia for service in the Gulf War. Ranging the night skies over Baghdad with impunity, it struck the most heavily defended Iraqi targets with stunning effect.

▲ *The intense secrecy surrounding Stealth meant that it was not until the late 1980s that the F-117's true shape was revealed. And that angled, faceted shape was like no other aircraft.*

PHOTO FILE

LOCKHEED F-117 NIGHTHAWK

◀ The "Wobblin' Goblin"

Rumors abounded that the handling of the F-117 was somewhat erratic, especially when refueling. As a result, one of the first nicknames for the plane was the "Wobblin' Goblin."

▲ An expensive bird

Only 59 production F-117s were built, yet the total cost of the program is over six billion dollars.

In harm's way ▶

The F-117 was the only Coalition aircraft able to operate with complete freedom over Baghdad's extensive anti-aircraft defenses.

▼ Gulf War spearhead

Forty F-117s were deployed to the Gulf.

▲ Lethal weapon

The Nighthawk used laser-guided weapons to destroy Iraqi headquarters and concrete bunkers.

FACTS AND FIGURES

- The 40 F-117s deployed to the Gulf flew more than 1,270 missions, dropping 30 percent of all precision-guided munitions.
- One B-52 bomber has a larger radar cross-section than all the F-117s put together.
- The F-117 was operational for seven years before it made its first public appearance.
- The F-117's weapon system can hit a target one yard square.
- The first combat use of the F-117 came in Panama on December 21, 1989.
- The F-117's radar cross-section is about one one-hundredth of a square yard—about the same as that of a seagull.

PROFILE

The invisible bomber

The sky over a modern battlefield is a dangerous place. Radar-guided missiles and guns endanger any aircraft flying more than a few inches above the ground. Flying fast and low makes survival more likely, but at the same time makes hitting the target a matter of split-second timing.

In an attempt to counteract the seemingly impossible advantage of the defenders, Lockheed's shadowy "Skunk Works"—the Advanced Development Project Office—was contracted by the U.S. Department of Defense in the late 1970s to produce a low-observable strike fighter. Operational by 1983, the F-117A Stealth fighter is perhaps the most unusual aircraft ever flown.

The F-117's unusual shape and the advanced material from which it is manufactured make the Stealth fighter all but invisible to radar. By flying at night, the black jet is also invisible to the eye.

Because it can't be detected, the F-117 can take its time in attack. This makes for remarkably accurate weapons delivery, as was shown to great effect during the Gulf War.

The unique arrow shape of the F-117 is naturally unstable. Stability is maintained by computerized fly-by-wire controls.

SPECIFICATIONS
F-117A Nighthawk

Type: Single-seat low-observable strike fighter.

Powerplant: Two non-afterburning General Electric F404-GE-F1D2 engines, each delivering 10,800 lb.-thrust.

Maximum speed: Mach 1 (estimated).

Combat radius: 750 mi. unrefueled, with 5,000 lb. weapon load.

Service ceiling: Not revealed.

Weapons: Up to 5,500 lb. carried internally. Principle weapons are BLU-109 low-level or GBU10/GBU 27 medium-level laser-guided bombs. Provision for two AIM-9L air-to-air missiles.

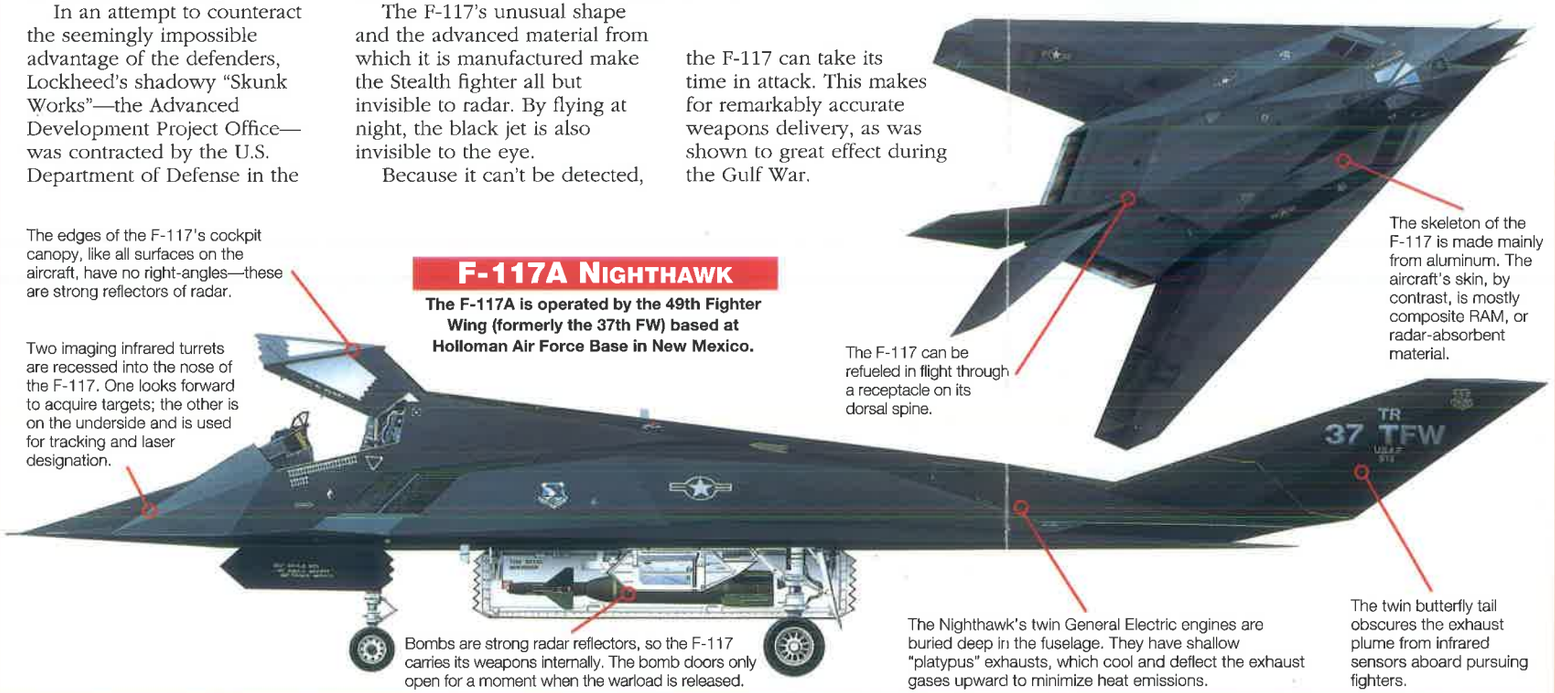
Weights: Empty 30,000 lb.; loaded 52,500 lb.

Dimensions:

Span	43 ft. 4 in.
Length	65 ft. 11 in.
Height	12 ft. 5 in.
Wing area (estimated)	913 sq. ft.

F-117A NIGHTHAWK

The F-117A is operated by the 49th Fighter Wing (formerly the 37th FW) based at Holloman Air Force Base in New Mexico.



The edges of the F-117's cockpit canopy, like all surfaces on the aircraft, have no right-angles—these are strong reflectors of radar.

Two imaging infrared turrets are recessed into the nose of the F-117. One looks forward to acquire targets; the other is on the underside and is used for tracking and laser designation.

The F-117 can be refueled in flight through a receptacle on its dorsal spine.

The skeleton of the F-117 is made mainly from aluminum. The aircraft's skin, by contrast, is mostly composite RAM, or radar-absorbent material.

Bombs are strong radar reflectors, so the F-117 carries its weapons internally. The bomb doors only open for a moment when the warload is released.

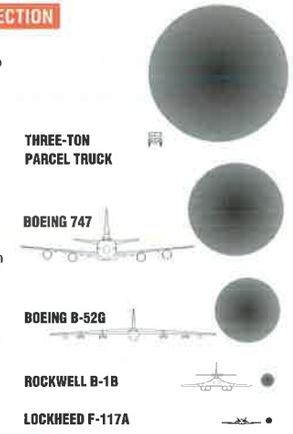
The Nighthawk's twin General Electric engines are buried deep in the fuselage. They have shallow "platypus" exhausts, which cool and deflect the exhaust gases upward to minimize heat emissions.

The twin butterfly tail obscures the exhaust plume from infrared sensors aboard pursuing fighters.

ACTION DATA

RADAR CROSS-SECTION

Radar cross-section is a measure of how large an object appears to be on a radar screen. Several things affect the cross-section. Right-angles are very good reflectors of energy, hence the immense signal returned by the truck. The fan blades in jet engines also return a significant signal, which is why the Boeing 747, with its huge exposed turbofans, or the B-52G, with its eight engines, generate such large returns. Both of the more modern aircraft show how effectively the radar cross-section can be reduced.

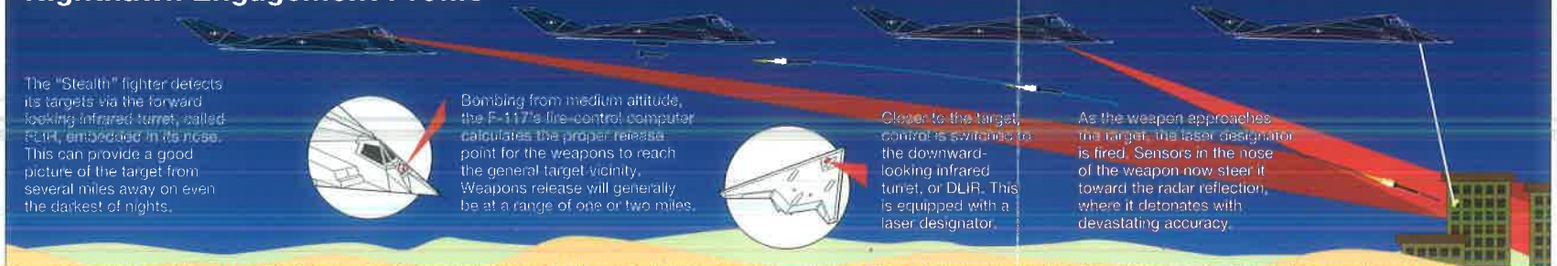


HOW STEALTH WORKS

The Stealth fighter has two main means of defeating enemy radar. The faceted construction deflects most radar energy in multiple directions, with only a very small fraction being intermittently reflected back to the transmitter.

Radar absorbent material (RAM) and composites absorb radar energy, leaving much less to be reflected.

Nighthawk Engagement Profile



The "Stealth" fighter detects its targets via the forward looking infrared turret, called FLIR, embedded in its nose. This can provide a good picture of the target from several miles away on even the darkest of nights.

Bombing from medium altitude, the F-117's fire-control computer calculates the proper release point for the weapons to reach the general target vicinity. Weapons release will generally be at a range of one or two miles.

Closer to the target, control is switched to the downward-looking infrared turret, or DLIR. This is equipped with a laser designator.

As the weapon approaches the target, the laser designator is fired. Sensors in the nose of the weapon now steer it toward the radar reflection, where it detonates with devastating accuracy.

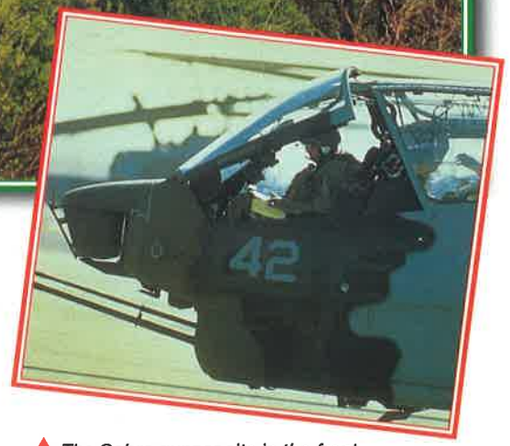
BELL

AH-1 COBRA

● The first "Gunship" ● Close support ● Precision antiarmor

NUMBER 2 GROUP 3

HELICOPTERS AND VERTIPLANES

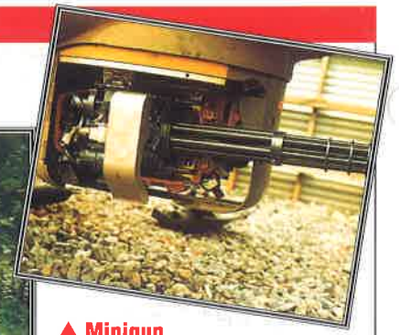


▲ *The Cobra gunner sits in the front cockpit. At his disposal is a fearsome array of guns and missiles that can be fired with frightening rapidity.*

The Bell AH-1 Cobra is the first true armed helicopter, designed from the skids up as a rotorcraft gunship. Twenty-five years after bringing vertical warfare to Vietnam, the Cobra continues to reach out with lethal guns and missiles, halting the enemy in its tracks. Today the Cobra is flown by Marine pilots who use the AH-1's speed and power to fight and win, no matter what the odds.

PHOTO FILE

BELL AH-1 COBRA



▲ Minigun
Early Cobras carried the Minigun, a six-barrel machine gun, which fired at rates of up to 100 rounds per second. Today the slower but harder-hitting M197 20-mm cannon is fitted.

▲ In the weeds
Like its serpentine namesake, the Cobra is designed to fight down among the trees and bushes where it can lurk undetected until it is time to rear up and strike.

◀ Riding shotgun
As well as taking out enemy tanks, the Cobra is charged with the vital task of escorting assault helicopters. These Army helos are seen on exercise in Egypt.

▼ Rapid turnaround
When it is out of missiles, the Cobra can be rearmed in minutes by a well-drilled ground team. The TOW missiles are prepacked in their launch tubes and are strapped straight onto the helicopter.

▲ TOW launch
Although some Marine Cobras carry the deadly Hellfire, most AH-1s rely on the TOW missile. As soon as it has been fired out of its tube, small spring-loaded wings and fins pop out of the missile's body, allowing it to fly to its target.

FACTS AND FIGURES

- The AH-1 first flew on September 7, 1965; new Cobras are being produced today.
- Building a Cobra requires 38,500 hours of factory-worker time.
- In Operation Desert Storm, four Marine squadrons flew 1,000 missions, including one that destroyed 60 tanks.
- The Cobra's stub wing provides some of the lift that keeps it in the air.
- Cobra pilots use night vision goggles and electronic sensors to fight in darkness and bad weather.
- The AH-1W Whiskey Cobra's cannon fires a depleted uranium shell.

Strike like a snake

The AH-1 Cobra evolved from the famous Bell UH-1 Huey. When the AH-1G model arrived in Vietnam, it became the first rotorcraft designed specifically to carry arms to enter combat. With the helicopter's miraculous ability to leap in and out of tight places, and with a deadly powerhouse of weapons hanging under its stub wings, the Cobra is the infantryman's best friend.

New, hard-hitting Cobras are at work today. The U.S. Army introduced TOW missiles to fight tanks. The Marines went a step further with the laser-guided Hellfire missile, fired from many miles away to kill a tank with pinpoint accuracy.

Today, Marines use the AH-1W "Whiskey Cobra." This warrior in the high-tech battlefield is as formidable in many situations as the Army's newer Apache, which came along years later. The "Whiskey Cobra" excels at amphibious warfare, flying from ship decks or from land. Pilots of this thin, graceful ship praise its nimble flying qualities and its flexibility and fighting prowess.

Helicopter killer—the Cobra can carry the Sidewinder missile on its stub pylons to shoot down other helicopters.

For use against "soft" targets such as troops and trucks, the Cobra carries seven-round rocket pods on the stub pylons.

SPECIFICATIONS
AH-1W "Whiskey Cobra"

Type: Two-seat attack helicopter.

Powerplant: Two General Electric T700-GE-401 turboshafts, each rated at 1,723 shp.

Maximum speed: 219 m.p.h.

Hover ceiling: 14,750 ft.

Range: 365 mi.

Weights: Empty 10,215 lb.; loaded 14,750 lb.

Weapons: One M197 20-mm cannon in undernose turret and four underwing hard points for guided antiarmor, air-to-air missiles, Minigun pods or unguided high explosive rockets.

Dimensions:

Rotor diameter	48 ft.
Fuselage length	45 ft. 6 in.
Height	13 ft. 6 in.
Rotor disc area	1,809 sq. ft.

AH-1W "Whiskey Cobra"

Spearheading the Marine assault is the AH-1W, sweeping ahead of the ground troops to root out enemy armor and artillery before they can do any damage.

The stub pylons provide not only the means to carry a large weapon load but also act as miniature wings, providing valuable extra lift when the Cobra is in forward flight.

The two-man crew works as a team. The pilot is in the rear cockpit, sitting high up so he can get a good all-around view over the head of the gunner in the front seat. The gunner has a commanding view of the battlefield and has night-vision sights to help him fire the weapons.

Above and below the pilot's cockpit are special blades that can cut cables and power lines. Such obstructions are a very real danger at the altitudes that Cobras normally work.

Cobras have been powered by a variety of engines over the years. Marine aircraft generally have two engines, as an added safety factor for long overwater operations.

Bell designed the Cobra before the days of modern composite materials. Its structure is conventional, with a semimonocoque aluminium skin.

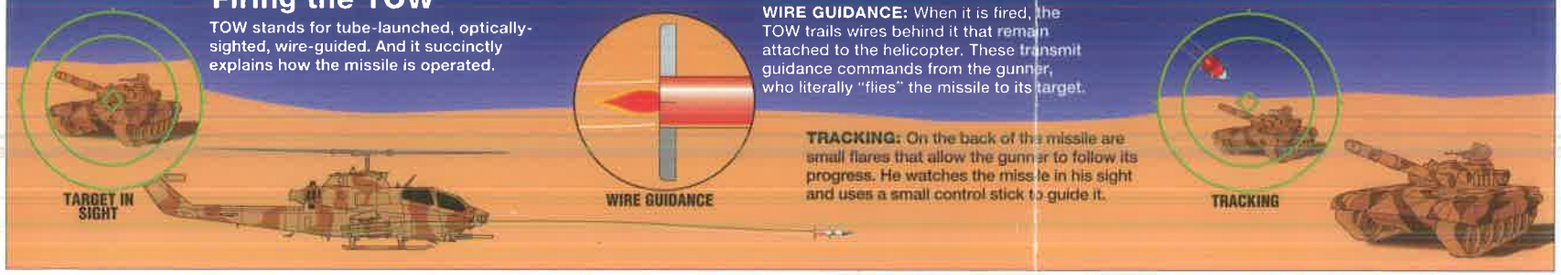
The Cobra's tail rotors are made from an aluminium honeycomb with a stainless steel skin and leading edge.

Under the AH-1W's chin is a General Electric turret which houses the deadly 20-mm M197 cannon. This weapon has three barrels and can fire at a rate of 675 rounds per minute, although each burst is limited to just 16 rounds. The turret can swing through 110 degrees either side of the nose.

Marine Cobras fly in a bewildering variety of color schemes, usually applied according to the type of terrain they will encounter. This strange sand-and-gray scheme was applied for the Gulf War.

Firing the TOW

TOW stands for tube-launched, optically-sighted, wire-guided. And it succinctly explains how the missile is operated.



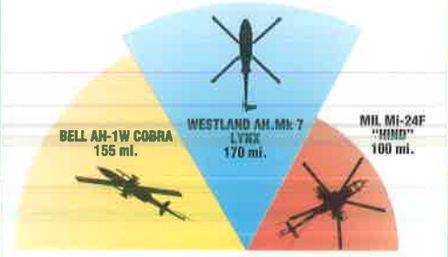
WIRE GUIDANCE: When it is fired, the TOW trails wires behind it that remain attached to the helicopter. These transmit guidance commands from the gunner, who literally "flies" the missile to its target.

TRACKING: On the back of the missile are small flares that allow the gunner to follow its progress. He watches the missile in his sight and uses a small control stick to guide it.

ACTION DATA

COMBAT RADIUS

Because of their unique abilities, helicopters do not need vulnerable fixed bases. Operating from hiding places close to the battle area, they can get into action very quickly, and their lack of range when carrying a full load of fuel, troops and weapons is no handicap.



B-17 FLYING FORTRESS

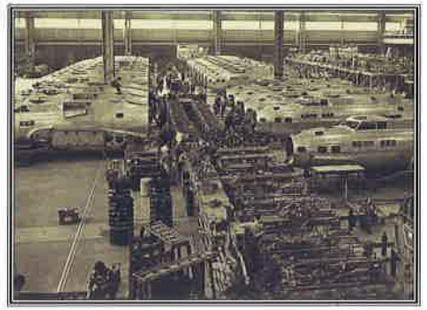
● Long-range heavy bomber ● Backbone of the U.S. Eighth Air Force

NUMBER 1 GROUP 11
AMERICAN AIRCRAFT OF WORLD WAR II

▲ *The Flying Fortress was America's main strategic weapon in Europe during World War II. From the summer of 1943, huge numbers of Boeing's great silver bird were to be found on English airfields.*

The Boeing B-17 Flying Fortress was one of the most important bombers in history. B-17s fought in every theater of World War II but won immortality in their epic daylight battles against the Luftwaffe. Thousands of young German and American fliers lost their lives, transforming the impotent United States Army Air Force of early 1943 into a force of devastating, destructive power in just 12 months.

BOEING B-17 FLYING FORTRESS



◀ Mass production

Nowhere was America's huge industrial might more visible than in the aircraft factories that turned out hundreds of B-17s each month.

Gun platform ▶

Key to the B-17's design was its heavy machine gun armament, designed to enable the bombers to penetrate defended airspace unescorted.

▼ A hard-fought battle

The Fortress was tough, but over Germany it was pitted against some of the most experienced fighter pilots in the world, and losses were heavy.

◀ The young man's war

It was a rare B-17 pilot who was older than 30. Most of the men who took the big bombers into battle were barely into their 20s.

▲ Silver machines

The B-17 soldiered on after World War II in some oddball roles. This is a rescue aircraft with a lifeboat carried under the fuselage.

FACTS AND FIGURES

- A B-17 shot down by Japanese Zeroes on the way to Pearl Harbor was the first American combat loss in World War II.
- The Boeing 299, the Flying Fortress prototype, first flew on July 28, 1935.
- 12,731 B-17s were built, with production of the B-17G model by Boeing, Douglas and Lockheed reaching 8,680.
- At the height of the war in Europe, B-17s flew from more than 25 airfields in the south and east of England.
- More than 47,000 U.S. 8th Air Force crew died in daylight raids over Germany.
- An SB-17, a Fortress converted for search and rescue duty, flew the first American sortie of the Korean War.

Fortress in the sky

Right: B-17s were used to make precision daylight attacks on German industrial centers.

In the mid-1930s, Boeing engineers suggested a big bomber to the U.S. Army Air Corps. The best American bomber at the time was an inadequate twin-engine adaptation of the DC-3 transport. The decision to go ahead with the B-17 Flying Fortress was a courageous leap forward: it gave the United States an embryonic strategic bomber force by the time the Japanese attacked Pearl Harbor. Early B-17s did not have enough guns and were not available in sufficient numbers, but as the war progressed the Flying Fortresses took command of the skies.

B-17 crews faced many unspeakable horrors, pressing ahead into Luftwaffe fighters and flak while blinded by smoke, slammed by turbulence, plagued with mechanical mishaps, and paralyzed by the numbing cold. On the first Berlin mission, B-17 crewmen killed in the air numbered the same as Germans killed on the ground by bombs (about 400). As the bombing campaign wore on casualties aboard the B-17s remained high, but the bombing became more effective.

Left: Hit by flak, a burning B-17 falls away from the protection of its fellows.

SPECIFICATIONS B-17G

Type: Nine/10-seat long-range bomber.

Powerplant: Four 1,200-hp. Wright R-1820-97 Cyclone turbocharged radial piston engines.

Maximum speed: 290 m.p.h. at 25,000 ft.

Ceiling: 35,600 ft.

Range: 2,000 mi. with 5,000-lb. bomb load.

Weights: Empty 37,300 lb.; loaded 65,500 lb.

Weapons: 13 .50 cal. machine guns in twin turrets, plus single dorsal and fore and aft beam positions; 17,600-lb. max bomb load.

Dimensions:

Span	103 ft. 9 in.
Length	79 ft. 9 in.
Height	19 ft. 1 in.
Wing area	1,420 sq. ft.

The "Mighty Eighth" Air Force was the premier user of the B-17 Flying Fortress.

B-17F "Fast Woman"

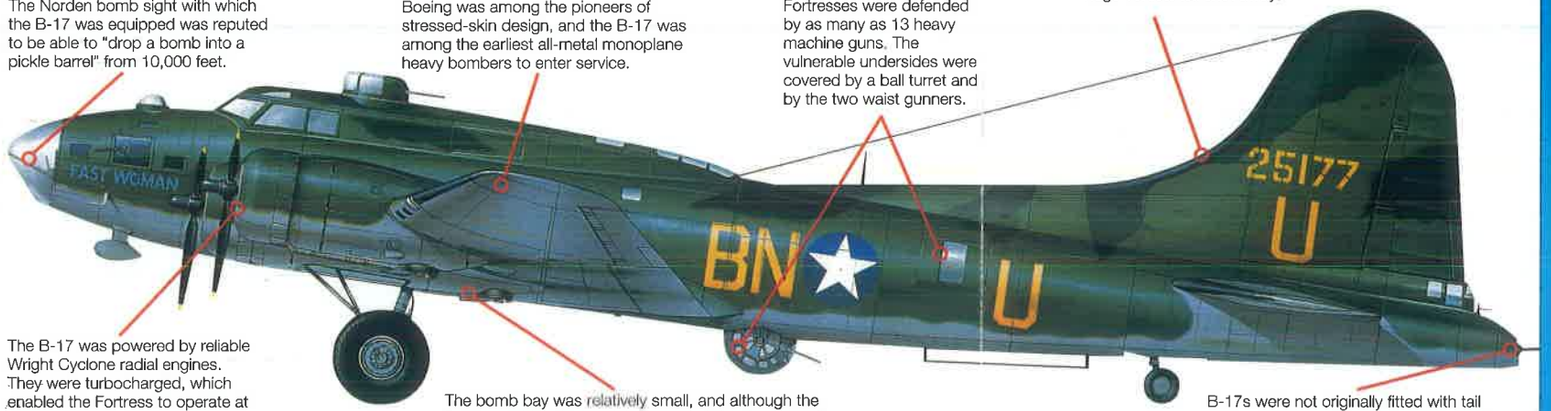
"Fast Woman" was one of the first American B-17s to arrive in Britain during World War II. Attached to the 359th Bomb Squadron of the 303rd Bomb Group, it was based at Molesworth in Huntingdonshire.

The Norden bomb sight with which the B-17 was equipped was reputed to be able to "drop a bomb into a pickle barrel" from 10,000 feet.

Boeing was among the pioneers of stressed-skin design, and the B-17 was among the earliest all-metal monoplane heavy bombers to enter service.

Fortresses were defended by as many as 13 heavy machine guns. The vulnerable undersides were covered by a ball turret and by the two waist gunners.

The B-17 was immensely strong. Aircraft managed to return to base with severe battle damage, and the big bomber could still fly even with large sections of the huge vertical tail shot away.



The B-17 was powered by reliable Wright Cyclone radial engines. They were turbocharged, which enabled the Fortress to operate at higher altitudes than its European contemporaries.

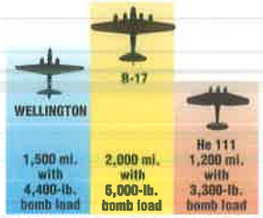
The bomb bay was relatively small, and although the B-17 could fly with an eight-ton bomb load it generally carried a quarter of that amount on operations.

B-17s were not originally fitted with tail guns. A tail gunner's position was added to the B-17E and all subsequent models.

ACTION DATA

RANGE

Designed at a time when other air forces still thought twin-engine machines were heavy bombers, the B-17 carried more bombs over much greater distances than its contemporaries.

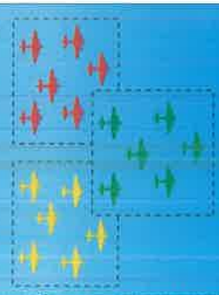


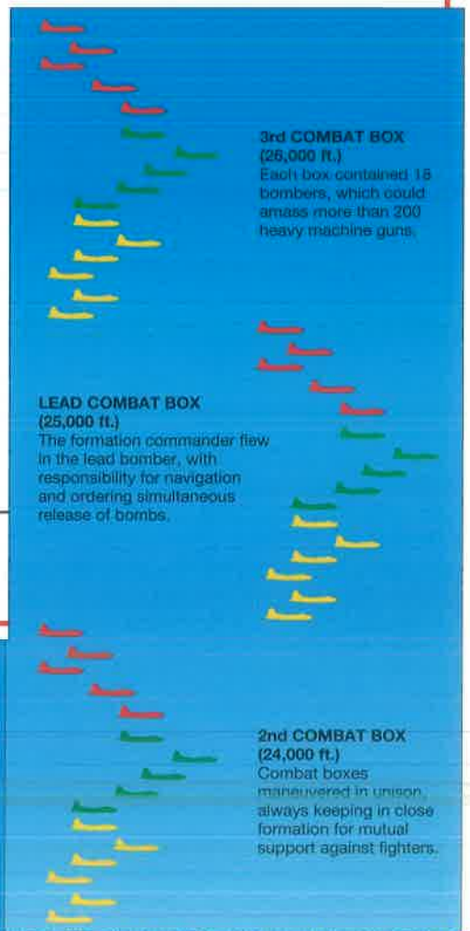
DEFENSES

Originally relatively lightly armed, the B-17 entered combat in armor plate and with all-around machine-gun emplacements. A box of just 18 bombers could bring hundreds of guns to bear on an attacker coming from any direction.

Layered defenses

Every B-17 aircraft contributed to the defense of the entire formation. Each squadron of six aircraft moved in unison in formations called boxes, and squadrons were layered and staggered horizontally and vertically, to allow the simultaneous release of bombs.





3rd COMBAT BOX (26,000 ft.)
Each box contained 18 bombers, which could amass more than 200 heavy machine guns.

LEAD COMBAT BOX (25,000 ft.)
The formation commander flew in the lead bomber, with responsibility for navigation and ordering simultaneous release of bombs.

2nd COMBAT BOX (24,000 ft.)
Combat boxes maneuvered in unison, always keeping in close formation for mutual support against fighters.