**Northrop Grumman B-2 Spirit**

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*"B-2" redirects here. For other uses, see* [*B2 (disambiguation)*](http://en.wikipedia.org/wiki/B2_%28disambiguation%29)*.*

*"Stealth Bomber" redirects here. For Stealth aircraft in general, see* [*Stealth aircraft*](http://en.wikipedia.org/wiki/Stealth_aircraft)*.*

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| **B-2 Spirit** |
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| A USAF B-2 Spirit in flight |
| **Role** | Stealth bomber |
| **National origin** | United States |
| **Manufacturer** | [Northrop Corporation](http://en.wikipedia.org/wiki/Northrop_Corporation)[Northrop Grumman](http://en.wikipedia.org/wiki/Northrop_Grumman) |
| **First flight** | 17 July 1989 |
| **Introduction** | April 1997 |
| **Status** | Active service: 20 aircraft |
| **Primary user** | [United States Air Force](http://en.wikipedia.org/wiki/United_States_Air_Force) |
| **Number built** | 21  |
| **Program cost** | US$44.75 billion (projected through 2004)  |
| **Unit cost** | $737 million (1997 cost for each aircraft only)  |

The [Northrop Grumman](http://en.wikipedia.org/wiki/Northrop_Grumman) **B-2 Spirit** (also known as the *Stealth Bomber*) is an [American](http://en.wikipedia.org/wiki/United_States) [heavy bomber](http://en.wikipedia.org/wiki/Heavy_bomber) with "low observable" [stealth](http://en.wikipedia.org/wiki/Stealth_aircraft) technology designed to [penetrate](http://en.wikipedia.org/wiki/Penetration_%28warfare%29) dense [anti-aircraft defenses](http://en.wikipedia.org/wiki/Anti-aircraft_warfare) and deploy both [conventional](http://en.wikipedia.org/wiki/Conventional_weapons) and [nuclear](http://en.wikipedia.org/wiki/Nuclear_weapon) weapons. Because of its considerable [capital](http://en.wikipedia.org/wiki/Capital_costs) and [operational](http://en.wikipedia.org/wiki/Operating_costs) costs, the [project](http://en.wikipedia.org/wiki/Megaproject) was controversial in Congress and among the [Joint Chiefs of Staff](http://en.wikipedia.org/wiki/Joint_Chiefs_of_Staff). During the late 1980s and early 1990s, [Congress](http://en.wikipedia.org/wiki/United_States_Congress) slashed initial plans to purchase 132 bombers to just 21.

The cost of each aircraft averaged US$737 million in 1997 dollars. Total [procurement](http://en.wikipedia.org/wiki/Procurement) costs averaged US$929 million per aircraft, which includes spare parts, equipment, retrofitting, and software support.[[3]](http://en.wikipedia.org/wiki/Northrop_Grumman_B-2_Spirit#cite_note-Gao-2#cite_note-Gao-2) The total program cost, which includes development, engineering and testing, averaged US$2.1 billion per aircraft (in 1997 dollars).[[3]](http://en.wikipedia.org/wiki/Northrop_Grumman_B-2_Spirit#cite_note-Gao-2#cite_note-Gao-2)

Twenty B-2s are operated by the [United States Air Force](http://en.wikipedia.org/wiki/United_States_Air_Force). Though originally designed in the 1980s for [Cold War](http://en.wikipedia.org/wiki/Cold_War) operations scenarios, B-2s were first used in combat to drop [bombs](http://en.wikipedia.org/wiki/Bomb) on [Serbia](http://en.wikipedia.org/wiki/Serbia) during the [Kosovo War](http://en.wikipedia.org/wiki/Kosovo_War) in 1999, and saw continued use during the ongoing [wars in Iraq](http://en.wikipedia.org/wiki/Iraq_War) and [Afghanistan](http://en.wikipedia.org/wiki/War_in_Afghanistan_%282001-present%29). One aircraft [was lost](http://en.wikipedia.org/wiki/Andersen_Air_Force_Base_B-2_accident) in 2008 when it crashed just after takeoff; the crew ejected safely.

The bomber has a crew of two and can drop up to 80 x 500 lb. (230 kg)-class [JDAM](http://en.wikipedia.org/wiki/Joint_Direct_Attack_Munition) [GPS](http://en.wikipedia.org/wiki/GPS)-guided bombs, or 16 x 2,400 lb. (1,100 kg) [B83 nuclear bombs](http://en.wikipedia.org/wiki/B83_nuclear_bomb) in a single pass through extremely dense [anti-aircraft defenses](http://en.wikipedia.org/wiki/Anti-aircraft_warfare). The B-2 is the only aircraft that can carry large air to surface [standoff](http://en.wikipedia.org/wiki/Standoff_missile) weapons in a stealth configuration. The program has been the subject of [espionage](http://en.wikipedia.org/wiki/Espionage) and [counter-espionage](http://en.wikipedia.org/wiki/Counter-espionage) activity and the B-2 has provided prominent public [spectacles](http://en.wikipedia.org/wiki/Spectacle) at [air shows](http://en.wikipedia.org/wiki/Air_show) since the 1990s.

**Development**

**ATB project**

The B-2 Spirit originated from the Advanced Technology Bomber (ATB) [black project](http://en.wikipedia.org/wiki/Black_project) that began in 1979. The [Cold War](http://en.wikipedia.org/wiki/Cold_War) was well underway, and on the campaign trail in 1979 and 1980, candidate [Ronald Reagan](http://en.wikipedia.org/wiki/Ronald_Reagan) promised a [restoration of American military strength](http://en.wikipedia.org/wiki/1980_presidential_election#Campaign_promises). On 22 August 1980, the incumbent [Carter administration](http://en.wikipedia.org/wiki/Carter_administration) publicly disclosed that the [Department of Defense](http://en.wikipedia.org/wiki/United_States_Department_of_Defense) was working to develop stealth aircraft including the ATB. In 2007, it was revealed publicly that [MIT](http://en.wikipedia.org/wiki/Massachusetts_Institute_of_Technology) scientists helped assess the mission effectiveness of the aircraft under [classified](http://en.wikipedia.org/wiki/Classified_information) contract during the 1980s.

After the evaluations of the companies' proposals, the ATB competition was reduced to the [Northrop](http://en.wikipedia.org/wiki/Northrop_Corporation)/[Boeing](http://en.wikipedia.org/wiki/Boeing) and [Lockheed](http://en.wikipedia.org/wiki/Lockheed_Corporation)/[Rockwell](http://en.wikipedia.org/wiki/Rockwell_International) teams with each receiving a study contract for further work. Both teams used flying wing designs. The Northrop design was larger while the Lockheed design was smaller and included a small tail. The black project was funded under the code name "Aurora". The Northrop/Boeing team's ATB design was selected over the Lockheed/Rockwell design on 20 October 1981.

The B-2's first public display in 1988

The B-2's first public flight in 1989

The Northrop design received the designation B-2 and the name "Spirit". The bomber's design was changed in the mid-1980s when the mission profile was changed from high-altitude to low-altitude, terrain-following. The redesign delayed the B-2's first flight by two years and added about US$1 billion to the program's cost. An estimated US$23 billion was secretly spent for [research and development](http://en.wikipedia.org/wiki/Research_and_development) on the B-2 by 1989. At the program's peak, approximately 13,000 people were employed at a dedicated plant in [Pico Rivera, California](http://en.wikipedia.org/wiki/Pico_Rivera%2C_California) for the aircraft's engineering and portions of its manufacturing.

The B-2 was first publicly displayed on 22 November 1988, at Air Force [Plant 42](http://en.wikipedia.org/wiki/Plant_42), [Palmdale, California](http://en.wikipedia.org/wiki/Palmdale%2C_California), where it was assembled. This initial viewing was heavily guarded and guests were not allowed to see the rear of the B-2. Its first public flight was on 17 July 1989 from Palmdale.

**Procurement**

A procurement of 132 aircraft was planned in the mid-1980s, but was later reduced to 75. By the [early 1990s](http://en.wikipedia.org/wiki/Early_1990s), the [Soviet Union](http://en.wikipedia.org/wiki/Soviet_Union) had disintegrated, which effectively rendered void the Spirit's primary [Cold War](http://en.wikipedia.org/wiki/Cold_War) mission. In light of budgetary pressures and congressional opposition, in his 1992 [State of the Union Address](http://en.wikipedia.org/wiki/State_of_the_Union_Address), President [George H.W. Bush](http://en.wikipedia.org/wiki/George_H.W._Bush) announced B-2 production would be limited to a total of 20 aircraft. In 1996, however, the Clinton administration, though originally committed to ending production of the bombers once the 20th aircraft was completed, authorized the conversion of a 21st bomber, a [prototype](http://en.wikipedia.org/wiki/Prototype) test model, to Block 30 full operational status at a cost of nearly $500 million.

In 1995 Northrop made a proposal to the USAF to build 20 additional aircraft with a flyaway cost of $566M each.[[17]](http://en.wikipedia.org/wiki/Northrop_Grumman_B-2_Spirit#cite_note-Ency_Mod_Mil-16#cite_note-Ency_Mod_Mil-16)

**Espionage**

In 1984 a [Northrop](http://en.wikipedia.org/wiki/Northrop_Corporation) employee, [Thomas Cavanaugh](http://en.wikipedia.org/wiki/Thomas_Patrick_Cavanaugh), was arrested for trying to sell [classified information](http://en.wikipedia.org/wiki/Classified_information) to the [Soviet Union](http://en.wikipedia.org/wiki/Soviet_Union), which apparently was smuggled out of the [Pico Rivera, California](http://en.wikipedia.org/wiki/Pico_Rivera%2C_California) factory. Cavanaugh was eventually sentenced to life in prison and released under parole in 2001.

[Noshir Gowadia](http://en.wikipedia.org/wiki/Noshir_Gowadia), a design engineer who worked on the B-2's propulsion system, was arrested in October 2005 for selling B-2 related classified information to foreign countries. His trial was initially scheduled for 12 February 2008, but he received a [continuance](http://en.wikipedia.org/wiki/Continuance). On August 9, 2010, Gowadia was convicted in the United States District Court for the District of Hawaii on 14 of 17 charges against him. Sentencing has been set for November 22, 2010.

**Program costs**

In a 1994 [live fire exercise](http://en.wikipedia.org/wiki/Live_fire_exercise) near [Point Mugu, California](http://en.wikipedia.org/wiki/Point_Mugu%2C_California), a B-2 drops forty-seven 500 lb. (230 kg) class [Mark 82](http://en.wikipedia.org/wiki/Mark_82_bomb) bombs, which is more than half of a B-2's total ordnance payload

The program was the subject of public controversy for its costs to American taxpayers. In 1996 the [General Accounting Office](http://en.wikipedia.org/wiki/General_Accounting_Office) disclosed that the USAF's B-2 bombers "will be, by far, the most costly bombers to operate on a per aircraft basis", costing over three times as much as the B-1B (US$9.6 million annually) and over four times as much as the B-52H ($US6.8 million annually). In September 1997, each hour of B-2 flight necessitated 119 hours of maintenance in turn. Comparable maintenance needs for the B-52 and the B-1B are 53 and 60 hours respectively for each hour of flight. A key reason for this cost is the provision of air-conditioned hangars large enough for the bomber's 172 ft (52.4 m) wingspan, which are needed to maintain the aircraft's stealthy properties, especially its "low-observable" stealthy skins. Maintenance costs are about $3.4 million a month for each aircraft.

The total "military construction" cost related to the program was projected to be US$553.6 million in 1997 dollars. The cost to procure each B-2 was US$737 million in 1997 dollars, based only on a fleet cost of US$15.48 billion. The [procurement](http://en.wikipedia.org/wiki/Procurement) cost per aircraft as detailed in [General Accounting Office](http://en.wikipedia.org/wiki/Government_Accountability_Office) (GAO) reports, which include spare parts and software support, was $929 million per aircraft in 1997 dollars.

The total program cost projected through 2004 was US$44.75 billion in 1997 dollars. This includes development, procurement, facilities, construction, and spare parts. The total program cost averaged US$2.13 billion per aircraft.

**Opposition**

In its consideration of the fiscal year 1990 defense budget, the House Armed Services Committee trimmed $800 million from the B-2 [research and development](http://en.wikipedia.org/wiki/Research_and_development) budget, while at the same time staving off a motion to kill the bomber. Opposition in committee and in Congress more largely was broad and bipartisan, with Congressmen [Ron Dellums](http://en.wikipedia.org/wiki/Ron_Dellums) (D-CA), [John Kasich](http://en.wikipedia.org/wiki/John_Kasich) (R-OH), and [John G. Rowland](http://en.wikipedia.org/wiki/John_G._Rowland) (R-CT) authorizing the motion to kill the bomber and others in the Senate such as [Jim Exon](http://en.wikipedia.org/wiki/Jim_Exon) (D-NE) and [John McCain](http://en.wikipedia.org/wiki/John_McCain) (R-AZ) also opposing the project.

The growing cost of the B-2 program, and evidence of flaws in the aircraft's ability to elude detection by radar, were among factors which drove opposition. At the peak production period specified in 1989, the schedule called for spending US$7 billion to $8 billion per year in 1989 dollars, something Committee Chair [Les Aspin](http://en.wikipedia.org/wiki/Les_Aspin) (D-WI) said "won't fly financially."

In 1990, the US Department of Defense accused Northrop of using faulty components in the flight control system. Efforts have also been made to reduce the probability of bird ingestion, which could damage engine fan blades.

In time, a number of prominent members of Congress began to oppose the program's expansion, to include former Democratic presidential nominee [John Kerry](http://en.wikipedia.org/wiki/John_Kerry) who cast votes against the B-2 Stealth Bomber in 1989, 1991 and 1992 while a United States Senator representing [Massachusetts](http://en.wikipedia.org/wiki/Massachusetts). By 1992, Republican President [George H.W. Bush](http://en.wikipedia.org/wiki/George_H.W._Bush) called for the cancellation of the B-2 and promised to cut military spending by 30% in the wake of the collapse of the [Soviet Union](http://en.wikipedia.org/wiki/Soviet_Union).

In May 1995, on the basis of its 1995 Heavy Bomber Force Study, the DOD determined that additional B-2 procurements would exacerbate efforts to develop and implement long term recapitalization plans for the [USAF](http://en.wikipedia.org/wiki/USAF) bomber force.

In October 1995, former [Chief of Staff of the United States Air Force](http://en.wikipedia.org/wiki/Chief_of_Staff_of_the_United_States_Air_Force), [General Mike Ryan](http://en.wikipedia.org/wiki/Michael_E._Ryan), and Former Chairman of the Joint Chiefs of Staff, General [John Shalikashvili](http://en.wikipedia.org/wiki/John_Shalikashvili), strongly recommended against Congressional action to fund the purchase of any additional B-2s, arguing that to do so would require unacceptable cuts in existing conventional and nuclear-capable aircraft to pay for the new bombers, and because the military had much higher priorities on which to spend its limited procurement dollars.

Some B-2 advocates argued that procuring twenty additional B-2s would save money because B-2s would be able to deeply penetrate anti-aircraft defenses and use low-cost, short-range attack weapons rather than expensive standoff weapons. However, in 1995, the [Congressional Budget Office](http://en.wikipedia.org/wiki/Congressional_Budget_Office) (CBO), and its Director of National Security Analysis, found that additional B-2s would reduce the cost of weapons expended by the bomber force by less than US$2 billion in 1995 dollars during the first two weeks of a conflict, which is when the Air Force envisions bombers would make their greatest contribution. This is a small fraction of the US$26.8 billion (in 1995 dollars) life cycle cost that the CBO projected an additional 20 B-2s would cost.

In 1997, as [Ranking Member](http://en.wikipedia.org/wiki/Ranking_Member) of the [House Armed Services Committee](http://en.wikipedia.org/wiki/U.S._House_Committee_on_Armed_Services) and National Security Committee, Congressman Ron Dellums, a long-time opponent of the bomber, cited five independent studies and offered an amendment to that year's defense authorization bill to cap production of the bombers with the existing 21 aircraft. The amendment was narrowly defeated. Nonetheless, Congress has never approved funding for the purchase of any additional B-2 bombers to date.

**Upgrades**

In 2008, the US Congress funded upgrades to the B-2s weapon control systems for hitting moving targets.

On 29 December 2008, Air Force officials awarded a production contract to Northrop Grumman to modernize the B-2 fleet's radar. The contract provides advanced state-of-the-art radar components, with the aim of sustained operational viability of the B-2 fleet into the future. The contract has a target value of approximately US$468 million. The award follows successful flight testing with the upgraded equipment. A modification to the radar was needed since the [U.S. Department of Commerce](http://en.wikipedia.org/wiki/United_States_Department_of_Commerce) required the B-2 to use a different radar frequency. It was reported on 22 July 2009 that the B-2 had passed the second of the two USAF audit milestones associated with this upgraded [AESA](http://en.wikipedia.org/wiki/AESA) radar capability.

On 28 April 2009, an Air Force/contractor team verified that the 30,000 pound [Massive Ordnance Penetrator](http://en.wikipedia.org/wiki/Massive_Ordnance_Penetrator) (MOP) would fit in the B-2's bomb bay.

**Design**

The B-2's engines are buried within its wing to conceal the induction fans and minimize their exhaust signature. The crew of two sit side-by-side in the cockpit.

The B-2's low-observable, or "[stealth](http://en.wikipedia.org/wiki/Stealth_aircraft)", characteristics give it the ability to penetrate an enemy's most sophisticated anti-aircraft defenses to attack its most heavily defended targets. The bomber's stealth comes from a combination of reduced acoustic, infrared, visual and radar signatures, making it difficult for opposition defenses to detect, track and engage the aircraft. Many specific aspects of the low-observability process remain classified. The B-2's composite materials, special coatings and [flying wing](http://en.wikipedia.org/wiki/Flying_wing) design, which reduces the number of leading edges, contribute to its stealth characteristics. The Spirit has a radar signature of about 0.1 m2. Each B-2 requires a climate-controlled hangar large enough for its 172-foot (52 m) wingspan to protect the operational integrity of its sophisticated radar absorbent material and coatings. The engines are buried within the wing to conceal the induction fans and hide their exhaust.

The blending of low-observable technologies with high aerodynamic efficiency and large payload gives the B-2 significant advantages over previous bombers. The U.S. Air Force reports its range as approximately 6,000 [nautical miles](http://en.wikipedia.org/wiki/Nautical_mile) (6,900 mi; 11,000 km). Also, its low-observation ability provides the B-2 greater freedom of action at high altitudes, thus increasing its range and providing a better field of view for the aircraft's sensors. It combines GPS Aided Targeting System (GATS) with [GPS](http://en.wikipedia.org/wiki/Global_Positioning_System)-aided bombs such as [Joint Direct Attack Munition](http://en.wikipedia.org/wiki/Joint_Direct_Attack_Munition) (JDAM). This uses its [passive electronically scanned array](http://en.wikipedia.org/wiki/Passive_electronically_scanned_array) [APQ-181 radar](http://en.wikipedia.org/wiki/APQ-181_radar) to correct GPS errors of targets and gain much better than laser-guided weapon accuracy when "dumb" gravity bombs are equipped with a GPS-aided "smart" guidance tail kit. It can bomb 16 targets in a single pass when equipped with 1,000 or 2,000-pound (450 kg or 900 kg) bombs, or as many as 80 when carrying 500 lb. (230 kg) bombs.

Vice President Dick Cheney sits inside the cockpit of a B-2 with pilot Capt. Luke Jayne during a visit to Whiteman AFB in 2006.

The B-2 has a crew of two: a pilot in the left seat, and mission commander in the right. The B-2 has provisions for a third crew member if needed. For comparison, the B-1B has a crew of four and the B-52 has a crew of five. B-2 crews have been used to pioneer [sleep cycle research](http://en.wikipedia.org/wiki/Sleep_deprivation#Scientific_study) to improve crew performance on long [sorties](http://en.wikipedia.org/wiki/Sorties). The B-2 is highly automated, and, unlike two-seat fighters, one crew member can sleep, use a toilet or prepare a hot meal while the other monitors the aircraft.

As with the [B-52 Stratofortress](http://en.wikipedia.org/wiki/B-52_Stratofortress) and [B-1 Lancer](http://en.wikipedia.org/wiki/B-1_Lancer), the B-2 provides the versatility inherent in manned bombers. Like other bombers, its assigned targets can be canceled or changed while in flight, the particular weapon assigned to a target can be changed, and the timing of attack, or the route to the target can be changed while in flight.

A B-2 during [aerial refueling](http://en.wikipedia.org/wiki/Aerial_refueling) which extends its range past 6,000 miles to support intercontinental sorties.

The prime contractor, responsible for overall system design, integration and support, is [Northrop Grumman](http://en.wikipedia.org/wiki/Northrop_Grumman). [Boeing](http://en.wikipedia.org/wiki/Boeing_Integrated_Defense_Systems), [Raytheon](http://en.wikipedia.org/wiki/Raytheon) (formerly [Hughes Aircraft](http://en.wikipedia.org/wiki/Hughes_Aircraft)), [G.E.](http://en.wikipedia.org/wiki/General_Electric_Aircraft_Engines) and [Vought Aircraft Industries](http://en.wikipedia.org/wiki/Vought_Aircraft_Industries), are [subcontractors](http://en.wikipedia.org/wiki/Subcontractors).

The original B-2 design had tanks for a [contrail](http://en.wikipedia.org/wiki/Contrail)-inhibiting chemical, but this was replaced in the final design with a contrail sensor from Ophir that alerts the pilot when he should change altitude and mission planning also considers altitudes where the probability of contrail formation is minimized.

**Operational history**

The first operational aircraft, christened *Spirit of Missouri*, was delivered to [Whiteman Air Force Base](http://en.wikipedia.org/wiki/Whiteman_Air_Force_Base), [Missouri](http://en.wikipedia.org/wiki/Missouri), where the fleet is based, on 17 December 1993. The B-2 reached initial operational capability (IOC) on 1 January 1997. Depot maintenance for the B-2 is accomplished by [U.S. Air Force](http://en.wikipedia.org/wiki/United_States_Air_Force) contractor support and managed at [Oklahoma City Air Logistics Center](http://en.wikipedia.org/wiki/Oklahoma_City_Air_Logistics_Center) at [Tinker Air Force Base](http://en.wikipedia.org/wiki/Tinker_Air_Force_Base). Originally designed to deliver nuclear weapons, modern usage has shifted towards a flexible role with conventional and nuclear capability.

**Into combat**

An Air Force maintenance crew services a B-2 at [Andersen AFB](http://en.wikipedia.org/wiki/Andersen_Air_Force_Base), [Guam](http://en.wikipedia.org/wiki/Guam), 2004

The B-2 has seen service in three campaigns. Its combat debut was during the [Kosovo War](http://en.wikipedia.org/wiki/Kosovo_War) in 1999. It was responsible for destroying 33% of selected Serbian bombing [targets](http://en.wikipedia.org/wiki/Bullseye_%28target%29) in the first eight weeks of U.S. involvement in the War. During this war, B-2s flew non-stop to Kosovo from their home base in Missouri and back. The B-2 was the first aircraft to deploy GPS satellite guided [JDAM "smart bombs"](http://en.wikipedia.org/wiki/Joint_Direct_Attack_Munition) in combat use in Kosovo.

B-2 Spirit [United States Air Force](http://en.wikipedia.org/wiki/United_States_Air_Force) video

The B-2 has been used to drop bombs on [Afghanistan](http://en.wikipedia.org/wiki/Afghanistan) in support of the ongoing [War in Afghanistan](http://en.wikipedia.org/wiki/War_in_Afghanistan_%282001%E2%80%93present%29). With the support of aerial refueling, the B-2 flew one of its longest missions to date from Whiteman Air Force Base, Missouri to Afghanistan and back.[[4]](http://en.wikipedia.org/wiki/Northrop_Grumman_B-2_Spirit#cite_note-B-2_AF_fact_sheet-3#cite_note-B-2_AF_fact_sheet-3)

During the ongoing [War in Iraq](http://en.wikipedia.org/wiki/War_in_Iraq), B-2s have operated from [Diego Garcia](http://en.wikipedia.org/wiki/Diego_Garcia) and an undisclosed "forward operating location". Other [sorties](http://en.wikipedia.org/wiki/Sortie) in Iraq have launched from Whiteman AFB. This resulted in missions lasting over 30 hours and one mission of over 50 hours. The designated "forward operating locations" have been previously designated as [Guam](http://en.wikipedia.org/wiki/Guam) and [RAF Fairford](http://en.wikipedia.org/wiki/RAF_Fairford), where new climate controlled hangars have been constructed. B-2s have conducted 27 sorties from Whiteman AFB and 22 sorties from a forward operating location, releasing more than 1.5 million pounds of munitions, including 583 JDAM "smart bombs" in 2003.

The B-2's combat use preceded a U.S. Air Force declaration of "full operational capability" in December 2003. The Pentagon's Operational Test and Evaluation 2003 Annual Report noted that the B-2's serviceability for Fiscal Year 2003 was still inadequate, mainly due to the maintainability of the B-2's low observable coatings. The evaluation also noted that the Defensive Avionics suite also had shortcomings with *pop-up threats*.

All B-2s, nuclear-capable B-52s, and nuclear intercontinental ballistic missiles have shifted to the nuclear-focused [Air Force Global Strike Command](http://en.wikipedia.org/wiki/Air_Force_Global_Strike_Command) set up on September 2009.

**Operators**

The "Spirit of Indiana" sits on the [ramp](http://en.wikipedia.org/wiki/Airport_ramp) at [Andersen AFB](http://en.wikipedia.org/wiki/Andersen_AFB) in Guam on 23 June 2006

B-2s are operated exclusively by the [United States Air Force](http://en.wikipedia.org/wiki/United_States_Air_Force) active units.

* [United States Air Force](http://en.wikipedia.org/wiki/United_States_Air_Force)
	+ [509th Bomb Wing](http://en.wikipedia.org/wiki/509th_Bomb_Wing), [Whiteman Air Force Base](http://en.wikipedia.org/wiki/Whiteman_Air_Force_Base) (currently has 19 B-2s)
		- [393d Bomb Squadron](http://en.wikipedia.org/wiki/393d_Bomb_Squadron)
		- [394th Combat Training Squadron](http://en.wikipedia.org/wiki/394th_Combat_Training_Squadron)
	+ [131st Bomb Wing](http://en.wikipedia.org/wiki/131st_Bomb_Wing), [Whiteman Air Force Base](http://en.wikipedia.org/wiki/Whiteman_Air_Force_Base) (Missouri Air National Guard)[[52]](http://en.wikipedia.org/wiki/Northrop_Grumman_B-2_Spirit#cite_note-51#cite_note-51)
		- [110th Bomb Squadron](http://en.wikipedia.org/wiki/110th_Fighter_Squadron)
	+ [412th Test Wing](http://en.wikipedia.org/wiki/412th_Test_Wing), [Edwards Air Force Base](http://en.wikipedia.org/wiki/Edwards_Air_Force_Base) (currently has 1 B-2)
		- [419th Flight Test Squadron](http://en.wikipedia.org/wiki/419th_Flight_Test_Squadron)
	+ [53d Wing](http://en.wikipedia.org/wiki/53d_Wing), [Eglin Air Force Base](http://en.wikipedia.org/wiki/Eglin_Air_Force_Base) (former)
		- [72d Test and Evaluation Squadron](http://en.wikipedia.org/wiki/72d_Test_and_Evaluation_Squadron), [Whiteman Air Force Base](http://en.wikipedia.org/wiki/Whiteman_Air_Force_Base)
	+ [57th Wing](http://en.wikipedia.org/wiki/57th_Wing), [Nellis Air Force Base](http://en.wikipedia.org/wiki/Nellis_Air_Force_Base) (former)
		- [325th Weapons Squadron](http://en.wikipedia.org/wiki/325th_Weapons_Squadron), [Whiteman Air Force Base](http://en.wikipedia.org/wiki/Whiteman_Air_Force_Base)
		- [715th Weapons Squadron](http://en.wikipedia.org/wiki/715th_Weapons_Squadron) (inactivated)

**Accident**

Main article: [Andersen Air Force Base B-2 accident](http://en.wikipedia.org/wiki/Andersen_Air_Force_Base_B-2_accident)

The crashed B-2

On 23 February 2008, a B-2 crashed on the runway shortly after takeoff from [Andersen Air Force Base](http://en.wikipedia.org/wiki/Andersen_Air_Force_Base) in [Guam](http://en.wikipedia.org/wiki/Guam). The *Spirit of Kansas*, *89-0127* had been operated by the [393rd Bomb Squadron](http://en.wikipedia.org/wiki/393rd_Bomb_Squadron), [509th Bomb Wing](http://en.wikipedia.org/wiki/509th_Bomb_Wing), [Whiteman Air Force Base](http://en.wikipedia.org/wiki/Whiteman_Air_Force_Base), [Missouri](http://en.wikipedia.org/wiki/Missouri), and had logged 5,176 flight hours. It was the first crash of a B-2. The two person crew ejected from the aircraft and survived the crash. The aircraft was completely destroyed, a [hull loss](http://en.wikipedia.org/wiki/Aviation_accidents_and_incidents) valued at US$1.4 billion. After the accident, the Air Force took the B-2 fleet off operational status until clearing the fleet for flight status 53 days later on 15 April 2008.

**Aircraft on display**

[Mockup](http://en.wikipedia.org/wiki/Mockup) of a B-2 Spirit on display at the [National Museum of the United States Air Force](http://en.wikipedia.org/wiki/National_Museum_of_the_United_States_Air_Force)

Because of its high cost, [strategic bombing](http://en.wikipedia.org/wiki/Strategic_bombing) role, and the still-classified aspects of its low observable coatings, no production B-2 has been placed on permanent display. However, B-2s have made periodic appearances on ground display at various [air shows](http://en.wikipedia.org/wiki/Air_show).

In 2004, one of the test articles (s/n AT-1000) built without engines or instruments for static testing was placed on display at the [National Museum of the United States Air Force](http://en.wikipedia.org/wiki/National_Museum_of_the_United_States_Air_Force) near [Dayton, Ohio](http://en.wikipedia.org/wiki/Dayton%2C_Ohio). The test article passed all structural testing.[[58]](http://en.wikipedia.org/wiki/Northrop_Grumman_B-2_Spirit#cite_note-nat_museum-57#cite_note-nat_museum-57) The Museum's restoration team spent over a year reassembling the fractured airframe.

From 1989 to 2004, the [South Dakota Air and Space Museum](http://en.wikipedia.org/wiki/South_Dakota_Air_and_Space_Museum) located on the grounds of [Ellsworth Air Force Base](http://en.wikipedia.org/wiki/Ellsworth_Air_Force_Base) displayed the 10-short-ton (9-[metric-ton](http://en.wikipedia.org/wiki/Metric_ton)) "Honda Stealth", a 60% scale [mockup](http://en.wikipedia.org/wiki/Mockup) of a stealthy bomber which had been built by North American [Honda](http://en.wikipedia.org/wiki/Honda) in 1988 for an [advertising campaign](http://en.wikipedia.org/wiki/Advertising_campaign). Although not an actual replica of a B-2, the mock-up was close enough to the B-2's design to arouse suspicion that Honda had intercepted classified, [top secret](http://en.wikipedia.org/wiki/Top_secret) information, as the B-2 project was still officially classified in 1988. Honda donated the model to the museum in 1989, on condition that the model be destroyed if it was ever replaced with a different aircraft. In 2005, when the museum received a B-1 Lancer for display (Ellsworth being a B-1 base), the museum destroyed the mock-up.

**Specifications (B-2A Block 30)**

*Data from* USAF Fact Sheet, Pace, Spick, Global security

**General characteristics**

* **Crew:** 2
* **Length:** 69 ft (21.0 m)
* [**Wingspan**](http://en.wikipedia.org/wiki/Wingspan)**:** 172 ft (52.4 m)
* **Height:** 17 ft (5.18 m)
* **Wing area:** 5,140 ft² (478 m²)
* [**Empty weight**](http://en.wikipedia.org/wiki/Manufacturer%27s_Weight_Empty)**:** 158,000 lb. (71,700 kg)
* **Loaded weight:** 336,500 lb. (152,200 kg)
* [**Max takeoff weight**](http://en.wikipedia.org/wiki/Maximum_Takeoff_Weight)**:** 376,000 lb. (170,600 kg)
* **Powerplant:** 4× [General Electric F118-GE-100](http://en.wikipedia.org/wiki/General_Electric_F118) non-afterburning [turbofans](http://en.wikipedia.org/wiki/Turbofan), 17,300 lbf (77 kN) each

**Performance**

* [**Maximum speed**](http://en.wikipedia.org/wiki/V_speeds#Vno)**:** Mach 0.95 (525 knots, 604 mph, 972 km/h)
* [**Cruise speed**](http://en.wikipedia.org/wiki/V_speeds#Vc)**:** Mach 0.85 (470 knots, 541 mph, 870 km/h)
* [**Range**](http://en.wikipedia.org/wiki/Range_%28aircraft%29)**:** 6,000 nm. (11,100 km (6,900 mi))
* [**Service ceiling**](http://en.wikipedia.org/wiki/Ceiling_%28aeronautics%29)**:** 50,000 ft (15,200 m)
* [**Wing loading**](http://en.wikipedia.org/wiki/Wing_loading)**:** 67.3 lb./ft² (329 kg/m²)
* [**Thrust/weight**](http://en.wikipedia.org/wiki/Thrust-to-weight_ratio)**:** 0.205

**Armament**

* 2 internal bays for 50,000 lb. (23,000 kg) of ordnance.
* 80× 500 lb. class bombs ([Mk-82](http://en.wikipedia.org/wiki/Mark_82_bomb)) mounted on Bomb Rack Assembly (BRA)
* 36× 750 lb. CBU class bombs on BRA
* 16× 2000 lb. class weapons ([Mk-84](http://en.wikipedia.org/wiki/Mark_84_bomb), JDAM-84, JDAM-102) mounted on Rotary Launcher Assembly (RLA)
* 16× [B61](http://en.wikipedia.org/wiki/B61_nuclear_bomb) or [B83](http://en.wikipedia.org/wiki/B83_nuclear_bomb) nuclear weapons on RLA

Later avionics and equipment improvements allow B-2A to carry [JSOW](http://en.wikipedia.org/wiki/JSOW), [GBU-28](http://en.wikipedia.org/wiki/GBU-28), and [GBU-57A/Bs](http://en.wikipedia.org/wiki/GBU-57A/B) as well. The Spirit is also designated as a delivery aircraft for the [AGM-158 JASSM](http://en.wikipedia.org/wiki/AGM-158_JASSM) when the missile enters service.

**List of B-2 bombers**

Side view of a B-2 Spirit

B-2 in flight over the [Mississippi River](http://en.wikipedia.org/wiki/Mississippi_River) ([St. Louis, Missouri](http://en.wikipedia.org/wiki/St._Louis%2C_Missouri)) with the [Gateway Arch](http://en.wikipedia.org/wiki/Gateway_Arch) and [Busch Stadium](http://en.wikipedia.org/wiki/Busch_Stadium) in the background

B-2 from below

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Air Vehicle No.** | **Block No.** | **USAF s/n** | **Formal name** | **Status** |
| AV-1 | Test/30 | 82-1066 | *Spirit of America* | 14 July 2000 — Active |
| AV-2 | Test/30 | 82-1067 | *Spirit of Arizona* | 4 December 1997 — Active |
| AV-3 | Test/30 | 82-1068 | *Spirit of New York* | 10 October 1997 — Active, Flight Test |
| AV-4 | Test/30 | 82-1069 | *Spirit of Indiana* | 22 May 1999 — Active |
| AV-5 | Test/20 | 82-1070 | *Spirit of Ohio* | 18 July 1997 — Active |
| AV-6 | Test/30 | 82-1071 | *Spirit of Mississippi* | 23 May 1997 — Active |
| AV-7 | 10 | 88-0328 | *Spirit of Texas* | 21 August 1994 — Active |
| AV-8 | 10 | 88-0329 | *Spirit of Missouri* | 31 March 1994 — Active |
| AV-9 | 10 | 88-0330 | *Spirit of California* | 17 August 1994 — Active |
| AV-10 | 10 | 88-0331 | *Spirit of South Carolina* | 30 December 1994 — Active |
| AV-11 | 10 | 88-0332 | *Spirit of Washington* | 29 October 1994 — Active |
| AV-12 | 10 | 89-0127 | *Spirit of Kansas* | 17 February 1995 — 23 February 2008, Crashed[[53]](http://en.wikipedia.org/wiki/Northrop_Grumman_B-2_Spirit#cite_note-Av_Week_crash-52#cite_note-Av_Week_crash-52) |
| AV-13 | 10 | 89-0128 | *Spirit of Nebraska* | 28 June 1995 — Active |
| AV-14 | 10 | 89-0129 | *Spirit of Georgia* | 14 November 1995 — Active |
| AV-15 | 10 | 90-0040 | *Spirit of Alaska* | 24 January 1996 — Active |
| AV-16 | 10 | 90-0041 | *Spirit of Hawaii* | 10 January 1996 — Active |
| AV-17 | 20 | 92-0700 | *Spirit of Florida* | 3 July 1996 — Active |
| AV-18 | 20 | 93-1085 | *Spirit of Oklahoma* | 15 May 1996 — Active |
| AV-19 | 20 | 93-1086 | *Spirit of Kitty Hawk* | 30 August 1996 — Active |
| AV-20 | 30 | 93-1087 | *Spirit of Pennsylvania* | 5 August 1997 — Active |
| AV-21 | 30 | 93-1088 | *Spirit of Louisiana* | 10 November 1997 — Active |
| AV-22 through AV-165 | Canceled |

Sources: FAS.org, B-2 Spirit (Pace)

**See also**

|  |  |
| --- | --- |
|  | [***United States Air Force portal***](http://en.wikipedia.org/wiki/Portal%3AUnited_States_Air_Force) |

**Related lists**

* [List of active United States military aircraft](http://en.wikipedia.org/wiki/List_of_active_United_States_military_aircraft)
* [List of bomber aircraft](http://en.wikipedia.org/wiki/List_of_bomber_aircraft)
* [List of flying wing aircraft](http://en.wikipedia.org/wiki/List_of_flying_wing_aircraft)
* [List of megaprojects, Aerospace](http://en.wikipedia.org/wiki/List_of_megaprojects#Aerospace_projects)

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