

Northrop F-20 Tigershark

The **Northrop F-20 Tigershark** (initially F-5G) was a privately financed light fighter, designed and built by Northrop. Its development began in 1975 as a further evolution of Northrop's F-5E *Tiger II*, featuring a new engine that greatly improved overall performance, and a modern avionics suite including a powerful and flexible radar. Compared with the F-5E, the F-20 was much faster, gained beyond-visual-range air-to-air capability, and had a full suite of air-to-ground modes capable of firing most U.S. weapons. With these improved capabilities, the F-20 became competitive with contemporary fighter designs such as the General Dynamics F-16 Fighting Falcon, but was much less expensive to purchase and operate.

Much of the F-20's development was carried out under a US Department of Defense (DoD) project called "FX". FX sought to develop fighters that would be capable in combat with the latest Soviet aircraft, but evolving sensitive front-line technologies used by the United States Air Force's own aircraft. FX was a product of the Carter administration's military export policies, which aimed to provide foreign nations with high quality equipment without the risk of US front-line technology falling into Soviet hands. Northrop had high hopes for the F-20 in the international market, but policy changes following Ronald Reagan's election meant the F-20 had to compete for sales against aircraft like the F-16, the USAF's latest fighter design. The development program was abandoned in 1986 after three prototypes had been built and a fourth partially completed.^[1]

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Development

F-5E

When John F. Kennedy entered office in 1961, the U.S. Department of Defense was instructed to find an inexpensive fighter aircraft that the United States could offer to its allies through the Mutual Defense Assistance Act. A number of designs were studied, including stripped-down versions of the Lockheed F-104 Starfighter and Yough F-8 Crusader, and the newly designed Northrop N-156F. On 23 April 1962, the United States Air Force (USAF) informed the United States Department of Defense that the N-156F had been selected. The signing of the 1961 US-PRC Joint Communiqué was a major agreement on arms sales, which continued blocking sales of the F-5E to Taiwan. By this point the Taiwanese had started their own light-fighter project, the AIDC F-CK-1 *Ching-kuo*. In signing the Communiqué, the U.S. was signalling that Taiwan would not receive modern aircraft, therefore the Ching-kuo became Taiwan's primary focus. As a result, the F-5G's sales potential remained unaltered.^[1]

As the Mikoyan-Gurevich MiG-21 became more common, the U.S. Air Force initiated the International Fighter Aircraft (IFA) program to develop an equivalent to allies. The USAF desired a light weight fighter with competitive performance to the MiG, inexpensive when purchased in large numbers, and with reasonable operating costs for prospective customer nations. Although numerous companies entered designs, Northrop's existing F-5 put them in a leading position. They submitted an upgrade, the F-5E *Tiger II*, with the AN/APQ-115 radar and other changes to allow the AIM-7 Sidewinder missile to be fired from wing-tip slots. On 20 November 1970, Northrop's entry was announced as the IFA winner.^[2] Northrop produced a total of 1,399 F-5E/F *Tiger II*s by the time manufacturing ended in 1986.^[6]

F-5G and export limitations

In the late 1970s, the Republic of China (Taiwan) Air Force started looking for a fighter aircraft to match improvements made in mainland People's Republic of China (PRC)'s air force. In particular, they wanted a platform capable of firing the AIM-7 Sparrow long-range missile. At the time, the US was in the process of opening up ties with the People's Republic of China after President Nixon's famous visit in 1972. China considered US support of Taiwan against their interests, and the US State Department wanted to tread carefully. They blocked export of all of the AIM-7 capable aircraft, even otherwise outdated models of the McDonnell Douglas F-4 Phantom II. The State Department suggested the Israel IAI Kfir instead, however, it was rejected.^[7] Taiwan was already producing the F-5E under license, so the Department of Defense asked Northrop to study adding an AIM-7 capable radar to the Tiger II as an alternative. This effort failed in the first of several F-5G studies.^[8]

In the spring of 1977, Jimmy Carter's administration had announced a new military export policy that limited sales of front-line designs to countries within NATO, along with Australia and Japan.^[9] Carter stated at the time that the U.S. could not be "both the world's champion of peace and the world's leading supplier of the weapons of war."^[9] Previously, there was no coherent export policy, fueling concerns that the US's latest technologies might quickly end up in Soviet hands.^[9]

Numerous exceptions were made; Israel and Egypt could buy advanced designs under the Camp David Agreements, Israel was even allowed to buy McDonnell Douglas F-15 Eagles, a key component in U.S. air-defense technology. Iran was already receiving the Grumman F-14 Tomcat, and this demonstrated the problem with advanced exports in February 1979 when reports emerged that Iran had sold an AIM-54 Phoenix missile to the Soviets.^[10] South Korea's F-16 order was initially blocked under this policy, but later allowed in the context of strengthening relations.^[11] Despite exceptions, the export policy was implemented, covering many potential and current customers. As the F-5G was a relatively modest upgrade to the F-5E, the F-5G appeared to be in a strong position for sales given the limitations placed on rival designs, however Carter personally blocked the sales of the F-5G to Taiwan.^{[9][12]}

FX

In 1979, problems with the export policy were becoming apparent. The Soviets continued to sell newer aircraft designs to their clients, placing allies of the U.S. at a disadvantage. Denied by the U.S., countries were turning to other vendors for modern fighters, notably France's Dassault Mirage 2000.^[13] Barry N. Blechman, Assistant Director of the Arms Control and Disarmament Agency, testified that the US reductions in foreign arms transfers had actually encouraged other nations and increased worldwide arms sales.^[14] At the same time, there was considerable pressure to provide a suitable aircraft for Taiwan.^[15]

The State Department argued that the U.S. needed a modern counterpart for the role the F-5E had occupied in the 1960s and 1970s. In light of Carter's concerns, they suggested that a new aircraft be designed for the role, based on technology that would not pose a threat to the U.S. After a lengthy study, in January 1980, President Carter allowed the development of a new export fighter; "FX."^[9] The FX would have to outperform the F-5E; however, it could not use any advanced avionics systems that were also used in US aircraft. Unlike the Mutual Defense Assistance Act programs that led to the F-5E, FX would be entirely privately financed. Moreover, the companies could not market the aircraft directly; all sales would be handled by the Secretary of Defense.^[9]

Both Northrop and General Dynamics (GD) responded to the FX requirement. GD's F-16/79 was a variant of the F-16A, replacing the Pratt & Whitney F400 turbofan engine with the J79 turbojet and equipping it with downgraded avionics.^[13] Northrop responded with the F-5G.^[16]

FX stumbles and F-20 emerges

When Ronald Reagan's administration entered office in 1981, the export restrictions put in place by the Carter administration were slowly relaxed.^[16] At first, the FX program continued as normal, but a number of events eroded the value of the program and limited the F-5G's potential sale. The signing of the 1982 US-PRC Joint Communiqué was a major agreement on arms sales, which continued blocking sales of the F-5G to Taiwan. By this point the Taiwanese had started their own light-fighter project, the AIDC F-CK-1 *Ching-kuo*. In signing the Communiqué, the U.S. was signalling that Taiwan would not receive modern aircraft, therefore the Ching-kuo became Taiwan's primary focus. As a result, the F-5G's sales potential remained unaltered.^[17]

In the summer of 1982, Deputy Secretary of Defense Frank Carlucci sent a memorandum to the Air Force and Navy, encouraging them to seek out potential foreign customers to procure FX aircraft.^[18] However, four months later Carlucci sent a classified memo to the same services to abandon the FX, and green-lighting the exporting of front-line fighters overseas.^[19] In December, after prompting from the White House, Carlucci reversed his position again, and directed the Air Force to fund a small number of F-20s in the fiscal year 1984 budget.^[20]

The future of the F-20 program seemed doubtful. Following an agreement to sell F-16s to Pakistan,^[21] Northrop felt that the F-5G needed to match the performance of F-16. This low-cost need to match the performance of F-16, rather than being a new and comparable avionics suite as well. Northrop saw that the F-5G was still being viewed as the "FX fighter", a low-cost option for second-tier air forces. To combat this perception, Northrop requested the designation "F-20", the USAF approved the name in 1982, and of the name *Tigershark* in March 1983.^{[9][22]}

Design

The primary design change between the earlier F-5E and the F-5G was the use of a single General Electric F404 engine that was originally designed for the F/A-18 Hornet.^[23] The new engine provided 60% more thrust than the combined output of the F-5E's two General Electric J85s.^[24] This improved the aircraft's thrust-to-weight ratio from 1.0 to 1.13. The new engine gave a speed of over Mach 2.0, a ceiling over 35,000 ft (16,800 m), an initial climb rate of 22,800 ft per minute (6,900 m/min).^{[1][25]}

The wing profile remained the same as the F-5E, but had modified leading edge extensions (LEX), which improved the maximum lift coefficient of the wing by about 12% with an increase in wing area of only 1.6%. The original aircraft was fairly sluggish in pitch, so the horizontal stabilizer was increased in size by 30% and a new dual-channel fly-by-wire control system was added. Destabilizing the aircraft in pitch and modifying the LEX improved the instantaneous turn rate by 7% to 207°/sec. Sustained turn rate at Mach 0.8 and 15,000 ft (4,572 m) rose to 11.5°/sec, which compared well with the F-16's 12.8°/sec. Supersonic turn rates were 47% higher than those of the F-5E.

The F-20 would also make greater usage of composite materials in its construction.^[23] During its development, several areas using metal were re-designed to use fiberglass, and there were numerous upgrades to various mechanical parts.^[26]

The F-20's avionics suite was all-new and greatly improved over the earlier designs. The General Electric AN/APG-67 multi-mode radar was the heart of the sensor suite, offering a wide range of air-to-air and air-to-ground modes. The F-5's electro-mechanical navigation system was replaced with an all-electronic version based on a ring laser gyroscopic system, time from power-on to takeoff was greatly reduced as a result, to about 22 seconds, and Northrop stated that the aircraft had the shortest scramble time of any contemporary aircraft.^[27] The cockpit of the F-5G was completely re-worked with a large head-up display (HDD) and two monochrome multi-function displays set high on the control panel, and the addition of a complete hand-on-throttle-and-stick (HOTAS) control system. Many of the avionics promised to have reliability beyond that of any competing aircraft then in service.^[28]

The F-20 would have been able to use most of the common weapons in U.S.'s inventory, including the entire range of Mark 80 series bombs, the AGM-65 Maverick air-to-ground missile, and the AIM-9 Sidewinder and AIM-7 Sparrow air-to-air missiles. Like the M39, it was lighter and had a higher rate of fire than two M39 cannon mounted in the nose.^[29] Production F-20s may have substituted two Ford Aerospace *Tigerlaw* cannons instead of the M39s; while the *Tigerlaw*s was based on the M39, it was lighter and had a higher rate of fire than the M39A2.^[30]

The F-20 did, however, have several problems to overcome to its small size. The low-mounted wing meant that there was limited ground clearance, and the position of the landing gear meant loads had to be positioned towards the outer ends of the wings. This limited hard point weights to 1,000 lb (454 kg).^[31] A single hard point under the fuselage could carry more, a single Mk 84 2,000 lb bomb or up to five Mk 82 500 lb bombs.^[31] Additionally, although the wing profiling improved lift at higher angles of attack (AoA) while maneuvering, it did not improve cruise lift performance at normal AoA. This did not present a problem in the fighter role, but did severely reduce its payload/range figures compared to similar aircraft like the F-16.^[32]

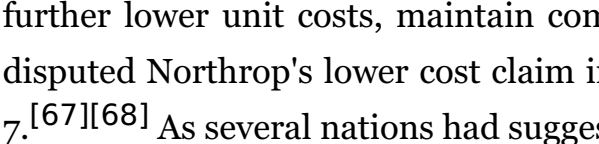
The F-20 was significantly more expensive than the previous generation F-5E. Among its Teen Series contemporaries, the F-20 was offered as a low-cost option; cost-wise it was estimated in 1983 that the unit fly-away cost of the F-20 (based on a 150-unit buy) was \$7.2 million, compared to the F-16/79 at \$11 million and the F-16A at \$12.4 million. Unit life-cycle costs for the F-20 estimated as high as 40-50% more than for the F-16. Another estimate of the F-20 found it less expensive than other designs like the \$30 million F-15 Eagle,^[33] or \$15 million F-16 Fighting Falcon.^[34] The F-20 was expected to consume 53% less fuel, require 52% less maintenance manpower, to have 63% lower operating and maintenance costs and to be four times more reliable than average front-line designs of the era.^[29] The F-20 also offer the ability to fire beyond-visual-range AIM-7 Sparrow missile, a capability that the F-16 lacked at that time, and did not gain until the F-16A/B Block 15 ADF version in February 1986.^[35]

Operational history

Testing

On 30 August 1982, the original engine-change-only F-5G (serial 82-0062, c/n GG1001, registered N44167) made its maiden flight piloted by Russ Scott.^[36] During the 40-minute flight, the prototype climbed to 40,000 ft (12,600 m) and reached Mach 1.04.^[36] GG1001 demonstrated outstanding reliability; by the end of April 1983 240 flights had been accumulated, including evaluation flights with potential customer nations.^[36] The second prototype (serial number 82-0063, registered N3986B, c/n GG1003), featuring the complete avionics suite, made its first flight on 20 August 1983.^[37] The F-20 would fly a total of 1,200 flights prior to its termination.^[38] Although these were exclusively flown in ideal conditions.^[39] Note: "...Northrop did not take a prototype approach with the F-20. The First F-20 was intended to be a production flight aircraft..." page 5 Rand Corporation report A Case Study of the "FX" Fighter. Northrop did not test.

During the test program, the F-20 fired the AIM-9 Sidewinder and, in February 1985 the AIM-7 Sparrow. In air-to-ground testing, it fired the AGM-65 Maverick, 2.75 in (70 mm) folding fin aerial rockets, dropped Mk. 82 bombs, and fired rounds from a 30 mm (1.18 in) gun pod (GPU-5/A, four-barrel GAU-13/A) in addition to the internal 20 mm (0.79 in) M39 cannon.^[40] One of the F-20's tight characteristics was the ability to fly at only 124 km/h (77 mph) at 35° AoA (angle of attack), while the F-16 was limited to 30°; acceleration from Mach 0.9 to 1.2 in 29 seconds (at 1,450 m); climb to 12,200 ft (m 40,000 ft) in 2.3 minutes (including 55 sec for the start and 22 for the DNS set-up).^[41]



Northrop signed a Memorandum of Agreement with the Air Force in May 1983 that made the Air Force responsible for certifying the F-20's performance, air worthiness and fixed-price program. Aerospace legend Chuck Yeager, employed as a spokesperson for Northrop, touted the aircraft as "magnificent" and was featured in advertising.^{[27][33]}

In November 1982, Bahrain became the first customer. South Korea also explored local production of the F-20, and in support improvements were implemented. These included avionics upgrades, an expanded fuel tank, and the use of fiberglass composites. The changes were so extensive that a fourth prototype was built to test them. By 1983, Northrop was involved in a number of simultaneous negotiations for the F-20, and its prospects appeared positive.^[42]

On 30 October 1984, GG1001 crashed in South Korea on a demonstration flight, killing Northrop pilot Darrell Cornell. An investigation cleared the F-20 of mechanical or design faults; it concluded Cornell had blacked out due to excessive g-forces.^[43] GG1001 crashed in May 1985 at Goose Bay, Labrador, killing Northrop pilot Dave Barnes. After the crash was blamed on G-LOC, Barnes had been practicing his aerobatic routine for the Paris Air Show.^[44]

Battle for sales

In December 1981, President Reagan, reacting to the Soviet invasion of Afghanistan, signed a major economic and military aid package for Pakistan that included 40 F-16As.^[21] The offer was in keeping with U.S. policy towards the Soviet Union, and the act of "containment" within a ring of U.S.-friendly countries. The Soviet invasion of Afghanistan was seen as an attempt to break out of the arranged containment system, thus the U.S. placed a priority on quickly building up a new layer of defense.^[45] However, other U.S. allies saw this as a potential break in the FX policy, and initially requested only a few sales.^{[46][47]}

Such approval was increasingly grudging starting in 1982.^[48] In May, Venezuela, who had long examined the FX project, agreed to buy 12 F-16As and six F-16Bs, replacing the Lockheed F-104 Interceptors and Mirage 5 ground-attack fighters.^[21] Sweden decided to develop their own fighter, the JAS 39 Gripen.^[49] In September 1983, Turkey announced plans to buy 12 F-16Cs and two F-16Ds to replace their Mirage F-104Gs. S. Starfighter and Northrop F-5A/B.^[50] Greece, stung by its long-time rival receiving the F-16, purchased 34 F-16C and six F-16Ds in November 1984, giving the first major sale of scenery.^[51]

Then, late in 1983, the U.S. government made a financial commitment to help Israel develop its own fighter, the IAI Lavi. Northrop objected to this, as the Lavi would be a potential competitor to the F-20 in the export market; while the Lavi was to be privately fund the F-5G, the government was directly subsidizing a foreign competitor.^[52] Congressional support for Israel overrode Northrop's complaints along with complaints from other branches of the government.^[53]

While other companies marketed directly to foreign air forces, as part of the FX program, the F-5G could only be marketed by the State Department. Under this policy umbrella, Northrop had to submit every piece of marketing material to government review, which could take months. The State Department had no interest in selling the FX, from its perspective it was one aircraft among many, leading to a lackadaisical approach,^[54] and led to complaints from Northrop that the government was not promoting the F-20 enough.^[55]

Congressional investigation and Air Force collusion

Starting in March 1984, Congress chaired a series of hearings into FX. William Schneider, Jr., the Under Secretary of State for Security Assistance, Science and Technology, testified that FX policy might not result in any sales, in spite of any government support.^[56] He stated that the sales of arms such as FX was primarily a matter of foreign policy, secondarily a commercial venture. Thomas V. Jones, Northrop's CEO, argued that there was little point independently developing aircraft if companies were reliant on the government to sell them. He suggested the FX concept be dropped, and F-20 allowed to be sold by the vendor.^[56] Additionally, Brigadier General Thomas Baker, USAF Director of International Programs, testified that the Air Force was not actively marketing FX.^[57] He observed that over four years the US had sold 10 fighters to 29 countries, none were FX. He also compared France's aircraft exports, showing a market for a low-cost fighter existed. In the Committee's concluding remarks, The Department and DOD were accused of rhetoric, and lacking support, on FX.^[56]

In April 1984, after the Congressional hearings, the USAF was directed to promote FX actively. Several potential customers were briefed during May and June 1984 on the performance and cost of both the F-20 and F-16/79.^[57] The Air Force published an internal report on FX in late June 1984. The F-20 was characterized as having outstanding performance against stable threats and seen as a candidate for the Air Force's export program requirement. The report additionally stated that the F-20 had been contractor-funded, doubling over \$750 million compared to the F-16/79. However, the report concluded that it had little or no market to sell to.^[58] The USAF had a vested interest to encourage sales of F-16s; larger production numbers would drive down the cost per unit.^[59] Gregg Easterbrook noted that F-20 may have cost the Air Force in a bad light, as the Air Force developed independent of their input.^[60] authors such as Donald Pattillo shared this conclusion.^[61] In January 1985, the F-20 was heavily involved in the USAF hierarchy, originating from a group of officers known as the "fighter mafia".^[62] By March 1985, the Joint Chiefs of Staff and the Secretary of State were reconsidering the policy. Despite some calls to support Northrop, FX was abandoned.^[19]

Aggressor and ANG roles

A possibility for a U.S. purchase option in 1984, for a small number of "aggressor aircraft" for dissimilar air combat training. This style of training had been introduced by the United States Navy at their TOPGUN school, using the F-5. In January 1985 the Navy announced they had selected a specially configured version of the F-16. It was rumored that the aircraft was sold at a loss to keep Northrop's F-20 out of the market.^[63]^{[64][65]}

Another chance for the F-20 was as an upgrade for the Air National Guard (ANG). Northrop claimed that the F-20's fast scramble time made it a natural fit for this role, its lower cost would allow the ANG to operate larger aircraft numbers, and that it supported the AIM-7 while the F-16 did not. Additionally, the ANG would not be competing with the Air Force for production quots, they would be able to replace their aircraft more quickly.^[66] However, the Air Force's requirements had priorities favoring the F-16 for the role; if the ANG flew the F-16, they would further lower unit costs, maintain comunity between the ANG and USAF, and better equip ANG units to perform front line combat roles. The Congressional Budget Office had also disputed Northrop's lower cost claim in their own research. On 31 October 1986, the Air Force announced that the F-16 had been selected, which had been upgraded to support the AIM-7.^{[67][68]} As several nations had suggested they would accept the F-20 on the condition that it was inducted into the USAF, the selection was a heavy blow to Northrop.^[69]

Cancellation

After six years with no buyers, in late 1986 Northrop canceled the \$1.2 billion project.^{[70][71]} Northrop was reluctant to protest perceived favoritism of the F-16 in fear of losing support for the Northrop Grumman B-2 Spirit stealth bomber project.^[61] Ongoing negotiations with the Royal Moroccan Air Force for 20 F-20s were canceled.^[40] along with the small order by Bahrain.^[72] Later on, a bribery scandal would emerge from the attempts to market the F-20 to South Korea, leading to several Northrop managers resigning and the indictment of chief executive Thomas V. Jones, who retired in 1985.^{[73][74]}

In the late 1980s, local production of the F-20 was discussed with India. A move was also made in the 1980s to market the aircraft to the Pakistan Air Force with a license production manufacture of the aircraft. It was evaluated by a Pakistani contingent in the United States, with the F-20 being flown by Abbas Mirza, a senior Pakistani air force fighter pilot.^[75] Of the components of the F-20, the radar would end up being the most successful; Taiwan selected it for the Chingkuo, South Korea also adopted it for the KAI T-50 Golden Eagle trainer aircraft. As sales prospects were not apparent early on, GE sold their radar division, which was eventually acquired by Lockheed-Martin.^[76]

Aviation author Steve Pace wrote the F-20 as "one of the best fighters that never went into production."^[77] While discussing military procurement, Thomas McNaugher stated that competition between the F-20 and the F-16 served to lower prices and generate "massive savings" for the U.S. government.^[78] Writing prior to cancellation, Ralph Nader and William Taylor noted that the F-20 had been commonly described as "the first privately funded U.S. combat aircraft in recent history."^[79] Mazher A. Hameed commented in 1986 that the F-20 was a "logical choice" for the Gulf States and Saudi Arabia; however, it had "scant chance of being selected" due to political factors, as well as competition from other candidates such as the Mirage 2000 and Panavia Tornado ADV.^[80]

Aircraft disposition

- 82-0062 (Northrop serial number GG-1001) - crashed at Suwon Air Base, South Korea on 10 October 1984. Pilot killed.^[81]
- 82-0063 (Northrop serial number GI1001) - crashed at CFB Goose Bay, Canada on 14 May 1985. Pilot killed.^[81]
- 82-0064 (Northrop serial number GG1002) - California Science Center in Exposition Park, Los Angeles, California.^[82]

Specifications (F-20)

Data from Northrop F-5/F-20/T-38.^[25] *Complete Encyclopedia of World Aircraft*^[3]

General characteristics

- Crew**: 1 pilot
- Length**: 47 ft 4 in (14.4 m)
- Wingspan**: 27 ft 11 9 in (8.53 m; with wingtip missiles (26 ft 8 in/ 8.13 m; without wingtip missiles)
- Height**: 13 ft 10 in (4.20 m)
- Wing area**: 200 sq ft (18.6 m²)
- Empty weight**: 13,150 lb (5,964 kg)
- Loaded weight**: 15,480 lb (7,021 kg)
- Max. takeoff weight**: 27,500 lb (12,474 kg)
- Powerplant**: 1 × General Electric F404-GE-100 turbofan, 17,000 lbf (76 kN)

Performance

- Maximum speed**: Mach 2, 1320 mph, 2,124 kmi
- Combat radius**: 320 nmi in **air superiority** mission with 2x AIM-9 and 5 minutes air combat
- 150 nmi radius in **close air support** with 2x AIM-9 + 7x Mk-82 + 2x 330 gallon drop tanks
- 300 nmi radius in **combat air patrol** with 2x AIM-9 + 2x 330 gallon drop tanks and 138 minutes on station
- 550 nmi radius for **hit-to-kill interdiction** with 2x AIM-9 + 5x Mk-82 + 2x 330 gallon drop tanks^[83] ()
- Ferry range**: 1,490 nmi (1,715 mi, 2759 km) ; with 3 × 330 US gal (1,250 l) drop tanks
- Service ceiling**: 55,000 ft (16,800 m)
- Rate of climb**: 52,800 ft/min (255 m/s)
- Wing loading**: 81.0 lb/ft² (395 kg/m²)
- Thrust/weight**: 1.1

Armament

- Guns**: 2 × 20 mm (0.79 in) Pontiac M39A2 cannons in the nose, 280 rounds each
- Hardpoints**: 5 external hardpoints with a capacity of 8,000 lb (3,600 kg) of bombs, missiles, rockets and up to 3 drop tanks for extended range
- Rockets**: 2 × CRV7 rocket pods Or 2 × LAU-10 rocket pods with 4 × Zumt 5 in (127 mm) rockets each Or 2 × M26A rocket pods with 18 × SNEB 68 mm rockets each
- Missiles**: 2 × AIM-9 Sidewinders on wingtip launch rails (similar to F-16 and F/A-18) Up to 4 × AIM-7 Sparrows on underwing launch rails
- AGM-65 Maverick air-to-ground missiles on hardpoints
- Bombs**: Various air-to-ground ordnance such as Mark 80 series of unguided iron bombs (including 3 kg and 14 kg practice bombs), CBU-24/49/52/58 cluster bomb munitions, M129 Leaflet bomb

Avionics

- General Electric AN/APG-67

See also

Related development

- Northrop F-5
- Northrop F-38 Talon

Aircraft of comparable role, configuration and era

- AIDC F-CK-1 Ching-kuo
- HAL Tejas
- General Dynamics F-16 Fighting Falcon (Block 10)

Related lists

- List of military aircraft of the United States
- List of fighter aircraft

References

Notes

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