

JAGUAR GR.Mk 1/GR.Mk 1B

● Anglo-French single-seat attack aircraft ● Gulf War veteran



▲ It was thought that the Jaguar was in the twilight of its career when both French and RAF Jaguars were sent to the Gulf to participate in Operation Desert Storm. Since then a new RAF version, the GR.Mk 1B, has entered service equipped with the TIALD imaging and laser pod.

One of the early successes of Anglo-French collaboration, the Jaguar fighter-bomber has also been the mainstay of the RAF's first-line squadrons over the last three decades. With improved weapons and avionics, it has developed into a useful tactical ground-attack and reconnaissance aircraft, despite its performance being somewhat modest compared with some of its contemporaries.

PHOTO FILE SEPECAT JAGUAR GR.Mk 1/GR.Mk 1B

Jaguar carries a B-24's load ▶
This GR.Mk 1 carries eight 1,000-lb. bombs, equivalent to the tonnage carried by a WWII-era B-24 Liberator bomber. A more normal load includes chaff and flare pods, fuel tanks and a pair of infrared missiles.



Multi-role aircraft ▶
When originally delivered to the RAF, Jaguars were tasked with nuclear strike, reconnaissance and conventional attack. Only the latter role is performed today.



◀ **The front office**
This pilot's eye view of a single-seater's cockpit shows that it is fairly typical of a jet fighter-bomber of the 1970s.



▲ **Taking off from a highway**
Demonstrating its ability to operate from dispersed sites, this Jaguar lifts off from a stretch of highway with a load of cluster bombs.

▼ **T.Mk 2 two-seater**
The two-seat conversion trainer version of the GR.Mk 1 features a longer nose with the crew seated in tandem under separate canopies.



FACTS AND FIGURES

- ▶ During the Cold War there were up to 5 RAF "Jag" squadrons in Germany, the theoretical front line in a major conflict.
- ▶ A Jaguar was once accidentally shot down by an RAF Phantom in Germany.
- ▶ Jaguars in the Gulf were armed with iron bombs, cluster bombs and rockets.
- ▶ During Operation Desert Storm, 12 RAF Jaguars flew 618 sorties in January and February 1991.
- ▶ The RAF Jaguars' home base is RAF Coltishall, home to three squadrons.
- ▶ An RAF Jaguar once survived a high-speed wire strike at an altitude of just 30 feet.

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PROFILE

The RAF's feline mud-mover

Throwing a fast fighter-bomber through mountains, at night, without radar, alone and unaided by a navigator may seem a recipe for disaster—but that is what RAF Jaguar pilots do on a regular basis without batting an eye. They know that the Jaguar, with 20-plus years of service behind it, is a tried and tested weapon that won't let them down.

When it came to a real war situation in the Gulf in 1991, the Jaguar showed that it still has

teeth and is able to fly missions as well as aircraft that are considerably younger.

A Franco/British project, the result of collaboration between the British Aircraft Corporation (now British Aerospace) and Dassault-Breguet, the SEPECAT Jaguar was first flown on September 8, 1968, as a single-seat attack aircraft with limited all-weather capability. It was intended to serve both the Armée de l'Air and the RAF; the French Jaguar A entered service first, in May 1972.

The RAF took delivery of its first GR.Mk 1 in May 1973. A well-equipped tactical strike-fighter, its equipment included an inertial navigation system, a head-up display and laser ranger. From 1983 navigation upgrades resulted in the GR.Mk 1A. Some were able to perform a secondary reconnaissance role. The GR.Mk 1B and two-seat T.Mk 2B was introduced in 1995 with the TIALD pod, which allows a Jaguar to deliver its own laser-guided weapons.



Jaguars are fitted with a retractable inflight-refueling probe, which greatly increases their range capability.

Jaguars were the first RAF attack aircraft sent to the Persian Gulf after the Iraqi invasion of Kuwait.

RAF aircraft are equipped with "zero-zero" ejection seats. These can be used at "zero height" and "zero forward speed."

XZ364 is armed for a typical Gulf War mission with four 1,000-lb. bombs, a jamming pod under the port wing, a chaff dispenser under the starboard and AIM-9 missiles for self-defense.

JAGUAR GR.Mk 1A

XZ364 "Sadman" was one of a detachment of Jaguars from the RAF Coltishall Jaguar Wing based at Muharraq, Bahrain and one of two RAF "Jags" that flew 47 missions in the Gulf.

"Nose art" was a feature of RAF aircraft during the Gulf conflict, featuring on this aircraft a caricature of Iraqi leader Saddam Hussein. Below the cockpit the bomb symbols each represent missions flown.

Standard fitting on RAF single-seat Jaguars is the "chisel-nose" containing a Ferranti laser rangefinder and marked target seeker (LRMST).

Like the RAF Tornado bombers and Buccaneers in the Gulf, Jaguars were painted in a temporary "desert pink" camouflage.

The Jaguar is unusual in being able to carry a pair of air-to-air missiles on overwing pylons. RAF Jaguars use AIM-9 Sidewinders.

The fin fairing contains a radar-warning receiver that warns the pilot when he is "illuminated" by enemy radar.

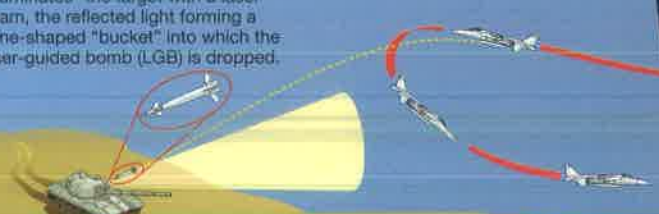


Continuing the Rolls-Royce tradition of naming its engines after rivers, the Jaguar's Anglo-French Rolls-Royce/Turbomeca Adour turbofans are named after a river in France.

Jaguar ground attack

IN THE GULF AND BEYOND: Typical ordnance loads during the Gulf War included general-purpose iron bombs, cluster bombs and rocket pods. Since then the RAF has equipped a number of single- and two-seat Jaguars with the TIALD (Thermal Imaging and Laser Designation) pod as used briefly by Tornados during Operation Desert Storm. This will allow Jaguars to deliver highly accurate laser-guided munitions autonomously, as well as "illuminate" targets for other aircraft.

TIALD ATTACK: The attacking Jaguar "illuminates" the target with a laser beam, the reflected light forming a cone-shaped "bucket" into which the laser-guided bomb (LGB) is dropped.



PRECISION GUIDANCE: The LGB homes in on the source of the reflected light for pinpoint accuracy.

CRV-7 ROCKETS IN THE GULF: After it was decided that attacks would be made at medium rather than low-level for safety, changes were made in the types of weapon used.



MACH 4 SPEED: The CRV-7 rocket, fired from a 19-tube, 530-lb. pod is accurate at up to 2,000 ft.

SPECIFICATIONS Jaguar GR.Mk 1A

Type: Single-seat attack bomber.

Powerplant: Two 8,000-lb.-thrust Rolls-Royce/Turbomeca Adour Mk 104 afterburning turbofans.

Maximum speed: 1,050 m.p.h. (Mach 1.5) at altitude.

Combat radius: 530 mi. on internal fuel.

Service ceiling: 45,986 ft.

Weights: Empty 15,400 lb.; max takeoff 33,972 lb.

Weapons: Two 30-mm Aden cannon plus provision for two AIM-9L Sidewinder air-to-air missiles on overwing pylons plus up to 9,975 lb. of underwing stores on five pylons.

Dimensions:

Span	28 ft.
Length	57 ft.
Height	16 ft.
Wing area	260 sq. ft.

ACTION DATA

SPEED

For ground-attack aircraft, speed at ground-level is far more important than absolute maximum speed. All three aircraft have similar performance at lower levels.



WEAPONS

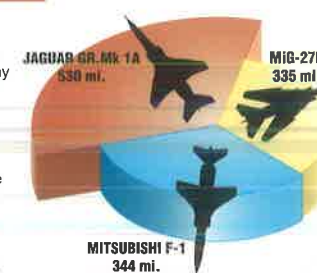
The Jaguar is an excellent attack aircraft with the ability to carry a useful bomb load, including laser-guided bombs, deep into enemy territory. The F-1 carries far less than the MIIG-27 or the Jaguar.



JAGUAR GR.Mk 1A	MIIG-27K	MIITSUBISHI F-1
2 x 30-mm cannon	1 x 30-mm cannon	1 x 20-mm cannon
9,974 lb. ordnance	8,800 lb. ordnance	5,986 lb. ordnance

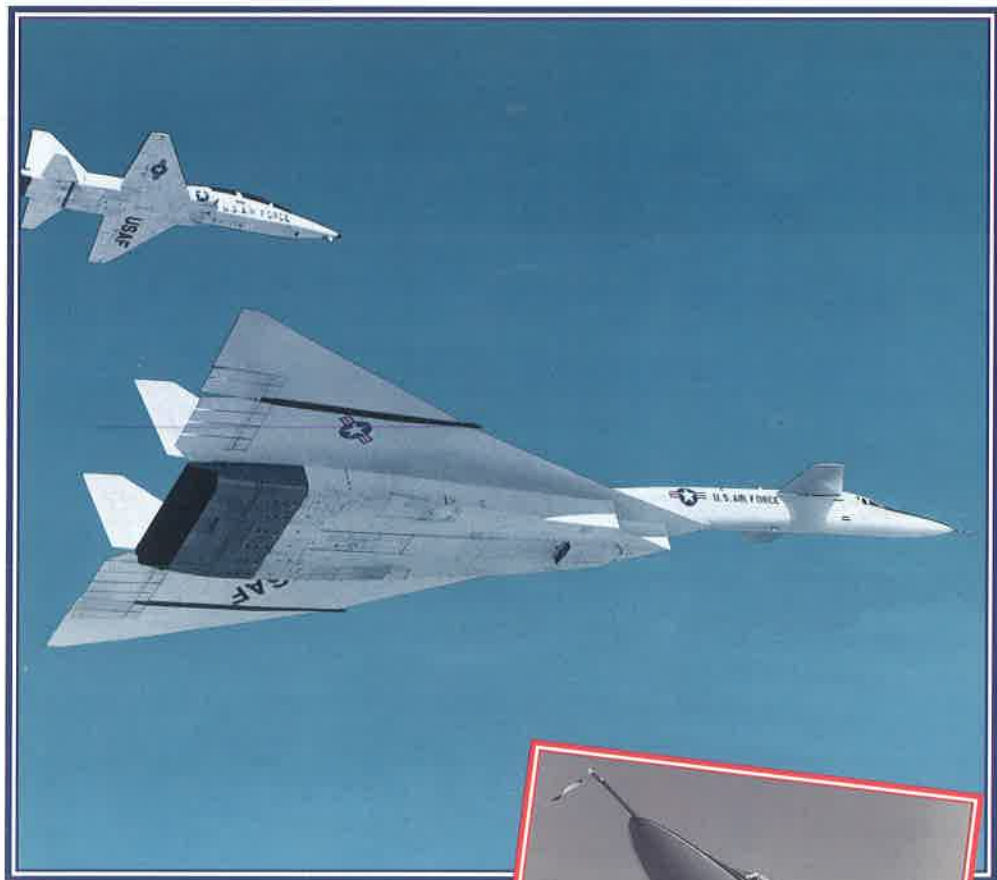
COMBAT RADIUS

With a typical bomb load, the Jaguar can strike deeper into enemy territory than the MIIG-27 or the Mitsubishi F-1. This capability was shown to good effect in the Gulf War of 1991 when RAF and French Jaguars attacked targets deep inside Iraq.



XB-70 VALKYRIE

● Mach 3 strategic weapon system ● Fastest bomber ever flown



▲ The XB-70 was the ultimate high-altitude bomber, with a performance that has never been matched. But it was a dead end; the future of the bomber lay in stealthiness and low-level penetration.

Flying at three times the speed of sound at a 15-mile altitude to deliver a nuclear attack was the role of the XB-70 Valkyrie. This massive delta with six enormous engines would have been uncatchable, and it worried Soviet generals. But the cost of the project spiralled, and problems culminated in a disastrous crash during flight trials. And then surface-to-air missile developments made the XB-70 obsolete at a stroke.

NORTH AMERICAN XB-70 VALKYRIE



▲ Vortex death trap

No one knows why F-104 chase pilot Joe Walker collided with the XB-70, but it is thought the crash was caused by the F-104 getting caught in the huge tip vortices generated by the large delta wings.



◀ Canard nose ▲

A combination of the large canard foreplanes and trailing-edge elevons controlled pitch. The four-man crew sat in a special ejection capsule, which was the only way to survive an ejection at the heights the Valkyrie flew.



▲ Giant delta

Like the YF-12A and the MiG-25, the XB-70 needed a very thin delta wing with large twin tailfins for stability in Mach 3 flight.



▲ Jet blast

Stealth was the last thing the XB-70's designers had in mind. Both its radar and infrared signatures were immense.

◀ On display

The surviving Valkyrie made its last flight in February 1969 to the USAF museum, where it remains on display to this day.



FACTS AND FIGURES

- The Valkyrie was used for "sonic boom" trials flights in support of the aborted U.S. Supersonic Transport (SST) project.
- During one test flight the XB-70 covered almost 1,000 miles in 33 minutes.
- Ethyl borane was planned to fuel the XB-70, but was found to be too expensive.
- Colonel Joe Cotton described flying the XB-70 as "like driving a Greyhound bus around the racetrack at Indianapolis."
- The project had cost \$500 million by the time the XB-70 crashed.
- The folding wingtips were designed to use aerodynamic "shock wave" effects.

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PROFILE

North American's Mach 3 Valkyrie

Even today, no aircraft can match the staggering performance of the XB-70 Valkyrie. The aim of the aircraft was to fly so fast and high that interception was impossible and nuclear strikes on the Soviet Union could be threatened. In order to evade the latest Mach 2 Soviet fighters, North American designed the huge bomber to cruise at Mach 3 for long distances at extreme altitude. The result was a six-engine delta that burned special fuel, and had wingtips that folded in

flight. The machine had to be built from special materials to cope with the heat stress of high-speed flight. The prototype first flew in 1964, and a second aircraft began trials the following year. At first all went well, and the XB-70 demonstrated that it could do everything promised by the makers, including flying at around 2,000 m.p.h.

Tragedy struck during a test flight in June 1966. A Lockheed F-104 Starfighter in formation with the XB-70 for a photo shoot accidentally crashed into

The Valkyrie was a stunning piece of engineering, but the cost of the Vietnam War made it hard to justify spending more money on it.

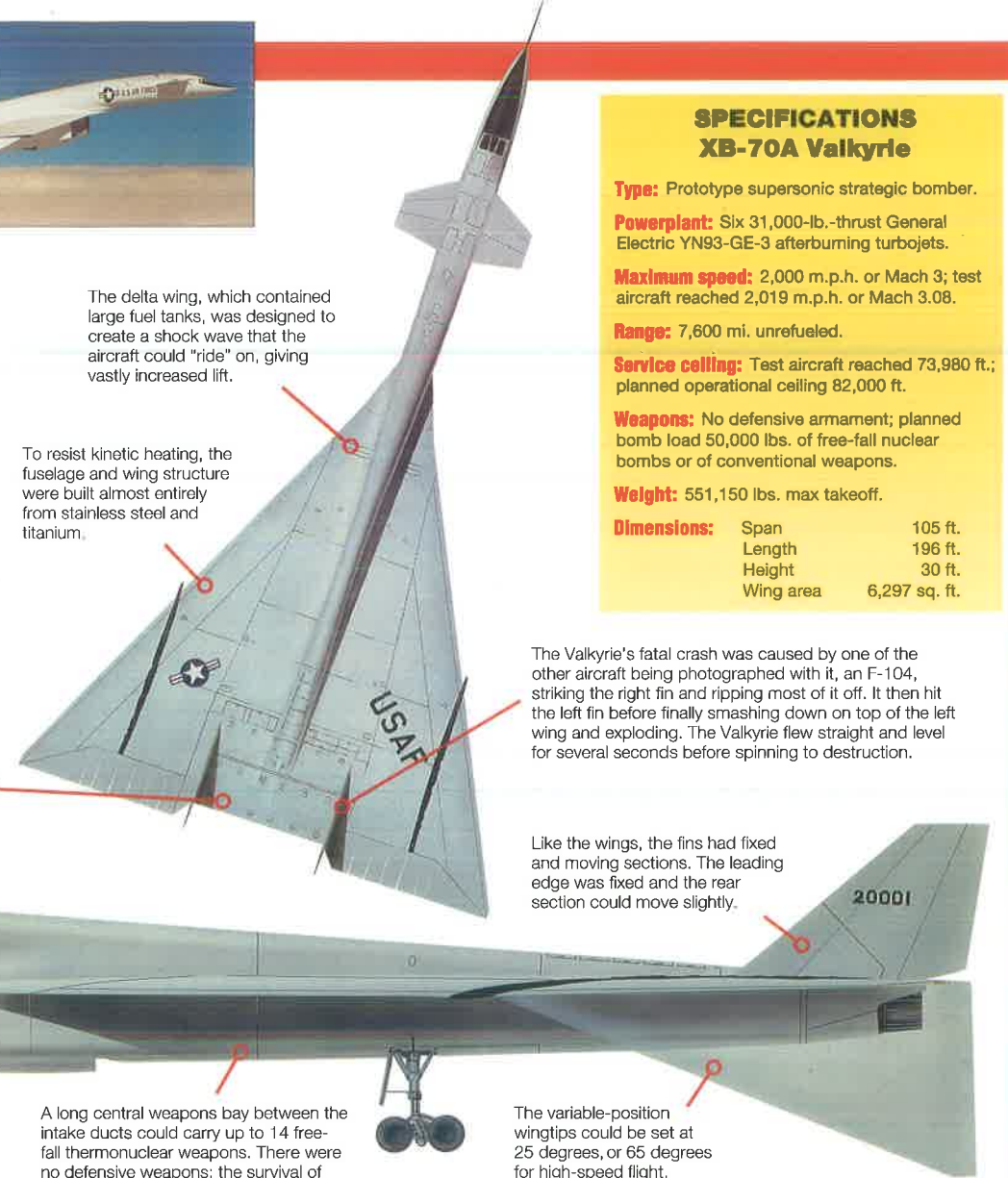
the Valkyrie, and both aircraft were destroyed. Only one of the Valkyrie crew ejected.

There was a political storm about the incident and the Valkyrie was cancelled, partly because new Soviet air defense missiles had, by the mid-1960s, made high-level bombers a thing of the past.



The delta wing, which contained large fuel tanks, was designed to create a shock wave that the aircraft could "ride" on, giving vastly increased lift.

To resist kinetic heating, the fuselage and wing structure were built almost entirely from stainless steel and titanium.



The Valkyrie's fatal crash was caused by one of the other aircraft being photographed with it, an F-104, striking the right fin and ripping most of it off. It then hit the left fin before finally smashing down on top of the left wing and exploding. The Valkyrie flew straight and level for several seconds before spinning to destruction.

Like the wings, the fins had fixed and moving sections. The leading edge was fixed and the rear section could move slightly.

A long central weapons bay between the intake ducts could carry up to 14 free-fall thermonuclear weapons. There were no defensive weapons; the survival of the Valkyrie depended on high speed and advanced electronics.

The variable-position wingtips could be set at 25 degrees, or 65 degrees for high-speed flight.

SPECIFICATIONS XB-70A Valkyrie

Type: Prototype supersonic strategic bomber.

Powerplant: Six 31,000-lb.-thrust General Electric YN93-GE-3 afterburning turbojets.

Maximum speed: 2,000 m.p.h. or Mach 3; test aircraft reached 2,019 m.p.h. or Mach 3.08.

Range: 7,600 mi. unrefueled.

Service ceiling: Test aircraft reached 73,980 ft.; planned operational ceiling 82,000 ft.

Weapons: No defensive armament; planned bomb load 50,000 lbs. of free-fall nuclear bombs or of conventional weapons.

Weight: 551,150 lbs. max takeoff.

Dimensions:

Span	105 ft.
Length	196 ft.
Height	30 ft.
Wing area	6,297 sq. ft.

XB-70 VALKYRIE

Two prototype XB-70 Valkyrie bombers were produced, flying between September 1964 and February 1969. Number 62-207 was destroyed, and 62-001 is now an exhibit at the USAF museum.

The cockpit afforded limited visibility to the crew, but there was little to see at the XB-70's cruising altitudes anyway.

The canards were essential for control of the XB-70 at low speed, as the elevons would have been masked by the wing at high angles of attack.

The six massive turbojets would have made the Valkyrie the most powerful aircraft ever built, and probably also the noisiest.



A large black anti-glare panel was painted in front of the cockpit. The overall paint scheme was a nuclear blast reflective white, which did not stand up well to Mach 3 kinetic heating.

Operational B-70s would have had a four-man crew, consisting of two pilots and two systems operators, all housed in the cockpit escape capsule.

The intake design was all-important, since control of the shock waves it produced affected thrust a great deal. The massive intake box had a huge radar signature.

Last ride of the Valkyrie: June 8, 1966



PUBLICITY SHOT: Five aircraft powered by General Electric engines were flying in formation for a publicity shot when a NASA F-104, piloted by Joe Walker, strayed too close to the massive vortex generated by the Valkyrie's downturned wingtip, sucking it in.

TRAGEDY: The tiny F-104 was hurled across the XB-70's wing, smashing one tailfin and then exploding. The Valkyrie flew on for several seconds before tumbling out of control and crashing into the Mojave desert miles below.



ACTION DATA

SPEED

The XB-70 was one of only three aircraft designed to reach Mach 3 operationally. The Soviet MIG-25 was designed primarily to intercept the massive American bomber, although it could not sustain its high speeds for nearly as long as the Valkyrie. Only the amazing SR-71, which was a smaller aircraft, could fly faster.

MIG-25	Mach 3	
SR-71	Mach 3.5+	
XB-70	Mach 3.08	

LOCKHEED MARTIN

F-16 FIGHTING FALCON

● Lightweight fighter ● Multimission capable ● "The Electric Jet"



The F-16 Fighting Falcon is over 20 years old but still a star performer. Fast and potent, it remains one of the best fighters in its class. This relatively lightweight and inexpensive warplane gave us electronic flight controls and other high-tech wizardry. In addition, its radar, missiles and cannon make it a genuine Top Gun, respected by friend and foe alike.



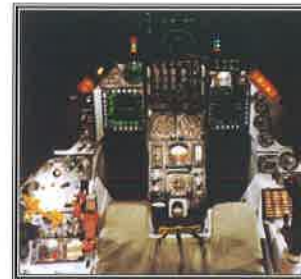
▲ The F-16 pilot has at his command the West's premier light-fighter. The view from the cockpit is outstanding, thanks to the massive one-piece bubble canopy.

LOCKHEED F-16 FIGHTING FALCON

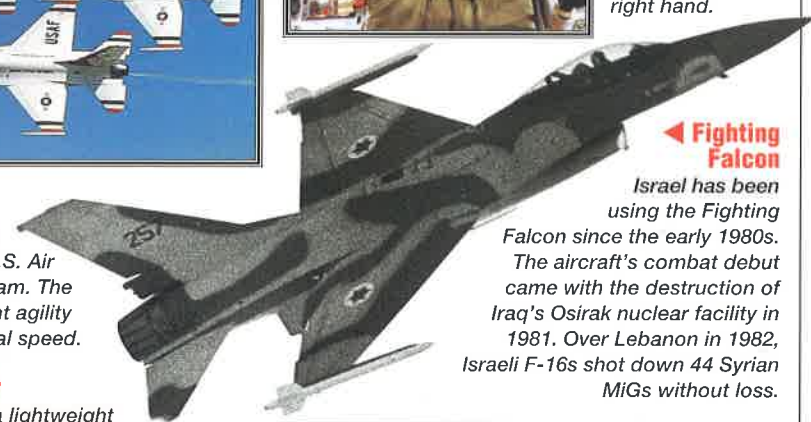


▲ **Flying the flag**
Perhaps the best known F-16s are those of the U.S. Air Force's Thunderbirds team. The F-16 gives them excellent agility matched with exceptional speed.

▼ **Fighter and bomber**
Originally conceived as a lightweight fighter, the F-16 emerged as a warplane capable of lifting just about every ground attack store available.



◀ **Head-up fighting**
The F-16 pilot reclines at 30 degrees and flies the fighter using a pressure-sensitive side-stick with his right hand.



◀ **Fighting Falcon**
Israel has been using the Fighting Falcon since the early 1980s. The aircraft's combat debut came with the destruction of Iraq's Osirak nuclear facility in 1981. Over Lebanon in 1982, Israeli F-16s shot down 44 Syrian MiGs without loss.



▲ **Air defender**
Falcons can launch the latest AMRAAM air-to-air missile. Using this weapon, a U.S. Air Force F-16 shot down a MiG-25 over Iraq.

FACTS AND FIGURES

- Lockheed acquired General Dynamics, creator of the F-16, in March 1993.
- The company says it can build a new F-16 today for \$20 million, less than half the price of an F-15E Strike Eagle.
- The F-16 ejection seat works safely at any speed and altitude.
- More than 4,000 F-16s serve in the U.S., NATO, Asia and Latin America.
- A delta-winged test version, the F-16XL, has wing area increased by 120 percent.
- F-16 pilots flew 13,500 combat sorties in Operation Desert Storm, more than any other aircraft.

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PROFILE

Lightweight superjet

The F-16 is proof that one aircraft can push back the boundaries of aviation. This marvelous warplane introduced features such as lightweight computers, "fly-by-wire" electronic controls and an arsenal of high-tech weapons.

No longer new, the F-16 is still a boon to those who fly it. Pilots say the F-16 is a super ship, without equal from the viewpoint of the airman at the controls.

Engineers intended the F-16 as a no-frills "hot rod." It gained weight with the addition of

improved radar and weaponry, but the F-16 is still smaller and more nimble than many fighters. Used mainly to drop bombs, the Fighting Falcon can turn and fight with unbridled fury when provoked. It also was one of the first operational fly-by-wire aircraft—its controls being electronically operated and computer controlled. The pilot sits in a seat that reclines at a 30-degree angle to withstand high-g maneuvers. In this position, he maintains a higher fighting ability than his enemy.



Halfway along its back, the F-16 has a refueling receptacle so that it can take on fuel in flight. This feature is now standard on most military fighting planes.

Despite its amazing agility, the F-16 is steady as a rock when it needs to be—diving in to attack a target with gun or missiles. Here a two-seater lets fly with a Maverick missile, a favorite against tanks.

F-16s are powered by a Pratt & Whitney F100 engine. It is very powerful and very resistant to changes in airflow.

Nearly all F-16s are painted light gray. This color was found to be the most difficult to see across a wide range of different weather conditions.



F-16A FIGHTING FALCON

In service with many nations, the F-16 can rightly be regarded as the world's standard fighter. This F-16 is one of Pakistan's aircraft, used to shoot down several types of Russian planes along the border with Afghanistan.

With its curved surfaces blending the fuselage and wing together, and its fly-by-wire electric flight control system, the F-16 ushered in a new era of fighter design. The radical shape had far better aerodynamics than earlier designs, making the F-16 far more agile for dogfighting.



The radar of the F-16 is as versatile as the aircraft. With a flick of a switch the pilot can change from air-to-air operation to air-to-ground. When dogfighting, the radar automatically follows the enemy and gives the pilot a steering cue on the large head-up display in front of him.

AIM-9 Sidewinders are the main air-to-air weapon of the F-16, seen here carried on the wingtips and on underwing pylons.

The AIM-9 is a heat-seeking missile, homing in on the heat of the enemy's exhaust. It is more maneuverable than an aircraft, very difficult to counter and nearly impossible to evade.

SPECIFICATIONS F-16C Fighting Falcon

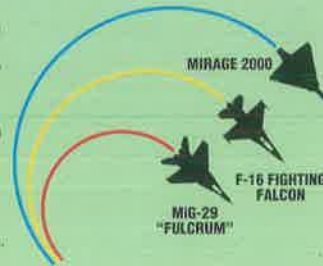
- Type:** Single-seat multirole fighter.
- Powerplant:** One 25,000-lb.-thrust P&W F100 or 25,200-lb.-thrust GE F110 afterburning turbojet.
- Maximum speed:** 1,320 m.p.h. (Mach 2.05) at 40,000 ft.
- Combat radius:** 800 mi. with drop tanks.
- Service ceiling:** 50,000 ft.
- Weights:** Empty 18,200 lb.; max takeoff 27,200 lb.
- Weapons:** One M61 Vulcan 20-mm cannon and up to 20,400 lb. of air-to-air and air-to-ground weaponry.
- Dimensions:**

Span	31 ft.
Length	47 ft. 8 in.
Height	16 ft. 5 in.
Wing area	278 sq. ft.

ACTION DATA

AGILITY

The F-16 was a revelation when it first appeared, being the most agile fighter in the world. Both the Mirage 2000 and the MIG-29 were designed to try to match the smaller American jet's superb handling.



SPEED

Although capable of twice the speed of sound at altitude, it is the F-16's performance at lower level and its acceleration at lower speeds that make it such an outstanding fighter.



Multirole fighter

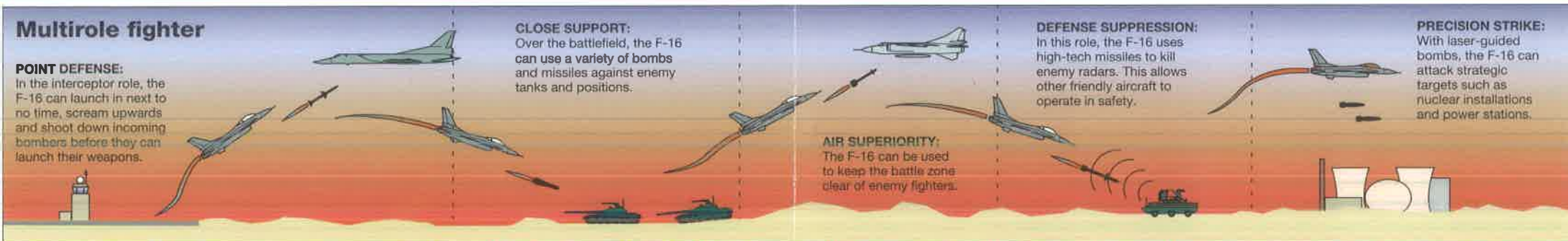
POINT DEFENSE: In the interceptor role, the F-16 can launch in next to no time, scream upwards and shoot down incoming bombers before they can launch their weapons.

CLOSE SUPPORT: Over the battlefield, the F-16 can use a variety of bombs and missiles against enemy tanks and positions.

AIR SUPERIORITY: The F-16 can be used to keep the battle zone clear of enemy fighters.

DEFENSE SUPPRESSION: In this role, the F-16 uses high-tech missiles to kill enemy radars. This allows other friendly aircraft to operate in safety.

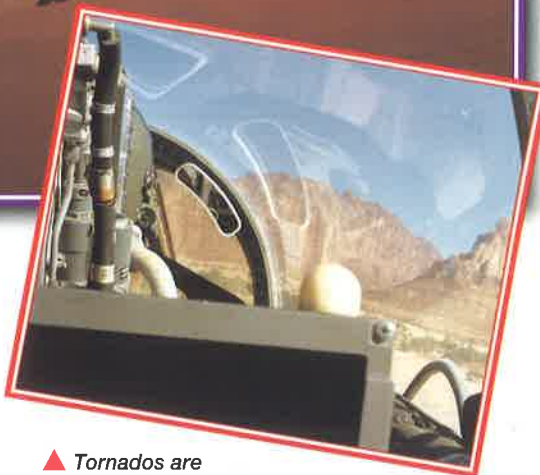
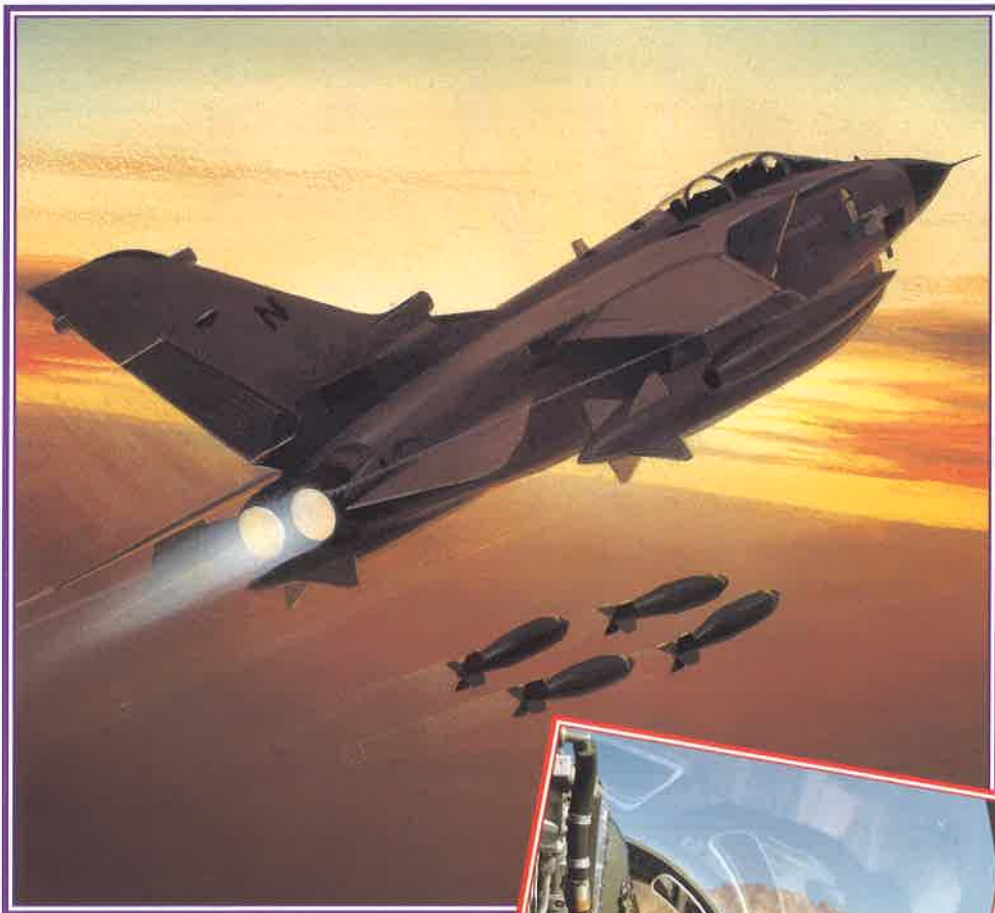
PRECISION STRIKE: With laser-guided bombs, the F-16 can attack strategic targets such as nuclear installations and power stations.



PANAVIA TORNADO GR.1

GULF WAR STRIKE

● Multirole strike fighter ● Dangerous low-level missions



They flew the most dangerous air missions of the Gulf War. Hurling through the night, less than 200 feet above the ground, their targets were the heavily defended runways of Iraq's military airfields. And the perilous nature of their role is reflected in the fact that the Royal Air Force's (RAF) Tornado GR.1s suffered proportionally the highest losses of all the aircraft taking part in Operation Desert Storm.

▲ *Tornados are designed to fly very fast, very low. Just how low is evident in this view from the cockpit of a Tornado as it races a hundred feet up through a desert "wadi."*

PANAVIA TORNADO GR.1



▲ On the deck

Control of this low-flying, exceedingly fast plane is largely automatic. The aircraft's terrain-following radar ensures that a constant ground clearance is maintained.

Multi-mission ▶

The nose of Tornado "MiG-Eater" records three JP233 missions, 23 bombing missions and 14 laser-guided bombing missions.



▲ Low-level attack

JP233 dispenses two types of bomblets. The larger SG357 munition at the rear penetrates a runway before exploding, causing craters. The tiny HB876 mines dispensed from the front are lethal against repair personnel and vehicles.

▼ Low-flying danger

Some crewmen, like Jon Peters (inset), managed to survive being shot down, getting out of their shattered Tornados only to suffer mistreatment at the hands of their captors.



▲ First mission

Strain shows on the faces of a returning Tornado crew after the first night's mission, along with relief at having survived unscathed.



FACTS AND FIGURES

- ▶ On the first three nights of the war Tornados flew 63 sorties, delivering JP233 runway attack munitions.
- ▶ Airfields hit included Al Asad, H-2, H-3, Shaibah, Tallil, Al Taqaddum and Ubaidah.
- ▶ Four Tornados were lost in the first five days, although only one carried JP233.
- ▶ Six RAF Tornados were lost in action, five crew members killed and seven captured.
- ▶ British Tornados flew a total of 1,600 bombing missions during the war, or 1.4 percent of the coalition total.
- ▶ Tornados delivered 100 JP233s, 4,250 free-fall bombs and 950 laser-guided bombs.

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Gulf War spearhead

“It was a very, very black night; probably one of the darkest I have ever flown on. Over the desert, especially over Iraq, there are no lights. You are flying very low, and all you see is the odd Bedouin camp flashing by.”

From the beginning of the Gulf War, British and Saudi air force Tornados made their trademark high-speed attacks. Passing low over their target, the huge JP233 containers beneath the fuselage dispensed runway-cratering munitions and area-denial mines, designed to prevent repair operations.

Low-level missions such as those employing the JP233 were among the most dangerous of the war. Five aircraft were lost to the full force of enemy anti-aircraft artillery.

“It’s absolutely terrifying. You’re frightened of failure; you’re frightened of dying. You’re flying as low as you dare but not too low to drop your weapons. You put it over the target as low as possible, then you get away as fast as you can.”

The problem was the size and multiple runways of the Iraqi air bases. It didn’t take the Tornado pilots long to decide

JP233 is no lightweight. Twenty feet long and weighing 5,150 pounds, it needs a powerful machine like the Tornado to carry its twin dispensers.

that destroying the taxiways leading to the runways was the most effective way of making the airfield unusable.

The lack of air opposition later in the war testified that the incredible courage of the crews was not wasted, and the Tornado force had done its job.

All of Tornado’s wing stations were occupied by tanks or defense pods, with weapons carried under the fuselage. The only exceptions were two Sidewinders carried for self-defense.

Tornado’s small swing-wing minimizes low-level, high-speed turbulence, so its two-man crew has a comfortable ride.

SPECIFICATIONS TORNADO GR.1

- Type:** Two-seat multirole combat aircraft.
- Powerplant:** Two Turbo-Union RB.199 Mk103 turbofans, each rated at 8,650 lb. dry and 16,100 lb. afterburning thrust.
- Maximum speed:** 920 m.p.h. at low level.
- Combat radius:** 870 mi. on a typical hi-lo-hi attack mission.
- Service ceiling:** More than 50,030 ft.
- Weapons:** Two 27-mm IWKA-Mauser cannons each with 180 rounds; 19,840 lb. of ordnance ranging from WE177B nuclear bomb, JP233 or MW-1 airfield attack weapons, Alarm or HARM anti-radar missiles, Paveway laser-guided bombs, and 1,200 lb. free-fall or retarded HE bombs.
- Weights:** Empty 30,620 lb; loaded 61,620 lb.
- Dimensions:**

Span (28 ft. sweep)	45 ft. 7 in.
Length	54 ft. 9 in.
Height	19 ft. 6 in.
Wing area	286 sq. ft.



TORNADO GR.1 “MIG-EATER”

British air force Tornados in the Gulf were notable for their colorful nose art. “MiG-Eater,” depicted here, was based at Tabuk. It was one of the most heavily used Tornados, being flown on 40 missions.

Tornado carries the Sky Shadow electronic countermeasures pod. This detects and jams enemy fire-control radars across a wide range of frequencies.



The Tornado’s multi-mode radar is its primary navigation and attack system. Behind the radar is the chisel-like housing for the laser seeker, used when dropping precision-guided munitions.

After the Iraqi airfields were neutralized, Tornados switched to laser-guided attacks, using British 1,100-lb. bombs fitted with the Paveway II laser-guidance system. Two or three bombs were carried side by side on fuselage hardpoints.

The tip of Tornado’s large vertical tail houses a VHF communications antenna. A pair of Marconi radar-warning receivers, which detect enemy search radars, project fore and aft immediately beneath.

ACTION DATA

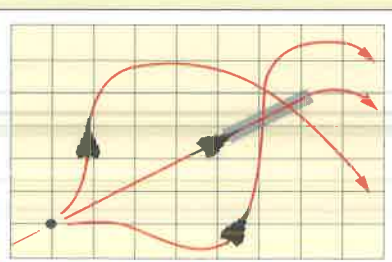


Iraq’s air bases were the Tornado’s primary target and were attacked with a number of different weapons. The two most effective required very different attack techniques.

JP233: Attacking with the specialized airfield denial weapon entailed approaching from as low as 250 feet, which made the fighter vulnerable to small arms and hand-held missiles.

LASER-GUIDED BOMBS: These were dropped with deadly accuracy from as high as 20,000 feet, as seen above, in almost complete safety from enemy defenses.

Tornado mission



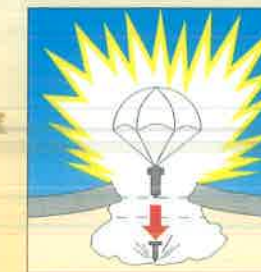
1 INITIAL POINT: About six miles from the target the Tornado reaches the IP, or initial point. This is the start of the bomb run itself, which is completely automatic.

2 WEAPONS RELEASE: The computerized fire control system continually monitors aircraft speed, height and position, calculating the exact moment at which to release weapons in order to hit the target.

3 LAYDOWN ATTACK: Usually involving multiples of four aircraft attacking several hundred yards apart at intervals of a few seconds, often from different directions, this makes target acquisition much more difficult for the enemy’s air defenses.

4 ESCAPE: Once weapons have been released the Tornado runs out at full speed in a more or less straight line to minimize the time spent in detection and weapons-firing range of the target’s defenses.

The armament is designed to penetrate and crater the runway.



NORTH AMERICAN

P-51D MUSTANG

☛ Long-range escort fighter ☛ Most Allied kills ☛ 281 Mustang aces



AMERICAN AIRCRAFT OF WORLD WAR II



As the bombers of the Eighth Air Force fought their way deep into Hitler's heartland, it was the Mustang that cleared the skies of Luftwaffe fighters. No other combat airplane of the war could fly as high, go as far and fight as hard as the mighty Mustang. In the skilled hands of young U.S. Air Corps pilots, it took on all comers and accounted for more kills than any other Allied airplane.

▲ One of the great Mustang heroes, Major Don Gentile, with his favorite machine "Shangri-La" during 1943. He made 15 kills in Mustangs—half of them in one month.

PHOTO FILE

NORTH AMERICAN P-51D MUSTANG



◀ All the way

With underwing tanks, Mustangs had enough range to be able to escort their charges 1,700 miles to the target. When they got there, they were agile enough to beat all comers.

▼ High flyer

The Mustang's phenomenal range and performance made it ideal for escorting high-flying B-29s across the vast Pacific.



◀ Mud movers

The Mustang's hard-hitting and accurate guns made it an excellent ground attack aircraft, that could also deliver air-to-ground rockets or bombs.



▼ Flying veterans

The Mustang's impeccable handling characteristics, bubble canopy and performance make it a popular rich man's toy—and many of them are still flying today. This example even carries a passenger.

▶ Powerpack

The early Mustang was transformed into a superb high-level fighter by the British-designed, Packard-built Rolls-Royce Merlin engine, which could deliver 1,510 horsepower.



FACTS AND FIGURES

- ▶ Ordered by the British, the prototype Mustang was proposed, designed, built and flown in an incredible 117 days.
- ▶ That initial aircraft was the first of 15,686 examples of the P-51 produced.
- ▶ The Mustang was flown by 11 Allied air forces in addition to the U.S. Air Corps.
- ▶ 281 Allied Mustang pilots qualified as "Aces," with five or more kills.
- ▶ The late-model P-51H was, at 472 m.p.h., one of the fastest piston-engine fighters.
- ▶ In October 1944, Mustang pilot Lieutenant Urban L. Drew managed the astonishing feat of shooting down two Me 262 jets.

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PROFILE

Top Gun to the bomber force

Faced with invasion in 1939 and desperately short of fighters, the Royal Air Force asked North American Aviation to quickly produce the existing but obsolete P-40 Warhawk. Instead, the company designed, built and flew a new airplane in just 117 days—the Mustang.

Using an existing Allison engine and the latest laminar-flow wing, the new fighter immediately went into service with the RAF. In

December 1941 the United States joined the war, and it too needed good fighters fast. So the U.S. Air Corps took the basic RAF Mustang, rearmed it with four machine guns, and added an uprated engine. It was a good performer, but couldn't operate well alongside the high-flying long-range bomber.

By 1944 the aircraft used the Rolls-Royce Merlin engine, adopted a new bubble cockpit and increased its firepower to six

Mustangs were flown by more aces than any other Allied fighter. Their prey even included the Me 262 jet.

.50 caliber machine guns. It was now the best fighter in the war and fought superbly in all theaters, as fighter, fighter-bomber and reconnaissance platform. It was loved by its aircrews, and no fewer than 281 Mustang pilots became aces—each shooting down at least five enemy aircraft.



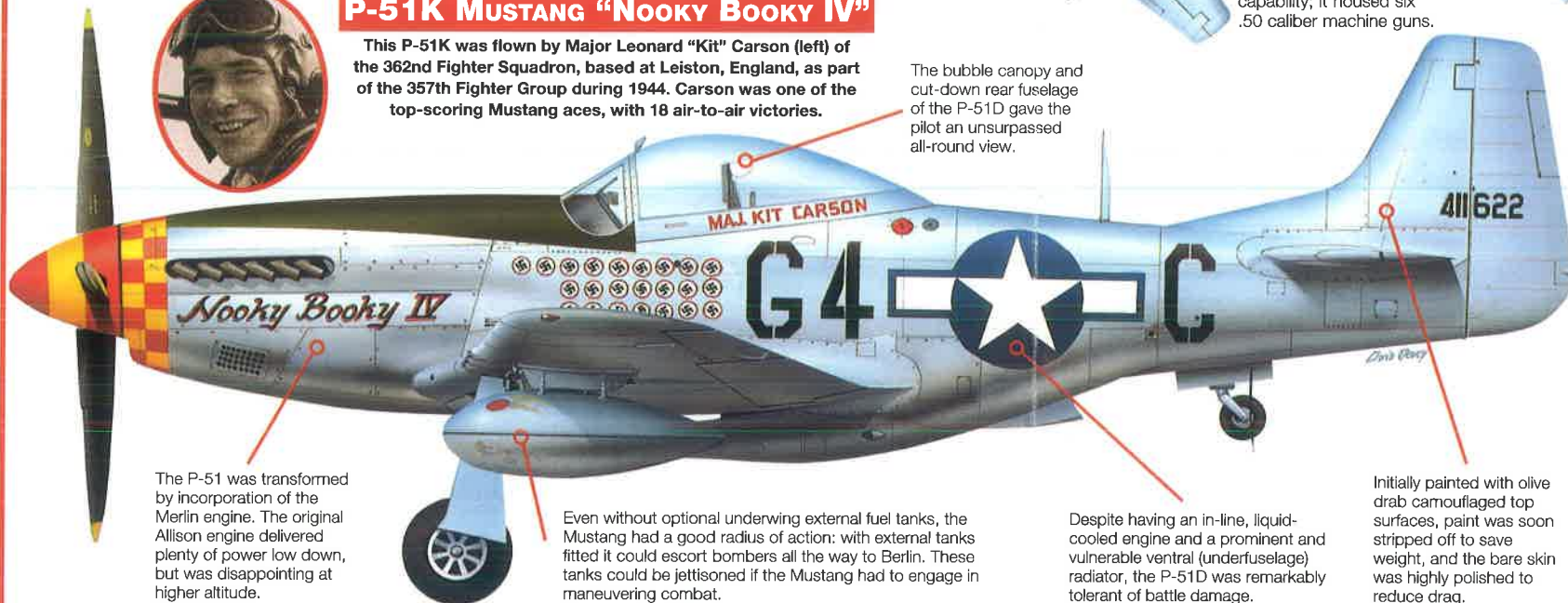
The low-drag laminar-flow wing was largely responsible for the Mustang's combination of agility and long-range capability; it housed six .50 caliber machine guns.

P-51K MUSTANG "NOOKY BOOKY IV"

This P-51K was flown by Major Leonard "Kit" Carson (left) of the 362nd Fighter Squadron, based at Leiston, England, as part of the 357th Fighter Group during 1944. Carson was one of the top-scoring Mustang aces, with 18 air-to-air victories.



The bubble canopy and cut-down rear fuselage of the P-51D gave the pilot an unsurpassed all-round view.



The P-51 was transformed by incorporation of the Merlin engine. The original Allison engine delivered plenty of power low down, but was disappointing at higher altitude.

Even without optional underwing external fuel tanks, the Mustang had a good radius of action; with external tanks fitted it could escort bombers all the way to Berlin. These tanks could be jettisoned if the Mustang had to engage in maneuvering combat.

Despite having an in-line, liquid-cooled engine and a prominent and vulnerable ventral (underfuselage) radiator, the P-51D was remarkably tolerant of battle damage.

Initially painted with olive drab camouflaged top surfaces, paint was soon stripped off to save weight, and the bare skin was highly polished to reduce drag.

SPECIFICATIONS P-51D Mustang

Type: Single-seat long-range escort fighter, fighter-bomber.

Powerplant: One 1,510-hp. Packard V-1650-7 (U.S.-built Rolls-Royce Merlin 61) inverted-vee 12-cylinder inline water-cooled piston engine.

Maximum speed: 445 m.p.h. at 25,000 ft.

Combat radius: 325 miles on internal fuel; 750 miles with two 130-gal. tanks.

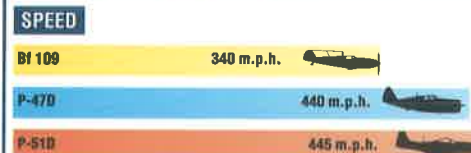
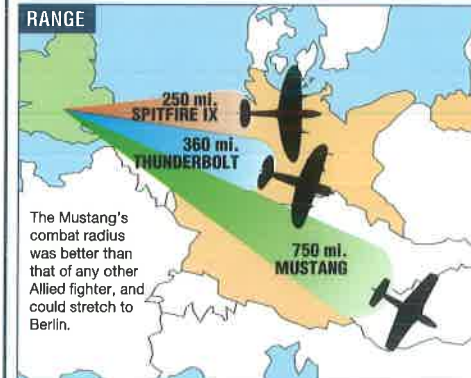
Service ceiling: 41,900 ft.

Weapons: Six .50 cal. Browning machine guns in wings; two 500-lb. bombs or eight 75-mm rockets in place of long-range drop tanks.

Weights: Empty 7,125 lb.; Loaded 11,600 lb.

Dimensions: Span 37 ft.
Length 32 ft. 3 in.
Height 12 ft. 2 in.
Wing area 235 sq. ft.

ACTION DATA



The P-51D's clean, low-drag airframe and powerful Merlin engine endowed it with superb performance.



Mustang, the all-the-way escort fighter

THE BOMBERS: Eighth Air Corps bombers left their British bases an hour ahead of the Mustangs, escorted in the first part of the mission by shorter-ranged P-38s and P-47s.



HAND OVER: The faster Mustangs would catch the formation over the Dutch/German border, where they would relieve the P-38s and Thunderbolts high above the B-17s.



ESCORT: Some fighters flew close escort. Their nearness boosted the morale of the bomber crews, who had been so severely mauled over Germany the year before.



DOGFIGHTER: The Mustang had more than long range. It was fast and it was a ferocious dogfighter, as the pilot of this Messerschmitt Bf 109G shot down by a P-51 discovered.



CONTROL OF THE SKIES: It was the appearance of swarms of these graceful fighters in the skies over Germany that was to signal the death knell of the Luftwaffe.

