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Mitsubishi F-2

Outlook

- F-2 production ended in September 2011
- Four flying prototypes and 94 production aircraft were built

Orientation

Description. Single- and twin-seat air combat fighter/interceptor aircraft.

Sponsor. Japanese Ministry of Defense; Japan Air Self-Defense Force (JASDF).

Status. F-2 production ended in 2011.

Total Produced. Four flying prototypes, two ground test aircraft, and 94 production aircraft were built.

Application. Air-to-air defense; attack.

Price Range. Approximately \$110 million.



JASDF F-2

Source: Japan Ministry of Defense

Mitsubishi F-2

Contractors

Prime

Mitsubishi Heavy Industries Ltd (MHI)	http://www.mhi.co.jp/en/ , 16-5 Konan 2-chome, Minato-ku, Tokyo, 108-8215 Japan, Tel: + 81 3 6716 3111, Fax: + 81 3 6716 5800, Prime
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Subcontractor

Fuji Heavy Industries Ltd	http://www.fhi.co.jp/english , Subaru Bldg, 1-7-2 Nishishinjuku, Shinjuku-ku, Tokyo, 160-8316 Japan, Tel: + 81 3 3347 2111, Fax: + 81 3 3347 2338 (Composite Upper Wing Skin; Nose Cone; Horizontal and Vertical Tail Assemblies)
IHI Corporation	http://www.ihl.co.jp , Toyosu IHI Bldg, 1-1, Toyosu 3-chome, Koto-ku, Tokyo, 135-8710 Japan, Tel: + 81 3 6204 7800, Fax: + 81 3 6204 8800 (F110-GE-129 Turbofan)
Kawasaki Heavy Industries Ltd (KHI)	http://www.khi.co.jp , World Trade Center Bldg, 4-1, Hamamatsu-cho 2-chome, Tokyo, 105-6116 Japan, Tel: + 81 3 3435 2111, Fax: + 81 3 3436 3037 (Center Fuselage)
Lockheed Martin Aeronautics Co	http://www.lockheedmartin.com , 1 Lockheed Blvd, Fort Worth, TX 76108 United States, Tel: + 1 (817) 777-2000, Fax: + 1 (817) 777-2115 (Aft Fuselage; Wing Leading-Edge Flaps; Data Entry Electronics Unit; Stores Management System; Left-Hand Wing Box)
Mitsubishi Electric Corp	http://www.mitsubishielectric.com , Tokyo Bldg, 2-7-3, Marunouchi, Chiyoda-ku, Tokyo, 100-8310 Japan, Tel: + 81 3 3218 2111, Fax: + 81 3 3218 2185 (Active Phased Array Radar)

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Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; rich.pettibone@forecast1.com

Technical Data

Design Features. The F-2 is based on the Lockheed Martin F-16C Block 40 aircraft, but incorporates a co-cured carbon/carbon composite wing designed and developed by Mitsubishi in conjunction with Fuji. The fuselage has a modest stretch. The airframe has about 20 percent composites by empty weight, of which

90 percent is carbon-fiber reinforced plastic in the wing and fuselage upper skins and horizontal tail. Japanese-developed electronics systems are included on the F-2. These include a Mitsubishi Electric active phased-array radar, the mission computer, the inertial reference system, and the integrated electronic warfare system.

	<u>Metric</u>	<u>U.S.</u>
Dimensions		
Length overall	15.52 m	50.92 ft
Height overall	4.96 m	16.27 ft
Wingspan over missile rails	11.13 m	36.52 ft
Wing area, gross	34.84 sq m	375.0 sq ft
Weight		
Empty, equipped	12,000 kg	26,455 lb
Max TOW with external stores	22,100 kg	48,722 lb
Performance		
Maximum level speed (approx.)	Mach 2.0	Mach 2.0

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Propulsion

F-2 (1) GE F110-GE-129 (Improved Performance Engine) twin-spool, axial-flow, augmented, low-bypass-ratio turbofan engine rated 131.2 kN (29,500 lbst) with afterburning. Engine is license-produced by IHI.

Armament

Initial configuration included Sparrow air-to-air missiles and a single, internally mounted 20mm multibarrel gun. One centerline, two wingtip, and 10 underwing external stores stations. Other possible armament includes anti-ship missiles, AIM-9L or AAM-3 air-to-air missiles, bombs, and rocket launchers. The centerline and inboard underwing stations are wet for the carriage of external fuel tanks.

Crew

The F-2A is a single-seat version. The F-2B is a two-seat tandem trainer.

Variants/Upgrades

F-2A. Standard production single-seater. Formerly known as the FS-X.

F-2B. Two-seat operational conversion trainer, which also replaced Mitsubishi T-2 advanced jet trainers in the JASDF active inventory. Two F-2B prototypes were produced alongside two single-seat development aircraft. The F-2B was formerly known as the TFS-X.

Super Kai. Mitsubishi and Lockheed Martin proposed a multirole F-2 variant, called the Super Kai, for the JASDF's F-X program to acquire an F-4EJ replacement.

The Super Kai was similar to the F-16C Block 50/52 aircraft, and featured a helmet-mounted cueing system, conformal fuel tanks, a new mission computer, new weaponry, and an upgraded radar. In December 2011, Lockheed Martin's F-35 Joint Strike Fighter was selected as the winner of the F-X competition.

Mitsubishi has also studied a possible F-2 derivative featuring a further improved radar and a more powerful engine, the GE F110-GE-132.

Program Review

Background. Japan began studies of a Mitsubishi F-1 replacement in the late 1970s to identify the technologies required for development and production of a next-generation fighter aircraft. In November 1988, Mitsubishi Heavy Industries was named prime contractor for the program. As originally envisioned, the FS-X was to be an all-Japanese effort and based in great part on digital flight control work performed in the F-1/T-2 Controlled Configuration Vehicle studies of the late 1970s and early 1980s.

As time went on, the Japanese government began examining other options to fill the FS-X requirement, including the purchase of an off-the-shelf aircraft. Japanese industry, the Air Staff Office of the Japan Defense Agency (JDA), and the Japanese Technical Research and Development Institute (TRDI) favored the option of an indigenous design, 100 percent the product of Japan's aerospace industry. Nevertheless, by 1984, the number of FS-X candidates under consideration totaled five in all. They included the General Dynamics (now Lockheed Martin) F-16, the McDonnell Douglas (now Boeing) F-18, the Panavia Tornado, an unspecified vertical takeoff and landing (VTOL) aircraft, and an all-Japanese development.

In 1985, the Japanese government formally asked General Dynamics, McDonnell Douglas, and Panavia for information on the F-16, F/A-18, and Tornado, respectively.

F-16 Selected as Baseline

In August 1987, the JDA and the U.S. Department of Defense agreed to cooperate in FS-X development and to base the aircraft on a modified version of an existing U.S. fighter. In October 1987, Japan selected the F-16 as the baseline for FS-X development.

F-2 Design. The F-2 was based on the F-16C Block 40 aircraft with a larger, co-cured, all-composite wing; radar-absorbing materials on the wing leading edges; and an extended nose to accommodate a large Mitsubishi radar. Plans to incorporate agility-enhancing vertical canards on the forward fuselage/engine compartment were dropped in 1991 at the request of the JDA. This change was expected to reduce aircraft weight by approximately 100 kilograms (220 pounds). The aircraft has a maximum takeoff weight of 22,100 kilograms (48,722 pounds). The F-2 is powered by the GE F110-GE-129 Improved Performance

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Engine, selection of which was made in December 1990. The engine was built under license in Japan by IHI.

Work-Share Arrangement. Lockheed Corp's 1993 purchase of the Fort Worth Division of General Dynamics led to the transfer of GD's interest in the F-2 program to Lockheed, which has since been absorbed into Lockheed Martin Corp. Lockheed Martin received about three quarters of the United States' 40-percent industrial share of F-2 development work. In the production phase of the F-2 program, U.S. companies also performed approximately 40 percent of the work; Lockheed Martin received a significant percentage of this. The company built the aft fuselage, the wing leading-edge flaps, the data entry electronics unit, the stores management system, and certain test equipment. Lockheed Martin also built 80 percent of all left-hand wing boxes.

Program Schedule. Mitsubishi delivered an F-2 ground test article to the JDA in March 1995 for use in structural-load testing. The initial flyable prototype had been rolled out in January 1995 at Mitsubishi facilities in Nagoya, Japan, and was flown for the first time in October 1995. After company flight testing, it was delivered to the JDA in March 1996.

Three more flying prototypes and one additional ground test article were also built. The fourth and final F-2

flying prototype made its initial flight in May 1996. Production deliveries began in September 2000.

Cost Growth and Delay

Development of the F-2 was marked by massive growth in the estimated cost of the program. The JDA originally estimated that development of the aircraft would cost JPY165 billion (\$1.64 billion). However, development funding eventually totaled JPY327 billion (\$3.27 billion), nearly double the original figure.

The F-2 program also suffered from delays. In late 1999, excessive fin root loads were discovered during testing. This problem resulted in initial production delivery being postponed to August 2000 (from May 2000). It also contributed to a further one-month delay in initial delivery to September of that year.

Prior to these postponements, initial delivery had been pushed to May 2000 from March 2000 due to structural cracking discovered on both the right and left wings of the F-2 during testing in mid-1999. Mitsubishi and the JDA agreed to reinforce the wings with metal plates on either side of where the cracks had appeared, adding 8.2 kilograms (18 pounds) to the weight of the aircraft.

Earlier problems with wing flutter and structural cracking of the wing had been discovered in 1998, leading to aircraft modifications.

Funding

F-2 development costs totaled JPY327 billion (\$3.27 billion). Procurement of 94 production F-2s was funded by the Japan Defense Agency which in 2007 became the Japanese Ministry of Defense.

Contracts/Orders & Options

Contractor	Award (\$ millions)	Date/Description
Lockheed Martin	\$250.0(a)	Apr 2008 – Contract from Mitsubishi for production of components for eight F-2s.

(a) Approximate

Timetable

Month	Year	Major Development
Late	1970s	FS-X studies begun
Aug	1987	JDA and Pentagon agreed to cooperate on FS-X development and to base FS-X on existing U.S. fighter
Oct	1987	F-16 selected as basis for FS-X
Nov	1988	Mitsubishi selected as prime contractor
Mar	1989	Initial contract issued to Mitsubishi to begin basic airframe design work
Feb	1990	MHI and GD signed basic agreement on FS-X program

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Mar	1990	Start of full-scale engineering development
Oct	1995	First flight of initial prototype
Sep	2000	Initial production delivery
Sep	2011	Final production delivery

Worldwide Distribution/Inventories

(January 2012)

Japan	81

Forecast Rationale

In September 2011, Mitsubishi delivered the 94th and final production F-2 to the JASDF, wrapping up production of the fighter aircraft.

F-2 production ended despite the fact that 12 F-2Bs were permanently lost to the JASDF fleet due to damage sustained during a March 2011 tsunami. 18 F-2Bs were damaged during the storm and, after inspecting the aircraft, the Japanese Ministry of Defense determined that 12 were beyond repair and would be scrapped. The remaining six aircraft were considered repairable, and are to be returned to active service.

An improved version of the F-2, dubbed the Super Kai, had been an early candidate for the JASDF F-X program, which involves procurement of a replacement aircraft for the service's F-4EJ Phantom fighters. Ultimately, however, the F-X competition came down

to a selection among the Boeing F/A-18E/F, the Eurofighter Typhoon, and the Lockheed Martin F-35. In December 2011, the F-35 was chosen as the F-X winner. Some 40-50 F-35s are to be procured. Mitsubishi has been selected by the Air Staff Office of the Ministry of Defense as a potential participant in the manufacture and support of the JASDF F-35s.

Meanwhile, the Ministry of Defense is embarking on a program to develop a new fighter to eventually replace the F-2 in service. Mitsubishi is to build a developmental aircraft called the Advanced Technology Demonstrator-X (ATD-X) for a planned initial flight in 2016. The ATD-X, also known as the Shinshin, is to be utilized as a prototype in the development of the F-2 successor aircraft, which is to be designated the F-3.

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