AIRCRAFT

Attack Aircraft

Argentine Attack Aircraft
British Attack Aircraft
Canadian Attack Aircraft
Chinese Attack Aircraft
Czech Attack Aircraft
French Attack Aircraft
International Attack Aircraft
Israeli Attack Aircraft
Italian Attack Aircraft
Romanian Attack Aircraft
Russian Attack Aircraft
Spanish Attack Aircraft
Swedish Attack Aircraft
Swiss Attack Aircraft
US Attack Aircraft
Yugoslavian Attack Aircraft

Bombers

[British Bombers]
[Chinese Bombers]
[Russian Bombers]
[US Bombers]

Cargo Aircraft

[British Cargo Aircraft]
[Canadian Cargo Aircraft]
[Generic Cargo Aircraft]
[International Cargo Aircraft]

[Israeli Cargo Aircraft]
[Italian Cargo Aircraft]
[Japanese Cargo Aircraft]
[Russian Cargo Aircraft]
[Spanish Cargo Aircraft]
[US Cargo Aircraft]

Fighters

[Chinese Fighters]
[French Fighters]
[International Fighters]
[Iranian Fighters]
[Israeli Fighters]
[Japanese Fighters]
[Romanian Fighters]
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[Swedish Fighters]
[Taiwanese Fighters]
[US Fighters]

Special Aircraft

US Special Aircraft

Trainers

US Trainers

Glossary for Aircraft Section

IA-58 Pucara

Notes: This is an Argentine ground attack aircraft that is robust and easy to fly, and not as fuel-thirsty as jet aircraft, nor as expensive or difficult to maintain. While not advanced, it is reliable. The crew have ejection seats, but the aircraft is not capable of in-flight refueling.

Twilight 2000 v1, v2/2.2/ 2013 Stories: This aircraft gained more customers around the world as the Twilight War wore on, before shipping finally stopped.

Twilight 2035/Merc 2000 Stories: The Pucara gained acceptance all around the world, as it was far less expensive than aircraft like the A-10. The US even bought about a squadron's worth, supplementing their A-10s in actions which were less heavy in EW, AAA/SAM, and enemy aircraft.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$3,570,610	JP4	1.5 tons	4.02 tons	2	16	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1162	581	NA 100 8/5 70/35	1020	750	8000	FF7 CF7 RF6 T5 W4*

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	615/745m Hardened Runway	+2	2x20mm KAA Autocannons, 4xMG-4, 3 hardpoints	300x20mm, 1050x7.62mm

IA-63 Pampa

Notes: This small aircraft was built to be a trainer during peacetime and a light attack aircraft during wartime. Though it was presented as a contender for the US Joint Primary Training System competition, it lost in that competition to the European Hawk aircraft (which became the T-45 Goshawk), and never saw any other foreign sales. By the 2020, almost all Argentine pilots had received their initial jet training on the Pampa. It is an economical aircraft to operate, but has only rudimentary avionics.

Twilight 2000 v1 Notes: The Pampa does not exist in the *Twilight 2000 v1* timeline.

Twilight 2000 v2/2.2 Notes: A new aircraft in the *Twilight 2000 2/2.2* timeline, the Argentines had only 12 of them in service at the beginning of the Twilight War. None were built after the beginning of hostilities, with production shifting primarily to the Pucara and an Argentine copy of the Mirage III.

Twilight 2013 timeline: Though some were retained at the rear area airbases for primary training, many Argentine pilots using the Pampa were essentially getting OJT. And thus the Pampa did not have a good combat record. This is not because of the aircraft, but the inexperience of the pilots.

Twilight 2035 Notes: Due to early Pucara losses, the Pampa took up the slack in the ground support role. They were modified to use almost all air weapons in the Argentine inventory, from GPS-guided SDBs to 30mm cannon pods.

Merc 2000 Notes: The Pampa was the primary jet trainer for the Argentine Air Force, and was also sold across South and to an extent Central America,

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$3,380,290	JP4	1.55 tons	2.82 tons	2	12	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1674	419 (100)	NA 113 8/5 80/50	1300	694	12900	FF4 CF4 RF4 T3 W4

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, Flare/Chaff Dispensers	890/565m Hardened Runway	+2	5 Hardpoints	None

Buccaneer

Notes: This was one the first British jet carrier aircraft. When Britain went to the smaller carriers with Harriers, the Buccaneers were relegated to land bases, usually as anti-ship planes, and then were eventually phased out. They were also operated by South Africa, usually in the long-range strike role, but were also phased out by that country. The Buccaneer has an internal bomb bay, unusual for an aircraft of its size; this bay can hold 1.81 tons or 2040 liters of fuel. The aircraft has ejection seats and is capable of in-flight refueling.

Twilight 2000 v1 Notes: Buccaneers became a primary long-range attack platform, as numbers of Tornados were lower than expected in the RAF due to the withdrawal of Italy from NATO and the need to replace German Tornado losses early in the Twilight War.

Twilight 2000 v2.2 Notes: Buccaneers were also used against land targets in the Twilight War, though by that war they were largely replaced by Tornadoes and were operated only in a secondary role or to replace Tornado losses. South Africa also used some of these aircraft in the Twilight War.

Twilight 2013 Notes: Buccaneers were out of service by 2013, though the British scraped up six for duty in the Twilight War, and South Africa managed to put two in the air for duty.

Twilight 2035 Notes: Buccaneers were for the most part museum pieces or rusted, picked-over hulks by 2035, though the RAF managed to scare up enough intact airframes and parts and avionics to put one in the air in 2036. (This Buccaneer, however, was shot down within weeks after beginning to conduct missions.)

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$25,114,176	AvG	7.26 tons	15.29 tons	2	36	Radar, FLIR	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
2274	569 (170)	NA 142 7/4 70/40	9240	5315	13715	FF5 CF6 RF5 T4 W4

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
IFF, Secure Radios, Radar Warning Receiver, Stealth 1	1800/1600 Hardened Runway	+3	Internal Weapon Bay, 4 hardpoints	None

Bulldog/Beagle Pup

Notes: This is a light primary trainer and liaison aircraft that is used as a counter-insurgency aircraft by many smaller air forces. There is also a civilian version without hardpoints called the Beagle Pup; these aircraft have a third seat behind the pilots' seats that can hold one adult or two children.

Twilight 2000 v1/v2/2,2/2013/2035/Merc 2000: This aircraft found military employment as a liaison and aerial FALO aircraft; others were used by some lucky civilians to escape war zones

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Pup 100	$251,760	G, AvG	290 kg	776 kg	1+1	2	None	Enclosed
Pup 150	$255,460	G, AvG	290 kg	917 kg	1+2	2	None	Enclosed
Pup 160	$256,160	G, AvG	290 kg	943 kg	1+2	2	None	Enclosed
Bulldog	$300,620	G, AvG	290 kg	1.05 tons	1+1	2	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	
Pup 100	428	107 (90)	NA 27 6/3 50/20	170	27	4000	FF3 CF3 RF3 T3 W2
Pup 150	600	150 (90)	NA 38 6/3 50/20	170	46	4000	FF3 CF3 RF3 T3 W2
Pup 160	628	157 (90)	NA 39 6/3 50/20	170	49	4000	FF3 CF3 RF3 T3 W2
Bulldog	738	185 (90)	NA 46 6/3 50/20	170	64	4000	FF3 CF3 RF3 T3 W2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Pup	None	500/400m Primitive Runway	None	None	None
Bulldog	None	500/400m Primitive Runway	None	4 Hardpoints	None

Hunter

Notes: This jet is a mid-1960s relic that is still in wide use by Lebanon, though recently they have been looking at ex-US F-16Cs and Ds to replace them. Its low-power engine does not lend itself to speed, maneuverability, or lifting power, and its lack of an afterburner does not give it good acceleration. However, it is a decent ground attack aircraft, and its four 30mm cannons pack quite a punch. The Hunter has the rare ability to fire only half its cannons at a time, if desired, usually done to save ammunition when attacking soft targets or to load different guns with different types of ammunition. Though the aircraft has a lot of hardpoints, eight of these may only be used for rocket pods or single rockets, with a load limit of 100 kg per hardpoint; if these hardpoints are used, the two center wing hardpoints may not be used. If the two center hardpoints are used, the eight rocket hardpoints may not be used.

Twilight 2000 v1/v2/v2,2: The Hunter's primary playground during the Twilight War was the Middle East; they were taken out of storage by several Middle Eastern countries during that war to replace aircraft losses

Twilight 2013: Most Arab Air Forces have replaced their Hunters with newer aircraft, and the remaining hunters sit idle, awaiting their call…

Twilight 2035: Hunters are found in museums or bombing ranges, long having been replaced by up-to-date aircraft,

Merc 2000: Another non-descript aircraft used by mercs,

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$7,123,180	AvG	2.54 tons	8.35 tons	1	14	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
2250	563 (150)	NA 141 7/4 70/40	1800	4523	16155	FF5 CF4 RF4 T4 W4

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	1200/800m Hardened Runway	+2	4x30mm Aden, 14 Hardpoints	1200x30mm

BAC Strikemaster

Notes: This light strike aircraft was developed from a jet trainer known as the Jet Provost. It is an unsophisticated aircraft for basic ground support missions, and is easy to maintain and inexpensive to operate. The aircraft has ejection seats, but is not capable of in-flight refueling.

Twilight v1 Notes: Generally used as a Sandy by NATO air forces, they were also adapted to operate from carriers, and often found themselves operating from US carriers.

Twilight v2/v2.2: Generally the same story, but much of their roles were taken over by Jaguar strike aircraft.

Twilight 2013: The Strikemaster was long since retired, though small amounts made a reappearance late in the war to replace aircraft losses,

Twilight 2035: The Strikemaster was very long ago retired, and could be found only in museums and in civilian hands,

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$1,436,300	AvG	1.2 tons	4.02 tons	2	6	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1448	362 (95)	NA 91 9/6 90/60	1860	1392	12200	FF4 CF3 RF3 T3 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	400/500m Primitive Runway	+1	2xMAG, 8 Hardpoints	1300x7.62mm

CL-41 Tutor

Notes: This Canadian aircraft is a trainer in peacetime and a light attack aircraft in wartime. They are simple aircraft that are easy to fly. They are also used by Malaysia, usually in a counterinsurgency role.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$2,069,840	AvG	1.59 tons	3.41 tons	2	6	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1510	378 (100)	NA 95 6/3 60/30	1140	1301	10000	FF4 CF4 RF3 T2 W4

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
IFF, Transponder	440/400m Hardened Runway	+2	6 hardpoints	None

Xi'an JH-7A Flying Leopard

Notes: This aircraft was at first rejected by the Chinese military in favor of the Su-27. Its low-thrust engines do not lend themselves to speed or lifting capability, and weapons load is small for an aircraft of its size. The two wingtip hardpoints may be used only for air-to-air missiles.

Twilight 2000v1/2/2.2 Notes: With the escalation of hostilities between China and Russia, the supply of Su-27s to China was abruptly cut off. The JH-7A was thus put into high production.

Twilight 2013 Thoroughly disappointed with JH-7A, the Chinese never exported it and kept it around only for ground defense and strikes in low-threat targets.

Twilight 2035: The JH-7A is long out service, finding homes in museums or ignoble ends on bombing ranges.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$85,190,380	AvG	5 tons	22.42 tons	2	42	Radar	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	
1950	488 (120)	NA 122 8/4 80/40	6580	4400	17000	FF5 CF6 RF4 T4 W5

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Radar Warning Receiver, HUD, IR Uncage, Look-Down Radar, Multitarget (3), Track While Scan, Target ID, Terrain-Following Radar, Auto Track, Laser Designator	1100/1050m Hardened Runway	+4	2x23mm autocannons, 5 hardpoints	600x23mm

Shenyang J-16 Red Eagle

Notes: The J-16 began as a license-built Su-30MKK (called J-11A in China), imported from Russia. However, the original aircraft diverged significantly from the Su-30MKK, and earned the right to be considered its own aircraft. It was modified/designed to replace the disappointing JH-7, and had almost totally replaced it in the PLAAF by 2018. The airframe and most of the working parts are those of the Su-30MKK, but the avionics, engines, and flight computers are all of Chinese make and tailored for its mission as a strikefighter. The J-16 is similar in role and capabilities to the US F/A-18E/F.

The attack suite is formed around a new AESA radar which also has ground attack and look-down shoot-down capabilities. Most Chinese AAMs can be carried, even to the exclusion of other ordnance if necessary. Thus, the J-16 can also function as an interceptor or an escort fighter, though it's primary role is that of a strike aircraft with some air-to-air capability. The J-16 also has an updated version of the VADS system called EOTS (Electro-Optical Targeting System), which greatly enhances the BVR engagement range and allows the J-16 to fire against ground targets and air-to air targets, depending upon the ordnance used, before the aircraft is within the engagement range of most SAMs and AAA. If all that fails, the J-16 has IRST capability. Perhaps one of the most easily-seen differences is the two-seat tandem cockpit, with a pilot and a WSO in the rear. The J-16 is capable of carrying almost all Chinese air-to-ground and air-to-air munitions. The J-16 is also often seen carrying ECM and IRCM jamming pods, and pods with extra flares and chaff. This is in addition to the J-16's own internal jammers. In the starboard wing is a GSh-30-1 30mm autocannon.

The J-16 makes use of many panels of RAM and carbon fiber construction, giving it a smaller RCS. The engines are a pair of WS-10A turbofans with afterburning; though these are based on the original engines that came with the Su-30MKK, which are themselves are close copies of the American F101.They develop 22000 pounds of thrust dry, or 33000 pounds each in afterburner. The cockpit sits in a titanium "bathtub" similar to that of the Russian SU-25, though not as strong as the A-10's cockpit armor.

Though originally designed as a land-based aircraft, the PLAN has also taken delivery of six J-16s, to give it's one aircraft carrier a significant strike capability. This is opposite from the normal deployment routine – normally, the PLAN gets first pick of new aircraft and air-launched weapons.

J-16D

The D variant of the J-16 is also known as the Red Eagle (or its Chinese translation of that); however, instead of being a strike aircraft, it is an electronic warfare aircraft, carrying a combination of ECM/ECCM/IRCM/Radio Jamming pods and ARMs. It is similar in concept and function, though reportedly not in capability, to the US Navy's EA-18G Growler, with the wing hardpoints carrying two or four EW pods, the wingtips carrying light ARMs, EW pods, sensors, designators, or even chaff and flare pods, and two or four of the hardpoints carrying two heavy or four light ARMs. The centerline hardpoint is wet and normally carries an extra fuel tank, though it too can carry a jamming pod or clusters of heavy or light ARMs. The J-16D is also capable of employing heat-seeking missiles or other non-ARM munitions; it does have a laser designator and can launch GPS-guided munitions, in pursuit of its SEAD mission. Though early reports place it as being not quite as effective in the EW field as the Growler, it is probably very close in capability, as the Chinese are known to have a strong electronics-manufacturing and testing capability, and though they can't seem to produce a jet engine worth a damn, their avionics almost equal European designs and even rival those of the Americans.

One thing the J-16D is not meant to do is get in short-range knife fights; in fact, the J-16D has no internal cannon (the gun being replaced with avionics) and has no IRST (having replaced with a more powerful AESA radar setup). In fact, the entire radome is reshaped to accommodate this more powerful radar. The surface of the aircraft is festooned with a plethora of conformal radar receivers, radio antennas, radar detectors and analyzers (to determine the exact frequency of incoming radar emissions to more precisely jam radar, IR tracks, and radios), making them easier to jam, MIJI, spoof, or otherwise make them less effective or completely ineffective.

They say that every plus has an equal minus, and the J-16D's is air-to-air combat. Supposedly, a fully-loaded J-16D maneuvers like a pig, and if you are in a fighter or even many attack aircraft, and you catch up with a J-16D, it is a sitting duck in most cases.

Twilight 2000 v1: These aircraft do not exist in the Twilight 2000 v1 timeline.

Twilight 2000 v2/2.2: Despite the early embargo the Russians put on technology transfer with the Chinese, espionage and reverse engineering really paid off in this case.

Twilight 2013: This was one of the most numerous Chinese attack aircraft,

Twilight 2035: Despite being a bit dated in a world dominated by 5th generation aircraft, the J-16 managed to largely retain its relevance,

	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
J-16	$137,482,030	Chinese Equivalent of JP5	12.98 tons	35 tons	2	51	AESA Radar (320 km), EOTS (100 km), IRST (60 km)	Shielded
J-16D	$381,650,387	Chinese Equivalent of JP5	12.98 tons	35 tons	2	58	AESA Radar (500 km), EOTS (150 km), SAR (50 km)	Shielded

	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	
J-16	2854	718 (195)	NA 72 4/2 40/20	4341	3447	17300	FF6 CF6 RF5 T4 W5*
J-16D	2854	718 (215)	NA 55 6/4 60/40	4341	3447	17300	FF6 CF6 RF5 T4 W5*

	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
J-16	All-Weather Flight, IFF, Radar Warning Receiver, HUD, IR Uncage, Look-Down Radar, Multitarget (5), Track While Scan, Target ID, Terrain-Following Radar, Auto Track, Laser Designator, Stealth 2, ECM 2, IRCM 2, Flares and Chaff (30 each), GPS, Satcom Radio, Secure Radios	900/850m Hardened Runway	+4	GSh-30-1 30mm Autocannon, 9 Hardpoints (3 Wet, 2 Wingtip)	300x20mm
J-16D	All-Weather Flight, IFF, Radar Warning Receiver, HUD, Look-Down Radar, Track While Scan, Target ID, Terrain-Following Radar, Auto Track, Laser Designator (2) Stealth 2, ECM 4, ECCM 4, IRCM 3, Flares and Chaff (50 each), GPS, Deception Jamming, Active Jamming, ELINT Suite, EW Suite, Laser Spot Tracker, Satcom Radio, Secure Radios	900/850m Hardened Runway	+4	9 Hardpoints (3 Wet, 2 Wingtip)	Nil

*The cockpit and canopy have light extra armor and is AV7.

L-29 Delfin

Notes: This Czech aircraft is a trainer that can also be used as a light attack aircraft. It is a light aircraft with a light weapon load, but it is cheap and easy to maintain. It is used by most of the former Warsaw Pact (though in steadily decreasing numbers). It has also been exported outside of Europe, mainly to the Middle East. The two wingtip hardpoints may be used only for drop tanks.

Twilight 2000 v1 Notes: Delfins undertook an increasing number of attack and close-air support as the war went on

Twilight 2000 v2/2.2 Notes: Some former East German Delfins were put into use by Germany during the Twilight War.

Twilight 2013 Notes: Defins were old machines by 2013, rarely used even in the Czech Republic and Slovakia. Some other countries did still operate them, though. In addition, several Delfins had been sold to private collectors or museums.

Twilight 2035 Notes: The only Delfins left are in private hands, museums, or a few Third-World countries,

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$693,000	AvG	272 kg	3.18 kg	2	4	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1310	328 (100)	NA 82 6/3 60/30	1120	865	10700	FF3 CF3 RF3 T2 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
IFF, Transponder	440/400 Hardened Runway	+1	4 hardpoints	None

L-39/L-159 Albatros

The L-39 is the successor to the L-29 Delfin in Warsaw Pact service. There are three versions, the trainer/attack aircraft, and the dedicated attack aircraft (L-39ZA) with a cannon under the fuselage. This aircraft is used by all former Pact air forces except Poland, and several other allied air forces. The two wingtip hardpoints may only carry drop tanks.

The L-159 is an L-39 with a more powerful engine, redesigned nose, upgraded avionics, standard internal cannon, and hydraulic assist for its controls. It can carry heavier loads and is more responsive at high speeds. Like the L-39, the two wingtip hardpoints may only be used for drop tanks.

Twilight 2000 Notes: A few of these aircraft (mostly L-39ZOs) were used by Germany during the Twilight War. These were aircraft that were captured intact from Czechoslovakia early in the war.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
L-39ZO	$1,182,080	AvG	1 ton	3.7 tons	2	6	None	Enclosed
L-39ZA	$1,595,770	AvG	1 ton	3.7 tons	1	6	None	Enclosed
L-159	$2,545,900	AvG	1.81 tons	5.19 tons	1	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
L-39ZO/ZA	1392	348 (110)	NA 87 7/4 70/40	1405	1684	12000	FF4 CF4 RF3 W4 T3
L-159	2246	562 (110)	NA 141 7/4 70/40	1602	2674	12000	FF4 CF4 RF3 W4 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
L-39ZO	Transponder	450/400 Hardened Runway	+1	6 Hardpoints	None
L-39ZA	Flare/Chaff Dispensers (30/20), RWR	450/400m Hardened Runway	+2	6 Hardpoints, 23mm autocannon	300x23mm
L-159	Flare/Chaff Dispensers (30/20), RWR, HUD, ECM 1	450/400m Hardened Runway	+2	23mm Autocannon, 7 Hardpoints	400x23mm

Magister

Notes: This light jet was originally produced as a trainer, but was used as a light attack aircraft by France and Israel. It was also built under license by Finland, Italy, and Germany, and used by Algeria, Bangladesh, Cameroon, El Salvador, Gabon, Ireland, Lebanon, Libya, Morocco, Senegal, and Brazil. Armament is light, and hardpoints are sparse, but the aircraft is cheap and easy to maintain, and has a long endurance. It is one of the few military aircraft in the world with a V-tail.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$903,280	AvG	135 kg	3.13 tons	2	4	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1430	358 (110)	NA 90 6/3 60/30	1680	776	10700	FF3 CF2 RF2 T2 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Secure Radios	440/400m Primitive Runway	+1	2xAAT-52, 2 Hardpoints	800x7.5mm

Mirage 5/50

Notes: This is the ground attack variant of the Mirage III. The Mirage 5 can carry a heavier weapon load, and has two extra hardpoints on the rear fuselage for bombs. The Mirage 5 has no air-to-air radar. They are used by Abu Dhabi, Argentina, Columbia, Egypt, Gabon, Libya, Pakistan, Peru, Zaire, Chile, and Venezuela. They were never used by France, but Israel received a number of them, which they developed into the Nesher and the Kfir.

The Mirage 50 is a Mirage 5 with a more powerful engine and better radar, as well as more sophisticated ground attack avionics and air-to-air radar. It can carry heavier loads and radar-homing missiles.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Mirage 5	$35,572,920	AvG	4.2 tons	13.7 tons	1	22	Radar (150 km)	Enclosed
Mirage 50	$43,470,020	AvG	4.88 tons	14.7 tons	1	24	Radar (250 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Mirage 5	4110	1028 (160)	NA 257 6/3 60/30	3900	3078	13500	FF5 CF4 RF4 T3 W5
Mirage 50	4670	1168 (160)	NA 292 6/3 60/30	3900	3771	13500	FF5 CF4 RF4 T3 W5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Mirage 5	All-Weather Flight, Radar Warning Receiver, Chaff/Flares (30/50), Stealth 1	700/800m Hardened Runway	+2	2x30mm DEFA Autocannons, 7 Hardpoints	600x30mm
Mirage 50	All-Weather Flight, Radar Warning Receiver, IR Uncage, HUD, Chaff/Flares (40/70), Stealth 1	700/800m Hardened Runway	+3	2x30mm DEFA Autocannons, 7 Hardpoints	600x30mm

Mirage 2000N

Notes: This is the ground-attack variant of the Mirage 2000 fighter-bomber, with an extra crewman (weapons officer) and different avionics. It is even capable of delivering nuclear weapons. It may be distinguished from the Mirage 2000 fighter-bomber by its longer nose, internal fuel probe, and larger hardpoints. It is capable of aerial refueling and has ejection seats for its crew. It is used only by France.

Twilight 2000 Notes: Many of these aircraft were responsible for nuclear strikes against German forces in the Rhineland.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$74,546,580	AvG	6.3 tons	10.7 tons	2	16	Radar (250 km)	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor

4837	1209 (120)	NA 302 9/5 90/50	3780	6892	18300	FF5 CF5 RF4 T3 W5*

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers (50/80), ECM 3, IR Uncage, Terrain Following Radar, Look Down Radar, Stealth 1	700/800m Hardened Runway	+4	9 Hardpoints	None

*The Mirage 2000N has an armored cockpit and canopy and has an AV of 7.

Super Etendard

Notes: This French-made strike fighter was first introduced in 1978. The only other user of this aircraft is Argentina, who used them with great success in the Falklands War against Britain. French models were upgraded starting in 1990 with additional avionics to increase their survivability and accuracy in strikes, but they are being increasingly replaced with the naval model of the Rafale. They are largely carrier-based aircraft in the French Navy, but land-based in Argentine service.

Twilight 2000 Notes: By the Twilight War, the design was a bit dated, but it was still used in large numbers by France and smaller numbers by Argentina.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Argentine	$50,132,160	AvG	2.1 tons	12 tons	1	18	Radar (75 km)	Enclosed
French	$57,035,990	AvG	2.1 tons	12.4 tons	1	18	Radar (125 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(Both)	2760	690 (110)	NA 173 6/3 60/30	3460	1600	13700	FF4 CF4 RF4 T3 W4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Argentine	Radar Warning Receiver, Flare/Chaff Dispensers, HUD	825/415m Hardened Runway	+2	2x30mm DEFA Autocannons, 5 Hardpoints	500x30mm
French	Radar Warning Receiver, Flare/Chaff Dispensers, HUD, ECM 2, Target ID, Laser Designator (3 km), Look-Down Radar	825/415m Hardened Runway	+4	2x30mm DEFA Autocannons, 5 Hardpoints	500x30mm

Alpha Jet

Notes: This is an aircraft that is a trainer during peacetime and a light strike aircraft during wartime. It is used by Belgium, Egypt, France, Ivory Coast, Morocco, Nigeria, Qatar, Togo, Portugal, Germany, and Cameroon. The aircraft's two-seat version is used as a trainer or FAC aircraft, but during wartime strike missions, the back seat is removed and replaced by an electronics suite that gives it a radar warning receiver and ECM. Of its five hardpoints, only the wings' 4 hardpoints may be used for drop tanks. The fuselage station is normally used by a gun pod, as the aircraft has no internal guns, but it may be used for other stores.

The Alpha Jet ACAS adds a laser rangefinder in a modified nose, as well as inertial navigation and a computerized attack system. The Alpha Jet 2 uses a more powerful engine and is capable of air-to-air combat with heat-seeking missiles. The Alpha Jet Lancier (Also known as the Alpha Jet 3) adds radar, a multifunction display, a laser rangefinder, an internal cannon, and integral smart munition delivery capability, as well as expanding air-to-air combat capability. German aircraft use the Mauser autocannon, while French Lanciers use the DEFA autocannon.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Alpha Jet E	$5,036,570	AvG	2.5 tons	8 tons	2	10	FLIR	Enclosed
Alpha Jet A	$16,541,810	AvG	2.5 tons	8.09 tons	1	12	FLIR	Enclosed
Alpha Jet ACAS	$16,951,730	AvG	2.5 tons	8.11 tons	1	12	FLIR	Enclosed
Alpha Jet 2	$17,532,260	AvG	2.55 tons	9.02 tons	1	12	FLIR	Enclosed
Alpha Jet Lancier	$25,638,074	AvG	2.55 tons	10.34 tons	1	16	FLIR, Radar (75 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Alpha Jet E/A/ACAS	2000	500 (130)	NA 125 6/3 60/30	2160	1368	13700	FF3 CF4 RF3 T2 W3
Alpha Jet 2/Lancier	2061	515 (130)	NA 129 6/3 60/30	2160	1568	13700	FF3 CF4 RF3 T2 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Alpha Jet E	None	550/495m Hardened Runway	+2	5 Hardpoints	None
Alpha Jet A	Radar Warning Receiver, ECM 2	550/495m Hardened Runway	+2	5 Hardpoints	None
Alpha Jet ACAS	Radar Warning Receiver, ECM 2, Inertial Navigation	550/495m Hardened Runway	+3	5 Hardpoints	None
Alpha Jet 2	Radar Warning Receiver, ECM 2, Inertial Navigation, HUD	550/495m Hardened Runway	+3	5 Hardpoints	None
Alpha Jet Lancier	Radar Warning Receiver, ECM 3, Inertial Navigation, HUD, Flare/Chaff (34/25), IR Uncage, Laser Designator (6km)	550/495m Hardened Runway	+4	5 Hardpoints, 1x27mm Mauser or 30mm DEFA	300x27mm or 30mm

AMX

Notes: This is a joint project of Italy and Brazil. It was designed to replace the G.91 in Italian service and to provide a high-speed attack capability to Brazilian forces. The aircraft has a day-night capability and is very stable at low speeds as well as high speeds. Brazilian aircraft have two 30mm cannons, while Italian versions have a 20mm Vulcan. The two wingtip hardpoints may only be used for air-to-air missiles or drop tanks.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Brazilian	$31,346,010	AvG	3.8 tons	12 tons	1	20	Radar (40 km)	Shielded
Italian	$32,924,920	AvG	3.8 tons	12.95 tons	1	20	Radar (50 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(Both)	1828	457 (130)	NA 114 8/4 50/25	4175	2760	15200	FF3 CF3 RF3 T2 W3

Vehicle	Combat Equipment	Minimum	RF	Armament	Ammo

		Landing/Takeoff Zone			
Brazilian	Flare/Chaff (30/20), ECM 2, Secure Radios, All-Weather Flight, RWR	1178/982m Hardened Runway	+3	2x30mm DEFA, 7 Hardpoints	400x30mm
Italian	Flare/Chaff (35/35), ECM 2, IRCM 1, Secure Radios, All-Weather Flight, RWR	600/500m Hardened Runway	+3	20mm Vulcan, 7 Hardpoints	400x20mm

AV-8B Harrier II

Notes: The Harrier is a VSTOL multirole aircraft able to perform as both a fighter and attack aircraft. It is used by Britain, the US Marines, Italy, India, and Spain. It has a raised cockpit for superior visibility, a composite material wing for lightness and strength, and a redesigned nose with air-to-air/ground radar. The aircraft has an ejection seat and is capable of in-flight refueling. When performing VIFF flight, the Harrier has an especially high heat signature, and attacks with heat-seeking missiles are one level easier. VSTOL flight may only be performed by removing 2.4 tons from the cargo capacity or fuel of the Early Model or 1.1 tons from the Late Model.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Early Model	$42,448,420	AvG	6 tons	14.06 tons	1	30	Radar (60 km)	Enclosed
Late Model	$47,467,730	AvG	6 tons	14.06 tons	1	34	FLIR (30 km), Radar (70 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Early Model	1845	462	NA 116 9/5 60/40	4200	6577	15200	FF6 CF6 RF6 W5 T5
Late Model	2118	530	NA 133 9/5 60/40	4200	7629	15240	FF6 CF6 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Early Model, USMC	All-Weather Flight, Flare/Chaff Dispensers (40/25), RWR	450/16m (VSTOL) or 450/505m (Conventional) Primitive Runway	+2	25mm GAU-12/A, 9 Hardpoints	300x25mm
Early Model, Non-USMC	All-Weather Flight, Flare/Chaff Dispensers (40/25), RWR	450/16m (VSTOL) or 450/505m (Conventional) Primitive Runway	+2	2x25mm ADEN, 9 Hardpoints	200x25mm
Late Model	All-Weather Flight, Flare/Chaff Dispensers (50/30), RWR, Inertial Navigation	450/16m (VSTOL) or 450/505m (Conventional) Primitive Runway	+3	25mm GAU-12; 9 hardpoints	300x25mm

Hawk

Notes: The Hawk is a trainer and light strike aircraft used by the UK, Abu Dhabi, Dubai, Finland, Indonesia, Kenya, South Korea, Kuwait, Saudi Arabia, Switzerland, Zimbabwe, Australia, Malaysia, Oman, Qatar, Canada, and South Africa. It is also used by the US Navy as a trainer (the T-45 Goshawk). It is an unsophisticated, but cheap aircraft, with a limited capability. The fuselage hardpoint is normally fitted with a gun pod, since the Hawk has no internal gun.

Twilight 2000 Notes: In the Twilight War, the US Navy modified some T-45 Goshawks for the strike role. Other countries often used 2-seat Hawks as FAC aircraft.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Hawk 50	$1,676,430	AvG	3.08 tons	5.7 tons	2	8	None	Enclosed
Hawk 100	$4,978,450	AvG	3 tons	9.1 tons	2	12	FLIR (60 km)	Enclosed
Hawk 200	$17,255,750	AvG	3 tons	9.1 tons	1	12	Radar (50 km), FLIR (60 km), Image Intensification (4.5 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Hawk 50	2076	519 (135)	NA 130 9/5 60/40	2400	2314	15240	FF3 CF3 RF3 T2 W3
Hawk 100	2076	519 (135)	NA 130 9/5 60/40	2400	2534	13545	FF3 CF3 RF3 T2 W3
Hawk 200	2034	509 (135)	NA 127 9/5 60/40	2400	2534	13715	FF3 CF3 RF3 T2 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Hawk 50	None	550/495m Hardened Runway	+1	5 Hardpoints	None
Hawk 100	RWR, Laser Designator (4.5 km)	550/495m Hardened Runway	+3	5 Hardpoints	None
Hawk 200	RWR Flare/Chaff (50/40), Laser Designator (5 km)	550/495m Hardened Runway	+4	2x25mm ADEN, 7 Hardpoints	200x25mm

IAR-93B/J-22 Orao

Notes: This is a strike aircraft jointly produced by Romania and Yugoslavia. The factory in then-Yugoslavia (now Bosnia) was dismantled in 1992 and never reassembled after that, but the Romanian factory continued to produce Oraos. This is a light aircraft with a limited weapons load, but it is cheap and easy to produce. There is also an unarmed variant with cameras for reconnaissance. An unusual feature of this aircraft is its ability to fire only two cannons at a time, if desired; this is normally done to conserve ammunition.

Twilight 2000 Notes: The Romanian factory manufacturing the Orao (and some other aircraft) was put out of action permanently by air strikes in 1999.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$4,405,520	AvG	2.8 tons	11.08 tons	2	11	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
2040	510 (115)	NA 128 9/5 90/50	3240	2224	12500	FF4 CF4 RF3 T3 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	950/600m Hardened Runway	+1	4x23mm Autocannons, 5 Hardpoints	400x23mm

Jaguar

Notes: This is an attack aircraft produced by an international effort of France and Britain. It is also used by Ecuador, India, Nigeria, and Oman. Two of its seven hardpoints are unusual; they are on top of the wing, to be used by air-to-air missiles. Three of its hardpoints may be used for drop tanks in addition to weapons. Two seat versions of this aircraft exist. This aircraft was a standout in the 1991 Gulf War, in Indian attacks on Kashmir and Kurdistan, and in the Twilight War. Though they were supposed to be replaced by the Eurofighter 2000 (Typhoon), the continual delays and budgetary problems with the Typhoon program mean that the Jaguar still keeps soldiering on. The pilot has an ejection seat, and the aircraft is capable of in-flight refueling.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Mk 804 Engines	$9,186,100	AvG	4.76 tons	15.7 tons	1	20	None	Enclosed
Mk 811 Engines	$9,284,170	AvG	4.76 tons	15.7 tons	1	20	None	Enclosed
Mk 106 Engines	$9,554,120	AvG	4.76 tons	15.7 tons	1	22	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Jaguar
Mk 804 Engines	3398	850 (140)	NA 212 8/4 80/40	4200	4720	13700	FF4 CF4 RF3 T3 W4
Mk 811 Engines	3524	881 (140)	NA 220 8/4 80/40	4200	4899	13700	FF4 CF4 RF3 T3 W4
Mk 106 Engines	3874	969 (140)	NA 242 8/4 80/40	4200	5393	13700	FF4 CF4 RF3 T3 W4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	Flare/Chaff (50/40), RWR, Secure Radios, Laser Designator (60 km)	1250/785m Hardened Runway	+2	2x30mm autocannons, 7 hardpoints	300x30mm

K-8 Karakorum

Notes: This basic trainer/light attack aircraft is a joint product of China and Pakistan. Pakistan built large numbers of them and used them in conflicts against Indian forces throughout the Twilight War. Like most aircraft of its class, it is an unsophisticated aircraft with a light weapon load, being primarily a trainer with secondary strike capability.

Twilight 2000 Notes: China only began ordering the K-8 just before the Twilight War, and few were available to Chinese forces.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$1,674,270	AvG	943 kg	4.33 tons	2	10	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1590	398 (100)	NA 99 6/3 60/30	1855	1598	13600	FF3 CF3 RF3 T2 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	440/400m Hardened Runway	+1	23mm autocannon, 4 hardpoints	200x23mm

Tornado IDS

Notes: This is the strike version of the Tornado multirole aircraft. It was a joint venture of Germany, Britain, and Italy, and is in service with those countries and with Saudi Arabia. The Tornado is a variable geometry aircraft with automatic sweep; the wings change their angle of sweep in response to changes in airspeed. The crew has ejection seats and the aircraft is capable of in-flight refueling. Up to 4 of its hardpoints may be used for drop tanks.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$63,955,770	AvG	9 tons	27.95 tons	2	36	Radar (90 km), FLIR (60 km), Thermal Imaging (30 km)	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
4676	1169 (130)	NA 292 9/6 90/60	8000	4316	19800	FF6 CF6 RF6 W5 T5*

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff (75/50), RWR, Deception Jamming (200 km), HUD, IR Uncage, TFR (30 km), Look-Down Radar, Track While Scan, Laser Designator (60 km), ECM 3, IRCM 2	760/500m Hardened Runway	+4	2x27mm autocannons, 9 hardpoints	400x27mm

*The cockpit has a Kevlar antispalling liner and has an AV of 7.

Nesher

Notes: This is an Israeli development of the Mirage V, a stop on the way to the Kfir. It is a dedicated ground attack aircraft, and has no radar except for a radar gunsight. The aircraft has part of the improvements of the Kfir, such as the more powerful engine, but it is mostly a Mirage in design. It is used by Israel and Argentina, where it is called the Dagger.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$31,727,200	AvG	4.2 tons	13.5 tons	1	22	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
4168	1042 (160)	NA 261 7/4 70/40	3900	3078	13500	FF3 CF4 RF4 T3 W4

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
ECM 2, IRCM 1	700/800m Hardened Runway	+3	2x30mm DEFA Autocannons, 7 Hardpoints	600x30mm

G.91

Notes: The G.91R reconnaissance and ground attack aircraft was adopted by Italy, Portugal, and Germany in the 1950s. The pilot has an ejection seat, and the aircraft is not capable of in-flight refueling. It is not an advanced aircraft, but is cheap to buy and maintain.

The G.91T is primarily a trainer variant, but also has a useful attack capability. It differs only in the extra seat, less machineguns, half the hardpoints, and less carrying ability.

The G.91Y (often known as the Yankee), on the other hand, is virtually a new aircraft. It replaced the single engine of earlier models with two engines, offering almost twice the thrust of the single-engined G.91R. The fuel capacity was also almost doubled. The machineguns were replaced by twin 30mm autocannons. The avionics suite, almost not present in the R model, was upgraded with Doppler navigation, a flight computer, radar altimeter, and a HUD. The Yankee can also be fitted with RATO bottles to decrease the takeoff run by half.

Twilight 2000 Notes: The G-91s were brought back into service to replace aircraft losses in the Twilight War.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
G.91R	$1,954,630	AvG	680 kg	5.5 tons	1	10	None	Enclosed
G.91T	$1,587,560	AvG	480 kg	6.05 tons	2	10	None	Enclosed
G.91Y	$5,409,230	AvG	1.91 tons	8.7 tons	1	14	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
G.91R	2150	538 (120)	NA 134 6/3 50/25	1610	2224	13100	FF4 CF4 RF4 T3 W3
G.91T	2048	512 (120)	NA 128 6/3 50/25	1610	2224	12190	FF4 CF4 RF4 T3 W3
G.91Y	2076	519 (120)	NA 130 6/3 50/25	3200	3620	12500	FF4 CF4 RF4 T3 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
G.91R	None	615/745m Hardened Runway	+1	4xM-2HB, 4 Hardpoints	1200x.50
G.91T	None	615/745m Hardened Runway	+1	2xM-2HB, 2 Hardpoints	600x.50
G.91Y	Radar Warning Receiver, HUD, Inertial Navigation	600/915m Hardened Runway	+2	2x30mm DEFA, 4 Hardpoints	250x30mm

MB-326

Notes: This aircraft is used as a trainer and a light strike aircraft. It is known as the Impala in South African service and the Xavante in Brazilian service. It has a light weapons load, but is easy to maintain and cheap to operate. It has been widely exported, to countries such as Argentina, Australia, Brazil, Paraguay, South Africa, Togo, Congo, Zambia, Dubai, Ghana, and Tunisia. There is a two-seat version used as a trainer and FAC aircraft. These aircraft do not carry internal guns or have a gunsight.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MB-326GB	$1,047,630	AvG	1.81 tons	5.22 tons	2	8	None	Enclosed
MB-326K	$2,204,480	AvG	1.81 tons	5.9 tons	1	8	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
MB-326GB	1734	434 (110)	NA 108 7/4 70/40	2700	1513	11890	FF3 CF3 RF3 T2 W3
MB-326K	1770	442 (110)	NA 111 7/4 70/40	2880	1777	14325	FF3 CF3 RF3 T2 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MB-326GB	None	500/400m Primitive Runway	None	6 Hardpoints	None
MB-326K	None	500/400m Primitive Runway	+2	2x30mmDEFA, 6 Hardpoints	250x30mm

MB-339

Notes: The MB-339 is an upgraded version of the MB-326 noted above. The MB-339 has a redesigned, sleeker silhouette and slightly better avionics and somewhat better performance. The two wingtip hardpoints may only be used for drop tanks. The A model corresponds is a trainer/attack version; the C Model is upgraded in the area of the engine and avionics; and the K model is a dedicated light attack aircraft with greatly upgraded avionics and armament.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MB-339A	$1,573,430	AvG	2.04 tons	5.9 tons	2	8	None	Enclosed
MB-339C	$4,226,110	AvG	1.81 tons	6.35 tons	2	10	None	Enclosed
MB-339K	$5,553,590	AvG	1.94 tons	6.35 tons	1	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
MB-339A	1634	409 (110)	NA 102 8/4 80/40	2880	1777	14325	FF3 CF4 RF3 T3 W3
MB-339C	1634	409 (110)	NA 102 8/4 80/40	2880	1777	14325	FF3 CF4 RF3 T3 W3
MB-339K	1854	464 (110)	NA 116 8/4 80/40	3030	1777	14325	FF3 CF4 RF3 T3 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MB-339A	Flare/Chaff (25/20)	500/400m Primitive Runway	+1	6 hardpoints	None
MB-339C	Radar Warning Receiver, Flare/Chaff (25/30), HUD, Laser Designator (6 km)	500/400m Primitive Runway	+2	6 Hardpoints	None
MB-339K	Radar Warning Receiver, Flare/Chaff (25/20), HUD, Laser Designator (6 km), ECM 1	500/400m Primitive Runway	+2	2x30mm DEFA, 6 Hardpoints	300x30mm

IAR-99 Soim

Notes: This Romanian aircraft is used for training pilots in attack missions during peacetime, and as a strike aircraft during wartime. It began production in 1992, but production was slow, and it is a relatively rare aircraft. It is a simple and easy to maintain aircraft with a light load, used mainly for ground support.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Standard	$8,481,910	AvG	1 ton	4.4 tons	2	10	Radar (75 km)	Enclosed
Upgraded	$9,707,110	AvG	1 ton	4.4 tons	2	10	Rada (90 km)r	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(Both)	1718	430 (100)	NA 107 6/3 60/30	1355	1171	12900	FF4 CF4 RF4 T3 W4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Standard	RWR, Flare/Chaff Dispensers (30/20)	440/400m Hardened Runway	+2	23mm Autocannon, 4 Hardpoints	200x23mm
Upgraded	RWR, Flare/Chaff Dispensers (35/25), HUD, Helmet Sight Interface, ECM 1, Inertial Navigation	440/400m Hardened Runway	+3	23mm GSh-23-2 Autocannon, 4 Hardpoints	200x23mm

MiG-27 Flogger

Notes: This is the tactical strike variant of the MiG-23 interceptor. The MiG-27 has a three-position swing-wing; in the forward position, handling characteristics are as shown (this is the normal position for strike configuration), but maximum speed is Tr Mov 450 and Com Mov 620. If wings are in mid-sweep, maximum speed is Tr Mov 605 and Com Mov 830, but minimum speed is 160, Agl is -2/-1, and Turn is -20/-10. If wings are in full sweep, maximum speeds are as shown, but minimum speed is 200, Agl is -3/-2, and Turn is -30/-20. It takes one phase to change sweep by one setting; during this phase, the plane may only fly level or be in a shallow dive and no weapons may be fired or launched. There is a more advanced version of this aircraft, the Flogger-J; this aircraft has added avionics and night vision. This aircraft is used by Russia, India, and Iran.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Flogger-D (Early)	$7,051,020	AvG	4 tons	20.3 tons	1	28	None	Enclosed
Flogger-D (Late)	$8,089,090	AvG	4 tons	20.4 tons	1	28	None	Enclosed
Flogger-J	$37,241,470	AvG	4 tons	16.3 tons	1	30	Radar (150 km), Image Intensification (9 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Flogger-D	3744	936 (130)	NA 234 8/4 80/40	6000	7872	14000	FF6 CF6 RF6 W5 T5
Flogger-J	3744	936 (120)	NA 234 8/5 80/50	6000	7872	14000	FF7 CF7 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flogger-D (Early)	RWR, Flare/Chaff (40/30)	700/500m Hardened Runway	+2	GSh-6-30 Autocannon, 7 Hardpoints	260x30mm
Flogger-D (Late)	All-Weather Flight, RWR, Flare/Chaff (45/35)	700/500m Hardened Runway	+3	GSh-6-30 Autocannon, 7 Hardpoints	260x30mm
Flogger-J	All Weather Flight, RWR, Flare/Chaff (50/40), Laser Designator (6 km), ECM 2	700/500m Hardened Runway	+3	GSh-6-30 Autocannon, 7 Hardpoints	260x30mm

SU-7 Fitter

Notes: This elderly ground-attack aircraft first flew in the 1950s. It remains in service with many Third-World countries that were former Soviet client states. Its highly swept wings do not lend themselves to maneuverability, and its underpowered engine does not give it high speed or good cargo capability. The aircraft has an ejection seat, but is not capable of in-flight refueling.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$5,513,770	AvG	2.5 tons	13.5 tons	1	22	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
3376	844 (150)	NA 211 5/3 50/30	4260	6892	15150	FF4 CF4 RF4 T3 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff (25/15), RWR	905/950m Hardened Runway	+1	2x30mm autocannons, 9 hardpoints	140x30mm

Su-17 Fitter-D/Su-22 Fitter-F

Notes: The Su-17 Fitter is basically an SU-7 Fitter equipped with variable geometry wings and a more powerful engine. The Fitter-D is capable of nuclear delivery, and has a higher weapons load. The swing wing has two positions, fore and aft, for low or high speeds. The wing sweep may be changed only when the aircraft spends 4 phases or more in straight-line or minimal turn rate flight.

Unless the wings are swept, the maximum combat speed is 585; but if the wings are swept, minimum speed is 150 and all agility ratings are -1 and turn rates are -20/-10. The aircraft has an ejection seat, but is not capable of in-flight refueling.

The Su-22 Fitter-F is an improved, export version of the Su-17. The same swing-wing restrictions of the Su-17 apply to the Su-22. The Fitter-F has greater internal fuel coupled with a more efficient engine, thus having greatly-improved range. It also has improved avionics.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Fitter-D	$5,709,140	AvG	4.25 tons	19.5 tons	1	28	None	Enclosed
Fitter-F	$41,033,650	AvG	4.25 tons	19.5 tons	1	30	Radar (100 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(Both)	2800	700 (110)	NA 175 7/4 70/40	6360	4645	15200	FF4 CF4 RF4 T3 W4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Fitter-D	Flare/Chaff (40/30), RWR	905/950m Hardened Runway	+2	2x30mm autocannons, 9 hardpoints	300x30mm
Fitter-F	Flare/Chaff (40/30), RWR, Terrain-Following Radar	905/950m Hardened Runway	+3	2x30mm autocannons, 9 hardpoints	300x30mm

Su-24 Fencer

Notes: This is the one of the Russian's primary strike aircraft. It is also in use by several former Russian republics, Iran, Libya, and Syria. It is a medium bomber in the same class as the US F-111. The Fencer is capable of delivering nuclear weapons. The aircraft has ejection seats and is capable of in-flight refueling. The Fencer has a variable geometry wing with auto sweep features.

Twilight 2000 Notes: Many tragic mistakes resulted from this aircraft's resemblance to the F-111; so much so that many aircraft of these types were mistakenly shot down by both sides.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$55,767,400	AvG	8 tons	36 tons	2	52	2nd Gen FLIR (12 km), Radar (300 km)	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
2624	656 (110)	NA 164 6/2 60/20	13200	12206	17000	FF8 CF8 RF8 W5 T5

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff (50/40), RWR, Deception Jamming (100 km), Active Jamming (ECM 4, IRCM 3), HUD, TFR, Laser Designator (12 km), Auto Track	1305/945m Hardened Runway	+3	2x30mm autocannons, 9 hardpoints	140x30mm

Su-25/Su-39 Frogfoot

Notes: This is the Russian counterpart of the A-10, being a dedicated ground attack aircraft. In addition to Russia, the Frogfoot is operated by Afghanistan, Angola, Bulgaria, Czechoslovakia, Iran, Iraq, North Korea, and Peru. This aircraft was first used in combat in Afghanistan. The pilot has an ejection seat, and the aircraft is capable on in-flight refueling.

The Su-39 (also known as the Frogfoot-B) is a development of the Frogfoot using lessons learned from the War in Afghanistan. Russia had about two-dozen of this development of the Su-25 at the start of the Twilight War. It is a two-seat trainer with the rear seat removed and replaced with additional fuel and avionics, and a radar set is carried in a pod beneath the fuselage. The cannon has been increased to 6 barrels for a greater fire rate, and ammunition supply has been increased. Armor in the fuselage has been increased. IR suppression has been achieved through cooling intakes in the upper fuselage and a new center body that masks hot turbines.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Su-25	$9,193,870	AvG	4.4 tons	18.6 tons	1	32	None	Enclosed
Su-39	$31,230,180	AvG	4.4 tons	19.2 tons	2	34	Radar (175 km), FLIR (12 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Su-25	1888	472 (100)	NA 118 6/3 60/30	6600	8853	7000	FF8 CF8 RF8 W5 T5*
Su-39	1888	472 (100)	NA 118 6/3 60/30	7000	8853	7000	FF9 CF9 RF8 W6 T5*

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Su-25	Flare/Chaff (25/15), RWR, Laser Designator (12 km)	1200/600 Primitive Runway	+3	AO-17A 30mm-2 Autocannon, 8 Hardpoints	250x30mm
Su-39	RWR, Flare/Chaff (50/30), ECM 2, HUD, Target ID, Laser Designator (12 km), IR Suppression	1200/600 Primitive Runway	+4	GSh-30-6 Autocannon, 8 Hardpoints	400x30mm

*The area just around the cockpit is armored with titanium and reinforced Perspex and has an AV of 12.

SU-34 Flanker-F

Notes: This widened, two seat version of the SU-30MK was meant to replace the SU-24 Fencer in Russian service, but it was introduced just prior to the war and few were built. It is an advanced weapons-delivery platform, with the improvements of the SU-30MK, and terrain following radar. The SU-34 also has a rear radar/radio/designator pod, and may fire missiles and weapon rearward at enemy aircraft and positions. This rear radar has a limited search arc and strength, but is mainly for defensive purposes. The bulbous profile of the Flanker-F has less streamlining and less speed than the SU-30MK. The crew has ejection seats and the aircraft is capable of in-flight refueling. The two wingtip hardpoints may only be used for AAM or electronics pods.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$106,710,720	AvG	8 tons	44.36 tons	2	29	Radar (300 km), 3rd Gen FLIR (20 km), 2nd Gen Image Intensification (12 km)	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
4970	1242 (115)	NA 311 9/7 90/70	11470	11721	19800	FF6 CF6 RF5 T5 W5

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, RWR, Flare/Chaff (60/40), ECM 3, Auto Track, HUD, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios. Terrain Following Radar, Laser Designator (12 km)	750/700m Hardened Runway	+4	GSh-301 30mm Autocannon, 12 Hardpoints	800x30mm

Yak-130

Notes: This Russian aircraft is used as an advanced operational trainer and light attack aircraft. It was designed to replace the L-29/L-39/L-59 series of aircraft in Russian and Czech service, and also had some orders from Italy. The controls are fly-by-wire and very responsive, and the Yak-130 is maneuverable enough to be used as an aerobatic stunt plane. The Yak-130 can use both Eastern and Western weapons.

Twilight 2000 Notes: As it was not introduced into service until early 1995, it is a rather rare aircraft. In Italian service, the Yak-130 is often armed with AIM-9 Sidewinders and Maverick missiles.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$3,019,680	AvG	3 tons	9.5 tons	2	14	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
2074	519 (110)	NA 130 9/5 70/50	2165	4328	13000	FF4 CF3 RF3 T3 W4

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
RWR, Flare/Chaff (20/15)	495/450m Hardened Runway	+2	7 hardpoints	None

C.101 Aviojet

Notes: This is a Spanish made trainer used to train pilots for ground attack during peacetime, and as an actual combat support aircraft during wartime. It is capable of carrying a wide array of weapons and is armed with one cannon or twin machineguns. It is also used by Chile (where it is known as the A/T-36 Halcon), Honduras, and Jordan.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MG-Armed	$2,879,000	AvG	1.84 tons	6.3 tons	2	8	None	Enclosed
Cannon-Armed	$2,952,230	AvG	1.84 tons	6.4 tons	2	8	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(Both)	1612	403 (100)	NA 101 6/3 60/30	1730	1905	12800	FF4 CF3 RF3 T3 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MG-Armed	None	440/400m Hardened Runway	+2	2xM-2HB, 6 Hardpoints	375x.50
Cannon-Armed	None	440/400m Hardened Runway	+2	30mm DEFA Autocannon, 6 Hardpoints	160x30mm

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Saab 105

Notes: In peacetime, this Swedish aircraft is used as a trainer in every stage from basic training to advanced tactical training. In wartime, this aircraft is also used as a light attack aircraft, usually for the direct support of ground troops. In addition to Sweden, the Saab 105 is also used by Austria.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Aubisque Engines	$1,103,520	AvG	1 ton	4.02 tons	2	8	None	Enclosed
FJ44-1C Engines	$1,167,140	AvG	1.05 tons	4.02 tons	2	8	None	Enclosed
J85-GE-3 Engines	$1,422,960	AvG	1.22 tons	4.02 tons	2	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Aubisque Engines	1540	385 (100)	NA 96 8/5 40/30	1000	1454	12200	FF4 CF4 RF4 T3 W3
FJ44-1C Engines	1614	403 (100)	NA 101 8/5 40/30	1000	1598	12200	FF4 CF4 RF4 T3 W3
J85-GE-3 Engines	1882	470 (100)	NA 118 8/5 40/30	1000	2180	12200	FF4 CF4 RF4 T3 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	None	550/495m Primitive Runway	+2	6 Hardpoints	None

Pilatus PC-7

Notes: This Swiss-built trainer was designed for basic training and the teaching of aerobatic maneuvers. It is easy to fly and a very forgiving aircraft. Many were sold in Africa, Latin America, and Europe. Though not normally armed, they do have this capability. It has no ejection seats and is not capable on in-flight refueling.

Twilight 2000 Notes: These aircraft were often armed as COIN aircraft during the Twilight War.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$395,560	AvG	1 ton	2.7 tons	2	4	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
824	206 (100)	NA 52 7/4 70/40	1370	195	10060	Ff3 CF3 FF3 T2 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	500/400m Hardened Runway	None	6 Hardpoints	None

Pilatus PC-9

Notes: Developed from the PC-7, this aircraft has had 70% of it redesigned. It has a pressurized cockpit, more powerful engine, and greater range. It is used by several countries, including the US, who uses them as the T-6A Texan II.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$432,510	AvG	1 ton	3.2 tons	2	4	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
995	249 (100)	NA 62 7/4 70/40	2015	344	11580	HF4 CF4 FF3 T2 W3

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	500/400m Hardened Runway	None	6 Hardpoints	None

Douglas A-1 Skyraider

Notes: Originally designed in the wake of World War 2 as a dive bomber, the Skyraider did not see any service in that war; however, it saw considerable use during the Korean War. The Skyraider was progressively upgraded between the late 1940s and early 1980s, despite questions about how relevant the Skyraider was in modern air power. The Skyraider, however, came into its own in the Vietnam war, where it's slow speed and long loitering capability, as well as its ability to haul heavy loads, made the aircraft of choice as a "Sandy." Sandies gave cover to helicopter extraction missions, able to provide accurate support due to its slow speed and the bravery of Sandy pilots in dragging their aircraft in low. Their heavy armament, including four 20mm wing cannons, proved invaluable. In addition to US Air Force service, is was used by the Navy, Marine corps, the VNAF, and RAF, Sweden (where they were only used as target tugs, with armament and hardpoints removed), and the French Air Force. A variety of Southeast Asian and African countries also procured retiring Skyraiders. The A-1 continued to be used by the reunited Vietnam until the late 1980s. Though it is controversial as to whether it is regarded to be a kill, four Skyraiders outmaneuvered and shot down a MiG-19 in 1967. It often took two or more MiGs to being down a Skyraider, due to the Skyraider's maneuverability and the low heat given off by its engine. Skyraiders were involved in several – ah, unusual exploits, including the rescue of a Special Forces trooper, with the Green Beret standing on the wing, and in 1965, the dropping of a toilet on Viet Cong (commemorating the pilot's 6 million pounds of ordnance dropped).

AD-1

The original production was designated AD-1; this designation was assigned before the joint service common designation redesignation, and for the fact that the Skyraider was originally a Naval aircraft. 242 were built. The AD-1 was powered by a 2500-horsepower Wright R-3350-24W Duplex Cyclone Radial, with 18 cylinders. The engine was canted slightly downward, reducing the need for trim changes. It was a tail-dragger, and the main wheels rotated 90 degrees to lay flush with the airframe when flying. Being originally a Naval aircraft, the winds folded up near the middle. Both the wings and tail carried ailerons and elevators, increasing maneuverability, and had effective flaps and an undercarriage suitable for rough-field operations. Weapon carriage consisted of its internal armament of an M-3 20mm autocannon in each wing. A centerline hardpoint, a hard point under each wing, six pylons under each outer wing, for a total of 15 pylons – 1.63 tons on the centerline pylon, each inboard pylon could handle 1.36 tons, and each outer wing pylons could carry 225 kg each. However, the outer wing in totality could not carry more than1.135 tons, and since the hardpoints were tightly spaced, clearance issues resulted; while the outer wing could handle 6 rockets, it could carry only 3 bombs on the outer wing. Essentially, if loaded with more than 250 kg of weapons, the pilot may load only every other of these hardpoints, as the heavier ordnance was literally hooked to two hardpoints. (Most Sandies did in fact carry rockets underwing. The centerline and inner wing pylons were wet; this was good, since the AD-1 was not capable of aerial refueling. Occasionally, an AD-1 was "bombed up," overloaded with ordnance; these configurations were not regarded as being a sane thing to do. Along with bombs, napalm, and rockets, the AD-1 could carry torpedoes; this was only done once, against a dam in North Korea. The AD-1 had no ejection seat, and clearing the big tail could be a problem in a bailout. The pilot sits in an armored cockpit.

The AD-1Q was a variant of the AD-1 that carried a second operator in the rear. His cockpit could be charitably described as cozy; he entered through a door on the right side below the canopy. (In an emergency, this could be difficult to get out of quickly.) He had limited view through the canopy, and his main window was on left side. Under the right wing outboard was a jammer pod, and a chaff dispenser was carried under the left wing outboard. The other hardpoints were not occupied and could carry normal ordnance, and the cannons remained. The AD-1Q had extra antennas for the ECM pod. In order to not lose the fuel tankage, a spine ran down the fuselage to the tail.

AD-2/AD-3/AD-4

Some 156 AD-2s were built, though some were converted to the variants below. The upgrades included airframe strengthening, allowing for better maneuverability, an increase in internal fuel, and the replacement of the engine by a later version, the Wright 3350-26W, developing 3020 horsepower. The AD-1 included doors for the main landing gear, something the AD-1 did not have. The engine mounting was improved and made more solid, and the cockpit arrangement was made more intuitive. This version entered service in 1948.

An AD-2Q was also produced, similar to the AD-1Q, but with a jammer with more capability.

The AD-3 was similar to the AD-2, had a further-strengthened airframe, lengthened main gear struts, and an updated propeller. The tailwheel was no longer retractable, the rudder was redesigned, and the cockpit layout was further revised. The tail pitot tube was removed, replaced by a simple inlet. 125 of these were built or converted in 1949.

The AD-3Q was an ECM platform version of the AD-3; it had an updated equipment configuration. Only 23 were built or converted.

The AD-3N was a night attack variant, with a second crewmember crammed into the rear canopy like on the AD-2Q. A second door, with a window, was put in the RIO space. Under one wing was an AN/APS-4 radar pod, while the other wing had a 1 million-candlepower searchlight. The fuselage dive brakes were deleted, though the belly dive brakes were retained. On some AD-3Ns, the cannons were given flash suppressors to keep from blinding the crew in the dark. 15 were built or converted.

The AD-3W was an AEW variant, with a large belly radome for an AN/APS-20A search and tracking radar. In addition, the fuselage had a spine that held more equipment. Again, two crewmembers were jammed in where only one should have gone. The cannons were deleted, and the inboard wing pylons were retained for fuel tanks (the extra equipment gave the AD-3W a considerable hit on fuel tankage); the outer wing hardpoints were removed. The AD-3W had the nickname "Guppy" during its service. 31 were built or converted.

The AD-4 was built in larger numbers than any other Skyraider, with 372 built, though most were later converted or upgraded to later models. A more fuel-efficient Wright R-3350-26WA engine, providing 2700 horsepower, was fitted, though there was a loss of speed. The windshield was made wider and made of armored glass. Firepower was increased by adding another 20mm autocannon in each wing.

The AD-4B was, unbelievably, fitted out for tactical nuclear delivery, though they could also carry conventional stores. 165 of these were built, with another 37 being modified from standard AD-4s. They could carry a Mk 7 or Mk 8 nuclear bomb on a reinforced centerline pylon. Pilots of the AD-4B had no great faith that they would survive such a mission; they knew the Skyraider was too slow to avoid the blast and radiation effects of the bomb. They did have a special bomb direction system, optimized for nuclear delivery; it was not useful for conventional ordnance.

The AD-4N was the night attack variant, similar in concept to the AD-3N. This version did not have the second cannon in each wing, remaining with two cannons. After redesignation, this aircraft became the A-1D

The AD-4Q was an ECM carrier, similar to the AD-3Q.

AD-4W was an AEW version, with 168 built, and similar to the AD-3W.

The AD-4L was a winterized version, specifically for fighting in Korea. It featured deicing boots on the leading edges of the wings and control surfaces, and an engine preheater. There were 63 conversions. The AD-4NL was a winterized AD-4N, with 38 conversions. Both are identical to the standard AD-4 or AD-4N for game purposes.

Near the start of the Korean War, 100 AD-4Ns were converted back to a day attack role. They were stripped of all night attack equipment, and had their hardpoints restored. They retained, however, their twin 20mm cannons, with flash suppressors. The rear seat remained, though it was normally empty.

Korean War Skyraiders: AD-5/AD-6/AD-7

In the Korean War, the Skyraider acquired the nickname “Able Dog,” from its designation of AD. They had a legendary reputation, as being easy to fly, maneuverable, able to haul lots or ordinance, and capable of sustaining incredible damage and bringing its pilot home. Later, after the tri-service designation system, the AD-5 would be redesignated the A-1E. The first AD-5s were rebuilt AD-4s.

The AD-5 was a significant upgrade for the Skyraider, with a stretched fuselage to carry more fuel, a width increase to allow even more fuel, a second crewmember, or specialized equipment. In some configurations, up to four crewmembers could be accommodated in the Skyraider, if so equipped. The fuselage airbrakes were deleted as unnecessary with all the brakes and slats already present. The outer wing pylons were moved so they just projected beyond the front of the wings; this helped maintain the center of gravity when carrying stores. The two seat configuration was used, with the second seat beside the pilot; this seat was often unoccupied, but often carried an observer with binoculars.

The AD-5N was a night attack version, similar in concept to the AD-4N, though the radar operator was beside the pilot instead of being crammed in the back. 239 were built. After redesignation, this became the A-1G.

The AD-5W was an AEW aircraft, similar to the AD-4W, and equipped with a tracking and scanning radar underneath the fuselage. The AD-1W had two radar operators and one EW officer; the radar operators in the rear needed their cockpit area dark, to see the radar scopes better. The Plexiglas of the canopy in the rear was replaced with aluminum sheets, and small windows were made in the sides of the rear section to supply what light was needed. Equipment included a searchlight and a chaff pod. After redesignation, this became the EA-1E.

The AD-5S was a one-off; it was an attempt to turn the Skyraider into an ASW platform. It had radar and searchlight on the wings and a MAD tail stinger, was a four seater, and generally carried torpedoes and sonobuoys on its wings. The Navy decided to use the S-2 Tracker instead. It will not be covered here.

The AD-5Q was an EW aircraft; like other AD-xQs, it carried chaff and ECM pods, and it also carried a four-man crew to operate the increase in ECM gear as well as chaff. Under its wings, there were two ECM pods and two chaff pods; there was some additional internal electronic gear in a spine fairing. After redesignation, this became the EA-1F.

Theoretically, the AD-5 was to an extent modular; literature suggests that it could be outfitted as an air ambulance with a capacity of four stretchers, a personnel transport able to carry eight passengers, a target tug, a photoreconnaissance aircraft, and a cargo aircraft with a capacity of 900 kg. I have not seen any hard evidence that the AD-5 was ever used in any of these roles, though the conversion kits were produced and distributed. At any rate, I have no hard information, or even something nebulous that I could fudge with, so they will not be included here. On a few occasions, the AD-5 has been used as a buddy refueler, with the inner wing hardpoints used as a kit for this purpose; only a few mentions of this use appear anywhere.

The AD-6, later redesignated the A-1H, was an even bigger upgrade, with its engine replaced by a Wright R-3350-26WD 2700-horsepower engine, which was easier to service. Hardpoints were modernized to be able to take any sort of ordinance in the US military. It also inherited the AD-4B’s alternate mission as a nuclear delivery platform. The avionics were simplified and improved. The airframe was reinforced, as were the landing gear. The AD-6 had a long ventral airbrake atop the fuselage. The AD-6/A-1H appeared to be optimized for air-to ground operations; the AD-6 had a rudimentary targeting computer. No other variants were built.

The AD-6/A-1H introduced a controversial feature – the rocket extraction device. This was not an ejection seat; attached to the pilot’s harness, it simply yanked him out of the plane. The pilot still had to pull his own rip cord. It is not sure what confidence the crews had in this system.

The AD-7/A-1J simply was an AD-6 with longer, stronger wings, and stronger landing gear. 72 were built, with the last one built in 1957.

The A-1E, A-1H, and A-1J later went on to glory as Sandies in the Vietnam War, with the last being retired from US service in

1972.

What Could Have Been: The Skyshark

In Jun 1945 the military asked Douglas to produce a prototype of a turboprop-powered Skyraider. It was to have more speed and better lifting capability, but be able to operate off *Essex* and *Casablanca*-class escort carriers, which were not big enough to operate jets. They would also provide an alternative for general ground support to thirsty jets. The result was the A2D Skyshark. While the Skyraider was clearly the base of the aircraft, the Skyshark was also a clearly different airplane.

The Skyshark was built around the new Allison XT-40-A2 5100-horsepower turboprop powering a two-layer contra-rotating propeller. The wing root thickness was decreased to increase streamlining, but the height and area of the tail grew.

The Skyshark program, however, was fraught with problems from the beginning. The Allison engine was not available until 1950; in the meantime an underpowered GE TE-100 was used for flight tests. In addition, the engine that Allison delivered at first were prototype engines; a production did not appear until 1953. During one of the first test flights, the gearbox, which had troublesome, could not handle the power of the engine, seized it up, and caused the nose to shed all of its propeller blades. Which is too bad, because when it was working, the Allison engine was capable of delivering near-sonic speeds.

By 1954, the A-4 Skyhawk was ready to fly; Douglas now had a much better design to sell to the Navy. Meanwhile, the escort carriers were being mothballed. Allison had still not delivered a reliable powerplant. Time was up for the troubled Skyshark. Of the 12 built, four were destroyed in testing, seven were scrapped, and one is now on display at the airport in Idaho Falls, Idaho.

I am including the Skyshark in this entry as a “what-if.”

Twilight 2000 Notes: By the Twilight War, very few of these aircraft were flying, but the few remaining -- perhaps 25 in all -- were recalled late in the war as ground support aircraft and Sandies.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
AD-1	$2,900,490	AvG	1.55 tons	4.76 tons	1	8	None	Enclosed
AD-1Q	$15,251,131	AvG	1.4 tons	4.81 tons	2	11	None	Enclosed
AD-2	$2,923,620	AvG	1.71 tons	4.76 tons	1	9	None	Enclosed
AD-2Q	$17,221,924	AvG	1.4 tons	4.81 tons	2	11	None	Enclosed
AD-3	$2,923,620	AvG	1.71 tons	4.86 tons	1	9	None	Enclosed
AD-3N	$19,715,380	AvG	1.46 tons	5.86 tons	2	13	Radar (50 km), WL Searchlight	Enclosed
AD-3W	$29,840,588	AvG	1.56 tons	5.48 tons	2	15	Radar (75 km), WL Searchlight	Enclosed
AD-4	$5,354,340	AvG	1.68 tons	4.9 tons	1	9	None	Enclosed
AD-4B	$5,527,530	AvG	1.68 tons	4.93 tons	1	11	None	Shielded
AD-4N	$15,531,153	AvG	1.43 tons	5.9 tons	2	13	Radar (60 km), WL Searchlight	Enclosed
AD-4Q	$17,464,996	AvG	1.37 tons	5.05 tons	2	11	None	Enclosed
AD-4W	$30,083,660	AvG	1.53 tons	5.52 tons	2	13	Radar (70 km), WL Searchlight	Enclosed
AD-4N (Stripped)	$3,338,860	AvG	1.79 tons	4.79 tons	1(2)	8	None	Enclosed
AD-5	$8,749,780	AvG	2.13 tons	5.58 tons	1(2)	8	None	Enclosed
AD-5N	$15,870,697	AvG	1.88 tons	6.68 tons	2	13	Radar(70 km), WL Searchlight	Enclosed
AD-5W	$57,477,478	AvG	1.98 tons	7.3 tons	2	13	Rada (100 km), WL Searchlight	Enclosed
AD-5Q	$19,101,939	AvG	2.04 tons	6.95 tons	4	13	Radar (100 km)	Enclosed
AD-6	$16,996,223	AvG	2.15 tons	6.62 tons	2	11	None	Enclosed
AD-7	$19,252,761	AvG	2.2 tons	6.84 tons	2	11	None	Enclosed
A2D-1 Skyshark	$17,992,767	AvG	2.64 tons	5.86 tons	1	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
AD-1/AD-1Q	999	200 (45)	6/4 30/20	1400	924	7925	FF7 CF7 RF7 W5 T5*
AD-2/AD-2Q	1098	220 (40)	5/3 32/15	1440	1112	7925	FF7 CF7 RF7 W5 T5*
AD-3/AD-3Q	1109	222 (40)	5/3 33/15	1440	1112	7925	FF7 CF7 RF7 W5

							T5*
AD-3N	1009	202 (45)	5/3 30/15	1440	1222	7925	FF7 CF7 RF7 W5 T5*
AD-3W	1042	209 (45)	6/4 31/20	1356	1178	7925	FF7 CF7 RF7 W5 T5*
AD-4/AD-4B/AD-4Q	1040	208 (40)	5/3 31/15	1440	991	7925	FF7 CF7 RF7 W5 T5*
AD-4N	946	189 (45)	6/4 28/20	1440	1079	7925	FF7 CF7 RF7 W5 T5*
AD-4W	978	196 (45)	6/4 29/20	1356	1054	7925	FF6 CF6 RF5 W5 T5*
AD-4N (Stripped)	1061	212 (40)	5/3 32/15	1440	971	7925	FF7 CF7 RF7 W5 T5*
AD-5	917	196 (40)	5/3 27/15	1670	1060	7925	FF7 CF7 RF7 W5 T5*
AD-5N	834	178 (45)	5/3 25/15	1670	1166	7925	FF7 CF7 RF7 W5 T5*
AD-5W	862	167 (45)	6/4 26/20	1573	1166	7925	FF7 CF7 RF7 W5 T5*
AD-5Q	816	174 (45)	6/4 25/20	1670	1187	7925	FF7 CF7 RF7 W5 T5*
AD-6	834	158 (40)	5/3 25/15	1670	1155	7925	FF7 CF7 RF7 W5 T5*
AD-7	809	153 (35)	5/3 24/15	1670	1190	7925	FF7 CF7 RF7 W5 T5*
A2D-1 Skyshark	1639	328 (35)	5/3 49/15	1837	1887	14664	FF7 CF7 RF7 W5 T5*

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
AD-1/2/3	Secure Radios, IFF, TACAN	615/745m Primitive Runway	+1	2x20mm M3 Autocannons, 15 Hardpoints	400x20mm
AD-1Q	Secure Radios, IFF, TACAN, ECM 1, Chaff (20)	615/745m Primitive Runway	+1	2x20mm M3 Autocannons, 13 Hardpoints	400x20mm
AD-2Q/3Q	Secure Radios, IFF, TACAN, ECM 2, Chaff (20)	615/745m Primitive Runway	+1	2x20mm M3 Autocannons, 13 Hardpoints	400x20mm
AD-3N	Secure Radios, IFF, TACAN	615/745m Primitive Runway	+1	2x20mm M3 Autocannons, 13 Hardpoints	400x20mm
AD-3W	Secure Radios, IFF, TACAN, ECM 1, Chaff (20)	615/745m Primitive Runway	+1	2x20mm M3 Autocannons, 2 Hardpoints	400x20mm
AD-4/AD-4B	Secure Radios, IFF, TACAN, RWR, Armored Windshield	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 15 Hardpoints	800x20mm

AD-4N	Secure Radios, IFF, TACAN, ECM (-3), Chaff (20)	615/745m Primitive Runway	+1	2x20mm M3 Autocannons, 13 Hardpoints	400x20mm
AD-4Q	Secure Radios, IFF, TACAN, ECM 2, Chaff (20)	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 13 Hardpoints	800x20mm
AD-4N (Stripped)	Secure Radios, IFF, TACAN, RWR,	615/745m Primitive Runway	+1	2x20mm M3 Autocannons, 15 Hardpoints	400x20mm
AD-5	Secure Radios, IFF, TACAN, RWR,	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 15 Hardpoints	800x20mm
AD-5N	Secure Radios, IFF, TACAN, RWR, ECM 2, ECCM 1, Chaff (20)	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 13 Hardpoints	800x20mm
AD-5W	Secure Radios, IFF, TACAN,, ECM 1, ECCM 1, Chaff (20), Radio Detection, Track While Scan	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 2 Hardpoints	800x20mm
AD-5Q	Secure Radios, IFF, TACAN, RWR, ECM 2, ECCM 1, Chaff (40), Radio Detection, Radio Jamming 2	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 11 Hardpoints	800x20mm
AD-6	Secure Radios, IFF, TACAN, RWR, ECM 1, ECCM 1, Chaff (10)	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 15 Hardpoints	800x20mm
AD-7	Secure Radios, IFF, TACAN, RWR,, ECM 1, ECCM 1, Chaff (10)	615/745m Primitive Runway	+1	4x20mm M3 Autocannons, 17 Hardpoints	800x20mm
A2D-1 Skyshark	Secure Radios, IFF, TACAN, RWR, ECM 1, ECCM 1, Chaff (10)	615/745m Primitive Runway	+2	4x20mm HS-404 Autocannons, 11 Hardpoints	800x20mm

*The cockpit area of the Skyraider has additional armor and has an AV of 8.

A-4 Skyhawk

Notes: Most versions of the A-4 have a hump behind the cockpit that houses avionics and ECM gear. Although it is small, it can carry a large weapon load for its size, including nuclear weapons. These aircraft were much used in the Twilight War, particularly in the Middle East and by the US, who recalled them from boneyards to replace aircraft losses and to use as close support aircraft.

The A-4A was the first production model, with a low-thrust engine and two hardpoints. The A-4B is the same aircraft with a slightly higher-powered engine. The A-4Q is a refurbished A-4B sold to the Argentine Navy. The A-4C has the addition of terrain-following radar and an autopilot as well as improvements to avionics. The A-4P is a refurbished A-4C supplied to the Argentine Air Force.

The A-4E introduced two new hardpoints to the wings. The A-4F introduced the avionics hump to the rear of the cockpit, housing ECM and equipment for the guidance of command-guided munitions. An A-4G is an A-4F built for the Australian Navy; it does not have the hump. The A-4K is the same aircraft after some years have gone by; it was refurbished, and then passed on the New Zealanders. The A-4H was built for the Israelis; it replaces the cannons with heavier ones. The A-4M was built for the US Marines and was known as the Skyhawk II; it has a more powerful engine, double the cannon ammunition load, and a laser designator. The A-4N was built for the Israelis; it has 30mm cannons, and more advanced avionics. The A-4Y is an A-4M with a refit to bring it up to the same level as the A-4N.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
A-4A	$13,186,570	JP5	3.59 tons	10.23 tons	1	18	Radar (40 km)	Shielded
A-4B/Q/S	$14,195,740	JP5	3.59 tons	10.23 tons	1	18	Radar (40 km)	Shielded
A-4C/P	$14,653,670	JP5	3.59 tons	10.23 tons	1	18	Radar (40 km)	Shielded
A-4E	$16,133,320	JP5	4.5 tons	11.14 tons	1	18	Radar (40 km)	Shielded
A-4F/K	$32,117,150	JP5	4.5 tons	11.14 tons	1	20	Radar (40 km)	Shielded
A-4G	$30,380,530	JP5	4.5 tons	11.14 tons	1	18	Radar (40 km)	Shielded
A-4H	$32,587,970	JP5	4.5 tons	11.14 tons	1	22	Radar (40 km)	Shielded
A-4M	$40,441,710	JP5	4.76 tons	11.14 tons	1	26	Radar (40 km)	Shielded
A-4N/Y	$40,219,410	JP5	4.76 tons	11.14 tons	1	26	Radar (40 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
A-4A	2115	529 (110)	NA 132 7/4 70/40	3120	1610	17100	HF3 HS3 HR3 W3 T2
A-4B/Q/S/C/P	2125	531 (110)	NA 133 7/4 70/40	3120	1647	17100	HF3 HS3 HR3 W3 T2
A-4E/F/K/G/H	2154	538 (110)	NA 135 7/4 70/40	3120	1908	17100	HF3 HS3 HR3 W3 T2
A-4H	2832	596 (110)	NA 149 7/4 70/40	3120	1932	17100	HF3 HS3 HR3 W3 T2
A-4M/N/Y	3097	774 (110)	NA 194 7/4 70/40	3120	2635	17100	HF3 HS3 HR3 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
A-4A/B/Q/S	None	1000/600m Hardened Runway	+1	2x20mm Mk 12 Autocannons, 2 Hardpoints	200x20mm
A-4C/P	RWR, Flare/Chaff (30/20), TFR	1000/600m Hardened Runway	+1	2x20mm Mk 12 Autocannons, 2 Hardpoints	200x20mm
A-4E/G	RWR, Flare/Chaff (30/20), TFR, ECM	1000/600m Hardened Runway	+1	2x20mm Mk 12 Autocannons, 4 Hardpoints	200x20mm
A-4F/K	RWR, Flare/Chaff (35/25), TFR, ECM, DJM	1000/600m Hardened Runway	+2	2x20mm Mk 12 Autocannons, 4 Hardpoints	200x20mm
A-4H	RWR, Flare/Chaff (35/25), TFR, ECM 2, DJM, IR Masking	1000/600m Hardened Runway	+2	2x30mm DEFA Autocannons, 4 Hardpoints	200x30mm
A-4M	RWR, Flare/Chaff (40/30), TFR, ECM 2, DJM, Laser Designator (6 km)	1000/600m Hardened Runway	+3	4x20mm Mk 12 Autocannons, 5 Hardpoints	400x20mm
A-4N/Y	RWR, Flare/Chaff (35/25), TFR, ECM 2, DJM, Laser Designator (6 km)	1000/600m Hardened Runway	+3	2x30mm DEFA Autocannons, 5 Hardpoints	100x30mm

A-6 Intruder

Notes: This is an older US Navy attack aircraft, partially replaced in US Navy service by the F/A-18. The Intruder can be refueled in flight and can carry drop tanks. Earlier versions of this aircraft were workhorses in Vietnam and the Gulf War. A tanker version, the KA-6D, remains in service, and carries 9500 liters of fuel in 5 drop tanks for buddy refueling of carrier aircraft.

The A-6A is the basic aircraft; it to include a digital integrated attack suite (the DIANE system). The A-6B is generally similar, but has an updated RWR and is able to use antiradiation missiles. The A-6C is also similar to the A-6B, but carries a FLIR and low-light TV system under the nose. The A-6E has a comprehensive avionics and ECM suite. The A-6E/TRAM has the TRAM system; this includes a steerable ball turret under the nose housing the FLIR, LLTV, and a laser designator. This aircraft is one of the few in the inventory able to deliver Tomahawk cruise missiles, or anything else in the US Naval inventory.

The A-6F includes better avionics, smokeless engines, higher load-carrying capability, and a new bomb delivery system with better accuracy. In addition, the A-6F adds air-to-air capability. The Navy chose to concentrate on the Super Hornet instead of building the A-6F.

Two electronic warfare versions of the A-6 were produced: the EA-6A, made in extremely limited numbers primarily as an operational experiment, and the EA-6B, the US Navy's primary electronic warfare aircraft. (This version will be detailed in another entry.) Work on the EA-6A started in 1962; it is basically a heavily-modified A-6A, distinguished by the canoe fairing on the tail. The fairing carried electronic warfare equipment such as radar and radio detectors and radar and radio jammers. In addition, the EA-6A could carry up to five electronic and/or infrared jamming pods (four under the wings, and under the fuselage). Flare and chaff dispensing pods could be carried in place of the underwing jammers if the mission called for them. The EA-6A retained a limited ground attack capability (though it was seldom used for it); it's most common weapon was the Shrike ARM. The radar of the EA-6A is not as powerful as that of the A-6A. Only 27 EA-6As were built, and the survivors of the Vietnam War were retired in 1985, after having been relegated to a training role after the war. Some were also converted into regular A-6As after the Vietnam War.

The KA-6D is a tanker version of the A-6, made by converting existing A-6s (mostly A-6As, though 12 of the 90 made were modified from A-6Es). The KA-6D is basically an A-6A which has been stripped down, with the radar and most of the DIANE system removed. (It retains a visual bombing system, but this was seldom used in Vietnam, and has not been used since.)The KA-6D is fitted with an inertial navigation system, a powerful navigation computer, and long-range radios, to allow it to find the aircraft which depend upon it. (The KA-6D also has a secondary role as an air/sea rescue control aircraft.) Internal fuel tanks are re-arranged, and the wings are strengthened to allow it to carry its huge external fuel tanks. The belly of the fuselage has a hose, reel, and basket-type refueling drogue. A special pod could also be carried on the fuselage hard point, allowing it to refuel Air Force aircraft and other aircraft which cannot be refueled by probe-and-drogue method; this pod would be carried in place of one of the KA-6D's external fuel tanks. Another pod may be carried on the centerline; this one acts as a backup to the primary hose and drogue, or may allow the KA-6D to ferry fuel to other carriers or land bases. The KA-6D may carry up to five external fuel tanks, all of which may be used refuel other aircraft if necessary; each one of these fuel tanks carry 1900 liters. The bombardier/navigator has greatly-reduced duties in the KA-6D; his primary is job is as a navigator and to conduct the refueling operations. There is a tiny chance that the hose can get stuck in the unreeled position; if this happens, the aircraft cannot land on a carrier or on land due to the inability to extend the tailhook and the high probability of a catastrophic fire as the unreeled hose drags the ground. Because of this, a device was installed which severs the hose from the aircraft at the fuselage. Though the KA-6D is also called the Intruder, it is more common for US Navy and Marine pilots to refer to the KA-6D by the name of "Texaco."

Twilight 2000 Notes: Many A-6s returned to service to replace aircraft losses during the Twilight War. The A-6F Intruder II aircraft was at first not going to be produced, but with the Twilight War emergency, it was produced in limited quantities (perhaps 50, plus about 25 conversions from A-6E aircraft) during 1998-99. Four EA-6As served in the Twilight War, replacing EA-6B losses after being pulled from boneyards and refurbished; these aircraft had more modern equipment than the original EA-6As.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
A-6A/B	$68,581,910	JP5	8.17 tons	26.58 tons	2	38	Radar (225 km)	Shielded
A-6C	$80,479,490	JP5	8.17 tons	26.78 tons	2	38	Radar (225 km), FLIR (30 km), Image Intensification (20 km)	Shielded
A-6E	$97,047,950	JP5	8.17 tons	27.4 tons	2	40	Radar (300 km), FLIR (40 km), Image Intensification (25 km)	Shielded
A-6E/TRAM	$111,880,910	JP5	8.17 tons	27.4 tons	2	38	Radar (300 km), FLIR (60 km), Image Intensification (40 km)	Shielded
A-6F	$121,465,060	JP5	8.55 tons	27.5 tons	2	40	Radar (300 km), FLIR (70 km), Image Intensification (50 km)	Shielded
EA-6A	$167,424,500	JP5	6.8 tons	24.77 tons	2	40	Radar (245 km)	Shielded
KA-6D	$69,669,500	JP5	9.5 tons	26.6 tons	2	35	Weather Radar (200 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
A-6A/B/C/E	2072	1518 (185)	NA 130 8/4 40/30	7300	4898	12925	FF 5 CF4 RF3 W4 T3
A-6F	2447	1611 (135)	NA 153 8/4 50/30	9600	7417	13500	FF 5 CF5 RF3 W4 T3
EA-6A	2072	1518 (185)	NA 130 8/4 40/30	7300	4898	12925	FF 5 CF4 RF3 W4 T3
KA-6D	2092	1550 (185)	NA 130 8/4 40/30	7300	4898	12925	FF 5 CF4 RF3 W4 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
A-6A/B	Flare/Chaff (45/35) , ECM 1, RWR, All Weather Flight	1400/785 Hardened Runway	+2	5 Hardpoints	None
A-6C	Flare/Chaff (45/35) , ECM 2, RWR, All Weather Flight, Inertial Navigation	1400/785 Hardened Runway	+3	5 Hardpoints	None
A-6E	EW Suite, Secure Radios, Flare/Chaff (60/50) , ECM 3, Radar Warning, Deception Jamming, All-Weather Flight, Inertial Navigation	1400/785 Hardened Runway	+3	5 Hardpoints	None
A-6E/TRAM	EW Suite, Secure Radios, Flare/Chaff (60/50) , ECM 3, Radar Warning, Deception Jamming, All-Weather Flight, Laser Designator (10 km), Inertial Navigation	1400/785 Hardened Runway	+4	5 Hardpoints	None
A-6F	EW Suite, Secure Radios, Flare/Chaff (70/60) , ECM, RWR, ECM 4, All-weather Flight, HUD, IR Uncage, Track While Scan, Terrain Following Radar, Laser Designator (12 km), Inertial Navigation	1400/785m Hardened Runway	+5	7 Hardpoints	None
EA-6A	Flare/Chaff (45/35) , ECM 3, RWR, All Weather Flight, Deception Jamming	1400/785 Hardened Runway	+1	5 Hardpoints	None
KA-6D	Flare/Chaff (45/35) , RWR, Secure Radios, Inertial Navigation	1400/785 Hardened Runway	+1	5 Hardpoints	None

A-7 Corsair II

Notes: The story of the A-7 Corsair II began in the early 1960s, when the US Navy realized that, while the A-4 Skyhawk was still hale, it was a small aircraft with limited capacity for external stores or updating, relatively fragile compared to more recent designs, and had limited fuel capacity. The Navy put out a call for a better aircraft, and Vought was able in short order to (extensively) modify their F-8 Crusader fighter into a subsonic ground attack platform able to address most of the design shortcomings perceived by the Navy. Deliveries began in 1967, with initial deliveries to the US Navy continuing until 1971. The US Air Force, in an unusual move (the US Navy and Air Force, out of service rivalries if nothing else, generally refuse to operate the same aircraft), decided to have a version made to their requirements. Then, seeing the Corsair II's successes in Vietnam, was taken up by several NATO and some other countries. The A-7 featured some innovative new technologies, such as the HUD and inertial navigation. The Turkish and Greeks still operate the A-7. Claims to fame included some of the first use of smart bombs (against the Than Hoa bridge in this case) and as one of the favorite steeds of

The First Corsair IIs

The airframe of the A-7A was essentially a shortened and stubby version of the F-8 Crusader's; it quickly acquired the nickname of SLUF (Short Little Ugly Fucker, or "Fellow" in its family-friendly guise). Most of the time, the "II" was omitted from the aircraft's name, leaving the aircraft of simply "Corsair." The Corsair went from first flight to squadron service in little over a year, with full operational service in February in 1967. The Corsair was one of the first aircraft able to do all-weather attack, due to its radar bombing system, which was linked to a weather radar and it's INS. This also linked with a second weapons computer, which allowed it to use some smart bombs and missiles from sometimes long distances (the limiting factor was primarily of the munitions and not of the A-7's bombing system). Another innovative feature was the landing system and autopilot; the A-7 could navigate to and from the pilot and land on the carrier with hands off by the pilot. (In actual service, this rarely done, as the skies over North Vietnam could give the pilot too many unpleasant surprises, as could carrier landings.) The early HUD showed information on the attitude and altitude of the Corsair, told the pilot if his aircraft was drifting off course, and gave the pilot an aiming circle appropriate to the munitions he was using, including for his gun and the pair of Sidewinders he carried (on either side of the aircraft behind and below the cockpit, for air-to-air combat). The INS could show had two scopes, one for attack and one for navigation. The pilot, when using the autopilot, the pilot could set up to nine waypoints for the autopilot to follow, in addition to start and endpoints. Finally, the A-7 was equipped with the latest version of TACAN navigation, normally used as a backup to the INS. The radio could use secured communications between aircraft which were possessed of the same sort of equipment.

However, the A-7A had its problems and teeth-cutting. The Corsair had poor crosswind stability and its brakes were slow to stop the aircraft upon landing on a carrier (before pilots got used to this, landings could miss the number two wire more often than normal, and landings left the aircraft near the edge of the landing deck. Some ended up hanging over the edge of the landing deck by the arrestor cable. The autopilot/INS combination was effective, but took a lot of babysitting by the pilot. The engine was a Pratt & Whitney TF30-P-6, an early version of the engine of the F-111 and early F-14s, omitting the afterburner and providing 11,350 pounds thrust, and this early engine version could be a little slow on the uptake. The A-7A struggled for altitude after launch due to the warm, humid conditions in Southeast Asia; fully-loaded A-7As could spend 20 minutes working up to their cruising speed of 580 miles per hour (933 KMH). (Pilots did what was termed a low-altitude transition phase, which held the A-7A just above the waves to get a wing in ground effect from the water to help it speed up before it climbed to cruising altitude.) The A-7A wings did not have precise control over the takeoff and landing flaps; they were always either fully-extended or completely retracted. The result of the hot, humid conditions led the pilots to hold back on power when being launched in order to be able to throttle up when trying to accelerate. The turbofan engine coupled with the INS and radar led to low fuel consumption compared to other attack aircraft. Wing hardpoints were plentiful, with eight under its wings and one on each side of the fuselage (Sidewinders or later, Sidearm ARMs only). The two inner wing hardpoints are wet.

The A-7B features dogtooth wings, something which increased maneuverability and lifting capacity by increasing wing area. The A-7B also had a full set of leading-edge slats, which further increased maneuverability, especially in combat maneuvering. The wings had less of a sweep than the A-7A, giving the A-7B lesser wing loading, increasing lift and increasing the accuracy of landings and takeoffs. Flap positions were changed so that the inner wing has flaps, while the outer edge had ailerons, even further increasing handling. A spoiler was added to the top of the wing, further enhancing carrier landings, and the ability to slow down dramatically in combat maneuverability and being able to hit more targets during bombing or get the "one that got away." The A-7B had a probe and drogue assembly, making aerial refueling possible. Doppler radar was added, allowing the A-7 target to be moving and still hit its target (as long as if the target was not moving fast). This system was not designed to be useful in air-to-air combat. The A-7B was equipped with a later version of the A-7A's engine developing 12,200 pounds thrust.

The A-7 was capable of using virtually all of the Navy's air-to-ground munitions. The A-7A was not equipped with the Vulcan rotary cannon of later A-7s; instead, the A-7A (and A-7B) were equipped with Mk 12 20mm autocannons, one on each side of the intake.

The A-7C was produced for the US Air Force as a stopgap between the Navy A-7s they had borrowed and the purpose-built A-7Ds that were on order. The A-7Cs were flown by only two squadrons and made only one combat deployment. The A-7C received the ready components of the A-7E, which was not yet in production or service. The A-7C received many of the avionics and weapon upgrades bound for the A-7E, including the replacement of the two Mk 12 cannon by a single M-61 Vulcan firing from the outside of the front end of the air intake. It also the improved HUD of the A-7E, and both the bombing computer and air-to-air computers were improved. The A-7C used the TF-30-P8 of the A-7B, due to delays in the engine designed for the A-7E. The carrier that hosted these A-7Cs, the USS *America*, later did two peacetime deployments before swapping it's A-7Cs for A-7Es.

Used by both the Navy and Air Force, the two-seat TA-7C was a trainer for the A-7. The TA-7C was about 86 centimeters longer than the standard A-7C to accommodate the IP, and there was a reduction in internal fuel carried. Despite having an instruction role, the TA-7C retained full combat capability (though neither the Air Force or Navy used it in combat). Eight TA-7Cs were outfitted as Aggressor aircraft for training; these were designated EA-7L. The EA-7Ls were used to simulate Wild Weasels and electronic warfare aircraft, though they could carry several jamming pods that other A-7s could not, and otherwise retained full combat capability. 49 TA-7Cs and EA-7Ls were upgraded to the Allison engine; these retained the designations of TA-7C and EA-7L.

The Navy replaced it's A-7s in the early 1980s, largely with the F/A-18.

Later US Corsairs

What's interesting is that the Air Force originally had no intention of buying the Corsair or any other dedicated ground attack platform. The Army, however, was (and still is) prohibited by law and regulation from owning and operating armed fixed-wing assets (and don't get me started on that one). The Army need close air support, and none of the aircraft in the Air Force's inventory really fit that bill, being supersonic attack or fighter aircraft. (The nickname of "fast movers" came about for a reason, and it was not a mark of respect for the Air Force aircraft's abilities at the time. And don't get me started on that one either.) The Air Force therefore went looking for something they could deploy quickly and easily and would get the Army off its back. This brought the first true Air Force version, the A-7D. However, the A-7D was not simply a repurposed Navy A-7; the Air Force added another improvements, and the A-7 became a true close air support platform.

The Air Force felt that the Navy A-7s were underpowered, and insisted upon an engine with more power that allowed the A-7 to take more munitions and give a little more speed. They selected the Allison TF41-A-1 turbofan, a license-built Rolls-Royce Spey engine. This boosted the A-7D's power to 14,500 pounds thrust. The A-7D could then produce near-sonic speeds in level flight and easily break the sound barrier in a dive, yet fly relatively slow for close support missions if necessary due to enlarged flaps. The A-7D had a new, more informative HUD with better visibility, yet did not interfere so much with the pilot's view of his surroundings. New avionics included a new ECM and ECCM package, increased-capacity chaff and flare launchers, and a further improved bombing avionics package. The A-7D had the M-61 Vulcan cannot as standard, instead of the somewhat ad hoc installation on the A-7C. The troublesome brakes of the Navy A-7s were fixed by upgrading the landing gear hydraulic system. The A-7D added "dogfight slats" to the leading edge of the wings, improving low-speed and mid-speed maneuverability. The A-7D was ready for squadron service by 1970, but did not arrive in Southeast Asia until 1972. Even though the A-7D also flew bombing missions against North Vietnam, Cambodia, and Laos, it quickly showed its mettle; in 12,928 sorties, only four A-7Ds were lost to ground fire or SAMs. The A-7D was largely replaced in the active Air Force by the mid-1980s and the early 90s in the Air National Guard, mostly by A-10s and F-16s.

The improved A-7D impressed the Navy, sufficient enough that it ordered its own navalized version of the A-7D. This was the A-7E. However, there were delays in the deliveries of the Allison engine to the Navy, so the A-7E saw duty at first with TF-30-P-6 engine for several months. 67 such lower-power A-7Es saw service, before they were upgraded to the Allison engine. The A-7E almost totally replaced the A-4 Skyhawk by 1970, as well as the earlier A-7As and A-7Bs (which were moved to reserve units that were not participating in the Vietnam War). Perhaps the A-7E's greatest claim to fame was its participation in the mining of Haiphong Harbor. By the late 1980s, the A-7E had been largely replaced by the F/A-18 in active Navy service, the A-7Es being retired to AMARC. Though the A-7E was largely a Navy/Marine version of the A-7A/A-7B, it featured several upgrades and the addition of new avionics. The A-7E could integrate its fighting and navigation equipment with the AN/AAR-45 FLIR pod, and later other FLIR pods as they became available. The ECM suite was improved and more effective than that of the A-7D.

In the early 1980s, the TA-7D version of the A-7E, later redesignated the A-7K, came into service. The A-7K's fuselage was extended both front and rear, so it did not have to lose any avionics and so the fuel reduction was not as severe. As with the TA-7C, the A-7K retained full combat capability. The A-7K could be easily distinguished by its humpbacked appearance around the canopy and the training edge of the canopy; this occurred because the rear cockpit was raised to give the IP or WSO a better view.

Foreign-Use Corsairs

The Greek A-7H was for the most part the same as the A-7D, with the exception of using some Greek-made avionics built under license. The A-7Hs replaced the Greek F-104s, which were put into storage at AMARC for the Greeks. The Greeks are still flying the A-7H, with avionics replacements and maintenance work, though in some cases there were actual improvements in the avionics. It is rumored that the Greeks had Israeli help for those improvements, but neither country has confirmed this. (The Israelis have done a lot of weapon and vehicle upgrades for several customers; however, on the other hand the Israelis are closer allies to Turkey than Greece.) 49 of Greece's TA-7Cs were upgraded to the Allison engine. At the same time, the Greeks bought a number of TA-7Cs; there are rumors that some were used in border incidents against the Turkish. A-7Hs have a secondary role of air defense and are modified to carry four Sidewinders.

In the early 1980s, some A-7A airframes were taken out of AMARC and largely brought up for the most part to A-7E standards. However, they used TF30-P-408 turbofans (equivalent in game terms to the TF30-P-8), and retained the dual 20mm autocannons of the A-7A. The customer for these A-7s was Portugal, and they were designated A-7P. For unknown reasons, the A-7Ps have heavily suffered from breakdowns and attrition, and Vought ended up providing 20 non-flyable A-7As for spares.

In 1995, 18 A-7Es and TA-7Cs were provided to the Thai Air Force, where they became the first Thai combat jets. Two non-flyable A-7Es were also provided as sources of spare parts.

The Strikefighter: the A-7F

The A-7F (more properly called the YA-7F, as it had very limited production for testing) had its genesis in an Air Force request for prototypes of a Close Air Support/ Battlefield Air Interdictor (CAS/BAI) in 1985. The Air Force thought that it's A-10s might be too vulnerable in the skies of Europe, and that a strike aircraft that could also fulfill the role of a fighter might be a good escort for the A-10s. The official name of the program was Corsair Plus, but its intended role led to the YA-7F being called the Strikefighter. The fuselage has sections added in front of and behind the wings, extending the length by 122 centimeters. The tail fin and rudder were enlarged to provide greater stability and more responsive turning. The wings were enlarged by adding leading edge root extensions. The fuselage was canted upwards, allowing the seat to be mounted a bit reclined (like that of the F-16). The flaps were larger, allowing better stability at low speed and when landing. The cockpit had was a partial glass cockpit, with a HOTAS-type stick and throttle, and the HUD was switchable between air-to-ground and air-to-air modes, and provided more information. This was combined to a precision bombing computer and air-to-air computer, and A-7F more and more conceptually similar to the F/A-18. The A-7F had integral night attack capability. The A-7F had a single Pratt & Whitney F100-PW-220 afterburning turbofan, capable of not only greater lifting power, but supersonic flight.

The YA-7F was not ordered into production; with the Air Force having lots of F-16s and the Navy having growing amounts of F/A-18s, it was considered redundant. In the end, though it was considered a pre-production aircraft, only two were built.

Twilight 2000 Notes: The A-7F was produced mainly for the US Air National Guard units in some states, and few of them were built at that (perhaps 150 of them). Some of them ranged as far as Nome, Alaska, and even one strike over the Bering Straits into Eastern Siberia.

Vehicle	Price	Fuel	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological

		Type						
A-7A	$27,385,439	AvG	6.8 tons	14.49 tons	1	27	Radar (Weather Only) 90 km	Enclosed
A-7B	$30,050,735	AvG	6.8 tons	13.52 tons	1	27	Radar (Weather/Bombing Only; 90 km)	Enclosed
A-7C	$29,957,340	AvG	6.8 tons	17.24 tons	1	30	Radar (100 km)	Enclosed
A-7D	$30,981,759	AvG	6.8 tons	17.24 tons	1	30	Radar (100 km)	Enclosed
A-7E	$31,479,759	AvG	6.8 tons	17.24 tons	1	31	Radar (100 km), FLIR (30 km), Image Intensification (20 km)	Enclosed
TA-7C/EA-7L	$33,197,156	AvG	6.8 tons	18.41 tons	2	32	Radar (100 km)	Enclosed
TA-7C/EA-7L (Allison Engine)	$34,193,071	AvG	6.8 tons	18.41 tons	2	32	Radar (100 km)	Enclosed
A-7K	$38,875,606	AvG	6.8 tons	18.44 tons	2	34	Radar (100 km), FLIR (30 km), Image Intensification (20 km)	Enclosed
A-7H (Upgraded)	$24,873,869	AvG	6.8 tons	16.67 tons	1	34	Radar (120 km)	Enclosed
TA-7H (Upgraded)	$31,211,005	AvG	6.8 tons	16.96 tons	2	34	Radar (120 km)	Enclosed
A-7P	$24,203,234	AvG	6.8 tons	16.49 tons	1	32	Radar (120 km), FLIR (35 km), Image Intensification (25 km)	Enclosed
A-7F	$40,060,838	AvG	8.16 tons	21.06 tons	1	34	Radar (150 km), FLIR (45 km), Image Intensification (40 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
A-7A	1376	688 (140)	NA 334 8/5 40/30	5600	1153	14996	FF5 CF5 RF5 W5 T5
A-7B	1400	650 (130)	NA 375 8/5 45/25	5600	1212	13381	FF5 CF5 RF5 W5 T5
A-7C	1350	675 (130)	NA 338 8/5 50/40	5600	1379	11826	FF5 CF5 RF5 W5 T5
A-7D/E	1376	689 (130)	NA 345 8/4 60/35	5600	1393	11826	FF6 CF6 RF6 W5 T5
TA-7C/EA-7L	1332	667 (130)	NA 334 8/5 50/40	5376	1541	11826	FF6 CF6 RF6 W5 T5
TA-7C/EA-7L (Allison Engine)	1359	671 (130)	NA 336 8/5 50/40	5376	1572	11826	FF6 CF6 RF6 W5 T5
A-7K	1359	671 (130)	NA 336 8/5 50/40	5488	1572	11826	FF6 CF6 RF6 W5 T5
A-7H (Upgraded)	1400	699 (130)	NA 350 8/4 60/35	5600	1393	11826	FF6 CF6 RF6 W5 T5
TA-7H (Upgraded)	1382	688 (130)	NA 335 8/5 50/40	5376	1407	11826	FF6 CF6 RF6 W5 T5
A-7P	1328	664 (140)	NA 332 8/5 40/20	5600	1196	14996	FF6 CF6 RF6 W5 T5
A-7F	2208	1020 (125)	NA 510 8/4 40/25	6600	1923	15200	FF7 CF6 RF6 W6

	T6

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
A-7A	Flare/Chaff (15 Each), Secure Radios, RWR, All Weather Flight, ECM 1	1200/800m Hardened Runway	+1	2x20mm Mk 12 Autocannons, 8 Hardpoints	1200x20mm
A-7B	Flare/Chaff (15 Each), Secure Radios, RWR, All Weather Flight, ECM 2	1200/800m Hardened Runway	+3	2x20mm Mk 12 Autocannons, 8 Hardpoints	1200x20mm
A-7C	Flare/Chaff (15 Each), Secure Radios, RWR, All Weather Flight, ECM 2	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 8 hardpoints	1032x20mm
A-7D	Flare/Chaff (20 Each), Secure Radios, RWR, All Weather Flight, ECM 2	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 8 hardpoints	1032x20mm
A-7E/A-7K	Flare/Chaff (20 Each), Secure Radios, RWR, All Weather Flight, Laser Designator (6 km), ECM 2, TFR	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 8 hardpoints	1032x20mm
TA-7C	Flare/Chaff (15 Each), Secure Radios, RWR, All Weather Flight, ECM 2	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 10 hardpoints	1032x20mm
A-7H/TA-7H (Upgraded)	Flare/Chaff (15 Each), Secure Radios, RWR, All Weather Flight, ECM 2, TFR	1200/800m Hardened Runway	+4	20mm Vulcan Gatling Gun, 8 hardpoints	1032x20mm
A-7P	Flare/Chaff (15 Each), Secure Radios, RWR, All Weather Flight, ECM 1	1200/800m Hardened Runway	+3	2x20mm Mk 12 Autocannons, 8 Hardpoints	1200x20mm
A-7F	Flare/Chaff (25 Each), HUD Interface, Secure Radios, RWR, All Weather Flight, Laser Designator (6 km), ECM 3, IRCM 2, ECCM 2, Track While Scan, TFR	1200/800m Hardened Runway	+4	20mm Vulcan Gatling Gun, 8 hardpoints	1032x20mm

Fairchild-Republic A-10 Thunderbolt II

The A-10 is heavily armored and carries a massive amount of ordinance to a long range. It is an ugly aircraft, and was quickly nicknamed the Warthog by its crews, and acquired a great reputation for tank-busting and general ground support during the Persian Gulf War of 1991 and the Twilight War. The A-10 may be refueled in air, and has an ejection seat. The A-10 is flown only by the US, though South Korea, Turkey and Iraq have expressed interest in it.

The Genesis: The A-X Program

As early as 1966, warfighters such as John P McConnell (then the CoS of the USAF) saw the effectiveness of the A-1 Skyraider in Vietnam, particularly in Close Air Support (CAS) missions, and realized that such aircraft, in that role, performed their duties with effectiveness that far outsized what were supposedly the capabilities of the aircraft. McConnell, however, felt that the Air Force could do better in the CAS mission, particularly with a new aircraft designed for the role. (It also helped that McConnell was not a “Member” of the Fighter or Bomber Mafias, and was, for part of his pre-Air Force Army career, a groundpounder.) He also gained some inspiration from the exploits of the Soviet Il-2 Sturmovik, US P-47 Thunderbolt (once it was taken out of the fighter role and put into the then-new CAS role), the British Hawker Typhoon, and the use of older and supposedly obsolete aircraft for CAS missions in the Korean War. He also looked at what he felt as the mistaken notion that a fast-mover could be effectely used for the CAS mission. He worked up some ideas on the subject with a small team, and in 1969 took those ideas to the Secretary of the Air Force. He asked the then-controversial Pierre Sprey, a civilian think-tank member, to put together a joint military/civilian team to start the A-X program, which eventually led to the A-10 Thunderbolt II (and it’s competitor, the YA-9A).

The A-X was to be unlike any other Air Force aircraft of its time period, with a low maximum speed, low stall speed, excellent maneuverability (primarily using large, straight wings with low wing loading), and the ability to lift heavy weapon loads, along with a general toughness and ability to take ground fire and keep operating, simplified operation, and easy maintenance and quick regeneration time. The initial contracts were issued to six companies, with Fairchild-Republic (who had produced the P-47 in World War II, and was producing the excellent strategic strike aircraft, the F-105, at the time), and Northrop having the final competitions and flyoffs. As about the same time, the GE/Philco-Ford GAU-8 Gatling Gun had been designed for just such a role, and was looking for a plane to be mounted in. Carrying the gun was added to the requirements for the A-X. In the end, only Fairchild-Republic's prototype (the YA-10) could carry and fire the GAU-8 without significant aerodynamic and recoil problems, and it was chosen as the A-10 in 1975, with first deliveries starting in 1976.

Though designed specifically for the skies of a World War III Europe, it proved itself in several other later conflicts, including the former Yugoslavian Republics, Panama, Desert Storm, and the invasions of Afghanistan and Iraq; in fact, it is still serving with distinction in Afghanistan, and the arrival of A-10s on station can bring a smile to an infantryman's face, The A-10 has survived dozens of attempts to kill it (something that started almost immediately upon adoption) and update it (both by the pilots in some cases and the command structure), and has proven its worth each time. Simply put, there is no aircraft in the Air Force inventory that can do the job that the A-10 does. Even most Air Force pilots don't want to fly the A-10 – it's not "sexy."

However, the A-10's days are numbered; some have literally been flown to death, and even the newer ones are reaching the end of repeatedly extended lifetimes. There is a new program to replace the A-10 with perhaps two or three other dedicated CAS aircraft, and in addition replace some of it's missions with modified F-16s or F/A-18s or even the F-35, all of which are woefully inadequate for the CAS role. The Harrier is perhaps a better fit, but it too is being replaced by the F-35 (and the F-35 is woefully inadequate for even the Harrier's mission).

Just a personal note: I don't think the Air Force should ever had the A-10. They didn't want it, and don't really want to fly CAS missions anyway (the pilots feel CAS is better suited to attack helicopters, and that "mud moving" itself is not sexy – it's an ego thing). The Department of Defense and the US Air Force need to get their heads out of their collective asses and let the Army fly the A-10, and produce new-build A-10s. (The prohibition of the US Army flying fixed-wing armed aircraft itself is an ego thing gone too far, despite the excuses the Air Force keeps spinning out.)

The Standard Version: The A-10A

After some minor upgrades needed after its testing phase as the YA-10, The A-10, dubbed the "Warthog" by both its crews and disdainful fighter jocks (because it is, well, an ugly aircraft, and as tough as its new namesake), entered service in 1976 as the A-10A. However, it has not simply remained static in its 40 years of service, instead receiving gradual upgrades which addressed everything to airframe strength and to increase service life length to avionics improvements and upgrades to widen the types of weapons it could deliver and increase the accuracy of its cannon and weapons delivery.

The A-10 is a cruciform, straight, wide-winged aircraft; it's shape led the Iraqi troops and insurgents to give the A-10A the name of "Cross of Death." It is designed for low-speed flying, in recognition of the fact that fast-movers typically cannot pick out small targets on a battlefield,. Most control surfaces are larger than normal to enhance control, and the wings and tail surfaces are wider than normal to further increase stability and in the case of the wings, allow for more and heavier weapon carriage while decreasing wing loading. The A-10A is designed to be operated and serviced from anything from rough airfields to straight sections of roads. In most cases, the A-10A can be completely refueled and rearmed in 30 minutes. Perhaps the best-known feature of the A-10A (other than its gun) is it's incredible capability to sustain damage and keep fighting, or at least bring its pilot home. The pilot is surrounded by a "bathtub" of titanium armor lined with Kevlar, and most of the flight control system is also protected by a combination of titanium and Kevlar sheets. Depending upon the angle of impact, these protected surfaces can take impacts from 23mm to 57mm rounds. Much of the aircraft can also take impacts from 20mm rounds, and even some SHORAD and AAM strikes. Even the canopy is resistant to strikes of up to 12.7mm rounds. The cockpit armor itself weighs an astounding 540 kilograms. The hydraulic systems are double-redundant, and if those are lost, there is a mechanical backup to the hydraulic system. (Controls with mechanical input will be noticeably heavier, but will still control the plane.) The entire fuel system is self-sealing, and is protected by a titanium/Kevlar shell. The engines are shielded from the rest of the aircraft by firewalls and have automatic fire detection, suppression, and explosion resistance systems. The ammunition drum for the gun is surrounded by varying degrees of armor and is designed to predetonate most explosive rounds without penetrating the ammunition drum. The A-10A can, in fact, keep flying with the loss of an engine, half the tail, one elevator, and half a wing missing. Supposedly, deadstick (ie, no power) landings in an A-10A are impossible to do safely; however, this was disproven repeatedly in Operation Iraqi Freedom. (It does remain difficult, however.)

The core weapon, the GAU-8/A seven-barreled Gatling Gun, generally fires APDU ammunition; current initiatives are experimenting with APDS-T ammunition based on a tungsten penetrator to reduce the use of toxic and pyrophoric DU ammunition on the battlefield. Other possible rounds include APHE rounds, similar to HEAT ammunition but with an armor piercing hardened ballistic cap nose backed with a HEAT-type filler, and AP ammunition, essentially solid hardened steel shot. The gun can be fired using two motors, at 4200 RPM, or using one motor, at 2100 RPM. Normal ammunition load carried on missions is 1174 rounds, though an overload of up to 1350 rounds will fit in the ammunition drum. (The extra rounds are counted against the Load limit.) The spent cases are not simply thrown out of the aircraft, like many combat aircraft; instead, they are returned automatically to the ammunition drum. The ammunition is linkless, instead of using a belt; this lightens the combat weight of the A-10 considerably. The forward and center of the A-10 are literally built around the GAU-8A and its ammunition drum, with fuel carriage being primarily in or near the center of the aircraft, protected as stated above. (This pattern of fuel carriage is to further increase the A-10's survivability.) The main wheels protrude about one third out from their sponsons when retracted, making belly landings easier and less damaging to the aircraft. The landing gear all open to the rear, and this helps aerodynamic forces to pull on and lock the landing gear if hydraulics are out, assuming the manual overrides are working.

The engines, a pair of 9065-pound-thrust GE TF34-GE-100 turbofans, are not designed for speed, but for lifting power. If compared to a tracked or wheeled vehicle, one would say that the A-10's engines are built more for torque than speed. They are mounted on pylons above and to the sides of the aircraft, shielded from IR detection by the tail surfaces and the pylons themselves. They are also housed in a thicker-than-normal skin, which further masks the IR profile of the engines. This placement also helps keep the damage from an engine hit from damaging the other engine and the fuselage. The high mounting also makes the engines almost immune to FOD damage, contributing in no small way to the A-10s ability to use rough takeoff fields. Crews can also service most of the aircraft while the engines are running, without fear of being sucked into the intakes. The engines are known for their quietness and smokeless operation; in Desert Storm, the Iraqis gave the A-10A the name of "Silent Death," as the GAU-8/A is also *relatively* quiet when firing, and rounds from the GAU-8/A would often impact the Iraqi armor and positions before the engines or gun could be heard.

Various camouflage patterns were used experimentally on the A-10A, including the standard Air Superiority Gray, the Peanut scheme with a sand base and spots of yellow and OD, black and white colors for winter operations, a tan, green, and mixed brown pattern, the European I woodland camouflage scheme (primarily for A-10s operating in Europe during the Cold War). Most of these patters have a light gray finish on the underside. The current camouflage pattern is called Compass Ghost, originating in the early 1990s. It is a two-tone dark-gray pattern on top and a light gray two-tone pattern underneath. Most A-10s have a false dark gray cockpit painted just behind the gun to further confuse ground gunners and enemy aircraft. Most also sport some kind of shark-mouth or warthog-mouth nose art.

The new A-10s were flown realistically, hard, and moistly at very low altitude when in an attack profile. In addition, the GAU-8 Gatling Gun's recoil, though designed into the A-10A, was still difficult on the airframe (many of the tales of the A-10s include an apocryphal one where the A-10 is stopped in its flight by the recoil of continuous firing of its gun). In addition, many ground crews and pilots were signing off on the carriage on the wing pylons of weapons and fuel tanks that were too heavy or otherwise unsuited to the particular pylon or hardpoint. Therefore, as early as 1979, A-10As were given structural strengthening on the wings and forward section of the aircraft, including the thickening those sections and improving their ability to take stress. Hardpoints and pylons were not strengthened, but many "days off" were given to A-10 crews, which they spent in classes receiving intensive instruction about what ordnance could be put where. A side effect of the airframe strengthening was the increase in (initial) service life from 6000 to 8000 hours. (Service life, in particular, was something repeatedly upgraded in the career of the Warthog, and as at least part of the Warthog fleet may fly until at least 2040, there will probably be more SLEPs.)

Before this, in 1978, the first avionics upgrade was begun, though it was several years before it was completed. The A-10 received a Pave Penny laser receiving pod, which allowed the A-10 to sense the energy from laser designators and pass the information to any laser-guided munitions it may be carrying for targeting. The pod was given a hard mounting projecting below the aircraft on an extension on the right side of the nose almost directly under the cockpit. This gave the Pave Penny a good view of the battlefield. Starting in 1980, the A-10 received an inertial guidance system as part of this upgrade, as well as radios with greater compatibility with those carried by FALO teams (now called TACPs) and some Army and Marine FISTs.

Avionics upgrades continued in the 1990s with the addition of the Low-Altitude Safety and Targeting Enhancement system (LASTE), which gave the Warthog better computerized ordnance and cannon-aiming, an autopilot, and a ground-collision warning system (which could, and reportedly often was, disabled by the pilot). In 1999, the LASTE system itself was upgraded, giving the Warthog improved aiming and delivery assistance with the Integrated Flight & Fire Control Computers system. The upgrade also gave the Warthog some of the elements of a fly-by-wire system, with flight computers helping the A-10's autopilot, fine control, and help in keeping the pilot from flying the aircraft beyond its limits. It also included "wake up" alarms, where the aircraft was able to detect that a pilot may be groggy or unconscious due to hard maneuvering or injury and basically sound loud audio and voice alarms to try to get the pilot back to full consciousness, something which was common on fighter and most strike aircraft.

In 2001, the Warthog was given integrated combat search and rescue beacon and radio locations systems, allowing the aircraft to function as a true CSAR platform in the modern sense. Also in 2001, it was officially recognized that the A-10A needed more engine power; though nothing has yet been done about this problem, some A-10As may yet receive more powerful engines, and the new A-10C does have more powerful engines.

Perhaps the greatest overlooked element of the A-10's design was the lack of any night vision equipment. In Desert Storm, A-10 drivers found a field-expedient solution: They would go ahead and carry night-vision-capable weapons, uplink the night vision cameras and sensors of the weapons to the cockpit and get an *ad hoc* night vision capability of sorts that way. The problem with this approach is that they only had night vision capability as long as they had night-vision-capable ordnance, and the screen in the cockpit used so see through the ordnance was slaved to a single piece of ordnance, which retained the night vision picture seen through the bomb or missile would be retained down to the target, at which point the picture in the cockpit would wink out until the pilot could slave the screen to another piece of ordnance. And when all the night-vision-capable ordnance was expended, the A-10's night vision capability was gone. After Desert Storm, this deficit was officially recognized, and A-10As started to carry a night vision pod (several are used) on one of the outermost stations, and in some cases the cockpit was rearranged to accommodate a new night-vision-dedicated screen. Those A-10As that were not so modified were generally flown at night with the pilot wearing NODs.

The OA-10A: The FAC with a Punch

The OA-10A is a minor variant of the A-10A Warthog; it's primary role is as a FAC (Forward Air Control) aircraft, supervising and controlling air strikes (and to a lesser extent, naval gunfire) and communicating with ground units to ascertain their air support needs. The OA-10A is for the most part the same as the A-10A, including upgrades at different times as was done to the A-10A fleet. In fact, the OA-10A can do the same missions as the A-10A, and can function as a full attack aircraft. The difference between the OA-10A and A-10A is the addition of advanced long-distance observation equipment, along with the associated viewers in the cockpit. The OA-10A is also optimized for the delivery of smoke rockets (primarily WP), though the same rocket pods may be equipped with other types of rockets, and there is a bonus for firing 2.75-inch rockets. The OA-10As also have additional radios for communication with ground units, air units, AWACS-type aircraft, and naval units. The additional equipment that makes an A-10A an OA-10A can be easily removed, turning the OA-10A back into an A-10A, though the OA-10A can function as an A-10A without modification. The OA-10A retains all wing hardpoints and the centerline hardpoint as well as the GAU-8/A cannon and a full load of ammunition.

Many OA-10A and A-10A pilots saw how the increased avionics could be used for other purposes, and asked, "Why don't we modify *all* Warthogs to this standard?" However, like most other things, the answer was the budget crunch, and only about 10% of A-10As were modified to the OA-10A standard.

The A-10B N/AW: What Could Have Been

The A-10B N/AW (or YA-10B) was an experimental version of the A-10 that addresses the A-10's greatest shortcoming -- the lack of night attack capability. The A-10B was a two seat all-weather CAS aircraft, able to deliver accurate ground support strikes at night and to an extent, in bad weather. It had a number of upgrades to accomplish this, as well as a two-seat configuration with a WSO in the rear to operate most of the new avionics. The A-10B began testing in 1979, but the Air Force brass, in love with fast, sexy fighters, let the program drag, and eventually get killed in 1990. In particular, the A-10B's funds were cut and then reassigned to the then-new F-15E Strike Eagle, another fast mover that was not well suited to CAS missions. In addition to those in the Air Force who were looking for a more capable A-10, several countries, such as South Korea, Thailand, Burma, and Spain were very interested in the A-10B, and export sales could have been quite large. However, over 20 years later, the A-10C now has most of the improvements that the A-10B would have provided, though without the valuable WSO.

The A-10B had a complete suite of improvements which gave the A-10B its N/AW (Night/All Weather) capability, as well as upgrades the A-10A pilots had been asking for. This included advanced inertial navigation, a fighter-type HUD, terrain-following radar, and an improved radio suite, amongst other upgrades, such as most of the same upgrades as the OA-10A. The terrain-following radar was in particular wanted by the A-10 pilots, as it made treetop-level attacks much easier to fly. The A-10B was also equipped to take on the same role as the OA-10A, having avionics to allow it to fly FAC missions with no modifications.

The Modernized A-10: The A-10C

The A-10, despite it's ruggedness and simplicity to fly and maintain, is beginning to show its age. This has led to many calls to replace the A-10 with another, newer CAS aircraft with newer technology and avionics, and able to carry a wider variety of ordnance and to function as a general bomb truck if necessary. Some lawmakers and USAF brass have even called for the A-10 to be replaced by the new F-35, though it is so well-known that the F-35 cannot perform the CAS mission that the Air Force is unwilling to conduct a flyoff between the A-10 and F-35. However, there have been just many calls to modernize the A-10, giving it new avionics, particularly advanced night vision and a GPS receiver, and of course the ability to carry a wider selection of ordinance in the USAF inventory, especially the newer generation of missiles and bombs. The cannon also received calls to be modernized, to be able to fire APDS-T ammunition instead of its standard APDSDU rounds. The result of these calls was the "new" A-10C, which began service in 2008 (with some combat trials starting in 2007). The A-10C is "new" because they are all heavily-overhauled and upgraded A-10As, with the overhauling including re-strengthening of the fuselage and wings, essentially bringing them to a zero-hours state.

To a large extent, the A-10C's avionics include features that on the A-10A are simply "tacked on" or otherwise attached in an ad hoc or "temporary-permanent" manner, now internalized or an integrated part of the modernized A-10. This includes GPS, night vision, a helmet-sight interface, fire control upgrades, an all-glass cockpit, an improved fire control system able to delver the newer generation of USAF ordnance such as JDAMs and JASSMs (amongst others) as well as ARMs, a moving map display, HOTAS stick and throttle, situational awareness data link, ECM and IRCM, and an upgraded electrical system. Most of these improvements have been added to earlier A-10s in a graduated process, but the A-10C will have them all, as well as improved radios allowing them to communicate with more types of ground-based radios, other aircraft, and AWACS-type aircraft as well as receive intelligence information from UAVs. The A-10C will also have Link-16 and SATCOM communications, even though most Warthog pilots and armament specialists deem them unnecessary. The nose side-mounted Pave Penny receive-only laser pod is removed, replaced by LITENING AT pods embedded in the wing that function as laser designators as well as laser rangefinders.

Other A-10C upgrades include more powerful 10,000-pound-thrust engines in more protected pods in the same position on the aircraft, and a possible Y-type tail that cures the yawing problem that often occurs when the A-10 is carrying centerline auxiliary fuel tanks. (This new tail is still being considered.) The more powerful engines do not actually do much to improve the A-10's speed, but increase the modernized A-10's lifting capability. The RCS is also reduced. Partially due to the new tail and engine housings, but mostly due to the partial use of RAM in strategic places. (Detecting the A-10C with radar or radio, or guiding weapons with this method, is at -3.) Some exhaust cooling is also employed (detection and guidance of IR weapons towards the A-10C is at -2, in addition to the IR Suppression effects).

A Civilian A-10?

After the innumerable tornadoes, microbursts, and supercell thunderstorms and other severe weather conditions which hit Oklahoma in the late 1990s and 2000s, the Fox station in Oklahoma City began looking for a storm-chasing aircraft they could fly themselves instead of having to hire one or use more fragile helicopters. The aircraft had to be relatively light, tough, able to handle rough weather, have easy maintenance, have good loiter characteristics, and lots of room for scientific instruments, radar, and radios, as well as some avionics. After looking into several aircraft, they decided to think out of the box and buy a demilitarized A-10A. It is based on an A-10A initial version, and has had the gun, the centerline hardpoint, and RWR, IFF, Flare and Chaff removed, and radios of a different, civilian-available sort installed (they are still secure). The aircraft, dubbed "WA-10 Stormchaser Warthog" has had several types of radar added in, various night vision and magnified vision devices, and scientific instruments such as barometric measuring, wind speed measuring, cloud density, movement and detection of funnel clouds, supercells, cloud rotation, and microbursts, as well as detection and measurement of intensity of rain, snow, freezing rain, and hail (as well as the approximate size of the hailstones. Lightning can be detected, categorized, and judged for frequency and intensity. It can detect, with its radars, conditions which may lead to severe weather. It is able to perform many of these functions simultaneously, and the aircraft includes several day/night TV-type cameras as well as a camera facing the pilot inside of the aircraft, allowing him to appear on camera. It has several computers to assist flight functions and the scientific instruments and radars. A fly-by-wire system has been added, as a ground-collision warning system, along with a GPS system and a mapping system. A secondary function of the Stormchaser Warthog is the tracking of fleeing vehicles and criminals, though the latter can be difficult. One the hardpoints often carries a baggage pod for the pilot in case he cannot land at his home base; the others usually carry additional scientific instruments and/or generators for additional power. The place where the cannon was now contains a probe-firing mechanism, with a magazine of 32 Weather Probes. The Stormchaser Warthog is robust enough to penetrate a hurricane, though this has not yet been done in practice.

Twilight 2000 Notes: The A-10 N/AW was very rare in the Twilight War, perhaps 50 being modified from existing A-10 aircraft, and being deployed to the American Southwest. Perhaps 5% of A-10As are modified into OA-10s. Most A-10As will have received the 1990 upgrades, with perhaps 10% still having the 1978 upgrades only, and 3% being original A-10As and OA-10As. The A-10C and WA-10 do not exist in the Twilight 2.2 timeline.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
A-10A (Initial)	$35,298,444	JP4	7.26 tons	22.68 tons	1	38	None	Shielded
A-10A (1978)	$40,671,569	JP4	7.26 tons	22.72 tons	1	40	None	Shielded
A-10A (1990)	$55,334,733	JP4	7.26 tons	23.05 tons	1	42	VAS (20 km), Day Only	Shielded
A-10A (1999)	$55,545,658	JP4	7.26 tons	23.09 tons	1	45	VAS (20 km), Day Only	Shielded
A-10A (2001)	$60,197,283	JP4	7.26 tons	23.09 tons	1	46	VAS (20 km), Day Only	Shielded
OA-10A (Initial)	$60,725,213	JP4	7.26 tons	22.89 tons	1	39	VAS (30 km), Day Only	Shielded
OA-10A (1978)	$60,955,857	JP4	7.26 tons	22.91 tons	1	41	VAS (30 km), Day Only	Shielded
OA-10A (1990)	$65,330,695	JP4	7.26 tons	23.1 tons	1	44	VAS (30 km), Day Only	Shielded
OA-10A (1999)	$65,704,120	JP4	7.26 tons	23.24 tons	1	47	VAS (30 km), Day Only	Shielded
OA-10A (2001)	$65,838,058	JP4	7.26 tons	23.24 tons	1	48	VAS (30 km), Day Only	Shielded
A-10B N/AW	$75,803,050	JP4	7.26 tons	24.15 tons	2	51	FLIR (6 km), Weather Radar (300 km), TFR (10 km), 2nd Gen Image Intensification (40x) , VAS (30 km), Radar Altimeter (14 km)	Shielded
A-10C	$92,246,263	JP4	8.07 tons	24.35 tons	1	53	2nd Gen FLIR (12 km), TFR (12 km), 3rd Gen Image Intensification (x60), VAS (30 km), Weather Radar (300 km), Radar Altimeter (14 km), Radar (40 km), Radar Detection (10 km), RDF (10 km)	Shielded
WA-10	$65,124,833	JP7	3 tons	22.54 tons	1	59	2nd Gen FLIR (12 km), 2nd Gen Image Intensification (40x), VAS (20 km), Radar Altimeter, Radar (40 km), Weather Radar (600 km), 4xLLTV (20 km) on Swivel	Shielded

Mounts, WL/IR Searchlight on swivel mount, Cell Phone Connection, Wi-Fi Internet Connection

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
A-10A (Initial)	1052	292 (74)	NA 72 9/6 50/40	3978	920	13636	FF8 CF8 RF8 W8 T8*
A-10A (1978)	1051	290 (74)	NA 72 9/6 50/40	3978	922	13636	FF8 CF8 RF8 W8 T8*
A-10A (1990)	1037	286 (74)	NA 71 9/6 50/40	3978	936	13636	FF8 CF8 RF8 W8 T8*
A-10A (1999/2001)	1035	286 (74)	NA 71 9/6 50/40	3978	938	13636	FF8 CF8 RF8 W8 T8*
OA-10A (Initial)	1047	291 (74)	NA 72 9/6 50/40	3978	925	13636	FF8 CF8 RF8 W8 T8*
OA-10A (1978)	1046	291 (74)	NA 72 9/6 50/40	3978	926	13636	FF8 CF8 RF8 W8 T8*
OA-10A (1990)	1042	290 (74)	NA 72 9/6 50/40	3978	930	13636	FF8 CF8 RF8 W8 T8*
OA-10A (1999/2001)	1039	290 (74)	NA 72 9/6 50/40	3978	933	13636	FF8 CF8 RF8 W8 T8*
A-10B N/AW	1020	285 (70)	NA 71 9/6 50/40	3903	952	13636	FF8 CF8 RF8 W8 T8*
A-10C	1095	304 (65)	NA 79 9/7 50/50	3978	924	13636	FF8 CF8 RF8 W8 T8*
WA-10	1054	294 (74)	NA 73 9/6 50/40	3978	919	13636	FF8 CF8 RF8 W8 T8*

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	Armament	RF	Ammo
A-10A (Initial)	RWR, IFF, Gyrocompass, Transponder, Secure Radios (3 Long Range, 1 Medium Range), Flare/Chaff (50/50), IR Suppression, HUD	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+1	1174x30mm (Up to 1350 Overload)
A-10A (1978)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (4 Long Range, 2 Medium Range), Laser Spot Tracker (12 km), Flare/Chaff (50/50), IR Suppression, HUD	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+2	1174x30mm (Up to 1350 Overload)
A-10A (1990)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (4 Long Range, 2 Medium Range), Laser Spot Tracker (12 km), Flare/Chaff (50/50), IR Suppression, HUD	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+3	1174x30mm (Up to 1350 Overload)
A-10A (1999)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (4 Long Range, 2 Medium Range), Laser Spot Tracke (12 km)r, Flare/Chaff (50/50), IR	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+4	1174x30mm (Up to 1350 Overload)

	Suppression, HUD				
A-10A (2001)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (5 Long Range, 2 Medium Range), Laser Spot Tracker, Flare/Chaff (50/50), IR Suppression, HUD, Armored Fuselage	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+4	1174x30mm (Up to 1350 Overload)
OA-10A (Initial)	RWR, IFF, Gyrocompass, Transponder, Secure Radios (4 Long Range, 2 Medium Range), Flare/Chaff (50/50), IR Suppression, HUD	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+1 (+2 RP)	1174x30mm (Up to 1350 Overload)
OA-10A (1978)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (5 Long Range, 3 Medium Range), Laser Spot Tracker (12 km), Flare/Chaff (50/50), IR Suppression, HUD, Armored Fuselage	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+2 (+3 RP)	1174x30mm (Up to 1350 Overload)
OA-10A (1990)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (1 Very-Long Range, 5 Long Range, 3 Medium Range), Laser Spot Tracker (12 km), Flare/Chaff (50/50), IR Suppression, HUD	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+3 (+4 RP)	1174x30mm (Up to 1350 Overload)
OA-10A (1999)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (1 Very-Long Range, 5 Long Range, 3 Medium Range), Laser Spot Tracker 12 km), Flare/Chaff (50/50), IR Suppression, HUD	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+4	1174x30mm (Up to 1350 Overload)
OA-10A (2001)	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (1 Very-Long Range, 5 Long Range, 3 Medium Range), Laser Spot Tracker (12 km), Flare/Chaff (50/50), IR Suppression, HUD	440/400m Primitive Runway	GAU-8/A Autocannon, 11 Hardpoints	+4 (+5 RP)	1174x30mm (Up to 1350 Overload)
A-10B N/AW	RWR, IFF, Gyrocompass, Transponder, Inertial Navigation, Secure Radios (1 Very-Long Range, 5 Long Range, 3 Medium Range), Laser Designator (12 km), Flare/Chaff (50/50), IR Suppression, HUD, Target ID, ECM 1, IRCM 1	440/400m Primitive Runway	GAU-8A Autocannon, 11 Hardpoints	+3	1152x30mm (Up to 1325 Overload)
A-10C	RWR, IFF, Gyrocompass, Transponder, GPS, Secure Radios (2 Very-Long Range, 6 Long Range, 3 Medium Range, 1 Short-Range), Laser Designator (12 km), Flare/Chaff (50/50), IR Suppression, HUD, Target ID, ECM 1, IRCM 1, Stealth 1	440/400m Primitive Runway	GAU-8A Autocannon, 11 Hardpoints	+4	1174x30mm (Up to 1350 Overload)
WA-10	Gyrocompass, Transponder, GPS, Secure Radios (1 Very-Long Range, 3 Long Range, 1 Medium Range), IR Suppression, HUD	440/400m Primitive Runway	Probe Launcher, 11 Hardpoints	+1	Up to 32 Weather Probes

*The cockpit is surrounded by a titanium shield and a high-strength Perspex canopy and has an AV of 13.

Cessna A-37 Dragonfly

Notes: This attack aircraft was developed from a trainer, the T-37 Tweet, in the late 1960s. It is not used by the US, but is used by Chile, Columbia, Dominican Republic, Ecuador, Guatemala, Honduras, South Korea, Peru, El Salvador, Thailand, Uruguay, and Vietnam. It did have limited service with US forces in the Vietnam War. The entry here will handle the A-37 but not the T-37 variant. The Dragonfly was also known in some circles as the “Super Tweet.” The A-37 platform was meant from the first to be useful in COIN, aircraft, light gunship, and trainer.

The history of the Dragonfly in combat began in mid-1967, when 25 were sent to Vietnam under the Combat Dragon program. For this role, they were outfitted with multi-use pylons capable of carrying bombs, (iron and cluster), rocket packs, napalm canisters, and as many as two SUU-11/A Minigun pods; this is in addition to an internal GAU-2B/A Minigun. An unusual type of MER used allowed the Dragonfly to carry a small external fuel tank and up to three 250-pound bombs on the same rack; however, if anything had to be ejected, everything on the pylon had to be ejected. Missions were to include Sandy flights, helicopter escort, CAS, FAC, and night interdiction. The second seat on FAS and CAS missions was normally occupied by an observer or a dedicated weapons officer; in practice, in all missions other than FAC, the second pilot/weapons officer seat was empty, allowing an increase of 200 kilograms in ordinance carriage. However, full controls were retained at both positions. The initial aircraft for this role was an A-37A, a heavily-modified Tweet initially designated YAT-37D Super Tweet, then AT-37D Super Tweet, with twin GE J85-J2/5 non-afterburning turbojets with 2400 pounds thrust each. Four hardpoints of surprising ability were carried under each wing and on the wingtips; however, the wingtip pylons were designed only for 1893-liter fuel tanks each.

Thousands of sorties were flown by the A-37A in the first year; in this year, numerous deficiencies were noted, enough that the pilots called the A-37A more often by the "Super Tweet" appellation, even though it was already designated the Dragonfly. Most complaints among pilots was range and endurance; speed was not as much as an issue to to the nature of its missions. Another complaint were the non-boosted controls, particularly in high-G or high-load situations. The A-37A was not armored, and the flight controls were non-redundant.

In 1967, the first A-37Bs arrived in country; most went to the AFRVN, who by this time were flying most of the A-37As in country. They were all new-build aircraft, though based on the design of the T-37C. The A-37B included higher external stores limits, four wet hardpoints per wing, higher G-limits for the airframe (from 5G to 6G); flight surfaces were made redundant, self-sealing fuel tanks replaced the internal fuel tanks. The cockpit seats were armored and ballistic nylon curtains were added to the front of the cockpit behind the instruments and to the sides of the cockpit and the rear. The flight surfaces allowed for more maneuverability. Aerial refueling capability was added, and updated avionics were installed (including de-icing and a suite of indicators and controls designed for the FAC mission). Higher-thrust 2850-pounds-thrust GE J85-GE-17A replaced the A-37A's engines. These engines could be turned on and off in the air, as pilots found that a one-engine cruise configuration was effective. A midair refueling probe helped the situation. Like its predecessors, the A-37B was not pressurized, though it did have oxygen and masks.

These aircraft went to boneyards after use or went into civilian ownership. Eventually, all were replaced by the A-10 Warthog.

When Vietnam fell, 92 A-37Bs and As were recovered from the AFRVN before the NVA could capture them. These aircraft were at first redesignated OA-37D and were assigned to former TAC units that were now AFNG or AFRES units. They flew in combat as Operation Just Cause, primarily in CAS missions. Some 95 were captured and used by the Vietnamese as late as the early-1980s, used for missions over Cambodia and against Chinese forces. The A-37B and OA-37B are still used today in Central and South America.

In flight and firing tests, the A-37B proved themselves able to carry GPU-2/A pods with M-197 20mm cannons or AMD pods with 30mm ADEN guns could be carried on the centerline and used effectively; however, no combat use of these pods are in evidence. Minigun pods, on the other hand, were used quite often to increase machinegun firepower.

Experimental Dragonflies

The A-37E, also called the A-37E/STOL, had more powerful engines, thrust reversers, and larger flaps to decrease takeoff run and landing run. It has a centerline gun pod for easier aiming (in a time where such an installation was important for radar gunsights and even a minigun in a small aircraft). It had weather radar, mild ECM, and flare and chaff dispensers. The fuselage was longer and the A-37E had greater lifting capability. This version was never built.

The A-37F has reduced lifting capacity compared to the A-37E, but because it has rotatable wingtip VTOL pods which could also be used for VIFF flying. This would have made the A-37F a STOVL aircraft, with a very short landing run or takeoff run (when not operating as a VTOL aircraft). It had a more advanced gunsight and a bombing radar gunsight. As the wingtips could no longer be used for fuel tanks, two fuselage hardpoints were added; in addition, space in the fuselage formerly used for the engines could be used for fuel. This version too was never built.

The Tebuan was a proposed Canadian variant of the CL-41 Tutor, itself a version of the T-37 Tweet. It was a fully weaponized version, with an extended nose containing the radar of an F-104B, and capable of using heat-seeking missiles (primarily Falcons or Sidewinders) in addition to the normal armament. It had a pair of GE J85-J4 turbojets with 2950 pounds thrust each. It never made it past a few mockups.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
A-37A	$5,726,120	JP4	2.13 tons	5.44 tons	2	10	None	Enclosed
A-37B	$5,850,680	JP4	2.67 tons	6.8 tons	2	10	None	Enclosed
OA-37B	$20,604,540	JP4	2.64 tons	6.94 tons	2	12	FLIR (6 km)	Enclosed
A-37E	$25,287,570	JP4	2.64 tons	7.07 tons	2	14	FLIR (6 km), Weather Radar (50 km)	Enclosed
A-37F	$27,020,770	JP4	2.48 tons	7.21 tons	2	17	FLIR (6 km), Weather Radar (50 km)	Enclosed
Tebuan	$64,246,000	JP4	2.5 tons	7.45 tons	2	13	FLIR (6 km), Weather Radar (50 km), Radar (25 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
A-37A	1242	248 (90)	NA 62 8/5 40/30	2000	1449	12730	FF3 CF3 RF2 W3

							T2
A-37B	1448	290 (80)	NA 70 9/5 30/20	2000	1698	12700	FF3 CF3 RF2 W3 T2
OA-37B	1420	284 (75)	NA 69 9/5 30/20	2000	1733	12700	FF3 CF3 RF2 W3 T2
A-37E	1567	312 (65)	NA 76 9/5 30/20	2200	1919	13970	FF3 CF3 RF2 W3 T2
A-37F	1567	312 (65)	NA 76 9/5 30/20	2500	2119	13970	FF3 CF3 RF2 W3 T2
Tebuan	1575	314 (90)	NA 77 9/5 30/20	2000	1929	13970	FF3 CF3 RF2 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
A-37A	IFF, Secure Radios	550/495m Primitive Runway	+1	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm
A-37B	IFF, Secure Radios	550/495m Primitive Runway	+2	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm
OA-37B	IFF, Secure Radios, Laser Designator (6 km)	550/495m Primitive Runway	+2	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm
A-37E	IFF, Secure Radios, Laser Designator (6 km), Flare/Chaff (16 each), ECM 1	440/396m Primitive Runway	+2	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm
A-37F	IFF, Secure Radios, Laser Designator (6 km), Flare/Chaff (16 each), ECM 1	330/200m Primitive Runway (& STOVL Characteristics)	+3	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm
Tebuan	IFF, RWR, Secure Radios, Flares/Chaff (16 Each), ECM 1, Laser Designator (6 km)	550/495m Primitive Runway	+3	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm

Textron AT-6 Wolverine

Notes: The AT-6 Wolverine is pumped-up version of the AT-6 Texan, which itself is an attack-capable variant of the T-6 Texan trainer. (The T-6A is used by the US Air Force for basic flight training, and the US Navy and Marines' T-6b does the same thing for their pilots.) The Wolverine is Textron's entry into the US Air Force's OA-X program (a program meant to partially replace the A-10 in the ground support and Sandy role. Like the other entries into the OA-X program, none can match the A-10, and that's the opinion of dozens of air combat experts, not just me.) On the whole, the OA-X program is proceeding slowly, and may never actually produce a new ground support aircraft, let alone use the AT-6 Wolverine. The Wolverine is also known as the AT-6 LAAR (Light Attack and Armed Reconnaissance aircraft). The Wolverine, however, does have a leg up on other OA-X entrants, because it's base airframe is already used by the Air Force; and the OA-X program may produce as many as three aircraft of differing capabilities. In addition to current and past operational tests, the AT-6 (along with the other entrants) proved its NATO interoperability during Exercise Ample Strike in 2015. The Wolverine is designed for use in "Permissive" environments – one where the US basically has air superiority and there is little to no AAA or MANPADS activity.

The Wolverine has greatly-strengthened wings and fuselage, allowing for a multiplicity of hardpoints, both wet and dry. It has proven itself capable of utilizing most smaller ground-attack-type weapons in the USAF inventory. The Wolverine uses most of the cockpit displays and architecture as the A-10C Warthog; however, these instruments are split up between the pilot and WSO, and the entire A-10C suite could not be fitted into the Wolverine. The Wolverine also uses the HOTAS system of the F-16, allowing the pilot less movement to fire ordnance,

The Wolverine has been tested successfully with a variety of laser-guided, and JDAMs up to 500 pounds. It is also capable of using most of the rocket pods in the NATO inventory, including the APKWS and other laser-guided rockets. It can also carry Hellfire and

Brimstone ASM. As part of the ongoing tests, the Wolverine has been armed with Small-Diameter Bombs, and more weapons capabilities are being tested. One or two hardpoints are usually taken by FN-Herstal HM-400 .50-caliber gun pods, or 20mm autocannon pods. The Wolverine carries communications equipment allowing it to communicate with troops on the ground as well as other aircraft and helicopters, via secure radios.

The engine has been replaced with a 1600-horsepower turboprop engine; this high horsepower is primarily to increase lifting capability and maneuverability, as the top speed is not great compared to most modern military aircraft. The aircraft is able to operate in light inclement weather. Construction of the skin of the Wolverine is of carbon composites. The large bubble canopy gives the crew an ample view of what's around them, and the canopy is bulged to allow the crew to see partially below the aircraft.

Promising tests have been conducted with Wolverines taking off and landing on aircraft carriers. Officially though, the US Navy and Marines have no interest in the Wolverine, though they appear to be watching the Air Force's tests closely.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$30,807,500	JP4	1.86 tons	4.54 tons	2	34	Radar (45 km), All-Around Day/Night Advanced CCTV (30 km), FLIR (23km)	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1003	279 (25)	NA 116 3/2 20/15	1432	356	9449	FF3 CF3 RF2 W2 T2

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Laser Designator (6 km), IR Suppression, Secure Radios, HUD, GPS, RWR, LWR, IFF, Flare/Chaff (30/30)	900/600 Primitive Runway	+3	7 Hardpoints	None

F-15E Strike Eagle

Notes: This version of the F-15 air superiority fighter was adopted by the USAF in 1984, and gave a stellar performance in the 1991 Gulf War. The Strike Eagle features new engines, navigation/attack pods under the intakes, and new skin for less radar observability. The Strike Eagle also has standard fit conformal FAST (Fuel and Sensor Tactical) pods fitted beside each intake that can carry up to 1000 kg of fuel and/or sensors, designators, or ECM/IRCM devices. The crewmembers have ejection seats, and the aircraft is capable of in-flight refueling. In addition to the US Air Force, the Strike Eagle is used by Israel and Saudi Arabia. The Strike Eagle retains its air-to-air capability, and is capable of delivering nuclear weapons.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F100-PW-220 Engines	$61,103,750	AvG	11 tons	36.74 tons	2	32	Radar (300 km), FLIR (90 km), Image Intensification (90 km)	Shielded
F100-PW-290 Engines	$64,855,680	AvG	11 tons	36.74 tons	2	37	Radar (300 km), FLIR (90 km), Image Intensification (90 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F100-PW-220 Engines	5280	1320 (130)	NA 330 10/7 100/70	13300	19390	18290	FF6 CF6 RF6 W5 T5
F100-PW-290 Engines	5888	1472 (130)	NA 368 10/7 100/70	13300	25159	18290	FF6 CF6 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	Secure Radios, Chaff/Flare (80/80), RWR, ECM	2800/1055m	+4	20mm Vulcan,	950x20mmM61

3, Deception Jamming (50 km), Auto Track, HUD, IR Uncage, Look-Down Radar, TFR, Track While Scan, All Weather Flight, Target ID	Hardened Runway	13 Hardpoints

F-105 Thunderchief

Notes: This aircraft was designed from the outset for tactical bombing missions, including nuclear bombing. It was not designed for maneuverability, just speed, range, and the ability to carry a nuclear weapon. This led to a great many nicknames, such as Lead Sled, Ultra Hog, Flying Speedbrake, and the favorite, Thud. The Thunderchief was a star in the bombing campaign against North Vietnam during the late 1960s and early 1970s. Flown only by the US Air Force and Air National Guard, the Thunderchiefs were retired in 1984. The Thunderchief has in its belly an internal bomb bay; this bay can carry 1.36 tons of weapons, but this was much more likely in operational use to carry a 1500-liter fuel tank. If the fuel tank is carried, a centerline hardpoint may be used. (EF-105s do not have this option; the bomb bay space is taken up with an extra crewmember and electronics.)

The F-105A was only a prototype; soon after testing was complete, a new, more powerful engine was available, and the new F-105B became the first production aircraft. The AF-105C was a proposed two-seat trainer, which was never put into production. The F-105D was the configuration that most in which most Thunderchiefs were built; this version had a RWR added in 1966 and flare/chaff dispensers added in 1969. The F-105D Thunderstick II model improved the bombing sights and accuracy. The F-105E was a two seat trainer variant of the F-105D that was, as with the F-105C, never put into production. The EF-105F and EF-105G were the first Wild Weasel electronic warfare aircraft built; their job was to act as "SAM bait," and then knock out the SAM and radar sites with antiradiation missiles.

Twilight 2000 Notes: Some F-105s 100 were pulled from boneyards starting in 1997, refurbished, and sent back into combat.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-105B	$5,275,420	AvG	6.35 tons	23.97 tons	1	22	None	Shielded
F-105D (Early)	$16,627,120	AvG	6.35 tons	23.85 tons	1	28	Radar (50 km)	Shielded
F-105D (Late)	$16,956,130	AvG	6.35 tons	23.97 tons	1	28	Radar (75 km)	Shielded
F-105D (T-Stick II)	$17,427,130	AvG	6.35 tons	23.97 tons	1	28	Radar (80 km)	Shielded
EF-105F	$19,000,570	AvG	5.68 tons	25.09 tons	2	32	Rada (90 km)	Shielded
EF-105G	$20,586,130	AvG	5.68 tons	25.09 tons	2	36	Radar (100 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-105B	4391	1098 (150)	NA 274 4/2 40/20	4500	6161	12560	FF6 CF6 RF5 W4 T4
F-105D (All)	4474	1119 (150)	NA 280 4/2 40/20	4500	6475	12560	FF6 CF6 RF5 W4 T4
EF-105 (Both)	4360	1090 (150)	NA 273 4/2 40/20	4500	6464	12560	FF6 CF6 RF5 W4 T4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-105B	None	1400/950m Hardened Runway	+1	20mm Vulcan, 5 Hardpoints, Internal Bomb Bay	1000x20mm
F-105D (Early)	None	1400/950m Hardened Runway	+2	20mm Vulcan, 5 Hardpoints, Internal Bomb Bay	1000x20mm
F-105D (Late)	RWR, Flare/Chaff (60/50), TFR	1400/950m Hardened Runway	+2	20mm Vulcan, 5 Hardpoints, Internal Bomb Bay	1000x20mm
F-105D (T-Stick II)	RWR, Flare/Chaff (75/75), TFR	1400/950m Hardened Runway	+3	20mm Vulcan, 5 Hardpoints, Internal Bomb Bay	1000x20mm
EF-105F	RWR, Flare/Chaff (80/80) , ECM 2, TFR	1400/950m Hardened Runway	+2	20mm Vulcan, 5 Hardpoints	1000x20mm
EF-105G	RWR, Flare/Chaff (80/80) , ECM 3,	1400/950m Hardened	+3	20mm Vulcan, 5	1000x20mm

IRCM 1, Deception Jamming (30 km), Active Jamming, TFR	Runway	Hardpoints

*The F-105 was originally meant to be a tactical nuclear bomber. Because of this, it received extra shielding around its cockpit, giving the cockpit AV7.

F-117A Nighthawk

Notes: Known more commonly to the public as the Stealth Fighter, the Nighthawk is the first operational aircraft to exploit low observable stealth characteristics. All detection attempts with IR detection gear (including thermal, IR, or FLIR) are two levels more difficult than normal, and detection attempts with radar are four levels more difficult than normal. Guiding radar guided missiles against the aircraft are likewise four levels more difficult than normal, and IR missile home at three levels more difficult than normal. When the aircraft's bomb bay doors are open, radar attempts are only one level more difficult than normal. Known to some pilots as the Wobbly Goblin, the Nighthawk requires great skill by its pilots.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$198,784,590	AvG	2.27 tons	23.81 tons	1	48	AESA Radar (80 km), FLIR (100 km), SAR (150 km)	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
2067	517 (150)	NA 129 4/2 40/20	4000	7598	11765	FF3 CF4 RF3 W4 T2

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
RWR, Flare/Chaff (50/40), ECM 3, IRCM 4, IR Masking, HUD, HUD Interface, Look-Down Radar, Target ID, TFR, Stealth 4, IR Stealth 3	1200/1500m Hardened Runway	+5	2 Weapons Bays	None

OV-1E Mohawk

Notes: The OV-1E is the definitive version of the Mohawk, versions of which have been flying since 1959. The Mohawk flew more hours per airframe than any other aircraft in the 1991 Gulf War. The Echo model has more powerful 1800-horsepower engines, a GPS flight system, new avionics, and a new SLAR system. They are dual-purpose surveillance and ground-attack aircraft. The usual armament is a mix of M2HB MG pods and 70mm rocket pods on the four free hardpoints.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$13,110,610	AvG	1.23 tons	8.21 tons	2	16	SLAR, FLIR	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
930	233 (120)	NA 58 7/4 45/35	930	472	7620	FF3 CF2 RF2 W3 T2

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
GPS, Flare/Chaff (16/10), Secure Radios	744/615m Hardened Runway	+2	4 Hardpoints	None

OV-10 Bronco

Notes: This aircraft was designed for forward air controllers, helicopter escort, and light ground attack and counterinsurgency work. The OV-10 was originally used by the US Marines and Air Force, but by the outset of the Twilight War was used in the active duty role only by Thailand, Venezuela, Morocco, Philippines, Indonesia, and Oman. The OV-10 was retired by US forces in 1994.

The OV-10D NOGS (Night Observation GunShip) version of the Bronco was used by the US as late as the Gulf War. It has night vision gear and a 20mm gun turret in the belly, as well as uprated engines to cope with the added weight.

Twilight 2000 Notes: The Bronco returned late in the Twilight War as an attack aircraft when no other aircraft was available.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
OV-10A	$2,270,210	AvG	1.63 tons	6.55 tons	2+4	8	None	Enclosed
OV-10D	$5,490,540	AvG	2.4 tons	6.6 tons	2	10	FLIR (30 km), Passive IR (10 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
OV-10A/D	904	226 (90)	NA 57 9/6 60/45	955	523	7315	FF3 CF3 RF3 W4 T4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
OV-10A	Flare/Chaff (40/30) , Secure Radios	600/500 Primitive Runway	+2	4xM-2HB, 9 Hardpoints	2000x.50
OV-10D	Flare/Chaff (49/30) , Secure Radios, GPS, Laser Designator (9 km), Laser Rangefinder (9 km)	600/500 Primitive Runway	+3	20mm M-197 Autocannon, 4 Hardpoints	1000x20mm

T-2 Buckeye

Notes: This was the US Navy and Marines' standard trainer before the introduction of the T-45 Goshawk, but some of them were recalled to duty during the Twilight War. It is also used by Venezuela and Greece. Like most aircraft of its class, it is unsophisticated and light. Its two wingtip hardpoints may only be used for drop tanks. The T-2A is powered by a single engine; the T-2B has two smaller engines; the T-2C has two slightly less powerful engines.

Twilight 2000 Notes: Some of these aircraft were returned to training duty to replace Goshawks that had been modified for an attack role. Later, some Buckeyes themselves were modified for the strike role.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
T-2A	$1,300,000	AvG	1.59 tons	5.66 tons	2	10	None	Enclosed
T-2B	$1,581,260	AvG	1.59 tons	6.19 tons	2	12	None	Enclosed
T-2C	$1,562,060	AvG	1.59 tons	5.98 tons	2	12	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
T-2A	1165	291 (100)	NA 73 6/3 60/30	2065	1508	10000	FF2 CF2 RF2 W3 T2
T-2B	1761	440 (100)	NA 110 6/3 60/30	2065	2672	12320	FF2 CF2 RF2 W3 T2
T-2C	1728	432 (100)	NA 108 6/3 60/30	2065	2627	12320	FF2 CF2 RF2 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	IFF,Transponder	500/450m Hardened Runway	+1	6 hardpoints	None

T-34C Mentor

Notes: This basic trainer was also used by many countries as a COIN and FAC aircraft. It is an improved version of the civilian Beechcraft Bonanza aircraft, with hardpoints added, and the piston engine replaced by a turboprop. The Mentor is actually able to use Maverick missiles, in addition to bombs, rocket pods, and machinegun pods. This aircraft, in addition to the US, is in use by many countries in Latin America, the Pacific Rim, and Africa. The Mentor has no ejection seats and is not capable on in-flight refueling. The T-34 is the base model; the T-34A and B are identical, but built for the Air Force and Navy respectively. The T-34C Turbo Mentor is equipped with a much more powerful engine.

Twilight 2000 Notes: Many of these aircraft were armed during the Twilight War and used in the continental US to fight Mexican and New American forces.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
T-34	$311,360	AvG	408 kg	1.25 tons	2	4	None	Enclosed
T-34A/B	$312,980	AvG	427 kg	1.32 tons	2	4	None	Enclosed
T-34C	$351,360	AvG	534 kg	1.95 tons	2	4	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
T-34	540	135 (95)	NA 34 6/3 60/30	450	74	6465	FF2 CF2 RF2 W3 T2
T-34A/B	556	139 (50)	NA 35 6/3 60/30	450	74	6465	FF2 CF2 RF2 W3 T2
T-34C	792	198 (50)	NA 50 6/3 60/30	450	139	9145	FF2 CF2

	RF2 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	IFF, Transponder	600/500m Primitive Runway	None	4 hardpoints	None

G-2A/G-3 Galeb/J-1 Jastreb

Notes: This Yugoslavian aircraft is an operational trainer, meaning that it can be used as a trainer and a combat aircraft. It was used by all former Yugoslav republics as well as Libya and Zambia. It is a light aircraft with a limited weapon load and few avionics. The Jastreb is a single seat dedicated ground attack version. It has a more powerful British-designed engine for improved lifting capability.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
G-2A	$1,482,320	AvG	300 kg	4.3 tons	2	8	None	Enclosed
G-3	$1,565,870	AvG	360 kg	4.82 tons	2	8	None	Enclosed
J-1	$2,933,210	AvG	1.2 tons	4.68 tons	1	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
G-2A	1624	406 (100)	NA 102 6/3 60/30	1560	1106	12000	FF3 CF3 RF3 T2 W3
G-3/J-1	1706	426 (100)	NA 107 6/3 60/30	1560	1330	12000	FF3 CF3 RF3 T2 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
G-2A/G-3	RWR	515/475m Hardened Runway	+1	2xDShK, 2 Hardpoints	300x12.7mm
J-1	RWR, Flare/Chaff (25/20)	515/475m Hardened Runway	+2	3xDShK, 8 Hardpoints	500x12.7mm

G-4 Super Galeb

Notes: This is the replacement for the G-2 in Yugoslav service, and also is used by Burma. The SOKO factory in Bosnia was dismantled in 1992, and production ceased at that time; however, the existing stocks of the Super Galeb were used by both Yugoslavia and Bosnia. The Super Galeb has a more aerodynamic shape and better performance than the Galeb, as well as better avionics. The G-4M is a dedicated light attack aircraft with further improved avionics and attack ability.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
G-4	$2,015,900	AvG	1.28 tons	6.3 tons	2	12	None	Enclosed
G-4M	$4,647,170	AvG	1.68 tons	6.14 tons	1	14	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
G-4/G-4M	1680	420 (105)	NA 210 7/4 70/40	1215	1777	12850	FF3 CF3 RF3 T2 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
G-4	RWR, Flare/Chaff (35/25)	530/490m Hardened Runway	+2	23mm GSh-23L Autocannon, 4 Hardpoints	250x23mm
G-4M	RWR, Flare/Chaff (35/25), HUD, Laser Designator (11 km) Inertial Navigation	530/490m Hardened Runway	+2	23mm GSh-23L Autocannon, 4 Hardpoints	250x23mm

Avro Vulcan

Notes: The Vulcan is – well, a *huge* bomber. It is in the class of the American B-52 Stratofortress and the B-47 Stratojet. Vulcans began research in 1952, with first deliveries beginning in 1956. The Vulcan at first filled the British air leg of its Nuclear Triad; later, most were converted to tankers. The Vulcan is a delta-winged tailless design with an absolutely huge wing; this design was chosen to allow the original Vulcans to fly high over Eastern Europe and the Soviet Union, and otherwise have long legs. Of the V-Bombers, the Vulcan was the technically most advanced. The Vulcans are now retired, except for three (one B.1 and two B.2s), which are kept in flying condition for appearances in air shows. Many pilots feel that the Vulcan handles astonishing well for its size; Avro test pilot Roland Falk even underlined this by putting a prototype Vulcan into a slow barrel roll while overflying officials and test personnel. Reportedly, Falk was so low that he smashed all the skylight windows in the Avro assembly building (he was admonished sternly to avoid this kind of dangerous maneuver in the future). However, the Vulcan did receive its Certificate of Airworthiness less than a month afterwards, and Falk did another low-level barrel roll at the 1955 Farnborough Air Show.

It is interesting that in the early 1980s, Argentina approached Britain with an offer to buy a number of Vulcans, which were at that point retired from the RAF. Britain was suspicious of the Argentine offer, with the Foreign and Commonwealth Office of the MoD noting that the Vulcans could be very useful to the Argentines in an invasion of the Falklands. And notably, Argentina invaded the Falklands three months later. It is there that the Vulcans were employed in their only combat action.

The Australians also considered the Vulcan B.1A as an interim bomber until they could start receiving the TSR.2s, which at the time were still delayed and not yet cancelled. The Australians again considered the Vulcan on an interim basis until their version of the F-111C was ready.

It is also notable, that Vulcans took part in the 1960, 1961, and 1962 Operation Skyshield, exercises, where they simulated Russian bomber attacks against New York, Chicago and Washington. The results of Operation Skyshield exercises were classified until 1997, and it was then found that the Vulcans had easily slipped through American and Canadian air defenses and delivered their simulated payloads to their targets without a problem. This apparently also happened during the 1974 Giant Voice exercise, against supposedly greatly tightened and improved American and Canadian air defenses.

As their airframes aged, starting in the mid-1980s the tactical nuclear weapon delivery roles were given to the Tornado and Jaguar aircraft. Strategic nuclear delivery was given to Britain's boomers. The remaining Vulcans became museum pieces (except for the three examples kept in flying condition – see the B.2 below. Many ended up in US, Australian, and Canadian bombing ranges; some were apparently farmed out to special ops units to practice seizing enemy aircraft. A few others were kept for as long as a decade (in one case) to conduct various flight tests of engines and avionics. The Vulcan Restoration Trust raises money to keep more Vulcans in museum condition, and is responsible for the Vulcans still flying.

Vulcan B.1

The B.1, when first tested, required a large wing design; the original wing was more of a swept/delta wing. This proved to make the B.1 unstable, and the wings were enlarged to a full delta design with a curve in the mid-wing. The original B.1s were fitted with Rolls Royce Olympus 101 engines, four engines in total, with a power rating of 11,000 pounds of thrust each. 15 of these were so equipped, after which a few were re-engined to Olympus 102 engines, with 12,000 pounds of thrust each, this was done due to fluttering on the wingtips with the Olympus 101 engines. The B.1A was fitted with 13,500 pounds thrust Olympus 104s each; it also required smaller inlets. (These were the engines that were supposed to power the cancelled TSR.2.) B.1s had a bulged fairing at the rear of the fuselage; this carried a tail-warning radar with a 45-degree angle of sweep to either side of the midline, along with the aircraft's ECM/ECCM suite and the IR flares. The electronics required for the use of the Skybolt SRAM, though the actual capability to carry and fire Skybolts was not installed until the advent of the B.2. In addition, part of the avionics for the later Olympus 200 engines were installed into the wings, though again those engines were not installed until the B.2s made their appearance.

The designers would have preferred to stack the engines on either side on top of each other, but the wing was so thin that this proved impossible.

Despite modifications to the tail, wings, and engines, the Vulcan B.1 still tended to pitch upwards at high speed. An auto-mach trimmer feature was added to help tame this effect; nonetheless, the B.1 still tended to pitch up a bit and the control stick actually had to be continually corrected forward by the pilots. Before the auto-mach trimmer was installed, the Vulcan had a tendency to pitch up into a stall, then enter an uncontrollable dive at high speed that only the skill of the test pilots manage to avoid a crash. (The Vulcan had a fighter-type control stick instead of the control yoke more common on large aircraft.) Vulcans were painted anti-flash white to help with the flare from nuclear explosions, and the cockpit windows had thick panels to slide over the windows to prevent blinding the crew from the same; on a run up to a target, the Vulcans flew on instruments, and using bombing radar. (Bombing radar could also used to drop conventional weapons, but a computerized bombsight was the normal procedure for this eventuality. In any case, the only instance of combat conventional bombing was during Operation Black Buck during the Falklands War.

The B.1's primary weapons load was either conventional 450-kilogram bombs or nuclear free-fall bombs. Due to the size of the nuclear bombs of the time, the load of nuclear bombs which could be carried was much smaller than its conventional bomb load. (By the time smaller nuclear bombs were available, the Vulcan was out of the nuclear-bomb-delivery business.). The weapon system operator, behind and below the pilot, was able to conduct visual or radar bombing. The pilot and co-pilot were also able to conduct radar bombing (at degraded accuracy), and fire any missiles carried by the Vulcan. Beside him was the air electronics operator, controlling and tweaking the ECM/ECCM suite, as well having auxiliary radar screens and able to deploy things like chaff, flares, and even decoys on the rare occasions when they were carried. In between them and behind was the nav plotter (navigator). The Vulcan carried its fuel in 12 bag-type tanks; their capacities were spilt into four equal sections, each feeding one of the engines. If one bag was holed, no more than 10% of the fuel load of that bag would be lost. Cross-feed was possible between bag groups, in case an engine went out or for some reason was sucking more fuel than normal.

The original specification for the Vulcan called for a jettisonable crew capsule, which have ejected the entire flight deck in an emergency. Avro, however, was never able to make this work, and the capsule was replaced by conventional ejection seats. The B.1s (and later Vulcans) had ejection seats for the pilot and copilot, but the other three crewmen had fall-away hatches and simply fell out of the bottom of the aircraft. If passengers were carried, they had to manually get out of their seats and drop out of one of the hatchways vacated by the rest of the crew.

Due to its shape, the Vulcan has a measure of “accidental stealth,” even though in this era things like RCS and stealth were not even thought of when designing a warplane.

At 90% power or greater, the Vulcan would emit a howling noise, caused by the arrangement of the air intakes. Though not tactically important, it was one of the things that made the Vulcan popular at air shows.

The original B.1s were painted in all over glass antiflash white and with colored RAF roundels. Some were also left with a natural metal finish, with a black radome and colored RAF roundels. With the adoption of the low-level penetrator role (primarily applicable to the B.2, as the B.1s were never strengthened for low-level penetration), Later B.2s were painted dark sea gray with dark green stripes, and a gray bottom. This was later changed to a wrap-around camouflage finish which was more effective in the low-level penetration role.

The B.1 had a rather short refueling probe, mounted in the nose. This probe position made is difficult for the pilot of the Vulcan to conduct aerial refueling (One level more of difficulty when trying aerial refueling in a B.1). The B.2s had a longer refueling probe that ran alongside the cockpit and extended beyond the cockpit. This allowed the pilot to aim the refueling probe easier.

Vulcan B.2

The Vulcan B.2 began with a re-engining in 1960; early in the B.1s development, the Olympus 6 was actually the first engines installed in the B.1. These had high thrust, which would have enabled the B.1 to carry more ordnance; but introduced a wingtip flutter, which would have required a further redesign of the wings. The first B.2 had Olympus 200 engines, which were improved Olympus 6s. The Olympus 200, like the Olympus 6, had 16,000 pounds thrust each. These were quickly replaced with Olympus 201s, which allowed the B.2 to carry a heavier fuel load and ordnance load. Later, the Olympus 201s were upgraded to 202s, which had the same thrust, but increased reliability by including a rapid air starter and a redesigned oil separator breathing system. The B.2 also featured a larger wing, an improved electrical system, improved ECM/ECCM, and a tail-warning radar with a 60-degree sweep to either side. The B.2 retained the later versions of the B.1’s narrower air inlets, though the actual intake was deepened. The B.2s could accommodate one or two additional fuel tanks in its bomb bay, something that became useful in later tanker variants of the B.2. Radar updates included general updates to range, discrimination, and miniaturization of components, as well as the addition for TFR, should the B.2 be used for low-level “skiing.” In the late 1970s, the B.2 was also updated with the ability to carry smart bombs in the weapons bay (though smart missiles still had to be carried on the hardpoints).

Later B.2s were equipped with Olympus 301 engines which could develop 30,000 pounds thrust each, but in normal practice were derated to 18,500 pounds thrust to conserve fuel and wear on the engines. These engines were uprated back to 30,000 pounds thrust for Operation Black Buck, the Vulcan strikes on the Falklands. (See Below.) The B.2 (and the K.2) were equipped with an early fly-by-wire system; the electronics did not have the full control as on modern fly-by-wire aircraft, but the Vulcan was difficult to control if the electronic system went out.

In the early 1970s, the B.2s got a general airframe strengthening to make them strong enough for long low-altitude flights, as they were to be used in the low-level penetration role. The Vulcans did do their low-level work successfully, but because of the size and design of the Vulcan, speed was severely hampered at low altitude. At typical altitudes where the aircraft’s TFR would be used, speed was often reduced to as little as 560 kilometers per hour. Fighters in exercises often found them easy pickings; however a new paint scheme that Vulcans started to deploy proved quite effective at low level. After this, the Vulcan Pilots got very adept at slipping past fighter screens.

The B.2 was from the beginning designed to carry two American-made Skybolt nuclear-tipped standoff missiles; they were also still able to carry conventional or free-fall nuclear bombs in its bomb bay. The Skybolts were too big to fit in the Vulcan’s bomb bay, and they were carried on two hardpoints under the air inlets. Unfortunately, late in development, the Skybolt was cancelled by the US DoD, and the British had to scramble to find a replacement. British designers worked overtime and produced the Blue Steel, a weapon which actually lighter and carried a higher-yield 1.1-megaton warhead. (Conventional-warhead Blue Steels were not produced and in fact never designed.) These hardpoints became important during Operation Black Buck.

Vulcan B.3

The B.3 was a projected enhanced version of the B.2, upon which development would have been started in 1960. The wing would have been massively larger, and six hardpoints would have been available for use with Blue Steel missiles or other missiles with conventional or nuclear warheads. Fuel capacity would be increased, including bag-type tanks in a dorsal spine and larger wing tanks. The landing gear would have been strengthened to support the increased weight. The engines would have been Olympus 23s with a power rating of 23,500 pounds thrust each. The fuselage would have been 3.28 meters longer, allowing a larger crew compartment to be installed, including a reclining seat for a relief pilot, an additional weapons system/defensive systems operator, and a folding passenger seat if needed. The Vulcan B.3’s job would have been that of a patrol/armed reconnaissance aircraft, particular for maritime patrols; it would range the battlefield or ocean at medium altitude (above most of the light or medium land or shipborne SAMs of the time). The B.3 would also have benefitted from the rapid increase in electronic advancements, included better ECM/ECCM, IRCM, additional packet flares and chaff, and a larger corridor chaff pod. The larger wings would have allowed for additional fuel in the wings. The larger wings would have also allowed for six missiles on wing hardpoints, and though they were initially designed for Blue Steel nuclear missiles, they could also carry two ALCM or four SRAMs on each hardpoint or a variety of conventional PGM or ARM (depending on the size of the weapon, up to six munitions could be carried on each hardpoint). The B.3 never got out of the development stage before it was cancelled.

Vulcan B.3s would have a modified fighter radar and could also carry AAM on its hardpoints, up to three per hardpoint (at this time in history, the AAMs would be Sidewinders, Sparrows, Red Tops, Skyflashes, or other NATO missiles of similar function and time frame).

An interesting variant of the B.3 would have carried three Gnat fighters on modified hardpoints under the wings and fuselage. They modified hardpoints were not designed to allow the Gnats to return to the Vulcan, and they would have refueled from tankers and returned to base or the battle area after completing their initial nuclear-delivery mission. (This version is not statted here.) Another interesting variant would have had the B.3 with hardpoints filled with ARMs and essentially acting as a large, long-ranged Wild Weasel.

Vulcan K.2

The K.2 was a tanker based on a converted B.2, also known as a B(K).2 or B.K2 or B.2(K). Though there a couple of conversions which were done before the Falklands War, the War and the decision to use Vulcan B.2s suddenly emphasized the need for tankers, both to support the bombers for Operation Black Buck and aircraft at home. More conversions were than done at warp speed, and eventually six such conversions were done. (As it was, however, Victor tankers were used for the Black Buck missions.) The Vulcans were fitted with three drum-type tanks in the bomb bay containing 15005 liters each, and a Mk 17 HDU (Hose Drum Unit) in the tail, in the space where part of the ECM/ECCM was installed. The tail warning radar also had to be deleted. The K.2 had large white rectangles on the bottom of the fuselage, with narrow red stripes on the white ones along the center of the fuselage, to better allow refueling aircraft to line up with K.2; in addition, the tail cone had three bright lights on each side of the HDU. The K.2's HDU was capable or transferring fuel at the rate of 1900 or 4000 liters per minutes, depending upon the capabilities or needs of the receiving aircraft.

The K.2 did not enjoy a long service life with the RAF, as the Vulcan was being retired due to airframe age and the HDUs used were essentially what Avro had laying around and were no longer manufactured. Not even parts were being manufactured and when an HDU needed a part to replace something broken, the unit machine shop had to make a new one. There was a push to replace the ad hoc HDUs with new Mk 17 HDUs, but these were allocated to the VC-10 tanker program and none were allocated for Vulcan use. As the number of VC-10 tankers increased, tankers based on the Vulcan (and the other V-Bombers) were no longer needed. The K.2.used the same Olympus 301 engines as the B.2, but they were derated to 18,500 pounds thrust.

The K.2s were the last Vulcans to fly operationally, and this squadron was retired in March 1984.

Vulcan B.2 (MRR)

Nine Vulcan B.2s were converted for Maritime Radar Reconnaissance (MRR). (These were also known as the SR.2, for Strategic Reconnaissance, as they were often used in this role.) Some electronics that were not needed, were removed or replaced by other equipment, while other equipment was added in. The MRR was equipped with a sonobuoy dropper and more powerful radar set; in particular, the bombing radar was improved, as it faced down. A separate look-down radar set was installed, as well as SLAR and an steerable IR sensor under the nose. A MAD boom was fitted internally in the tailcone. They were also fitted with additional navigation gear and avionics appropriate to their role. The engines were the same as those on the B.2, though they were derated to 18,500 pounds thrust to conserve fuel and allow longer missions, Hardpoints were typically used for antishipping missiles (the MRR had four hardpoints under the intakes), Under each wing near the outside were mounted air sampling units, used for the MRR's secondary role as an air sampling aircraft. The MRR normally operated at high altitude, but would occasionally go to low altitude for closer inspection of shipping. The MRR had small sampling pods under each wing, both to detect and measure exhaust from ships and their supporting aircraft and to detect and sample nuclear explosions if necessary.

Operation Black Buck

Operation Black Buck was the operational name given to the Vulcan operations during the Falklands War. (I have seen in one source the Vulcans modified for Black Buck being designated "B.2 BB," but I doubt this is an official designation as it appears only in this one source.) The Vulcans staged from Ascension Island, as this island had the closet runway and base to the Falklands that could handle the Vulcans and their supporting tankers. Ascension was still 6900 kilometers from Britain and 6100 kilometers from the Falklands. Black Buck was basically what would later be called by President George W Bush as a "shock and awe" campaign; there were actually no strategic or tactical targets in the Falklands or on South Georgia Island would make Vulcan bombardment necessary, and though Brazil gave permission for the Vulcans to stage out of the airport at Rio de Janeiro, Margaret Thatcher didn't want to take the chance of widening the conflict to a general South American War. The Wideawake base on Ascension Island was actually a USAF base; the fact that the British aircraft were staging from an American base was not acknowledged until it appeared in the press several months later.

The long ranges made the Vulcan bombers completely dependent on the 23 Victor K.2 tankers available to the RAF (the Vulcan

K.2 not being modified from the B.2 at that point). Nine tankers were required to get one Vulcan to the Falklands, plus one alternate Vulcan, which would also carry our an alternate bombing mission if it did not need to take over for a defective Vulcan. Each tanker would refuel the Vulcans once, then turn back to Ascension Island. Next, another Victor would refuel the Vulcans and then be refueled by another Victor, and then go back to Ascension Island. And this would continue until the Victors used all their refueling fuel and had turned back to Ascension Island. If a Vulcan had to turn back, this aircraft would still have to refueled so it could make it back to Ascension Island. As the tankers arrived back at Ascension Island, they were refueled and their fuel tanks for refueling were replenished, and then they immediately took off to support the Vulcans as they returned from the Falklands. For the flight from the UK to Acension, unknown to the world until about two years after the Falklands War, the Vulcans and Victor tankers were actually refueled by American KC-135s staging out of the Canary Islands, and using British call-signs.

As stated above, the Vulcans' Olympus 301 engines, normally derated to 18,500 pounds thrust, were restored to 30,000 pounds thrust, allowing the Vulcan to carry a greater fuel load (drum-type tanks took up part of the bomb bay), and still carry a respectable load of 450-kilogram bombs, and keep up a decent speed on the run in to their targets. The Vulcans carried a reduced bomb load of 21 bombs for these missions.

Before the actual bombing runs, a Victor reconnaissance variant took a run over South Georgia Island and the Falklands, both in support of Operation Black Buck and on behalf of an SAS group which to recapture South Georgia Island. (Operation Paraquet is an interesting story in itself.) This Victor recon variant itself took a large amount of tanker support. A dangerous daylight photoreconnaissance run at high speed was also undertaken by a pair of Sea Harriers prior to the Black Buck strikes. Another such run was undertaken after each Vulcan strike. These Sea Harrier runs caused controversy in the Task Force as the Vulcan strikes were to conduct strikes that the Sea Harriers couldn't do much damage to or would be highly dangerous to the Sea Harriers.

The Vulcans' initial jobs, Black Buck 1-3, was to crater the runway at Port Stanley, which was being used by Argentine aircraft. It was also expected that parked aircraft near the runway and support facilities and antiaircraft guns and missiles near the runway might also be damaged or put out of commission. To minimize the utility of those AAA guns and SAMs, the Vulcans would bomb at night, preferably in bad weather, from low level (about 150-300 meters).

The Black Buck Vulcans were modified by the addition of a Carousel INS navigation system, additional ECM/IRCM pods carried on improvised underwing pylons, advanced IFF, and additional flare dischargers. In addition, the Black Buck 4-6 aircraft had modifications to its hardpoints, and additional avionics at the WSOs and pilot's position to allow the Vulcans to use the Shrike ARMs.

Black Buck 4,5, and 6 had two Vulcans carrying Shrike ARMs on the under-air-intake pylons. At the time, the British standard ARM was the Martel, which was long known to be inaccurate and inadequate for the Black Buck missions, which was to destroy the radar, SAM sites, and radar-directed AAA, which were still a problem at Port Stanley. The US gave the Shrikes, plus some spares, to the British "under the table", and this was not revealed until one of the Black Buck 6 bombers had a fuel-feed problem and got permission to divert their landing to Rio de Janeiro. The crew and aircraft were held for nine days, during which the fuel feed problem was fixed, but also Brazilian technicians gave the Vulcan a good examination – especially the one Shrike missile the Vulcan landed with, which was not expended in the strike on Port Stanley.

Black Buck 7's job was essentially in support of ground forces; the Vulcans bombed any remaining intact aircraft as well as the Argentine garrison.

Twilight 2000 Notes: Vulcans, including at least three B.1s, served in the RAF during the Twilight War. They were used mostly for conventional bombing, but did on occasion deliver tactical nuclear weapons, and were known for using what became known as the "one-two-melt" – the delivery of two tactical nukes to one target with less than a second between dropping them (usually the bombs were slowed by small parachutes to allow the Vulcans to gain distance from the nuclear explosions).

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
B.1 (Olympus 101 Engines)	$135,537,599	JP-A	32.55 tons	77.11 tons	5+2	48	Radar (300 km), Weather Radar (500 km), Bombing Radar (200 km), Tail Radar (100 km)	Shielded
B.1 (Olympus 102 Engines)	$145,536,128	JP-A	35.39 tons	77.11 tons	5+2	48	Radar (300 km), Weather Radar (500 km), Bombing Radar (200 km), Tail Radar (100 km)	Shielded
B.1A	$145,860,400	JP-A	37.26 tons	77.27 tons	5+2	48	Radar (300 km), Weather Radar (500 km), Bombing Radar (200 km), Tail Radar (100 km)	Shielded
B.2 (Early)	$191,301,330	JP-4	40.28 tons	78.22 tons	5+2	50	Radar (400 km), Weather Radar (600 km), Bombing Radar (300 km), Tail Radar (150 km)	Shielded
B.2 (Mid)	$196,609,035	JP-4	40.48 tons	77.79 tons	5+2	52	Radar (400 km), Weather Radar (600 km), Bombing Radar (300 km), Tail Radar (150 km)	Shielded
B.2 (Late)	$232,950,071	JP-4	41.19 tons	79.73 tons	5+1	54	Radar (400 km), Weather Radar (600 km), Bombing Radar (300 km), Tail Radar (150 km), TFR (40 km)	Shielded

B.2 (Black Buck)	$239,202,479	JP-4	51.83 tons	80.8 tons	5	56	Radar (400 km), Weather Radar (600 km), Bombing Radar (300 km), Tail Radar (150 km), TFR (40 km)	Shielded
B.3	$410,614,936	JP-4	46.03 tons	81.77 tons	5+1	58	Radar (400 km), Weather Radar (600 km), Bombing Radar (300 km), Tail Radar (150 km), TFR (40 km), SLAR (150 km), VAS (40 km)	Shielded
K.2	$233,285,450	JP-4	390 kg	82.39 tons	5+1	58	Radar (400 km), Weather Radar (600 km)	Shielded
B.2 (MRR)	$255,919,221	JP-4	1.2 tons	80.53 tons	5+1	58	Radar (400 km), Weather Radar (600 km), Tail Radar (150 km), SLAR (150 km), IRST (40 km), VAS (50 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap*	Fuel Cons	Ceiling	Armor
B.1 (Olympus 101 Engines)	1492	414 (94)	NA 18 4/3 40/30	42200	2727	17000	FF8 CF7 RF6 T5 W6
B.1 (Olympus 102 Engines)	1625	451 (87)	NA 20 4/3 40/30	42200	4066	17000	FF8 CF7 RF6 T5 W6
B.1A	1820	506 (87)	NA 22 4/3 40/30	42200	4574	17000	FF8 CF7 RF6 T5 W6
B.2 (Early)	2126	591 (87)	NA 27 4/3 40/30	44500	5421	18830	FF8 CF7 RF6 T5 W6
B.2 (Mid)	2138	594 (87)	NA 27 4/3 40/30	44500	5421	18830	FF8 CF7 RF6 T5 W6
B.2 (Late)	2601	722 (87)	NA 33 4/3 40/30	44500	6777	18830	FF8 CF7 RF6 T5 W6
B.2 (Black Buck)	3835	1065 (87)	NA 49 4/3 40/30	54500	10166	18830	FF8 CF7 RF6 T5 W6
B.3	2975	827 (82)	NA 38 4/3 40/30	54570	7964	18900	FF8 CF7 RF6 T5 W7
K.2	2331	648 (87)	NA 30 4/3 40/30	44500 + 45015	6269	18830	FF8 CF7 RF6 T5 W6
B.2 (MRR)	2575	715 (77)	NA 33 4/3 40/30	44500	6777	18830	FF8 CF7 RF6 T5 W6

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
B.1	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, LABS, Flare and Chaff Dispensers (60 Flares, 60 Chaff), Stealth 1	1900/1500m Hardened Runway	+1	Internal Weapons Bay, 2 Semi-Recessed Hardpoints	Normal Load 21x450 kg Gravity Bombs or two Blue Danube Nuclear Bombs or two Mk 5 Nuclear Bombs or four Red Beard Nuclear Bombs, two Blue Steel Nuclear SRAM Missiles on Hardpoints; Other

					Loadouts Possible
B.1A	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN-C, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, LABS, Flare and Chaff Dispensers (70 Flares, 70 Chaff), Stealth 1	1900/1500m Hardened Runway	+2	Internal Weapons Bay, 2 Semi-Recessed Hardpoints	Normal Load 21x450 kg Gravity Bombs or two Blue Danube Nuclear Bombs or two Mk 5 Nuclear Bombs or four Red Beard Nuclear Bombs, two Blue Steel Nuclear SRAM Missiles on Hardpoints; Other Loadouts Possible
B.2 (Early)	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, Flare and Chaff Dispensers (70 Flares, 70 Chaff), Stealth 1	1900/1500m Hardened Runway	+2	Internal Weapons Bay, 2 Semi-Recessed Hardpoints	Normal Load 32x450 kg Gravity Bombs or four Red Beard Nuclear Bombs, or one Yellow Sun Thermonuclear Bombs or six x WE.177B Retarded Nuclear Bombs, two Blue Steel Nuclear SRAM Missiles on Hardpoints; Other Loadouts Possible
B.2 (Mid)	IFF, RWR, Secure Radios (One 1000 km, One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 3, ECCM 3, Flare and Chaff Dispensers (80 Flares, 80 Chaff), Stealth 1, Laser Designator (20 km)	1900/1500m Hardened Runway	+2	Internal Weapons Bay, 2 Semi-Recessed Hardpoints	Normal Load 32x450 kg Gravity Bombs or LGBs, or four Red Beard Nuclear Bombs, or one Yellow Sun 2 Thermonuclear Bombs or six x WE.177B Retarded Nuclear Bombs, two Blue Steel Nuclear SRAM Missiles or PGM on Hardpoints;

					Other Loadouts Possible
B.2 (Late)	IFF, RWR, Secure Radios (One 1000 km, One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 3, ECCM 3, IRCM 1, Flare and Chaff Dispensers (80 Flares, 80 Chaff), Corridor Chaff Pod (100), Stealth 1, Laser Designator (30 km)	1900/1500m Hardened Runway	+3	Internal Weapons Bay, 2 Semi-Recessed Hardpoints	Normal Load 32x450 kg Gravity Bombs or LGBs, or four Red Beard Nuclear Bombs, or one Yellow Sun 2 Thermonuclear Bombs or six x WE.177B Retarded Nuclear Bombs, two Blue Steel Nuclear SRAM Missiles or PGM on Hardpoints; Other Loadouts Possible
B.2 (Black Buck)	Advanced IFF, RWR, RDF, Radar Direction Finder, Secure Radios (One 1000 km, One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 3, ECCM 3, IRCM 2, Flare and Chaff Dispensers (90 Flares, 90 Chaff), Corridor Chaff Pod (250), Stealth 1, Laser Designator (35 km)	1900/1500m Hardened Runway	+3	Internal Weapons Bay, 2 Semi-Recessed Hardpoints	21x450 kg Gravity Bombs (LGBs Possible, But Not Carried During Black Buck), 4x Shrike ARMs on Double Mounts on two Hardpoints (Only Used On Black Buck 4, 5, and 6 Missions). Other Loadouts Possible (But Not Used); Nuclear Weapons carry Possible (Again, Not Used During Black Buck); 10,000-Liter Fuel Tank carried in Bomb Bay
B.3	Advanced IFF, RWR, RDF, Radar Direction Finder, Secure Radios (One 1000 km, One 700 km, Two 300 km, One AM), Digital Computerized Bombsight, Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN, TACAN, Radar	1900/1500m Hardened Runway	+3	Internal Weapons Bay, 6 Heavy Hardpoints Under Wings	Normal Load 32x450 kg Gravity Bombs or LGBs, or four Red Beard Nuclear

	Beam Riding, Radio Beacon Detection, ILS, ECM 3, ECCM 4, IRCM 2, Flare and Chaff Dispensers (100 Flares, 100 Chaff), Corridor Chaff Pod (250), Chaff Rockets (4) Stealth 1, Laser Designator (40 km), Multitarget (4)				Bombs, or six x WE.177B Retarded Nuclear Bombs, Blue Steel, Nuclear SRAM Missiles or ALCM or PGM or AAM on Hardpoints; Other Loadouts Possible
K.2	IFF, RWR, Secure Radios (One 1000 km, One 700 km, Two 300 km, One AM), Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 1, ECCM 1, Flare and Chaff Dispensers (60 Flares, 60 Chaff), Stealth 1	1900/1500m Hardened Runway	Nil	3x15005-Liter Fuel Tanks in Internal Weapons Bay	3x15005-Liter Drum Fuel Tanks. HDU Mk 17 Unit
B.2 (MRR)	Advanced IFF, RWR, Secure Radios (One 1000 km, One 700 km, Two 300 km, One AM), Transponder, Inertial Navigation, Gyrocompass, Barometric Altimeter, LORAN-C, Radar Beam Riding, Radio Beacon Detection, RDF, Radar Direction Finder, ILS, ECM 2, ECCM 2, IRCM 1, MAD Array, Sonobuoys (50), F.95 Film Day/Night Camera, Flare and Chaff Dispensers (80 Flares, 80 Chaff), Laser Designator (40 km) Stealth 1	1900/1500m Hardened Runway	+3	Internal Weapons Bay, 4 Hardpoints, 2 Atmospheric Sensing Pods	Normal Load 21x450 kg Gravity Bombs or LGBs, Nuclear Weapons Carry Possible, SRAM or PGM on Hardpoints; Other Loadouts Possible

*Vulcan Bombers could carry up to three 10,000-liter drums of extra fuel in their bomb bays, and still carry a reduced load of bombs. (The Black Buck loadout included one of these drums.) The K.2, of course, cannot carry these drums, as their bomb bays are filled with much larger drums for refueling other aircraft. The B.2 MRR typically carried a full complement of three of these drums.

English Electric Canberra

Notes: The initial requirement for what became the Canberra was issued in 1944 for an aircraft to replace bomber versions of the Mosquito. The Air Ministry called for a medium bomber which had an ability to bomb from high altitude with a good level of accuracy. The RAF received the first Canberra in 1951. The RAF, at the Canberra's peak, had 900 Canberras; Australia also used 49 Canberras, and 403 modified forms designated B-57 Canberra were used by the US (and built by Martin in the US); other users include the Royal New Zealand Air Force and Indian Air Force. Later users of the Canberra include Argentina, Chile, Ecuador, Ethiopia, France, Pakistan, Rhodesia (current fate unknown), South Africa, Sweden, West Germany, Venezuela, and Peru. The Canberra has sometimes been described as appearing to look like a scaled-up Gloster Meteor.

English Electric deemed that the needed performance could be attained without the use of swept wings or tail. The basic design presented to the Air Ministry, had numerous problems and several redesigns had to be carried out before the Air Ministry would accept the Canberra. In addition, the Air Ministry seemed to have a great deal of difficulty deciding what featured they wanted in the future Canberra, also leading to several redesigns and tweaks. Some of these were the use of uprated Avon RA 3 engines instead of the lower-rated Nene engines; the Canberra's distinctive wingtip teardrop-shaped extra fuel tanks were added. Early fight testing revealed instances of buffeting in the rudder and elevator; after these were corrected, pilots remarked that the Canberra handled more like a fighter than a bomber.

The Martin B-57 Canberra will be covered in US Bombers.

RAF Canberras

The first production version, the Canberra B.2, had 132 orders from the Air Ministry, in bomber, reconnaissance, and training variants. As the advanced H2S Mk9 bombing radar meant for the B.2 was not ready for production when the B.2 was built, the B.2. had a glazed nose for a bombardier using an advanced version of the US Norden bombsight. When the Korean War broke out, the demand for B.2s increased, with 196 more produced by English Electric, 75 by Avro and Handley Page, and 60 by Shorts. The numbers of B.2s produced was greater than any other Canberra variant. Many of these were stationed in Europe (largely Germany), though many were also sent to the far east, based in Japan.

The B.2 used Rolls-Royce Avon RA 3 engines, one on each wing, developing 6500 pounds of thrust each. Each engine further drove a 6kW generator to power electrical avionics, as the engines did not provide enough power to electronics. At the rear were the two main fuel tanks; a further flexible-bag lace-supported fuel call was mounted in the forward fuselage, it's flexible shape allowing it to fit around the bomb bay and avionics. The B.2 had ejection seats for the pilot and navigator, but the bombardier up front in the glazed nose had to release a hatchway under him, allowing him to fall free from the aircraft, along with his seat, which then separated normally. The two bomb bays could carry a total of 4.5 tons, and in the B.2, this was limited to free-fall bombs. Underwing pylons could carry an additional 900 kilograms. Due to the limits of its range, and its inability to carry the nuclear bombs of the time, the B.2 Canberra was generally relegated to the role of tactical comber. The PR.3 photo-reconnaissance version of the B.2 was modified by the addition of a 36-centimeter fuselage plug, forward of the wing and behind of the cockpit, to house seven types of cameras. In addition, an additional fuel tank was mounted in the bomb bay to allow prolonged dash speeds. The PR.3 can carry stores on wing hardpoints, normally for ECM pods, though it is capable of armed reconnaissance. The Canberra T.4 trainer version of the B.2 differed primarily in being equipped with dual controls and duplication of flight instruments on both side of the cockpit, rather than having all of the navigation equipment.

The B.5 served as the prototype for the B.6, which differed primarily in having a solid nose along with the addition H2S Mk9 radar bombing equipment.; the bombardier remained at his station in the nose. The B.6 moved the main fuel tanks to the wings. A slight, 0.3-meter fuselage stretch, mainly in the forward bomb bay, gave the B.6 the ability to carry the more modern weapons available in its day (about 1953), along with the ability to carry one of smaller nuclear weapons also available at the time. The engines were replaced by Rolls-Royce Avon RA 7 engines, which had a thrust of 7490 pounds each. Some 106 were built for the RAF by English Electric, and Shorts and Harland both built 49 for the RAF. English Electric also built 12 for its first export customers.

The B.15 was an upgraded B.6, designed for low-level tactical strikes. The avionics were modernized and fittings for two cameras were also carried, though the cameras were rarely carried on operational missions. The B.15 was also equipped with LABS. The B.15 could use the AS.30 ASM, carried on wing pylons, though to the size of the AS.30's fins, only one hardpoint could be used when the Canberra was carrying AS.30s. The B.16 was a further upgraded B.15, different primarily in having slightly uprated engines, with 7510 pounds thrust; they were also easier to maintain.

An interdictor version of the B.6, designated the B(I).6, marked the beginning of the transition of the Canberra in the RAF to a more tactical, ground support role. In the B(I).6, the rear bomb bay was taken up with a pack of four HS-404 20mm autocannons. The front bomb bay could also be fitted out with a rotary launcher for 36 50mm Matra SNEB unguided rockets, which could be fired singly or in sets of three, six, 10, 20, or the full 36. The B(I).8 is a further modification of the B(I).6, with the forward fuselage redone to replace the side-by-side seating with a tandem arrangement, the canopy was also offset somewhat to the left. This also allowed the addition of new avionics (and also some which were replaced by more modern, somewhat miniaturized components. The B(I).6 and B(i).8 were still able to conduct the nuclear strike role using its forward bomb bay. In both cases, underwing weapons carriage was increased, with the B(I).6 and B(I).8 primarily having underwing pylons for rockets and bombs. Both had underwing carriage for 1.2 tons of stores. The B(I).8 operated primarily as a long-range interdictor, ranging far behind enemy lines, due to the larger fuel load it carried. Due to their ground support roles, the B(I).6 and B(I).8 were fitted with the LABS (Low-Altitude Bombing System) to increase accuracy of bombing or rocketing as altitudes of 500 meters or less. The LABS could also be used in conjunction with nuclear weapon delivery. The B(I).6 and B(I).8 also had a secondary role as interceptors, and for this role were equipped with air intercept radar, and could carry radar-homing missiles and heat-seeking missiles on their wing pylons. The B)I).8 also had the uprated engines of the B.16.

The B.6(RC), was a very different animal than the B.6. It was a specialist ELINT and EW version, with an enlarged nose for a more powerful forward-looking radar and a SLAR. The bomb bays were primarily filled with its ELINT gear, recorders for the ELINT gear, radar and radio direction finders, and large amounts of ECM gear; they also carried two specialist crewmembers to operate the ELINT/EW suite. The B.6(RC) was part reconnaissance aircraft and part electronic warfare aircraft. Only four were built and went into operation.

The PR.7 variant of the B.6 was another photoreconnaissance variant. The PR.7 had restored its rear fuselage tanks, as well as having the mid-aircraft flexible bag storage and the new wing tanks. It used the more powerful RA 7 engines of the B (I).8 and antilock brakes.

The PR.9 was a greatly-modified version of the PR.7, with the fuselage stretched by 27.72 meters, wingspan was increased by 1.22 meters to improve high-altitude operations, and Rolls-Royce Avon RA 27 engines, which put out 10,030 pounds thrust each. New types of cameras were installed, as well as a primitive form of SAR and look-down radar.

As late as 1957, Canberras stationed overseas (other than Europe) had not yet been modified to deliver nuclear ordnance.

The Canberra U.10 (later redesignated D.10) were B.2s converted to maneuvering target drones. 18 conversions were made. The U.14 (later D.14 were six B.2s converted for the same role for the Royal Navy. These versions will not be otherwise covered here.

T.17s were B.6(RC)s designed for training ELINT/EW crews. An additional seat was added for an instructor. Despite their training role, they are able to function as normal EW/ELINT aircraft, though they have updated components. Unlike most Canberra trainers, the PR.9s do not have dual controls, the crewmembers being trained were the EW/ELINT crewmen. The T.17 were T.19s converted back into conventional training aircraft.

Most T.x Canberras are training aircraft, and have dual controls. They do have functioning weapon bays and have hardpoints typical for Canberras of their time period, to allow the trainees to practice bombing and rocketing.

Four B.2s were sold to the US; these were used to develop the Martin B-57 Canberra, and Martin received a license to build further B-57s in the US. However, not all B-57s were built by Martin.

RAAF Canberras

After World War 2, the Royal Australian Air Force initiated Plan D, which called for a massive reorganization of the Air Force, including the replacement of propeller-driven aircraft by jets. The acquisition of the Canberra was one of the first jets acquired; the first Canberras they got were based on the B.2, (designated B.20) followed soon thereafter by the B.5 (designated the B.50). All of the Australian Canberras (48 in total) were built under license in Australia at the Government Aircraft Factories (GAF). One of the features the Australians requested was the capability for nuclear delivery, though the Australian Canberras never carried nuclear weapons and the Australians kept no nuclear weapons on their soil. Australian B.20s had additional fuel tanks in their wings, while B.50s retained their two rear fuel tanks. Australian Canberra B.2s and B.5s had a single BDAR film camera to the rear of their rear weapons bay.

Australian Canberras saw much combat use, including during the Malaysian Emergency (along with RZNAF and RAF Canberras), and in South Vietnam during the Vietnam War, where they deployed eight Canberras for the ground support role. While their USAF counterparts were usually armed with a pack of M3 .50-caliber or 20mm autocannons, Australian Canberras were not so equipped and were strictly low-level bombers or rocketing aircraft. In addition, Australian Canberras have been modified with the addition of an autopilot and enhanced navigation equipment, including allowing the use of radar beam navigation, TACAN, and the ability to home on a friendly radio or radar beam. They also had updated navigation equipment and bombing equipment, including bombing radar and the H2S Mk9 equipment. Australian Canberras assigned to Vietnam (or for that matter, US B-57s) could not drop napalm canisters from their weapons bays, but could carry them on their hardpoints.

As early as 1954, it was recognized that the Canberra was becoming obsolete. In particular, the Canberra did not have the range for targets in Indonesia, and it was judged that the Canberra would not fare well even against relatively aged aircraft like the MiG-17, Australia evaluated the (cancelled) BAC TSR.2, Dassault Mirage IV, F-4 Phantom II, and A-5 Vigilante, and even looked at the Vulcan and Victor, before settling on a modified version of the F-111C..Despite the procurement of the F-111, the Canberra remained in service until 1982. (Supposedly, if the RAAF had its way, it would have gone with the TSR.2, but the British seemed intent on cancelling the project.)

The Australians used a small number of PR.7 (designated PR.17s)., The PR.7s saw extensive use in the Malaysian Emergency and over Indonesia, due to its increased range.

RZNAF Canberras

New Zealander Canberras are B(i).8s modified by the addition of an autopilot and enhanced navigation including updated to allow radar beam navigation, TACAN, and the ability to home on a friendly radio or radar beam.

Indian Air Force Canberras

In 1972, the US sold the Indians a small number of Standard ARMs, later followed by Shrike ARMs. The sale also included an unknown number of the then-new Paveway I laser-guided bombs, along with laser designators. This undisclosed sale included avionics for use of the missiles and ECM pods; it was not publicly acknowledged until the Indians retired their Canberras in 2007. The Indians used B(I).5s (modified to B(I).6 standards), which were designated B(I).58s, and they bought 54 of them; six were modified for Wild Weasel duty, but used the same designation, The Wild Weasels were further modified with chaff and flare dispensers In Wild Weasels, the bombardier also functions as the EW officer, and has a downlinked TV viewer to spot the targets. He also operates the EW gear and the ARMs. The Indians also bought eight PR-57 photo reconnaissance versions, and six T.4 training variants. Indian Air Force Canberras had autopilots and updated navigation gear, as per the RAAF Canberras above.

South African Canberras

South African Canberras were B(I).8s, and were mostly used for armed reconnaissance.. with the gun pack and rocket pack in the weapons bays and rockets on the wing hardpoints., They were also modified with enhanced navigation gear and had an autopilot. Radios had an encryption/decryption system (essentially a more clumsy system of secure radios). Essentially, with different makes of avionics, they are the same as RZNAF Canberras.

Swedish Canberras

The Swedish bought two B.2s in 1960, and then had them modified to T.11 trainers. However, this was a ruse; in Sweden, the two Canberras were re-modified into EW/ELINT versions, similar to the B.6(RC), though with a more advanced ELINT suite. They were officially designated as would be a training aircraft, with the designation of Tp.52, and referred to as “testing” aircraft. These aircraft were used primarily to eavesdrop on Soviet, Polish, and East German radio and radar emissions. The modifications were not admitted to for ten years.

Twilight 2000 v1/v2/v2,2s: The Canberra was primarily used in the Twilight War by Britain for reconnaissance, though it was sometimes used for attack, and other countries also used it for bombing.

Twilight 2013: Few flying examples exist; most of these are employed In research (such as by NASA and the USGS).

Merc 2000:Some Merc organizations looking for a non-descript bomber or jump aircraft (the paratroopers being carried in the weapons bays) employ Canberras

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
B.2	$7,135,859	JP-A	5.44 tons	20.86 tons	3	41	None	Enclosed
PR.3	$15,285,386	JP-A	900 kg	21.26 tons	3	49	Cameras (7)	Enclosed

B.6	$9,844,437	JP-A	6.06 tons	20.86 tons	3	41	Radar (100 km), Radar Bombing (60 km)	Enclosed
B(I).6	$17,259,665	JP-A	1.2 tons	21.38 tons	3	43	Radar (100 km), Radar Bombing (60 km)	Enclosed
B(I).8	$17,333,201	JP-A	1.2 tons	22.45 tons	3	44	Radar (100 km), Radar Bombing (60 km)	Enclosed
B.15	$11,024,374	JP-A	6.06 tons	20.96 tons	3	42	Radar (120 km), Radar Bombing (70 km)	Enclosed
B.16	$11,024,928	JP-A	6.08 tons	20.96 tons	3	42	Radar (120 km), Radar Bombing (70 km)	Enclosed
B.5(RC)	$20,628,875	JP-A	1.2 tons	24.7 tons	5	51	Radar (150 km), SLAR (150 km)	Enclosed
PR.7	$25,459,710	JP-A	1.2 tons	27.33 tons	3	52	Radar (150 km), SLAR (150 km)	Enclosed
PR.9	$43,026,595	JP-A	1.2 tons	28.7 tons	3	55	Radar (165 km), SLAR (165 km), Passive IR (35 km)	Enclosed
T.17	$31,769,147	JP-A	1.2 tons	24.9 tons	6	56	Radar (165 km), SLAR (165 km), Passive IR (35 km)	Enclosed
B.20	$8,288,111	JP-A	5.44 tons	21.06 tons	3	42	Bombing Radar (60 km)	Enclosed
B.50	$10,351,937	JP-A	6.06 tons	21.06 tons	3	42	Radar (100 km), Radar Bombing (60 km)	Enclosed
B(I).58	$15,589,853	JP-A	6.06 tons	21.08 tons	3	43	Radar (100 km), Radar Bombing (60 km)	Enclosed
B(I).58 (Indian Wild Weasel)	$39,301,130	JP-A	4.86 tons	21.09 tons	3	52	Radar (165 km), SLAR (165 km), Passive IR (35 km)	Enclosed
Tp.52	$42,510,004	JP-A	1.2 tons	25 tons	5	53	Radar (165 km), SLAR (165 km), Passive IR (35 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
B.2	1626	455 (87)	NA 19 6/4 60/40	10500	2642	15000	FF6 CF7 RF6 T5 W5
PR.3	1596	447 (87)	NA 19 6/4 60/40	15876	2642	18288	FF8 CF7 RF6 T5 W5
B.6	1869	524 (87)	NA 22 6/4 60/40	11500	3044	15000	FF8 CF7 RF6 T5 W5
B(I).6	1824	511 (87)	NA 22 6/4 60/40	11500	3044	15000	FF8 CF7 RF6 T5 W5
B(I).8	1742	488 (87)	NA 21 6/4 60/40	12570	3050	15000	FF8 CF7 RF6 T5 W5
B.15	1860	517 (87)	NA 22 6/4 60/40	11500	3044	15000	FF8 CF7 RF6 T5 W5
B.16	1864	518 (87)	NA 22 6/4 60/40	11500	3050	15000	FF8 CF7 RF6 T5 W5
B.5(RC)	1580	439 (87)	NA 19 6/4 60/40	11500	3044	15240	FF8 CF7 RF6 T5 W5
PR.7	1437	399 (87)	NA 17 6/4 60/40	18501	3050	15240	FF8 CF7 RF6 T5 W5
PR.9	1865	518 (77)	NA 22 5/4 50/40	19758	3050	17000	FF8 CF7 RF6 T5 W5
T.17	1574	437 (87)	NA 19 6/4 60/40	11500	3050	15240	FF8 CF7 RF6 T5 W5
B.20	1611	448 (87)	NA 19 6/4 60/40	11500	2642	15000	FF8 CF7 RF6 T5 W5
B.50	1852	514 (87)	NA 22 6/4 60/40	11500	3044	15000	FF8 CF7 RF6 T5 W5
B)I).58	1850	514 (87)	NA 22 6/4 60/40	11500	3044	15000	FF8 CF7 RF6 T5 W5
B(I).58	1849	514 (87)	NA 22 6/4 60/40	11500	3044	15000	FF8 CF7

(Indian Wild Weasel)							RF6 T5 W5
	1562	434 (87)	NA 19 6/4 60/40	11500	3044	15000	FF8 CF7 RF6 T5 W5
Tp.52	2568	435 (87)	NA 19 6/4 60/40	13500	3044	15500	FF8 CF7 RF6 T5 W5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
B.2	IFF, Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Advanced Norden Bombsight, LORAN, Radar Beam Riding, Radio Beacon Detection	1020/805m Hardened Runway	+1	2xInternal Weapons Bay, 2 Hardpoints*	
PR.3	IFF, RWR, Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Cameras (Four Film Cameras, Three IR Cameras), Radio Beacon Detection (100 km), ECM 1	1020/805m Hardened Runway	Nil	2 Hardpoints*******	
B.6	IFF, RWR, Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), LORAN	1020/805m Hardened Runway	+2	2xInternal Weapons Bay, 4 Hardpoints**	
B(I).6	IFF, RWR, Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, Optic Gunsight, LABS, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), LORAN, ECM 1	1020/805m Hardened Runway	+2	2xInternal Weapons Bay (One w/4x20mm Gun Pack, One with 36-round Matra Rocket Pod), 4 Hardpoints***	2880x20mm HS404, 36x50mm Matra Rockets.
B(I).8	IFF, RWR ,Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, Optic Gunsight, LABS, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), Radar Beam Riding Navigation, LORAN, ECM 1	1020/805m Hardened Runway	+2	2xInternal Weapons Bay (One w/4x20mm Gun Pack, One with 36-round Matra Rocket Pod), 4 Hardpoints***	2880x20mm HS404, 36x50mm Matra Rockets.
B.15	IFF, RWR, Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, Optic Gunsight, LABS, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), Radar Beam Riding Navigation, LORAN, ECM 1, One Film Camera, One IR Camera	1020/805m Hardened Runway	+2	2 Weapon Bays, 4 Hardpoints****	
B.16	IFF, RWR, Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, Optic Gunsight, LABS, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), Radar Beam Riding Navigation, LORAN, ECM 1, One Film Camera, One IR Camera	1020/805m Hardened Runway	+2	2 Weapon Bays, 4 Hardpoints*****	
B.5(RC)	IFF, RWR, Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, RDF, Radar Direction Finder, Radio Beacon Detection (100 km), Radar Beam Riding Navigation, LORAN, ECM 2, ELINT 2, Two Film Cameras, Two IR Cameras	1020/805m Hardened Runway	+2	4 Hardpoints*****	
PR.7	IFF, RWR, Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter,	1020/805m Hardened Runway	+2	4 Hardpoints*******	

	Cameras (Four Film Cameras, Three IR Cameras, One Radar Camera), Radio Beacon Detection Optic Gunsight, (100 km), ECM 2				
PR.9	IFF, RWR, Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Cameras (Four Film Cameras, Two Panoramic Film Cameras, Two Panoramic IR Cameras, Primitive SAR (10 km), Three IR Cameras, Two Radar Cameras), Radio Beacon Detection, Optic Gunsight, (100 km), ECM 2	1020/805m Hardened Runway	+2	4 Hardpoints*******	
T.17	IFF, RWR, Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, RDF, Radar Direction Finder, Radio Beacon Detection (100 km), Radar Beam Riding Navigation, LORAN, ECM 2, ELINT 2, Two Film Cameras, Two IR Cameras	1020/805m Hardened Runway	+2	4 Hardpoints*******	
B.20	IFF, Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, LORAN, TACAN, Radar Beam Riding, Radio Beacon Detection, Autopilot	1020/805m Hardened Runway	+2	2xInternal Weapons Bay, 2 Hardpoints*	
B.50	IFF, RWR, Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, LABS, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), LORAN, TACAN, Autopilot	1020/805m Hardened Runway	+2	2xInternal Weapons Bay, 2 Hardpoints*	
B(I).58	IFF, RWR, Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, Optic Gunsight, LABS, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), LORAN, TACAN, ECM 1, Autopilot	1020/805m Hardened Runway	+2	2 Weapon Bays, 4 Hardpoints*****	
B(I).58 (Indian Wild Weasel)	IFF, RWR, Secure Radios (Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, Radar Bombsight, Optic Gunsight, LABS, Cameras (Two Film Cameras), Radio Beacon Detection (100 km), RDF, Radar Direction Finder, LORAN, TACAN, ECM 2, Flare Chaff (6/10), Laser Rangefinder/Designator, Autopilot	1020/805m Hardened Runway	+3	2 Weapon Bays, 4 Hardpoints*******	2 Standard ARMs or 4 Shrike ARMs
Tp.52	Advanced IFF, RWR, Secure Radios (Three 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, RDF, Radar Direction Finder, Radio Beacon Detection (100 km), Radar Beam Riding Navigation, LORAN, ECM 2, IRCM 1, ELINT 2, Two Film Cameras, Two IR Cameras, Flares/Chaff (6/6)	1020/805m Hardened Runway	+2	4 Hardpoints*****	

*Hardpoints may carry only 900 kilograms; weapons bays may carry then 4.54 tons if the hardpoints are filled.

**Hardpoints may carry 1200 kilograms; weapons bays may then carry 4.86 tons if the hardpoints are filled.

***Hardpoints may carry 1200 kilograms, If the forward weapons bay is not taken up with a rocket launcher, the bay may carry up to 3.03 tons of other ordnance.

****Though the B.15 can carry 1200 kg on its hardpoints; however, if it does so, the Canberra may carry only 4.86 tons in its weapon bays   Though the B.15 has four hardpoints, the fins of the AS.30 are large enough that only two AS.30s may be carried.

*****Though the B.16 can carry 1200 kg on its hardpoints; however, if it does so, the Canberra may carry only 4.88 tons in its weapon bays   Though the B.16 has four hardpoints, the fins of the AS.30 are large enough that only two AS.30s may be carried.

******The B.5(RC) can carry 1200 kg on its hardpoints

*******These aircraft can carry bombs and rockets on their hardpoints, and are capable of conducting armed reconnaissance. However, their hardpoints, when used, are normally taken up with ECM pods or chaff and flare pods. The PR.3 can carry 900 kg; the PR.7, PR.9, and T.17 may carry 1200 kg.
********The Indian Wild Weasels can carry ARMs on their hardpoints. Standard ARMs are too big and heavy to carry more than two on the hardpoints. Four Shikes, however, may be carried. ARMs may not be carried in the weapon bays (they normally carried HE bombs to "finish the job."). If ARMs are not carried (the Wild Weasel may carry 6.06 tons in its Weapon Bays).

Handley Page Victor

Along with the other V-Bombers, the Victor is heavily-linked with the United Kingdom's nuclear deterrent; though it did not use ICBMs, it had bombers and (later) boomers. Prototypes began to be tested in 1952, but almost immediately cracking around the bolt-holes holding the tailplane on was detected, including a crash during a full-speed low-altitude pass, killing the entire crew. This was remedied by adding a fourth bolt-hole to the tailplane, all of which were also strengthened. The tailplane also tended to flutter as top and near-top speeds; this was fixed by adding large ballast weights to the tail roots and tailplane roots. The escape position near the air intakes, which partially led to the loss of crew in the aforementioned crash, was moved away from the air intakes; the rear crewmembers were essentially pulled along a short tunnel, out of the aircraft. This was not an optimal solution from a crew injury standpoint, but was better than the rear crewmembers being sucked into the air intakes. The Victor was retired in 1993; by this point, almost all had been converted into tankers.

The Victor itself had a mostly conventional planform, with a bulged forward fuselage as the wing root forward and a crescent-shaped wing with a graceful curve. The wing not only provided the best wing shape for subsonic cruise, but enhanced low-level, landing, and takeoff characteristics. The four turbojets (later turbofans) were mounted close to the fuselage, with two on either side of the fuselage in the wing root. The tail is a high T-Tail, to clear the turbulence caused by the wing and engines.

Though the normal loadout for the Victor was a single or number of nuclear bombs, the Victor could also conduct standard bombing exercises, carrying 35 454-kilogram free-fall bombs, 70 227-kilogram free-fall bombs, or 52 340-kilogram bombs. It could also carry a number of specialist bombs or PGM in its bomb bay. However, the design strength of the Victor proved inadequate for low-level penetration flights, with cracking appearing in the wings and tail.

Original 1950 plans for the Victor had the entire nose ejecting as an escape pod in emergencies, but this was discarded before the first prototype was built.

Victor B.1

The original Victor (other than the prototypes) was the B.1, designed to handle the high-altitude, high-subsonic, nuclear-delivery role. It was powered by four 11,000 pound-thrust Armstrong Siddley ASSa.7 turbojets, and was equipped by a number of ECM and ECCM devices, and weather, long-range, and bombing radars, though no tail-warning radar. The original Victors also carried an optical analog bomb computing system, basically a greatly-improved Nordon bombsight of World War 2. The B.1 originally carried the 9.98-ton Blue Danube nuclear bomb as its only weapon, though this was later changed to the two of the smaller, more powerful Yellow Sun, then a set of three Mark 5 450-kilogram nuclear bombs or four smaller Red Beard tactical nuclear bombs. The Victor had a long aerial refueling probe above and between the front windows.

In 1956, test pilot Johnny Allam dove a Victor B.1 at high speed and accidentally broke the sound barrier at a speed of Mach 1.1. At the time, it was the largest aircraft to break the sound barrier.

The B.1A modifications, performed from 1956-1960, added a tail-warning radar, RWR, and additional ECM and ECCM capability. The nose was also lengthened, again to move the ejection position of the rear crewmembers; they were switched to downward ejection.

Victor B.2

The Victor B.2 was designed for a higher night altitude mission, and the engines were swapped out for Sapphire 9 turbofans, developing 14000 pounds thrust each and requiring larger air intakes.

However, the Sapphire 9 engine was cancelled, so the Phase 2A version was tried with two engine types: the original engines, which were quickly rejected, and Rolls-Royce Conway turbofans developing 17250 pounds thrust each. This required large intakes later called "elephant ear" intakes. These led to ram air intakes inside the intake path. These provided additional electrical power to systems. The ECM/ECCM suite was modernized, as were the chaff and flare dispensing system. It was this aircraft that became the B.2.

It should be noted that during testing of the Phase 2A aircraft, the first of the prototypes disintegrated at high altitude. It was many years later, on other Victors, that longitudinal cracks in the wings were discovered in several Victor B.2s, that were likely the cause of the disintegration of the prototype aircraft. This cracking would later lead to the early curtailment of the Victor's bombing mission.

Twenty-one B.2s were later modified into the B.2R standard. This entailed of a large-scale modification of the Victors, including the bomb bay, the section of the fuselage ahead of the bomb bay, and on into the rear nose of the aircraft. The engines were also replaced with Conway RCo.17 turbofans giving 20600 pounds thrust. These modifications were to allow the carriage of the large Blue Steel stand-off nuclear-tipped missile (a conventional version was contemplated, but never built). The warhead for the Blue Steel would be the Green Bamboo boosted fission warhead, or the Granite-series of thermonuclear warheads; however, later, these were replaced by Red Snow warheads, a version of the US W-28. The Blue Steel itself is a huge missile, 4 meters across its fins, 10.7 meters long, and with a diameter of 1.22 meters, and is similar in concept to the Hound Dog missiles carried for a time by American B-52 aircraft. It was essentially a rocket aircraft, with a range of 926 kilometers.

Blue Steel was eventually cancelled, in part due to the dangerous steps necessary to fuel the missile, the complicated process it took to arm the missile, and the difficulty with which arming the B.2R took. (In addition, during testing in the Australian Outback, fueling the missile could be done only in the pre-dawn coolness due to the hypergolic nature of the fuel in hotter weather.) That, and with the new deployment of the Polaris SLBM with Renown-class submarines, meant that the Blue Steel was no longer necessary from a strategic standpoint. Despite its significant limitations, Blue Steel was used on Victor (and Vulcan) aircraft from 1963-70.

The Blue Steel was fitted with an advanced (for the time) inertial navigation unit. The missile's inertial navigation unit was, in fact, more advanced than that of the B.2R's unit, and the B.2R could hook into the Blue Steel's INU during the time that the aircraft was carrying the Blue Steel, allowing a more precise arrival at the release point.

The B(SR).2 was a strategic reconnaissance version of the Victor; nine were built. The bomb bay was filled with a radar mapping system and a total of nine cameras photographing as different wavelengths, angles, and resolutions, as well as technicians to monitor this intelligence. One of the day cameras had a range of 600 kilometers. Atop the wing were sniffers to detect radioactive particles from nuclear tests. The B(SR).2 was also equipped with ELINT and other electronic reconnaissance gear, along with an enhanced ECM/ECCM suite. In an odd way for things to turn out, the B(SR).2s were replacing Valiants which had been modified for the same role, but had been retired due to metal fatigue; this is strange due to the Victors' history of surface cracking.

When the high-altitude nuclear penetration flights no longer made sense for the Victor (or many other large bombers in the world), the Victor was modified for the low-level penetration role and for low-level conventional bombing. Internal modifications were successful; however, it was discovered during training for this role that the Victors' very design, along with defects discovered earlier in the Victors' career, that it was not going to be able to operate as a low-level penetrator or bomber. The design, particularly the tail and wing roots, tended to develop cracks during low-level high-speed runs, the types that would be necessary is the fulfillment of its role. Though no aircraft were lost during these tests and training, it was obvious that it was only a matter of time, and the Victors were withdrawn from the low-level penetration and bombing role and never used for such again.

The Victor Tankers – the Conclusion of the Victors' Careers

The Valant fleet had to be withdrawn early due to metal fatigue; this included those that had been modified as tankers. This left the RAF with no strategic tanker aircraft. The B.1s and B.1As were deemed surplus aircraft by this point, so many of them were modified into tankers. It was somewhat a hurried affair at first, with B.1s and B.1As being converted to the B(K).1A standard being fitted with a hose system under each wing with a drogue attached to the hose, and a reel system attached to sponsons under the wings. Six such aircraft were converted. These aircraft became operational in August of 1965. While these aircraft were adequate for short-tern use, they could pass fuel at only a very limited speed, and were not suitable for refueling large aircraft such as the Vulcan (which was still on active bomber duty). It should be noted that the B(K).1A had a reduced volume of space in the bomb bay (most was taken up by a large cylindrical tank for refueling), and the B(K).1A could carry a reduced mount of bombs or PGM in the bomb bay, giving it a secondary role as a bomber.

The refueling problems were addressed in the next iteration of B.1 and B.1A-based tankers, the K.1 and K.1A. These versions (though the B.1 base aircraft were no longer brought up to B.1A standard first) had a three-hose system, with another hose under the fuselage near the tail. The wing refueling points retained the same fuel flow as the B(K).1A, but a high-speed hose and drogue was fitted under the fuselage just ahead of the tail bulge, with three times the fuel flow rate of the wing hoses.

24 B.2s were also modified into tankers, similar to the K.1 and K.1A, and designated K.2. Other than uprated specifications, they were similar to the K.1 and K.1A.

For the Black Buck missions (the Vulcan bombing missions against Port Stanley airport in the Falklands), the K.2s were modified to carry three day/night long range cameras in the former bombardier's position. These cameras were upgrades of those carried on the B(SR).2 and had a day/night high-resolution range of 800 kilometers. While they did some long-range reconnaissance of the Falklands during their refueling work with the Vulcans on the mission, their primary role of the cameras was to reconnoiter South Georgia Island. (They were also to conduct reconnaissance on Argentine airfields and harbors in the hypothetical raids based out of Rio De Janeiro, but it was elected not to conduct these raids to prevent a wider was in South America.) The K.2s retained the ability for aerial refueling and so relays of tankers could be set up. The K.2s also received new inertial navigation gear, as their normal navigation equipment was inadequate for navigation over the trackless Atlantic.

Vickers tankers were often fitted with JATO bottles on the rear sides to decrease the heavy Victor tanker's takeoff length. This decreases the takeoff run by 30%. The JATO bottles are expended shortly after the Victor gets into the air and fall off of their own accord shortly after they are expended.

The K.2s. were retired in 1993, replaced by Vickers VC-10 tankers.

Aircraft	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Victor B.1	$334,064,700	JP-A	32.95 tons	92.99 tons	5	105	Radar (300 km), Weather Radar (500 km), Bombing Radar (200 km)	Shielded
Victor B.1A	$367,811,400	JP-A	33.32 tons	94.49 tons	5	108	Radar (300 km), Weather Radar (500 km), Bombing Radar (200 km), Tail Radar (100 km)	Shielded
Victor B.2	$380,995,200	JP4	34.02	94.77	4	111	Radar (400 km), Weather Radar	Shielded

			tons	tons			(500 km), Bombing Radar (200 km), Tail Radar (150 km)	
Victor B.2R	$429,940,500	JP4	406 kg	102.47 tons	4	125	Radar (400 km), Weather Radar (500 km), Bombing Radar (200 km), Tail Radar (150 km)	Shielded
Victor B(SR).2	$444,370,600	JP4	681 kg	95.28 tons	8	115	Radar (400 km), Weather Radar (500 km), Tail Radar (150 km), SLAR (150 km), 3 Day Cameras (50 km), 3 Wide-Angle Day Cameras (50 km), 2 Night/IR Cameras (40 km), UV Camera (40 km), Radar Camera (30 km)	Shielded
Victor B(K).1A	$387,629,900	JP4	5.45 tons	111.92 tons	5	107	Radar (300 km), Weather Radar (500 km), Bombing Radar (200 km), Tail Radar (100 km)	Shielded
Victor K.1	$460,010,300	JP4	520 kg	143.46 tons	5	106	Radar (300 km), Weather Radar (500 km)	Shielded
Victor K.1A	$506,479,830	JP4	589 kg	144.96 tons	5	108	Radar (300 km), Weather Radar (500 km), Tail Radar (100 km)	
Victor K.2	$524,634,050	JP4	585 kg	145.24 tons	5	110	Radar (400 km), Weather Radar (500 km), Tail Radar (150 km)	Shielded
Victor K.2 (Black Buck)	$546,383,040	JP4	465 kg	145.34 tons	5	111	Radar (400 km), Weather Radar (500 km), Tail Radar (150 km), Two Day/Night Cameras (800 km), One Radar Camera (600 km)	Shielded

Aircraft	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Victor B.1	1248	347 (145)	NA 68 7/5 70/50	36713	4492	17000	FF8 CF7 RF7 T6 W5
Victor B.1A	1228	341 (145)	NA 67 7/5 70/50	36713	4492	17000	FF8 CF7 RF7 T6 W5
Victor B.2	1901	528 (145)	NA 104 7/5 70/50	36713	7015	19000	FF8 CF7 RF7 T6 W5
Victor B.2R	2823	784 (145)	NA 154 7/5 70/50	36713	11356	19000	FF8 CF7 RF7 T6 W5
Victor B(SR).2	3034	943 (145)	NA 185 7/5 70/50	36713	11356	19000	FF8 CF7 RF7 T6 W5
Victor B(K).1A	1042	289 (145)	NA 57 7/5 70/50	36713+37854	4492	17000	FF8 CF7 RF7 T6 W5
Victor K.1	819	228 (145)	NA 45 7/5 70/50	36713+50472	4492	17000	FF8 CF7 RF7 T6 W5
Victor K.1A	811	225 (145)	NA 44 7/5 70/50	36713+50472	4492	17000	FF8 CF7 RF7 T6 W5
Victor K.2	2001	556 (145)	NA 109 7/5 70/50	36713+50472	7015	19000	FF8 CF7 RF7 T6 W5
Victor K.2 (Black Buck)	2001	556 (145)	NA 109 7/5 70/50	36713+50472	7015	19000	FF8 CF7 RF7 T6 W5

Aircraft	Combat Equipment	Minimum Landing/Takeoff	RF	Armament	Ammo

		Zone			
Victor B.2	IFF, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 1, ECCM 1, INS, Flare and Chaff Dispensers (40 Flares, 40 Chaff)	2400/1840m Hardened Runway	+1	Internal Bomb Bay	Various Nuclear Bomb(s), 35x454 kg or 52x340 kg or 70x227 kg Bombs
Victor B.1A	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, INS, Flare and Chaff Dispensers (40 Flares, 40 Chaff)	2400/1840m Hardened Runway	+1	Internal Bomb Bay	Various Nuclear Bomb(s), 35x454 kg or 52x340 kg or 70x227 kg Bombs
Victor B.2	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, IRCM 1, INS, Flare and Chaff Dispensers (50 Flares, 50 Chaff), One Chaff Rocket	2400/1840m Hardened Runway	+2	Internal Bomb Bay	Various Nuclear Bomb(s), 35x454 kg or 52x340 kg or 70x227 kg Bombs
Victor B.2R	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, IRCM 1, INS*, Flare and Chaff Dispensers (50 Flares, 50 Chaff)	2400/2200m Hardened Runway	+4	Internal Bomb Bay (Modified)	Blue Steel Standoff Missile**
Victor B(SR).2	Advanced IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 3, ECCM 3, IRCM 1, DJM, ELINT 3, Radar Detection 2, Radio Jamming 1, INS, Target ID, Flare and Chaff Dispensers (80 Flares, 60 Chaff), Corridor Chaff Pod, Chaff Rocket, Radiation Detector (800 km)	2400/2000m Hardened Runway	Nil	Nil	Nil
Victor B(K).1A	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, INS, Flare and Chaff Dispensers (40 Flares, 40 Chaff)	2400/2600m Hardened Runway	+2	Internal Bomb Bay	12x454 kg Bombs
Victor K.1	IFF, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 1, ECCM 1, INS, Flare and Chaff Dispensers (40 Flares, 40 Chaff), Two Hose/Drogue Reels	2400/2600m Hardened Runway	Nil	Nil	Nil
Victor K.1A	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, INS, Flare and Chaff Dispensers (40 Flares, 40 Chaff), Two Hose/Drogue Reels	2400/2600m Hardened Runway	Nil	Nil	Nil
Victor K.2	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, IRCM 1, INS, Flare and Chaff Dispensers (50 Flares, 50 Chaff), One Chaff	2400/2600m Hardened Runway	Nil	Nil	Nil

	Rocket, Three Hose/Drogue Reel Units				
Victor K.2 (Black Buck)	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, IRCM 1, INS, Flare and Chaff Dispensers (50 Flares, 50 Chaff), One Chaff Rocket, Three Hose/Drogue Reel Units	2400/2600m Hardened Runway	Nil	Nil	Nil

*While the Blue Steel missile is mated to the B.2R, the crew may use the missile's INS, which has a range of 125 km and eases the navigator's task of guiding the aircraft by one level.
**Preparing the Blue Steel and mating it to the B.2R takes a minimum of four hours. Mating the missile to the aircraft is a Difficult Mechanic task and requires a minimum of six persons. Fueling the missile is an Impossible Mechanic task. Arming the missile is an Easy ADM or Average Mechanic task. The cost of the Blue Steel is subsumed in the cost of the B.2R.

Vickers Valiant

What? No this isn't about the British tank – no, it's the British *bomber*. Yes – I know they have the same name and are both made by Vickers and are -- yes, they are BOTH Vickers Valiants – every so often, those nutty Defense Contractors like to play games and tricks on us…oh, anyway…

Notes: Though the Valiant was the first of the V-Bombers in service, it is often regarded as the "forgotten V-Bomber;" it had the shortest life in service due to design limitations, and even did not serve as a tanker or special aircraft for very long, as did the other V-Bombers. The design for the Valiant began in the late 1940s, in response to Specification B.35/46 for a nuclear-armed bomber jet-powered bomber. At the time, nuclear bombs were huge, and the aircraft which would become the Valiant could just barely carry one. The initial prototype flew in early 1949 (known then as the Vickers 660). Vickers initially proposed a six-engine bomber, but as jet engine technology rapidly increased, Vickers was able to reduce the number of engines to four, which were buried in the wings. (This aircraft appeared in prototype form in 1951.) LRIP began in 1953, with full production beginning in 1955.

The original Vickers 660 prototype essentially comprised what would be the operational aircraft except for certain electronics. It was powered by Rolls-Royce RS.3 Avon turbojets developing 6500 pounds thrust each. Meanwhile, the second prototype was referred to as the Vickers 667 and was intended to be They were initially to be powered by Armstrong Siddeley Sapphire turbojets, with 7500 pounds thrust each; however these were not available, and RS.7 Avons were used again, and these had the same power as the Sapphires. Upon the success of the prototypes, the aircraft was given the name Valiant. Some 108 Valiants were built, including the sole B.2.

One observer said the Valiant looked sort of like a DeHaviland Comet airliner; this may have kicked off a short-lived program to make a passenger-carrying variant of the Valiant, designated as the V.1000. The sole prototype was scrapped only a few months before its scheduled first flight, as BOAC was not interested in the V.1000. There are rumors that some of the features of the V.1000 later reappeared in the Vickers VC.10.

Valiant B.1

In 1951, the B.1 was given an initial production order of 25. In 1955, the first aircraft of this order was delivered to the RAF. It was declared the first of the V-Bomber force. The first five aircraft delivered to the RAF were not in a full operational mode; it was considered that the RAF may want to make additional refinements to the Valiant B.1, and they did, though by and large they were happy with the aircraft.

In addition to the Valiant's role as a nuclear bomber, the Victor was also to be used as a high-altitude and low-level bomber. In 1962, the role of the Valiant was changed to low-level flight due to the proliferation of SAMs; the SAMs would have a more difficult time to track and lock-on to Valiants traveling at high subsonic speed at low levels.

It should be noted that during the Anglo-French Suez intervention in 1956, Valiants staged out of Malta to bomb Egyptian targets. Their primary targets were Egyptian airfields, but though 856 tons were delivered, results were said to have been disappointing. This was said to be because all of the bombardiers on the mission were trained to use radar bombing exclusively, and not all of the Valiants were yet equipped with radar bombing equipment.

The Valiant initially was powered by Avon RA.3 engines developing 6500 pounds thrust, installed in fireproof pairs under each wing root. The intakes were at the front of each wing root, and were reminiscent of the later Victor V-Bomber. While the installation of the engines made it more possible that a fire in one engine would ignite the second engine in the pair, it made maintenance easier, so the risk was considered acceptable. The installation also increased the complexity of the main wing spar. The wings were a crescent shape which were used again on the later Victor. A short landing was made more possible by the installation of a drogue chute, and a rocket pack could be added to shorten the takeoff; these were intended for use when the Valiant was using shorter dispersal runways and highway sections, and the Valiant could take off with the rocket pack in less than 1220 meters and slow to a stop within 1800 meters. When more powerful engines were installed, the rocket packs were no longer considered necessary. Valiants were also given a water/methanol-injection system for the engines, increasing takeoff thrust by 1000 pounds thrust for three minutes.

The Victor was equipped with an early form of fly-by-wire surfaces actuation; the control surfaces and flaps were actuated by electric motors instead of hydraulic pressure. Though the first five aircraft had the Avon RA.3 engines, but further production aircraft were powered by Avon 201 turbojets developing 9500 pounds thrust each. In addition to powering the aircraft, the engines also gave power to the pressurization, ice protection and boots, and air conditioning and heating systems. Heaters were also installed in the air intakes to mitigate ice buildup, which was a continuing problem with the Valiant.

In addition, a strategic reconnaissance version entered service, as well as multipurpose version optimized for conventional bombing and tactical missile delivery, a conventional aerial reconnaissance version, an EW version, and a tanker. Several Valiants were used in tests of the Blue Steel Nuclear Missile, though the Valiant never carried the Blue Steel operationally. Valiants were also used to test some of the British nuclear bombs in the Australian Desert. The Valiants were thus the only of the V-Bombers to actually drop nuclear weapons.

The Valiant used a five-man crew, with the pilot and co-pilot facing forward, and the EW officer, navigator, and bombardier facing to the rear. The pilots had standard ejection seats; the rest of the crewmen were to bail out of an oval hatch in port side of the aircraft, one at a time. It was well known among aircrews and designers that the rear three crewmen would probably not be able to bail out successfully in an emergency situation.

The lower half of the nose contained the H2S radar in a glass fiber radome; in addition, a visual bombsight supplemented the radar bombsight. The avionics bay was not accessible from the cockpit; it could only be accessed on the ground via a normal catwalk after opening a narrow hatch in the rear of the nose section. Under the nose and cockpit was a SLAR installation. An ARI 5800 radar was contained in the rear. This gave the Valiant a frontal radar arc of 180 degrees, a tail radar arc of 60 degrees, and a weather radar arc of 120 degrees. Later, the glazed radome was replaced by a metal radome and a port in the underside of the nose used with a port for visual bombsighting.

Valiants could also carry large fuel tanks on their wings, with a capacity of 7500 liters each. They could be jettisoned, but are not actually meant to be drop tanks. There was an idea for carrying stand-off missiles on those hardpoints, but in the end this was never done. The huge tanks were a nod to the fact that the internal tankage of the Valiant was a bit small.

After less than a decade of faithful service, crystalline cracks began to appear in the wing spars of all Valiants except those few who were not subjected to low-level flying. All Valiants also showed fatigue in the wing spars, and specifically, the wing attachment points. The Valiants were then separated into three groups: Cat A -- no cracks and certified to continue low-level flights, Cat B -- a group which was to fly to a repair base, but deemed more easily repairable. Cat C Valiants would require major overhauls before becoming flyable again, including close inspection of the wings and tail and replacement of the wing spar. Cat C Valiants formed the largest members of the Valiant fleet. This was what was supposed to happen, and in 1964 was already beginning. (A stronger replacement wing spar which could be simply “slotted” in was devised in particular for this purpose.) However, there was a change in government in 1965, the new MoD minister decided that Cat B and Cat C aircraft were not worth the expense of repairing; Cat A aircraft would, however, remain flying (for a short time), but were subject to additional checks for cracks after each flight. For the most part, Cat B and C Valiants were scrapped, though some were moved to the Canadian Training Grounds for use in bombing and strafing practice. The last active-duty Valiant was retired in 1965. One Valiant, however, had its wing spar replaced and continued to fly as a test aircraft until 1968. One preserved Valiant (though not in flying condition) is kept at the Cold War Exhibit at RAF Museum Cosford; this is the only place in the world where all three V-Bombers can be seen together.

Unlike other V-Bombers, the Valiant never received an upgrade to a more capable Mark 2 model like the other V-Bombers; the B.2s mentioned above were never used as operational aircraft. In addition, original LRIP Valiants were not equipped for aerial refueling.

New Roles for Old Aircraft

Some of the Cat B aircraft, as well as the Cat A aircraft, were taken off bombing duty and given a number of alternate roles. By far, most Valiants were refitted as tankers, but some were outfitted for strategic reconnaissance, tactical reconnaissance, and electronic warfare,

The first modifications were designated B(PR).1s; 11 Cat B aircraft were modified for the photoreconnaissance role. For this purpose, the bombardier’s position received a new panel to control the cameras. The camera suite was in the bomb bay and consisted of two wide-angle BW cameras, one wide-angle color camera, two survey cameras, four high-resolution cameras, an IR camera, and a trainable BW camera which could zero in on a particular item of interest.

The B(PR)K.1 was sort of a jack of all trades; these were 14 Cat A aircraft which had a camera suite, room for a smaller amount of bombs, as well as a tank in the bomb bay for refueling other aircraft and a HDU unit to accomplish this. These carried two survey cameras, an IR camera and four high-resolution cameras.

The B(K).1 were bomber/tanker aircraft; they carried a large drum-type fuel tank in the bomb bay, along with room for a single rack of bombs. The fuel tank could be removed along with the HDU, allowing the Valiant to function as a standard bomber. A further 16 B(K).1s were ordered, but later cancelled before conversions could take place.

The B(EW).1 carried mostly electronic warfare equipment in the forward bomb bay. Two of the crewmembers (the bombardier and EW officer) manned the EW equipment; they had different instrument panels than normal. The B(EW).1 carried a large amount of additional electronic gear ranging from electronic listening and detection equipment to additional ECM, flares, and chaff.

Valiant B.2

I have included stats for a B.2 below as a “what-if.”

The first B.2. prototype flew in late 1953. The B.2. was originally intended as a Pathfinder aircraft for the main bomber force, and had an entirely gloss black paint scheme; it would drop flares as well as bombs ahead of the main bomber force, and had enhanced navigation equipment. (However, it was envisioned that a production B.2 force would function as bombers as well as Pathfinders.) In this role, the B.2 would fly at little more than 1500 meters at a speed of nearly 940 kmh. This made necessary the installation of a primitive form of TFR – nothing like what was in development for the future F-111, but able to allow the B.2 to fly as low as 500 meters at a reduced speed of 700 kmh. (One speed test had the B.2 flying at 1030 kmh at less than 1000 meters altitude for a few minutes.) The intended role as a bomber of night missions also led to the installation of night vision gear a tank crewman of the time would have given his eye teeth for.

The Valiant B.2 was powered by four Rolls Royce Conway turbojets, developing 10,000 pounds thrust each. The B.2 had a wider wingspan, allowing it to carry a pair of Blue Steel SRAMs as well as its standard wing fuel tanks; the B.2 was also to have inner hardpoints which allowed fuel tanks or Blue Steel missiles. The outer hardpoints could also carry a variety of alternate stores, from additional gravity bombs to extra fuel to chaff rockets or corridor chaff pods to some of the new generation of guided munitions.

Other changes included a longer fuselage, allowing for a larger bomb bay, one which could also carry two Blue Steel missiles if desired, more gravity bombs, or the new generation of TV-guided and radar-beam-riding bombs and missiles. On the whole, the entire airframe was strengthened, including internal components; internal fuel tanks were also changed to self-sealing fuel tanks. One change which had effects beyond what one would think was the main handing gear retracting into pods at the rear of the wing, giving room for the stronger wing spar, a slightly larger bomb bay and electronics bay, and a little more fuel in the wings. The wings were also lengthened, due to center-of-gravity needs more than anything else, but this also allowed for more fuel carriage.

The B.2 retained the Conway engines, and the gloss black paint scheme, for which it was known as the "Black Bomber." The B.2, though 17 were ordered, only one was built, and remained used as prototype, test, and experimentation aircraft, well into the 1960s.

One high-level member of the RAF noted that the production of the B.2 and its inevitable variants would have probably made the Victor and Vulcan redundant, as the B.2 would be able to fill all their roles. (Thus, there may have been some politics involved in the cancellation of the B.2, as Avro and DeHavilland would not have been happy with the loss of money that the approval of the B.2 might bring.) However, the main "problem" at the time was that the B.2 was optimized for the low-level penetration role, and at the time, only a few forward-looking people thought that a low-level penetrator would be necessary anytime in the foreseeable future.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
B.1 (LRIP Aircraft)	$109,041,283	JP-A	30.52 tons	63.5 tons	5	190	Radar (250 km), Weather Radar (400 km), Bombing Radar (100 km), Tail Radar (75 km), SLAR (75 km)	Shielded
B.1 (Production)	$145,536,128	JP-A	29.41 tons	64.52 tons	5	190	Radar (250 km), Weather Radar (400 km), Bombing Radar (100 km), Tail Radar (75 km), SLAR (75 km)	Shielded
B(PR).1	$672,098,056	JP-A	1.27 tons	64.71 tons	5	225	Radar (250 km), Weather Radar (400 km), Tail Radar (75 km), SLAR (75 km)	Shielded
B(PR)K.1	$327,494,660	JP-A	1.33 tons	76.43 tons**	5	275	Radar (250 km), Weather Radar (400 km), Bombing Radar (100 km), Tail Radar (75 km), SLAR (75 km)	Shielded
B(K).1	$255,919,221	JP-A	1.49 tons	78.93 tons**	5	295	Radar (250 km), Weather Radar (400 km), Bombing Radar (100 km), Tail Radar (75 km), SLAR (75 km)	Shielded
B(EW).1	$321,461,031	JP-A	1.26 tons	71.44 tons	5	308	Radar (250 km), Weather Radar (400 km), Tail Radar (75 km), SLAR (75 km), IRST (40 km), VAS (20 km)	Shielded
B.2	$290,650,603	JP-4	34.68 tons	66.68 tons	5	180	Radar (300 km), Weather Radar (400 km), Tail Radar (115 km), SLAR (120 km), IRST (40 km), VAS (20 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap*	Fuel Cons	Ceiling	Armor
B.1 (LRIP)	1078	300 (75)	NA 13 4/3 40/30	20400	2641	16000	FF7 CF6 RF6 T5 W4
B.1 (Production)	1539	427 (75)	NA 19 4/3 40/30	20400	3862	16000	FF7 CF6 RF6 T5 W4
B(PR).1	1534	426 (75)	NA 19 4/3 40/30	20400	3862	16000	FF7 CF6 RF6 T5 W4
B(PR)K.1	1304	362 (75)	NA 16 4/3 40/30	20400+7500	3862	16000	FF7 CF6 RF6 T5 W4
B(K).1	1263	351 (77)	NA 15 4/3 40/30	20400+10000	3862	16000	FF7 CF6

							RF6 T5 W4
B(EW).1	1393	387 (75)	NA 17 4/3 40/30	20400	3862	16000	FF7 CF6 RF6 T5 W4
B.2	1567	435 (70)	NA 19 4/3 40/30	24500	4065	19000	FF7 CF7 RF7 T6 W6

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
B.1 (LRIP)	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 1, ECCM 1, INS (75 km), Flare and Chaff Dispensers (40 Flares, 40 Chaff)	1800/1500m Hardened Runway	+1	Internal Weapons Bay, 2 Hardpoints (Wet Only)	Normal Load 21x450 kg Gravity Bombs or one Blue Danube Nuclear Bombs or two B28 Nuclear Bombs or two B43 Nuclear Bombs or one Yellow Sun Nuclear Bomb or one Red Beard Nuclear Bomb; Other Loadouts Possible
B.1 (Production)	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 1, ECCM 1, INS (75 km), Flare and Chaff Dispensers (40 Flares, 40 Chaff), TFR (20 km)	1800/1300m Hardened Runway	+1	Internal Weapons Bay, 2 Hardpoints (Wet Only)	Normal Load 21x450 kg Gravity Bombs or one Blue Danube Nuclear Bombs or two B28 Nuclear Bombs or two B43 Nuclear Bombs or one Yellow Sun Nuclear Bomb or one Red Beard Nuclear Bomb; Other Loadouts Possible
B(PR).1	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Inertial Navigation (75 km), Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2,	1800/1300m Hardened Runway	Nil	2 Hardpoints (Wet Only)	None

	ECCM 2, ELINT 2, Flare and Chaff Dispensers (40 Flares, 40 Chaff), Two Wide-Angle BW Cameras, One Wide-Angle Color Camera, Two Survey Cameras, Four High-Resolution Cameras, One IR camera, Trainable BW Camera				
B(PR)K.1	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Inertial Navigation (75 km), Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, Flare and Chaff Dispensers (40 Flares, 40 Chaff), Two Survey Cameras, Four High-Resolution Cameras, One IR Camera	1800/1300m Hardened Runway	+1	Internal Weapons Bay, 2 Hardpoints (Wet Only)	10x450 kg Gravity Bombs, Nuclear Weapons Carry Possible, Other Loadouts Possible;
B(K).1	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 1, ECCM 1, INS (75 km), Flare and Chaff Dispensers (40 Flares, 40 Chaff)	1800/1300m Hardened Runway	+1	Internal Weapons Bay, 2 Hardpoints (Wet Only)	10x450 kg Gravity Bombs, Nuclear Weapons Carry Possible, Other Loadouts Possible;
B(EW).1	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 3, ECCM 3, ELINT 3, INS (75 km), Flare and Chaff Dispensers (75 Flares, 75 Chaff), Chaff Rocket	1800/1300m Hardened Runway	Nil	2 Hardpoints (Wet Only)	None
B.2	IFF, RWR, Secure Radios (One 700 km, Two 300 km, One AM), Navigation Bombing Computer, Transponder, Gyrocompass, Barometric Altimeter, LORAN, Radar Beam Riding, Radio Beacon Detection, ILS, ECM 2, ECCM 2, INS (75 km), Flare and Chaff Dispensers (80 Flares, 80 Chaff), TFR (40 km)	1900/1500m Hardened Runway	+2	Internal Weapons Bay, 4 Hardpoints	Normal Load 40x450 kg Gravity Bombs or one Blue Danube Nuclear Bomb or two B28 Nuclear Bombs or two B43 Nuclear Bombs or two Yellow Sun Nuclear Bombs or two Red Beard Nuclear Bombs or two Blue Steel Missiles; Other Loadouts Possible

*The Valiant may carry one 6500-liter fuel tanks on each its wing hardpoints. (They were originally to have been also able to carry external weapons, but this idea was later dropped.)
**The Aircraft Weight figure is with all possible bomb-bay stores carried.

Xi'an H-20

Notes: The H-20 (alternatively the H-X, denoting the fact that only protypes have been built and it is in advanced field testing) is a subsonic stealth bomber. It is not expected to be in service until about 2025. The H-6 was developed in response to the USAF's B-2 and upcoming B-21, as well as a heavy bomber capable of stealth and having the range to range far away from their bases – different sources state this range variously at 8000km, 8050 km, and 12,000 km. The H-20 will also be capable of aerial refueling, and has ejection seats.

The H-20 is a flying-win design with flight computers to make more stable; the US DoD are pretty sure the H-20 was built using stolen intelligence from the US B-2 and B-21, but resembles the projected B-21 more than the B-2. . It's primary role is to attack US Carrier Task Forces, though bombing of Japan is also mentioned in it's possible targets. US intelligence is skeptical that the Chinese could essentially build a B-2 near-clone in such a short period of time, unless US manufacturers have spies in US manufacturing companies of the B-2, the DoD, and the Pentagon, as well as hackers who targeted the B-2.

The H-20 is likely powered by WS-10 engines (which, it should be noted, the Chinese have not yet been able to manufacture). The H-20 has an AESA radar as well as a terrain-following radar, both of which are like the B-2, whose radars are extremely difficult to detect when in use. The Chinese also used parts of the design features of the US X-47B stealth drone. (Indeed, the H-20 looks like an enlarged X-47B, with a combination of B-2 and B-21 features.) The stealth features mimic those of the B-2 and B-21 in stealth design. The H-20 is capable of using most air-to-ground munitions, from cruise missiles to antishipping missiles to conventional ASM and bombs (both guided and unguided), as well as nuclear weapons and nuclear-tipped missiles. The H-20 has a rotary launcher similar to that of the B-2. The crew consists of a Pilot, Co-Pilot, and a WSO/ECM Operator.

The H-20 is said to be not as stealthy as the B-2 or B-21, or the X-47B for that matter. The H-20 is essentially a long-range bomber in which the Chinese did not completely successfully copy the B-2, B-21, or X-47B.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$616,775,320	JP6 Equivalent	30.72 tons	114.48 tons	3	60	Radar (300km), Rear Radar (150km), 2nd Gen FLIR, LIDAR, TFR (300m)	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
2971	825 (60)	NA 166 5/3 50/30	104,726	30628	15250	HF5 CF5 FF4 T0 W7*

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Flare/Chaff (50/40), ECM 2, IR, Stealth 5 IR Stealth 3, Deception Jamming (59 km), Laser Designator (20 km), Inertial Navigation, GPS, RWR, Secure Radios, Satcom Radio, Target ID,	1800/2200m Hardened Runway	+4	2 Bomb Bays	Nil

*The H-20 has no tail to target or become damaged.

Il-28 Beagle

Notes: Designed shortly after World War 2, the Beagle was built in huge numbers by Russia and China, with over 6000 built. They are a very basic sort of combat aircraft with a minimum of avionics, and today's fighter-bombers easily outperform it. The bomb bay may hold 2 tons of the total weapons load; the two wingtip hardpoints may only be used for special 335-liter drop tanks designed especially for it. The Beagle is not capable of aerial refueling. The tail gunner does not have an ejection seat.

Twilight 2000 Notes: By the Twilight War, only about 500 of this number remained in active service, primarily with Middle Eastern and African nations, and air forces such as those of Vietnam and Cuba.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$24,351,140	JP4/5	3 tons	21.2 tons	3	26	Radar (75 km)	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1004	451 (130)	NA 113 4/2 40/20	6780	2913	12300	FF6 CF6 RF6 T5 W5

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
RWR	835/760m Hardened Runway	+1	2x23mm Autocannons (Front), 2x23mm Autocannons (Rear), Bomb Bay, 2 Hardpoints	750x23mm

Tu-16 Badger

Notes: There were at least 22 variants of this medium bomber built. In particular, the variants designed to carry specific large cruise missiles, such as the Tu-16K series, were no longer in use, because the primitive cruise missiles were replaced by later weapons that could be carried in conventional bomb bays. These models were either scrapped or modified into other versions. Other versions were made for conventional bombing, long-range search and rescue, long-range reconnaissance, electronic warfare, refueling, and UAV launching. Not all of these are detailed here; the Tu-16A is the standard bomber, the Tu-16RM-2 is for long-range reconnaissance, and the Tu-16Ye is an electronic intelligence (ELINT) aircraft, the Tu-16P is an electronic warfare aircraft (Wild Weasel). Besides Russia, the Badger is used by Iraq and China.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Tu-16A	$222,619,380	JP4/5	9 tons	75.8 tons	6	51	Radar, RLR	Shielded
Tu-16RM-2	$268,452,780	JP4/5	2.72 tons	74.19 tons	6	55	Radar, RLR	Shielded
Tu-16Ye	$281,544,800	JP4/5	1.5 tons	72.6 tons	6	57	Radar, RLR	Shielded
Tu-16P	$282,568,280	JP4/5	1 ton	72.6 tons	6	55	Radar, RLR	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Tu-16RM-2	1984	496 (120)	NA 124 5/3 50/30	43800	6720	12300	FF7 CF7 RF7 T6 W7
Others	1984	496 (120)	NA 124 5/3 50/30	42400	6720	12300	FF7 CF7 RF7 T6 W7

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Tu-16A	All-Weather Flight, RWR, Flare/Chaff (80/80), ECM 2	1675/2045m Hardened Runway	+2	2x23mm Autocannons (Front, Rear, Belly, Dorsal), Bomb Bay	6000x23mm
Tu-16RM-2	All-Weather Flight, RWR, Flare/Chaff (80/80), ECM, Still Cameras (5; 20-120 km), Video Cameras (3, 10-120 km), Look-Down Radar, SAR (120 km)	1675/2045m Hardened Runway	+2	2x23mm Autocannons (Front, Rear, Belly, Dorsal), 2 Hardpoints	6000x23mm
Tu-16Ye	All-Weather Flight, RWR, Flare/Chaff (80/80), ECM 2, IRCM 1, Radar Detectors (100 km), Radio Detectors (100 km), ELINT 2, Recording Gear, Still Camera (50 km), Video Camera (30 km)	1675/2045m Hardened Runway	+2	2x23mm Autocannons (Front, Rear, Belly, Dorsal), 2 Hardpoints	6000x23mm
Tu-16P	All-Weather Flight, RWR, Flare/Chaff	1675/2045m	+2	2x23mm Autocannons	6000x23mm

	(100/90), ECM 3, IRCM 2, Deception Jamming (40 km), Chaff Rockets (20), Corridor Chaff Pods (2)	Hardened Runway	(Front, Rear, Belly, Dorsal), 2 Hardpoints

Tu-22 Blinder

Notes: This supersonic medium bomber was designed as a counter to the US B-58 Hustler, just coming into service at the time (1959). Few were in use by Russia during the Twilight War, most of them having replaced by the Backfire, but hundreds were in use by other countries, most notably by Iraq, and Libya, as well as a few by Syria. The variants depicted here are the Blinder-A bomber and the Blinder-C maritime armed reconnaissance aircraft; the Blinder-B is a variant specially-modified to carry the huge Kitchen cruise missile, the Blinder-D is a trainer, and the Blinder-E is a dedicated long-range reconnaissance aircraft.

Twilight 2000 Notes: Most Russian examples used during the Twilight War were reconnaissance models or tankers. Due to their poor maneuverability, they were easy pickings for enemy fighters and SAMs.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Blinder-A	$274,584,670	JP4/5	12 tons	84 tons	4	51	Radar, RLR	Shielded
Blinder-C	$483,036,080	JP4/5	4.5 tons	84.1 tons	4	53	Radar, RLR, MAD, Image Intensification	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Blinder-A	3002	750 (135)	NA 188 3/2 30/20	51480	10438	13300	FF7 CF8 RF7 T6 W6
Blinder-C	3002	750 (135)	NA 188 3/2 30/20	128705	10438	13300	FF7 CF8 RF7 T6 W6

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Blinder-A	All-Weather Flight, Flare/Chaff (20/20), RWR	1445/1765m hardened Runway	+2	23mm Autocannon (R), Bomb Bay	1000x23mm
Blinder-C	All-Weather Flight, Flare/Chaff (20/20), RWR, Sonobuoys (100), Look-Down Radar, Deception Jamming (20 km), Inertial Navigation	1445/1765m hardened Runway	+3	23mm Autocannon (R), Bomb Bay	1000x23mm

Tu-22M Backfire

Notes: Mistakenly referred to by NATO sources as the Tu-26 for many years, the correct designation is Tu-22M, because the Backfire is in fact a highly-modified Tu-22 Blinder. The differences include the variable-geometry wings, engines of much higher power that are relocated to the fuselage, avionics that are vastly improved, and improved weapon delivery systems. There were several variants, including the standard bomber, cruise/antiship missile carrier, and long-range reconnaissance variant. The bomb bay may hold up to 14.5 tons in the Tu-22M1 and Tu-22M2, and 18 tons in the Tu-22M3.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Tu-22M1	$199,336,650	JP4/5	24 tons	125 tons	4	67	Radar, RLR	Shielded
Tu-22M2	$241,012,450	JP4/5	24 tons	126 tons	4	70	Radar, RLR, MAD	Shielded
Tu-22M3	$294,068,460	JP4/5	24 tons	130 tons	4	74	Radar, RLR, SLAR, Image Intensification	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Tu-22M1	3574	894	NA 223 5/3 50/30	87000	27680	13000	FF8 CF8 RF7 T6 W6
Tu-22M2	3874	969	NA 242 6/4 60/40	87000	29986	13000	FF8 CF8 RF7 T6 W6
Tu-22M3	3974	994	NA 248 6/4 60/40	90000	30555	13000	FF8 CF8 RF7 T6

	W6

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Tu-22M1	All-Weather Flight, Flare/Chaff (30), RWR, ECM 2, Terrain Following Radar, Laser Designator, Auto Track	1445/1765m Hardened Runway	+2	2x23mm Autocannons (Rear), Bomb Bay, 6 Hardpoints	2000x23mm
Tu-22M2	All-Weather Flight, Flare/Chaff (30), RWR, ECM 2, Terrain Following Radar, Laser Designator, Auto Track, Chaff Rockets (8), IRCM 1, Inertial Navigation	1390/1700m Hardened Runway	+3	2x23mm Autocannons (Rear), Bomb Bay, 6 Hardpoints	2000x23mm
Tu-22M3	All-Weather Flight, Flare/Chaff (30), RWR, ECM 2, Terrain Following Radar, Laser Designator, Auto Track, Chaff Rockets (8), IRCM 1, Inertial Navigation, Deception Jamming, Secure Radios, Look-Down Radar, Target ID	1325/1620m Hardened Runway	+4	2x23mm Autocannons (Rear), Bomb Bay, 6 Hardpoints	2000x23mm

Tu-160 Blackjack

Notes: This Russian heavy bomber is similar in appearance to the US B-1B Lancer, but is much larger and is a less-efficient design, requiring more fuel. Though designed in the late 1970s, the first flight did not take place until 1981. They were generally equipped with the best avionics the Russians could offer at the time.

Twilight 2000 Notes: In the Twilight War, they were used as low-level penetration bombers ion long-range missions in a similar manner to the B-1B (they were even seen over the Continental US on some occasions).

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$364,079,720	JF	40 tons	275 tons	4	75	Radar, RLR, SLAR, Image Intensification	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
4416	1104 (120)	NA 276 4/2 40/20	196045	53031	15500	FF89 CF9 RF8 T7 W7

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Flare/Chaff (50), Chaff Rockets (10), Stealth 1, ECM 3, IRCM 3, Deception Jamming, Active Jamming, Terrain-Following Radar, Track While Scan, Inertial Navigation, RWR, Secure Radios, Target ID, Look-Down Radar	1730/2115m Hardened Runway	+4	2 Bomb Bays	None

B-1 Lancer

Notes: The Lancer was originally conceived of in its B-1A guise in the early 1960s. The high, fast-flying XB-70 Valkyrie was defeated before any flew into enemy territory – by rapidly-improving Russian SEAD and aircraft like the MiG-25 interceptor. Nevertheless, the Air Force felt that there was a need for the fast bomber, but perhaps in the low-fast penetrator role. Several such studies were carried out on paper in the 1960s and 1970s, with McNamara and the DoD fighting the proposals the entire way. (They felt that the FB-111A and the B-52, together, could fulfill the high-altitude penetrator and low-altitude penetrator requirement.) Finally, Nixon's new DoD Chief Melvin Laird broke the deadlock and directed that the last study, AMSA (Advanced Manned Strategic Aircraft) be developed fully into a modern bomber. RFPs were solicited starting in 1969, the first B-1As were built in 1971, and first flight went off in 1974. IOC took place in 1979, with 240 originally ordered. It was eventually intended that the B-1A would replace the B-52, B-58, and FB-111A. The B-1 is known to its pilots as the Bone (B-one).

B-1A

The B-1A had the planform of a slim, blended wing-body design with swing wings for good operation at low, medium, and high speeds and automatic wing sweep. The fuselage flared to the rear, and the tail incorporated slab all-moving tailplanes. There were no ailerons; the B-1A used a combination of wing slotted flaps and slats for such a purpose. Leading-edge slats improved maneuverability, particularly at low altitude.

The engines were GE F101-100 afterburning turbofans, arranged in pairs on either side of the fuselage at the wing roots. They were positioned as close as possible to the center of the aircraft line to provide stability if one or more engines failed, and the air intake were complicated and variable to properly feed air into the engines at both low-altitude low-Mach flight and high-altitude high-Mach flight. The engines were, however, far enough apart to allow retraction of the main landing gear. The three bomb bays were in the center of the aircraft and the center of the center bomb bay was at the center of gravity of the aircraft. (Bet you can't say that three times fast!)

The blended wing-body had an ancillary effect – a measure of stealth. The high tailplane which was above the wings when they were fully swept contributed to this. The B-52 looked like a house on radar. The B-1A looked like a fighter about the size of an F-15 or F-4 on radar. The leading edges were made of titanium; this not only dealt with heat as high speeds, but it just a very bit radar-absorbent.

Eight internal fuel tanks were carried; four in the wings, and the rest in the fuselage. This allowed a copious amount of fuel carriage and thus excellent range at low and high altitude.

Each bomb bay was normally meant to carry a rotary launcher for a variety of weapons from SRAM missiles to ALCMs to a massive amount of 750 or 1000-pound gravity bombs. In practice, the B-1A was stuck in the nuclear triad role, set up and loaded and only to carry standoff nuclear weapons. The B-1A carried no defensive armament (despite the wargame *Airwar* having it armed with a tail Vulcan cannon stinger). It did carry a large amount of ECM, ECCM, chaff, flares, IRCM, and even corridor chaff dispensers and chaff rockets. Tied to this was a large amount of computing power for the time (it was basically the same computing setup as the Space Shuttle, though with different crew instruments and software, of course.) Radar and navigation were state of the art for the time, including a Doppler Radar to better detect movement at range and a Doppler altimeter for assistance in low-altitude TFR flight, The B-1A essentially had radar coverage almost around the entire aircraft, missing only the 180-240-degree area on each side.

The B-1A had four crewmembers – pilot, copilot, offensive WSO and defensive WSO. In an emergency, the entire crew capsule separated from the aircraft and stabilized by a set of spoilers, descended on three parachutes. The capsule then served as a crew survival shelter, and was fully able to float in water.

Though there were originally 240 ordered, President Carter cancelled the B-1A in 1977. Carter did, however, allow testing of existing airframes to continue. However, only eight B-1As had been built by this time.

In 1984, one B-1A was essentially internally outfitted as a B-1B, though externally and airframe-wise it remained a B-1A. Though Reagan had re-authorized the B-1, this began the road to the B-1B.

B-1B Lancer

Though President Reagan reinstated the B-1 program, the B-1 that was to be developed was a low-altitude penetrator that was very different from the B-1A. The engines were to be less-fuel-hungry than those of the B-1A, Avionics and software and computers were upgraded and given the task of low-altitude penetration, while still being able to conduct the occasional high-altitude bombing mission.

Perhaps the biggest change was the engines, intakes and fairings. The intakes in particular were drastically simplified, and made without the variable geometry that to a great deal that made high-Mach travel possible. Though the GE F101-GE-102 turbofans made low altitude penetration speed increase from Mach 0.86 to 0.92 (or Mach 1.2 at altitude). The simplified air intakes could be redesigned as a result that the B-1B's RCS decreased somewhat.

The internal fuel carriage increased with two tanks in the wings, one in the wing sweep carriage box, and four others in the main fuselage. In addition, the bomb bays could carry a 75,708-liter cylindrical fuel tank if necessary for long-range missions; rumors state that in the beginning of the Afghanistan and Iraq Wars, When the B-1Bs were required to fly from their bases in the US to their targets, B-1B's were carrying up to two of these. Of course, the B-1B (and B-1A, for that matter) can be air-refueled, with the receptacle being just in front of the windshield.

The B-1B has a complex avionics and weapon delivery suite known as OAS (Offensive Avionics System). This is complimented by another integrated system, the DAS (Defensive Avionics System). The OAS allows accurate munitions release and delivery, regardless of aircraft speed and attitude up or down. The system allows changes of target or angle of approach to the target, making changes in the munitions delivery data automatically. Though gravity and free-fall munitions may be delivered accurately without any laser or optical assistance, the B-1B also has the assistance of a laser designator and a laser boresight capability. However, the primary assistance for aiming freefall and gravity munitions is bombing radar. Notably, this radar system is separate from the TFR system, though it uses the same antenna.

The radar system, in fact, uses the same antenna for all radar emissions, though some minor systems have their own emitters, and the radios and ECM/ECCM/IRCM have their own emitters as well. The radar can emit in 11 ways – Ground Mapping Mode, High-Res Ground Mapping mode, Velocity Update Mode, TFR, Terrain Avoidance Mode, Precision Position Update, High-Altitude Calibration, Rendezvous Beacon Mode, Standard Rendezvous Mode and Weather Detection Mode. The different modes may change in microseconds, and in practice are continuous in all modes.

TFR includes terrain avoidance scans to the front and side, in addition to photo scans of the upcoming terrain in a 60-degree sweep. The pilots may choose from a variety of TFR modes, from 610 meters to as low as 60 meters; pilots often call them a Soft Ride, Bumpy Ride, and Hard Ride. The OAS automatically adjusts to whatever TFR mode the B-1B is in.

The B-1B originally used an INS system, but upgrades in the early 2000s gave an ever-improving GPS capability. The B-1B also has a velocity sensor, a gyro-stabilization system, a radar altimeter, and a system for dead reckoning (if all else fails).There is a plethora of radios ranging from satellite radios to several UHF, HF, and VHF radios; essentially, the B-1B can talk to whoever it needs to. One of the UHF antennas also gives off the IFF signal. Upgrades in the early 2000s gave it the ability to use GPS-guided ordnance, including 750-pound, 1000-pound, and 2000-pound JDAMs. Like the B-52 and B-2, it can carry many of such bombs, individually targeting them, potentially surgically taking out up to 84 targets or breaking the back of an armored advance,

The DAS, of course, controls the defensive systems, from ECM/ECCM/IRCM, chaff and flares, and chaff rockets. (The B-1A's corridor chaff dispensers were deleted.) The DAS also includes Active Jamming and Deception Jamming capabilities. The DAS controls the radar in the rear tailcone as well.

Recent upgrades have given the B-1B Link 16 capability, essentially an aerial version of a BMS that also interfaces with ground units and intelligence from a variety of sources.

It has been rumored that some of the external skin has been replaced by carbon fiber and/or RAM, as well as treated with RAM paint. This is the version I have statted below.

Despite these changes, the basic airframe of the B-1B was identical to the B-1A (with a change in paint scheme). However, the structure was strengthened and the landing gear beefed up, allowing the B-1B a significantly-higher takeoff weight, and landing weight if necessary. The bomb bays were lengthened by nearly a meter, with one being relocated in wing fuselage section and the other two being forward in the fuselage, and the two forward weapon bays could be connected to carry very large ordnance. There are four crewmen; with the pilot and copilot having a fighter-type stick and HOTAS throttle. Unlike the B-1A, the Offensive and Defensive WSOs have a small window to their sides. Unlike the escape capsule of the B-1A, the crew of the B-1B have ejection seats with standard aircrew bailout bags and equipment.

The B-1B can carry external weapons pylons on the lower fuselage sides, each able to carry two weapons, Eight other single-weapon pylons could be carried on hardpoints on the fuselage, allowing a total of 13 external weapons to be carried later. (See the B-1R in the next section for more on these hardpoints.) In fact, this external weapons carriage severely degrades performance and increases RCS dramatically, and in practice have been rarely used. Today, it is believed that external weapons carriage has been removed from the B-1B, including deleting from the computer and software, though interestingly the hardpoints do remain. (Under SALT/START, a B-1B may carry no more than twelve nuclear weapons externally at a time.)

An interesting note is that the B-1B has the radar and software to employ AIM-120 AMRAAMs, though it has yet to do so operationally.

B-1R Lancer – the "Aerial Battleship"

The B-1R was conceived in the early 2000s as a partner to the F-22A or as an aircraft able to quickly break up large formations of enemy aircraft. Though it is an upgrade of the B-1B, it has more in common with the B-1A, able to reach Mach 2.2 and having vastly more powerful Pratt & Whitney F119 engines (the same as those on the F-22 Raptor) -- and fuel-hungry engines; the estimated range of the B-1R is about 20% less than that of a B-1B, even with a full load of fuel. Though the planform is basically the same as the B-1B, the inlets and engines give it away immediately – if that doesn't, the Y-shaped tail will – a tail shape that further increases the stealth profile of the B-1R (not by a full step however – it gives the radar and his missiles an additional -2), and somewhat increases its maneuverability. The radar has an additional mode, which is at the cost of some other modes – an AESA air-to-air fire control radar developed from that of the F-22 and F-15S (and rumors also say the Israeli version of the F-15). This is, however, at the cost of some radar modes like Ground Mapping and High-Res Ground Mapping and High-Altitude Calibration modes. The B-1R does not carry chaff rockets. It does have, however, several new air-to-air attack modes.. Some conceptions give the R-1R the ability, one it has fired all its externally-carried missiles, to jettison its MERs and use a rotary launcher in each bomb bay, each able to carry eight missiles. Some conceptions also have the B-1R able to carry AIM-9X Sidewinder missiles or AGM-122 Sidearm ARMs. Some conceptual designs also call for the carriage capability of the HARM ARM as well. I have included these in the stats below. Note that the normal missile loadout for the B-1R is the AIM-120 AMRAAM, and the most common version associated with the B-1R is and AIM-120D; however, the B-1R is able to use any version of the AIM-120 (or the Sidewinder, for that matter).The B-1R is able to lock onto 24 targets per phase, and is able to ripple-launch 12 missiles at twelve different targets the following phase (or if the offensive WSO wishes, later phases, as long as the B-1R maintains its lock-ons).Note that the B-1R's missiles and attack radar is operated by the Offensive WSO.

So far, the B-1R exists only in computers, computer simulations, and aircraft simulators.

Twilight 2000 Notes: These aircraft excelled at the low-level deep penetration raids for which they were designed, and were responsible for a lot of damage to targets ranging from Europe to the Middle East to Southeast Asia, as well as flying missions over the North American continent. However, the gradual loss of suitable airfields and support facilities, the reduction in available jet fuel, and combat losses meant that its use decreased steadily in the later stages of the Twilight War; though some 40 Lancers survived the Twilight War, it is believed that the last B-1B mission was flown in mid-1999.

Aircraft	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
B-1A	$192,386,263	JP5	34.02 tons	179.169 tons	4	51	Radar (250 km), SLAR (100 km), RLR (80 km), SAR (20 km), FLIR (100 km), Image Intensification (60 km)	Shielded
B-1B	$237,790,077	JP5	34.02 tons	216.37 tons	4	61	Radar (300 km), SLAR (150 km), RLR (100 km), SAR (50 km), FLIR (100 km), LIDAR (120 km), Image Intensification (60 km), VAS (50 km)	Shielded
B-1R	$181,074,470	JP5	34.02 tons	208.4 tons	4	59	Radar (300 km), SLAR (150 km), RLR (100 km), SAR (50 km), FLIR (100 km), LIDAR (150 km), Image Intensification (60 km), VAS (65 km)	Shielded

Aircraft	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
B-1A	1331	370/646 (130)	NA 87/152 6/4 60/40	112635	9252	18898	FF5 CF6 RF4 T6 W4
B-1B	956	265/550 (130)	NA 62/151 5/3 50/30	112635	7936	18288	FF7 CF8 RF7 T6 W6
B-1R	3979 (1276)	1105/2293 (130)	NA 900/1867 5/3 50/30	112635	9524	19564	FF7 CF8 RF7 T6 W6

Aircraft	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
B-1A	All-Weather Flight, Flare/Chaff Dispensers (75/75), Chaff Rockets (10), Corridor Chaff Pods (4) ECM 2, IRCM 2, Deception Jamming (60 km), Active Jamming, Stealth 1, IR Stealth 1, TFR (40 km), Track While Scan, Laser Designator (40 km), INS, IFF, RWR, Secure Radios, Look-Down Radar	3000/2300m Hardened Runway	+3	3 Bomb Bays	None
B-1B	All-Weather Flight, Flare/Chaff Dispensers (75/75), Chaff Rockets (10), ECM 3, IRCM 3, IR Suppression, Deception Jamming (75 km), Active Jamming, Stealth 2, IR Stealth 1, TFR (40 km), Track While Scan, Laser Designator (75 km), INS, GPS,IFF, RWR, Secure Radios, Satcom Radio, Target ID, Look-Down Radar, Multitarget (6)*	1800/2200m Hardened Runway	+4	3 Bomb Bays, 14 Hardpoints**	None
B-1R	All-Weather Flight, Flare/Chaff Dispensers (75/75), Chaff Rockets (10), ECM 3, IRCM 3, IR Suppression, Deception Jamming (75 km), Active Jamming, Stealth 2, IR Stealth 1, TFR (40 km),, INS, GPS, Advanced IFF, RWR, Secure Radios, Satcom Radio, Target ID, Look-Down Radar, Multitarget (12), Auto Track, Track While Scan,	1800/2200m Hardened Runway	+5	3 Bomb Bays, 3 Hardpoints/MERs (24 Attachment Points)***	Up to 48 AMRAAMs or Sidewinders or Sidearms or HARMs (or combination)****

HUD Interface, IR Uncage, Supercruise

*Though the B-1B can carry AMRAAMs and the Multitarget ability can apply to them, the Multitarget capability normally applies to the number of guided munitions that the B-1B can launch at once.
**Though the B-1B can carry 14 low-capacity hardpoints around the aircraft, this is almost never done, as it reduces the speed by 10% and increases fuel consumption by 10%, and partially spoils the B-1Bs stealth profile (Stealth profile degrades by one step).
***While the B-1R is carrying it's external hardpoints, it suffers the same effects as the B-1B when it is using its external hardpoints.
****The B-1R could carry conventional free-fall and guided munitions in its weapon bays or fuel tanks, but though the fuel tanks are possible (to increase range), carriage of air-to-ground munitions is unlikely (but of course, mission-dependent).

B-2 Spirit

Research on this aircraft began in the mid 1970s, but its existence was not confirmed until the late 1990s (except for President' Carter's slip of the tongue in 1978). You see, in 1978, President Carter secretly authorized the development of a low-observable full-sized bomber, and invited Lockheed, Boeing, and Northrop to compete on the project, called the ATB Program (Advanced Technology Bomber). Northrop had a leg up, having had developed in its past the low-observable XB-35 and YB-49 flying wing bombers. These designs had a natural stealth profile to them, having buried engines, small canopies, only the barest amount of a tailcone (more to improve stability than anything else), and very small multiple vertical stabilizers, more fins than anything else, and again more for stability than anything else. (This was waaaaay before fly-by-wire technology…) Carter thought that the ATB could replace the escalating-cost B-1A, and the B-52 which he felt was increasingly obsolete. (Boy, was he wrong on all counts!)

The Northrop ATB was given the code name Senior Ice while the Lockheed proposal became Senior Peg. (Boeing had teamed with Northrop and Vought earlier in the process.)

Northrop's design was a barbed-arrowhead design which was essentially a flying wing design with no fins, fairings, projections, only the barest of blisters for antennas and emitters – many of the antennas and blisters could even be retracted into the aircraft in a process that later on, B-2A crews would call "stealthing up." You would be hard put (if the guards would let you near a B-2A) to find a surface that does not bounce radar off at a wrong angle to reflect properly. Most of the upper and lower surfaces are smoothly blended into each other, yet designed to also reflect incoming radar and guidance signals into off angles. Most of the B-2A is covered in a special elastic material which enforces its smoothness, and on top of this is the still-classified RAM material and RAM paint.

In 2005, Jack Northrop, then in his 90s and long a proponent of the flying wing, was shown a model of the soon-to-go-into-production B-2A Spirit. He broke down crying. He died within a year.

The chaff used by the B-2 is similar to that used by the Eurofighter; it actively broadcasts jamming signals, and functions one level better in effectiveness than normal chaff.

The centerbody contains the cockpit, some of the avionics in front and below the cockpit, a large avionics bay, and the weapons bay. (There is also a small, flat space behind the cockpit about big enough the one of the crewmen to lay out flat; most crews put a full length lawn chair or a cot there so on long missions they can switch off and rest. There is also a chemical toilet which suctions waste like you might find inside a passenger airline. There are only two crewmen; the pilot is usually designated the Aircraft Commander and flies the aircraft, performs the duties of a Defensive WSO, and in general keeps track of the stealth profile and the defensive avionics. The second crewman is designated the Mission Commander, and takes care of offensive operations as well as avionics such as the radar and radios. The B-2A has satellite radio and essentially enough radios to talk to anyone friendly on or above the battlefield or ships out at sea. It should be noted that much of the avionics operate on voice command, and some operate automatically.

The design of the B-2A was dictated by the need for stealth and the need for a high subsonic speed. Thus, the barbed arrowpoint/boomerang shape, complete with nose point. The wings are swept back and have a jagged rear edge that send detection beams off at angles and give the design maximum controllability. It should be noted that without the B-2A's avionics, it would probably crash the second it left the runway; the B-2A is almost completely unstable in flight without computer assistance. Intakes and exhausts are angular; even when control surfaces actuate, they are shaped and angled such that they are still stealthy. The B-2A has such a large wing that flaps are not needed. Though there is a set of control surfaces above the wings for yaw control, it is believed that the engines can be used to create differential thrust for additional yaw control, as the direction of greatest instability on the B-2A is the yaw axis.

Though the B-2A looks to casual inspection like it has only two engines, it in fact has four, GE F118-GE-11 non-afterburning turbofans. The engine is based on the F101-X, which itself is based on the F-100 that originally powered the F-16 and F-15, The F-100-X was eventually developed into the engines that powered the B-1A. The engines are buried far enough inside the intakes that the compressor blades cannot be seen by any sort of radar or guidance emission. The intakes are buried and the inlets covered with special S-shaped sections inside curved wedge shapes to confuse radar and reflect it as all sorts of odd angles; In early wind tunnel tests, it was found that the shapes of the inletsw led to a loss of power due to the inlets and intakes being unable to feed the engines enough air at low speeds. Therefore, at low speed, the B-2A's wings on either outer side of the intakes open auxiliary scoops to properly feed the engines. The engines were designed to run relatively cool, and the exhausts were likewise buried in the aircraft and let out to special (and still classified, but are supposedly based on a large improvement on the Space Shuttle's heat shield tiles). The engines are in barely-rising nacelles blended into the wing on either side of the crew compartment and weapons bay, which was itself low and blended smoothly into the rest of the structure. At the end of the aircraft, known as the beavertail, there are further moveable surfaces which help dampen the heat from the exhausts.

The wings are basically full of fuel, the central body, as stated, has the cockpit, avionics, and two bomb bays. These weapon bays generally carry rotary launchers carrying heavy JDAMs, ALCMs, JASSMs, LRASMs, and other such ordnance. The rotary launchers normally carry eight weapons per bay, but one or both bays may be reconfigured to carry a marked increase in smaller JDAMs or gravity bombs.

As stated, the B-2A has two crewmen. They are seated on ejection seats. There is a jumpseat behind and between the crewmembers for visitors , trainers, or evaluators, but in most cases, this is kept in the stowed position, and it is almost never used on a combat mission. The B-2A is capable of midair refueling, through a receptacle behind the cockpit on the upper fuselage; the receptacle rotates smoothly when not in use, leaving a smooth surface that blends into the rest of the aircraft.

Though it may seem that putting radar on a stealth aircraft would negate its stealth, the B-2A has an AESA radar which already has a low probably of being seen, and also has additional LPI (Low Probably of Intercept) features. Much of the radar system is classified, but it can function as a weather radar, and also has the tasks of detection, classification, identification, and location of any hostile threats (or non-hostile targets). The radar, like the F-22 and F-35, receives inputs from several locations on the aircraft, and essentially has 360-degree coverage around and even *through* the aircraft.

The Block 20 version of the B-2A appeared ion 1996. The primary difference is a strengthening of the airframe, landing gear, and weapon racks and rotating racks that allow it to operate at a higher weight. The INS navigation was also replaced with a GPS receiver (though the vanilla B-2A has partial GPS capability in order to drop JDAMs and some other GPS-guided ordnance). The Block 20 B-2A is also equipped with Link-16, which is essentially a BMS for aircraft which interfaces with ground BMSs like Blue Force Tracker.

The Block 30 is, so far, the definitive version of the B-2A. Essentially, all the RAM coating and paint was removed and replaced with even more efficacious materials. The TFR system allows the B-2A to follow terrain at an altitude as low as 60 meters – essentially giving it the ability of the B-1B, F-111F, or FB-111A. The Block 30 B-2A is integrated with the AFMSS (Air Force Mission Support System, which makes the aircraft extremely flexible in approaching, egressing, choosing, and changing targets based on the needs of higher headquarters, target prosecution, or evasion needs. It also allows the Block 30 B-2A to interacts with the sensors of UAVs within range, and receive pictorial data from satellites.

By the end of 2000, all B-2As had been upgraded to the Block 30 standard. In 2012, development began on what will become Block 40, with improvements primarily centering in the radar and radio systems, as well as some other avionics and equipment. The exact update list is still unspecified.

There are currently 21 B-2As; there were originally to be 50 B-2A's built, each one named *Spirit of [name of one of the US States]* However, the entire DoD chain of command, as well as the President, Vice President, the Congress, the Senate, several white House, Congressional, and Senatorial staffers…collectively gagged on the price on *one* B-2A, let alone 50; the RL price of a B-2A is rumored to be about $2 Billion. *Each*. The Acquisition program was cut before the halfway point, with 21 being built. In early 2008, the B-2A *Spirit of Kansas* crashed on takeoff from Guam; ofservers reported the aircraft had seemingly spontaneously caught fire, damaging the avionics and causing the *Spirit of Kansas* to roll sharply to starboard. The crewmembers ejected safely and are reportedly still flying B-2As. The cause of the crash was corruption of the air data system; somehow, moisture got introduced into the avionics while some parts of the avionics were being calibrated. The *Spirit of Kansas*, unfortunately, was essentially a total loss and no replacement B-2A was authorized.

Unfortunately, due to its design, the B-2 is not an agile aircraft, nor is it a fast aircraft, though it *is* fuel efficient.

Twilight 2000 Notes: This aircraft's existence was still only a rumor until just after the start of the Twilight War, when an NBC news camera crew shot some footage at Diego Garcia and caught the first public sight of the strange-looking aircraft, which the President later confirmed was the rumored "Stealth Bomber." These aircraft were used to penetrate heavy defenses all over the globe. Some 32 B-2As were built before the beginning of hostilities; most of these were upgraded to Block 20, but 12 were built to Block 30 standards.

Aircraft	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
B-2A Block 10	$833,549,931	JP5	22.68 tons	170.1 tons	2	49	AESA LPI Radar (300 km), AESA LPI SLAR (150 km), AESA LPI RLR (100 km), FLIR (100 km), LIDAR (120 km), Image Intensification (60 km), SAR (50 km)	Shielded
B-2A Block 20	$834.224,913	JP5	23.46 tons	177.11 tons	2	50	AESA LPI Radar (300 km), AESA LPI SLAR (150 km), AESA LPI RLR (100 km), FLIR (100 km), LIDAR (120 km), Image Intensification (60 km), SAR (50 km)	Shielded
B-2A Block 30	$902,609,453	JP5	23.46 tons	177.11 tons	2	54	AESA LPI Radar (300 km), AESA LPI SLAR (150 km), AESA LPI RLR (100 km), FLIR (100 km), LIDAR (120 km), Image Intensification (60 km), SAR (50	Shielded

	km)

Aircraft	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor*
B-2A Block 10	1582	434 (140)	NA 109 6/4 60/40	81646	7755	18288	FF6 RF6 RF6 T0 W6
B-2A Block 20	1521	417 (140)	NA 105 6/4 60/40	81646	8078	18288	FF6 RF6 RF6 T0 W6
B-2A Block 30	1521	417 (140)	NA 105 6/4 60/40	81646	8078	18288	FF6 RF6 RF6 T0 W6

Aircraft	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
B-2A Block 10	All-Weather Flight, Flare/Chaff Dispensers (60/80), Chaff rockets (4), ECM 2, IRCM 4, Stealth 3, IR Stealth 3, IR Suppression, Deception Jamming (75 km), Active Jamming, TFR (50 km), Track While Scan, Laser Designator (75 km), INS, GPS, RWR, Secure Radios, Satcom Radio, Target ID, Look-Down Radar, EW Suite, HUD Interface, Advanced IFF	1600/2000m Hardened Runway	+5	2 Bomb Bays	None
B-2A Block 20	All-Weather Flight, Flare/Chaff Dispensers (60/80), Chaff rockets (4), ECM 2, IRCM 4, Stealth 3, IR Stealth 3, IR Suppression, Deception Jamming (75 km), Active Jamming, TFR (50 km), Track While Scan, Laser Designator (75 km), INS, GPS, RWR, Secure Radios, Satcom Radio, Target ID, Look-Down Radar, EW Suite, HUD Interface, Advanced IFF, Link 16, Multitarget (4)	1600/2000m Hardened Runway	+5	2 Bomb Bays	None
B-2A Block 30	All-Weather Flight, Flare/Chaff Dispensers (60/80), Chaff rockets (4), ECM 2, IRCM 4, Stealth 4, IR Stealth 3, IR Suppression, Deception Jamming (75 km), Active Jamming, TFR (50 km), Track While Scan, Laser Designator (75 km), INS, GPS, RWR, Secure Radios, Satcom Radio, Target ID, Look-Down Radar, EW Suite, HUD Interface, Advanced IFF, Link 16, Multitarget (6), UAV Interaction	1600/2000m Hardened Runway	+5	2 Bomb Bays	None

*The B-2 has no tail or vertical stabilizer surfaces. Any tail hits are considered misses.

Boeing B-52 Stratofortress

Notes: Known affectionately to its crews as the BUFF (Big Ugly Fat Fellow, or Big Ugly Fat Fucker), the B-52's design goes back to the late 1940s, when plans for a heavy, turboprop-powered intercontinental bomber were drawn up. The engines were quickly replaced with what were then 8 of the most powerful jet engines available, the wings got swept and the fuselage sleeker, and in the intervening years, the design has been steadily upgraded with a stronger frame and skin, ever-more powerful electronics and bomb-delivery equipment, rebuilds to allow the carriage of heavier and more versatile weapons, and an upgraded rear gun position. Over the years, it was supposed to be replaced by a variety of newer bombers, including the B-58 Hustler, the XB-70 Valkyrie, and the B-1 Lancer, but it has outlasted any aircraft ever built. One misconception is that the B-52 is merely an enlarged B-47; this is far from the truth as the design work for the B-52 began before the design work for the B-47. That the B-52 bears any resemblance to the B-47 is coincidental. Some of the different iterations of the B-52 are so different that they could almost be regarded as separate aircraft, especially the different versions of the B-52H. Currently, the Air Force plans to keep the B-52 in service until at least 2020 and possibly as long as 2040; some of the present crop of B-52 crews are the children and even grandchildren of the original B-52 aircrew.

BUFF Prototypes – the XB-52 and YB-52

After years of failed design work on a piston, turbofan, and underpowered turbojet, the first true B-52, the XB-52, went into testing. One was built; its job was to wring out any problems with the upcoming B-52. The design had been lengthened from the original drawing board design by 4.26 meters, and huge above-wing spoilers were added to add to maneuverability and slow landing speeds. Pairs of huge flaps replaced the earlier conceptual flaperons. The wings were hugely thick at the roots, tapering to less than 0.6 meters at the tips. Some experience was gained from the B-47 program; the wings are swept at 35 degrees, the engines were podded, and the double bicycle landing gear with wingtip stick gear were used. The XB-52 used a bubble canopy, similar to that of the B-47 (though larger). The landing gear could be pivoted 20 degrees in either direction, making crosswind landings possible despite the size of the XB-52. Further braking was accomplished by a 13.4-meter wide parachute carried in the rear of the aircraft under the horizontal stabilizer.

The XB-52 was powered by eight Pratt & Whitney YJ57-P-3 turbojets, delivering 8700 pounds of thrust each, for a total of 26,100 pounds of thrust. Defensive armament consisted of four M-2HB machineguns mounted in a manned tail, with the tail gunner sitting above the gun turret. The turret could fire upwards 20 degrees, almost straight downwards, and about 45 degrees to either side. If the crew had to escape the aircraft, the tail gunner's compartment would be jettisoned by explosive bolts so the tail gunner could jump out. The bomb bay was located in the center of the aircraft between the wheel bogeys; provisions were made for both conventional and nuclear bombs. The standard crew was five: the pilot and copilot sat under the bubble canopy, the bombardier and defensive weapons (ECM) operator sat further back and downwards from the canopy, and the tail gunner was in the rear. The front had one more seat – the tail gunner took off in this seat, and before the XB-52 reached altitude, he would climb back to the tail gunner's position and lock himself in while the rest of the aircraft other than the cockpit were depressurized.

The XB-52 flew once, then was returned to Edwards for extensive ground experimentation and modifications. It would not fly again until after the YB-52s flew, using lessons learned from the XB-52.

The second prototype, the YB-52, was a service test model. It incorporated changes in response to the XB-52 flight and ground experimentation. Perhaps the biggest change in the YB-52 was the use of a shorter vertical stabilizer, a feature which would not appear again until the B-52G.

Early BUFFs – B-52A-C

The first production model was the B-52A, which first flew in 1954. Three B-52As were built, and used for advanced service testing, though they were also fully capable of carrying out missions. They however never saw squadron service. The nose of the B-52A was completely changed – instead of the bubble canopy, the B-52A had the side-by-side seating and nose we all know and love now. The crew accommodation of the B-52A was changed to six – pilot, copilot, tail gunner, radar navigator/bombardier, defensive systems operator, and navigator. The pilot and copilot sat in the top deck of the B-52A, while everyone else except the tail gunner sat in a lower deck behind the cockpit which later got tagged with names such as "the pit," the hole," and "the black hole;" the deck was dark and cramped. A seventh seat was a folding seat behind and between the pilot and copilot for an instructor pilot. The pilot and copilot had ejection seats; the four members of the crew on the lower deck simply fell out of the floor of the B-52. If an IP was present, he had to leave his seat, put on a parachute, then jump out of one of the spaces on the lower deck left by the escaping lower deck crew.

At first, the bombing system was not finished; a temporary system was installed until the actual MA-6A bombing/navigation system was ready. The B-52A was not only capable of aerial refueling, it carried, under the outer wings a pair of 3785-liter drop tanks.

The first 10 B-52Bs were to have been B-52As, but technical improvements based on the B-52As test program were incorporated into the new aircraft. The B-52B was the first version to see squadron service, and first flight was in 1955. 50 B-52Bs were originally to have been delivered as bombers; however, only 23 B-52B bombers were actually delivered. The remaining 27 were outfitted as RB-52B long-range reconnaissance aircraft. The B-52B used an A-3A fire control system for the tail gunner, but some later were retrofitted with the more advanced MD-5 system, which incorporated short-range tail radar. The RB-52 could still perform a bombing mission; a small portion of the bomb bay could still carry bombs, and the special wing MERs could carry weapons. All B-52Bs used the MA-6A bombing/navigation system. The B-52Bs were powered by J57-P-1W turbojets, each with a rating of 11,400 pounds of thrust.

A notable achievement (for the time) was a flight by three B-52Bs on a nonstop trip around the world, aided by aerial refueling. This flight took 45 hours 19 minutes for the 39,148-kilometer trip.

The RB-52B had an interesting internal setup: in the bomb bay was a two-man pressurized capsule who, depending on the mission, carried out photographic reconnaissance, radar reconnaissance, ELINT, or one of those activities and the use and launching of ECM or drones such as the Quail, which was designed to look on radar like a B-52.

Two RB-52Bs were later modified into X-15 launch aircraft. The other B-52Bs and RB-52Bs were modified to the B-52C standard in 1957-58.

The B-52C first flew in 1956; it was essentially an improved B-52B which had the capability to carry the RB-52Bs bomb bay pod (though the "R" designation was not used, as the mounting was not permanent). 35 total were produced. Internal fuel capacity was increased, and the size of the drop tanks was increased to 11,356 liters (though the smaller tanks of the B-52A and B could still be mounted). The B-52C was the first B-52 to carry the "SAC" paint scheme – largely natural metal with the underside of the aircraft painted in a reflective antiradiation white paint. This paint was classified – and it led to questions about why the underside of the B-52C was white. For the most part, these questions were never answered until the paint scheme was declassified, and ironically, the questions stopped and the paint scheme was rarely questioned. Power was again increased by use of the J57-P-19W, which had a rating of 11,750 pounds thrust.

An interesting feature present on all B-52s is a small water heater, generally for heating coffee and tea. Like all B-52s, the B-52A had antiflash curtains to pull across the windshield to protect the pilot's and copilot's eyes from nuclear flashblindness. The aircraft had to be flown on IFR when the curtains are deployed.

Large-Scale Production Begins: The B-52D, B-52E, and B-52F

The service entry in 1956 of the B-52D marks the B-52 as part of the triad of nuclear delivery systems that was the foundation of defense and offensive combat power for the US Air Force. The B-52D, B-52E, and B-52F were also capable of carrying out conventional bombing missions. Some 170 B-52Ds were built. The B-52D was essentially the B-52C without the capability to carry the special pod in its bomb bay. The B-52D got another power upgrade by the use of J57-P-29W turbojets, each developing 12,100 pounds of thrust. Production was extended to Boeing's plant in Wichita, Kansas, as in the Seattle plant, much of production was dedicated to the KC-135. The fire control system for the tail gunner was the A-3A or the MD-9, a later version of the MD-5. The bombing/navigation system remained the MA-6A. The Doppler radar system was updated from the AN/APN-108 to the AN/APN-89A, and a form of Terrain-Following Radar (TFR) was added.

The B-52E appeared in 1957, with 100 built. The E Model was very similar to the B-52D, with a more advanced bombing/navigation system, electrical system, and more advanced ECM and ECCM. The B-52E was capable of carrying the AGM-28 Hound Dog cruise missile, a small unmanned aircraft with inertial guidance and a thermonuclear warhead. Two could be carried, one each on hard points on the inner wing. Some B-52Es were used to test low-altitude penetration of enemy defenses, an activity at which they were largely successful.

The B-52F was the last B-52 to be manufactured in Seattle (though some modification work was carried out in Seattle). Squadron service began in 1958, and 44 were built. The biggest change was that the B-52F had self-starting engines; no external power cart was required. The self-starting module was carried on the port side of each port engine nacelle. Power was further increased by use of the J57-P-43W engine, with a thrust of 13,750 pounds thrust each. The B-52F suffered from a problem with leaky fuel lines, presenting a possible fire hazard; though this was not the first instance of this problem, it was the biggest. When operations over Vietnam started, the B-52Fs had their ECM and ECCM upgraded. A Loran homing navigation device was also added. The upgraded electronics limited the bomb load. The guns equipping earlier models of the B-52 were traded for M-3s, doubling their rate of fire.

One modification applied only to B-52Ds was the "Big Belly" refit, which increased the capacity of the bomb bay dramatically. This was a direct result of requirements for missions over the Hanoi-Haiphong area and Route Pack Six. Along with the Big Belly refit was the retrofitting of more advanced ECM/ECCM capability and an increase in chaff and flare carriage. It should be noted that the Big Belly refit did not actually change load-carrying capacity, it simply rearranged storage in the B-52, allowing it to carry more iron bombs for saturation bombing missions. It allowed up to 107 500-pound bombs, plus another 24 on the wing MERs. Other modifications made to Vietnam-bound B-52Ds included the Rivet Rambler ECM fit, which included an improved RWR, a radar receiver which could be left on to warn the crew, SLAR. Three more radar jamming modules (to cover the large amount of equipment the Russians were giving the North Vietnamese), and high-capacity flare and chaff dispensers were installed.

The B-52D was the model most used in the Vietnam War; rumors are that the actor James Stuart, an Air Force Reserve officer and qualified heavy bomber pilot, flew one mission against a VC stronghold in Cambodia. B-52 strikes in Vietnam were popularly known, especially to the ground troops, as Arc Light missions. Missions in Route Pack Six were called Linebacker missions. A result of B-52D (and E and F) operations is that they had to undertake an in-theater IRAN (Inspect and Repair as Necessary) upgrade.

First of the Last: The B-52G

The B-52G had perhaps the most marked change in appearance of all the B-52 series – the shorter vertical stabilizer like that used on the YB-52. Boeing's data indicated that the large vertical stabilizer of earlier models was not only unnecessary from a design and aerodynamic standpoint, but shortening the tail saved thousands of kilograms of weight and also reduced the RCS by a bit. Internally, there were also large changes – most notably the elimination of the rubber bladder-type tanks, with hollow tanks taking their place, allowing for a big increase in fuel capacity. The wing tanks in particular were joined, forming what Boeing and the Air Force called a "wet wing." However, the size of the external drop tanks was greatly reduced in response to the increase in fuel capacity; they now were physically smaller and held only 2650 liters each. Unlike earlier such tanks, these were attached permanently and are a part of the B-52G's (and H's) fuel load. The loss of weight in the tail led to an increase in possible takeoff weight. On the inner wings, the B-52G could carry huge multiple ejector racks, able to carry twenty-four 500-pound or 750-pounds bombs or eighteen 1000-pound bombs. Another type of rack could be installed on those wing hardpoints, allowing the B-52G to carry a pair of Hound Dogs. The B-52G was also to have carried the GAM-87A Skybolt medium-range attack missile, but the Skybolt program was cancelled during the B-52G's development. Instead of the Skybolt, four ADM-20 Quail decoys were carried in the bomb bay in addition to the B-52G's weapons load. These decoys used a preprogrammed flight path and had an RCS similar to the B-52.

Another large change to the B-52G was the elimination of the tail gunner's position. The former tail gunner was brought up to the lower deck of the B-52G, and he became the defensive weapons operator (generally an NCO Staff Sergeant, Technical Sergeant, or Master Sergeant). He was still responsible for the defense of the aircraft, and could launch chaff, flares, and chaff rockets, or the Quail (when so equipped). His primary job, however, was the firing of the tail guns by remote control; he had a wide-angle CCTV viewer with a reticle that varied by range, and the tail radar was more powerful and could also help direct the guns. The gunner could also leave aiming the guns to the AGS-15 fire control system, meaning that he only had to drop the trigger on enemy aircraft. He faced the rear, and had an upward-firing ejection seat.

The B-52G introduced TERCOM to the B-52, to go with the new low-level penetration role of the B-52. This allowed the B-52G to be safely flown as low at 200 feet, in a soft or hard ride flight configuration.

Like the B-52H, the B-52G was used over North Vietnam, South Vietnam, Cambodia, and Laos, with mixed results. Though the Vietnamese were justifiably afraid of the havoc they could bring down, they were suited more for urban and industrial targets than bombing of the Ho Chi Minh trail and other such tactical targets. In addition, the air defenses of the Hanoi-Haiphong area were much thicker than the designers of the B-52 ever thought about, and the B-52G and B-52H took heavy losses, especially during the Linebacker II bombing campaign.

B-52Gs (and Hs) dispensed with the wing ailerons, using spoilers and the tail to do the job formerly dome with ailerons.

The tail of the B-52G was increased by about a meter, and used for some of the new electronic systems and flare and chaff dispensers.

The B-52G is the B-52 variant featured in HBO's *By Dawn's Early Light.* Last combat use for the B-52G was during Desert Storm, though eight B-52Gs remained in service until 1995.

The "Last" Version: The B-52H

The B-52H was intended to be the last version of the B-52 to fly before it was to be replaced by more advanced bombers such as the XB-70 and later the B-1. It was also intended to be primarily a nuclear weapons carrier, and that it's primary armament would be the Skybolt missile with thermonuclear warheads. This would keep the B-52H, for the most part, from having to penetrate enemy air defenses while still being able to attack the target. The B-52H would still carry four Quails in its bomb bay. However, with the demise of the Skybolt program, the B-52H carried paired Hound Dog missiles, and free-fall nuclear weapons in its bomb bay. 102 were built; only 80 remain in service, with some being destroyed at AMARC as a part of the START treaty while others are preserved at AMARC as a source of spare parts. Some of these 80 B-52s are still in use over Afghanistan.

The B-52H had the same shortened tail as the B-52G; however, the tail armament was changed to the more effective M-61 Vulcan Gatling Gun. The engines were changed to more fuel efficient and higher-rated Pratt & Whitney TF33-P-3 turbofans, rated at 17,000 pounds of thrust each. This engine was a highly-modified J57, turning it into a turbofan. A power cart was again necessary, as the engines required a pneumatic blast to start. These engines have larger air intakes than the J57-powered aircraft and incorporate bypass air outlets that make the engine nacelle look very different from earlier models.

The B-52G introduced the rotary launchers that later could equip all B-52Gs and Hs. These were modular in nature, and could be removed to increase conventional bomb carrying capability. Two of these rotary launchers could fit into a B-52s bomb bay.

The B-52H had increased ECM and ECCM capability, as well as increased-capacity flare and chaff dispensers and the ability to carry 10 chaff rockets in its bomb bay. These systems were collectively referred to as the Phase VI Countermeasures Suite. A takaway from the earlier CCV program (see below) was a modification of the control surfaces and a small flight computer which gave the B-52H greater agility than its earlier cousins.

B-52H: Later Iterations

The B-52H has been the recipient of repeated and heavy modifications; some modifications programs should rightfully earned the B-52H a higher letter designation, despite the fact that this was never done.

The first such heavy modification was done to 281 B-52Gs and Hs. These modified B-52s began service in 1972. This involved the installation of a rotary-type launcher in for forward bomb bay, designed to carry eight of the then-new SRAM short-Range Attack Missiles, which could carry a nuclear or conventional warhead. Six further SRAMs could be carried on the wing hardpoints on an MER designed for this purpose. The B-52Gs and Hs could still carry four Quails in its bomb bay, but in late 1972, the Quails on the B-52H were replaced by the AGM-69A SCAD (Subsonic Cruise Armed Decoy Missile). Six of these were carried on a rotary launcher in the rear bomb bay; the SCAD was not only a decoy, but could be programmed to, at any point in its flight, to attack a target using a conventional warhead, using either flight programming or using an integral antiradar capability.

Next, the B-52H sprouted an ever-increasing amount of antennas, both faired and short, but free-standing. All over the aircraft are antennas for use with the B-52Hs extensive communications suite, including a two secure VLF radios, a pair of extreme-long range secure radios, and a medium-range secure link primarily to communicate with other B-52s and escorts in the same strike package, as well as tanker aircraft. Fairings on either side of the nose held advanced (for the time) ECM, ECCM, and Deception Jamming transmitters. Above the radome is a further fairing; this carries a AN/ALT-28 "noise generator," used for hard jamming of enemy air defenses by filling their scopes with static and false targets. A further fairing on the each side, with a small air intake in front of it, allows the B-52Hs air conditioning and heating to function even without the engines being on. (This is something anyone who has sat on a large aircraft on the ground can appreciate.) The mechanism also provided cooling for the ECM equipment. The lower fairings on both sides could be steered within its housing to get a better jamming effect. The AN/ASQ-38 bombing/navigation system was replaced with the up-to-date (at the time) AN/ASQ-176 Offensive Avionics System (OAS). The OAS gave the B-52H true radar bombing capability and greatly increased radar and bombing accuracy. Also added with the OAS was a FLIR. This is referred below as the B-52H-1.

The OAS (Block II) was necessary for the next upgrade: the carriage of the AGM-86B ALCM, also carried on the B-52Hs rotary launchers, and carryable on the wing hardpoints. Twelve ALCMs could be carried in the bomb bay, and another six on each wing MER. The electronics necessary for operation and aiming of the ALCM were also added, as well as allowing the bombardier to program a flight path, including various turns and other maneuvers. (Some B-52Gs also received this modification.) B-52s carrying cruise missiles are fitted with wing root extensions at the front of the wing to allow the Russians to tell whether we have too many B-52s with potential nuclear weapons to comply with treaty obligations (as we did, at the beginning of the modification program). All B-52H bomb bays now had a pair of rotary launchers, which could deliver nuclear weapons, conventional munitions, and most of the tactical missiles in the USAF inventory. This is referred to below as the B-52H-2.

The next modification was relatively small: the addition of the AN/AVQ-22 Electro-Optical Viewing System. This was a long-range sight that could be swiveled 45 degrees to either side, 15 degrees upward, and 45 degrees downward. It also provided long-range LLTV. This sight not only allows the B-52H to identify enemy aircraft at beyond visual range, is allows the crew their first look at a target, again from long range. In 1982, the wing hardpoints of the B-52H (and G) were modified to carry six Harpoon missiles, giving the B-52 an antishipping capability. The crewmembers on the lower deck were given CCTV monitors to allow them a view outside (these were later replaced flat panels). The OAS Block II was improved and modified into the Flight Management System, which combined the navigation functions with the Stores Management Overlay (SMO); the SMO facilitated the use of several different types of weapons by merely loading the software for use of a particular weapon into memory. The SMO function of the FMS would see continual upgrades over the years as new weapons were added to the B-52H's repertoire – and continues to be upgraded. This is referred to below as the B-52-3.

In the mid-1980s, ECM capability and strength was further increased by new equipment in the belly of the B-52H forward of the bomb bay; this resulted in a "farm" of eight blade-type antennas underneath the B-52H. An IRCM device was also installed, providing more protection against heat-seeking missiles and providing false targets for aircraft with IR seekers. A datalink device was used, with the antenna atop the rear fuselage; this gave the B-52H a direct link not only with each other, but with AWACS aircraft and ground radars. The addition of another extreme long-range secure radio allowed contact with ground units. GPS was added to the FMS in the late 1980s. The OAS Block II was modified into the Block III, which included the AN/APQ-166 Strategic Radar, which had increased range, had a planar-array radar. The longer-ranged AN/AAQ-23 FLIR replaced the AN/AAQ-6. The AN/AVQ-22 EOVS was replaced by the longer-ranged, more flexible, and more reliable AN/AVQ-37. Another, more general upgrade was done to switch to systems that had more availability of spare parts. These collective modifications are referred to the B-53H-4.

In October of 1991, the tail gun of the B-52H was deemed unnecessary and was removed. This meant that the gunner and his station were removed and the remaining functions of the Offensive Systems Operator were folded into a redesigned Offensive/Defensive Systems Operator station; the use of more advanced computers also allowed this integration to take place without unduly increasing the O/DSO's workload. Though at first the guns remained on the aircraft and were operated by the O/DSO, they were finally totally removed by 1994. Interestingly, the tail gunner's seat, reticle gunsight, and AN/ASG-21 defensive fire control system remained in the tail, though the area was covered over by a bolt-on fairing. In addition, the tail radar was increased in ability into a full search and tracking radar.

The mid-1990s also saw communications upgrades for the B-52H. The AN/ARC-210(V) VHF/UHF replaced the old VHF/UHF radio, and provided the B-52H with secure, long-range communications. It could be used in LOS or SATCOM modes, and unified the shorter-range communications with other aircraft as well as air-to-ground communications. The radio set also had a commercial Have Quick I set for communications with civilian aircraft, and a Have Quick II module which gave the set a strong antijamming capability as well as an interface with the SINCGARS radios used by ground units and military helicopters. It was capable of multiple simultaneous communications, and could be used in manual mode to talk to ships and submarines.

Another addition was a receive-only radio called the AN/ARR-85(V), letting the aircraft listen to VLF and LF transmissions. This was meant primarily for the B-52H to be able to receive attack orders even in heavily ionized atmospheric conditions like those during a general nuclear exchange. The AN/ARR-85(V) was operated by the navigator, who would then print out the orders and give them to the bombardier. Computers and software developed from commercial counterparts, called Falcon View and Combat Track II, were added; this included three laptop computers which controlled the entire communications and ECM setup. The computer system made the entire communications, ECM/ECCM, and attack profile much more agile. The Combat Track II also included a fold-up LCD which functioned as sort of an additional HUD. The collective developments in the past three paragraphs are called below the B-52H-5.

In 2000, the B-52H began to receive the Avionics Mid-life Improvement (AMI), which essentially brought the bombing and navigation systems into the 21st century. AMI replaced the avionics computer and data transfer unit, which under OAS had severe limitations, with full digital capability and supporting advanced data entry such as a trackball for targeting, a digital mapping unit, and modernized the base computer language. A problem with the B-52H's navigation capability over the poles was fixed. The AMI was a bit slow in implementation and the AMI was not fully operational until 2006.

After AMI, the Combat Network Communication Technology (CONECT) replaced all the old, monochrome TV monitors with full-color LCD monitors. A client/server architecture replaced previous communications technology with other aircraft, ground units, and AWACS aircraft. The Link-16 Tactical Datalink (TDL) with Windows Mail allowed higher commands to give the crew of the BUFF the ability to change targets or weapons use as needed. It also gave the B-52H a wideband wireless internet and data connection ability. This upgrade occurred in 2007. A removable Litening II targeting pod allowed the B-52H to use virtually all smart weapons in the USAF inventory. This upgrade included the modification of the bombardier's panel into the Advanced Guided Weapon Control Panel (AGWCP). The Litening Pod was itself upgraded several times to improve resolution, range, coordinates for GPS-guided weapons, and the ability to automatically transfer the BUFF's weapons complement and targeting information to ground units. The AGWCP software also transmitted coordinates to ground units in both latitude and longitude and in the grid coordinates used by ground units. Part of the AGWCP included a joystick which resembled that of a gamer's flight-type joystick. The AN/AAQ-28A(V)3 Litening AT/ISR allowed the B-52H to transmit pictures from the weapons' receivers to a properly-equipped ground unit or AWACS aircraft (or back to the AWACS). The two paragraphs above are referred to below as B-52H-6.

In general, virtually all BUFFs received structural strengthening and improvements throughout their lifetimes. This is particularly true of the B-52G and H; while the aircraft were older in most cases than their aircrews, many structural components and skin had been replaced several times. Modifications were legion, including the replacement of whole systems, electronic and electrical. Most B-52Hs are well beyond the original 5000 hours projected for their airframes at the time of their construction.

As for the designations I am using – B-52H-1 through -6 – **these are not official designations,** merely designations to easily delineate them.

Special BUFFs

One B-52A went on to serve into the late 2000s; it was modified into the NB-52A configuration and used to launch research aircraft such as the X-15, lifting body aircraft, and the X-37, as well as various scale models of actual aircraft in a pre-prototype testing phase.

The NB-52A was getting really long in the tooth by 2001. It's supposed replacement was a B-52H, which was heavily-modified for it's role (but not given an NB designation). However, NASA contracted such use to Scaled Composites and its White Knight research aircraft, and the modified B-52H was retired in 2006, having never flown a research mission.

The NB-52E was a part of a larger research program into Controlled Configuration Vehicles (CCVs). CCVs sport extra aerodynamic surfaces in addition to modifications designed to deliberately cause the aircraft to be unstable and capable of maneuvers that a stock aircraft cannot do. (The B-52E is largely unable to perform most air combat maneuvers.) Special computers allow the unstable to be flown by continually adjusting aerodynamic surfaces, sometimes as much as 20 such corrections per second. The NB-52E was largely differentiated by it's bright-colored test paint scheme canards just behind and below the cockpit, and vertical fin under the nose. Special modifications were designed to reduce the structural bending and control surface flutter which could happen to a B-52 in severe air turbulence. The flight computer array was linked to sensors literally everywhere in the aircraft. Gyroscopes and accelerometers detected abrupt or unexpected movements of the aircraft and caused the flight computers to jigger the control surfaces, or the canards and nose fin. The system, computers, and canards and fin were collectively called the Ride Control System. In some places, the skin was replaced with anti-radar paint or actual anti-radar materials. Testing started in 1973, but the configuration was never included in actual production B-52s. Though the NB-52E had a bomb bay largely containing instrumentation, I have included a "combat example" below for interest and comparison. I have given this the designation of "YB-52H", **but let me stress that this is not a real designation.**

Another NB-52E was used to test the B-52 while powered by four Pratt & Whitney JT9D turbofans, also employed on the Boeing 747. This was done primarily in an effort to come up with a configuration that required less maintenance and less fuel, and produced 43,500 pounds of thrust apiece. Ultimately, the costs of re-equipping the entire B-52 fleet got in the way, along with the costs and time to train ground crews on the new engines, train the pilots to proficiency with the new engines, etc, etc, etc. I have decided to add a "combat version" below. Another NB-52E was used to test a fly-by-wire system, which later reappeared on the B-52H. As above, I have given this the **non-real designation** of "YB-52J." This re-engined B-52 is, however, showing every sign of becoming the real B-52J.

Twilight 2000 Notes: By the Twilight War, the only official service variant was the B-52H, with a fully modern electronic warfare suite and modernized attack center able to conduct both low-level penetration missions and high-altitude bombing with anything from conventional iron bombs to air-launched cruise missiles. In the Twilight War, they are perhaps best known for the bombing of the Krefeld Salient, where, despite staggering losses, they were able to break the back of the Russian invasion of Germany; and the carpet bombing of Baghdad and the surrounding area, practically reducing the Iraqi capital to total ruins along with most of the Republican Guard in a single 22-hour campaign of non-stop bombing.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
B-52A	$177,497,303	JP5	19.2 tons	187.5 tons	6+1	166	Weather Radar (200 km), Radar (200 km), Bombing Radar (40 km)	Shielded
B-52B	$186,844.635	JP5	20.57 tons	200.89 tons	6+1	176	Weather Radar (200 km), Radar (200 km), Tail Radar (50 km), Bombing Radar (40 km)	Shielded
RB-52B	$1,265,960,000	JP5	2.57 tons	200.44 tons	8+1	186	Weather Radar (200 km), Radar (300 km), Tail Radar (50 km), Bombing/Mapping Radar (50 km)	Shielded
B-52C	$187,226,535	JP5	20.57 tons	200.89 tons	6+1	176	Weather Radar (200 km), Radar (200 km(, Tail Radar (60 km), Bombing Radar (50 km)	Shielded
B-52D	$166,228,788	JP5	20.57 tons	200.89 tons	6+1	180	Weather Radar (220 km), Radar (220 km), Tail Radar (65 km), Bombing Radar (55 km)	Shielded
B-52D (Big Belly)	$182,851,667	JP5	26.79 tons	207.11 tons	6+1	186	Weather Radar (220 km), Radar (220 km), Tail Radar (65 km(, Bombing Radar (55 km)	Shielded
B-52E	$232,960,809	JP5	19.2 tons	200.89 tons	6+1	181	Weather Radar (240 km), Radar (240 km), Tail Radar (75 km), Bombing Radar (60 km), Doppler Radar (40 km)	Shielded
B-52F	$286,089,129	JP5	22.32 tons	217.68 tons	6+1	124	Weather Radar (275 km), Radar (275 km), Tail Radar (86 km), Bombing Radar (66 km),	Shielded

							Doppler Radar (45 km), Loran (299 km)	
B-52G	$211,325.360	JP5	22.32 tons	217.68 tons	6+1	124	Weather Radar (303 km), Radar (303 km), Tail Radar (95 km), Bombing Radar (75 km), Doppler Radar (58 km), Loran (299 km)	Shielded
B-52H	$247,281,408	JP5	22.32 tons	217.68 tons	6+1	125	Weather Radar (336 km), Radar (336 km), Tail Radar (105 km), Bombing Radar (83 km), Doppler Radar (64 km), Loran (299 km), Advanced FLIR (80 km)	Shielded
B-52H-1	$231,749,000	JP6	22.32 tons	217.68 tons	6+1	130	Weather Radar (336 km), Radar (336 km), Tail Radar (105 km), Bombing Radar (83 km), Doppler Radar (64 km), Loran (299 km), Advanced FLIR (80 km)	Shielded
B-52H-2	$292,749,000	JP6	22.32 tons	217.68 tons	6+1	132	Weather Radar (336 km), Radar (336 km), Tail Radar (105 km), Bombing Radar (83 km), Doppler Radar (64 km), Loran (299 km), Advanced FLIR (80 km)	Shielded
B-52H-3	$492,189,088	JP6	22.32 tons	217.68 tons	6+1	135	Weather Radar (336 km), Radar (336 km), Tail Radar (105 km), Bombing Radar (83 km), Doppler Radar (64 km), Loran (299 km), Advanced FLIR (80 km)	Shielded
B-52H-4	$448,399,872	JP6	22.32 tons	217.68 tons	6+1	136	Weather Radar (336 km), Radar (336 km), Tail Radar (105 km), Bombing Radar (83 km), Doppler Radar (64 km), Loran (299 km), Advanced FLIR (80 km)	Shielded
B-52H-5	$457,750,528	JP6	22.32 tons	216.02 tons	5+1	138	Weather Radar (336 km), Radar (336 km), Tail Radar (105 km), Bombing Radar (83 km), Doppler Radar (64 km), Loran (299 km), Advanced FLIR (80 km)	Shielded
B-52H-6	$683,145,600	JP6	22.32 tons	216.02 tons	5+1	140	Weather Radar (336 km), Radar (336 km), Tail Radar (105 km), Bombing Radar (83 km), Doppler Radar (64 km), Loran (299 km), Advanced FLIR (80 km)	Shielded
YB-52H	$798,529,728	JP-6	20.09 tons	221.41 tons	6+1	153	Weather Radar (370 km), Radar (370 km), Tail Radar (60 km), Bombing Radar, (92 km). Doppler Radar (71 km), Loran (329 km), Advanced FLIR (88 km)	Shielded
YB-52J	$683,187,264	JP-6	22.32 tons	211.73 tons	6+1	140	Weather Radar (409 km), Radar (409 km), Tail Radar (66 km), Bombing Radar (102 km), Doppler Radar (79	Shielded

				km), Loran (361 km), Advanced FLIR (97 km)

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
B-52A	1960	914 (169)	NA 122 4/2 60/50	134761	7316	15420	FF7 CF7 RF7 T6 W8
B-52B	1838	857 (169)	NA 114 4/2 60/50	134761	9857	14417	FF7 CF7 RF7 T6 W8
RB-52B	1838	857 (169)	NA 114 4/2 60/50	134761	9857	14417	FF7 CF7 RF7 T6 W8
B-52C	1894	942 (169)	NA 125 4/2 60/50	135139	9857	13960	FF7 CF7 RF7 T6 W8
B-52D	1894	942 (169)	NA 125 4/2 60/50	135139	9857	13960	FF8 CF7 RF7 T6 W8
B-52D (Big Belly)	1879	934 (169)	NA 124 4/2 60/50	135139	9936	13960	FF8 CF7 RF7 T6 W8
B-52E	1894	942 (169)	NA 125 4/2 60/50	135139	9857	14082	FF8 CF7 RF7 T6 W8
B-52F	1894	942 (169)	NA 130 4/2 60/50	157295	9857	14234	FF8 CF7 RF7 T6 W8
B-52G	1974	982 (169)	NA 135 4/2 60/50	181853	10277	14326	FF8 CF7 RF7 T7 W8
B-52H/B-52H-1	1992	920 (170)	NA 127 5/2 70/40	1133481	12291	14539	FF8 CF7 RF7 T7 W8
B-52H-2/3/4	2070	1992 (160)	NA 175 5/2 70/40	1133481	12291	14539	FF8 CF8 RF7 T7 W8
B-52H-5/6	2091	2012 (155)	NA 177 5/2 70/40	1133481	11062	14539	FF8 CF8 RF7 T7 W8
YB-52H	2039	1962 (140)	NA 173 6/4 80/35	1133481	11339	14539	FF8 CF8 RF7 T7 W8
YB-52J	2099	2020 (160)	NA 178 5/2 70/40	1133481	10620	15993	FF8 CF8 RF7 T7 W8

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
B-52A	All Weather Flight, Flare/Chaff Dispensers (35 Each), RWR, ECM 3), ECCM 3, Magnetic Compass, Gyrocompass, Secure Radios	2200/2600m Hardened Runway	+1 (Bombing) or +2 (Tail Guns)	4xM-2HB, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	600x.50

B-52B	All Weather Flight, Flare/Chaff Dispensers (35 Each), RWR, ECM 3, ECCM 3, Magnetic Compass, Gyrocompass, Secure Radios	2200/2600m Hardened Runway	+1 (Bombing) or +2 (Tail Guns)	4xM-2HB, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	600x.50
RB-52B	All Weather Flight, Flare/Chaff Dispensers (40 Each), RWR, ECM 5, ECCM 5, Magnetic Compass, Gyrocompass, Secure Radios, ELINT 2	2200/2600m Hardened Runway	+1 (Bombing) or +2 (Tail Guns)	4xM-2HB, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	600x.50
B-52C	All Weather Flight, Flare/Chaff Dispensers (40 Each), RWR, ECM 3, ECCM 3, Magnetic Compass, Gyrocompass, Secure Radios	2200/2600m Hardened Runway	+1 (Bombing) or +2 (Tail Guns)	4xM-2HB, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	600x.50
B-52D	All Weather Flight, Flare/Chaff Dispensers (48 Chaff, 56 Flares), RWR, ECM 3, ECCM 5, Magnetic Compass, Gyrocompass, Secure Radios, TFR	2200/2600m Hardened Runway	+1 (Bombing) or +2 (Tail Guns)	4xM-2HB, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	600x.50
B-52E	All Weather Flight, Flare/Chaff Dispensers (48 Chaff, 56 Flares), RWR, ECM 5, ECCM 5, Magnetic Compass, Gyrocompass, Secure Radios, TFR	2200/2600m Hardened Runway	+2 (Both)	4xM-2HB, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	600x.50
B-52F	All Weather Flight, Flare/Chaff Dispensers (48 Chaff, 56 Flares), RWR, ECM 5, ECCM 5, Magnetic Compass, Gyrocompass, Secure Radios, TFR	2200/2600m Hardened Runway	+3 (Bombing) or +2 (Tail Guns)	4xM-3, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	600x.50
B-52G	All Weather Flight, Flare/Chaff Dispensers (60 Chaff, 58 Flares), RWR, ECM 5, ECCM 5 Active Jamming, Magnetic Compass, Gyrocompass, Secure Radios, TFR	2200/2600m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	20mm M-61 Vulcan, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	1242x20mm
B-52H	All Weather Flight, Flare/Chaff Dispensers (75 Chaff, 90 Flares), 10 Chaff Rockets, RWR, ECM 5, ECCM 5, IRCM 3, ELINT 2, Magnetic Compass, Gyrocompass, Secure Radios, TFR	2200/2600m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	20mm M-61 Vulcan, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	1242x20mm
B-52H	All Weather Flight, Flare/Chaff Dispensers (75 Chaff, 100 Flares), 10 Chaff Rockets, RWR, ECM 5, ECCM 5, TRCM 3, ELINT 2, Magnetic Compass, Gyrocompass, Secure Radios, VLF/LR Radios Secure Radios, TFR, Inertial Navigation, GPS	2200/2600m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	20mm M-61 Vulcan, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	1242x20mm
B-52H-1/2/3/4	All Weather Flight, Flare/Chaff Dispensers (75 Chaff, 100 Flares), 10 Chaff Rockets, RWR, ECM 5, ECCM 5 ,IRCM 3, ELINT 2, Magnetic Compass, Gyrocompass, Secure Radios, TFR, Inertial Navigation, GPS	2200/2600m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	20mm M-61 Vulcan, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	1242x20mm
B-52H-5/6	All Weather Flight, Flare/Chaff Dispensers (75 Chaff, 159 Flares), 10 Chaff Rockets, RWR, ECM 5, ECCM,5 IRCM 3, ELINT 2, Magnetic Compass, Gyrocompass, Secure Radios, VLF/LR Radios Secure Radios, TFR, VAS, Inertial Navigation, GPS	2200/2600m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	Nil
YB-52J	All Weather Flight, Flare/Chaff Dispensers (75 Chaff, 159 Flares), 10 Chaff Rockets, RWR, Stealth 1, ECM 5, ECCM 5, IRCM 4, ELINT 3, Magnetic Compass, Gyrocompass, Secure Radios, VLF/LR Radios Secure Radios, TFR, VAS, Inertial	2000/2400m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	20mm M-61 Vulcan, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	1242x20mm

Navigation, GPS

F-111 Aardvark

Notes: Despite the designation, this is not a fighter, but is in fact a medium bomber. It has variable geometry (swing) wings, which change the sweep angle automatically according to speed. The aircraft has four hardpoints and an internal bomb bay. In the F-111E, this normally carries up to 1.8 tons of weapons, or a 20mm Vulcan pod with 2084 rounds of ammunition; in the F-111F, this bay carries the Pave Tack pod, but the Pave Tack pod may be removed and internal weapons carried instead. If internal weapons only are carried, the weapons do not count when determining agility or turning. The F-111 uses an escape pod instead of ejection seats; the entire cockpit is ejected in an aerodynamic shell, and lowered on a parachute. This pod floats. The F-111 is capable of in-flight refueling and nuclear weapons delivery. In addition to the USAF, the Aardvark is used by Australia.

Early F-111s

The F-111A was the first model. It was designed under the TFX (Tactical Fighter Experimental) program. At first, it was meant to be a long-range defensive fighter, and was to carry two Phoenix missiles in its bomb bay allow with two Sidewinder missiles, and four Sparrow (later AIM-120) missiles in its inner wing hardpoints.

The F-111 had a checkered history, suffering several mysterious crashes during its first deployments to the Vietnam War. It was one of the first operational aircraft to use a variable-geometry ("swing") wing, allowing good performance at high and low speeds and a comparatively short takeoff and landing run. Compared to later Aardvarks, the F-111A was a relatively primitive aircraft, with unsophisticated ECM systems, bombsights that were heavily slaved to the radar (if performing radar or level bombing only, RF is +2), and the swing wing was not automatic. The original 11 had conventional ejection seats; on all others, the entire cockpit capsule was blasted out of aircraft, supposedly to increase crew safety. However, landing in the crew capsule usually resulted in severe injuries to the crew; this was partially ameliorated by the use of one large parachute instead of three smaller ones (which usually resulted in the three chutes streamering around each other in tests).

The F-111B was to be a naval interceptor version of this aircraft, but this version was cancelled. The F-111B had the same basic structure as the F-111A, but the side-by-seating was a concession to the Navy, as was the escape crew capsule. The nose was 2.6 meters shorter than the F-111A, necessitating a smaller, less capable radar to be mounted. In the end, however, the Navy decided that the F-111B was a lost cause and began preliminary work on what would become the F-14 Tomcat. I have done no stats below for the F-111B.

The RF-111A was supposed to be a tactical reconnaissance version of the RF-111; a prototype was built, but the project was not carried further. The RF-111A did not have the ability to carry weapons and had no fire control software, though its wing hardpoints were envisioned to carry one or two extra fuel tanks per wing. In its bomb bay, the RF-111A would carry several film, TV, and infrared cameras, as well as a primitive digital suite that could transmit grainy pictures back to base. The RF-111A had a radar boresight mode, used to focus a single camera on a target, and a long-range laser rangefinder, used to keep the camera suite on target. Imagery obtained good results; imagery from the digital system was even better than expected, However, the USAF baled because, while General Dynamics assured the Air Force that conversions would only take a few hours and could be done in the field, in fact conversions took several days and needed considerable technical support to accomplish. The RF-111A, had it worked out, would have been an excellent reconnaissance platform because it supported complex electronics, was a stable reconnaissance platform, and could absorb damage while maintaining the ability to take stable pictures. It was also fairly light next to most F-111s and was therefore a fast variant. Therefore, I have included a version of the RF-111A below as a "what-if."

In 1969, the RAF and British MoD, in the wake of the TSR.2 debacle (and it *was* a fiasco – almost on scale with the Avro Arrow fiasco in Canada), still felt the need for a light, nuclear-capable, tactical bomber. They thus looked to the US, and the then-new F-111A. (And the F-111A for that time would have been a step down from TSR.2 – someday, I'm going to have to put the TSR.2 in the Best Aircraft That Never Were section…) Anyway, the RAF and MoD, already haven taken twin body-blows from the costs of the defunct TSR.2 program, were than shocked again by the potential costs of training, conversion, and maintenance of the F-111A, and pulled the plug, eventually deciding to go with the Blackburn Buccaneer for the nuclear low-altitude penetration role. The British version would have been essentially the same as the F-111A, except for its nomenclature, which would have been the F-111K.

Australian F-111Cs

The F-111C is the Australian Air Force version; it is an F-111A with the longer wings of the FB-111A, more hardpoints, a reinforced undercarriage, and upgraded radar, bomb delivery systems, and ECM. It also has some of the electrical system of the F-111B, which was felt by the RAAF to be more robust. The F-111C was to replace the RAAF's antiquated Canberra bombers. The F-11C was equipped with a forward-looking attack radar, which could also be used as a weather radar, used for navigation, air-to-ground delivery of ASMs and as a bombing radar. It had a multimode radar, and could in fact perform all these functions at once. Theoretically, the F-111C's radar could also be used in the air-to-air mode (for use with a Vulcan cannon or air-to-air missiles), but the Australians never used their F-111Cs in that way.

Four unmodified F-111As were also bought by the RAAF and equipped as RF-111Cs. They have cameras, IR Cameras, and early digital reconnaissance equipment in its bomb bay. The bay also has a small bubble which contains a TV system that keeps the reconnaissance equipment lined upon the targets. Some of the radar modifications of the F-111C were also added.

Originally the F-111C's were to keep in the inventory until 2020, but upgrade and maintenance costs led the Australians to return the F-111Cs and RF-111Cs to Palmdale. California, where they were made, and now they are kept in working order as the Boneyard.

The Australians got unnamed vehicles, aircraft, and other concessions for the return of essentially well-kept and modified F-111s.

F-111D/E

In the late 1960s, soon after the development of the F-111A, the USAF and DoD decided to “max up” the F-111A. They did this by replacing the engines with a pair of Pratt & Whitney TF30P-9 engines, a nearly 30% in power. In addition, the F-111D has special Triple Plow 2 intakes, which prevent the compressor stalls at low speed all too frequent on F-111As The Mark II electronics suite revolved around 7 items – INS patched to the attack and bombing radar, an IBM computer system to master all the aircraft’s functions (though the F-111D was *not* a fly by wire aircraft), an integrated display set (an early version of a glass cockpit), a Doppler radar to sharpen the other radar and INS systems, and stores management, and a forward-looking/TFT radar with MTI. In addition, the F-111D could use radar-homing AAMs, though they were almost never carried.

This was all good, but the scale of improvements took a great deal of time and rebuilding. The F-111D did not fly until 1970, then was put on hold after an F-111A crash. It was not until late 1971 before the first examples were sent to an Air Force unit for testing, and IOC wasn’t declared until late 1972. Then, seemingly just to rain on the parade, the F-11D was crippled by software problems during most of 1972. The F-11D was not considered operationally ready until early 1974. It was not until then that the F-11D’s problems were finally ironed out for good (for the most part; there were still some “ghosts in the machine” that were not chased down for a few months). The F-111D Fleet remained at their home base at Cannon AFB until the early 2000s.

Meanwhile, the DoD was getting impatient with how long the F-111D was taking in development and how long its software was taking ti iron out. So the DoD commissioned the F-111E, a simplified version of the F-111D. (It should be noted that the Air Force did not want the F-111E, feeling it was simply a “dumbed-down” version of the F-111D that they really wanted. It should be further noted that the F-111E’s development also slipped, though not as much as the F-111D, due to F-111A accidents.) The F-111E has the same engines as the F-111D, but paired with simplified air intakes that did not eliminate all of the low-speed compressor stalls. The F-111E threw out nearly all of the F-111D’s avionics and software suite, substituting a radar system based on a lower-power radar which was used for navigation, the TFR suite, ASM and bombing targeting, It did not have a master computer to monitor and correct the avionics and weapons suite. It did have an air to air mode, though again it was almost never used. The F-111E suffered heavily from losses in Vietnam and accidents, and the entire fleet was grounded (though lifted in in 1970).

The first prototype of the F-111E was loaned to NASA for tests in support of the Integrated Propulsion Support System. This was sort of a fly-by-wire system that controlled the changes in weight caused by changes in win sweep, contents of the bomb bay, and fuel state. The first such flight was carried out in mid-1975, the last in early 1976. The modified F-111E was returned to it’s normal configuration. Later, it was used as a chase plane for the then-new B-1A bomber (the B-1 hadn’t been given the name Lancer yet).

F-111F

TAC (Tactical Air Command) ordered a “plus version of the F-111D in 1970, and the entire F-111F wing was declared operational by late 1972. (At that point, the final bombing halt had been declared, but the F-111F would later see action in the first and second bombings of Libya and in Desert Storm. (The Dale Brown story *Chains of Command* has the protagonist on a mission to Baghdad in Desert Storm in a modified F-111F with a nuclear weapon; he refuses to obey orders to nuke Baghdad and gets in a lot of trouble thereafter…) No F-111Fs were lost in Desert Storm and only one in the Libyan strikes despite being engaged several times by aircraft and SAMs, a testament to their combat effectiveness. The F-111Fs were particularly impressive during Desert Storm, due to their ability to deliver precision-guided ordnance under all weather conditions. They were also the only aircraft able to deliver the hastily-devised GBU-28 5000-pound “Bunker Busters.”

The first 30 F-111Fs were engined with the same TF30P-9 engines of the F-111D; this was done because the F-111F’s TF30P-100s were not ready when the first prototypes and LRIP models were rolled out and the Air force wanted to get the bugs worked out of the new avionics and to start training new crews. The prototypes and LRIPs were later re-engined with the more powerful (and reliable) TF30P-100s. One other mechanical component that was improved was the main landing gear, which which in previous models did collapse on occasion. The F-111F carried a simpler (ie, more modernized) avionics suite that did the avionics suite on the F-111D about two steps better. The avionics centered around the Mark IIB avionics suite, which included a navigational and digital weapons computer which was borrowed from the FB-111A (also being developed at the time). The attack reticule used a reticule which could be widened out to 2.5 miles, made possible by the attack computer’s 0.2-second pulse-width capacity.

The F-111F has the standard F-111 weapons bay, which can carry air-to-air missiles, bombs or ASMs, or a Vulcan cannon. It should be also noted that the F-111F has the ability to carry almost any type of air-to-air missile on its wing pylons or in it’s bomb bay (it can, for example, theoretically carry four AMRAMMs or Sparrows in its bomb bay if the Pave Tack is not carried), in practice neither AAMs or the Vulcan cannon has been carried on any operational mission. However, the F-111F normally carried in the bay the Pave Tack Pod, which gave the F-111F a long-range laser designator and FLIR-capability. The FLIR and laser designator are boresighted to a rotating TV receiver which allows the F-111F to record the bombing and essentially do its own BDAR. (This is why in some videos of the F-111Fs bombing Libyan airfields, the picture suddenly flips upside down.) The FLIR and TV views are also shown on the WSO’s monitors, so they can get an instant idea of how well they did in their bombing run and whether they might have to go around again.

FB-111A

OK, let’s go back to the F-111A. Yes, all the way back there. (It wasn’t really a big difference in time, anyway.) The Air Force thought, “We need an interim replacement for the B-52 and B-58 until the B-1A is available, and why don’t we modify some of the impending F-111As to fulfill the role? We don't have to keep them forever, anyway… (And if only the Air Force know how soon the FB-111A would be retired and how long the B-52 would stick around!) Some DoD officials, including Robert McNamara, thought the aircraft should have been designated the BF-111A, but the Air Force was against that.

The Air Force wanted 263 FB-111As, but Robert McNamara cut that order to 126, plus a few examples for training, testing, and development. McNamara cited the rising costs of the FB-111A program. From inception to last deliveries, the FB-111A program went from 1965-1971.

General Dynamics took the F-111A and lengthened the fuselage by a meter to accommodate a larger bomb bay., then they took the longer wings that the F-111B was supposed to have; when they were in their fully forward position, the FB-111A had a wingspan over two meters wider. Due to the extra hardpoints and larger bomb bay, internal fuel load was not as large, but the new engines and air intakes made the FB-111A more fuel-efficient. .The engines were replaced by more powerful TF30P-7 engines, and to keep them properly fed with air, used the new Triple Plow II air intakes that would later be used on the F-111E and F. It had stronger landing gear for the heavier weight in aircraft in weapons, It was equipped with the Mark IIB avionics suite which was planned for the F-111F, except with the displays (which were in of themselves advanced for the time) of the F-111D. (It did not have the Pave Tack pod, it having not been developed yet, but the FB-111A *did* have a decent laser designator and night vision, as well as a beacon-following capability and a photo-recorder.)

Though the FB-111A could carry a host of weapon types in its enlarged bomb bay and four wing pylons, but its primary offensive weapon was to be the AGM-69A SRAM, which would later make appearances on the B-52 and B-1. (More on the SRAM in US ASMs, if it's not there already…if it *is* there, it's probably wrong considering the research I've done lately on it.)

When the B-1B Lancer came into service and took the FB-111A's role as a long-range penetration bomber, the FB-111As became redundant. Their ability to carry nuclear weapons was removed and deleted from their software, and they took the tactical deep-penetration strike role. At this point, they were redesignated F-111Gs. A Have Quick UHF radio was installed, able to communicate with ground units and ships in the littoral combat zone.

F-111Gs has their capability to carry SRAMs and nuclear weapons removed (including from their software). A conventional weapons carriage and release system was re-installed, allowing gravity-bomb and AAM use. Unlike almost all F-111s, the F-111Gs were known to have carried their Vulcan cannon on some strike missions during Desert Storm. In 1994, the RAAF bought 16 F-111Gs, but they returned them to the US about the same time as their F-111Cs; like the F-111Cs, they were originally supposed to stay on with the RAAF until 2020 and be further modified in that time, but were taken out of service in the late-1990s for the same reasons.

However…

In 1979, the B-1B Lancer was still not ready for action. In response, the General Dynamics proposed a lengthened, upgraded, up-engined version of the FB-111A, using versions of the same engines that would have been used on the B-1A. Heavily upgraded, it had a larger fuel capacity to provide fuel to the new fuel-hungry engines and provide a bit extra range. The FB-111B was to provide nuclear alert role, with four SRAMs in the bomb bay and four SRAMs under each wing. The avionics were to be sort of an amalgamation of the FB-111A and F-111G, along with upgraded attack computers and software and better radar and night vision/VAS, along with some new gadgets.

In 1980, however, other General Dynamics executives thought they could take the low-level penetration mission away from Rockwell outright. They essentially started working to build an upgraded FB-111A, then started getting ideas from the technicians working on the FB-111B, then took the idea even further. And created (on paper and in large-scale models, anyway), the FB-111H.

Personally, I think the FB-111H would have been an awesome version of the F-111 series to have had in service. It was similar in idea to the FB-111B, but extended even longer, with a bomb bay greatly increased in size (big enough for 12 SRAM missiles, for example). It would have had six hardpoints which could carry a variety of weapons or tanks – for example six SRAMs or twelve ALCMs, and the wings could sweep with all hardpoints occupied. It was also to have an enhanced conventional strike capability, with all hardpoints being able to pivot with the wings. The avionics were based on those of the FB-111A and F-111G, but, as Walt Disney would say, "plussed." The fire control, navigation, and main computers were state-of-the-art (for the late 1970s-early 1980s). The FB-111H used the same engines as the B-1B and that the FB-111B would have used. Almost everything avionics-related was new or state-of-the-art. Internal fuel capacity was increased. The new bomb bay could no longer mount a Vulcan cannon, but this was thought of as unimportant since F-111-series aircraft almost never carried one operationally.

I personally think the FB-111H would have been able to carve out a decent niche complementing the B-1B; there are a lot of missions that don't require a heavy bomber, but where a medium bomber would fit just right, and you need something more than a fighter-bomber. The stats below, however, are highly conceptualized and may be nothing like a real FB-111H would have been.

EF-111A Raven

The EF-111A Raven will be covered in US Special Aircraft.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-111A	$45,204,982	JP5	13.61 tons	28.8 tons	2	32	Radar (150 km), Bombing Radar (90 km)	Shielded
RF-111A	$89,795,989	JP5	9 tons	24 tons	2	34	Radar (150 km), FLIR (90 km), VAS (45 km), 3xFilm Camera (60	Shielded

							km), Digital Camera (40 km)	
F-111C	$95,553,400	JP5	13.82 tons	28.9 tons	2	34	Radar (150 km), FLIR (90 km), VAS (45 km), 3xFilm Camera (60 km), Digital Camera (40 km)	Shielded
RF-111C	$91,494,960	JP5	11 tons	24 tons	2	34	Radar (150 km), FLIR (90 km), VAS (45 km)	Shielded
F-111D	$141,676,350	JP5	13.33 tons	30 tons	2	33	Radar (185 km) Bombing Radar (110 km)	Shielded
F-111E	$118,063,625	JP5	13.78 tons	28.8 tons	2	32	Radar (158 km), Bombing Radar (95 km)	Shielded
F-111F	$161,622,212	JP5	14.23 tons	32.57 tons	2	36	Radar (205 km), Bombing Radar (120 km), (With Pave Tack) FLIR (40 km), 3rd Gen Image Intensification (40 km), VAS (40 km)	Shielded
FB-111A	$214,494,777	JP5	17.73 tons	37.96 tons	2	40	Radar (225 km), Bombing Radar (135 km), FLIR (45 km), VAS (45 km), Photo Recorder (20 km)	Shielded
F-111G	$214,494,777	JP5	17.73 tons	33.43 tons	2	41	Radar (225 km), Bombing Radar (135 km), FLIR (45 km), VAS (45 km), Photo Recorder (20 km)	Shielded
FB-111B	$292,165,344	JP5	18.8 tons	35.44 tons	2	41	Radar (250 km), Bombing Radar (150 km), FLIR (50 km), VAS (50 km), Photo Recorder (22 km)	Shielded
FB-111H	$313,401,044	JP5	19.19 tons	35.71 tons	2	43	Radar (280 km), Bombing Radar (170 km), FLIR (50 km), VAS (50 km), Photo Recorder (25 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-111A	2899/3343	806/1232 (105)	NA 201/308 5/3 50/35	19090	3649	17679	FF5 CF6 RF6 T5 W6
RF-111A	3842/4430	1067/1227 (105)	NA 231/266 5/3 50/35	19090	5413	17679	FF5 CF6 RF6 T5 W6
F-111C	2892/3321	803/1222 (100)	NA 200/305 5/3 50/30	19090	3771	17679	FF5 CF6 RF6 T5 W7
RF-111C	3842/4430	1067/1227 (105)	NA 231/266 5/3 50/35	19090	5413	17679	FF5 CF6 RF6 T5 W7
F-111D	2778/3190	772/1175 (105)	NA 185/282 5/3 50/35	19060	3271	17679	FF5 CF6 RF6 T5 W6
F-111E	2892/3321	803/1222 (105)	NA 200/305 5/3 50/35	19090	3271	17679	FF5 CF6 RF6 T5 W6
F-111F	2580/3695	717/1098 (105)	NA 179/274 5/3 50/35	19089	3622	17267	FF5 CF6 RF6 T5 W6
FB-111A	2292/3283	637/976 (100)	NA 159/244 5/3 50/30	18964	3407	15320	FF6 CF6 RF6 T5 W7
F-111G	2598/3271	722/1033 (100)	NA 228/326 5/3 50/30	18964	3407	15320	FF6 CF6 RF6 T5 W7
FB-111B	3401/4825	945/1191 (100)	NA 228/285 5/3 50/30	20292	4741	18000	FF6 CF7 RF6 T5 W7

FB-111H	3376/4790	938/1183 (100)	NA 226/283 5/3 50/30	20900	4741	18000	FF6 CF7 RF6 T5 W7

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-111A	All Weather Flight, Flare/Chaff (50/50), Advanced RWR, ECM 2 ECCM 1, TFR (40 km), INS, Secure Radios	1400/1105m Hardened Runway	+2	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
RF-111A	All Weather Flight, Flare/Chaff (50/50), Advanced RWR, ECM 2, ECCM 1, TFR (40 km), INS, Secure Radios, Radar Boresight, HUD Interface	1400/1105m Hardened Runway	Nil	6 Hardpoints	Nil
F-111C	All Weather Flight, Flare/Chaff (55/55), Advanced RWR, ECM 2, ECCM 1, IRCM 1, TFR (40 km), INS, Secure Radios, Radar Boresight	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 8 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
RF-111C	All Weather Flight, Flare/Chaff (55/55), Advanced RWR, ECM 2, ECCM 1, IRCM 1, TFR (40 km), INS, Secure Radios, Radar Boresight, HUD Interface	1400/1105m Hardened Runway	Nil	8 Hardpoints	Nil
F-111D	All Weather Flight, Flare/Chaff (60/60), Advanced RWR, ECM 2, ECCM 2, IRCM 1, TFR (44 km), INS, Secure Radios, HUD Interface, Track While Scan, Auto Track	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
F-111E	All Weather Flight, Flare/Chaff (50/50), Advanced RWR, ECM 2, ECCM 1, TFR (44 km), INS, Secure Radios, HUD Interface, Track While Scan	1400/1105m Hardened Runway	+2	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
F-111F	All Weather Flight, Flare/Chaff (60/60), Advanced RWR, ECM 3, ECCM 2, IRCM 2, TFR (44 km), INS, Secure Radios, HUD Interface, Track While Scan, Auto Track, Target ID, (With Pave Tack) Laser Designator (40 km)	1400/1105m Hardened Runway	+3, (With Pave Tack) +4	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay (Except with Pave Tack)	(Optional) 2084x20mmM61
FB-111A	All Weather Flight, Flare/Chaff (70/70), Chaff Rocket (1), Advanced RWR, ECM 3, ECCM 3, IRCM 2, TFR (50 km), INS, Secure Radios, HUD Interface, Track While Scan, Auto Track, Laser Designator (40 km)	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 8 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
F-111G	All Weather Flight, Flare/Chaff (70/70), Chaff Rocket (1), Advanced RWR, ECM 3, ECCM 3, IRCM 2, TFR (50 km), INS, Secure Radios, HUD Interface, Track While Scan, Auto Track, Laser Designator (40 km), Radar Boresight	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 8 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
FB-111B	All Weather Flight, Flare/Chaff (80/80), Chaff Rocket (1), Advanced RWR, ECM 3, ECCM 3, IRCM 2, TFR (55 km), INS, Secure Radios, HUD Interface, Track While Scan, Auto Track, Laser Designator (40 km), Radar Boresight	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 8 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
FB-111H	All Weather Flight, Flare/Chaff (80/80), Chaff Rocket (1), Advanced RWR, ECM 3, ECCM 3, IRCM 3, TFR (55 km), Radio Jamming 1,	1400/1105m Hardened Runway	+3	6 Hardpoints, Internal Bomb Bay	Nil

INS, Secure Radios, HUD Interface, Track While Scan, Auto Track, Laser Designator (50 km), Radar Boresight	

C-23 Sherpa

Notes: This light transport is used by a number of countries, most notably Britain and the US, where they are mostly operated by the Air National Guard, though some are used by SOCOM, and a few are used by the US Army's Golden Knights parachute demonstration team. It is a simple aircraft that is easy to maintain and fly, and can be safely flown at a very slow speed. The aircraft has a rear ramp and two doors just behind the cockpit; it has no ejection seats and is not capable of in-flight refueling. It does, however, have a toilet. The C-23B Super Sherpa is similar, but has more engine power and is larger.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-23A	$2,388,840	AvG	3.18 tons	11.59 tons	3+30, or 27 paratroops, or 18 stretchers	14	None	Enclosed
C-23B	$2,458,930	AvG	3.77 tons	12.83 tons	3+36, or 32 paratroops, or 22 stretchers	18	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
C-23A	698	174 (80)	NA 44 6/3 60/30	2235	881	3500	FF4 CF4 RF3 T3 W4
C-23B	723	181 (80)	NA 45 6/3 60/30	2351	1050	3500	FF4 CF4 RF3 T3 W4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	Secure Radios	500/400m Primitive Runway	None	None	None

De Havilland Rapide

Notes: The Rapide appeared in 1934; it was intended to fulfill the same role as the Douglas DC-3, being a general purpose cargo aircraft able to fly heavy (for the period) cargoes at a decent speed and capable of fairly high-altitude operations. The Rapide design is an evolution of earlier designs, most notably the De Havilland DJ-83 Fox Moth (appearing in 1932) and the heavier DH-84 Dragon. (The Rapide was essentially a scaled-down version of the Dragon, thus the Rapide was often called the “Dragon Rapide.”) The Rapide did not fall victim to the problems that its predecessors displayed, such being underpowered, having balky controls, and poor maneuverability; its pilots praised the Rapide as an aircraft that was easy to fly (though it often struggled in bad weather due to its light weight). They had an illustrious World War 2 career, with most Rapides belonging to Commonwealth countries being pressed into military service. While the Rapide’s design did not lend itself to high-volume paradrops, the British often used the Rapide for the delivery of OSS agents and other small-unit insertions. However, these operations led to high casualties among the Rapide, and of 205 at the disposal of the British Commonwealth at the beginning of World War 2, only 81 survived the war. The Rapide was manufactured for a few years after World War 2, but were quickly made obsolete by new designs. By 2000, only five airworthy Rapides remained: two in New Zealand, often used for sightseeing, one flown by the Military Aviation Museum in Virginia Beach, one privately-owned in Yolo County California, and two operated by Classic Wings in the UK, used primarily for sightseeing and short hops over to Ireland. In addition, it is possible that the Rapides at Museum of Science and Industry at Manchester, the Rapide on display at Old Warden Airfield in the UK, and the Rapide at Duxford Aerodrome, are also in flying condition; their care is quite meticulous and thorough, but they have never actually flown since the late 1950s.

Design work on what would become the Rapide began in 1933 after a request from the Australians for a medium transport with good low-altitude speed and the ability to land on unimproved surfaces, such as the Australian Outback. This led to an aircraft similar, but smaller and less powerful than, the DH-89 – the DH-86 Dragon Express. Few DH-86’s were built, though a few did serve in the 1930s and early 1940s, so I have included stats for them below. The head of the design team at De Havilland, AE Hagg, quickly realized that a more power version of the engines intended for the Dragon Express recently made available could support a larger and more powerful version of the DH-86. This aircraft was at first designated the DH-89 Dragon Express, but by 1935, the name of the aircraft had changed to the Dragon Rapide. Shortly later, this was simplified to the Rapide. The British, oddly, were one of the last to jump on the Rapide design; nearly 20 countries ordered at least a few Rapides in the 1930s, and the British actually ordered very few. Most British Rapides were those pressed into wartime service of built during the short production run after World War 2. Military Rapides used by the British Commonwealth were renamed to “DH-89 Dominie,” though production of military versions dated back almost to the beginning of production. The Italian Breda BA-44 was derived directly from the Rapide, so much so that in many cases parts were interchangeable.

The Rapide was an all-metal biplane in an era of monoplanes; only its power and good handling characteristics led to its being placed into production. World airlines quickly realized that it was a good design, despite having only about half the cargo and passenger capability of its contemporaries, the DC-3 and Ford Trimotor. The wings were strong despite a minimum of cross supports, and the fuselage, despite looking a bit lumpish, was actually a good, aerodynamic design. The Rapide had large control surfaces, which made to a great extent it’s excellent low-speed handling and good takeoff and landing performance. Unusually, the engines were carried in pods on the lower wings near the fuselage, with the main wheels below the engines in fairings that were built as a part of the engine pods. The Rapide was a "taildragger" design, with a tail wheel in addition to the main landing gear. The cockpit windows were large and afforded excellent visibility to the crew, and the side windows were also large for an aircraft of its type and praised by passengers. Passengers and crew both entered through a door on the left side over the lower wing.

Though easy to fly, the Rapide did require some familiarization with the pilots. The Rapide was much lighter than it looked and could be thrown around by high winds, was subject to bouncing at the wrong time on takeoff and landing, and had higher acceleration than most pilot were used to from such an aircraft. In addition, passenger flight was a bit spartan; civilian passenger Rapides had little more than a cramped kitchenette and shelves for in-flight refreshment, and passenger seating was limited and a little cramped at a time when passengers were beginning to expect a little more luxury. One of the radios carried was usually tuned to civilian broadcasts. On the other hand, mail and cargo runners often had an internal layout similar to a Dominie, though sometimes the kitchenette was retained. And again, takeoffs and landings could be a bit bouncy, and flying in bad weather could be harrowing.

The first production versions were designated DH-89 Rapide. The same aircraft, equipped with a landing light in the nose, modified wingtips that slightly improved low-altitude and low-speed performance, and a cabin heater, were designated DH-89A Rapide. All DH-89s were quickly converted to the DH-89A standard within a few months after the DH-89A standard was defined. The DH-89 Mk 4 referred to at first experimental modifications, equipped with Gipsy Queen II engines; some civilian Rapides were produced with these engines, which were designated Gipsy Six II engines in civilian use, but on the other hand, this upgrade was common in military service. Even less civilian models were equipped with Gipsy Six III engines, though somewhat more were produced with the equivalent military engine (the Gipsy Queen III). Civilian modifications to the Gipsy Six III did not begin in earnest until after World War 2, and eventually 1350 Gipsy Six IIIs were built solely for civilian use. Dominies with Gipsy Queen engines were built for specific roles and therefore quite rare; the fact that they were originally built for military use only and few were retrofitted after the war makes them even rarer.

Military Dominies had their civilian accommodations stripped out, and the interior converted to a large cargo space. The passenger door was retained, but converted to a sliding door. This was still where personnel were loaded, and often, parachutists exited the aircraft through this door. (The procedure for parachuting from a Dominie was for the parachutist to go out the door, get into a seated position, and let the slipstream slide the parachutist off of the lower wing. The tailplanes were low enough that the parachutist did not hit them. Afterwards, the parachutist deployed his parachute manually.) On the right side, a larger sliding door was added, allowing bundles on parachutes to be thrown out of the door or larger cargoes to be loaded and unloaded on the ground. The Dominies had a new suspension for the main landing gear, making them even more capable of landing and taking off from unimproved surfaces. The engine cowlings and air intakes were also modified to do a better job of keep FOD out of the engines, and the wooden propeller blades in most cases were replaced with metal blades. Dominies sometimes had folding metal seats along the exterior walls; these were installed in sections for one, two, or three passengers and could be removed or installed as needed.

Though some Dominies were used for special operations insertions and paradrops, a large number were actually used as trainers for future bomber and larger cargo aircraft. In this role, pilots and navigators both received instruction, though not usually at the same time. Radio operators also received some training in this aircraft, but most of their training took place on the ground. Most of these trainers were then modified again, into mobile communications aircraft. In this role, the Dominies normally operated as aerial retransmission aircraft, allowing the troops on the ground to dramatically increase their communications range. They were important aircraft to airborne forces and scouts operating sometimes far ahead of the main body of troops. Generally, a fourth seat was added just behind the cockpit (in case a pilot and navigator *was* being trained at the time), as well as two other seats with desks at the front of the cargo bay for two other students. Another use for the Dominies were as aerial command posts, though normally they didn't carry the actual field commanders, relaying orders instead. In this role, they carried extra radios, including at least one very-long-range VHF set, and seats for radio operators and the "aerial commander," plus spaces, drawers, and suchlike for maps, codebooks, and office-type supplies.

Dominies were more widely used in the early part of World War 2, and leads to perhaps their most heroic role. Dominies were used as part of the evacuation of troops from France, often flying deep into enemy territory to retrieve troops cut off from the main body. An unknown number of civilian Rapides were also used in the evacuation, sent into France without being modified in any way for a military role. During this time, their losses were severe; ten Dominies and an unknown amount of Rapides were shot down; some sources state that possibly as many as 32 Rapides were shot down in the evacuation. The Dominies and Rapides used in the evacuation generally left France overloaded with troops and with the severe decrease in performance one would expect.

Another role for Dominies were to fly dignitaries around Britain and to Ireland; despite being officially called Dominies, these aircraft were essentially Rapides, retaining their civilian internal fit, though with one or two extra radios. A surprisingly small amount were actually used as straight cargo aircraft, since the bulk of Dominies (about 150) were used as trainers and communications aircraft. 14 were used to fly needed military supplies around Britain to some of the more far-flung sites, including ammunition, food and water, spare parts, and some small creature comforts such as newspapers, mail, books, and occasional pure luxury items such as chocolate, candy, and suchlike. Two were used as medical evacuation aircraft, primarily for British or (later) American pilots who had been shot down or crashed over British soil, or British civilians or troops injured in Nazi attacks on Britain. The primary modifications for these two aircraft were the conversion of most of the interior space to carry stretchers as well as storage for medical equipment. Two medical personnel were usually assigned to such flights, normally specially-trained nurses.

In addition to the Dominies used in Britain, two were used in Africa and the Middle East, and nine were used in India. These were generally used as communications aircraft in Africa and the Middle East as shown above, and as special operations and straight cargo aircraft in India and some of the surrounding countries; some were even known to fly even farther, supplying special ops units such as

Merrill's Marauders and even other far-flung and largely unsung special operations units. Extra fuel tanks were often carried internally in this role, as well as extra long-range radios and odd bits of equipment needed by the troops, as well as the occasional reinforcements. Their excellent low-speed performance and unimproved landing and takeoff qualities served them well in these roles. Military Dominies outfitted for training roles were designated DH-89 Dominie Mk 1 and were most often based on DH-89 Mk 4s, though with special governors and derated engines to aid in the training process. Dominies outfitted as Commo/air command posts were designated DH-89B Dominie Mk IIs, regardless of what other Mark they may have carried (usually Mk 4s or Mk 5s). Special ops Dominies were generally given fictitious designations and names that changed on a regular basis, though they were generally based on stripped cargo aircraft. Special ops Dominies outfitted with internal extra fuel tanks were generally designated the same way as other Special ops aircraft. Dominies designed for cargo carrying of whatever type were usually given the simple designation of DH-89B and usually based on DH-89As or DH-89 Mk 4s. (After World War 2, military Dominies that were refitted back to civilian specifications were usually designated DH-89B, with the appropriate Mark number appended to the end. Dignitary transportation and medical transport aircraft were usually designated DH-89B, though unofficially given the designation of DH-89D Dominie.

Statistics-wise, the most of the prototype Rapides and very early production Rapides were powered by a pair of De Havilland Gipsy Six I 200-horsepower 6-cylinder engines, improved versions of the engines that powered the DH-86. The Gipsy Six I had bronze cylinder heads and could be coupled only to fixed-pitch propellers. The Gipsy Queen I was the military version of the Gipsy Six I, essentially identical except that it could burn either leaded or unleaded aviation gasoline, could be coupled to variable-pitch propellers, and was slightly more powerful at 205 horsepower; this engine powered early military models. Most military versions and some civilian Rapides were powered by the Gipsy Queen II/Gipsy Six II, which were basically identical; improvements included strengthened crankcase and a slight increase in power to 210 horsepower. These were referred to as the DH-89 Mk 4s. Some Dominies were powered by the Gipsy Queen III, which provided a further-strengthened crankcase, a tapered crankcase (which allowed only fixed-pitch propellers), and slightly-derated power to 200 horsepower; however, the Gipsy Queen III was far more maintenance-friendly, and reduced the required time for maintenance greatly. These aircraft were designated DH-89 Mk 5. A few rare Rapides and Dominies had Gipsy Queen IV engines, which were supercharged versions of the Gipsy Queen III. The supercharger allowed the Rapides and Dominies equipped with them a higher service ceiling, though at higher fuel consumption. These aircraft were often referred to as DH-89Cs in both civilian and military service, though officially they were also designated DH-89 Mk 5s. One Rapide was produced, stripped of all unnecessary weight and designated the DH-88 Comet; this used 223-horspower versions of the standard engines called Gipsy Six "R" engines, and I have not been able to discover its fate after flying in the races it was built for. The Rapide had a length of 10.51 meters, a height of 3.096 meters (to the top of the tail), and a wingspan of 14.63 meters. The controls, though not boosted in any way (control boosting was an experimental design at the time of the Rapide's development), they did have special linkages that made the controls easier to move.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
DH-89 Rapide	$611,520	AvG	555 kg	1.62 tons	3+10	12	None	Enclosed
DH-89A Rapide	$622,850	AvG	562 kg	1.62 tons	3+10	12	None	Enclosed
DH-89 Mk 4 Rapide	$623,820	AvG	569 kg	1.62 tons	3+10	12	None	Enclosed
DH-89 Mk 5 Rapide	$617,540	AvG	555 kg	1.64 tons	3+10	10	None	Enclosed
DH-89C Rapide	$674,510	AvG	555 kg	1.66 tons	3+10	12	None	Enclosed
DH-89B Dominie	$422,060	AvG	1.19 tons	1.5 tons	3+10 or 8 Paratroopers	11	None	Enclosed
DH-89B Dominie (Special Ops Fit)	$1,923,770	AvG	893 kg	1.65 tons	3+4 or 3 Paratroopers	15	None	Enclosed
DH-89A Dominie (Special Ops Fit, Extra Fuel)	$1,925,900	AvG	706 kg	1.9 tons	3+4 or 3 Paratroopers	16	None	Enclosed
DH-89 Mk I Dominie	$439,430	AvG	1.17 tons	1.6 tons	4+4	13	None	Enclosed

DH-89 Mk II Dominie	$1,072,930	AvG	595 kg	1.89 tons	3+4	15	None	Enclosed
DH-89D Dominie (Medical)	$458,420	AvG	595 kg	1.53 tons	4+4 Stretchers*	10	None	Enclosed
DH-89C Dominie	$468,060	AvG	1.16 tons	1.52 tons	3+10 or 8 Paratroopers	10	None	Enclosed
DH-88 Comet	$419,480	AvG	1.19 tons	1.35 tons	2	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
DH-89 Rapide	872	219 (73)	NA 52 4/2 40/20	249	56	5090	FF3 CF3 RF2 T2 W3
DH-89A Rapide	892	224 (66)	NA 53 4/2 40/20	249	57	5090	FF3 CF3 RF2 T2 W3
DH-89 Mk 4 Rapide	913	229 (60)	NA 54 4/2 40/20	249	57	5090	FF3 CF3 RF2 T2 W3
DH-89 Mk 5 Rapide	872	219 (60)	NA 52 4/2 40/20	249	57	5090	FF3 CF3 RF2 T2 W3
DH-89C Rapide	862	215 (60)	NA 51 4/2 40/20	249	65	6108	FF3 CF3 RF2 T2 W3
DH-89B Dominie	915	230 (66)	NA 55 4/2 40/20	249	55	5090	FF3 CF3 RF2 T2 W3
DH-89B Dominie (Special Ops Fit)	853	209 (66)	NA 50 4/2 40/20	249	61	5090	FF3 CF3 RF2 T2 W3
DH-89A (Dominie Special Ops Fit, Extra Fuel)	806	202 (66)	NA 48 4/2 40/20	381	63	5090	FF3 CF3 RF2 T2 W3
DH-89 Mk I Dominie	858	216 (60)	NA 52 4/2 40/20	249	58	5090	FF3 CF3 RF2 T2 W3
DH-89 Mk II Dominie	732	184 (70)	NA 44 4/2 40/20	249	69	5090	FF3 CF3 RF2 T2 W3
DH-89D Dominie (Medical)	897	225 (60)	NA 54 4/2 40/20	249	56	5090	FF3 CF3 RF2 T2 W3
DH-89C Dominie	903	227 (60)	NA 54 4/2 40/20	249	64	6108	FF3 CF3 RF2 T2 W3
DH-88 Comet	1074	266 (60)	NA 64 4/2 40/20	249	64	5090	FF3 CF3 RF2 T2 W3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
DH-89/DH-89A/DH-89A Mk 4 & Mk	2xLong-Range Radios, Magnetic Compass, Kitchenette	200/350 Unimproved Runway	None	None	None

5/DH-89C Rapide					
DH-89B/C Dominie	2xLong-Range Radios, 1 Short-Range Radio, Magnetic Compass	200/350 Unimproved Runway	None	None	None
DH-89B Domnie (Special Ops Fit)	2xLong-Range Radios (One Aircraft-Ship), Very-Long-Range Radio, Radar Altimeter, Transponder, 550-Candlepower Spotlight, RDF, Magnetic Compass	200/350 Unimproved Runway	None	None	None
DH-89A Mk I Dominie	2xLong-Range Radios, 1 Short-Range Radio, Magnetic Compass	200/350 Unimproved Runway	None	None	None
DH-89 Mk II Dominie	1 Very-Long-Range Radio, 2xLong-Range Radios, 2xMedium-Range Radios, Gyrocompass, Barometric Altimeter	200/350 Unimproved Runway	None	None	None
DH-89D Dominie (Medical)	2xLong Range Radios, Magnetic Compass, Standard Medical Supplies.	200/350 Unimproved Runway	None	None	None

*Two stretchers may be removed, making room for up to two seated casualties per stretcher.

DHC-4A Caribou

Notes: This Canadian cargo aircraft comes in civilian and military versions. The civil version seats 30 passengers, while the military versions carry 32 troops. This aircraft is used by Canada (where it is known as the CC-108), the US (where it is known as the C-7A), Australia, Cameroon, Costa Rica, Malaysia, and Thailand. It is a basic transport first built in 1958.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$2,739,480	AvG	3.64 tons	14.23 tons	3+32, or 26 paratroops, or 22 stretchers	14	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
694	174 (100)	NA 43 4/2 40/20	2410	1069	7559

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	565/470m Primitive Runway	None	None	None

DHC-5 Buffalo

Notes: This is a turboprop, STOL, stretched version of the Caribou. It is known as the CC-115 in Canadian service, and the C-8A in US service. It was also sold to about 20 world air forces. In addition to the basic cargo aircraft, specially equipped Buffaloes are used for maritime patrol.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
DHC-5	$5,308,580	AvG	4.82 tons	17.27 tons	3+41, or 35 paratroops, or 24 stretchers	16	Radar	Enclosed
DHC-5A	$5,339,190	AvG	5.68 tons	18.6 tons	3+41, or 35 paratroops, or 24 stretchers	18	Radar	Enclosed
DHC-5D	$5,394,890	AvG	8.18 tons	22.36 tons	3+41, or 35 paratroops, or 24 stretchers	18	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
DHC-5	736	184 (100)	NA 46 4/2 40/20	3800	875	7620
DHC-5A	736	184 (100)	NA 46 4/2 40/20	3800	941	7620
DHC-5D	736	184 (100)	NA 46 4/2 40/20	3800	1055	7620

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	All-Weather Flight	500/400m Primitive Runway	None	None	None

Ultralight

Notes: This is a generic category of very light, man-portable (in the sense that one man can lift it), one-passenger aircraft based on a light engine and a paraglider. They usually are collapsible and fit into a wooden box or metal or fiberglass carrying case. There are no hardpoints, and no ejection seats. The ultralight is not capable of in-flight refueling.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$2,369 (S/R)	G, AvG	200 kg (including pilot)	48 kg	1	2	None	Open

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
352	88 (40)	NA 22 7/4 50/30	24	5	3000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	175/55m Primitive Runway	None	None	None

C-160 Transall

Notes: This is a French-German built, medium-range transport aircraft. South Africa and Turkey also use this aircraft. Newer aircraft (built from 1980-1982) have upgraded electronics. The Transall has paratrooper doors near the rear of the fuselage, and a rear cargo ramp. A flexible fuel bladder may be carried internally at the expense of cargo to add an additional 9000 liters to fuel capacity. The C-160 has no ejection seats, but is capable of in-flight refueling.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-160	$15,627,270	AvG	16 tons	51 tons	3+93 or 64 paratroopers	46	Radar	Enclosed
C-160D	$23,796,000	AvG	16 tons	51 tons	3+93 or 64 paratroopers	48	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(All)	1030	258 (120)	NA 64 2/1 30/15	19000	2162	7925	FF7 CF6 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
C-160	None	550/720m Primitive Runway	None	None	None
C-160D	Flare/Chaff Dispensers, RWR, GPS	550/720m Primitive Runway	None	None	None

CN-235M

Notes: This is a joint project of Indonesia and Spain. It is a cargo aircraft that can also used as an anti-ship aircraft; anti-shipping versions are known as CN-235MP and have additional electronics, with weapons being dropped out of the back. It is also produced in a commercial passenger version, with 44 seats. This aircraft has been widely exported and is used by a large amount of countries.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$5,224,180	AvG	6 tons	16.5 tons	4+48, or 44 paratroopers, or 24 stretchers	24	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
890	223 (105)	NA 56 4/2 40/20	2820	1288	10000	FF7 CF7 RF7 T6 W7

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, Flare/Chaff Dispensers	500/420m Primitive Runway	None	None	None

Arava

Notes: This is an Israeli cargo aircraft that has also found use as a special missions aircraft in the Israeli Air Force. Many versions exist, such as EW, ELINT, ESM, reconnaissance, and others. It is also used to deliver special teams behind enemy lines due to its ability to fly low and maneuverable. The rear end of the fuselage hinges to the right for bulk cargo loading, and there are also doors on each side. The aircraft does not have ejection seats and is not capable of in-flight refueling. The Arava is also in service with Thailand and several Latin American and African countries. The two hardpoints are on the fuselage and normally carry machinegun pods or rockets.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Arava 201	$2,303,510	AvG	2.5 tons	6.8 tons	2+24, or 16 paratroops, or 12 stretchers	10	None	Enclosed
Arava 202	$2,327,700	AvG	2.6 tons	7.71 tons	2+24, or 16 paratroops, or 12 stretchers	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
Arava 201	652	163 (80)	NA 41 6/4 60/40	1450	547	7620	FF3 CF3 RF3 W3 T2
Arava 202	663	166 (80)	NA 41 6/4 60/40	2365	603	7620	FF4 CF4 RF3 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	None	350/450m Primitive Runway	None	2 hardpoints	None

C-27 Spartan

Notes: The C-27 Spartan is the Italian G-222-710 aircraft in military paint. The aircraft was adopted to provide the Air Force with a STOL transport suitable for use on unpaved airstrips. The main difference between the Italian aircraft and the C-27 is the installation by Chrysler of upgraded navigation and communication systems. The Spartan does not have ejection seats and cannot be refueled in the air.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-27A	$6,795,370	AvG	9.4 tons	28 tons	3+46 or 40 paratroops or 24 stretcher cases	56	Radar	Shielded
C-27J	$16,781,960	AvG	10.1 tons	30 tons	3+46 or 40 paratroops or 24 stretcher cases	46	Radar	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
C-27A	974	244 (120)	NA 61 4/2 40/20	12000	2473	7620	FF6 CF6 RF6 T5 W5
C-27J	1000	250 (120)	NA 62 4/2 40/20	12000	3674	7620	FF6 CF6 RF6 T5 W5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
C-27A	Secure Radios	600/500m Primitive Runway	None	None	None
C-27J	Flare/Chaff Dispensers, GPS, Secure Radios, TFR	600/500m Primitive Runway	None	None	None

C-1A

Notes: This Japanese transport was first accepted into service in 1970 to replace the C-46 in its Air Defense Force's service. Looking similar to a smaller, shorter C-17, these aircraft have been steadily upgraded with more advanced electronics allowing it to be used under almost any conditions and to drop large items or do LAPES insertions. The primary use for the C-1 is to supply outlying islands, support Japanese industry, and to support military assistance and humanitarian operations.

Twilight 2000 Notes: During the Twilight War, they were standouts in the defense of islands like Okinawa, and were also used for limited paratrooper drops as far away as Korea, Russia, and the Philippines. In addition, an electronic warfare variant, the EC-1, was used to jam Russian and North Korean radio and radar transmissions to good effect, as well as to conduct reconnaissance.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$47,410,190	AvG	11.9 tons	45 tons	5+60 or 45 paratroopers or 36 stretchers	45	Radar	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1612	403 (100)	NA 101 6/3 60/30	15280	12833	11580

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Secure Radios, Flare/Chaff Dispensers	1200/2200m Hardened Runway	None	None	None

US-1

Notes: This is a Japanese built amphibian that may be used for cargo transportation, search and rescue, and ASW duties. The US-1 has one door on each side and a cargo door in the rear. No ejection seats are provided, and the aircraft is not capable of in-flight refueling.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$22,187,570	AvG	10 tons	45 tons	7+36 or 12 stretchers	50	Sonar (ASW Only)	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
990	248 (90)	NA 62 5/2 35/20	19340	4546	8200

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	900/550m Water	None	None	None

An-12 Cub

Notes: This aircraft was produced in very large number and sold worldwide to former Soviet client states and trading partners. It is also used by civilian agencies. Variants include ELINT and ECM versions, as well as a SAR version. A similar version is built in China and known as the Y-8. The aircraft has a rear ramp for cargo and paratroopers. Military users of this aircraft include Afghanistan, Angola, Czechoslovakia, Ethiopia, Iraq, Russia, Yemen, China, Burma, Sri Lanka, and Sudan.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
An-12	$78,376,180	AvG	20 tons	61 tons	5+91 or 60 paratroopers	59	Radar	Enclosed
An-12BK	$79,304,570	AvG	23 tons	64 tons	5+130 or 100 paratroopers	57	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
An-12	1554	389 (130)	NA 97 4/2 40/20	29350	4707	10200	FF4 CF4 RF3 W3 T3
An-12BK	1360	340 (130)	NA 85 4/2 40/20	29350	5821	10200	FF4 CF4 RF3 W3 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
An-12	None	1200/1100 Hardened Runway	+1	Twin 23mm autocannons (Rear)	500x23mm
An-12BK	None	1200//1100 Primitive Runway	+1	Twin 23mm autocannons (Rear)	500x23mm

An-14 Clod/An-28 Cash

Notes: Known to the Russians as the Pchelka (Little Bee), the An-14 is a light transport originally produced for civil aviation, but pressed into military service, particularly for insertion of small Spetsnaz teams. The Clod has excellent low-speed characteristics, and it is capable of short and rough-field takeoffs and landings. The An-14 has a clamshell rear end that can open for cargo loading, but this rear end cannot be opened in flight. The first version ceased production in 1968, but later versions with turboprop engines (An-28 Cash) were produced starting in the 1980s. The An-14 is used by Russia, Bulgaria, Mongolia, and Yugoslavia.

Twilight 2000 Notes: Germany had 44 An-14s at the start of the Twilight War that once belonged to the former East Germany.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
An-14	$1,045,600	AvG	570 kg	3.63 tons	2+9 or 7 paratroopers	6	None	Enclosed
An-28	$1,278,440	AvG	960 kg	6.1 tons	2+20 or 15 paratroopers	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
An-14	444	111 (70)	NA 28 5/3 50/30	770	213	5000	FF3 CF3 RF3 W3 T3
An-28	863	216 (70)	NA 54 5/3 50/30	880	704	5000	FF3 CF3 RF3 W3 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	None	110/110m Primitive Runway	None	None	None

An-22 Cock

Notes: This is a Russian transport designed for the shipment of bulk cargo, and has little accommodations for troops. The aircraft is fitted with two radars, one being terrain-following radar that lends itself to low approaches and flying. Some of these aircraft are fitted with pylons above the fuselage to carry outsize cargoes. These aircraft have a third vertical stabilizer in the center.

Twilight 2000 Notes: Only about 45 remained in service by the time of the Twilight War, most being used by Russian Airborne forces and Special Forces for the delivery of vehicles and other large cargoes.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$193,816,730	AvG	80 tons	250 tons	6+29	127	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1480	370 (120)	NA 93 4/2 40/20	165000	22107	10000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo

All-Weather Flight, Terrain-Following Radar, Flare/Chaff Dispensers	2450/2250m Hardened Runway	None	None	None

An-26 Curl

Notes: The An-26 is a military version of the An-24 Coke passenger aircraft, first flown in 1960. It is a short-range transport with a rear ramp for loading cargo, and has an enlarged cargo compartment. The aircraft is very popular in the Third World. The An-26 also has paratrooper exit doors in the side near the rear. No ejection seats are provided, and the aircraft is not capable on in-flight refueling.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$3,589,480	AvG	6 tons	24 tons	3+40 or 30 paratroopers	28	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1080	270 (110)	NA 68 2/1 40/20	5200	2194	7500	FF5 CF5 RF5 W6 T4

Combat Equipment	Minimum Landing/Takeoff Zone	Armament	Ammo
All-Weather Flight	1240/1740m Primitive Runway	None	None

An-32 Cline

Notes: This is a development of the An-26, with a high-lift wing and engines mounted above the wing to improve unimproved airstrip performance. The engines are more powerful, the aircraft is larger, and the tail is higher. The aircraft is optimized for high-altitude takeoff and landing. It is used by Russia and 9 other countries. There are doors in the rear fuselage for paratroopers, and a rear ramp. The aircraft has an upper deck that can hold up to 3 tons of the cargo. The aircraft has no ejection seats and is not capable of in-flight refueling.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$3,922,920	AvG	6.7 tons	27 tons	5+40, or 39 paratroops, or 24 stretchers	32	None	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
1053	263 (100)	NA 66 3/2 40/20	4327	3799	9400	FF25 CF5 RF5 W6 T20

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight	925/1300m Primitive Runway	None	None	None

An-70

Notes: This is one of the newest Russian transports. It has a very low running cost and good low-speed characteristics due to its all-propfan engines. It was designed as a replacement for the An-12. The cargo hold may be sectioned by a removable bulkhead into an upper and lower section. The aircraft has a rear ramp and 4 side doors (the two front are for paratroopers). The takeoff run may be reduced to 600 meters with payload reduced to 20 tons.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$131,631,090	AvG	35 tons	130 tons	5+170 (300 with extra deck) or 130 paratroops	82	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1500	375 (115)	NA 94 4/2 60/30	52140	20312	12000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff Dispensers, All-Weather Flight	1800/1900m Primitive Runway	None	None	None

An-72 Coaler

Notes: This is a Russian transport aircraft designed for STOL operations from unpaved runways. The engines are located above the wing to keep them clear of debris. There are other versions than the basic cargo carrier, but it is the most numerous; there is also a civilian transport, a maritime patrol and attack version, a luxury transport version, and an all-weather version. Besides Russia, this aircraft is used by Iran and Peru.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$31,305,960	AvG	10 tons	34.5 tons	4+68 or 57 paratroopers or 24 stretchers	58	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1410	353 (110)	NA 88 5/3 50/30	7270	12502	11800

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff Dispensers, (An-74-200) All-Weather Flight	465/490m Primitive Runway	None	None	None

An-124 Condor

Notes: The second-largest aircraft in the world, it is the largest that was in regular production (the An-225 Cossack modification having had only two models made, both especially for transport of the Buran, the Russian space shuttle). The Condor may be loaded from the front and rear, but only the rear doors or the side doors may be opened in flight.

Twilight 2000 Notes: By 2000, the survivors of the fleet were rarely flown due to the large amount of fuel required to fly them even short distances. However, earlier in the war they were used for massive spot insertions of troops and heavy equipment, as they can move even heavy tanks, and are fairly fast aircraft.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
An-124	$232,459,541	AvG	120 tons	392 tons	7+300 or 200 paratroopers or 84 stretchers	132	Radar	Enclosed
An-124-210	$263,641,620	AvG	150 tons	405 tons	4+300 or 200 paratroopers or 84 stretchers	150	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
An-124	1600	400 (120)	NA 100 3/2 30/20	289600	91712	12000
An-124-210	1700	425 (120)	NA 106 3/2 30/30	371590	105847	12000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	All-Weather Flight, Flare/Chaff Dispensers	915/2125m Hardened Runway	None	None	None

Il-76/Il-76MF Candid

Notes: This was one of the primary transports of Russia during the Twilight War, and was also produced as a tanker (Il-78 Midas) and an AWACS aircraft (A-50 Mainstay). It is similar in appearance to the US C-17; the Il-76MF is a rare stretched version, 6.6 meters longer and slightly wider and with more powerful engines. The Il-76 was also produced as a civilian airliner. Military versions are unusual in that they have tail guns. There are side doors for crew entry near the front, at the rear for paratrooper exit, and clamshell doors and a ramp at the rear.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Il-76	$375,699,140	AvG	52 tons	170 tons	7+148 or 124 paratroopers or 78 stretchers	74	Radar	Enclosed
Il-76MF	$433,820,000	AvG	50 tons	181.6 tons	7+184 or 154 paratroopers or 96 stretchers	74	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
Il-76	1700	425 (130)	NA 106 4/2 40/20	113400	47029	15500
Il-76MF	1700	425 (130)	NA 106 4/2 40/20	113400	40728	15500

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	Radar Warning Receiver, Flare/Chaff Dispensers	1110/2580m Hardened Runway	+1	2x23mm Autocannons (Rear)	2000x23mm

C.212 Aviocar

Notes: This is a Spanish transport for both military and civilian uses, in use by a large amount of countries all over the world. The basic version is the C-212, and they get progressively bigger and more capable. The SH-89 is an antisubmarine version, with an extended nose for search radar, sonar, ECM, and SIGINT gear.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C.212	$3,295,400	AvG	2.82 tons	8 tons	3+18 or 16 paratroops	12	None	Enclosed
C.212-200	$3,692,720	AvG	3.16 tons	9 tons	3+18 or 16 paratroops	12	None	Enclosed
C.212-300	$6,241,580	AvG	3.26 tons	9.19 tons	3+18 or 16 paratroops	14	Radar, FLIR	Enclosed
C.212-400	$7,562,650	AvG	3.95 tons	11.14 tons	3+25 or 25 paratroopers or 14 stretchers	14	Radar	Enclosed
SH-89	$11,372,590	AvG	3 tons	7.7 tons	5	20	Radar, SLAR, FLIR, Sonar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
(All)	740	185 (110)	NA 46 4/2 40/20	932	655	7925

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
C.212/C.212-200	None	600/500m Hardened Runway	None	None	None
C.212-300	Flare/Chaff Dispensers	600/500m Hardened Runway	None	None	None
SH-89	ECM 2, Signals Intelligence Gear, Secure Radios, Sonobuoys (60)	600/500m Hardened Runway	None	None	None

C-295

Notes: This is an improved version of the CN-235M listed in International Aircraft. It can move 50% more cargo with the same range as the CN-235M, and can go a little faster and higher as well. For a short time in the early 2000s, the C-295 was studied for possible conversion to a gunship, similar to the AC-130 series.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$11,971,110	AvG	9.7 tons	23.2 tons	4+78 or 48 paratroopers or 27 stretchers	38	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1185	296 (115)	NA 74 4/2 40/20	7700	1859	12500

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, Flare/Chaff Dispensers, All-Weather Flight, Secure Radios	775/960m Primitive Runway	None	None	None

C-2A Greyhound

Notes: This is the base chassis of the E-2C Hawkeye naval AWACS aircraft. In this role, the aircraft is a cargo aircraft, the primary cargo aircraft of the US Navy and also operated by Israel, France, and Taiwan. Only Israeli versions were capable of aerial refueling, and none had ejection seats. There is a cargo ramp in the rear and two doors in each side behind the cockpit; the ramp may be opened in flight and was sometimes used for the deployment of SEAL and Marine Recon teams. They are capable of navigation across trackless spaces, but are hampered by a low speed. Their endurance is very long, with low fuel consumption. They were also known for their easy maintenance and the large amount of time that they were available for duty. The "Land" figures refer to operations totally from land bases, while the "Ship" figures are for if the Greyhound must take off, land, or both from a carrier.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$10,158,130	AvG	(Land) 6.8 tons, (Ship) 4.54 tons	26.08 tons	4+39 or 20 stretchers	32	Radar	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1132	283 (90)	NA 71 6/4 60/40	10184	3269	8778

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Secure Radios, Flare/Chaff Dispensers, All-Weather Flight	500/400m Hardened Runway	None	2 Hardpoints (Drop Tanks Only)	None

C-17A Globemaster

Notes: The C-17A was designed to carry large, bulk items such as the M-1 Abrams main battle tank and AH-64 Apache helicopter. It is the only aircraft in the US inventory able to air drop large items such as the M-2 Bradley IFV or the M-8 Ridgeway AGS. The aircraft has a rear ramp and side doors for paratroopers. It is capable of aerial refueling, but does not have ejection seats. It was designed to replace the C-141 in the tactical transport role.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$483,960,590	AvG	76.44 tons	265.31 tons	3+154 or 102 paratroopers	90	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1600	400 (105)	NA 100 5/3 40/20	175000	72947	13716

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All Weather Flight, Flare/Chaff Dispensers, TFR	985/2285 m Primitive Runway	None	None	None

C-21/C-21A

Notes: The C-21 and C-21A are is the military version of the Learjet 25/35. The US military uses these as VIP transports. The C-21A has increased range, at the expense of passenger capacity. The C-21 and C-21A do not have ejection seats and cannot be refueled in the air.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-21	$7,428,560	AvG	1.43 tons	8.24 tons	2+8	16	None	Shielded
C-21A	$7,428,560	AvG	1.41 tons	8.24 tons	2+7	16	None	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
C-21	1696	424 (165)	NA 106 4/2 40/20	3538	3059	13716
C-21A	1696	424 (165)	NA 106 4/2 40/20	4118	3059	13716

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	None	900/750m Hardened Runway	None	None	None

Douglas C-47 Skytrain

Notes: The origins of the C-47 go back almost a decade before World War 2, starting in 1932 with the design of the DC-1, then the DC-2, and then the DC-3 in 1935. These were designed for the then-new civilian airlines, designed for long-range travel with a relatively small passenger and cargo load. When US involvement in World War 2 began in earnest, the US military suddenly found themselves with a dearth of cargo aircraft, and basically asked any company who could supply cargo aircraft to dramatically increase their production. Douglas was the most capable of filling this role, having already a large production line for their DC-3. The US military pretty much sucked up all unsold DC-2s and DC-3s, making some modifications on most of them to increase their utility as military cargo aircraft. (The DC-2/R2D/C-33 will be handled in a separate entry.) C-47s were built by several countries, with and without a license, and the last new aircraft of the basic C-47 line is believed to have been built in 1962. The C-47 has also been the subject of numerous modifications and experiments, including the famous AC-47 gunship modifications first done during the Vietnam War, and several variants with more powerful engines, turboprop engines, or somewhat different dimensions, cargo capacities, and fuel capacities. The US Navy also used C-47s, designated as the R4D. Generals Eisenhower, Patton, and MacArthur all acknowledged the C-47 as one of the most important weapons of World War 2.

Note that this entry does not deal with the civilian version, the DC-3, though the C-47 was developed from the DC-3.

Some 2000 C-47s and DC-3 are still in service today; most are still being used as cargo aircraft, some by Third-World air forces, but mostly by private individuals in various places; another common use for the C-47/DC-3 today is as a drop aircraft for civilian skydivers. These original C-47s (and DC-3s) still fly on, in various states of repair.

The Initial C-47s: C-47, C-47A, C-47B

The C-47 began limited use in 1941, which turned into full, if not massive, production in 1942. The US, whether in Army service as the C-47 or the R4D in its Navy guise, called it the Skytrain. The British, Canadians, Australians, and New Zealanders called it the Dakota. Many aircrews and other troops, particularly US troops, called it the Goony Bird. However, it was the Dakota name that had the longest lifespan; examples still being used in Africa and other out-of-the-way places generally refer to the DC-3/C-47 as the Dakota. The C-47 is legendary for it's capability to absorb damage and keep flying; this is in part due to the over half a million rivets used in the construction of its airframe. A C-47 crashed during World War 2 on a glacier in Iceland and was abandoned; months later, it reappeared further down the glacier, was brought to Reykjavik, and found to still be in flyable condition. Also in World War 2, a C-47 was rammed by a Japanese fighter; the Japanese fighter crashed several thousand feet below, while the C-47, minus part of its wing, was able to fly home. (The crew received credit for a Japanese kill and was allowed to display a kill marking on their aircraft.)

The first C-47s were delivered in late 1941. For the most part, the airframe remained unchanged. The most visible change from the exterior was a large double cargo door on the left rear side of rear fuselage; this double door has a smaller passenger door was set into right cargo door, with folding steps on the passenger door. The span of each wing was increased by 15 centimeters, which gave the C-47 better handling, but the primary reason the wingspan increase was to allow the fitting of larger wing fuel tanks. The floor of the interior was reinforced to allow the carriage of heavier cargoes. The floor was also fitted with pulleys, lock-down points, and tie-down points. Behind the cockpit, a navigator's position was added, complete with a low navigation astrodome. The interior could carry bulk cargo, 28 fully-equipped troops or paratroopers, or up to 18 stretchers and six medics, nurses, or doctors. In addition, three hardpoints under each wing could be loaded with airdrop supply containers. The last change was the replacement of the DC-3's engines with supercharged Pratt & Whitney R-1830-92 Twin Wasps developing 1200 horsepower each. Some 935 of these initial C-47s were built.

Demand for the C-47 was so high that Douglas put up another, larger production line for the C-47 in Tulsa, and another in Long Beach. However, at the same time, the electrical system was uprated, and the designation was changed to "C-47A." For game purposes, however, the C-47 and C-47A are identical. Some 4931 C-47As were built between Tulsa and Long Beach.

With operations in Asia becoming more important, with that the necessity of flying over the Himalayas to supply China from India and Burma, the C-47B was designed. These had uprated versions of the C-47A's engines, either Pratt & Whitney R-1830-90 or R-1830-90Bs; engine power was identical, but the C-47B's engines had two-stage superchargers to give them more power at high altitude. They also generally carried extra fuel in their cargo bay (at the expense of cargo capacity), though this could be removed. The C-47B carried powerful cabin heaters to protect the crew despite the altitude at which they flew. About 3108 C-47Bs were built. Note that the C-47B was essentially a special model, designed specifically for flying "The Hump" from India and Burma to China.

Some special versions of the C-47 were built. 217 examples, known as the C-53A Skytrooper, were built; these had no double cargo doors, instead having a single wide passenger door which was also the jump door. The seats were simple metal seats, and the aircraft had an attachment point for a glider tow rope. The C-53B was a winterized version of the C-53B; eight were built, and they had full heating for the cockpit and cabin, as well as extra fuel capacity in the form of a fuel tank in the cargo cabin, which took up some of the aircraft's cargo capacity and room for troops. The C-53B also had a separate navigator's station, and for that reason had a larger cockpit. Seventeen versions, designated the C-53C, were built; this version was simply a C-53A which had a door about 150% the size of a standard door. The C-53D is simply a C-53C with an improved electrical system; 159 were built. In 1962, these aircraft were redesignated C-117A, B, or C. One C-117C was converted to a SARBird configuration and was designated the SC-117A. Several C-53Bs had their high-altitude superchargers removed; these were designated C-117B. Some retained their high-altitude superchargers, and were designated C-117D. Three were converted for use in the Antarctic; these were similar to other such C-47s. They were until 1962 designated R4D-8L, when they were redesignated LC-117D. The Naval training version, used for navigational and ASW training, was at first designated R4D-8T, then redesignated TC-117D.

A single prototype of a winterized version designed to land on show and ice was built, the XC-47A. This was followed by eight winterized C-53Bs (no special designation); these had the same features as the XC-47A except for increased fuel capability (at the expense of cargo space and carrying capacity).

In addition, several VIP transport versions of the C-47A and C-47B were built. These aircraft, designated VC-47A and VC-47B, had many of their conventional passenger aircraft features restored, and had equipment to cook meals, heat tea and coffee, special cargo storage, and in some cases, small sleeper compartments. Though 131 were ordered, only one VC-47A and sixteen VC-47Bs were actually built and delivered. Later, more were built, but they have always been few in number; these later versions were based on the C-53A and C-53B Skytrooper. The ones owned by the Navy were at first designated R4D-8; later, both the Air Force and Navy redesignated theirs to C-117A. Though the standard C-117As were fitted out as VIP transports, three of them had even more lavish appointments and were designated VC-117A. A few C-117Bs were converted to the VC-117A standard, and designated VC-117B. Another version, based on the C-53C and called by the Navy the R4D-8Z, was later redesignated the VC-117D; for game purposes, it is identical to the VC-117B except for its service ceiling.

The SC-47 (designated HC-47 after 1962) was a SAR variant of the C-47A, which served well into the Vietnam War in US service. The SC-47 was fitted with two heavy and four light hardpoints under each wing; the heavy hardpoints were also wet hardpoints and could mount fuel tanks or heavy droppable rescue assistance gear, such as large inflatable life rafts or bulk survival gear. The SC-47 was fitted with a searchlight under the fuselage, and had dispensers for flares.

Though the AC-47 we all know and love is the Spooky gunship, the first version of the C-47 (actually, C-47A) to be designated the AC-47 was an electronic warfare version that entered service in 1953. It was so designated until 1962, when it was redesignated the RC-47, then a few months later, the EC-47N. This version was used to monitor radio and radar frequencies, primarily those known to be in use by Soviet and Chinese equipment of the time, (i.e., depending on the time period, frequencies used at a given time between about 1950 and 1975) and in addition could offer limited tactical support through the use of flare dispensers and a searchlight under the fuselage. EC-47Ns also carried cameras in the belly for photographic reconnaissance of targets which were being jammed, as well as targets that resisted jamming partially or completely. These cameras were slaved to special ELINT gear which identified and measured the radar and radio emanations from targets, both those being jammed and those which resisted jamming. Other electronic gear included a short radome in the nose which carries a weather radar system, Up to six wire antennas for detection of Y-Band and Q-Band radios and radar, eight whip antennas for X-Band equipment, a trailing antenna which was extended after takeoff for detection of Z-Band equipment, antennas below the nose for a marker beacon and the TACAN system, a VOR antenna above the crew cabin, a radio and radar detection and direction-finding antenna below and behind the wing center, another antenna was mounted above the crew cabin for a UHF radio. Inside the crew cabin were large consoles for the electronic warfare specialists to ply their trade, while two radiomen were seated near the cockpit. Other parts of the cabin were crammed with anything from flare droppers to personal equipment. As the EC-47N, this version served through most of the Vietnam War. The AC/RC/EC-47N can be distinguished by its plethora of antennas, some of which deploy after takeoff due to their size. An extra internal fuel tank completed the fit. A common nickname for this aircraft is the “Electric Gooney.” EC-47Ns based on the C-47A were largely replaced by later versions by the early 1960s.

The US Navy essentially used the same aircraft, for the most part with the same design features. Navy C-47s were designated the R4D-1, C-47As were designated the R4D-5 (later redesignated the C-47H after 1962), C-47Bs were designated the R4D-6 (later redesignated the C-47J), and C-53s were designated the R4D-3. The Navy also used a small number of DC-3s that were impressed into military service and little-modified from their DC-3 form, designating those R4D-2s. These aircraft generally filled the same role in the Navy as the VC-47A/B.

Some specialist versions were also employed, most based on the C-47A (R4D-5). This includes the R4D-5L (later redesignated the LC-47H); this had removable skis, special wheel brakes, and slates which could be raised above and below the wing for additional braking power. The R4D-5Q (redesignated in 1962 the EC-47Q) served as a trainer for ECM crews; the “equipment” was mostly for training purposes and had little or no actual functionality. The R4D-5R (redesignated the TC-47H) was a trainer for cargo pilot crews, most notably for prospective C-2A Greyhound crews; it is essentially the same as a C-47A, but with extra seating behind the crew positions for six students. It can otherwise be used as a troop or cargo carrier.

133 TC-47Bs were produced; these were essentially standard C-47Bs with additional tables and other equipment and special layouts to fit them for their role as navigational trainers for cargo aircraft and bomber crews. For Twilight 2000 purposes, the TC-133 is a C-47B with an unusual cockpit layout.

Though “Dakota” is now used as a general designation in many places of the world, its origin began with the British designation of the C-47 as the Dakota; the British received large amounts of C-47s under the Lend-Lease Program. The Dakota I was the RAF designation for the C-47 and R4D-1; the Dakota III was the designation for the C-47A, and the Dakota IV was the RAF designation for the C-47B. The RAF did not use the later iterations of the C-47. The Canadians also used the C-47, C-47A, and C-47B; they also used the Dakota I/II/II designation, until 1970, when the designations were changed to CC-129, CC-129A, and CC-129B respectively.

Perhaps the strangest experiment for the C-47, undertaken using a C-47-DL (a minor variant of the C-47), was undertaken in 1944. The new, more powerful C-54 was becoming available in increasing numbers, and it was thought that a new glider should be designed to take advantage of the C-54’s power. The XCG-17 was therefore designed in 1944; this was a modified C-47, with the engines removed and replaced with aerodynamic nacelles (and the rest of the housing containing weights to compensate for the removal of the engines and help remain the aircraft’s stability in flight). Virtually all of the wiring and bulkheads were removed, as was the navigator and radio operator’s positions. Though the conversion proved to be mostly satisfactory, the XCG-17 was not capable of landing safely on surfaces like open fields and other places an assault glider might have to land. In addition, World War 2 was coming to a close, and by 1946 the Army was transitioning rapidly to the use of all-airborne forces and the deletion of gliderborne forces. The XCG-17 was capable of carrying 6.8 tons of bulk cargo, 40 fully-equipped troops, three jeeps in a single load, or two 105mm field howitzers plus a reduced load of ammunition. The single XCG-17 was converted back to a C-47 and later received several upgrades in its Army and Air Force career. The aircraft was sold to Mexico in 1959, where it served until 1980.

Various C-47s, C-47As, and C-47B were given a number of minor modifications, and were designated C-41A, C-48, C-49, C-50, C-51, C-52, and C-82. The C-41A could just as easily referred to as the VC-41A (though I stress it was NOT), as it was simply a DC-3A with its engines replaced by the Pratt & Whitney R-1830-21 1200-horsepower radials. Only one was built, and was used by the Chief of Staff or the Army Air Corps. The C-42 was also equipped for use by a VIP (in this case, the Commanding General of the Air Force GHQ after World War 2). Again, only one was built, and is essentially the same as C-41A, but it retained the civilian-standard 1000-horsepower Wright R-1820-21 radials. The C-48 refers to DC-3As rebuilt into military cargo standard. The C-49 was the designation given over to 138 DC-3 taken over from the airlines and rebuilt into military cargo standard; these also had the 1000-horswepower civilian-standard engines. The C-50s are the same as the C-49s, but never reached airline service before they were appropriated into military service. The C-52 is sort of a "pre-Skytrooper," as noted above. As such, these six aircraft were taken over by the Army Air Corps straight off the DC-3 production line and fitted out as paratrooper aircraft. The C-52 did, however, have a large double door, did not have a reinforced floor, and have the navigator's astrodome that was deleted on the C-53. The C-82 was a postwar development of the DC-3B, essentially turning it into a C-47B.

Later versions: the C-47D and its iterations – the chameleon of Skytrains

A large number of C-47Bs, starting during World War 2 but mostly after that war, has their two-stage high-altitude superchargers removed, essentially giving them performance equal to the C-47A, but with many of the non-engine improvements of the C-47B, including the capability to carry an extra internal fuel tank, the powerful cabin heaters, and various wiring and hydraulic improvements. Again, for game purposes, the C-47D is identical to the C-47A.

The C-47Ds claim to fame is the large number of variants into which it was modified. Some of the less drastic variants include the VIP transport, the VC-47D, which is essentially the same as the VC-47A and B in its internal arrangements and otherwise the same as the the VC-47A in game terms. A SARBird version, first designated the SC-47D and later the HC-47D, was also put into service; this is the same as the SC/HC-47A above in game terms, and it too served well into the Vietnam War.

Unlike the RC-47 above, the RC-47D was more a straightforward photo reconnaissance platform, though it also had some ELINT capability in the form of detecting radios and radar. The RC-47D's forte was the photographing of heavy jungle; it's slow speed meant that it could catch details faster aircraft could not, and also allowed the RC-47D to photograph targets that could be seen by the aircrew. Photography was aided by the mounting of a spotlight in the belly, and a plethora of flare dispensers. Some were also used in operations above the Ho Chi Minh trail, where they would drop motion and sound detectors (ideally, just off the Trail).

The EC-47P was the electronic warfare version of the C-47D. As was the EC-47N, the EC-47P was often called the "Electric Gooney." The ELINT equipment was basically the same as on the EC-47N, and it carried the same flare dispensers and searchlight under the fuselage, as well as the same camera setup. The EC-47Q is the same aircraft, but was re-engined with a pair of 1290-horsepower Pratt & Whitney R-2000-4 engines.

The C-47E has a rearranged interior which allows for more passengers or larger cargoes. (It does not actually increase the weight of cargo the C-47E can carry.) For game purposes, it is the same as a C-47A, but has a Crew rating of 3+32 or 24 paratroopers.

The C-47L and M were designed as VIP aircraft for the American Legate US Navy Attaché and the Military Assistance Advisory group; for game purposes, they are the same as the VC-117A. The C-47R was a singular version designed for high-altitude VIP transport at the request of Ecuador; the C-47R has the twin superchargers added back in to allow it to accomplish its role as a VIP aircraft who could fly over the Andes. For game purposes, the C-47R is the same as the VC-117B.

The AC-47D Spooky Gunship, arguably the most famous version of the C-47, will be handled in US Special Aircraft.

Modernized and Post-War Skytrains

Not long after the Skytrain and DC-3 went out of mainline service and many of their number became available on the civilian market, various companies and individuals began modifications and modernizations, big and small. These ranged from simple rewiring to more modern standards and improved hydraulic systems to more drastic updates such as lengthening, rendering the cargo deck much more conducive to loading and unloading, and re-engining, including with turboprops and trimotor versions.

One of these is Basler Turbo Conversions' BT-67. BTC begins with an overhaul of the C-47 or DC-3, restoring the aircraft to nearly an "As New" condition. This version is stretched by over a meter forward of the wing, and the cockpit bulkhead is moved ahead 1.5 meters to further increase cargo space and also counteract the unbalancing caused by the stretching of the fuselage. The BT-67 therefore has 35% more interior space and 43% more useful load. The outer leading edge and wingtip are modified to improve low-speed handling, provide some anti-stall characteristics. The wings are furthermore greatly-strengthened to give the BT-67 improved lifting capacity as well as to support the weight of larger fuel tanks. The BT-67 is completely rewired, and de-icing equipment was added for the windshield as well as the leading edge of the wings and the leading edge of the propellers. Part of the instrument panel even uses glass-cockpit-type instruments. Both the cockpit and the cargo space are heated, partially by heat bled off the engines. The cockpit is also given an overhaul in the controls and instruments, making them more understandable, accounting for new equipment, and with the BT-67 providing a hydraulic boost for the controls. Modern navigation equipment and radios are fitted, including GPS. The engines are replaced by Pratt & Whitney Canada PT6A-67R turboprops with a rating of 1424 horsepower each and offering more acceleration and lifting power. The propeller is replaced by a 5-bladed propeller with aluminum blades made by Hartzell. The BT-67 can be outfitted for cargo operations, military operations, or conventional passenger operations. The BT-67 uses a large double door with a smaller door within the right door for loading. The BT-67 is designed to function optimally even in Arctic conditions, and can even be fitted with skis for landing on ice or snow. The US military was once seriously considering taking the BT-67 into service, going as far as assigning the designation "C-47T" to the aircraft. Basler is willing to outfit an individual BT-67 to many different specifications; a few are noted below.

After World War 2, Douglas Aircraft hoped to produce and sell more C-47s to the military, as well as more civilian DC-3s to the airlines. To this end, they produced two prototypes of the "Super DC-3," also known as the "DC-3S." These prototypes were modifications of C-47Ds, with fully retractable landing gear, flush rivets, aerodynamic antennas, a longer fuselage, a taller tail, and squared-off wingtips. The radio operator's position had become unnecessary due to better technology and was eliminated. The wings were redesigned; they became a bit longer and had some sweep in them to accommodate a change in the center of gravity caused by the lengthening of the fuselage and rearrangement of the interior. In addition, the Super DC-3 had larger flaps, allowing for a lower stall speed and better takeoff and landing performance. The first prototype used Wright R-1820-C9HE Cyclone radials with an output of 1475 horsepower each, while the second prototype used Pratt & Whitney R-2000-D7 engines with an output of 1380 horsepower each; for the rest of production, the Cyclones were used. So much of the Super DC-3 was new that Douglas claimed the Super DC-3 was 75% new. The big problem with the Super DC-3 was its altitude restriction; the cabin was unpressurized, meaning that the carriage of certain cargoes or people kept the Super DC-3 from flying as high as the aircraft was capable of flying. The civilian airlines largely passed on the Super DC-3, and Douglas managed to sell only three of them to the airlines. The Air Force got the first prototype in 1949, but they passed on it and the Navy, who were more impressed with the aircraft, and bought 100 of them. These were designated at first "R4D-8," but the designation was later changed to "C-117D." Sometime later, these were again redesignated "C-47F."

Conroy Aircraft attempted to get interested going in their versions of the C-47/DC-3, which were called the Turbo Three and the Tri-Turbo-Three. The first, the Turbo Three, was often called the Super Turbo Three since it was converted from a pair of Super DC-3s. They used surplus Vickers Viscount engines, which were 1800-horsepower turboprops. This led to an increase in speed and some increase in lifting power, but also to a large increase in fuel consumption, and it is probably because of the fuel consumption along with the generally outdated design of the C-47 that meant there were no takers for the design. In addition, the propeller radius was small due to the retention of the original Viscount propellers, air flow was restricted by the retention of the original C-47-type nacelles, and the landing gear fairings partially restricted the exhaust. This led to long takeoff and landing run, and the expected increases in performance were not what was hoped for. The first Turbo Three was dismantled and the parts sold, while the second Turbo Three ended up parked at the Groton-New London airport. In 1984, it's cockpit was hit by the wing of a C-130 and largely torn off, and never replaced or repaired.

The Conroy Tri-Turbo-Three was an even more ambitious project: it turned the C-47/DC-3 into a trimotor aircraft, with three Pratt & Whitney Canada PT-6A engines each developing 1940 horsepower. Two of the engines were in the usual place, while the third engine was in a greatly-extended nose section. This increased the top speed, but the increased weight again did not deliver the hoped-for increase in performance, and increasing fuel consumption as well. However, the nose engine could be turned off in flight to increase cruising range. Despite the potential drawbacks, Polair and the Canadian/American Maritime Patrol and Rescue service each ordered one. Polair modified theirs with skis to allow takeoffs and landings on snow and ice, as well as improved brakes and slats on the bottoms of the wings and atop the wings to help slow the aircraft. Polair's first Tri-Turbo-Three was accidentally destroyed by maintenance technicians on the ground at Santa Barbara Municipal airport in May 1986; Conroy built them a new Tri-Turbo-Three, which is still functioning today. The Tri-Turbo-Three operated by the Maritime Patrol and Rescue service was replaced by a model of the C-130. Both the Turbo Three and the Tri-Turbo-Three were capable of great speed and lifting power, but their engines gulped a lot of fuel.

Not Made Here: The Lisunov Li-2

Both the Japanese and Russians had licenses to produce C-47s/DC-3s. The Russians got their license during the War, while the Japanese got theirs in 1938, promising that the aircraft were not to be used by the military (honest, Mr Douglas, airlines only!).

The Soviets manufactured almost 3000 C-47/DC-3s under license. Though the Russians took considerable effort not to change the design of the aircraft, several tweaks did in fact creep in. The wings had a slightly smaller span, provisions were made for the attachment of skis (for some Siberian operations), the Li-2 received structural reinforcement in the wing roots, lower section of the fuselage, some window rearrangements, and the main passenger door was placed on the right of the fuselage, across from the cargo doors. Perhaps the greatest change was in the engines; the Russians chose an engine they were experienced with, the Shvetsov Ash-62 radial; this unfortunately developed only 1000 horsepower, and the Li-2's performance lagged behind Western C-47s/DC-3s. To make matters worse, the Li-2 had a slightly smaller wingspan, which impacted maneuverability; they had attachments and hardpoints designed specifically to allow ski landing gear to be attached, slightly increasing weight; and they were structurally reinforced and had thicker skin on the belly and around the cockpit – this gave the Li-2 the ability to carry slightly heavier loads (though the space inside was unchanged) and increased the survivability of the Li-2, but also did a good job of increasing the Li-2's weight. Some other changes included some rearrangement of the windows and the main passenger door being moved from the left to the right (the cargo door remained on the left).

Several versions of the Li-2 were built. The Li-2P is a basic passenger model, equivalent to the DC-3 (and will not be detailed here); the Li-2G is a basic cargo hauler, with a reinforced floor and tie-downs, and large double doors on the left for the loading of cargo. The Li-2P could be readily changed from its basic passenger version into a cargo hauler.

The Li-2T is a fully militarized version. In a dorsal turret was a ShKAS or UBT machinegun, and on either side of the aircraft a ShKAS machinegun could be mounted on either side of the aircraft firing out of windows. Any of these positions could be removed or use passengers to man them. Under the fuselage, racks could be fitted; a typical load was four 250-kg bombs centerline and six 82mm rockets under each outer wing. The Li-2T did not have the attachment for skis. The Li-2D was also a military version; it was optimized for delivering paratroopers, and was also equipped with a glider tow hook, but the dorsal turret opening has doors to cover the opening to allow more paratroopers (or regular troopers) to be carried. Late versions of the Li-2D had a glazed front left crew door with a bulged window to allow the deputy jumpmaster to observe the paratroopers as they left the Li-2 and started to fall. A long range version, the Li-2DB, was for use in special operations and had long-range fuel tanks which took up part of the cargo bay. The Li-2R, used by both the military and civilians, was a survey version; it was essentially a reconnaissance aircraft, with a battery of cameras in the belly, a flare dropper, and a spotlight. The Li-2V was a postwar version, equipped with superchargers for the engines and used at high altitudes and in the Arctic.

Perhaps the most extreme variant of the Li-2 was the Li-2VV – an Li-2D converted into a bomber. For the most part, the Li-2VV was used as a night bomber and few such conversions were built. Those that were built had a decent wartime record, but were not known for their bomb-carrying capacity. The Li-2VV retained the dorsal turret and waist guns, with the bombs being mounted on the wings and under the fuselage. Though up to 1500 kilograms of bombs could be carried under the wings and fuselage, in practice the Li-2VV carried only 1000 kilograms to increase range. A small amount of 50-kilogram bombs were also carried in the fuselage. The Li-2VV bombardier was equipped with a rather poor bomb sight and the Li-2VV was not known for its accuracy; accuracy with the bombs in the bomb bay was even worse than with the wing and fuselage bombs. The Li-2VV could be easily distinguished by its glazed nose, which also longer than on a standard Li-2. Accuracy improved on the Li-2NB, an Li-2VV with an improved bomb sight and with a window that allowed the bombardier to look straight down and also slightly to the rear. In both cases, the aircraft could carry a small amount of cargo; often, this cargo space was used for anything from mortar shells and grenades to chunks of scrap iron and things like old wheels or roadwheels from destroyed vehicles – the cargo door and passenger door remained, and the waist gunners and the radio operator would often throw them out of the doors when passing over a target, to cause more damage.

For the most part, information on the Soviet/Russian version of the C-47 is a bit sketchy, particularly what happed to the Li-2 after World War 2. Their career is believed to have stretched into the late 1950s, and it is possible that client states received some Li-2s and used them even later. NATO knew of Soviet use of the Li-2 after World War 2 and assigned the aircraft the reporting name of "Cab."

Also Made Elsewhere, Perhaps Under Shady Circumstances: The Showa L2D

Just before World War 2 in 1938, Douglas sold several DC-3s to Japan for evaluation, and were built by Showa and Nakajima. Mitsui, the design and retroengineering company, went on to buy a license from Douglas, and obtained all the specifications from Douglas along with two unassembled DC-3s. Of course, aster the Japanese attack on Pearl Harbor, Douglas terminated their contract with the Japanese; by then, however, the Japanese had the full specifications for the DC-3, which they called the L2D series.

The first 71 of this series were simple DC-3 clones, with one exception – including the original 1000-horsepower Pratt & Whitney R-1830 Twin Wasp engines of the original DC-3A instead of the uprated engines of the US military versions. These were essentially identical to the original DC-3A, but used Mitsubishi Kinsei 43 radials. Nakajima built these 71 aircraft, then stopped building DC-3 clones. These were designated L2D2. Showa, however, continued building DC-3 clones, building the first one in 1941; they built a few L2D2s, then moved on to different and improved models. (Being a commercial aircraft variant, the L2D2 will not be discussed here. Maybe if in the future I do commercial aircraft…)

The L2D2-1 was essentially the Japanese equivalent of the C-47; most of the passenger seats were removed except for four at the front and fold-down seats down the length of the cargo cabin. The cargo floor was reinforced, and on the left side of the fuselage were double cargo doors. The L2D3 was essentially the same aircraft, except for its improved Kinsei 51 1300-hosepower radials. The L2D3-1, L2D3a, and L2D3-1a were essentially the same, except for the electrical system, in some cases the cockpit instrument layout, and differences in the window layout. The L2D3-1a could also airdrop supplies.

The L2D4 was an armed VIP variant, essentially an armed DC-3A with less seats, and extra radios. Another version, the L2D4-1, was an armed cargo carrier. Atop the aircraft (not in a turret) was a 13mm Type 93 machinegun; through side windows on either side of aircraft, Type 98 8mm machineguns were mounted (copies of the MG-15). The L2D5 was the same aircraft, but by this stage of the war, as many "non-strategic" metals were used in production (wood and remilled scrap steel), and the engines were replaced by 1560-horsepower Kinsei 62 radials. (It is speculative, but these engines may have been too hot for the aircraft.) The L2D5s were produced only as prototypes, and production did not begin before the Surrender of Japan; if they had entered production, pilots and plane captains would have discovered that, due to the increased weight of the L2D5's use of less-than-optimum materials and the engines themselves, the performance increase would not have been as great as one might think.

Showa built 416 or these aircraft, in addition to the 71 built by Nakijima. Allied pilots called them the "Tabby."

Twilight 2000 Notes: At the beginning of the Twilight War, it is estimated that there were about 2000 flying examples of this aircraft. Most are DC-3s and C-47 variants, and most of the C-47 variants are cargo hauler types. Most specialist versions have long been out of service; though some may be found at the Boneyard in Arizona, the specialist Skytrains are as rare as hen's teeth, and specialist versions with functioning special equipment are rarer still. These C-47 variants and DC-3s are most common in the US, Canada, and Africa. In the US and Canada, virtually all of them were in the hands of civilians, most commonly being restored and flown for exhibition at air shows. A few were flown by the Confederate Air Force in the US. Perhaps 50 of these aircraft were used by civilians for skydiving. Some 500 were actually "working" aircraft, hauling cargo to remote areas (especially in Africa and other out-of-the-way places).

Some 40 Basler BT-67s were available at the start of the Twilight War; most were outfitted for use by various research organizations.

The status of Li-2 variants, even during the Cold War and beyond, was always the subject of debate. It is believed, however, that few Li-2s are in flying condition; as more and more were simply parked in the grass at airfields of open fields, and the survivors increasingly stripped for parts to keep Li-2s in better condition flying. Nonetheless, the arrival of more advanced aircraft (especially Soviet-built aircraft) gradually consigned the Li-2s to air shows, and later trailing targets for ground gunners or equipped with remote controls and used as target drones. By 1960, the Soviets stated that there were no Li-2s in active service.

Almost all Showa L2Ds were destroyed by the US military occupation forces in Japan after World War 2, though some of them in better shape were upgraded and used by US forces and later (for a short time) Japanese forces. They were retired from service by 1955; I have not been able to find out if Japan has any L2D variants in flying condition.

The Twilight War saw the use of C-47 and DC-3 variants by guerilla forces, irregular forces, partisans, and even emergency use by regular military troops. Many have, in fact, been pressed into military use by US and Canadian forces, and even the Mexican forces use three of them. The BT-67s were based in various places in the world, basically in range of wherever the research project was. Most of them were impressed into service by the countries that they happened to be in between 1996 and late 1997. It turned out that one flyable Showa L2D4-1 was present in Japan. Twelve Lisunov Li-2s were operational at the start of the Twilight War; half of these were Li-2Gs, and another quarter were Li-2Ps. However there was also a flyable Li-2T, an Li-2DB, and an Li-2NB. Most of these were kept in the rear supplying cargo which would be taken to the front. The Li-2T, Li-2DB, and Li-2NB were used closer to the front, with the Li-2NB used in actual bombing missions. Most of these surviving Li-2s got shot down fairly quickly; by 2000, only four Li-2s were still flyable; for some reason, the sole Li-2NB survived all of its combat missions.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-47/C-47A/C-47D/C-53A/C-53C	$313,620	AvG	4.1 tons	7.7 tons	3+28 or 20 paratroopers	8	None	Enclosed
C-47B	$325,830	AvG	4 tons	8.1 tons	3+28 or 20 paratroopers	10	None	Enclosed
C-53B	$332,910	AvG	3.1 tons	8.2 tons	3+21 or 15 paratroopers	8	None	Enclosed
SC-47A/SC-117A/HC-47D	$1,301,480	AvG	3.6 tons	8.7 tons	5	11	Searchlight	Enclosed
XC-47A	$350,250	AvG	3.81 kg	8.86 tons	3+28 or 20 paratroopers	9	None	Enclosed
C-53B (Winterized)	$385,700	AvG	2.81 tons	8.7 tons	3+21 or 15 paratroopers	9	None	Enclosed
EC-47N/P	$24,279,860	AvG	1.48 tons	8.84 tons	11	13	Searchlight, Radar (30 km)	Enclosed
VC-47A	$435,700	AvG	1.75 tons	8.3 tons	3+14	10	None	Enclosed
VC-47B	$457,910	AvG	1.75 tons	8.3 tons	3+14	12	None	Enclosed
VC-117A/C/C-47L/C-47M	$477,340	AvG	1.73 tons	8.35 tons	3+14	11	None	Enclosed
VC-117B/C-47R	$499,550	AvG	1.73 tons	8.35 tons	3+14	13	None	Enclosed
XCG-17	$138,060	N/A	6.8 tons	5 tons	2+40	2	None	Enclosed
RC-47D	$5,699,570	AvG	1.55 tons	8.7 tons	6	10	Searchlight, Radar (20 km)	Enclosed
EC-47Q	$24,283,530	AvG	1.5 tons	8.84 tons	11	13	Searchlight, Radar (30 km)	Enclosed
BT-67 (Standard)	$4,759,770	JP4/5/6	4.63 tons	8.44 tons	3+32 or 23 paratroopers	11	Radar (30 km)	Enclosed
BT-67 (Cargo/Passenger)	$5,176,860	JP4/5/6	3.1 tons	8.57 tons	3+10	12	Radar (30 km)	Enclosed
BT-67 (Arctic Fit-Out, Standard)	$4,796,400	JP4/5/6	4.47 tons	8.77 tons	3+32 or 23 paratroopers	12	Radar (30 km)	Enclosed
BT-67 (Arctic Fit-Out, Cargo/Passenger)	$5,200,190	JP4/5/6	3 tons	8.97 tons	3+10	13	Radar (30 km)	Enclosed
Super DC-3	$556,420	AvG	4.7 tons	8.86 tons	2+30	8	None	Enclosed
Turbo Three	$436,280	JP4/5/6	5.13 tons	8.43 tons	3+28 or 20 paratroopers	9	None	Enclosed
Tri-Turbo-Three	$546,760	JP4/5/6	6.41 tons	8.8 tons	3+28 or 20 paratroopers	10	None	Enclosed

Li-2G	$376,490	AvG	4.3 tons	7.9 tons	3+28 or 20 paratroopers	8	None	Enclosed
Li-2T	$1,655,900	AvG	3.3 tons	8.9 tons	6+22 or 15 paratroopers	10	None	Enclosed
Li-2D	$1,665,740	AvG	3.3 tons	8.9 tons	6+28 or 20 paratroopers	10	None	Enclosed
Li-2DB	$1,774,730	AvG	2.1 tons	9.2 tons	6+14 or 10 paratroopers	10	None	Enclosed
Li-2R	$1,237,300	AvG	1.8 tons	8.58 tons	8	12	Searchlight	Enclosed
Li-2V	$388,700	AvG	4.2 tons	8.3 tons	3+28 or 20 paratroopers	10	None	Enclosed
Li-2VV	$2,417,770	AvG	1.26 tons	9.68 tons	6	11	None	Enclosed
Li-2NB	$2,508,570	AvG	1.26 tons	9.68 tons	6	11	None	Enclosed
L2D2-1	$289,020	AvG	4.1 tons	7.45 tons	3+28 or 20 paratroopers	8	None	Enclosed
L2D3	$313,620	AvG	4.34 tons	7.83 tons	3+28 or 20 paratroopers	8	None	Enclosed
L2D3-1a	$326,860	AvG	4.34 tons	7.83 tons	3+28 or 20 paratroopers	8	None	Enclosed
L2D4	$763,430	AvG	2 tons	8.1 tons	3+14	11	None	Enclosed
L2D4-1	$623,940	AvG	4.14 tons	8.03 tons	3+28 or 20 paratroopers	9	None	Enclosed
L2D5	$671,500	AvG	4.28 tons	8.82 tons	3+28 or 20 paratroopers	9	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
C-47/C-47A/C-47D/C-53A/C-53B/C-63C	573	146 (41)	NA 36 5/3 40/30	1500	696	7070
C-47B	551	138 (41)	NA 36 5/3 40/30	1500	792	8230
C-53B	544	136 (41)	NA 36 5/3 30/30	1600	719	7070
SC-47A/SC-117A/HC-47D	522	136 (41)	NA 34 5/3 40/30	1700	742	7070
XC-47A	538	135 (40)	NA 32 5/3 40/30	1500	721	7070
C-53B (Winterized)	544	136 (41)	NA 32 5/3 40/30	1600	742	7070
EC-47N/P	539	135 (41)	NA 34 5/3 40/30	1600	748	7070
VC-47A	555	207 (41)	NA 35 5/3 40/30	1500	723	7070
VC-47B	555	139 (41)	NA 35 5/3 40/30	1500	723	8230
VC-117A/C/C-47L/C-47M	554	139 (41)	NA 34 5/3 40/30	1500	725	7070
VC-117B/C-47R	554	139 (41)	NA 34 5/3 40/30	1500	725	8230
XCG-17	**	** (34)	NA None 5/3 40/30	None	None	7070
RC-47D	543	136 (41)	NA 34 5/3 40/30	1500	742	7070
EC-47Q	547	137 (41)	NA 34 5/3 40/30	1500	776	7070
BT-67 (Standard)	630	157 (37)	NA 39 5/3 40/30	3028	1564	5791
BT-67 (Cargo/Passenger)	625	156 (37)	NA 39 5/3 40/30	3028	1576	5791
BT-67 (Arctic Fit-Out, Standard)	617	155 (37)	NA 38 5/3 40/30	3028	1594	5791
BT-67 (Arctic Fit-Out, Cargo/Passenger)	611	153 (37)	NA 38 5/3 40/30	3028	1613	5791
Super DC-3	599	150 (34)	NA 37 5/3 40/25	1700	761	9144****
Turbo Three	669	168 (41)	NA 42 5/3 40/30	1700	1991	9000
Tri-Turbo-Three	782	196 (41)	NA 49 5/3 40/30	1700	3004	9000

Li-2G	459	115 (42)	NA 29 5/3 40/35	1500	590	7000
Li-2T	412	103 (44)	NA 26 5/3 40/35	1500	627	7000
Li-2D	412	103 (44)	NA 26 5/3 40/35	1500	627	7000
Li-2DB	400	100 (44)	NA 25 5/3 40/35	1700	636	7000
Li-2R	423	106 (42)	NA 27 5/3 40/35	1700	615	7000
Li-2V	440	110 (42)	NA 28 5/3 40/35	1700	605	8160
Li-2VV/Li-2NB	378	95 (44)	NA 24 5/3 40/35	1700	656	7000
L2D2-1	488	122 (41)	NA 30 5/3 40/30	1500	590	7000
L2D3/L2D3-1a	600	150 (41)	NA 37 5/3 40/30	1500	770	8000
L2D4	580	145 (41)	NA 36 5/3 40/30	1500	783	8000
L2D4-1	575	144 (41)	NA 36 5/3 40/30	1500	786	8000
L2D5	639	160 (41)	NA 39 5/3 40/30	1500	926	7500

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Most C-47 Variants	None	600/500m Primitive Runway	None	3 Hardpoints (Non-Weapon Only; 3xWet)	None
SC-47A/SC-117A/HC-47D	32xFlares	600/500m Primitive Runway	None	4 Light Hardpoints (600 kg max), 2 Heavy Hardpoints (1200 kg max; Wet); None May Carry Weapons	None
EC-47N/P/Q	32xFlares	600/500m Primitive Runway	None	4 Light Hardpoints (247 kg max), 2 Heavy Hardpoints (494 kg max; Wet); None May Carry Weapons	None
XC-47A/C-53B (Winterized)	None	600/500m Primitive Runway*	None	3 Hardpoints (Non-Weapon Only; 3xWet)	None
XCG-17	None	600m Primitive Runway***	None	None	None
RC-47D	40xFlares	600/500m Primitive Runway	None	4 Light Hardpoints (260 kg max), 2 Heavy Hardpoints (516 kg max; Wet); None May Carry Weapons	None
BT-67	None	400/500m Primitive Runway	None	None	None
BT-67 (Arctic Fit-Out)	None	400/500m Primitive Runway*	None	None	None
Super DC-3	None	500/400m Primitive Runway	None	3 Hardpoints (Non-Weapon Only; 3xWet)	None
Turbo Three/Tri-Turbo-Three	None	400/500m Primitive Runway	None	3 Hardpoints (Non-Weapon Only; 3xWet)	None
Li-2G	None	600/500m Primitive Runway	None	3 Hardpoints (Non-Weapon Only; 3xWet); 8 Hardpoints on Wings and Fuselage for Attachment of Skis	None
Li-2T	None	600/500m Primitive Runway	None*****	4 Hardpoints (113 kg max), 2 Hardpoints (6x82mm Rockets only), 1 Hardpoint (No Weapons; Wet); Dorsal Turret with ShKAS; 2xWaist Guns with ShKAS	3000x7.62mm
Li-2D/Li-2DB	None	600/500m Primitive Runway	None*****	4 Hardpoints (113 kg max each), 2 Hardpoints (6x82mm Rockets only); Dorsal Turret with ShKAS; 2xWaist Guns with ShKAS	3000x7.62mm
Li-2R	None	600/500m Primitive Runway	None	None	None
Li-2V	None	600/500m Primitive Runway	None	3 Hardpoints (Non-Weapon	None

				Only; 3xWet)	
Li-2VV	6xFlares	600/500m Primitive Runway	-1******	6 Hardpoints (250 kg max), Bomb Bay (6x50 kg Bombs max); Dorsal Turret with ShKAS; 2xWaist Guns with ShKAS	3000x7.62mm
Li-2NB	12xFlares	600/500m Primitive Runway	+1******	6 Hardpoints (250 kg max), Bomb Bay (6x50 kg Bombs max); Dorsal Turret with ShKAS; 2xWaist Guns with ShKAS	3000x7.62mm
L2D	None	600/500m Primitive Runway	None	None	None
L2D3-1a	None	600/500m Primitive Runway	None	3 Hardpoints (360kg each; Wet)	None
L2D4/L2D4-1/L2D5	None	600/500m Primitive Runway	None	3 Hardpoints (360kg each; Wet); 13mm Type 93; 2x8mm Type 98	500x13mm, 2000x8mm

*Increase landing run by 50% and takeoff run by 10% when using ice as an airfield.
**The XCG-17's starting speed will be the same as that of the aircraft which is towing it (the XCG-17 was meant to be towed by a single C-54 at a speed of approximately 230 kmh). Once released, the XCG-17's speed will fall by 10% each turn, assuming a safe landing profile (safe in a utility glider being a matter of terms).
***Though the XCG-17 can land safely in 600 meters on a primitive runway, it was meant to land in a space as little as 50 meters on a decently-flat surface, with the wings shearing off, the tail surfaces shearing off, and possibly worse damage occurring to the XCG-17.
****This is the maximum ceiling, but the Super DC-3 normally operated at a maximum ceiling of half that when carrying passengers, due to the unpressurized cabin.
*****The dorsal turret gunner has a simple reticle gunsight, giving him RF +1.
******The dorsal turret gunner on both aircraft has a simple reticle gunsight, giving him RF +1. As stated above, the Li-2VV's bombardier has a rather poor gunsight; the RF rating above worsens to -2 when using the bombs from the bomb bay. On the Li-2NB, the RF when using the bombs in the bomb bay is +0 (i.e., no penalty or bonus).

C-123 Provider

Notes: This tactical assault transport had its genesis as a design for a heavy cargo glider during World War 2. The glider version proved to be impractical, but in 1949 engines were added to the design and it became a viable transport. The Provider proved to be too slow in the coming era of jet aircraft, and two small jet engines (under the wings or on the wingtips) were added to enable to keep up with escorting fighters and refuel those aircraft as well as carry more cargo. (This is the C-123K, below.) During the Vietnam War, these aircraft were common in the skies above Vietnam, Cambodia, and Laos during their participation in Operation Ranch Hand, the spraying of Agent Orange. More were used as transports to forward areas due to their ability to land on the most primitive strips and fields. After the Provider's retirement from US service in 1979, many of the former Ranch Hand aircraft were modified by civil aviation for dumping water on forest fires, and some were operated by the CIA and civil aviation as transports.

Twilight 2000 Notes: By 2000, the only active military users were in the Far East, Southeast Asia, and South America, except for about 10 or so that were used by the Alaska Air National Guard during the latter stages of the war.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-123B	$14,318,570	AvG	6.81 tons	27.22 tons	3+62 or 43 paratroopers or 30 stretchers	32	Radar	Enclosed
C-123K	$17,090,180	AvG	10.89 tons	27.22 tons	3+60 or 41 paratroops or 28 stretchers	42	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
C-123B	768	192 (75)	NA 48 5/3 50/30	6150	1607	8839
C-123K	772	193 (75)	NA 48 5/3 50/30	6150	3882	8534

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	Flare/Chaff Dispensers	700/500m Primitive Runway	None	2 hardpoints (drop tanks only)	None

C-130 Hercules

Notes: The C-130 is produced in a huge amount of variants, including cargo transport, weather reconnaissance, Antarctic transport, search and rescue, tanker, surveillance, maritime patrol, electronic warfare, command post, and bombardment (the C-130 is able to carry the 10-ton Daisy-Cutter FAE bomb). It has a large rear ramp and paratrooper doors on both sides near the rear. It is used throughout the world, including by the US, Australia, Belgium, Canada, Denmark, Egypt, France, Greece, Honduras, Iran, Israel (these aircraft are often used to deliver commandos), Italy, Japan, South Korea, Mexico, Netherlands, New Zealand, Norway, Oman, Saudi Arabia, Spain, Taiwan, Thailand, Turkey, Britain, and several countries in Africa and South America. It is also in use by many civilian agencies.

The C-130A is the original "blunt nose" version. It was superseded by the C-130B, with more powerful engines. The C-130E was probably the most exported version. The C-130H was probably the most produced. The C-130J is the current US standard model. The C-130J-30 is a stretched version, about a meter longer.

The MC-130 Combat Talon is basically a C-130 brought up to special operations standards. The MC-130E Combat Talon 1 is based on the C-130E; the MC-130H Combat Talon 2 is based on the C-130J. Improvements include a comprehensive ECM/IRCM suite with flare and chaff dispensers, an ability to navigate by GPS or inertial navigation, terrain-following radar (and the ability to conduct paving), equipment to extract skyhook-equipped ground forces, and the ability to conduct parachute and LAPES drops with greater precision and at higher speeds. From an altitude of over 9000 meters, a Combat Talon can locate and accurately drop cargo or troops into a drop zone little larger than a football field; from lower altitudes, greater feats are possible. Deviation during parachuting is half normal if a navigational fix is made before the jump, and such jumps may be made at 50% higher speeds. The cockpit gauges and controls show up well when the crew is wearing night vision goggles. The Combat Talon has a full-time electronic warfare officer to counter enemy detection attempts, and it was rumored that some Israeli and American Combat Talons carry antiradiation missiles or even Maverick missiles. One weapon known to be used by the Combat Talons was the massive 15,000-pound "Daisy Cutter" fuel-air explosive bomb. The Combat Talons do not have ejection seats, but are capable of aerial refueling.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-130A	$46,093,380	AvG	17.04 tons	56.33 tons	4+92 or 64 paratroopers	34	Radar	Enclosed
C-130B	$47,047,090	AvG	18.41 tons	61.22 tons	4+92 or 64 paratroopers	36	Radar	Enclosed
C-130E	$49,737,280	AvG	19.09 tons	69.75 tons	4+92 or 64 paratroops	38	Radar	Enclosed
C-130H	$52,004,570	AvG	19.09 tons	69.75 tons	4+92 or 64 paratroops	38	Radar	Enclosed
C-130J	$53,457,290	AvG	19.09 tons	69.75 tons	4+92 or 64 paratroops	38	Radar	Enclosed
C-130J-30	$53,890,370	AvG	19.96 tons	74.39 tons	3+128 or 92 paratroopers	39	Radar	Enclosed
MC-130E	$149,753,090	AvG	7.24 tons	69.75 tons	9+53 or 26 paratroopers	54	Radar, FLIR	Enclosed
MC-130H	$150,534,620	AvG	10.25 tons	69.75 tons	7+77 or 52 paratroops or 57 stretchers	57	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
C-130A	1236	309 (115)	NA 77 5/3 35/20	24000	5335	12588
C-130B	1236	309 (115)	NA 77 5/3 35/20	24000	5782	12588
C-130E	1104	276 (110)	NA 69 5/3 50/30	24000	6156	5846
C-130H	1171	293 (110)	NA 73 5/3 50/30	24000	6729	7077
C-130J	1334	334 (110)	NA 83 5/3 50/30	24000	6967	8615
C-130J-30	1312	328 (115)	NA 82 5/3 50/30	24360	6967	8000
MC-130E	960	240 (100)	NA 60 5/3 50/30	24000	6629	10000
MC-130H	960	240 (100)	NA 60 5/3 50/30	24000	6946	10000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All Others)	Flare/Chaff Dispensers, Secure Radios	1105/800m Primitive Runway	None	2 Hardpoints	None
C-130J-30	Flare/Chaff Dispensers, Secure Radios	1220/975 Primitive Runway	None	2 Hardpoints	None
MC-130E/H	Secure Radios, Flare/Chaff Dispensers (80), ECM, IRCM, Deception Jamming, Terrain-Following Radar	800/1105m Primitive Runway	+1	4 Hardpoints	None

C-141 Starlifter

Notes: This aircraft entered service in 1964 as the US Air Force's first all-jet transport. The main problem with its design is that the fuselage is very narrow, causing the interior space to be packed to its limits before the maximum cargo weight is reached. Wide vehicles and cargo often cannot be accommodated within its fuselage. This led to the stretched C-141B. The C-141 has a large ramp in the rear and paratrooper doors on both sides of the fuselage near the rear. It has no ejection seats, but the C-141B is capable on in-flight refueling. (The C-141A is not.)

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
C-141A	$251,611,180	AvG	32.14 tons	143.6 tons	5+154, or 123 paratroopers, or 80 stretchers	52	Radar	Enclosed
C-141B	$256,835,130	AvG	41.22 tons	155.56 tons	5+200 or 155 paratroops or 104 stretchers	55	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
C-141A	1820	455 (145)	NA 114 4/2 30/15	90850	36961	12680
C-141B	1820	455 (145)	NA 114 4/2 30/15	90850	37620	12680

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
C-141A/B	All Weather Flight, Flare/Chaff Dispensers	1770/1130m Hardened Runway	None	None	None

V-22 Osprey

Notes: This aircraft is a radical hybrid of helicopter and fixed-wing aircraft. The propellers and engines of the Osprey tilt 90º from their forward position, giving V/STOL performance. The Osprey is able to lift 2/3 it's listed load in VTOL mode, and it's full load with a short (150 m) takeoff run. The CV-22 version was added as an assault helicopter substitute by the US Marines in the early 1990s. No ejection seats are provided, but the Osprey is equipped for aerial refueling. The Osprey has two forward doors and a rear ramp, and can carry a slung load of up to 4500 kg at half it's listed safe speed (in VTOL mode). The CV-22 version's hardpoints normally carry drop tanks and Sidewinder missiles, and an optional 8000-liter flexible fuel bladder may be carried at the expense of cargo.

The HV-22 is the SARbird (Search And Rescue) version of the Osprey. The HV-22 has a large internal fuel tank, which accounts for the higher fuel capacity. The HV-22 also has a rescue winch (capacity 300 kg) on its front left door. The HV-22 retains the CV-22s armament, for use in rescues in hostile areas, and can also carry a smaller flexible fuel bladder (4000-liter) at the expense of cargo. The HV-22 has no ejection seats, but may be refueled in the air and may conduct buddy refueling.

The MV-22 Pave Hammer is the special operations version of the Osprey, flown by the US Navy, Marines, and Air Force. In this role, the Osprey is heavily modified with extra armament, fuel, and electronics. The MV-22 has an electronics suite similar to the MH-53H Pave Low, and shares its terrain-following capability, though Paving in an Osprey is only a Difficult: Pilot task. The MV-22 can carry almost anything on its hardpoints, and in addition may carry a large flexible fuel bladder in its cargo bay (1775 liters), at the expense of cargo. The MV-22 may conduct in-flight refueling and buddy refueling, but has no ejection seats.

The V-22 program has been plagued by repeated crashes; it has seemingly been in development forever. It was recently killed by the DoD, but there are periodic attempts to resurrect the program. The Notes above and the stats below are estimates for versions that actually work, something that may or may not come to pass.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
CV-22	$9,949,210	AvG	9.07 tons (up to 4.5 tons of that slung)	21.54 tons	3+24 or 24 paratroops or 12 stretchers	30	None	Enclosed
HV-22	$10,794,970	AvG	5.69 tons (up to 4.5 tons of that slung)	23.21 tons	3+14	32	Radar	Enclosed
MV-22	$22,218,130	AvG	7.78 tons (up to 4.5 tons of that slung)	25.12 tons	5+17 or 17 paratroops	36	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
CV-22	1020	255	45/64 6/4 35/25	7628	4657	7925
HV-22	1020	255	45/64 6/4 35/25	9628	4567	7925
MV-22	1020	255	45/64 6/4 35/25	8628	4567	7925

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
CV-22	Secure Radios,	(VTOL) 50m	+2	20mm Vulcan, M-2HB	1000x20mm, 900x.50BMG

	Flare/Chaff Dispensers	(STOL) 150m Primitive Runway		(Rear), 4 Hardpoints	
HV-22	Secure Radios, Homing Equipment, Flare/Chaff Dispensers	(VTOL) 50m (STOL) 150m Primitive Runway	+2	20mm Vulcan, M-2HB (Rear), 4 Hardpoints	1000x20mm, 900x.50BMG
MV-22	Laser Designator, Secure Radios, Flare/Chaff Dispensers, ECM, IRCM, GPS, Engine Noise Reduced by 50%, TFR	(VTOL) 50m (STOL) 150m Primitive Runway	+3	M-197 30mm; M-2HB (Rear); 2xDoorguns (20mm Vulcan or BRG-15 or M-134 or M-60E2 or M-214 or M-2HB); 4xHardpoints	660x30mm, 900x.50BMG; 250x20mm or 665x15.2BRG or 1250x7.62N or 2780x5.56N or 665x.50BMG

J-8 Finback

Notes: Beginning as a variant of the J-7 (the Chinese version of the MiG-21 Fishbed), the J-8 was first designed as an enlarged and upgraded MiG-21 and then was further modified by placing a more powerful engine in it, moving the air intakes to the sides, and enlarging the nose and upgrading the radar and avionics. The J-8IID uses leading edge flaps for improved maneuverability, a more powerful engine than the standard J-8II, titanium surfaces and frame in high-stress areas, and more powerful radar and better avionics. This aircraft had a very long development time and was almost cancelled several times before the designers finally got it right and production was authorized; however, until the introduction of the J-8IIM/D, the Finback was considered by most analysts to be a sub-par aircraft for its day and age. Only the J-8IIM and J-8IID are capable of aerial refueling.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
J-8	$5,029,200	AvG	4.5 tons	16.58 tons	1	24	None	Enclosed
J-8I	$18,967,050	AvG	4.5 tons	17.58 tons	1	26	Radar	Enclosed
J-8E	$35,634,760	AvG	4.5 tons	17.58 tons	1	26	Radar	Enclosed
J-8II	$33,894,500	AvG	4.5 tons	17.8 tons	1	28	Radar	Enclosed
J-8IIM	$36,944,470	AvG	4.5 tons	19.6 tons	1	30	Radar	Enclosed
J-8II Block 2	$34,213,260	AvG	4.5 tons	17.7 tons	1	28	Radar	Enclosed
J-8IID	$37,557,880	AvG	4.5 tons	19.6 tons	1	30	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
J-8/J-8I/J-8E	4664	1166 (125)	NA 292 6/4 60/40	5770	7776	20800
J-8II	4676	1169 (120)	NA 292 7/4 70/40	5290	5568	20200
J-8IIM	5138	1284 (125)	NA 321 6/4 60/40	5290	7419	20200
J-8II Block II	4676	1169 (120)	NA 292 7/4 70/40	5290	5568	20200
J-8IID	5138	1284 (120)	NA 321 7/5 70/50	5290	7419	20000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
J-8	Flare/Chaff Dispensers	800/575m Hardened Runway	+1	2xType 23-III Autocannons, 5 Hardpoints	200x23mm
J-8I	RWR, Flare/Chaff Dispensers	800/575m Hardened Runway	+1	2xType 23-III Autocannons, 5 Hardpoints	200x23mm
J-8E	RWR, Flare/Chaff Dispensers, HUD	800/575m Hardened Runway	+2	2xType 23-III Autocannons, 5 Hardpoints	200x23mm
J-8II	RWR, Flare/Chaff Dispensers	755/540m Hardened Runway	+1	2xType 23-III Autocannons, 5 Hardpoints	200x23mm
J-8IIM	RWR, Flare/Chaff Dispenser, ECM 1, HUD Interface, Multitarget (2), Look-Down Radar	755/540m Hardened Runway	+3	2xType 23-III Autocannons, 7 Hardpoints	200x23mm
J-8II Block 2	RWR, Flare/Chaff Dispensers, ECM 1, HUD	755/540m Hardened Runway	+2	2xType 23-III Autocannons, 5 Hardpoints	200x23mm
J-8IID	RWR, Flare/Chaff Dispensers, HUD Interface, ECM 1, Auto Track, IR Uncage, Target ID, Multitarget (2)	725/515m; Hardened Runway	+3	2xType 23-III Autocannons, 7 Hardpoints	200x23mm

J-9

Notes: The J-9 is also known by several other designations, including FC-1, Super-7, and JF-17. This Chinese fighter-bomber is based on the design of the MiG-33, which was rejected by the Russian Air Force. It was designed to replace the J-7 (MiG-21) Fishbed and also provide a more useful air-to-ground capability than that aircraft. The J-9 has maneuverability similar to the US F-16, though it is smaller than the F-16. Doppler pulse radar equips the aircraft. The J-9 has a computer system that makes it easy to switch from air-to-air to air-to-ground modes. The J-9 also carried out many air strikes against Russian forces during its conflict with that country. The two wingtip hardpoints may only be used for air-to-air missiles or electronics pods.

Twilight 2000 Notes: This aircraft is also used by Pakistan, and was a standout in combat against the Indians during the Twilight War.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological

$33,181,090	AvG	3.8 tons	12.7 tons	1	22	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
3818	955 (120)	NA 239 10/5 100/50	2320	3225	16500

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM 1, Auto Track, HUD, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Laser Designator	700/500m Hardened Runway	+4	1xGSh-23-2 23mm Autocannon, 9 Hardpoints	400x23mm

Q-5 Fantan

Notes: This aircraft is a Chinese modification of the Russian MiG-19 of the 1950s. It has a totally redesigned forward fuselage and air intakes. Export versions can use US-made air-to-air missiles. Four of the ten hardpoints may be used for drop tanks or stores. It has been marketed overseas as a less-expensive alternative to other countries' planes. The aircraft has an ejection seat, but is not capable of in-flight refueling. This aircraft is used by China, Bangladesh, North Korea, Burma, and Pakistan. Chinese versions of this aircraft are capable of delivering nuclear weapons.

The Q-5 is the basic model; it has a small bomb bay in the fuselage (1 ton capacity). The Q-5A has been modified to carry the large and heavy atomic bombs that the Chinese possessed in the 1970s, and is radiologically shielded, but can also be used for conventional attack. The Q-5I deletes the bomb bay, replacing it with additional fuel tanks, and also uses more powerful engines. The Q-5IA adds a better gunsight and two more underfuselage hardpoints. The Q-5II adds a radar warning receiver.

The Q-5B, built for the Chinese Navy, has a Doppler radar and the ability to carry heavy antiship missiles. It also has an autopilot. The Q-5III, known as the A-5C in export form, has an improved ejection seat, updated avionics, and hardpoints conversion lugs that allow it to carry Western weapons.

The Q-5K has greatly upgraded electronics and avionics, most of which are French-made. The Q-5M has further upgraded avionics, as well as two additional hardpoints under the wings. The Q-5E/F (also known as the A-5M) has a more powerful engine than the Q-5K and even better fire control.

	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Q-5	$26,063,230	AvG	1.5 tons	11.3 tons	1	20	Radar	Enclosed
Q-5A	$26,063,230	AvG	1.5 tons	11.3 tons	1	20	Radar	Shielded
Q-5I	$26,288,780	AvG	2 tons	11.83 tons	1	24	Radar	Enclosed
Q-5IA	$27,085,410	AvG	2 tons	11.88 tons	1	24	Radar	Enclosed
Q-5II/B	$27,882,040	AvG	2 tons	11.88 tons	1	24	Radar	Enclosed
Q-5III	$28,920,350	AvG	2 tons	11.4 tons	1	24	Radar	Enclosed
Q-5K	$33,477,810	AvG	2 tons	12 tons	1	26	Radar, Image Intensification	Enclosed
Q-5M	$36,715,320	AvG	2 tons	12 tons	1	26	Radar, Image Intensification	Enclosed
Q-5E/F	$37,935,410	AvG	2 tons	12.2 tons	1	28	Radar, Image Intensification	Enclosed

	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
Q-5/Q-5A	2380	595 (90)	NA 149 4/2 40/20	1008	2715	16000
Q-5I/IA/B/II	2420	605 (90)	NA 151 4/2 40/20	1714	4970	16000
Q-5III/K/M	2420	605 (90)	NA 151 5/3 50/30	1714	4970	16000
Q-E/F	2440	610 (90)	NA 153 6/4 60/40	1714	4825	16000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Q-5/Q-5A	Flare/Chaff Dispensers	760/500m Primitive Runway	None	2xType 23-2K Autocannons, 6 Hardpoints, 1 Bomb Bay	200x23mm
Q-5I	Flare/Chaff Dispensers	760/500m Primitive Runway	None	2xType 23-2K Autocannons, 6 Hardpoints	200x23mm
Q-5IA	Flare/Chaff Dispensers	760/500m Primitive Runway	+1	2xType 23-2K Autocannons, 8 Hardpoints	200x23mm
Q-5II/B	Flare/Chaff Dispensers, RWR	760/500m Primitive Runway	+1	2xType 23-2K Autocannons, 8 Hardpoints	200x23mm
Q-5III	Flare/Chaff Dispensers, RWR	760/500m Primitive Runway	+2	2xType 23-2K Autocannons, 8 Hardpoints	200x23mm
Q-5K	Flare/Chaff Dispensers, RWR, HUD	760/500m Primitive Runway	+3	2xType 23-2K Autocannons, 8 Hardpoints	200x23mm

Q-5M	Flare/Chaff Dispensers, RWR, HUD, IR Uncage, ECM 1	760/500m Primitive Runway	+3	2xType 23-2K Autocannons, 10 Hardpoints	200x23mm
Q-5E/F	Flare/Chaff Dispensers, RWR, HUD, IR Uncage, ECM 1, Laser Rangefinder	760/500m Primitive Runway	+4	2xType 23-2K Autocannons, 12 Hardpoints	200x23mm

Mirage III

Notes: The Mirage IIIE was the last version of the Mirage III fighter-bomber, used by many countries worldwide, including Argentina, Brazil, Pakistan, South Africa, Switzerland, Brazil, and Pakistan. It has excellent high-speed characteristics, but its delta design limits maneuverability at low speeds. Radar homing missiles may only be carried on the center hardpoint.

The Mirage IIIA was built largely as a test aircraft, but low-scale production was undertaken. The Mirage IIIB was a trainer version of the IIIA. The Mirage IIIC was mostly similar externally to the IIIA, but was over a half a meter longer and stuffed with additional electronics and a different engine. The Israeli Mirage IIICJ has a more powerful Atar 9C engine, made from stolen plans. The South African Mirage IIICZ has the engine of the Mirage V and some additional electronics. The Mirage IIIE has a more powerful engine, upgraded electronics, and leading edge slats that allow better handling; it is, however, much heavier than other Mirages.

Twilight 2000 Notes: France and Israel kept some in reserve and trotted them out during the Twilight War, mostly late Mirage IIICs and Mirage IIIEs.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Mirage IIIA	$24,538,010	AvG	4 tons	10.2 tons	1	18	Radar	Enclosed
Mirage IIIC (Early)	$24,560,980	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIIC (Late)	$26,049,520	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIICJ	$26,066,320	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIICZ	$28,707,160	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIIE	$31,913,280	AvG	4 tons	13.5 tons	1	20	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
Mirage IIIA	2450	613 (160)	NA 153 6/3 60/30	3340	1721	20740
Mirage IIIC	5390	1348 (160)	NA 337 6/3 60/30	3340	1770	18000
Mirage IIICJ/CZ	5496	1374 (160)	NA 344 6/3 60/30	3340	1806	18000
Mirage IIIE	5390	1348 (150)	NA 337 7/4 70/40	3340	3000	17000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Mirage IIIA/C (Early)	All-Weather Flight, Radar Warning Receiver	700/800m Hardened Runway	+2	2x30mm DEFA Autocannons, 3 Hardpoints	250x30mm
Mirage IIIC (Late)/CJ	All-Weather Flight, Radar Warning Receiver	700/800m Hardened Runway	+2	2x30mm DEFA Autocannons, 5 Hardpoints	250x30mm
Mirage IIICZ	All-Weather Flight, Radar Warning Receiver, HUD	700/800m Hardened Runway	+3	2x30mm DEFA Autocannons, 5 Hardpoints	250x30mm
Mirage IIIE	All-Weather Flight, Radar Warning Receiver, HUD Interface	700/800m Hardened Runway	+3	2x30mm DEFA Autocannons, 5 Hardpoints	250x30mm

Mirage 2000

Notes: This fighter-bomber is the replacement for the Mirage III and Mirage 5 in French service and was also in the service of Abu Dhabi, Egypt, Greece, India, Peru, Qatar, and Taiwan. The Mirage 2000 differs from the earlier Mirages by having two more powerful engines, better avionics, and a higher weapon load, along with air-to-air/air-to-ground capability comparable to the US F/A-18 in its flexibility.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$49,578,280	AvG	6.3 tons	17 tons	1	26	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
4890	1222 (120)	NA 306 9/5 90/50	3950	4740	20000	FF6 CF6 RF6 W5 T6

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan	700/800m Hardened Runway	+3	2x30mm DEFA Autocannons, 9 Hardpoints	250x30mm

Mirage F-1

Notes: The Mirage F-1 is a French-built fighter-bomber used by 11 countries, including Ecuador, France, Greece, Iraq, Jordan, Kuwait, Libya, Morocco, South Africa, and Spain. Unlike the normal delta-winged Mirage, the F-1 has a normal wing and tail, allowing greater control at low altitudes and speeds. Three of its seven hardpoints may mount drop tanks (two wing and one underfuselage), and its two wingtip hardpoints may mount only air-to-air or antiradiation missiles. The aircraft has an ejection seat and a refueling probe.

The first version was the F1C; it is a multirole combat aircraft capable of interception, ground attack, armed reconnaissance, or fighter roles. The F-1B is a two-seat variant of this aircraft. The F-1CT is an F-1C with upgraded avionics and air-to-air systems; its role is air superiority. The F-1E is a dedicated strike aircraft with avionics more oriented to this role. The F-1D is a trainer version of the F-1E. The South African F-1A is an attack variant without radar. The F-1S is an upgraded F-1C for the Spanish Air Force.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Mirage F1C	$53,440,030	AvG	4 tons	16.2 tons	1	24	Radar	Enclosed
Mirage F1CT	$57,448,030	AvG	4 tons	16.2 tons	1	26	Radar	Enclosed
F-1E	$57,400,690	AvG	4 tons	16.3 tons	1	24	Radar, FLIR	Enclosed
F-1A	$23,856,710	AvG	5 tons	15.2 tons	1	24	FLIR	Enclosed
F-1S	$58,166,410	AvG	4.5 tons	15.3 tons	1	25	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(All)	4670	1168 (120)	NA 292 8/4 80/40	4100	3842	20000	FF6 CF6 RF6 W6 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F1C	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, Look-Down Radar, IR Uncage	670/600m Hardened Runway	+2	2x30mm DEFA, 7 Hardpoints	270x30mm
F1CT	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, Look-Down Radar, IR Uncage, HUD Interface, Auto Track	670/600m Hardened Runway	+3	2x30mm DEFA, 7 Hardpoints	270x30mm
F1E	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, Look-Down Radar, IR Uncage, HUD Interface, ECM 1	670/600m Hardened Runway	+3	2x30mm DEFA, 7 Hardpoints	270x30mm
F1A	Flare/Chaff Dispensers, Radar Warning Receiver, IR Uncage, HUD Interface, ECM 1	670/600m Hardened Runway	+3	2x30mm DEFA, 7 Hardpoints	270x30mm
F1S	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, Look-Down Radar, IR Uncage, HUD Interface, Auto Track, ECM, Track While Scan	670/600m Hardened Runway	+4	2x30mm DEFA, 7 Hardpoints	270x30mm

Rafale

Notes: This French multi-role aircraft was slated to replace the Jaguar and Mirage 2000 in most roles, but its introduction has been rather slow, and costs have escalated well beyond those expected. It is an advanced aircraft that is just as good as a fighter as an attack aircraft, and is in a class with the US F/A-18 in that regard. It is, however a more advanced aircraft, with an excellent avionics suite and the capability to carry just about any sort of weapon. Of the 14 hardpoints, the two on the wingtips may only be used for air-to-air missiles or ECM/IRCM pods.

Twilight 2000 Notes: The Rafale was introduced shortly before the Twilight War, and few actually saw service during that conflict.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$79,541,720	AvG	8 tons	19.5 tons	1	32	Radar, FLIR	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
7350*	1065 (80)	NA 266 10/6 100/60	5325	8890	19810

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispenser, HUD Interface, IR Uncage, Look-Down Radar, Auto Track, Track While Scan, Terrain-Following Radar, Helmet-Sight Interface, Multitarget (3), GPS	550/400m Hardened Runway	+4	30mm DEFA Autocannon, 14 Hardpoints	125x30mm

*The Rafale is Suprcruise capable.

EF-2000 Eurofighter (Typhoon)

Notes: Designed to replace a variety of aircraft in several European nations, this aircraft has been plagued by delays. The Eurofighter was produced for Germany, France, Spain, Britain, and Italy. The Eurofighter is an advanced multi-role aircraft using some of what was the latest aircraft design before the Twilight War, including a supercruise capability (cruise speeds in excess of Mach 1), special chaff that radiates a radar signal of its own, towed decoys that deploy behind the aircraft when cruising to further confuse enemy radar and IR detection equipment, a "semi-stealth" design, and the latest electronics. The Eurofighters were typically piloted by the best pilots in the countries involved and were very successful.

The chaff designed for the Eurofighter radiates a radar and radio frequency. This chaff degrades enemy radar detection and guidance attempts against the Eurofighter in the same manner as normal chaff, but at one level better in effectiveness. This chaff can be loaded into other aircraft, but only in the US F-22 Raptor or B-2 Spirit will it function with the special effectiveness. The chaff can also be loaded into the airbrakes of the Eurofighter, but if this is done it will function only as normal chaff. This chaff costs triple the normal amount of standard chaff. The Eurofighter can tow two decoys from the rear of the aircraft; these decoys follow the aircraft at a distance of 30 meters and add another level of deception jamming capability, and also function as IRCM devices. They will be lost 40% of the time is the Eurofighter turns with an agility of 8 or greater. In addition, they will be lost on the same roll if the Eurofighter flies at 80% or greater of its maximum speed. These two circumstances are additive. The Eurofighter was not specifically designed to have stealth features, but has them as a consequence of its design; this makes radar and IR detection and guiding attempts against one level harder. The chaff and flare dispensers on the Eurofighter are very large, carrying up to 30 decoys (typically 15 chaff bundles and 15 flares). The two wingtip hardpoints may only be used for heat-seeking air-to-air missiles, and four of the underfuselage hardpoints may only be used for radar-homing or active-homing air-to-air missiles, flare or chaff pods, or ECM or IRCM pods. Only 5 of the remaining hardpoints (two under each wing, and one under the fuselage) may be used for drop tanks.

Twilight 2000 Notes: Very few Typhoons were ready for the Twilight War. So few were built that only Germany got more than 10 of them (and they only got 12).

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$11,203,369	AvG	6.5 tons	21.01 tons	1	30	Radar, FLIR, Image Intensification	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
6375*	1063 (100)	NA 266 10/8 100/80	5040	11104	15240

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers (See Above), HUD, IR Uncage, Auto Track, Track While Scan, Look-Down Radar, Target ID, Terrain-Following Radar, Multitarget (4), Laser Designator, ECM 3, Deception Jamming	700/300m Hardened Runway	+5	27mm Mauser Autocannon, 13 Hardpoints	300x27mm

*The Typhoon is Suprcruise capable.

HESA Kowsar

Notes: The Kowsar (Thunderbolt) is basically an upgraded F-5B Freedom Fighter; despite Iran's claims that the Kowsar is "100 percent domestically manufactured," the airframe is a strengthened to give it a sort of Mid-Life Upgrade and keep them relevant and fight-quality instead of being a thoroughly-obsolete aircraft unable to hold its own with fighters and air-to-ground targets. The production line (perhaps it should called an upgrade line) opened in 2018, and 25 Kowsars have been manufactured as of the end of 2019. The Iranians plan to convert the remaining 48 F-5Bs into Kowsars in the following years. Western experts say it is still deficient as a fighter-bomber, and should perhaps be used as a trainer instead of a frontline fighter-bomber. They say that the Kowsar is already obsolete, despite the upgrade package. The upgrade makes use of stolen technology from the US and other NATO countries, as well as bought technology from China. The Iranians claim that the Kowsar is a Generation 4 fighter, but if it is, it is just barely so. The Kowser upgrade package is being marketed to countries which have F-5-series aircraft.

The Kowsar is a two-pace aircraft, with a pilot and WSO. The WSO does not have much of a function in air-to-air combat; his primary job is in air-to-ground operations. The Kowsar's airframe follows its F-5 roots. The Kowsar has an enlarged canopy for better visibility.

Engines have been upgraded with J90 turbofans, which are unlicensed copies of the GE J85-GE-13 (but still considered by experts as deficient),and deliver a total of 10,000 pounds thrust. The fuel the Kowsar is able to carry limits to short-duration attack missions and short dogfights. Maneuvering slats have been added to the wings' leading edges, and control surfaces have been enlarged. The wings themselves have more swept leading edges, and the air intakes slope slightly back toward the rear, though the reason for this in unknown.

Avionics were designed with Russian help; the cockpit display and combat avionics are partially based on the MiG-29. The whole avionics suite was not compatible with the Kowsar, and thus provided only limited improvements. Most of these improvements are in the cockpit, and the Kowsar essentially has a glass cockpit, with most instruments being LCD panels. The radar has increased range and is capable of using command-guidance munitions and radar-homing AAMs. The Kowsar uses fly-by-wire technology, which increases maneuverability and keeps the plane from performing maneuvers which would "outmaneuver the aircrew." The WSO does not have flight controls; his cockpit is primarily concerned with radar and ground targets, though he does fire any radar-homing AAMs the Kowser may carry. The avionics suite, unlike the rest of the Kowser, has near-state-of-the-art avionics..

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$36,381,067	JP4 equivalent	3.8 tons	6.18 tons	2	22	Radar (200 km), IRST (50 km)	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
3127	869 (125)	NA 196 5/3 50/30	4068	1015	15932	FF4 CF4 RF3 W2 T2

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Flare/Chaff Dispensers (40/40, RWR, ECM, HUD, IR Uncage, Track While Scan, Target ID, Laser Designator	700/500m Hardened Runway	+3	2xM39 20mm Autocannons, 6 Hardpoints	400x20mm

Kfir

Notes: This Israeli fighter-bomber is based on the French Mirage III. The aircraft was modified by making it more sleek, replacement of the engine with one of the more powerful ones fitted to the F-4 Phantom II, a better radar, and more hardpoints, along with better maneuverability. The US Navy and Marines fly some of these aircraft as well, stationed at the Top Gun school as aggressor aircraft; these are designated F-21 Lion Cub. The pilot has an ejection seat, and the aircraft is capable of in-flight refueling.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Kfir C2	$3,808,985	AvG	6.09 tons	16.5 tons	1	22	Radar	Enclosed
Kfir C7	$4,364,245	AvG	6.09 tons	16.2 tons	1	22	Radar	Enclosed

	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(Both)	4880	1220 (155)	NA 305 9/5 90/50	3360	2306	22860	FF6 CF6 RF6 W5 T6

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Kfir C2	Flare/Chaff Dispensers, Radar Warning Receiver, Secure Radios	1500/850m Hardened Runway	+2	2x30mm DEFA Autocannons, 7 Hardpoints	280x30mm
Kfir C7	Flare/Chaff Dispensers, Radar Warning Receiver, Secure Radios, HUD Interface, Laser Designator	1500/850m Hardened Runway	+3	2x30mm DEFA Autocannons, 9 Hardpoints	280x30mm

F-1

Notes: This was one of Japan's first post-war fighter designs, being first produced in 1967. It is a combat version of the T-2 trainer, with the rear seat replaced by additional fuel, a gun and hardpoints added, and the nose filled with radar and avionics. It bears a marked resemblance to the Jaguar, and it is often mistaken for the Jaguar at air shows. By the time of the war, it was a dated design, but still saw a lot of use. The two wingtip hardpoints may only carry heat-seeking air-to-air missiles or the Sidearm antiradar missile.

Twilight 2000 Notes: The main limitations on the use of the F-1 during the Twilight War were its short range and the inability to refuel from US or South Korean tanker aircraft.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$34,972,470	AvG	2.72 tons	13.7 tons	1	22	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
3400	850 (130)	NA 213 6/3 60/30	3848	1509	15240

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, Flare/Chaff Dispensers, HUD, Laser Designator	810/540m Hardened Runway	+2	20mm Vulcan, 6 Hardpoints	750x20mm

F-2

Notes: In the late 1980s, Japan was looking for an aircraft to replace its aging and outmoded F-1 strike fighters. To this end, they designed the FS-X, based on an enlarged and modernized F-16A airframe; after more modernization and development, this became the F-2. Compared to the F-16A, the F-2 is a much more capable aircraft, with air-to-air capability nearly on par with the F-15 and an air-to-ground capability similar to the F/A-18. Chaff was developed similar to that used in the Eurofighter; this chaff is one level better in fighting lock-on and guidance attempts.

Twilight 2000 Notes: These aircraft were standouts in the Twilight War, both over Korea and in defense of Japan.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$81,507,490	AvG	11.82 tons	22.27 tons	1	30	Radar, Image Intensification	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
4600	1150 (115)	NA 288 10/6 100/60	4536	5873	20000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispenser, ECM 2, Auto Track, HUD, IR Uncage, Track While Scan, Multitarget (2), Target ID, Laser Designator	800/530m Hardened Runway	+4	20mm Vulcan, 9 Hardpoints	750x20mm

MiG-21 Lancer

Notes: This is the most modern development of the MiG-21. It was produced as an upgrade kit for Romania by the Israelis in the early 1990s, and the first Lancer went into squadron service in Romania in 1994. It is essentially a MiG-21 with upgraded electronics, controls, navigation systems, and attack systems, as well as more powerful autocannons.

Twilight 2000 Notes: Though the official data from Israel said that the upgrades take six months to perform, the Romanians were performing the upgrade in as little as two weeks before the work was stopped by Russian airstrikes in 1998.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$50,078,880	AvG	2.4 tons	12.29 tons	1	24	Radar, FLIR	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
4435	1109 (120)	NA 277 7/4 70/40	2979	2329	14000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, All-Weather Flight, Flare/Chaff Dispensers, ECM 1, IRCM 1, IR Uncage, HUD, Multitarget (3), Target ID, Look-Down Radar, GPS	600/700m Hardened Runway	+4	25mm GAU-12/A Autocannon, 5 Hardpoints	400x25mm

MiG-15 Fagot

Notes: The MiG-15 is not an outstanding aircraft by 2000 standards, though it makes a serviceable ground attack aircraft with its heavy cannon (originally designed for shooting down bombers). It has a light bomb load. A version of the Fagot, the MiG-15P, was built with radar taking the place of the 37mm cannon, as a night fighter after the Korean War. It is very rare in 2000, mainly being found in Romanian and Albanian service. The MiG-15ISh is a "what-if" ground attack version.

Twilight 2000 Notes: This workhorse of the Korean War was used in a frontline role only by several African and Middle Eastern Third World countries, as well as Albania and Romania, during the Twilight War, though the two seat version was used by several other countries, such as China, as trainer, and many of these were modified for combat roles.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MiG-15	$2,296,340	AvG	500 kg	6 tons	1	8	None	Enclosed
MiG-15bis	$2,501,790	AvG	500 kg	6.06 tons	1	8	None	Enclosed
MiG-15P	$11,729,450	AvG	500 kg	6.8 tons	1	12	Radar (7 km)	Enclosed
MiG-15ISh	$3,216,590	AvG	909 kg	6.5 tons	1	8	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
MiG-15	2001	500 (100)	NA 125 5/2 50/20	1500	2269	15545
MiG-15bis/P/ISh	2150	538 (100)	NA 134 5/2 50/20	1500	2269	15500

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MiG-15	None	750/480m Hardened Runway	None	2x23mm NR-23, 1x37mm N-37, 2 Hardpoints	80x23mm, 40x37mm
MiG-15bis	None	750/480m Hardened Runway	+1	2x23mm NR-23, 1x37mm N-37, 2 Hardpoints	80x23mm, 40x37mm
MiG-15P	None	750/480m Hardened Runway	+2	2x23mm NR-23, 2 Hardpoints	120x23mm
MiG-15ISh	None	750/480m Hardened Runway	+1	2x23mm NR-23, 1x37mm N-37, 4 Hardpoints	80x23mm, 40x37mm

MiG-17F/PF Fresco-C/D

Notes: This aircraft was first encountered in Chinese use over the Formosa Straits in the mid 1950's. It is a much-improved MiG-15, with better streamlining, a more powerful engine, and the ability to use air-to-air missiles, an ability the MiG-15 lacked. The Fresco's weakness is high-speed flight; if Combat Move is greater than 400, all pilot rolls are one level more difficult, Agility is -1, and turns are -10. At lower speeds, the Fresco is known for its nimbleness. These aircraft were the bane of US pilots in Vietnam, being flown by most of North Vietnam's top aces.

The base MiG-17 uses the same engine as the MiG-15, but is otherwise not different than its successor, the M-G-17F Fresco-A; it is not capable of using air-to-air missiles. The MiG-17P Fresco-B adds a small, short-ranged radar set; it was designed as a night fighter, but is not equipped to use radar-homing missiles. The MiG-17F Fresco-C adds two more hardpoints under the wings, can use heat-seeking missiles, and has a more powerful afterburning engine. The MiG-17PF Fresco-D is a night fighter version of the Fresco-C. The MiG-17PFU Fresco-E is has a larger and more versatile radar set, at the cost of its internal guns; it can use radar homing missiles. The F-5 is the Chinese version of the MiG-17F; it has a different cannon arrangement. The Mideast Modification adds two more hardpoints under the fuselage; these small hardpoints may carry only iron bombs, single rockets, or rocket pods.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MiG-17	$2,319,970	AvG	501 kg	6.09 tons	1	10	None	Enclosed
MiG-17P	$11,942,200	AvG	501 kg	6.5 tons	1	14	Radar (7 km)	Enclosed
MiG-17F	$2,754,000	AvG	501 kg	6.09 tons	1	10	None	Enclosed
MiG-17PF	$12,765,800	AvG	501 kg	6.5 tons	1	14	Radar (7 km)	Enclosed
MiG-17PFU	$1,168,432	AvG	501 kg	6.42 tons	1	12	Radar (10 km)	Enclosed
F-5	$2,966,500	AvG	501 kg	6.11 tons	1	10	None	Enclosed
Mideast Modification	$2,937,600	AvG	1.14 tons	6.09 tons	1	10	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
MiG-17	2164	541 (100)	NA 135 7/3 70/30	1777	2560	16460
(All Others)	2275	568 (100)	NA 142 7/3 70/30	1777	3321	16600

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MiG-17	None	750/480m Hardened	+1	3x23mm NR-23 Autocannons, 2	150x23mm

		Runway		Hardpoints	
MiG-17P	None	750/480m Hardened Runway	+2	3x23mm NR-23 Autocannons, 2 Hardpoints	150x23mm
MiG-17F	None	750/480m Hardened Runway	+1	3x23mm NR-23 Autocannons, 4 Hardpoints	150x23mm
MiG-17PFU	None	750/480m Hardened Runway	+2	4 Hardpoints	None
F-5	None	750/480m Hardened Runway	+1	2x23mm NR-23 Autocannons, 1x37mm N-37 Autocannon, 4 Hardpoints	100x23mm, 50x37mm
Mideast Modification	None	750/480m Hardened Runway	+1	3x23mm NR-23 Autocannons, 6 Hardpoints	150x23mm

MiG-19 Farmer

Notes: This was the first Russian supersonic fighter. The Chinese are the largest user of this aircraft, with over 2000 in service with that country, and factories for the aircraft still operational at the beginning of the war, and most copies of this aircraft still functioning around the world are Chinese-made.

The MiG-19F Farmer-A was considered a major disappointment. It used the same engine as the MiG-17, as well as most of the structural components of the Fresco, and even the same gun pack. It was generally considered underpowered and with only two hardpoints, under-armed. The MiG-19P Fresco-B, had improvements in armament and a radar set, but the same underpowered engine.

The MiG-19SF Farmer-C was a major upgrade, with a new more powerful engine, more cannons, and a primitive radar warning receiver. The MiG-19PF Farmer-D sacrificed the nose cannon for a radar set. The MiG-19PM Farmer-E sacrificed all the guns for a radar set and equipment to fire and guide radar-homing missiles.

The F-6 was a Pakistani variant with an engine that gave it exceptional lifting capacity, as well as more hardpoints. The Chinese J-6I was a high-altitude interceptor that sacrificed almost everything for climb ability and a long-range radar. The more advanced J-6II gave the J-6I back its wing cannons; the J-6IV is the same, except that its radar is optimized for high-speed intercepts. The J-6III returned the nose cannon to the J-6I.

Twilight 2000 Notes: By the Twilight War, the MiG-19 was out of active service in the Warsaw Pact, but still used in front line service by China, Cuba, Egypt, Albania, Vietnam, and Pakistan. In those countries, it is mainly used as a ground attack aircraft, since it cannot keep up with modern fighters.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MiG-19F	$2,765,040	AvG	1.68 tons	8.9 tons	1	12	None	Enclosed
MiG-19P	$13,493,200	AvG	1.68 tons	9.1 tons	1	14	Radar (10 km)	Enclosed
MiG-19SF	$3,912,890	AvG	1.68 tons	8.9 tons	1	16	None	Enclosed
MiG-19PF	$14,279,120	AvG	1.68 tons	9.1 tons	1	18	Radar (12 km)	Enclosed
MiG-19PM	$14,414,340	AvG	1.68 tons	9 tons	1	18	Radar (12 km)	Enclosed
F-6	$4,039,110	AvG	2.78 tons	10 tons	1	16	None	Enclosed
J-6I	$14,412,750	AvG	1.68 tons	13 tons	1	28	Radar (15 km)	Enclosed
J-6II/IV	$15,386,060	AvG	1.68 tons	13.1 tons	1	28	Radar (15 km)	Enclosed
J-6III	$15,879,120	AvG	1.68 tons	13.1 tons	1	28	Radar (15 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
MiG-19F/P	2488	622 (105)	NA 155 6/2 60/20	2230	3321	16800
MiG-19SF/PF/PM/F-6	3080	770 (105)	NA 193 6/2 60/20	2230	5115	17900
J-6I/II/III/IV	3158	790 (105)	NA 197 6/2 60/20	2230	7665	20000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MiG-19F	None	760/500m Hardened Runway	+1	2x23mm NR-23, 1x37mm N-37, 2 Hardpoints	120x23mm, 70x37mm
MiG-19P	None	760/500m Hardened Runway	+2	2x30mm NR-30, 4 Hardpoints	110x30mm
MiG-19SF	Radar Warning Receiver	760/500m Hardened Runway	+1	3x30mm NR-30, 4 Hardpoints	190x30mm
MiG-19PF	Radar Warning Receiver	760/500m Hardened Runway	+2	2x30mm NR-30, 4 Hardpoints	110x30mm
MiG-19PM	Radar Warning Receiver	760/500m Hardened Runway	+2	8 Hardpoints	None
F-6	None	760/500m Hardened Runway	+1	3x30mm NR-30, 6 Hardpoints	190x30mm
J-6I	Radar Warning	760/500m Hardened Runway	+2	4 Hardpoints	None

	Receiver				
J-6II/IV	Radar Warning Receiver	760/500m Hardened Runway	+2	2x30mm NR-30, 4 Hardpoints	110x30mm
J-6III	Radar Warning Receiver	760/500m Hardened Runway	+2	3x30mm NR-30, 4 Hardpoints	190x30mm

MiG-21 Fishbed

Notes: Though originally produced as an interceptor, in most countries flying them, the MiG-21 has been relegated to the role of close support aircraft. It was widely exported and is used by a large amount of African nations, Afghanistan, Bulgaria, Croatia, Cuba, Czechoslovakia, Egypt, Hungary, India, Iraq, North Korea, Laos, Libya, Mongolia, Poland, Romania, Syria, Vietnam, Yemen, and Yugoslavia. Its utility as a ground support aircraft is hampered by its not having been designed for that role. All models of the MiG-21 have a thick armored windshield; this protects the pilot in head-to-head passes, but also causes the pilot to take a -2 penalty when observing to the front of the aircraft.

The first two models (Ye-2 Fishbed-A and MiG-21F Fishbed-B) yielded rather disappointing results, so only a total of 40 were built between the two of them. The first production model was the MiG-21F-13 (Fishbed-C); this aircraft was a daylight interceptor with only a limited radar set and the ability to fire only heat-seeking AAMs in the air-to-air role.

The MiG-21PF (and its Indian counterpart, the Mig-21FL, both known as the Fishbed-D) have no internal guns, but normally carried a gun pod on the fuselage hardpoint when in the interception role. They carry better radar and can use radar-homing missiles. The Improved PF and FL also have combat slats that allow better low-speed maneuverability. The MiG-21PFM Fishbed-F is an improved PF; it has a side-opening canopy, one large airbrake instead of two smaller ones, a larger fuel tank, an improved afterburner, and blown flaps for better clean maneuverability.

The MiG-21M (Fishbed-H) restored the internal cannon, carried more fuel, and added a slightly more powerful afterburner. It was also considerably heavier and it’s handling more sluggish. The MiG-21PFMA (Early Fishbed-J) deleted the gun, but used a more powerful radar set and had the ability to use radar-homing missiles. The MiG-21MF gave the M a more powerful engine to compensate for the poor performance of its predecessor. Flare/chaff dispensers were added to the MiG-21MF in 1985.

The MiG-21bis-A (Fishbed-L) further increased the engine power, and added a more powerful search radar. The MiG-21bis-B increased the power of the engine a little more.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MiG-21F-13	$12,477,750	AvG	1 ton	8.5 tons	1	16	Radar	Enclosed
MiG-21PF	$11,975,300	AvG	1 ton	8.44 tons	1	16	Radar	Enclosed
MiG-21 PF (Impvd)	$13,134,200	AvG	1 ton	8.63 tons	1	16	Radar	Enclosed
MiG-21FL	$12,285,920	AvG	1 ton	8.44 tons	1	16	Radar	Enclosed
MiG-21PFM	$13,541,370	AvG	1 ton	9.08 tons	1	16	Radar	Enclosed
MiG-21M	$13,685,270	AvG	1.25 tons	9.66 tons	1	16	Radar	Enclosed
MiG-21PFMA	$13,134,200	AvG	1.25 tons	9.59 tons	1	16	Radar	Enclosed
MiG-21MF	$14,514,480	AvG	1.25 tons	9.87 tons	1	16	Radar	Enclosed
MiG-21bis-A	$15,190,870	AvG	1.25 tons	10.1 tons	1	16	Radar	Enclosed
MiG-21bis-B	$15,352,660	AvG	1.25 tons	10.1 tons	1	16	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
MiG-21F-13	4250	1063 (125)	NA 266 5/2 50/20	2400	2757	19000
MiG-21PF	4250	1063 (125)	NA 266 5/2 50/20	2700	2757	19000
MiG-21PF (Impvd)	4250	1063 (115)	NA 266 6/3 60/30	2700	2757	19000
MiG-21FL	4250	1063 (115)	NA 266 6/3 60/30	2400	2757	19000
MiG-21PFM	4350	1088 (115)	NA 272 7/3 70/30	2870	2757	19000
MiG-21M/PFMA	4160	1040 (115)	NA 260 6/3 60/30	2870	2757	19000
MiG-21MF	4660	1165 (115)	NA 291 6/3 60/30	2870	2807	17700
MiG-21bis-A	4413	1103 (115)	NA 276 7/3 70/30	2980	2963	17800
MiG-21bis-B	4660	1165 (115)	NA 291 7/3 70/30	2980	2963	17800

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MiG-21F-13	Armored Windshield	800/550m Hardened Runway	+1	1x30mm NR-30 Autocannon, 3 Hardpoints	180x30mm
MiG-21PF/FL/PFM	Armored Windshield, RWR	800/550m Hardened Runway	+1	3 Hardpoints	None
MiG-21M	Armored Windshield, RWR	800/550m Hardened Runway	+1	1x30mm NR-30 Autocannon, 5 Hardpoints	180x30mm

MiG-21PFMA	Armored Windshield, RWR	800/550m Hardened Runway	+1	5 Hardpoints	None
MiG-21MF	Armored Windshield, RWR, Flare/Chaff Dispensers (see text)	800/550m Hardened Runway	+1	1x30mm NR-30 Autocannon, 5 Hardpoints	180x30mm
MiG-21bis-A/B	Armored Windshield, RWR, Flare/Chaff Dispensers, All-Weather Flight	800/550m Hardened Runway	+2	1x30mm NR-30 Autocannon, 5 Hardpoints	180x30mm

MiG-29 Fulcrum A/C/D

Notes: These are some of the best of the Russian fighters, useful as ground attack aircraft and air superiority fighters. It is also one of the most exported of Russian aircraft, used by Russia, Algeria, Angola, Bulgaria, Cuba, Hungary, India, Iraq, North Korea, Moldova, Malaysia, Peru, Poland, Romania, Czechoslovakia, Syria, Yemen, and Yugoslavia. The Fulcrum-C adds increased jamming capability and extra fuel in a raised spine, and the Fulcrum-D adds these features and a laser designator. Of the three wing hardpoints, the two inner ones may only be used for drop tanks.

The MiG-29B (Fulcrum-A) is the basic model; it has advanced search and attack avionics, but is not especially suited for ground attack. The MiG-29SD (Fulcrum-A2) adds a FLIR and some additional avionics at the expense of some cannon ammunition. These are mostly installed in a "fatback" avionics hump behind the fuselage. The MiG-29S (Fulcrum-A3) miniaturizes some avionics, adds more, and 70 liters of extra fuel is also squeezed in. The MiG-29SE (Fulcrum-A4) was produced primarily for export; it does not have the "fatback," but does have a lot of the same attack capability. The MiG-29S2 (Fulcrum-C) adds an additional active jamming ECM capability as well as an air-to-ground mode similar to that of the US F/A-18. The MiG-29SM (Fulcrum-C2) adds considerable ground attack capability with a laser designator and equipment for guiding other types of PGM. The MiG-29K (Fulcrum-D) was designed for carrier use, with the ability to use a ski-jump type takeoff if needed. It also has more powerful engines. The MiG-29M (Fulcrum-E) is the most up to date version; it has a glass cockpit, and up-to-date electronics and avionics.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
MiG-29B	$28,484,280	AvG	3 tons	17.72 tons	1	36	Radar, VAS	Enclosed
MiG-29SD	$30,162,750	AvG	3 tons	17.72 tons	1	36	Radar, VAS, FLIR	Enclosed
MiG-29S	$31,473,790	AvG	4 tons	19.7 tons	1	36	Radar, VAS, FLIR	Enclosed
MiG-29SE	$28,448,640	AvG	3 tons	17.72 tons	1	38	Radar, VAS	Enclosed
MiG-29S2	$30,891,930	AvG	4.01 tons	19.7 tons	1	38	Radar, VAS, FLIR	Enclosed
MiG-29SM	$57,891,610	AvG	4.01 tons	19.7 tons	1	33	Radar, VAS, FLIR	Enclosed
MiG-29K	$33,282,540	AvG	4 tons	19.7 tons	1	38	Radar, VAS, FLIR	Enclosed
MiG-29M	$77,442,200	AvG	5 tons	21.05 tons	1	33	Radar, VAS, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
MiG-29B/SD/SE	4800	1200 (100)	NA 300 10/6 100/60	4300	8525	18000	FF6 CF6 RF6 W5 T5
MiG-29S	4800	1200 (100)	NA 300 10/6 100/60	4376	8525	18000	FF6 CF6 RF6 W5 T5
MiG-29S2/SM	4800	1200 (100)	NA 300 10/6 100/60	4616	8525	18000	FF6 CF6 RF6 W5 T5
MiG-29K	5189	1297 (100)	NA 324 10/6 100/60	6419	9283	18000	FF6 CF6 RF6 W5 T5
MiG-29M	5189	1297 (100)	NA 324 10/6 100/60	4980	9283	18000	FF6 CF6 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
MiG-29B	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 1, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan	700/500m Hardened Runway	+2	2x30mm NR-30 Autocannons, 7 Hardpoints	300x30mm
MiG-29SD	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 1, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan	700/500m Hardened Runway	+2	2x30mm NR-30 Autocannons, 7 Hardpoints	240x30mm
MiG-29S	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 1, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan, Multitarget (2)	700/500m Hardened Runway	+2	2x30mm NR-30 Autocannons, 7 Hardpoints	240x30mm
MiG-29SE	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 2, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan, Active Jamming	700/500m Hardened Runway	+2	2x30mm NR-30 Autocannons, 7 Hardpoints	300x30mm
MiG-29S2	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 2, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan, Multitarget (2)	700/500m Hardened Runway	+3	2x30mm NR-30 Autocannons, 7 Hardpoints	240x30mm
MiG-29SM	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 2, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan, Active Jamming, Laser Designator	700/500m Hardened Runway	+3	2x30mm NR-30 Autocannons, 7 Hardpoints	240x30mm
MiG-29K	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 2, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan, Multitarget (2)	700/500m Hardened Runway	+3	2x30mm NR-30 Autocannons, 7 Hardpoints	240x30mm
MiG-29M	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 3, Auto Track, HUD, IR Uncage, Look-Down Radar, Track while Scan, Active Jamming, Multitarget (2), Laser Designator	700/500m Hardened Runway	+4	2x30mm NR-30 Autocannons, 7 Hardpoints	240x30mm

SU-27 Flanker

Notes: The Flanker is one of the most advanced Russian aircraft, and is optimized for long missions. It has an ejection seat and is capable of in-flight refueling. Wingtip stations may only carry air-to-air missiles or electronics pods.

The Su-27 (Flanker-A) is the base fighter, optimized for interception and dogfighting. It is almost in a class with Western contemporaries like the F-15, F-14, or Tornado ADV, but suffers due to the shorter range of its radar. The Su-30 is a two-seat interceptor version of the Su-27; it has the ability to interface directly with other Flankers, ground radars, and AWACS aircraft. It is often referred to as a “Command Fighter.” The Su-30M (Flanker-C) is a similar concept to the F-15E Strike Eagle, being a strike aircraft with equal air-to-air capability. The Su-30MK is the export model, but except for minor modification required by customers, it is the same as the Su-30.

The Su-33 (Flanker-D) is a naval version of the Su-27 Flanker. Modifications include folding wings, strengthened undercarriage, and canard wings to increase lift and increase maneuverability.

The Su-35 (Flanker-G) is an Su-27 with more powerful engines, canards above the intake for improved handling, the rear pod of the Su-34, and overall improved performance. It may fire weapons rearward, due to the rear “stinger” equipped with short-ranged radar and RLIR. The pilot has a glass cockpit and the seat is inclined 30 degrees to help fight GLOC. The two wingtip hardpoints may only be used for AAM or electronics pods. It is built with lighter engines and lighter materials. It is capable of in-flight refueling and the pilot has an ejection seat.

The Su-37 (Flanker-H) is a further evolution of the Su-35. It is equipped with variable-geometry exhaust nozzles that allow the aircraft to achieve “supermaneuverability.” It is capable of maneuvers few other aircraft in the world can manage.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Su-27	$129,026,660	AvG	6 tons	30 tons	1	39	Radar	Enclosed
Su-30	$136,926,250	AvG	6 tons	31 tons	2	39	Radar	Enclosed
Su-30M/MK	$136,721,060	AvG	8 tons	33 tons	2	39	Radar, FLIR	Enclosed

Su-33	$134,091,810	AvG	6.5 tons	30 tons	1	39	Radar, FLIR	Enclosed
Su-35	$179,455,960	AvG	8 tons	34 tons	1	42	Radar, FLIR, VAS, RLR, RLIR	Enclosed
Su-37	$189,225,540	AvG	8 tons	34 tons	1	46	Radar, FLIR, VAS, RLR, RLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
Su-27/30/30M/30MK	5758	1439 (125)	NA 360 8/6 80/60	6413	14190	17500
Su-33	5317	1329 (115)	NA 332 9/7 90/70	6413	14190	17000
Su-35	5758	1439 (110)	NA 360 10/7 100/70	13860	17429	18000
Su-37	5964	1491 (90)	NA 373 12/7 120/75	13860	18114	18800

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Su-27	All-Weather Flight. RWR, Flare/Chaff Dispensers, ECM 2, Deception Jamming, Auto Track, HUD Interface, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios	670/550m Hardened Runway	+2	2xGSh-30 30mm Autocannons, 10 Hardpoints	150x30mm
Su-30	All-Weather Flight. RWR, Flare/Chaff Dispensers, ECM 2, Deception Jamming, Auto Track, HUD Interface, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios, Multitarget (2)	670/550m Hardened Runway	+3	2xGSh-30 30mm Autocannons, 10 Hardpoints	150x30mm
Su-30/30MK	All-Weather Flight. RWR, Flare/Chaff Dispensers, ECM 2, Deception Jamming, Auto Track, HUD Interface, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios	670/550m Hardened Runway	+3	GSh-301 30mm-3 Autocannon, 10 Hardpoints	150x30mm
Su-33	All-Weather Flight. RWR, Flare/Chaff Dispensers, ECM 2, Deception Jamming, Auto Track, HUD Interface, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios	670/550m Hardened Runway	+3	GSh-301 30mm-3 Autocannon, 10 Hardpoints	150x30mm
Su-35	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 3, Auto Track, HUD, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios, Multitarget (6), TFR	670/550m Hardened Runway	+4	GSh-301 30mm-3 Autocannon, 12 Hardpoints	150x30mm
Su-37	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM 3, Auto Track, HUD, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios, Multitarget (6), TFR, VG Nozzles, Active Jamming	600/500m Hardened Runway	+4	GSh-301 30mm-3 Autocannon, 12 Hardpoints	150x30mm

Yak-38 Forger

Notes: This was Russia's first operational VTOL combat aircraft, and the second one operational in the world. The Yak-38 is a very difficult aircraft to fly, especially so in VTOL mode, and landings and takeoffs in VTOL mode are one level more difficult than normal. The Forger is a very fuel hungry aircraft and range is limited. Unlike the Harrier, the Forger is not capable of VIFF flight.

The Yak-38 (Forger-A) is the basic model. Load is limited to 800 kg in Vertical Takeoff mode. The Forger-A has no “wet” hardpoints; i.e., hardpoints that can carry external drop tanks. The Yak-38U (Forger-B) is a two-seat version of the Forger-A, normally used for transition training, but also useful as a FAC aircraft. The Yak-38M (Forger-C) is an improved model with an uprated engine.

Twilight 2000 Notes: The Forger was being phased out of Russian service before the Twilight War in favor of the Yak-141 due to its many shortcomings, but as the Twilight War intensified, they were recalled to duty.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Yak-38	$50,882,730	AvG	1.36 tons	13 tons	1	30	Radar, FLIR	Enclosed
Yak-38U	$51,466,490	AvG	1.36 tons	13.3 tons	2	30	Radar, FLIR	Enclosed
Yak-38M	$51,208,030	AvG	1.36 tons	13.6 tons	1	30	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
Yak-38/Yak-38U	2020	505	NA 126 5/3 50/30	3465	3518	12000

Yak-38M	2420	605	NA 151 5/3 50/30	3465	4177	12000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	Radar Warning Receiver, Flare/Chaff Dispensers, HUD, Laser Designator	18m (VTOL), 450/500m (STOL), Primitive Runway	+2	GSh-30 30mm Autocannon, 4 hardpoints	250x30mm

<u>Yak-141 Freestyle</u>

Notes: This is the successor to the Yak-38 in Russian service, and is a much better aircraft. It is capable of VIFF flight, and the instability in VTOL mode that caused so many crashes has been solved. The Freestyle has better avionics and radar comparable to the MiG-29. The aircraft is composed largely of carbon fiber and aluminum-lithium alloys to reduce weight and increase strength. Load is limited to 1 ton in Vertical Takeoff mode.

Twilight 2000 Notes: Before the Twilight War, some air forces in Asia and Latin America were interested in the Yak-141, but few, if any were sold outside of Russia.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$57,587,650	AvG	2.6 tons	19.5 tons	1	44	Radar, FLIR	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
3600	900	NA 225 7/4 70/40	5544	5201	15000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, Flare/Chaff Dispensers, HUD, Auto Track, ECM 2, IR Uncage, Look-Down Radar, Track While Scan, Laser Designator	20m (VTOL), 450/500m (STOL), Primitive Runway	+3	GSh-30 30mm Autocannon, 5 Hardpoints	250x30mm

J-35 Draken

Notes: The Draken was Sweden's first supersonic fighter, first flying in 1955. It has remained in service with Sweden, as the Gripen never fully replaced it, and with Austria, Denmark, and Finland. The version shown here is the multirole version, with a strike capability and use as an air-to-air fighter. The Draken is known for its rough field and small field performance, often operating from roadways. The seat is tilted back 30 degrees to help fight GLOC.

The J-35A is the base model. In the late 1950s, the Swedes developed one of the first integrated defense networks in the world; the J-35B was the first model of the Draken compatible with this network, and had a datalink system to link it to that network. The J-35C was a trainer based on the J-35A. The J-35D featured a new, more powerful engine, and a more effective radar set, as well as more fuel. The J-35E is a reconnaissance model of the J-35D. The J-35F was a substantially improved J-35D, with an improved afterburner, greatly increased fuel capacity, and improved electronics. One cannon and its ammunition have been replaced with the additional avionics. The J-35F-2 adds a FLIR. The J-35J is a further upgraded J-35F-2. The F-35 is an export model for the Danish Air Force; this version adds a laser designator and removes the capability to fire radar-homing missiles. The “missing” cannon is restored,

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
J-35A/B	$25,560,110	AvG	1.7 tons	10.09 tons	1	18	Radar	Enclosed
J-35D	$26,783,960	AvG	2.2 tons	11.86 tons	1	22	Radar	Enclosed
J-35F	$41,014,060	AvG	2.5 tons	12.07 tons	1	26	Radar	Enclosed
J-35F-2	$49,471,030	AvG	2.5 tons	12.07 tons	1	28	Radar, FLIR	Enclosed
J-35J	$54,099,520	AvG	2.9 tons	12.27 tons	1	30	Radar, FLIR	Enclosed
F-35	$32,865,040	AvG	4.09 tons	12.27 tons	1	22	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
J-35A/B	4250	1063 (120)	NA 266 6/3 60/30	2240	2329	19810
J-35D	4900	1225 (120)	NA 306 6/3 60/30	2920	3269	19810
J-35F/F-2/J/F-35	4900	1225 (120)	NA 306 6/3 60/30	4100	3269	19810

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
J-35A/B	RWR	600/550 Primitive Runway	+2	2x30mm Aden Autocannons, 5 Hardpoints	180x30mm
J-35D	RWR, HUD	600/550 Primitive Runway	+2	2x30mm Aden Autocannons, 5 Hardpoints	300x30mm
J-35F/F-2/J	RWR, HUD, Auto Track, IR Uncage	600/550 Primitive Runway	+3	30mm Aden Autocannon, 5 Hardpoints	150x30mm
F-35	RWR, HUD, Auto Track, IR Uncage, Flare/Chaff Dispensers, Laser Designator	600/550 Primitive Runway	+3	2x30mm Aden Autocannon, 8 Hardpoints	300x30mm

J-37 Viggen

Notes: The Viggen was the Swedish's mainstay aircraft for about 20 years, and was still in common use. This version is an all-weather strike aircraft that retains its air-to-air capability. The Viggen is capable of operating from rough airstrips and short fields, and it has a short landing run since it is one of the few fighter aircraft with a thrust reverser.

The first version, the JA-37, was designed primarily as an interceptor. As such, it is optimized for the fighter role. The AJ-37 is a strike variant, with a different avionics package and no internal gun. The AJS-37 is an upgraded Viggen that blends the JA-37 and AJS-37 into one multirole aircraft; however, the primary reason for the upgrade was to make it compatible with newer weapons.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
JA-37	$38,267,230	AvG	3.6 tons	17 tons	1	26	Radar	Enclosed
AJ-37	$39,445,150	AvG	6 tons	18 tons	1	26	Radar, FLIR	Enclosed
AJS-37	$43,915,800	AvG	6 tons	17.6 tons	1	30	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
(All)	4250	1063 (110)	NA 266 7/4 70/40	3660	5318	18000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
JA-37	All Weather Flight, RWR, Auto Track, HUD	600/350m Primitive	+3	30mm KCA	150x30mm

	Interface, IR Uncage, Look-Down Radar, Track While Scan	Runway		Autocannon, 7 Hardpoints	
AJ-37	All Weather Flight, RWR, HUD Interface, Auto Track	600/350m Primitive Runway	+3	7 Hardpoints	None
AJS-37	All Weather Flight, RWR, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Track While Scan, Laser Designator, Flare/Chaff Dispensers	600/350m Primitive Runway	+3	30mm KCA Autocannon, 7 Hardpoints	150x30mm

JAS-39 Gripen

Notes: This was Sweden's new fighter at the start of the Twilight War. It has replaced the Draken in Swedish service, but not the Viggen. It is an agile and advanced aircraft able to fulfill both fighter and attack missions.

The first version was the JAS-39A. It was then upgraded to the JAS-39C configuration, with two dedicated semirecessed AMRAAM mounts under the fuselage, a FLIR, and higher G-loading with heavy loads. In both cases, the two wingtip hardpoints may be used only for air-to-air missiles.

Twilight 2000 Notes: The Gripen was used by Sweden and South Africa during the Twilight War, and a few demonstrator models were also flown by Hungary. Most of the Gripens used during the Twilight War were JAS-39As.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
JAS-39A	$44,763,580	AvG	4.68 tons	12.5 tons	1	24	Radar	Enclosed
JAS-39C	$47,301,400	AvG	5.3 tons	14 tons	1	25	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
(Both)	4900	1225 (95)	NA 306 9/5 90/50	3000	3787	16800

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
JAS-39A	All Weather Flight, Radar Warning Receiver, HUD, IR Uncage, Look-Down Radar, Multitarget (4), Track While Scan, Target ID, Terrain Following Radar, Auto Track	750/700m Hardened Runway	+4	27mm Mauser Autocannon, 7 Hardpoints	300x27mm
JAS-39C	All Weather Flight, Radar Warning Receiver, HUD, IR Uncage, Look-Down Radar, Multitarget (4), Track While Scan, Target ID, Terrain Following Radar, Auto Track, Flare/Chaff Dispensers	750/700m Hardened Runway	+5	27mm Mauser Autocannon, 9 Hardpoints	300x27mm

IDF Ching-Kuo

Notes: Named after a former Taiwanese president, the IDF (Indigenous Defense Fighter) was first designed when the US attempted to placate China in the late 1970s by cutting off some arms shipments to Taiwan, including the F-16. The Ching-Kuo looks like a composite of several of its contemporaries; the nose and much of the avionics are based on those of the F-20 Tigershark, the wings and tail surfaces are based on those of the F-16, the engines and intakes are based on those of the F/A-18, and the fuselage is partly based on the F-16 and F/A-18. Avionics are advanced, with both air-to-air and air-to surface modes. The primary weakness of the Ching-Kuo is its engines, which, though large in size, are somewhat underpowered, and performance is below what a fighter of its class should be. The two wingtip hardpoints may only be used for heat-seeking air-to-air missiles or Sidearm antiradar missiles.

Twilight 2000 Notes: After the Taiwan Relations Act was enacted and arms shipments to Taiwan resumed, work on the Chin-Kuo slowed, but continued, and with the storm clouds of war brewing in the early 1990s, and the knowledge that the US would soon be engaged elsewhere, the Ching-Kuo project was stepped up and within a few months production versions were being rapidly turned out.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$33,967,410	AvG	3.9 tons	12.25 tons	1	24	Radar	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
3542	886 (120)	NA 221 10/5 100/50	3815	3659	16760

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Secure Radios, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, Auto Track, HUD, IR Uncage, Look-Down Radar, Track While Scan, Target ID	765/510m Hardened Runway	+4	20mm Vulcan, 7 Hardpoints	300x20mm

McDonnell-Douglas F-4 Phantom II

Notes: The Phantom II, one of the most ubiquitous fighters in the free world during its service, was conceived to fly a totally different mission than it eventually found itself in – as a high-speed, high-altitude interceptor for US carrier battle groups. However, it found itself largely in a role it was not designed for – turn-and-burn dogfighter. And, especially in the skies of North Vietnam, only the skill and bravery of pilots and aviators made the kill-to-loss ratio in the Vietnam War less than one might think. The first operational deployment of the Phantom was in December 1960, then designated by the US Navy the F4H-1. By August 1964, 13 of the US Navy's fighter squadrons were equipped with the Phantom, now designated the F-4B. In US service, the last Phantom in service, an F-4S in a Marine squadron, was replaced by an F/A-18A in January 1992. Subsequent use of the Phantom by the US included research aircraft by NASA and a rather ignoble end as aerial targets. The Phantom is or was operated by 12 other air forces or navies, but only parts or refurbished aircraft from AMARC are sold now. Iran, South Korea, Japan, Egypt, Greece, Spain, and Turkey still use the Phantom (mostly F-4E-based versions), and the Luftwaffe still operates a small number of them.

The Phantom – The Beginning

The first glimmer of a thought for the Phantom II began in the mid-1950s, as an improved version of the F-3H Demon naval fighter. However, the Navy was more interested in a high-speed interceptor than an improved dogfighter/ground attack aircraft like the F3H-G Demon. After lots of design work, and radically-redesigned aircraft was shown – The XF4H-1 Phantom II. (The first Phantom was the end-of-World-War-2 FH-1, which did not have performance any better than the piston-engined fighters of the period and was not proceeded with.) Though the original mock-up of the XF4H-1 had a pair of 20mm cannons in the wing roots, the Navy decided these were unnecessary in an interceptor and they were deleted before the first flight. This was also the time before Vietnam, when the Navy and Air Force felt that guns on a fighter were obsolete. McDonnell-Douglas also gave the Navy a one-seater Phantom and a two-seater Phantom to choose from – in the end, once again for the Phantom's role as an interceptor, the two-seat version was chosen, with the back-seater being a RIO, operating the radar and long-range weapons. As a technology demonstrator, the XF4H-1 was armed only with four of the new AIM-7 Sparrow missiles. However, the XF4H-1 prototypes set several speed, range, altitude, and climb records for the time. Some evaluation and test Phantoms were retroactively given the designation F-4A, but these did not see service.

The Early Phantom

When the F4H-1 came into service, the Navy and Marines were eager to find out what their new fighter could do. The Phantom had six wing and one fuselage hardpoints, as well as the four Sparrow semi-recessed hardpoints. They discovered that the F4H-1 could haul a lot of munitions, including extra missiles or even air-to-ground ordinance. The F4H-1 was fitted with TACAN (Tactical Air Navigation), a radio compass, a radar altimeter, an air data computer (simple by today's standards), ISS, and a 3-channel-capable UHF long-range radio. They also discovered that the RIO had almost no ability to see ahead of the aircraft, and his controls were removed. The Phantom was designed with maintenance in mind, with a total of 199 access doors and engines that could be removed as a set on a wheeled stand. The radar set (which was a problem child at the time) could also be slid out on rails for servicing. The Phantom had radar and also an early IRST (Infrared Search and Tracking) which could provide direction to a target but not range. Some 10% of the Phantom was built from titanium, a new aircraft technology at the time. The engines of the Phantom, now called the F-4B, were either a pair of J79-GE-2s and later J79-GE-2As, both of which provided 10,350 pounds of thrust per engine or 16,150 pounds of thrust per engine in afterburner. The 46th production aircraft introduced the J79-GE-8 engines, with 10,900 pounds thrust each or 17,000 pounds thrust each in afterburner. The 19th production aircraft gave the Phantom the AN/APQ-72 radar; while it was more powerful and able, it resulted in the drooped nose characteristic of early Phantoms. Other systems included carrier landing equipment that was fitted by making one of the fuel tanks in the fuselage a little smaller. The F-4B was introduced with an ECM/ECCM suite, one of the first.

The F-4C was the Air Force's first Phantom. The Air Force originally designated this aircraft the F-110 Spectre, but changed the designation under orders from Robert McNamara. The first flight was in May 1963. The F-4C had a number of commonalities with the F-4B (even down to retaining the arresting gear and folding wings). The F-4C used J79-GE-15 engines; though they were only slightly uprated from the F-4B's engines (not enough to be useful in *Twilight 2000* rules), used a pyrotechnic cartridge engine start system that gave it self-starting capability. The aerial refueling arrangements of course changed, to match Air Force tankers. The tires were wider tread and lower pressure, as the F-4C would be operating from land runways instead of hard carrier decks. The drooped nose allowed the back seater (called a WSO in the Air Force) good enough forward vision that he could effectively fly the plane, and so controls were installed in the rear seat. (The higher back seat position was later adopted for all Phantoms.) The F-4C carried the more powerful AN/APQ-100 radar and a better visibility for instruments. Long-range navigation was taken up by an inertial navigation system, and an AN/ABJ-7 bombing system was added. Electronics allowing the control of the command-guided Bullpup AGM was also introduced and integrated with the F-4C's bombing system. The ECM/ECCM suite was deleted; the result were adapters that allowed the forward Sparrow missile hardpoints to carry certain ECM/ECCM pods or flare/chaff dispensers. When first deployed to Vietnam, the F-4C developed corrosion and problems with the humidity and its effects on the electronics of the F-4C, as well as fuel leaks. These problems were addressed by the end of 1965.

The F-4D was basically an improved version of the F-4C, built for the Air Force. Primary improvements lay in the electronics suite. The radar was replaced with the AN/APQ-100 with the addition of solid-state components, reducing the weight and complexity of the system. New attack and navigation systems were added which were more reliable. Finally, the F-4D was the first Phantom to regularly carry gun pods, usually on the centerline (though some instances of F-4Ds carrying three pods existed). The pod was an SUU-23/A, which was a Vulcan electrically-powered gun pod. The F-4D was provided with a special gunsight for the pod. The IRST was deleted for most of the F-4D's production run; however, an RWR was added. When first deployed, the F-4D was unable to use the Sidewinder heat-seeking missile; as a result, F-4Ds went to Vietnam for a while equipped with Falcon heat seeking missiles. This was quickly rectified, and the F-4Ds were carrying Sidewinders in less than a year after their introduction.

In 1962, the US Air force decided to replace their RF-101 Voodoos in the reconnaissance role (though the RF-101 served on for several more years in Vietnam). The platform chosen was the F-4C, and the result was the RF-4C. The IRST system was removed, and radar downgraded, and the RF-4C fitted with a plethora of photoreconnaissance and ELINT gear, including three sets of cameras, SLAR (Side Looking Airborne Radar), a Moving Target Indicator that picked out moving targets in the cameras' fields of view and marked them on the film, an IR Line Scanner that added heat mapping to the film, a Radar Homing and Warning System which marked radio and radar emitters on the film, and mechanisms to mark date, time, and altitude on the film. The RF-4Cs inertial navigation system was substantially upgraded, and the radios replaced with longer-ranged HF radios. In addition, high-resolution night photos could be taken through the use of photoflash dispensers (essentially large flares). However, the RF-4C had it's Sparrow missile hardpoints faired over, fire control systems removed, the pilot's gunsight replaced with an aiming pointer for film shots, and the radar set replaced with a simplified set that was used for navigation only. Following the Vietnam War, an upgraded ELINT suite was installed.

In 1965, the McDonnell-Douglas fitted an RF-4C's nose and avionics to F-4Bs, producing the RF-4B. Except for systems peculiar to the F-4B, the RF-4B was for game purposes the same as an RF-4C. Later, the same was done to the F-4E, producing the RF-4E; however, the RF-4E was built exclusively for export sales, and not used by the US. After Vietnam, all these aircraft received substantial upgrades in avionics, including their photo and ELINT suites, a datalink, increased numbers of flares and chaff bundles carried, and structural strengthening. Seemingly forgotten in all this was the back-seater; he had little do except navigate and monitor the automatic photo reconnaissance and ELINT suites.

The F-4E – The Phantom Gunfighter

Even as the Phantom came into service, there was grousing about the lack of a gun in the Phantom. The fighter pilots knew what the Pentagon seemed to not to want to know – that ranges in dogfights could shrink so much that missiles (especially the missiles of the time) could not be launched at an enemy aircraft because the target aircraft was inside the minimum range of the missile. This would lead to a missile shot that never armed or never guided properly. The Navy and Marines felt they still didn't need a gun on their Phantoms, but Air Force pilots were persistent and were not going away on the gun issue. In response, McDonnell-Douglas modified the Phantom into the F-4E. This version was the most produced Phantom, and in addition to the US Air Force, virtually every foreign buyer opted for F-4E-based Phantoms.

Early modifications included new J79-GE-17 engines, with the same dry thrust as the F-4C, but 17,900 pounds thrust each available on afterburner. The F-4E was the first Phantom II to receive leading-edge combat slats to improve maneuverability. These slats were not fitted until 1972, and earlier F-4Es use the Maneuverability ratings of the F-4D. In addition, a combat slat was added to the all-moving tailplane to aid in turning further. The ejection seats were changed to the new Martin-Baker "zero-zero" ejection seats; this meant that the crew could eject, if necessary, when the F-4E was standing on the runway. Another fuel tank was added in the tail above the engine nozzles; it was not a big tank, but helped. The wings of the F-4E could not be folded hydraulically; instead, they were folded manually by ground crews. The signature feature of the F-4E was, of course, the M-61 Vulcan Gatling gun mounted in the nose. This made lengthening the nose necessary, along with the fitting of the more compact (but just as powerful) AN/APQ-120 radar.

The F-4E also addressed two serious problems with the Phantom; a tendency to go into a flat spin when wrapped up in tight turns; these spins were almost unrecoverable. This was fixed by the combat slats. In addition, the use of the Phantom as a dogfighter led to premature wing metal fatigue. Earlier Phantoms went through an expensive strengthening; the F-4E has that strengthening from the start. Late in F-4E production, the TISEO (Target Identification System Electro-Optical) system was F-4Es. The system was essentially a long-range camera, and it was designed to defeat the Visual ROE (where US aircraft had to send one of their number ahead to eyeball the target and make sure it was a bogey) and allow the Phantom to shoot its Sparrows from a longer range. Most foreign F-4Es did not have TISEO.

Late-Model US Phantoms

The Navy still did not see the need for an internal gun on their Phantoms, but they were impressed with the F-4E's maneuverability. So they came up with something like an F-4E, but with no cannon and some other improvements, designating it the F-4J. These entered service not long after the F-4E. F-4Js had the combat slats on the wings and tail, the Martin-Baker zero-zero ejection seats, and the strengthened airframe and wings. The F-4J also had new avionics and radar gear, a new fire control system (including an improved ground attack/bombing system), a data link for automatic carrier landings, and an RWR. The radar was a solid-state system capable with Track While Scan and "Look Down, Shoot Down" capabilities. The radar set was powerful, with a range of over 60 kilometers. The engines, however, required external power to start them, not normally a problem on a carrier or a land base. Randy Cunningham and Willie Driscoll, the top scoring US aces from the Vietnam War, did their work in an F-4J.

The Navy and Marines chose to update their F-4Js; the upgraded aircraft was designated the F-4S. Perhaps the best upgrade on the F-4S was a problem that plagued previous Phantoms: All other engines of Phantoms produced a thick, oily smoke trail, visible for miles. It led to the North Vietnamese referring to Phantoms as "smokers." The F-4S's modified J79-GE-10B engines did not produce this smoke trail. The F-4S retained the combat slats of the F-4J, but had a digital, long range, improved radar set. The F-4S was the last Phantom used by the US, present in squadron service with the Marines until 1992.

By 1970, the Navy and Marines were becoming concerned about the geriatric nature of their F-4Bs. So under Project Bee Line, 228 F-4Bs were upgraded and modified into a new version of the Phantom, the F-4N. The first thing addressed was structural strength and wear condition. The electrical system got a big upgrade, including a 30 kVA generator to keep constant electrical power to the aircraft. The F-4N did not get most of the benefits of later Phantoms, such as combat slats on the wings; they simply did not mix with the F-4B-based airframe. The F-4N had one feature very rare among Phantoms – a deception jamming system. There are long fairings on the fuselage sides and top for the antennas required for much of the F-4Ns avionics. The F-4N had RWR, both to warn the crew and activate the deception jamming system. The F-4N's crew received a primitive helmet-sight interface, as well as Target ID and IR Uncaging features. Improved IFF was fitted, plus a datalink. The engines of the F-4B were retained, though smoke abatement equipment was added. The radar and IRST of the F-4B were retained, along with the ECM/ECCM suite. The F-4N had a rather short service life, with service ending in 1985, though some were converted to the F-4S configuration.

A Phantom of a Different Kind – The F-4G Wild Weasel Variant

In the Vietnam War, the US Air Force began to use specially-modified aircraft and specially-trained crews whose job it was to act as "SAM Bait" – get the North Vietnamese Air Defense to turn on its radars and keep them on long enough to fire antiradar missiles at the radar transmitters and take them out of the fight. Though the first Wild Weasel aircraft was a modified F-100, and the burden of Wild Weasel duties in Vietnam were done by the F-105F, towards the end of the war another Wild Weasel took to the skies – the F-4G, based on the airframe of the F-4E. F-4Gs continued to service the Air Force as late as the early phases of Operation Iraqi Freedom.

Again, the primary modifications to make an F-4G were in the nose, though new avionics were spread all over the aircraft. The nose cannon was replaced by special sensors to detect radar and radio emissions; 52 antennas for this system were spread all over the aircraft. The F-4G crew could use this system to pinpoint and target antiradar missiles or smart cluster bombs. Originally, the F-4Gs primary armament was the Shrike ARM, but when the HARM became available, this became the standard. However, some F-4Gs in Desert Storm and Operation Iraqi Freedom found themselves carrying Shrikes due to shortages. The F-4G had no shortage of flares and chaff bundles, and the forward Sparrow missile recesses were taken up by an ECM pod and an IRCM pod, adding to internal ECM/ECCM and IRCM. The F-4G can use Sparrow and Sidewinder missiles, but it was far more common for it to carry more ECM, IRCM, or Flare/Chaff pods or antiradar missiles and ordnance.

British Phantoms

The first foreign users of the Phantom were the British; the Royal Navy began using them on their carriers in the 1966s. By 1978, The Phantom was out of service by both the RN and RAF. The British Government felt that it was cheaper to buy foreign weapons than to develop their own weapons and aircraft. (Unfortunately, this meant that many promising British weapons and aircraft were cancelled or not proceeded with.) The first British version was designated the F-4K by the US and the FAA FG.1 by the Royal Navy, and entered service in 1965. In an interesting turn of events, there was not enough room on Britain's carriers for all 56 FG.1s they ordered; 14 FG.1s were actually used by the RAF until the mid-1970s. The FG.1 was derived from the F-4J, but substantial changes were made to the aircraft at the request of the Royal Navy. The only Royal Navy unit to fly the Phantom was No. 892 squadron aboard the *Ark Royal.*

The FG.1 had an AN/AWG-11 radar, roughly equivalent to the F-4J's AN/AWG-10 radar in game terms, but the entire nose/radar assembly could be swing completely sideways alongside the aircraft, to fit on a British carrier's smaller elevators. The engines were probably the biggest change; they were Rolls Royce Spey 202/203 turbofans with a dry thrust of 12,250 pounds thrust each and 20,515 pounds of thrust each in afterburner. The nose strut was much longer than on US Phantoms, giving the FG.1 a higher angle-of-attack when taking off from the *Ark Royal's* shorter flight deck; the higher thrust of the engines also assisted in this. The struts were of variable height, to allow for landings at land bases or US aircraft carriers. The strut could be raised as much 15.75 centimeters. Another nod to the short decks of British carriers was a variable-angle horizontal stabilators, again to accommodate the higher nosewheel strut. The Spey 202 provided a massive increase in engine power, but also required more air to operate, and the air intakes were enlarged to fulfill this. The FG.1 ceased operations in the Royal Navy in late 1969, in favor of the Harrier. Note that the FG.1 not only did not have an internal gun, it could not carry a gun pod. FG.1s transferred to the RAF had this problem rectified and could carry one gun pod centerline.

The FGR.2s (US designation F-4M) also modified F-4Js; the copies sold to the British were chosen by the US from F-4Js who had the lowest time. The British carrier force was shrinking at the time, and only 29 FGR.2s were ordered by the British. The surviving FG.1s were assigned to the RAF 111 Squadron, along with the FGR.2s. The FGR.2 used the same base radar set as the FG.1, but the version used by the FGR.2 was European-built by Ferranti and could interface with the inertial navigation feature of the FGR.2. The new radar system also gave the FGR.2 Multitarget capability as well as Track While Scan and Look Down, Shoot Down capabilities. Improvements to the inner wing hardpoints allowed the FGR.2 carry external gun pods. Other improvements included anti-skid brakes for the landing wheels. Though the combat slats were retained on the wings, the tail slotted combat slat was eliminated. The ASM-46 computer was added to give the FGR.2 inertial navigation ability. The surviving FGR.1s flew their last flight (except for the occasional air show) in 1989, and were replaced by the Jaguar and the Lightning.

The FGR.2 were used in reconnaissance role at well. For this role, the FGR.2 used a special EMI pod equipped with cameras looking in all directions. The pod also contained an IR linescan device and SLAR. The pod's film cameras could mark moving and stationary targets. In addition, three additional cameras or sensors could be added to the pod as long as they were not large. This pod was normally carried centerline. The F-4M had a RWR installed.

The Japanese F-4EJ

The Japanese F-4E, named F-4EJ in Japanese service, was essentially a stock F-4E. However, in 1984, the Japanese started an upgrade program on the F-4EJs, resulting in the F-4EJ Kai. ("Kai" means "Augmented" in Japanese.). First attention was given to the radar; The Kai used the Westinghouse AN/APG-66J Pulse-Doppler radar. The new radar was smaller and lighter, yet easier to service; this offered room for Multitarget, Track While Scan, and Look Down, Shoot Down capabilities which were unique in 1984 in their power and resistance to ECM. The aircraft was also equipped with an advanced HUD, IFF system, and inertial navigation capabilities. Moreover, the Kai had a pair of small, low power, and short-range radar sensors to augment observation. The radios (two UHF long-range data-capable) and a medium-range, also data-capable), had large external antennas, including a large blade-type at the middle of the fuselage behind the back-seater. The centerline hardpoint was strengthened for use with the ASM-1 antishipping missile. The centerline also carries the 2109-liter centerline fuel tank normally carried by the F-15. The F-4E's combat slats were not used on the F-4EJ, due to cost.

German Phantoms

The F-4F (at first designated the F-4E(F)) was a greatly simplified version of the F-4E, to achieve the German's wishes to keep costs down, lower maintenance costs, but keep the performance of the F-4E at a high standard. Major components were to be manufactured or assembled in Germany. Perhaps the biggest difference was that the F-4F had no ability to launch or guide radar-homing air-to-air missiles, and all avionics were removed relating to such. The actual radar itself was also greatly simplified. It is strange that though the inflight refueling ductwork was installed in the F-4F, the external arrangements for such refueling were not installed. The slotted tailplane was removed to save costs and weight. The F-4F lacked a poorly-known capability which almost all Phantoms had – the ability to carry nuclear weapons. In addition, the F-4F could not use command-guided weapons or some more advanced weapons such as the Maverick, Shrike (though it could use the HARM) and Walleye. The F-4F was a shadow of its former self, in my mind. 175 were delivered between September 1973 and April 1976.

Between 1980 and 1983, the F-4F's ability to use Sparrow AAMs was returned, and the F-4F gained the ability to use the AIM-9L AAM, as well as the Maverick ASM.

In 1983, the Germans decided that their stripped-down Phantoms weren't getting the job done, and they also wanted the Phantoms to assume some more missions, such as interception and more comprehensive ground attack. Initially, two Phantom squadrons were supposed to get the upgrade and part of a third Phantom squadron, but when JBG 36 changed to the interception role, it was decided to give that squadron a complete refit. The upgrade caused the redesignation to F-4F/ICE (Improved Combat Efficiency), sometimes seen as F-4F+/ICE.

First among the upgrades was for the F-4F to get it's radar spurs back. To this end, the radar was replaced by the Hughes APG-65, which was the original radar installed in F/A-18As. This new radar was a quantum leap for the Phantom, and at the time, gave it the best radar of all Phantoms in service. The radar could guide both AIM-7 and AIM-120 missiles, as well as the Skyflash if necessary. The radar missile interface could eject the missiles into the airstream and ignite the motor in a little over a second. Virtually every F-4F system was upgraded, including the F-4F, the bombing/PGM system, the flare and chaff dispensers, the RWR, the air data computer, and the inertial navigation system (later supplemented with GPS). The cockpit received a complete redo, incorporating the best "glass cockpit" technology of the period.

By the early 1990s, new budgetary pressures arose. Reunification caused drawdowns on virtually the entire German military. The costs of the German participation in the Eurofighter program were spiraling upward, and on top of that, the Eurofighter program was years behind, and many other partner countries were dropping out. The result was an ICE program that upgraded as little as six F-4Fs a year. It did mean that the F-4F has to soldier on for longer than anyone thought it would, that the ICE program was not completed until the early 2000s, and that the Luftwaffe still has F-4F/ICEs in service.

In 1997, DASA of Germany upgraded nearly all of Greece's F-4E Phantom fleet. The result was a Phantom nearly identical to the F-4F/ICE, and called the EPA Phantom. EPA Phantoms normally carry one less Sparrow or AIM-120, filling the hardpoint with a LITENING sensor and targeting pod.

Israeli Phantoms

Between 1969 and 1976, the Phantom was about the most powerful aircraft the IDF had in its arsenal. Though most of the Phantom's roles have been taken over by the F-16 and F-15, the IDF/AF still keeps a number of Phantoms in service, primarily as bomb trucks. (It is believed that if Israel were to deliver a nuclear weapon by aircraft, it would be a Phantom that does it.) Phantom sales and deliveries to Israel were spurred by the Israeli's pyrrhic victory in the 1967 War, and the huge number of aircraft losses they suffered. Before then, the US refused to sell the Phantom to Israel, as it was one of the US's latest aircraft.

The Israeli's Phantoms were based on the F-4E variant. At first, these were stock F-4Es (which the Israelis call the Kurnass), but after the 1969-71 War of Attrition, in which there were a good number of tangles between the IDF/AF and the Egyptian Air Force, the Israelis suffered again many losses, not only to the Egyptian Air Force, but to MiGs flown by Soviet pilots and SAM sites partially manned by Soviet "advisors." At this point, a secret deal led them to the installation of US levels of ECM/ECCM protection, and the larger-capacity flare and chaff ejectors that the US was using over Vietnam. In the 1973 War, the Israelis were almost totally surprised by the Egyptians and Syrians, and this time the Soviets had equipped their allies with even more advanced equipment, especially the new SA-6 SAM. The operating mode of the SA-6 and its speed meant that detecting a launch was critical, and this led to more advanced RWRs on the Phantom and other IDF/AF aircraft. (Reportedly, some of those mods were made while the Phantoms were running hot in the shelters about to pull out on missions. This seems unlikely to me.) ECM was also improved dramatically to account for the wider operating band of the SA-6.

In this way, bit by bit, mostly according to operational needs, the Israeli F-4E were progressively upgraded, along with their weapons capabilities. Often, entire squadron-sized buys and, gifts for lack of a better word, were delivered to Israel on an emergency basis. (Some were fresh off the factory floor.) Radars were improved, ECM and ECCM was improved even further, and more and more Phantoms were carrying advanced electronic warfare pods. Some of these pods sharpened the radar's capability, some provided IRCM or more chaff bundles and flares. Israeli Phantoms through the years were modified to carry more domestically-developed weaponry.

By 1989, Phantom upgrades reached a pinnacle – the Kurnass 2000 upgrade, designed to take the Phantom into the 21st century. When Phantoms were scheduled for D-level overhauls, they were upgraded to the Kurnass 2000 standard instead. One of the core upgrades was a new radar, a multi-mission radar designed around synthetic aperture radar, a system originally designed for the proposed A-6F upgrade and the cancelled A-12. This system gave the Kurnass an air-to-ground/air capability similar to that of the F/A-18C. The system is further improved by use of a mission computer which tells the crew all they need to know and keeps track of ground and air threats and the positions of friendly forces. The system uses the SAR to read the terrain, allowing low-altitude attack and terrain matching to alert the crew if they are getting off target. A GPS system also aids in this, helping the crew to get back on target if, for example, they've had to knock down some bothersome enemy aircraft. Both cockpits have special heads-down displays and glass cockpits, while the pilot has a holographic HUD system. A modern HOTAS system was added, greatly increasing the efficiency of the pilot. Special sighting systems allow the Kurnass 2000 to fire the most modern air-to-air and air-to-ground ordinance.

One upgrade which would have given the Kurnass 2000 a major increase in performance was the replacement of the Phantom's standard engines with Pratt & Whitney PW1120 turbofans. The engines were originally designed for the Israeli's abortive Lavi fighter and were a derivative of the F100 engines used by the F-15 Eagle. These engines had 70% commonality with the F100, and the Israelis were already flying the Eagle. The new engines offered a fantastic increase in performance – the Kurnass 2000 tested with the PW1120s was supercruise-capable and in afterburner could hit almost Mach 3. The PW1120 gave 13,530 pounds of dry thrust and 20,585 in afterburner. Though it was rumored that the existence of operational Lavis and "Super Phantoms" would have jeopardized sales of the F/A-18 and the engine transfer was killed by the US government, it more likely that such an upgrade of the Kurnass 2000 was simply not cost-effective (the engines were expensive), and costs of the Lavi had already spiraled out of control.

The name *Kurnass* is the name used for most Phantoms in the IDF/AF; it means "Heavy Hammer." Israeli RF-4Es are known as *Oref* (Raven). IAI upgraded most of the Turkish F-4E Phantom fleet in the late 1990s, producing a Phantom similar to the German F-4F/ICE. The Turks called the upgraded Phantoms the "Phantom 2020," though their pilots refer to the aircraft as the "Terminator."

Twilight 2000 Notes: By the beginning of hostilities in the Twilight War, a surprising number of Phantoms were operational worldwide. The hardest-working Phantoms were probably the Luftwaffe's F-4F/ICEs and upgraded F-4Fs, which saw every duty from interceptor to armed reconnaissance to close support aircraft. A runner-up would go to Turkish F-4Es, which often struck deep into Iraq, Iran, and the southern Soviet Union and Eastern Europe.

In the Twilight 2000 timeline, the Israeli Kurnass 2000 upgrades were nearly complete; at the beginning of the war, there were even five Super Phantoms in service. The German F-4F/ICE upgrades were only about half complete. The F-4S was in US Navy and Marine service in two squadrons. As the war went on, AMARC was almost totally stripped of Phantoms, many of which were used in CONUS. Four former QF-4s were even converted back to manned F-4Es.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-4B	$85,703,658	JP5	7.27 tons	20.23 tons	2	26	Radar, FLIR	Shielded
F-4C	$77,907,322	JP4	10 tons	22.83 tons	2	28	Radar, FLIR	Shielded
F-4D	$87,424,206	JP4	10.01 tons	22.83 tons	2	26	Radar	Shielded
F-4E/F-4EJ	$93,893,410	JP4	11.98 tons	25.38 tons	2	28	Radar, VAS	Shielded
F-4G	$159,017,543	JP4	11.98 tons	26.47 tons	2	32	Radar, SLAR	Shielded
F-4J	$113,625,602	JP5	9.29 tons	23.25 tons	2	29	Radar, VAS	Shielded
F-4N	$151,829,000	JP5	7.21 tons	26.3 tons	2	30	Radar, FLIR	Shielded
F-4S	$97,654,857	JP5	9.29 tons	23.25 tons	2	29	Radar, VAS	Shielded
FG.1 (F-4K)	$137,753,960	JP5	7.26 tons	26.31 tons	2	29	Radar, VAS	Shielded
FGR.2 (F-4M)	$72,550,120	JP5	9.7 tons	23.76 tons	2	29	Radar, VAS	Shielded
F-4EJ Kai	$51,019,482	JP4	9.58 tons	25.5 tons	2	31	Radar, VAS	Shielded
F-4F	$76,193,684	JP4	12.84 tons	21.95 tons	2	24	Radar	Shielded
F-4F (MLU)	$85,232,327	JP4	12.71 tons	22.08 tons	2	26	Radar	Shielded
F-4F/ICE	$47,004,634	JP4	11.42 tons	23.37 tons	2	31	Radar	Shielded
Kurnass (Upgraded)	$50,037,637	JP4	11.98 tons	25.41 tons	2	28	Radar, VAS	Shielded
Kurnass 2000	$69,416,560	JP4	14.27 tons	28.03 tons	2	34	Radar, VAS	Shielded
Kurnass		JP4	16.77 tons	28.03 tons	2	35	Radar, VAS	Shielded

2000 (Engine Upgrade)

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-4B	3428	686 (130)	NA 206 7/4 50/30	7518	3677	18898	FF6 CF6 RF6 W5 T5
F-4C	3038	609 (130)	NA 179 7/4 50/30	7518	4151	17099	FF6 CF6 RF6 W5 T5
F-4D	3038	548 (130)	NA 179 7/4 50/30	7518	4151	17023	FF6 CF6 RF6 W5 T5
F-4E/F-4EJ/Kurnass (Upgraded)	2734	493 (130)	NA 161 6/4 40/20	7548	4608	18974	FF6 CF6 RF6 W5 T5
F-4G	2621	473 (130)	NA 155 6/4 40/20	7548	4806	18974	FF6 CF6 RF6 W5 T5
F-4J	2983	538 (130)	NA 176 6/4 40/20	7548	4220	16672	FF6 CF6 RF6 W5 T5
F-4N	2637	476 (130)	NA 156 7/4 50/30	7257	4773	15239	FF6 CF6 RF6 W5 T5
F-4S	2983	538 (130)	NA 176 6/4 40/20	7548	4220	16672	FF6 CF6 RF6 W5 T5
FG.1 (F-4K)	3445	621 (130)	NA 203 6/4 40/30	7022	4134	18300	FF6 CF6 RF6 W5 T5
FGR.2 (F-4M)	3814	687 (130)	NA 225 6/4 40/30	7022	3733	18531	FF6 CF6 RF6 W5 T5
F-4EJ Kai	2720	491 (130)	NA 160 7/4 50/30	7548	4631	18974	FF6 CF6 RF6 W5 T5
F-4F	3226	582 (130)	NA 190 6/4 40/20	7548	3885	18974	FF6 CF6 RF6 W5 T5
F-4F (MLU)	3207	579 (130)	NA 189 6/4 40/20	7548	3908	18974	FF6 CF6 RF6 W5 T5
F-4F/ICE	3031	547 (130)	NA 179 6/4 40/20	7548	4135	18974	FF6 CF6 RF6 W5

							T5
Kurnass 2000	2480	496 (130)	NA 162 6/4 40/20	7548	4561	18974	FF6 CF6 RF6 W5 T5
Kurnass 2000 (Engine Upgrade)	4050	730 (130)	NA 239 6/4 40/20	7548	4840	16500	FF6 CF6 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-4B	All-Weather Flight, Flare/Chaff Dispensers (10 Each), ECM 2	1200/800m Hardened Runway	+1	9 Hardpoints	None
F-4C	All-Weather Flight, Flare/Chaff Dispensers (10 Each), ECM 2	1200/800m Hardened Runway	+1	9 Hardpoints	None
F-4D	All-Weather Flight, RWR, Flare/Chaff Dispensers (10 Each), ECM 2	1200/800m Hardened Runway	+2	9 Hardpoints	None
F-4E/F-4EJ	All-Weather Flight, RWR, Flare/Chaff Dispensers (10 Each), ECM 1, HUD Interface, IR Uncage	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 9 Hardpoints	639x20mm
F-4G	All-Weather Flight, RWR, Flare/Chaff Dispensers (20 Each), ECM/ECCM 3, IRCM 1, Deception Jamming, Active Jamming, Look-Down Radar, Target ID	1200/800m Hardened Runway	+3	9 Hardpoints	None
F-4J	All-Weather Flight, RWR, Flare/Chaff Dispensers (10 Each), ECM 2, HUD Interface, Look-Down Radar, Track While Scan, IR Uncage	1200/800m Hardened Runway	+2	9 Hardpoints	None
F-4N	All-Weather Flight, RWR, Flare/Chaff Dispensers (10 Each), ECM 2, Deceptive Jamming, HUD Interface, IR Uncage, Target ID	1200/800m Hardened Runway	+2	9 Hardpoints	None
F-4S	All-Weather Flight, RWR, Flare/Chaff Dispensers (12 Each), ECM 2, HUD Interface, IR Uncage, Look-Down Radar, Track While Scan	1200/800m Hardened Runway	+3	9 Hardpoints	None
FG.1 (F-4K)	All-Weather Flight, RWR, Flare/Chaff Dispensers (15 Each), ECM 2, HUD Interface, Look-Down Radar, Track While Scan, IR Uncage	1200/800m Hardened Runway	+3	9 Hardpoints	None
FGR.2 (F-4M)	All-Weather Flight, RWR, Flare/Chaff Dispensers (15 Each), ECM 2, HUD Interface, Multitarget (2), Track While Scan, Look-Down Radar, IR Uncage	1200/800m Hardened Runway	+3	9 Hardpoints	None
F-4EJ Kai	All-Weather Flight, RWR, Flare/Chaff Dispensers (10 Each), ECM 2, HUD Interface, IR Uncage, Target ID, Multitarget (2), Track While Scan, Look-Down Radar	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 9 Hardpoints	639x20mm
F-4F/F-4F MLU	All Weather Flight, RWR, Flare/Chaff Dispensers (12 Each), IR Uncage, HUD Interface	1200/800m Hardened Runway	+1	20mm Vulcan Gatling Gun, 7 Hardpoints	639x20mm
F-4F/ICE	All-Weather Flight, RWR, Flare/Chaff Dispensers (15 Each), ECM 2, HUD Interface, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 9 Hardpoints	639x20mm
Kurnass (Upgraded)	All-Weather Flight, RWR, Flare/Chaff Dispensers (18 Each), ECM 2, HUD Interface, IR Uncage	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 9 Hardpoints	639x20mm

Kurnass 2000/Kurnass 2000 (Engine Upgrade)	All-Weather Flight, RWR, Flare/Chaff Dispensers (24 Each), ECM 2, HUD Interface, IR Uncage, Auto Track, Target ID, Track While Scan, Look-Down Radar, TFR	1200/800m Hardened Runway	+3	20mm Vulcan Gatling Gun, 9 Hardpoints	639x20mm

F4U Corsair

Notes: This was the best naval fighter of World War 2, literally built around its massive Double Wasp engine and the huge propeller necessary to harness its power. The Corsair has 10 hardpoints, but 8 of these hardpoints are only for air-to-ground rockets, and two of them are for bombs or drop tanks. If even one of the rocket hardpoints on a wing are used, the bomb hardpoint may not be used, or vice versa.

The choice of a Double Wasp engine, and the massive propeller required to properly harness its power, proved to be a problem. The landing gear had to be very long for the propeller to clear the ground. This made it difficult for the pilot to see the ground when landing. Compounding this were the reports that the chosen armament, two .30 caliber machineguns and two .50 caliber machineguns, was too light for modern aerial combat. This meant that the nose-mounted .30 caliber machineguns were replaced with .50 calibers and moved to the wing (two more were added before production began). Most of the wing fuel therefore had to be moved to the fuselage; this meant lengthening the fuselage, moving back the cockpit, making it even harder for the pilot to see over the nose on landing. This meant that the Corsair was not certified for carrier landings for over two years. To help this, the Corsair had the bent gull wings.

The F4U-1 was the first model. The later production versions were significantly different from other F4U-1s, in that the cockpit was raised 18 centimeters to give the pilot better visibility, and the canopy was replaced with a bulged Malcolm Hood. They also had an uprated engine. These were the F-4U-1As. The F4U-1C had the machineguns replaced by four 20mm autocannons, and were used primarily for ground support. The F4U-1D was an F4U-1A with one wet hardpoint on the center fuselage and two on the wings.

The F4U-2 was a night fighter with a radar set under the right wing. One of the machineguns and ammunition were removed from that wing so as to not unbalance the aircraft. This primitive radar could be very fragile, so dogfighting or even tight turning was avoided as much as possible.

The F4U-4 introduced a more powerful engine, giving more speed and better high-altitude performance. The F4U-4B and 4C were version with autocannons substituted for the machineguns.

The first post-World War 2 model was the F4U-5. It continued the trend of increasing engine power. The fuselage was lengthened by 127mm, and the engine was angled down about 2 degrees to increase the stability. The controls were given hydraulic boost, and the cockpit heater was improved. The -5N was a night fighter with the radar under the right wing.

The AU-1 was a ground attack version built for the US Marines. It has greatly increased armor, more ammunition for its cannons, and, unfortunately, more sloppy handling. It was considered distinctly difficult to fly, but capable of wreaking great havoc.

The F-4U-7 was built for the French Navy. The pilot was seated a bit higher for better visibility, but it was otherwise similar to the F4U-4C. They remained in service until 1964, the last Corsairs in active service.

Twilight 2000 Notes: By 2000, some 35 of these planes remained airworthy, and 6 were reactivated during the war, mostly in the US, but there were some French Corsairs flying in Europe, and at least one in El Salvador. These aircraft were either used as reconnaissance and observation aircraft, or rearmed and flown as ground support aircraft, something they excelled at as late as the Korean War.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F4U-1	$208,687	AvG	908 kg	5.76 tons	1	6	None	Enclosed
F4U-1A/1D	$210,169	AvG	908 kg	6.35 tons	1	6	None	Enclosed
F4U-1C	$208,110	AvG	908 kg	6.27 tons	1	6	None	Enclosed
F4U-2	$461,280	AvG	908 kg	6.46 tons	1	8	Radar	Enclosed
F4U-4	$217,687	AvG	908 kg	6.65 tons	1	6	None	Enclosed
F4U-4C	$209,569	AvG	908 kg	6.48 tons	1	6	None	Enclosed
F4U-5	$211,046	AvG	908 kg	6.84 tons	1	8	None	Enclosed
F4U-5N	$484,367	AvG	908 kg	7.04 tons	1	10	Radar	Enclosed
AU-1	$537,234	AvG	1.81 tons	9.07 tons	1	10	None	Enclosed
F4U-7	$209,569	AvG	908 kg	6.48 tons	1	6	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F4U-1	1262	316 (80)	NA 79 9/5 90/50	662	700	11310	FF3 CF3 RF3 W2 T2
F4U-1A/1C/1D	1342	336 (80)	NA 84 9/5 90/50	662	786	11250	FF3 CF3 RF3 W2 T2
F4U-4/4C/7	1436	359 (80)	NA 90 9/5 90/50	662	868	12649	FF3

							CF3 RF3 W2 T2
F4U-5/5N	1512	378 (80)	NA 95 9/5 90/50	662	951	13400	FF3 CF3 RF3 W2 T2
AU-1	766	192 (70)	NA 48 7/4 70/40	662	748	5944	FF5 CF5 RF5 W3 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F4U-1/1A/1D/4	None	560/500m Hardened Runway	+1	6xM3, 8 Hardpoints (see text)	2350x.50BMG
F4U-1C/4C/5/5N	None	560/500m Hardened Runway	+1	4x20mm M2 Autocannons, 8 Hardpoints (see text)	480x20mm
F4U-2	None	560/500m Hardened Runway	+1	5xM3, 8 Hardpoints (see text)	1950x.50BMG
AU-1	None	560/500m Hardened Runway	+1	4x20mm M3 Autocannons, 10 Hardpoints (see text)	924x20mm
F4U-7	None	560/500m Hardened Runway	+1	4x20mm M3 Autocannons, 10 Hardpoints (see text)	480x20mm

F-5A/C Freedom Fighter

Notes: This was the predecessor of the F-5E and was also used by a large amount of world air forces. It differs primarily in its lack of maneuvering slats and less powerful engines, as well as having virtually no modern avionics. It was designed to be cheap and easy to fly while still giving decent performance, and is very much a "no-frills" design. As with the Tiger, the Freedom Fighter's wingtip hardpoints may only be used for heat-seeking air-to-air missiles, Sidearm antiradar missiles, or small, 350-liter drop tanks. The F-5A may not be refueled in the air; the F-5C adds a refueling probe.

The F-5A is just about as basic as a "modern" fighter can get. It cannot be refueled in the air. The F-5C was a model for the Aggressor Squadrons of the USAF and US Navy; they have a refueling probe.

The Canadians had a special version of the F-5A built for them, calling them CF-5s. They had different Canadian engines than their US-built counterparts, engines with more power. They were equipped with a radar warning receiver and a refueling probe. The nose wheel was lengthened slightly; this increased the angle of attack, shortening takeoff and landing distances by 25%.

Eventually, Canada (and especially the Trudeau government) decided that the defense budget needed to be cut. It was also decided that the CF-5 was best used as a transition trainer rather than a combat aircraft, and that Canada would not need nearly as many CF-5s as they thought. Some were kept in service, but many were mothballed or sold. Some of those CF-5s were sold to the Netherlands. The Netherlands refurbished them, updating equipment, correcting fatigue-related deficiencies, and in some cases, adding new equipment. These were the NF-5s. Some of the improvements include flare and chaff dispensers and leading edge combat slats.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-5A	$3,136,980	JP4	2.81 tons	9.38 tons	1	10	None	Enclosed
F-5C	$3,232,040	JP4	2.81 tons	9.38 tons	1	10	None	Enclosed
CF-5	$3,388,420	JP4	2.81 tons	9.7 tons	1	12	None	Enclosed
NF-5	$4,637,230	JP4	2.81 tons	9.7 tons	1	12	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-5A/C	2960	740 (130)	NA 185 7/3 70/30	2207	2380	15392	FF3 CF2 RF2 W2 T2
CF-5	3019	755 (130)	NA 189 7/3 70/30	2207	2511	15392	FF3 CF2 RF2 W2 T2
NF-5	3019	755 (130)	NA 189 8/4 80/40	2207	2511	15932	FF3 CF2 RF2 W2 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-5A	None	745/900m Hardened Runway	+1	2x20mm M39 Autocannons, 7 Hardpoints	275x20mm
F-5C	RWR	745/900m Hardened Runway	+1	2x20mm M39 Autocannons, 7 Hardpoints	275x20mm
CF-5	RWR	595/720m Hardened Runway	+2	2x20mm M39 Autocannons, 7 Hardpoints	275x20mm
NF-5	RWR, Flare/Chaff Dispensers (8/8)	595/720m Hardened Runway	+2	2x20mm M39 Autocannons, 7 Hardpoints	275x20mm

Northrop F-5E Tiger

Notes: This is possibly the most successful fighter ever produced, used by the US (for its Aggressor squadrons), Botswana, Brazil, Greece, Morocco, Philippines, Saudi Arabia, Spain, Thailand, Turkey, Venezuela, Yemen, Bahrain, Chile, Honduras, Indonesia, Iran, Jordan, Kenya, South Korea, Malaysia, Mexico, Singapore, Sudan, Switzerland, Taiwan, and Tunisia. It is a light, no-frills fighter that cannot match more advanced aircraft, but is agile and better than nothing. The pilot has an ejection seat, and it is capable of in-flight refueling. The two wingtip hardpoints may only be used by air-to-air missiles or small, 350-liter maximum drop tanks. The Tiger may not use radar-homing missiles.

Taiwanese F-5Es have a laser designator added.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-5E	$10,236,750	JP4	3.18 tons	11.19 tons	1	14	Radar	Enclosed
Taiwanese	$11,607,810	JP4	3.18 tons	11.33 tons	1	15	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
(Both)	3994	998 (130)	NA 250 9/6 90/60	2563	1225	15789	FF3 CF3 RF2 W2 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-5E	Flare/Chaff Dispensers, Radar Warning Receiver	615/745m Hardened Runway	+2	2x20mm M39A2, 7 hardpoints	560x20mm
Taiwanese	Flare/Chaff Dispensers, Radar Warning Receiver, Laser Designator	615/745m Hardened Runway	+2	2x20mm M39A2, 7 hardpoints	560x20mm

Grumman F-14 Tomcat

Notes: The Tomcat was originally designed as a fleet interceptor. It was to carry the large Phoenix air-to-air missile (and still is the only aircraft that can carry the Phoenix) and be used to down the heavy maritime bombers of the Russians.

The F-14A was designed almost totally for this role. It is, however, a very agile aircraft for its size, capable of dogfighting with much smaller aircraft. The Tomcat uses a swing wing that is controlled by a computer optimizing the degree of sweep for the speed and tactical situation. It also controls glove vanes above the intakes that further enhance lift and maneuverability. It features what were very advanced avionics and weapon systems for its time (and still is very sophisticated). It does not, however, have the systems required for air-to-ground combat, except for strafing at opportunity targets with its cannon. If the centerline hardpoint is loaded, the hardpoint at the rear of the fuselage, the small centerline hardpoint, and the two hardpoints on the fuselage forward of the tail are not useable (and vice versa). If the two hard points on the fuselage forward of the tail are loaded, the small centerline hardpoint and the rear fuselage hardpoint are not useable (and vice versa). If the two forward outside fuselage hardpoints are loaded with Phoenix missiles, the small centerline fuselage hardpoint is not useable (and vice versa). The Iranians were also sold the F-14A, when they were still ruled by the Shah's government; however, theirs were not equipped with ECM, nor was the radar as powerful as US F-14As.

From the beginning, it was felt that the F-14A was underpowered. The F-14A+ was re-engined with turbofans taken from the abortive F-14B program, and modified further.

The F-14D, dubbed the Super Tomcat, or Bombcat, was a major upgrade for the F-14. The previously analog systems were almost completely replaced by digital electronics. New, more powerful engines were installed. Finally, the Tomcat was given air-to-ground capability, able to carry bombs and air-to-surface missiles.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-14A	$72,563,660	JP5	4.81 tons	33.72 tons	2	50	Radar, VAS	Shielded
F-14A (Iran)	$71,312,560	JP5	4.81 tons	33.72 tons	2	48	Radar, VAS	Shielded
F-14A+	$73,705,560	JP5	4.81 tons	34.02 tons	2	50	Radar, VAS	Shielded
F-14D	$79,800,000	JP5	6.58 tons	34.02 tons	2	48	Radar, FLIR, VAS	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-14A (Both)	4941	1235 (110)	NA 309 8/5 80/50	9028	7602	16764	FF6 CF6 RF6 W5 T5
F-14A+	5103	1276 (110)	NA 319 8/5 80/50	9028	9079	16794	FF6 CF6 RF6 W5 T5
F-14D	4941	1235 (100)	NA 309 9/6 90/60	9028	12357	17679	FF6 CF6 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-14A/A+	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Track While Scan, Multi-Target (6)	1500/600m Hardened Runway	+4	20mm Vulcan autocannon, 11 hardpoints	675x20mm
F-14A (Iran)	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Track While Scan, Multi-Target (6)	1500/600m Hardened Runway	+4	20mm Vulcan autocannon, 11 hardpoints	675x20mm
F-14D	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Track While Scan, Multi-Target (6), Target ID, Deception Jamming	1500/600m Hardened Runway	+4	20mm Vulcan autocannon, 11 hardpoints	675x20mm

F-15 Eagle

Notes: The F-15A was one of the few aircraft designed on a computer and then ordered straight off the drawing board, without a prototype having been flown. (It went straight into "YF," or service test status.) The F-15's design grew out of the Air Force's frustration with the relative ineffectiveness of the then-star F-4 Phantom in Vietnam, an ineffectiveness that was mitigated only by the skill of its pilots. This led the Air Force to design the first air superiority fighter to be designed in decades, apart from the missile-only armed interceptors like the Phantom. The Air Force was looking for a fighter that could perform the high-speed interceptor mission, but could also turn and burn with small, light aircraft like the MiG-17s and MiG-21s that the Air Force encountered over North Vietnam, and could also fight with new Russian fighters like the MiG-25 at long range. (At least, what they thought the MiG-25 was at the time…)

The F-15 turned out to be a large aircraft, about the same size as the F-4, but possessed of more fuel, more powerful engines, more powerful sensors, and a more powerful defensive suite. The design used a twin tail for more positive rudder authority, large, high-lift wings with large control surfaces, and a wide, flat body which also served as an effective lifting surface. The canopy is also large and is a bubble canopy, with only one rail where the canopy opens and closes to provide further unobstructed vision. Originally, the Eagle was to have been a fighter-only aircraft; designers used to say "Not a Pound for Air-To-Ground," though it eventually evolved into a multirole configuration.

The service test period was interesting, including the "Streak Eagle" special edition used to set speed and altitude records, and even an incident in which an Eagle was hit by a live Sidewinder missile and still landed safely! Very few problems were encountered (though the wingtips were reshaped due to flutter problems) and the aircraft passed into active service very quickly. This is when the problems with maintenance, especially of the engines, were discovered; the F-15A required mountains of very meticulous maintenance to keep it in operating order. An upgrade program was quickly placed into operation.

F-15A/B Eagle

The original model of the Eagle was the F-15A. A two-seat version was also produced, at first called the TF-15A, but later designated the F-15B. (Every seventh F-15A was actually built as an F-15B.) It is powered by twin Pratt & Whitney F100 afterburning turbofans with 14,590 pounds thrust, or 23,920 pounds thrust in afterburner each; these provide superior thrust, but at the cost of gulping fuel liberally at high military power and afterburner. Nonetheless, they have high acceleration and provide redundancy, and the F-15 is capable of accelerating even when climbing straight up. The F-15 is built around its avionics, which include the APG-63 pulse-Doppler radar which can look up at high-flying targets and down at low-flying targets and discern them against ground clutter, and look at targets in between, all in the same scan. F-15As and Bs were able to produce and maintain a lock-on to two targets at once and also fire Sidewinder IR AAMs at other targets while maintaining these lock-ons. The F-15A and B are BVR (Beyond Visual Range)-capable; they are capable of tracking, identifying, locking-on to, and destroying enemy targets without the pilots ever having laid eyes on the target. The F-15 has an active ECM and IRCM suite, including automatic threat identification and automatic flare and chaff ejection. The F-15A and B can also do the kind of down and dirty knife fighting that would make Maverick blush.

The early 1980s MSIP (Multi-Stage Improvement Program) allowed the F-15A to work with all current and projected air weapons at the time. ECM was improved, and flare and chaff projectors were increased in capacity. Weapons avionics were increased in capability, and the radar’s range was increased. A big increase was made in the F-15A’s computer suite. The ergonomics and workload of the cockpit was also addressed. At first, this MSIP was cancelled because it was deemed too costly, especially in view of the pending arrival of the F-15C. However, due to delays in the fielding of the F-15C/D and since some of the F-15A/B fleet did not have high flight hours as of yet, and because some of the MSIP’s features may be applied to export aircraft, the MSIP I was applied to some of the F-15A/B fleet.

The first few Eagles used larger wingtips for more lift and control. This larger wing caused severe buffeting during mid-range flight speeds. This problem was solved by “clipping” the wingtips, angling them inwards, and this did not turn out to have the negative control authority that was at first forecast for the clipped wingtips. For the ground crew, the F-15 has 300 more access panels than the F-4, and the BITS (Built-In Test System) allows crews to rapidly diagnose and test faults, and turn around an F-15 in combat in only 12 minutes average.

The F-15A was used early in the Eagle’s career to set several speed, altitude, and climb records; these records were set by a special variant of the F-15A, the “Streak Eagle.” It was essentially a stock F-15A that was stripped of all possible avionics and weight to allow the F-15A to be lighter and therefore more responsive aerodynamically.

A specially-equipped F-15A was used to test an ASM-135 antisatellite missile, successfully killing an obsolete US science satellite.

The F-15B retains the F-15A’s full armament and weapons avionics suites, but loses some electronics, especially radios, in making space for a second seat. It does not, notably, lose any of its warfighting chops.

An F-15B was used to test the FAST Packs that would become standard on the F-15C, D, E, and EX. An F-15B was also used to test systems for what would become the F-15E Strike Eagle.

USAF F-15As and Bs were retired from the Oregon Air National Guard in September 2009, making them the last F-15As and Bs to serve with the US Air Force.

F-15C/D/I

The F-15C sharpened the Eagle’s air-to-air capability while still making it (especially in its F-15D configuration) into a capable strike aircraft, though not so much as its cousin, the Strike Eagle. The F-15C has a 107-0 kill ratio in air-to-air combat, mostly in the Israeli Air Force. After a midair collision with an A-4 Skyhawk in Israel, an F-15I version of the F-15C landed safely minus its right wing. F-15Cs and Ds have been further modified into several subtypes for use by the air forces of several countries. The F-15C exceeds the F-15A in almost every parameter, from avionics to radar to weapons delivery. The F-15C can carry conformal FAST packs; these packs hug the air intake and engine bay when installed and can carry up to 3214 liters of fuel or the equivalent in sensors, ECM/IRCM devices, or reconnaissance gear. They do not give the F-15C an aerodynamic penalty. F-15Cs and Ds have been progressively modified over the years, in both hardware and software, to carry virtually any weapon, electronics pod, or other equipment pod in the USAF inventory, or in the inventory of other countries that may fly versions of the F-15C/D.

The MSIP II upgrades the avionics and subsystems of the Eagle. Improvements were especially made to the weapon systems, computing power, and engines. The ergonomics of the cockpit were further improved, with large LCD multifunction displays replacing much of the plethora of instruments and controls, and the HOTAS (Hands-On Throttle And Stick) system being ergonomically improved.

The EPAWSS (Eagle Passive/Active Warning and Survivability) upgrade primarily integrates the EW and IRW suites into more up-to-date digital modules, increasing their effectiveness in some cases. The upgrade also introduces the Helmet/Sight Interface and improves the targeting capability by increasing computing power.

The F-15I Baz (Falcon) is an Israeli subtype of the F-15C/D, different primarily in the use of Israeli-made and tuned electronics and avionics in its construction. For the most part, however, the F-15I is equivalent in game terms to the standard F-15C/D. The F-15I Baz-2000 is equivalent to the F-15C/D MSIP II version. F-15Is are often in use as strike platforms.

Saudi F-15S

The initial Saudi F-15s were not supplied with the best or more up-to-date electronic systems, and were in general dumbed down in comparison with F-15C/Ds supplied to the US Air Force or Israeli Air Force, for example. Despite this, Saudi F-15Ss were still some of the most capable fighters in the world. The attitude of supplying the Saudis with less well-equipped F-15s would later change for the advent of the F-15SA version.

Saudi/Qatari F-15SA/QA

The SA (Saudi Advanced) and QA (Qatari Advanced) versions have the EPAWSS and MSIP II upgrades along with four additional hardpoints (two under the intakes and two outboard on the wings). The intake hardpoints are usually loaded with electronics, targeting, or sensor pods. Outboard wing hardpoints are usually loaded with AAMs, allowing the inner hardpoints to be loaded with air-to-ground munitions, extra fuel tanks or even more AAMs.

Mitsubishi F-15J/DJ

Japan selected the F-15C/D as replacement for their F-104J Starfighters and F-4EJ Phantom IIs. Though initially the Japanese Eagles were produced in the US, production quickly shifted to Mitsubishi in Japan. The F-15C equivalent is designated the F-15J, while the F-15D equivalent is designated the F-15DJ. The F-15J differs primarily in using Japanese electronics and avionics, and having these matched to Japanese air-to-air and air-to-ground weapons. However, they use uprated versions of the F100 engines, developing 15,249 pounds thrust each or 25,000 pounds thrust each in afterburner, and they are radiation shielded. They do not have a Link 16 equivalent, and support only datalinks from other F-15Js or F-35s and from ground stations. The F-15J/DJ Kai is an updated version of the F-15J, equivalent in game terms to the MSIP II, but also including the Helmet/Sight Interface. Japanese Eagles typically an IRST pod in addition to other ordnance.

The MTDP (Mid-Term Defense Program) upgrade is a further improvement on the MSIP II. This includes a new, better ejection seat, new IHI-220E engines (equivalent in game terms to the Japanese F100 mentioned above), more powerful computer processors, an upgraded electrical bus, and an upgraded radar.

The Japanese were considering producing an RF-15J version, replacing the RF-4 Phantom II. These have conformal synthetic aperture radar pods on the belly, extra data transmission equipment, and do not typically carry armament, in order to be as light and fast as possible. The Japanese Air Self-Defense Force is still up in the air as to whether to produce such a version. If produced, the variant will be based on the latest F-15J MTDP version, and will likely be a single-seat model. Hypothetical stats are given below.

F-15EX Eagle II

In 2018, Boeing pitched to the USAF a comprehensively-updated version of the Eagle, the F-15X Advanced Eagle. This was to be based on the F-15QA Eagle, and was to be a single-seat version. However, Boeing and the USAF decided to make the Eagle II a two-seat model because the production line for two-seat F-15Es was still open and the new version, the F-15EX Eagle II, could be implemented for a lower cost if the Eagle II was made a two-seat variant. The new variant would be a Strikefighter like the F-15E Strike Eagle, but it's primary use would be as an air superiority fighter in areas where the opposing air and antiair threat is low, or as a "missile truck," carrying large amount of air-to-air missiles and standoff weapons for targets designated by stealthy aircraft like the F-22 or F-35, and carrying as many as 22 AIM-120 missiles. The F-15EX would essentially be an advanced version of the Eagle superior in every way to earlier Eagles. LRIP production of the F-15EX began in 2021. The USAF bought the F-15EX since production of the F-22 was never enough, the F-35 was delayed, and F-15Cs and Ds were aging.

F-15EXs have a complete computer, avionics, ECM, and electrical upgrade. The engines are also greatly upgraded, being F110-129 turbofans developing 17,155 pounds thrust, or 29,500 pounds in afterburner.

The F-15IA (Israeli Advanced) model is a version for the Israeli Air Force, and differs primarily in having Israeli-made computers and avionics instead of using American-made systems. F-15IA may be both new-build aircraft and upgraded two-seat F-15Is; it should be noted that the IAF has not decided whether to purchase new F-15EXs or simply upgrade their two-seat F-15Is.

The F-15KA is a version for South Korea; this has, like the IA, indigenous electronics and avionics, as well as Korean-produced engines, but is otherwise for game purposes the same as the F-15EX.

F-15SE Silent Eagle

The Silent Eagle was a technology demonstrator Boeing produced in 2009, and demonstrated to several countries, most notably to South Korea, who toyed quite heavily towards buying them for the ROKAF. However, in the end, Boeing was unable to sell the Silent Eagle, though it continues to play with its technology, and some improvements made it into the F-15SA/QA and F-15EX. (Chief among the technology pioneered for the Silent Eagle were the new agile computers and radar system.)

The Silent Eagle was essentially an F-15D with those tech improvements and some stealth technology. The skin over most of the wing and over part of the fuselage was made of composites and RAM. The geometry of the intakes, side of the aircraft, nose, and tail were subtly changed to make reduce the RCS of the aircraft. Modified FAST packs were fitted which housed four air-to-air internally-carried missiles or low-profile munitions. Most notable of these changes was the twin vertical stabilizers, which were angled outward at 20 degrees. Exact figures are classified, but supposedly, RCS of the Silent Eagle without external stores was not much more than 1 cubic meter, an astounding change. With external stores, however, the RCS reduction is all but negated.

Twilight 2000 Notes: The F-15C is responsible for more air-to-air kills than any other US aircraft in the Twilight War.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-15A	$66,657,140	JP4	5.44 tons	29.94 tons	1	54	Radar (161 km)	Enclosed
F-15B	$66,657,870	JP4	5.44 tons	30.39 tons	2	54	Radar (161 km)	Enclosed
F-15A MSIP I	$64,042,828	JP4	5.44 tons	29.94 tons	1	54	Radar (177 km)	Enclosed
F-15B MSIP I	$64,043,558	JP4	5.44 tons	30.39 tons	2	54	Radar (177 km)	Enclosed
F-15C/J/I Baz	$72,793,949	JP4	7.26 tons	29.94 tons	1	42	Radar (226 km)	Enclosed
F-15D/DJ/I	$72,794,679	JP4	7.26 tons	30.39 tons	2	42	Radar (226 km)	Enclosed

Baz								
F-15C MSIP II/I Baz-2000	$61,919,680	JP4	7.26 tons	29.94 tons	1	44	Radar (254 km)	Enclosed
F-15D MSIP II/I Baz-2000	$61,920,410	JP4	7.26 tons	30.39 tons	2	44	Radar (254 km)	Enclosed
F-15J Kai	$61,920,337	JP4	7.26 tons	29.94 tons	1	44	Radar (254 km)	Shielded
F-15DJ Kai	$61,921,067	JP4	7.26 tons	30.39 tons	2	44	Radar (254 km)	Shielded
F-15J MTDP	$73,233,787	JP4	7.26 tons	29.94 tons	1	45	Radar (270 km)	Shielded
F-15DJ MTDP	$73,234,517	JP4	7.26 tons	30.39 tons	2	45	Radar (270 km)	Shielded
RF-15J	$88,618,035	JP4	7.26 tons	27 tons	1	50	Radar (270 km)	Shielded
F-15C EPAWSS	$70,168,499	JP4	7.26 tons	29.94 tons	1	45	Radar (254 km)	Enclosed
F-15D EPAWSS	$70,169,229	JP4	7.26 tons	30.39 tons	2	45	Radar (254 km)	Enclosed
F-15S	$72,000,338	JP4	5.44 tons	29.94 tons	1	54	Radar (177 km)	Enclosed
F-15SA/QA	$70,296,597	JP4	9.12 tons	30.39 tons	2	46	Radar (254 km)	Shielded
F-15EX/IA Eagle II	$97,739,523	JP4	13.38 tons	37 tons	2	49	Radar (280 km)	Shielded
F-15SE Silent Eagle	$90,714,837	JP4	9.12 tons	31 tons	2	60	Radar (270 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-15A	4071	1131 (130)	NA 283 10/7 100/70	6776	9602	19812	FF6 CF6 RF6 W5 T5
F-15B	4011	1114 (130)	NA 279 10/7 100/70	6776	9602	19812	FF6 CF6 RF6 W5 T5
F-15C	4071	1131 (130)	NA 283 10/7 100/70	7836	9602	19182	FF6 CF6 RF6 W5 T5
F-15D	4011	1114 (130)	NA 279 10/7 100/70	7836	9602	19182	FF6 CF6 RF6 W5 T5
F-15J	4275	1188 (130)	NA 297 10/7 100/70	7836	9842	19182	FF6 CF6 RF6 W5 T5
F-15DJ	4212	1170 (130)	NA 293 10/7 100/70	7836	9842	19182	FF6 CF6 RF6 W5 T5
RF-15J	4515	1254 (130)	NA 314 10/7 100/70	7836	9602	19182	FF6 CF6 RF6 W5 T5
F-15SA/QA	4011	1114 (130)	NA 279 10/7 100/70	7836	9602	19182	FF6 CF6 RF6 W5 T5
F-15EX/IA	4478	1248 (130)	NA 312 10/7 100/70	8620	9122	19182	FF6 CF6 RF6 W5 T5
F-15SE	4267	1185 (130)	NA 297 10/7 100/70	7836	9754	19182	FF6 CF6 RF6 W5 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-15A	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Flare/Chaff Dispenser (50/50), ECM 2, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Multitarget (2)	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	940x20mm
F-15A MSIP I	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Flare/Chaff Dispenser (60/60), ECM 2, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Multitarget (2)	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	940x20mm
F-15B	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Flare/Chaff Dispenser (50/50), ECM 2, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Multitarget (2)	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	940x20mm
F-15B MSIP I	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Flare/Chaff Dispenser (60/60), ECM 2, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Multitarget (2)	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	940x20mm
F-15C/D/I/J/DJ	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (60/60), ECM 3, IRCM 1, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (3), Target ID, Deception Jamming	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	950x20mm
F-15C/D/I MSIP II	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (70/70), ECM 3, IRCM 1, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (4), Target ID, Deception Jamming	2800/1055m Hardened Runway	+4	20mm Vulcan, 9 Hardpoints	950x20mm
F-15J/DJ Kai	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (70/70), ECM 3, IRCM 1, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (4), Target ID, Deception Jamming	2800/1055m Hardened Runway	+4	20mm Vulcan, 9 Hardpoints	950x20mm
F-15J/DJ MTDP	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (70/70), ECM 3, IRCM 1, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (5), Target ID, Deception Jamming	2800/1055m Hardened Runway	+4	20mm Vulcan, 9 Hardpoints	950x20mm
RF-15J	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (70/70), ECM 3, IRCM 1, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Deception Jamming, 2xSAR (70 km), Optical Camera (70 km), 3rd Gen FLIR Camera (20 km), Video Camera (15 km)	2800/1055m Hardened Runway	Nil	9 Hardpoints	Nil
F-15C/D EPAWSS	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (75/75), ECM 4, IRCM 2, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (8), Target ID, Deception Jamming	2800/1055m Hardened Runway	+4	20mm Vulcan, 9 Hardpoints	950x20mm
F-15S	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Flare/Chaff Dispenser (50/50), ECM 2, IRCM 1, Auto Track, HUD Interface, IR	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	950x20mm

	Uncage, Look-Down Radar, Track While Scan, Multitarget (2), Target ID, Deception Jamming				
F-15SA/QA	All-Weather Flight, Secure Radios, INS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (75/75), ECM 4, IRCM 2, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (8), Target ID, Deception Jamming	2800/1055m Hardened Runway	+4	20mm Vulcan, 13 Hardpoints	950x20mm
F-15EX/IA	All-Weather Flight, Secure Radios, INS, GPS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (80/80), ECM 5, ECCM 3, IRCM 3, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (12), Target ID, Deception Jamming	2800/1055m Hardened Runway	+5	20mm Vulcan, 13 Hardpoints	950x20mm
F-15SE	All-Weather Flight, Secure Radios, INS, GPS, Radar Warning Receiver, Advanced IFF, Flare/Chaff Dispenser (75/75), Stealth 2, ECM 4, ECCM 2, IRCM 2, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (8), Target ID, Deception Jamming	2800/1055m Hardened Runway	+5	20mm Vulcan, 7 Hardpoints, 4 Internal Weapon Bays	950x20mm

General Dynamics F-16 Fighting Falcon

Notes: In Vietnam, US pilots often looked at the nimble aircraft of the North Vietnamese with envy. The US fighter pilots were qualitatively superior, but their aircraft were in most cases not built for dogfighting, but instead for speed and missile-carrying ability. They wanted something that could "turn and burn" with their adversaries; they wanted a flying hot rod. General Dynamics responded with the F-16 Fighting Falcon.

The F-16A was designed to be a daylight light fighter. It was meant to be a point defense air superiority fighter. It was quickly discovered that the F-16A was a pretty decent "bomb truck," too, and the F-16 has been used more as an attack aircraft than a fighter by the US Air Force (one general even suggested its designation be changed to F/A-16). Today, the F-16 is one of the most numerous fighter-bombers on the planet, used by over 25 countries, often in large numbers due to its (IRL) low acquisition and operational costs. Several of these countries have had special versions made for them, and others have modified or upgraded their F-16 fleets. The official name of the F-16 is the Fighting Falcon, but most pilots call it the Viper, due to its perceived resemblance to the *Battlestar Galactica* fighter and it's appearance as it leaves the ground when viewed from the front. Another common nickname is the Electric Jet, due to its fly-by-wire controls (unusual at the time of its introduction) and large amounts of digital subsystems.

Blocks and Variants

The types and technology upgrades of the F-16 may be delineated two ways: in development blocks and in broader marks of the F-16's type designated by the aircraft's suffix (F-16A, F-16B, etc.)

The F-16's block numbers are primarily assigned by the company to distinguish the design and avionics changes. They are not part of the designation of the F-16 (though they are often printed by publications as a clarification). These are production sets with graduated improvements (most of which have no effect in game terms, and will not be listed). Block improvements can also seem to be intermixed and confused; this is because some aircraft were given serial upgrades, some received some parts of the Block improvements ahead of time, and some were "jumped" from a low block to a higher block, and given their own Block improvement numbers as a result.

F-16A/B

The F-16A was the original production version; the F-16B is the same aircraft, but a two-seater. They were built with an AN/APG-66 Pulse-Doppler Radar, and a Pratt & Whitney F100-PW-200 with a rating of 14,670 pounds in military power and 23,830 pounds thrust in afterburner. Construction is largely of aluminum; at first this was an aluminum honeycomb glued to epoxy, but as seen below, changed to corrugated aluminum bolted to the lower epoxy subsurface. In addition to being available to carry virtually all USAF and Navy ordinance (of the time), it could also carry up to six Sidewinder, Falcon, or similar missiles of NATO make. (It did not yet have radar-homing missile capability.) In general, two-seat F-16s have a reduced internal fuel supply.

Block 1/5/10

Blocks 1-5 were the original F-16As, and their two-seat counterparts, the F-16Bs. Block 1 was the original operational testing and limited production version, and blocks 1-10 introduced relatively minor changes. The Block 1 aircraft had a nose cone painted black; the type of black paint used helped the resolution of aircraft radars. It was also an obvious visual cue, so new paint the same color as the rest of the aircraft was formulated to make the special black paint unnecessary in Block 5. It was also discovered that in certain places in the fuselage, rain would accumulate and increase corrosion. A small amount of strategically-placed holes were drilled at points on the fuselage to allow rain to drain away. Block 10 primarily consisted of differences in construction and materials. The Soviet Union had locked down their titanium sales to deny them to the West, so Block 10 aircraft used aluminum instead of titanium whenever possible. In addition, Block 10 aircraft have the corrugated aluminum used in the construction of major wing and fuselage segments bolted to the underlying epoxy instead of the special glue used on earlier blocks.

Block 15

Notes: The Block 15 improvements were in fact a major upgrade for the F-16. Block 15 introduced track while scan capability, changed the radios for greater range and security (the Have Quick II), additional wing strengthening for added carrying capability (before, the F-16 could carry wingtip missiles, but lost -1/-10 of maneuverability when doing so), and the ability to carry a wider array of ordnance. A larger wing area and larger tail surface area further increased the maneuverability of the F-16 (for the first time, onboard computers had to put limits on the severity of turning or maneuvering, though these could be overridden). The larger tail surfaces also acted as a counterweight for the hardpoints added to the wings. (The size of the horizontal stabilizers, for example, grew by 30%.) The Block 15 aircraft are the most numerous F-16s, with the last one going to Thailand in 1996.

In 1988 selected Block 15 aircraft were selected for the Block 15OCU (Operational Capability Upgrade). These aircraft were equipped with the wide-angle HUD that was otherwise a part of the Block 20 upgrade, improved ECM, ECCM, and IRCM capability. New weapons carriage allows for the use of the AGM-65 Maverick, AGM-119 Penguin, and AIM-120 in full-capability mode. This was a popular upgrade at the time, and many foreign F-16 operators received this upgrade in addition to the standard Block 15 upgrades.

In 1989, a two year study began which culminated in the F-16A/BMLU (Mid-Life Upgrade). The first of these upgrades was for NATO aircraft, though some of these aircraft or kits were later sold to other countries. The MLU gave these earlier aircraft the capability to use radar (and later, active)-homing missiles. Otherwise, the Block 15 aircraft were basically made more modular and capable of more upgrades in the future; in particular, the mission computer was made more adaptable, acquiring more weapons capability with time.

The Block 15 ADF (Air Defense Fighter) is a special version of the Block 15; it is also called the Block 16, or the F-16A/B ADF. The ADF mounted a spotlight on the right side in a conformal installation which could be turned straight forward, or turned to illuminate an aircraft on the right side of the ADF. The searchlight takes some of the room for the cannon ammunition drum, with the resulting reduction. The F-16A/B ADF have a computer module and software that allows the ADF to directly interrogate a large aircraft's computer to prevent spoofing of IFF signals.

Block 20

The Block 20 has sort of an interesting story, because at the time, the actual current production version of the F-16 was the F-16C/D. The F-16A/B Block 20 aircraft were originally designed for use by Taiwan, and the designation "F-16A/B Block 20" was more or less a made-up term for these aircraft – they are in fact almost the equivalent of F-16C/D Block 50/52 aircraft. The "F-16A/B Block 20" designation was made up to deceive the Chinese; at the time, they thought the Taiwanese were actually getting only slightly-modified versions of the F-16A/B Block 15 aircraft. This deception was quickly discovered, however, and after that, Block 20 upgrades were offered to many countries flying older F-16A/B aircraft. This "Block 20 Upgrade" is known as the MLU (Mid-Life Upgrade) today.

The Block 20 also allowed the carriage of the LANTIRN pod, which allowed the use of several laser-guided, TV-guided, and some command-guided air-surface missiles and bombs. The Block 20 introduced radar-homing AAM capability to the F-16A; these F-16As are not used by the US, but are used by many export customers (most notably Taiwan and most countries using the F-16A in Europe). The new radar which allows the use of RHM is the AN/APG-66(V)3, allowing for the use of the AIM-7 Sparrow and the AIM-120 Rattler. The Block 20s radar has a 25% greater range. The Block 20 upgrades include an almost completely "glass cockpit" (the plethora of instrumentation largely replaced with a pair of liquid crystal displays which are also night vision device-compatible), a wide-angle HUD, an improved data modem, improved ECM, encrypted IFF, more powerful radar (though not quite as powerful as a true F-16C/D Block 50/52), and hardpoints fitted to the sides of the forward portion of the air intakes allowing the mounting of a LANTIRN pod. Optional upgrades for the Block 20 a microwave landing system, and a helmet-mounted display. Further MLU upgrades, available from the spring of 2004, include a helmet-sight interface, improved computer power, a limited GPS receiver (primarily to allow the use of JDAMs and similar GPS-guided weapons, and not capable of providing the pilot with his own position), and TERPROM (Terrain Profile Matching, which makes low-altitude navigation safer). A few Block 20 customers have the later MLU upgrades (also known as the MLU M2 and MLU M3 upgrades).

F-16C/D

The F-16C is an updated version of the F-16 fighter-bomber. It is both a very agile air superiority fighter and a good ground attack platform. The F-16C version has larger tail control surfaces for more positive control and better maneuvering characteristics. It also makes the F-16 all-weather capable. The F-16C comes standard with radar-homing AAM capability. Since the F-16C/D was in production for the USAF as the Block 20 was in production for other countries, the Block 20 aircraft received a number of features from other Blocks with time; the Block 20 aircraft benefitted with time with from Block 25 to 50/52 upgrades in some cases.

Block 25

The first version of the F-16C (and D, the two-seater) is the Block 25. The Block 25 version has more powerful radar (the AN/APG-68, to allow the full use of radar-homing and active-homing missiles) with a wider search angle. ECCM was also improved, as was the ECM suite, in addition, several new electronic gizmos were added. Air-to-ground capability was also improved, with improved look-down radar (primarily in the area of better anticlutter capability and sharper resolution), antishipping attack capability, and better ability to track moving ground targets. The Block 25 has greater fire control capability. In the cockpit, a wide-angle HUD was added, allowing the projection of almost everything the pilot needs to know in most attack profiles projected on the canopy. A "FLIR" interface was added, along with a cockpit interface allowing the pilot to see through weapons which have night-vision capability and project that as a video picture on one of the LCD screens of the now-glass cockpit. Currently, the US ANG are the only one using Block 25 aircraft, and they are used by the ANG and Randolph AFB's Air Education and Training Command. The engine of the Block 25 fighter is an improved Pratt & Whitney F100-PW-220E, which has improvements in metallurgy and durability. Other improvements include to data-transfer equipment, more MFDs, and an improved radar altimeter. Block 25s were also upgraded to the Pratt & Whitney F100-PW-200E engine, which has a rating of 17,800 pounds thrust in military power and 29,160 pounds thrust in afterburner.

Block 30/32

Block 30 and 32 aircraft differ primarily by the different engines that power them under the Alternative Fighter Engine project. Essentially, the difference is that the Block 32 aircraft uses a Pratt & Whitney F100-PW-220E, and the Block 30 F-16 uses a General Electric F-110-GE-100 engine. The GE engine has more thrust and uses a little less fuel (it is a turbofan instead of being a turbojet), but requires more airflow, necessitating a larger intake mouth. The F110-GE-100 is rated at 21,800 pounds thrust in military power, but only 28,000 pounds in afterburner. Block 30 and 32 engines can alternatively use the Pratt & Whitney and GE engines as required. Essentially, these blocks and future blocks ending in 0 are powered by Pratt & Whitney, and Blocks ending in 2 are powered by GE.

Most Block 30/32 improvements center around the F-16's ability to carry external stores. New weapons which may be carried included the AGM-45 Shrike and AGM-88 HARM. The AIM-120 could also be used to its full envelope by the F-16 (before this point, the F-16 could not hand off information that allowed the AIM-120's Active Homing capability). These Blocks also introduced multitarget capability to the Falcon, doubled the capacity of the flare/chaff dispensers, and added the ability to carry a number of older weapons as well as some newer ones (older weapon use ability was added primarily with an eye towards export sales). Other modifications were mostly in the area of upgraded software and repositioned antennas. Optional upgrades for these Blocks included the ASPIS system, which improved the RWR and ECM, and the ability to use the TARS (Theater Airborne Reconnaissance System) pod. The Block 30/32 was equipped with INS, and an improved ECM/ECCM suite. The LITENING Targeting Pod could also be carried in place of one of the intake stores. The older INS was replaced with a ring laser gyro, and then later to a combination INS/GPS/mapping computer system in the EGI upgrades to Block 30/32. The EGI upgrade also gave the Fighting Falcon the ability to use JDAMs and other GPS-guided munitions. The F-16C, with all of the Block 30/32 and EGI upgrades, is often called the F-16++.

The versions known as the Block 32H/J are special aircraft used by the USAF's Thunderbirds Flight Demonstration team. They have the improved engines, but other upgrades, weapons, and hardpoints that are not necessary for flight demonstrations are kept in storage at their home base. They have special smoke-producing spray tanks at the rear and the wingtips, with the smoke-producing compounds being in a tank where the cannon ammunition drum is normally kept.

A special Block 30 version, designated the F-16N (or TF-16N for the two-seater), was modified for it's role as Aggressor aircraft at the Top Gun Fighter Weapons School. These aircraft were little modified from their "stock" condition, other than special equipment added on to allow the reporting of mock combat conditions. The aircraft, over the course of years at Top Gun, became overstressed to the point that it was no longer safe to operate them. Fortunately, about a dozen F-16A/Bs were available, taken from F-16s that had been held back from Pakistan during the US embargo.

Block 40/42

The Block 40/42 modifications unified previous sets of air-to-ground modifications and added a few more; it is the first block of improvements to fully address the F-16's air-to-ground deficiencies. The LANTIRN pod, previously-carryable in place of a radar or active-homing missile, could now be semi-permanently mounted at the aircraft's starboard chin. An AN/AAQ-13 targeting pod is mounted on the port chin pylon, with a full interface system for the pilot. Radar was further improved, particularly in the look-down mode. The EGI system which a part of the Block 30/32 improvements was applied at this time F-16s which did not have them. New weapons for the F-16 included the WCMD and the EGBU-27 Paveway. Weather radar has been added. The Block 40/42 included the modification of the interior and HUD lights to be compatible with ANVIS equipment, as well as datalink capability between the F-16 and AWACS aircraft. The landing gear were beefed up to carry higher loads, as were the hardpoints. The new Combat Edge system was added, allowing the pilot to withstand greater G-forces due to improved oxygen-pumping ability. Though previous iterations of the F-16 were stressed for up to 9 positive Gs while carrying up to 12.2 tons, the Block 40/42 aircraft were stressed for 9G maneuvering while carrying up to 12.93 tons. The improvement in air-to-ground night performance was so dramatic that aircraft of these Blocks are informally known as "Night Falcons."

Block 50/52

The Block 50/52 was the last production Block adopted by the USAF; though other improvements and upgrades have taken place, they have not been organized into Blocks. One of the modifications given the F-16 Block 40/42 improvements, if they didn't already have them. However, the Block 50/52 included a more-powerful engine; the Block 50 received the F110-GE-129 while the Block 52 uses the F100-PW-229. The F110-GE-129 is rated at 23,200 pounds thrust, or 29,400 in afterburner. The F100-PW-229 has a rating of 20,200 pounds thrust in military power and 43,560 pounds thrust in afterburner.

F-16CJ/DJ (Block 50D/52D)

An unreleased number of Block 50/52 Vipers have been tapped to provide a partial replacement for F-4G Wild Weasel aircraft. Unofficially known by the "J" suffix or "Electric Viper," these F-16s are Block 50/52 aircraft with more ECM, ECCM, and IRCM capability. Their armament is normally AGM-88 HARMs and AGM-45 Shrike ARMs, though their chin-mounted Pave Penny pod allows them to guide virtually sort of PGM. Enhanced HARM targeting and control is also given through the use of the AN/ASQ-213 HTS (HARM Targeting System). The F-16CJ is more like an F-4G than an EA-18G – The F-16CJ is a Wild Weasel, meant to find and eliminate SAM sites instead of being a full-blown electronic warfare aircraft like the EA-6B or the EA-18G.

Special Foreign Falcons

In addition to the major blocks and marks of the F-16, the majority of countries that receive the F-16 modify them to some extent. This may be as little as the changing of the labels and software to exhibit the appropriate language, to major upgrades of electronics and hardware.

Block 50/52+

The Block 50/52+ F-16s are not used by the USAF; they were offered, but turned away by an Air Force more interested in F-15s, F-22s, F-35, and (due to Congressional bullshit moves) the C-17. The most noticeable difference in this Block is the capability to carry Conformal Fuel Tanks (CFT's) above each wing. (Just a personal note: I think a Viper equipped with CFTs is ugly as sin.) The CFT's do carry 1400 liters of additional fuel, but the Viper pays for it in drag and weight (this not reflected in the base stats below, however). A dorsal spine for additional avionics or fuel may also be added, which can carry up to 800 kg or 850 liters. Another improvement is an Onboard Oxygen Generation system, allowing the aircraft to recharge the pilots' oxygen tanks at altitude 4500 meters or below and a JHCMS helmet, which is sort of a helmet sight interface and a night vision helmet in one.

Further modified Israeli F-16I versions and its Singapore equivalents are based on Block 52+ aircraft. Egypt is currently flying F-16s of Blocks 20-32; they are being upgraded to Block 50+ standards.

F-16E/F (Block 60)

Originally, the aircraft which was to arise out of the F-16XL Super Scamp was to be the F-16E/F. However, the F-15E Strike Eagle won that competition. The Block 60 appellation was also supposed to go somewhere else – to the F-16 variant which would have become the A-16. In the end, neither aircraft reached fruition, and the designations were used for a special version designed for the UAE.

The F-16E (and F) are based on block 50/52 aircraft, though the engine used in all cases is the F110-GE-129. One of the big improvements in the F-16E is track while scan capability. Both the RWR and ECM suite have increased range. RWR, ECM, ECCM, IRCM, and countermeasures are tied together in an integrated and automated suite called Falcon Edge. The new AIM-132 ASRAAM is supported. All of this is controlled by a data bus which has 1000 times the speed and storage capability than even Block 52+ aircraft. The F-16E does not carry the chin pods of the Block 40/42 and 50/52 – these functions are integrated into the F-16E, along with a FLIR and a laser designator.

F-16C/D Ogzur (Turkey)

Turkey's Falcons are Block 30 and 32 aircraft and are currently undergoing modifications which will essentially turn them into Block 50/52 aircraft. However, some Falcons – named Ozgur – are further modified to allow them to be used as training aircraft for Turkey's TFX next-generation stealth fighter project. The greatest difference is in the software for the flight controls; the Ogzur can mimic most other modern aircraft's flight regimes, as well as the believed characteristics of aircraft arising from the TFX program.

F-16I Sufi

In 1999, the IAF had the choice of the F15I and F-16I. They chose the F-16I (at the time; they still got the F-15I later), due to lower costs per aircraft, lower costs of upkeep and operational costs, and the largely modular construction that would make modification easier. And the Israeli's put this ease of modification to good use, replacing some 50% of the avionics of the original Block 52 roots. An example of this is the addition of the Israeli Aerial Towed Decoy. Another modification allows ground-attack exercises to take place while the Sufi carries no ordinance. Some systems are simply a change to Israeli systems, which are at least just as good as American systems if not better; their purpose is to keep as many systems as possible within Israel. This includes the helmet-sight interface, HUD, mission computer, and the mapping computer. The Sufi has been modified to use Israeli weapons. The Israelis have developed their own conformal fuel tanks for use with the Sufi, which hold 1730 liters each. The upgrades turn the Sufi into what some have called an "F-16C++." The Sufi uses the AN/APG-68 radar which was later used on the F-15I. This is a powerful radar which also provides SAR capability and enhanced Target ID. The Israelis have also made undisclosed major modifications to the standard F100-PW-229 engine which dramatically increase performance while minimizing the fuel consumption one would expect from an engine of greater power. Extra-large flaps, slats, ailerons and elevators and rudders, as well as the addition of flaperons give the Sufi an increase in maneuverability.

The Singaporeans fly basically the same F-16Cs, which are called F-16S. They were built with Israeli assistance and differ primarily in the domestic production of avionics and other internal details. The F-16Ss are also based on Block 25 aircraft instead of newer Block 50s.In game terms, the results are the same as the F-16I, but the GM may want to assign a greater wear value to some parts of the F-16S, such as the airframe and engine.

Twilight 2000 Notes: The F-16CJ/F-16DJ is not available in the Twilight 2000 timeline, nor are any special foreign variants. However, in the waning days of air combat in the Twilight War, with missiles getting short, an F-16C (a Block 52) with the name of *Skycobra* flown by LTC Mark Shanlin was often seen carrying two 30mm GAU-5/A gun pods in addition to its internal Vulcan cannon. LTC Shanlin often equipped *Skycobra* with the same gear and some cluster bomb pods when covering ground convoys.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-16A (Block 1-15)	$31,871,600	JP4	4.83 tons	17.01 tons	1	21	Radar	Shielded
F-16A (Block 15OLU)	$37,260.763	JP4	5.58 tons	17.11 tons	1	21	Radar	Shielded
F-16A (Block 15 ADF)	$35,847,998	JP4	5.58 tons	17.46 tons	1	23	Radar, WL Spotlight (Right)	Shielded
F-16A (Block 20)	$39,005,485	JP4	5.58 tons	17.82 tons	1	24	Radar	Shielded
F-16C (Block 25)	$38,317,886	JP4	5.58 tons	17.95 tons	1	27	Radar	Shielded
F-16C (Block 30)	$40,154,197	JP4	5.58 tons	18.11 tons	1	28	Radar	Shielded
F-16C (Block 32)	$40,121,060	JP4	5.58 tons	18.03 tons	1	28	Radar	Shielded
F-16C (Block 40)	$41,101,477	JP4	5.58 tons	18.44 tons	1	28	Radar, FLIR	Shielded
F-16C (Block 42)	$42,048,757	JP4	5.58 tons	18.52 tons	1	28	Radar, FLIR	Shielded
F-16C (Block 50)	$42,064,128	JP4	5.58 tons	18.52 tons	1	29	Radar, FLIR	Shielded
F-16C (Block 52)	$42,020,093	JP4	5.58 tons	18.44 tons	1	29	Radar, FLIR	Shielded
F-16CJ (Block 50D)	$50,940,670	JP4	5.58 tons	18.87 tons	1	33	Radar, FLIR	Shielded
F-16CJ (Block 52D)	$50,896,634	JP4	5.58 tons	18.75 tons	1	33	Radar, FLIR	Shielded
F-16C (Block 50+)	$42,274,449	JP4	5.58 tons	18.61 tons	1	29	Radar, FLIR	Shielded
F-16C (Block 52+)	$42,230,193	JP4	5.58 tons	18.53 tons	1	29	Radar, FLIR	Shielded
F-16E (Block 60)	$42,025,945	JP4	5.58 tons	18.61 tons	1	29	Radar, FLIR	Shielded
F-16I Sufi	$55,502,105	JP4	6.15 tons	19.43 tons	1	32	Radar, Advanced FLIR	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-16A (Blocks 1-15)	4409	2402 (120)	NA 179 10/5 100/50	3160	2410	15240	FF6 CF6 RF6 W4 T5
F-16A (Block 15 OLU)	4364	2386 (115)	NA 177 10/4 100/40	3160	2434	15240	FF6 CF6 RF6 W4 T5
F-16A (Block 15 ADF)	4924	2434 (115)	NA 169 10/4 100/40	3160	2473	15240	FF6 CF6 RF6 W4 T5
F-16A (Block 20)	4211	2294 (115)	NA 170 10/4 100/40	3160	2526	15240	FF6 CF6 RF6 W4 T5
F-16C (Block 25)	4620	2517 (110)	NA 188 10/6 100/60	3160	2526	16764	FF6 CF6 RF6 W4 T5
F-16C (Block 30)	4700	2560 (110)	NA 150 (164) 10/6 100/60	3160	2412	16764	FF6 CF6 RF6 W4 T5
F-16C (Block 32)	4602	2407 (110)	NA 187 (307) 10/6 100/60	3160	2536	16764	FF6 CF6 RF6 W4 T5
F-16C (Block 40)	4615	2513 (110)	NA 148 (189) 10/6 100/60	3160	2455	16764	FF6 CF6 RF6 W4 T5

F-16C (Block 42)	4505	2356 (110)	NA 183 (232) 10/6 100/60	3160	2589	16764	FF6 CF6 RF6 W4 T5
F-16C (Block 50)	4521	2444 (110)	NA 148 (243) 10/6 100/60	3160	2406	16764	FF6 CF6 RF6 W4 T5
F-16C (Block 52)	4633	2504 (110)	NA 147 (189) 10/6 100/60	3160	2465	16764	FF6 CF6 RF6 W4 T5
F-16CJ (Block 50D)	4435	2397 (120)	NA 180 (229) 10/6 100/60	3160	2452	16764	FF6 CF6 RF6 W4 T5
F-16CJ (Block 52D)	4554	2461 (120)	NA 148 (330) 10/6 100/60	3160	2507	16764	FF6 CF6 RF6 W4 T5
F-16C (Block 50+)	4498	2432 (110)	NA 182 10/6 100/60	3160	2418	16764	FF6 CF6 RF6 W4 T5
F-16C (Block 52+)	4610	2491 (110)	NA 151 10/6 100/60	3160	2477	16764	FF6 CF6 RF6 W4 T5
F-16E (Block 60)	4521	2444 (110)	NA 183 10/6 100/60	3160	2406	16764	FF6 CF6 RF6 W4 T5
F-16I Sufi	4517	2383 (100)	NA 183 9/5 90/50	3160	2579	16764	FF6 CF6 RF6 W4 T5

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-16A (Block 1-15)	Flare/Chaff Dispensers (32 Each), RWR, Auto Track, HUD Interface, IR Uncage, ECM/ECCM 1, IRCM 1	800/530m Hardened Runway	+3	20mm Vulcan, 7 Hardpoints	515x20mm
F-16A (Block 15/20)	Flare/Chaff Dispensers (32 Each), RWR, Auto Track, HUD Interface, IR Uncage, ECM/ECCM 1, IRCM 1	800/530m Hardened Runway	+3	20mm Vulcan, 7 Hardpoints	515x20mm
F-16A (Block15OLU)	Flare/Chaff Dispensers (32 Each), RWR, Auto Track, HUD Interface, IR Uncage, ECM/ECCM 1, IRCM 1	800/530m Hardened Runway	+3	20mm Vulcan, 7 Hardpoints	515x20mm
F-16A (Block 15 ADF)	Flare/Chaff Dispensers (32 Each), RWR, Auto Track, HUD Interface, IR Uncage, ECM/ECCM 1, IRCM 1	800/530m Hardened Runway	+3	20mm Vulcan, 7 Hardpoints	511x20mm
F-16A (Block 20)	Flare/Chaff Dispensers (32 Each), RWR, Auto Track, HUD Interface, IR Uncage, ECM/ECCM 1, IRCM 1	800/530m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	515x20mm
F-16C (Block 25)	Flare/Chaff Dispensers (32 Each), RWR, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, ECM/ECCM 2, IRCM 2	800/530m Hardened Runway	+4	20mm Vulcan, 11 Hardpoints	515x20mm
F-16C (Block 30/32)	Flare/Chaff Dispensers (64 Each), RWR,	800/530m Hardened	+4	20mm Vulcan,	515x20mm

	Auto Track, HUD Interface, IR Uncage, Look-Down Radar, ECM/ECCM 2, IRCM 2	Runway		11 Hardpoints	
F-16C (Block 40/42/50/52/50+/52+)	All-Weather Flight, Flare/Chaff Dispensers (64 Each), RWR, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, ECM 2, ECCM 1, IRCM 2, Laser Designator	800/530m Hardened Runway	+4	20mm Vulcan, 11 Hardpoints	515x20mm
F-16CJ (Block 50D/52D)	All-Weather Flight, Flare/Chaff Dispensers (96 Each), RWR, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, ECM 3, ECCM 2, IRCM 3, Laser Designator	800/530m Hardened Runway	+4	20mm Vulcan, 11 Hardpoints	515x20mm
F-16E (Block 60)	All-Weather Flight, Flare/Chaff Dispensers (96 Each), RWR, Track While Scan, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, ECM 3, ECCM 2, IRCM 3, Laser Designator	800/530m Hardened Runway	+4	20mm Vulcan, 11 Hardpoints	515x20mm
F-16I Sufi/F-16S	All-Weather Flight, Flare/Chaff Dispensers (96 Each), RWR, Track While Scan, Auto Track, HUD Interface, Helmet/Sight Interface, IR Uncage, Look-Down Radar, ECM 4, ECCM 3, IRCM 4, Laser Designator	750/500m Hardened Runway	+5	20mm Vulcan, 11 Hardpoints	515x20mm

Lockheed F-22A Raptor

Notes: This third-generation stealth aircraft also makes use of advanced maneuvering systems to allow it unprecedented combat capability. The Raptor's stealth capability in the standard clean configuration (all weapons stored in the weapon bays) makes the aircraft four levels more difficult to detect or guide weapons by radar, and two levels more difficult to detect or guide by IR or thermal means. If the Raptor uses its hardpoints, it is only one level more difficult than normal to detect, or two levels if the Raptor has empty pylons. Its maneuverability is such that it is capable of high-angle of attack maneuvers, including stable level flight at up to 60 degrees off angle. Avionics are some of the most advanced placed in any fighter, rivaling those of the B-2, including integrated air-to-air/air-to-ground attack modes.

Twilight 2000 Notes: The F-22 came very late to the scene; one understrength squadron was formed, and it was sent to the Middle East, where it deployed out of Bahrain.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$161,815,850	AvG	7.2 tons	28.12 tons	1	47	Radar, FLIR, VAS	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
6960*	1160 (95)	NA 290 11/8 110/80	15350	21038	19812	FF5 CF6 RF5 W4 T4

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Auto Track, Helmet/Sight Interface, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Radar Warning Receiver, Flare/Chaff Dispensers, Deception Jamming, ECM/ECCM 3, IRCM 2, Multitarget (4), Laser Designator	1150/1450m Hardened Runway	+5	20mm Vulcan Autocannon, 6 Weapon Bays, 4 Hardpoints	950x20mm

*The Raptor is supercruise capable.

Lockheed F-80 Shooting Star

Notes: The F-80, originally designed as the P-80 in 1943, was delivered in just 143 days from the first blueprints to pre-production prototypes, complete with armament. Before production started, two pre-production examples were sent to Italy in 1944, though they did not see combat service, as Air Corps generals did not want to see them shot down by enemy aircraft; however, it is believed that had World War 2 lasted six weeks longer, some 24 P-80As would have found themselves in tangles with the Me-262s. Designed before Nazi flight research was available, the P-80 had straight wings instead of swept wings, and thus was limited in speed and maneuverability as speed climbed. Despite its shortcomings, the F-80 saw extensive service as a ground support aircraft in the

Korean War. The original P-80 prototypes were based on a much-revised version of the Bell P-59 Airacomet, but as design changes mounted it was clear that the P-80 was a new aircraft and the new designation of P-80 was given to Lockheed's design. The P-80, F-80, and T-33 were produced in the several thousands (the P-80/F-80 alone had 1714 produced), and as late as the early 1990s, upgraded variants were still being proposed for the T-33 model, and the last NASA NT-33 was not retired until 1997. F-80 variants were also used by Brazil, Chile, Colombia, Ecuador, Peru, and Uruguay; all of these exported F-80s were the F-80C model. Yugoslavia also employed the P-80A for a short time; when Tito took over Yugoslavia, the US and what would become NATO during the Cold War embargoed P-80A parts and engines, and their P-80As could not be kept in flying condition.

XP-80

The original XP-80 prototype was so secret that of the 130 people working on the XP-80, only five (including Kelly Johnson) knew exactly what they were designing. It was one of the first aircraft designed in the now-famous Skunk Works, where super-secret Lockheed aircraft have since been designed. As noted above, the Skunk Works needed only 143 days to go from blueprints to finished prototype.

The original prototype was actually called the Lulu-Belle, but nicknamed the Green Hornet due to its paint scheme. (It had an overall green paint scheme with yellow high-visibility stripes.) The XP-80 originally flew on 08 Jan 1944, with an engine based on blueprints of the British deHavilland Goblin engine, as an actual Goblin engine was unavailable at the time. The wings were derived from those of the P-51, much modified, and were straight instead of being swept, as the research the Nazis did non swept wings was not available in 1944 (though some intelligence photos of the Me-262 were available). The first engine for the XP-80 was destroyed when the intake walls were sucked into the engine during a run-up; the British tried to warn Kelly Johnson that the original XP-80 intake walls were too thin, but Johnson did not listen, as he was seeking to reduce weight as much as possible.

An actual Goblin engine had by then been delivered to the US, and it was put into the second XP-80, the XP-80A, and the thickened intake walls proved to fix that problem. Test pilots remarked that the engine was so quiet that they could not properly judge how fast the XP-80 was going without looking at the airspeed indicator. The first flight was, in a word, unimpressive, with the XP-80A capable of no faster than a specially-modified version of the P-47 that was capable of 808 kmh, and Kelly Johnson felt the XP-80A was capable of much better performance than that. The first flight, however, allowed Lockheed to iron out most of the other problems with the XP-80A. The two XP-80As were nicknamed the Silver Ghost and Gray Ghost due to their finishes, natural metal and a flat gray paint scheme. (The natural metal finish would go on to be the standard finish for the P-80/F-80/T-33.)

The XP-80's and the first XP-80A's Goblin engine had a thrust of 3000 pounds; this does not seem like much, and it wasn't, contributing to the first XP-80A's unexceptional performance. The second XP-80A used an Alison J33 engine with 4000 pounds of thrust. The wings were laminar flow in profile, 11.81 meters across, with the aircraft being 10.49 meters long.

The Gray Ghost was lost during testing, killing its pilot Milo Burcham. He described the Gray Ghost as a "dog," as its engine was 25% heavier than that of the Silver Ghost and it made the XP-80A a bit sluggish.

Production Begins: The P-80A/F-80A

The P-80A was the first block of production P-80s for the US Army Air Corps. These aircraft retained the Alison J33 engines. It was discovered during the XP-80A's development that the fuel consumption, compared to propeller-driven fighters, was dramatically greater. Wet hardpoints were fitted under the wingtips, which each had a capacity of 850 liters. These tanks were almost always fitted to the P-80A; of course, delete 1700 liters of fuel if they are not carried, as the figures below are figured with the wingtip fuel tanks in place.

At first, 12 LRIP YP-80As were made; they were semi-production models which were for game purposes the same as full production P-80s, but did not have the wingtip tanks nor the wet wingtip hardpoints of the P-80A. One of the YP-80As was sent to Rolls-Royce in Britain and used for the development of the Nene engine, which powered the British YP-80A and had 5000 pounds of thrust. (The Nene was later sold to the Soviets during that short window before the Cold War, and the Soviets used the Nene to power the MiG-15.)

A YP-80A was lost in testing, killing the pilot. The first production P-80A was making an acceptance flight when it killed Major Richard Bong, the highest-scoring US World War 2 ace. Other test pilots included Chuck Yeager. One of these test pilots had also flown a captured Me-262 and remarked that the YP-80A was inferior to the Me-262 in acceleration, speed, and climb rate.

The P-80A was armed with six M3 .50-caliber machineguns, the same as used in the F-86 Sabre. They were all located in the lower nose. It could also carry FFAR or HVAR rocket pods on its hardpoints or a pair of 1000-pound standard gravity bombs or napalm bombs.

One YP-80A was modified into an XF-14 reconnaissance variant, to test the suitability of the P-80A to that role. The XF-14 was found wanting, having neither the desired speed nor range. (The wingtip tanks were not yet fitted at this time.) Later, a small amount of P-80As were modified into the F-80A, which was an operational reconnaissance version. These were later redesignated FP-80A, later the RF-80A, and saw service in Korea. They differed from the XF-14 in having the wingtip tanks and a cleaner configuration, and the guns were removed to make room for the cameras. Later, one modified P-80A was made over to the XFP-80A model, which tested a hinged nose for access to the cameras. The hinge was found to loosen during landing, takeoff, and taxiing, and the model never made it to production.

49 P-80As were acquired by the US Navy for training purposes. Though the Navy was developing its own carrier-based jets, they were at first not enough to allocate Navy jets for training purposes. These aircraft, designated TO-1 (later TV-1), had an arrester hook, hinged wings, and strengthened landing gear. Despite being used as jet conversion trainers, they carried full armament. They didn't

have quite the performance of the P-80A due to their heavier weight, though this is partially mitigated due to the more streamlined nose. Experience in this model was later applied to the T-33 trainer version.

Other P-80A variants include the DF-80A, which had a second seat to carry a drone director, in the days before the drone director was in a ground station. The QF-80A is a target drone version. Some P-80As were actually built by North American, and these were designated the P-80N. These will not be covered further.

Combat Service: The P-80C/F-80C

The F-80C was an improved model of the P-80A, with the primary improvement being the use of a more powerful version of the Alison J33 engine. Armament remained the same in the P-80C. As a fighter, the F-80C was handily outclassed by the MiG-15, though one F-80C pilot did actually manage to shoot down six MiG-15s, and others shot down several Yak-9s and Il-10s. As the F-86 came to the Korean Theater, the F-80C was used as a ground attack fighter/bomber, a role in which it excelled. By the end of the Korean War, the only F-80Cs flying combat missions were RF-80C photo reconnaissance aircraft.

The J33-A-27 turbojet developed 4600 pounds thrust. The engine also had a water/alcohol injection system which allowed the pilot to increase thrust to 5400 pounds thrust for 20 seconds total in flight, giving the F-80C short bursts of high acceleration and speed. (This was, in essence, a primitive form of an afterburner.) The injection system came in handy during the Korean War, as at first the F-80C was deployed as an air superiority fighter. The RF-80C was the same as the RF-80A except for the improvements brought by the F-80C. Some F-80Cs were actually rebuilt F-80As.

Some 113 F-80Cs were lost to ground fire, 14 to enemy aircraft, 54 due to unknown causes, and 96 were lost to training and testing accidents. F-80Cs were credited with 17 air-to-air kills and another 24 air-to ground aircraft kills.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
XP-80	$812,790	JP-A	907 kg	5.31 tons	1	10	None	Enclosed
XP-80A #1	$812,790	JP-A	907 kg	5.31 tons	1	10	None	Enclosed
XP-80A #2	$846,790	JP-A	907 kg	5.44 tons	1	10	None	Enclosed
YP-80A	$846,790	JP-A	907 kg	5.33 tons	1	10	None	Enclosed
YP-80A (British)	$879,790	JP-A	907 kg	5.33 tons	1	10	None	Enclosed
F-80A	$846,790	JP-A	907 kg	5.53 tons	1	10	None	Enclosed
F-80C	$906,790	JP-A	907 kg	5.53 tons	1	10	None	Enclosed
XF-14	$1,526,900	JP-A	151 kg	5.28 tons	1	11	None	Enclosed
RF-80A	$1,526,900	JP-A	151 kg	5.48 tons	1	11	None	Enclosed
RF-80C	$1,635,090	JP-A	151 kg	5.48 tons	1	11	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
XP-80	1474	409 (100)	NA 68 5/3 50/30	1609	913	13716*	FF2 CF2 RF1 W1 T1
XP-80 #1	1474	409 (100)	NA 68 5/3 50/30	1609	913	13716*	FF2 CF2 RF1 W1 T1
XP-80 #2	1912	531 (100)	NA 70 5/3 50/30	1609	1219	13716*	FF2 CF2 RF1 W1 T1
YP-80A	1951	542 (100)	NA 90 5/3 50/30	1609	1219	13716	FF2 CF2 RF1 W1 T1
YP-80A (British)	2419	672 (100)	NA 112 5/3 50/30	1609	1516	13716	FF2 CF2 RF1 W1 T1
F-80A	1881	523 (100)	NA 87 5/3 50/30	3350	1219	13716	FF2 CF2 RF1 W1 T1
F-80C	2155	599/701** (100)	NA 100/117** 5/3 50/30	3350	1399	13716	FF2 CF2 RF1 W1 T1
XF-14	1969	547 (100)	NA 91 5/3 50/30	1609	1219	13716	FF2 CF2 RF1 W1 T1

RF-80A	1898	527 (100)	NA 88 5/3 50/30	3350	1219	13716	FF2 CF2 RF1 W1 T1
RF-80C	2174	604/707** (100)	NA 101/118** 5/3 50/30	3350	1399	13716	FF2 CF2 RF1 W1 T1

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
XP-80/YP-80A/F-80A	None	820/680m Hardened Runway	+1	6xM3 Machineguns, 2 Hardpoints	1200x .50
F-80C	IFF	820/680m Hardened Runway	+2	6xM3 Machineguns, 2 Hardpoints	1800x .50
XF-14/RF-80A	None	820/680m Hardened Runway	None	None	None
RF-80C	IFF	820/680m Hardened Runway	None	None	None

*Though the XP-80/YP-80A are capable of this altitude, the cockpit is not pressurized.
**The F-80C and RF-80C are equipped with a water/alcohol injection system, which increases the speed and acceleration to the figures on the right side of the slash for up to 20 seconds.

North American F-86 Sabre

Notes: Upon its entry into the Korean War, the US Air Force was armed with a variety of elderly and otherwise inadequate fighters, from the F-51 (essentially an upgraded P-51D) to the F-80 (the Air Force's first operational jet) to the F-84 and the night fighter F-85. And the North Koreans entered the war with a fighter that was more than their match - the MiG-15. Small, powerful, swept wing, with phenomenal climb rates and near-sonic performance, US Air Force (and Navy and Marine) losses became unacceptably high in a hurry. American pilots were told not to engage the MiG-15 if it could at all be avoided.

Now the F-86 was available for the start of the war, just not in large numbers, as brass felt their jets could handle the MiGs. This was quickly proven wrong. And the Sabre went up and tangled with the MiG-15 in larger and larger numbers and with better pilots (many of whom were World War 2 fighter pilots) and made mincemeat out of them. And thus, an American legend was started. The Sabre would fly with various air forces around the world until 1993.

The XP-86

In 1949, the XP-86 entered testing service with the USAF in 1949, after a design period starting in 1944 that basically took a P-51 and dropped a jet engine in it and moved the guns to the sides of the intake. The straight wings and tail did not last long, and quickly became swept on the strength of captured Nazi data.

The project was called NA-134, and began as a US Navy fighter that could be carrier based. Hence the broad straight wings. This became the XFJ-1 Fury. (More on that later.) The fuselage was rather tubby, and the wing, borrowed from the P-51D, was a laminar-flow wing which, though advanced when the P-51 was designed, was now old hat. The intake was in the nose, and it was powered by a GE TG-180 turbojet which was a license produced British Goblin engine. Power produced was 4000 pounds thrust. However, the wings and tail were replaced by swept surfaces, and performance received a quantum boost. By the end of the test program, three prototypes had been made.

F-86A "Sabre-Able"

The Air Force actually received its first 33 F-86As in late 1946, while it was still part of the Army, and at first received the designation P-86A. The Army received the P-86A even before the XP-86 prototype had flown, as North American gave the XP-86 some modifications and let the P-86A out for field testing at Muroc Dry Lake. North American equipped the P-86A with many of the features being tested on the XP-86, such as deletion of the fuselage speed brake, and rear-opening speed brakes on the rear of the fuselage instead of front-opening brakes. A big difference between the XP-86 and the P-86A was the engine -- J47-GE-1, with an extra compressor stage, and delivering 4850 pounds of thrust. Another change was the gun bay doors, which opened automatically when the pilot fired and closed automatically after that. Though the P-86A was heavier, the increase in thrust increased the speed and climb rate.

The P-86A was armed with six M3 versions of the M3, which were longer and had a greater ROF of 1100 rpm. Each gun was fed from a tray in the lower front fuselage below the guns; each tray carrying 300 rounds. The P-86A had two underwing hardpoints which were wet, and often used for extra range when doing MiG patrols as each carried 782 liters in an aerodynamic package. Bombs or rocket launchers could also be carried. Military avionics was added, including a long-range radio, a radar compass, and an IFF set. The IFF, new tech at the time, was equipped with a self-destruct that actuated upon a crash. The IFF was a simple model that allowed the pilot to tell between a friendly aircraft and an enemy one. The P-86A had an ejection seat, though the canopy had to be manually-jettisoned.

In June 1948, the advent of the US Air Force caused a change in designation to F-86A. The canopy windscreen had a v-shape instead of the rounded windscreen. In addition, an optical lead computing gunsight was added, which improved accuracy in combat. There was then a hiccup in the production of the J47-GE-1; the hole was filled by the similar-thrust J47-GE-3, and then the high-performance J47-GE-7, offering 5340 pounds thrust. At this point, full production resumed. None of the initial P-86As ever entered squadron service, and a second production batch of 188 were ordered early in 1949. This 188 had an automatically jettisoning canopy. Wing slats operated automatically instead of having to be set by the pilot. Controls were given a power boost, something the MiGs did not have, allowing the F-86As to stay in control as speed or Gs increased to near-sonic speeds of Gs of 6+. Another 333 were ordered, but these had a different engine that had 5200 pounds of thrust. Beyond the 282nd of that batch, they were given improved boosting for their controls. Third batch F-86As were equipped with a new sight and a radar gunsight, further improving accuracy, and this was retrofitted to the second batch.

In 1951, some F-86As were retrofitted with the J47-GE-13 engine, which delivered 5450 pounds of thrust.

Photo reconnaissance was a problem in the Korean War. Various platforms were tried: the RF-80, RB-45C, F-9F Panther, F-84. All proved to not have the speed to operate against MiGs unescorted, essentially necessitating a strike package for what should be a flight of 2-3 aircraft. To solve this problem, several F-86As were modified to become the first reconnaissance platforms based on the F-86, the RF-86A. Modifications were not extreme; the two lower port guns and their ammunition were removed and replaced with cameras; the four other guns were retained and the RF-86A was, for all intents, an armed reconnaissance platform. Engines were generally the most powerful available. Later versions carried more cameras; these retained only the upper two guns with limited ammunition capacity. These were much lighter and faster than conventional RF-86As. Most carried extra fuel tanks on their hardpoints to keep the fuel on hand for a high-speed runup to the target.

F-86B

The F-86B grew out of simple desire -- allow the Sabre to operate out of soft field forward bases by using larger, softer tires and screens for its intake. In practice, those larger, softer tires led to a huge set of modifications -- the wheels required larger wheel wells, which required that the fuselage be widened by nearly 18 centimeters, which required a more powerful engine to maintain performance. This changed the Sabre so much that it required a change in designation to F-86B. In the end, improved landing gear of normal size and better wheel brakes meant that the F-86B was not required, and development was not continued. The F-86B will not be discussed here in any more detail.

F-86C (YF-93A)

This penetration fighter version of the Sabre was so heavily modified that is it's Sabre roots are barely recognizable. If I do this, I will put it in the Best Aircraft Never Made, instead of here.

F-86D

Being the best fighter in the Air Force at the time, the Air Force wanted a high-speed, all-weather interceptor version of the Sabre for incoming strategic bombers. To this end, they began testing such a version in mid-1949. Some 979 were built. They were often called the Sabre-Dog, and for a short time, were given the designation F-95, as the F-86D had only 25% parts commonalty with the F-86A progenitor. The F-86D began service in late 1952. Exportation was not allowed until 1958, but then, exports were made all over Western Europe, the Far East, and even Albania and Yugoslavia. F-86D served until 1980.

Many of the onboard controls were automated, as most such interceptors in the past were two-seaters and there was a need to relieve the single pilot of the F-86D from having to monitor minor operations of the aircraft, especially the engine. This need to automate monitoring, along with the SAGE requirements, necessitated the first flight computers incorporated into a fighter aircraft. A radar intercept system was installed that allowed ground control to automatically guide the Sabre to it's interception point. The F-86D was built around a J47-GE-17 afterburning turbojet, and was provided with electronic fuel control so that as little fuel as possible was used, including auto cruise. The afterburner was used because an interceptor would need to climb to altitude fast, but did eat fuel. (This started a problem that would not be fixed until the advent of the F-22 decades later.)

The nose required heavy modification. The nose was made bulbous, with the intake becoming a wide smile below this radar-carrying nose. The radome was 76 centimeters wide, covering the 38-centimeter width of the search radar, giving it room to oscillate and search the sky. The Radome included a Radar Gunsight matched to the radar range. At first, the .50 M3s were to be replaced by 20mm cannon; however, a more sure destructive potential (in theory) would come if they used a fuselage drop-down tray with a battery of 24 2.75-inch FFARs (called Mighty Mouses). One-quarter or one-half of them could be launched at a time against a single target, or all of them in a gigantic ripple against one target for a surer kill. The actual firing moment was chosen by computer and not the pilot. The F-86D had an E-4 radar gunsight which offered range matching its radar range.

The early engine gave 5000 pounds thrust, or 6650 with afterburner. This was a preproduction version of the J47-GE-17; the production version could reach 5425 pounds thrust or 7500 in afterburner. Even later versions has a J-47-GE-17B, with 5500 pounds thrust or 7650 with afterburner. The rear fuselage has a smaller outlet, with vortex generators added to the tail and rear fuselage to increase stability. Piloting the F-86D always required careful piloting, due to the addition to an all-moving tailplane, which the pilots complained has an artificial feel. Various fixes over the career of the Sabre-Dog did not do much to combat this problem, and careful piloting was always required. Even the trial use of a rudder without a trim tab did not help; however, 36 such aircraft were built, followed later by 200 such aircraft, but with a manual trim tab.

Other modifications included an HF command radio in addition to the VHF long-range radio. A new glide path indicator was added, and an exhaust temperature gauge was added to the control panel. The F-86D-30-NA introduced an Omnidirectional Ranging Set, which allowed the radar to get the range to a target at a wider angle than the tight angle required by earlier ranging systems. A primitive inertial navigation set was added to later models.

The large amount of radar and electronic subsystems required an enormous amount of training on the part of its pilots, even more than the B-47 with its nuclear load. Despite the simplification I have presented here, the number of blocks of F-86Ds took very different maintenance requirements.

In the early 1950s, the need for a interceptor to take down Soviet bombers was realized. However, the US did not want to employ the advanced F-86D overseas, largely due to it's advanced fire control and radar suite. The result was a "dumbed down" version with downgraded radar and cannons instead of the FFAR armament. This was the F-86K. The first such aircraft were made from kits manufactured in California and assembled by FIAT in Italy, who would assemble them for European concerns. 50 were also fully assembled in California in order to kick-start deployment. The F-86K did have some interesting components that the F-86D did not have, such as a modicum of primitive ECM and ECCM and a low-tech computer that computed proper range for the 30mm cannons and then suggested a breakaway point to avoid debris from damage to the bomber (something that, in reality, would take a supercomputer of the time). The cannons used were M24A1s (the same as HS 404s). These were lighter cannons to partially offset the weight of the avionics in the nose. Originally, the F-86K was to have had a two-man crew, but adding a second crewman would enlarge the aircraft unacceptably, seriously affecting performance. essentially altering it into another subtype.

The wings used on the F-86K were the F-40 wings. Italy, Norway, Netherlands, Germany, Venezuela, Honduras, (from Venezuela; only two actually airworthy), and Turkey.

The F-86L was for the most part simply standard late model F-86Ds which had been modified to operate in the SAGE (Semi-Automatic Ground Environment) system, which partially automated bomber intercepts over North America. The modifications began in 1956. A receiver/datalink was added to enable the automatic two-way passing of data and instructions. This meant that a blade-like antenna was added to the starboard wing root. A new very-long-range radio replaced the HF set of the F-86D. A new IFF replaced the old one. A glide slope receiver was added to further facilitate intercepts.

By 1965, all F-86Ls had been replaced by F-102s. The only foreign used of the F-86L was Thailand, who used them until 1976.

F-86E

The F-86E was designed in the early months of the Korean War, based on flight test experiments and experiences from the F-86A. Chief among these was a perceived loss of control at near sonic speeds, particularly in steep dives. In the F-86A, the controls were actuated by cables with a hydraulic boost; in the F-86E, the hydraulic boost was applied directly without the cables, which provided more positive control, in normal maneuvering as well as in dives and near sonic flight regimes. Externally, the only difference was a bulge near the the front of the horizontal stabilizer to house the gearing mechanism, as the rear surfaces of the F-86E were an all-flying tailplane, which provided even more control in maneuvering and in near-sonic flight. The fully-hydraulic controls did have their detractors -- many pilots felt that they had lost their feel for the control surfaces and control of the airplane, and as a result many preferred the Sabre-Able. An artificial "feel system" was created for the F-86E, which was no more than a bungee-and-bobweight affair. Thereafter, the F-86E has performance slightly better than the F-86A.

Internally, the radar gunsight model used on the late F-86A was made standard on the F-86E. In addition, the J47-GE-13 engine used in some late F-86As was made standard on the F-86E, and provided 5450 pounds of thrust.

As many pilots preferred the F-86A, there was no hurry to replace them. As a result, all F-86As were not replaced until mid-1952. This was exacerbated by the licensing of the Canadian Sabre Mk 2, which was essentially a F-86E with some changes. (The Mk 1s were essentially stock late model F-86As.) The USAF leased them back from the Canadian Forces, in many cases leasing entire production runs. Differences can be seen below. though virtually all leased aircraft were sent straight to California to be fitted with American gear, then sent straight to combat squadrons in Korea.

Canadian Sabre Mk 2s used optically-flat glass for it's windscreen instead of the V-shaped windscreen of American Sabres. The instrument panel layout was altered, though again they were refitted before going to American units. They were otherwise stock F-86Es. It should be noted that a Canadian production run called E-10 went directly to combat duty, without modifications. Wings were replaced with F-40 wings.

F-86F

The F-86F was the most numerous of the Sabres built. It was essentially an F-86E with a more powerful engine, the J47-GE-27, developing 5910 pounds of thrust. The engine was originally going to go into a subtype of the F-86E, but then the Air Force decided to make other changes, and the aircraft was designated F-86F. Design work began in mid-1950, almost as soon as the F-86E began to roll off the production lines. The F-86F marked the return to service of the Curtiss-Wright Aeroplane Division plant, which fell into disuse and had not seen manufacturing since the end of World War 2. The initial contract was for 109 aircraft, followed closely for 333 more aircraft, and then another 441 Sabres.

Manufacturing pace was high, but engine manufacturing pace was lacking. The first 132 aircraft out the doors were essentially F-86Es with most of the other improvements and modifications for the F-86F, but the engines of the F-86E. These were designated F-86E-10. They had the new optically-flat windscreen, and a slightly different instrument panel layout. All told, about 1400 F-86Fs were built.

Combat introduction was slowed while the new engine was unavailable, though they were introduced as fast as they were received. The new F-86Fs finally saw the combat zone in mid-1952, and began making an immediate mark with their faster speeds and relatively less fuel consumption, as well as being able to follow MiGs up to their service ceiling (older F-86s had to break off pursuit at high altitude, a shortcoming the MiGs often exploited).

The F-86-5 introduced the F-86F to the ability to carry 757-liter drop tanks due to stronger hardpoints. The F-86-10 introduced the robust new A-4 radar gunsight, replacing the A-1CM that was prone to breakage in high G flight. It was easier to use as well. The last 100 in the original contract were F-86F-15s, which buried vital control connections further inside the aircraft and behind semi-armored metal to decrease damage from enemy fire. Experience showed that even a minor hit or near miss from a MiG could cause a loss of an aircraft.

Later, Sabres were called upon for the ground attack role, but this requires the use of the hardpoints normally used for fuel tanks, severely limiting range. This was fixed by another set of underwing hardpoints, though only the inner tanks could be used for stores This was the F-86F-30. The F-86F-30 also tested an innovative new wing -- no combat slats, but decreasing wing loading by increasing the size of the wing. Since the wing root increase occurred in front of the wing spar, the space could be used for extra fuel carriage. A wing increase also occurred at the trailing edge. the "6-3 wing" eliminated the need for maneuvering slats, the decrease in wing loading taking the place of them and more. Other F-86Fs were quickly converted to this standard. At this point, the F-86 could now outmaneuver the MiG-15.

The F-86F-35 was a little-known version -- is was capable of delivering the Mk 12 Special Store -- in other words, a 12 kt nuclear bomb. It has a special computer to compute the RP, after which a high, sharp Immelman was to be executed to reverse direction and increase altitude. The -35 could also carry conventional stores and drop tanks.

A version of the F-86F-30, under Project Haymaker, was converted, and later purpose-manufactured, into RF-86Fs. They were unarmed, and all four hardpoints were generally fitted with drop tanks. They had a bulge on the starboard side for the camera suite and 340 kilograms of ballast on the now-empty port side of the nose to balance the nose. fake gun ports were painted on each side to fool the marauding MiGs. Eight were built for action in Korea, but arrived not long before the cease-fire. They reportedly continued to operate on some classified missions after the Korean War for a short time. For game purposes, they are treated as standard late-model F-86Fs except for the lack of armament.

The F-86F-35 was for the most part the final version built for the USAF, but a later version of the F-86F, the -40, was built for Japan. These aircraft were built as kits in California and shipped to Japan, where they were assembled by Mitsubishi. (As a result they are sometimes called Mitsubishi F-86Fs.) The -40 was an almost standard -30, but in addition to the 6-3 wing, it had the old maneuvering slats. This markedly reduced stall speeds as well as improved low-speed handling. In addition, the wingtips were extended, further decreasing wing loading and reducing stall tendencies further (particularly wingtip stalls). While on the rest of the F-86Fs, the aileron extended all the way down the wing, on the -40, it was a separate control surface.

After the USAF could see what the -40 could do, they had upgrade kits made for their F-86Fs. In addition, several foreign air forces ordered the same upgrade kits for their F-86Es and Fs. This version was first shipped to Japan in mid-1955, with work completed at the end of 1956, and modification taking place thereafter in their various countries and the US. Later, hardpoints were added for the carriage of two Sidewinder missiles. (F-86Es and Fs were also given this modification.)

F-86F "Gunval"

The pilots had a lot of good to say about their F-86s, particularly the F-86F. But one thing they didn't like was their guns -- the .50 M3s were perceived to be lacking in range and punch, and in some cases, speed of projectiles. The MiG-15 turned out to actually be a tough little adversary, and some two-thirds of MiGs were able to beat a retreat over the Yalu despite being riddled with machinegun fire. The pilots wanted cannons. They had to be light in weight but superior in as many ways as possible, and with the aircraft able to carry as much ammunition as possible (the MiGs had cannons, but little room for ammunition). The result was the Gunval program, which was on the F-86F-1. Ten F-86Fs were taken off the manufacturing line after completion and modified with four T-160 (M39) 20mm autocannons. This, of course, required redesigned gun bays and feed mechanisms, including stronger gun mounts, a new blast panel between the guns, a strengthened nose, and small doors cut inside the air intake in order to vent the firing gasses and to cool the guns.

The gun vents were the first thing to go; the firing gasses caused the engine to flame out immediately when the guns fired. At lower altitudes, this was not a problem -- firing the guns did not flame out the engines. However, at 7000 meters or higher, the lesser amount of oxygen in the air coupled with the gun gasses meant that the engine simply could not get enough oxygen at these altitudes. Finally, bleed holes at the bottom of the guns and horseshoe-shaped clips on the recessed trough of each gun broke up the gas enough to not have it sucked down the intake en masse.

These aircraft were sent to Korea for combat testing. They were quite successful, racking up 9 kills and 13 damaged MiGs. The guns would appear again on later models of F-86s, and the ten that came out of Gunval were sent to the Colorado ANG's Minuteman demonstration team.

TF-86F

In early-1953, a trainer version of the F-86F was proposed, and based on the -30. The student's cockpit was placed just ahead of the instructor's. The aircraft was based on a very early F-86F, and did not have the 6-3 wing, and instead retained the leading-edge slats. Fuel tanakage was actually greater than the very early F-86F on which this version was based, and despite the increase in length was only 91 kilograms heavier. The pilot and instructor are seated under a long clamshell canopy. To combat the change in COG, the wing had to be moved forward about 20 centimeters.

The TF-86F first flew on late-1953. Then, two crashes occurred in 1954 in what should have been easy maneuvers. Early F-86E/F maneuvering slats were added. The program was eventually scrapped, (though the slats solved the low-speed handling problem) but it served for many years as a chase plane with cameras added,

Unlike many trainers, the TF-86F was armed with a pair of guns in the upper bay.

F-86H: The Fighter-Bomber

The USAF felt that a purely fighter-bomber version of the F-86 should exist, so development of the F-86H was started in early-1951. It marked a radical redesign of the Sabre, primarily to make the aircraft bigger and more powerful to carry a larger load. The first adaptation towards a larger load was a new engine, a GE J73-3D, with 8920 pounds of thrust. This meant adding another 15 centimeters to the length at the intake, then another 61 centimeters at the mid-point of the fuselage. At the same time, the fuselage was widened by a few centimeters, and the air intake was spit in two to help even airflow. The horizontal stabilizer was some 7.6 centimeters taller than on an F-86F.

Originally, the design was to have the slatted wing extensions, but this was later changed to the 6-3-type wing. The first F-86H's were to have six M3 machineguns, but these were later replaced with 20mm Cannon with the -5s (T-160s or M39s, which are the same as KAAs). The aircraft was to have nuclear bombing capacity, and therefore had the electronics for it, an M-1 LABS toss-bombing suite. First flight was in mid-1953, though it did not have the top speed with ordnance that they were told to expect. The combat radius was longer; the extra fuselage space was partially filled with fuel, more than any other Sabre variant. The first operational service of the F-86H was in the fall of 1954. Production run was however rather short and shortened even more, due to the design limitation of subsonic flight. Later F-86Hs had a modicum of RCM, and all remaining Hs were fitted with the F-40 wing (the -10s).

Many F-86Hs ended their service in ignoble ends as QF-86Hs, destroyed by missiles. Some however, saw a different fate: those with the lowest miles were taken on to TOP GUN fighter training school in the US Navy, as when clean or with tanks, they had performance similar to the MiG-17. These were later superseded by A-4s being retired from Navy and Marine service.

Navalized Sabres: The Furies

FJ-1

The first "Sabre" was the FJ-1 Fury. This was essentially a stubby, straight-winged shadow of the later F-86 built for the US Navy and Marines, built by taking a modified P-51 fuselage, the same wing and tail, and a new jet engine with a nose intake. 100 were ordered. Originally, the FJ-1 was equipped with slatted wing air brakes, but these were later changed to fuselage-mounted "barn-door" brakes. The slow acceleration speeds of the FJ-1 led directly to the adoption of the catapult on Navy carriers. The was faster than the F-80 in straight-line dashes, but became difficult to handle when loaded with items such as bombs, rockets, and fuel tanks. It also had no cockpit pressurization or heating. The FJ-1 was equipped with 625-liter wingtip tanks, there were feed problems and again, the aircraft performed poorly with them mounted, particularly because of the laminar-flow wing, and this was never really cured despite a "fix" by North American. The wing was also too thin to accommodate hardpoints.

The FJ-1 operated until 1949, when they were replaced by F9F Panthers, with the FJ-1 moving to the training role. The pilots were glad to see them go.

FJ-2

The FJ-2 Fury came after the Navy was forced to bite the bullet; all of the Navy's straight-wing fighters were no match for the MiG-15 in a dogfight. Their fastest aircraft, the F9F-2 Panther and the F2H Banshee were 113 kilometers per hour slower than the MiG-15. Though naval aircraft of the period were capable fighter-bombers, they simply could not go toe-to-toe with a MiG-15. The Navy had their own problems with swept-wing carrierborne aircraft, mostly having to do with retrofits of stronger catapults and higher landing speeds.

The FJ-2 was basically a navalized F-86E (Early Model), and had only superficial resemblances to the FJ-1. Unlike the Air Force, the Navy and Marines preferred cannon armament for its aircraft and armed them with four Mk 12 20mm cannons (equivalent to the KAA). Carrier qualifications did not go well; problems from inadequate catapult power, weak landing gear and tail hooks, and damaged aircraft during takeoffs and landings were all too common. Another change from it's F-86E kin was the engine used: the J47-GE-2, with 6000 pounds of thrust. The FJ-2 had wings with the leading-edge slats of the F-86F, but not the 6-3 wing planform; it was believed that it would be too large for landing on some of the Navy's smaller carriers, and that it had a low-speed performance penalty. Wheel track was widened 20 centimeters, and the landing gear in general was beefed up and given harder tires to land on steel decks. Folding wings were fitted.

Unfortunately, the Air Force had priority on Sabre orders, and by the time of the Armistice in Korea, only seven had been delivered, and none had actually seen combat action. The order was cut back from 300 to 200. In addition, the Fury had a competitor, the F9F-6 Cougar, which was a better carrier aircraft and performance a slight bit better than the FJ-2. The 200 FJ-2s were relegated to land-based Marine squadrons, though one of these squadrons saw carrier service in 1955.

FJ-3

The FJ-3 proved from the outset to have much less problems than the FJ-2, and also used a much more powerful Wright J64-W-2 (a US version of the British Sapphire engine) and had a phenomenal thrust of 7650 pounds, though of course, design limitations took a lot away from this high engine ourtput. In addition to the quartet of four 20mm cannons (with more ammunition), the FJ-3 had an armored cockpit. Leading edge slats were not used; instead a wing with larger area was used, good for low-speed characteristics, and able to carry more fuel. An aerial refueling probe was added to the starboard wing. 1956 they were modified to carry the Sidewinder, and such aircraft were designated FJ-3M. Despite popularity with its pilots, the Navy felt that it was an aircraft for an earlier era and but its orders for it drastically.

FJ-4

In June 1953 were basically looking for what would become the last gasp of the Fury -- the FJ-4. It was to have a design speed of 0.95 Mach, thusfar unobtainable in the Sabre design. The design called for an almost all-wet wing of exceptional thinness, and a modified fuselage that held the most internal fuel held in a Sabre. A tank was added below the engine, as well as one in a dorsal spine that extended from the rear of the cockpit all the way to the tail. The wingspan was increased by two feet, but were exceptionally thin and were furthermore made of very thin aluminum plates. The wingtips tipped about four degrees as 4 inches from the wingtips to improve low-speed characteristics. The wings' sweepback was increased to 35 degrees, to help high-speed characteristics. Like almost all naval aircraft,
The wings folded just inside their halfway point. They were powered by a Wright J65-W-16A developing 7700, but the new design was also to help in the speed department. Armament consisted of the standard four 20mm cannons. The innernmost hardpoint could carry racks for two sidewinders each, and the other hardpoints could carry weapons or fuel tanks as desired.

The FJ-4 was meant to serve as a fleet point defense aircraft with some limited ground attack ability, but a variant called the FJ-4B was designed from the outset as a fighter-bomber. The FJ-4B was actually built in larger numbers than the FJ-4; 139 FJ-4s were built, and 222 FJ-4Bs The primary design change between the FJ-4 and FJ-4B is the strengthened hardpoints, able to carry heavier stores. The wings had an additional set of spoilers, and had six hardpoints and two hardpoints for Sidewinder AAMs. It has yet another pair of spoilers ad the bottom of the fuselage, The FJ-4B could also land hotter during carrier landings, increasing the safety margin in the case of a bolter. The FJ-4B had an auxiliary generator installed, as a backup and to allow self-starts. It was capable of carrying the Bullpup ASM, which was command-guided and the aircraft had additional avionics to allow this. The FJ-4B had the LABS system and could deliver Special Store 12.

The FJ-4 was retained in Naval Reserve squadrons until the mid-1960s, when it was finally retired. Many ended their operational lives in museums; more ended up as ground targets or as QF-1E or QAF-1E target drones.

In 1962, the FJ-2 was redesignated the F-1C, in accordance with the tri-service designation system. The FJ-3 was redesignated the F-1D, and the FJ-4 was redesignated the F-1E. The FJ-4B was designated the AF-1E. The designations F-1A and F-1B were never assigned, though it has been speculated that they were reserved for the FJ-1 and early model FJ-2.

Foreign-Built Sabres

Canadian

The first license-producers of the Sabre were the Canadians, specifically the Canadair Company. The CL-13 Sabre Mk 1 was essentially an F-86A, built from a kit at Canadair to test its knowledge and ability to accomplish the task of building a Sabre. Only one Mk 1 was built. The Mk 2 was essentially an F-86E, with some minor changes in the instrument panel and other minor features. In an interesting turn of events, the USAF bought almost all of the Mk 2s back built at the time in early 1952 to fill needs in Korea. This amounted to some 60 aircraft.

The Mk 4 was essentially the same aircraft as the Mk 2, except for minor changes such as more efficient cockpit air conditioning, a gyroscopic compass, improved pressurization controls, and an improved canopy release. It was originally meant to use the Canadair-built Orenda engine, but it was not ready in time for incorporation into the Mk 4 (as the Mk 3 and 4 were concurrent in production. It was decided to make the Mk 4 a variant of the Mk 2.

The Mk 3 was that Sabre with the Canadair Orenda 3. This gave 6000 pounds thrust, but required a slight fuselage redesign; for example, the Orenda engine was wider, so the fuselage had to become wider. The Mk 3 is sometimes referred to as the F-86J, as the US was going to buy some Orenda engines from Canadair and power a new version of the Sabre with them.

In 1958, Canadian Sabres were modified to carry a pair of Sidewinder AAMs.

The CL-13A Mk 5 was powered by the 6355 -pounds thrust Orenda 10. Despite the increased engine power, it was possible to wring only so much speed out of the Sabre design, and the hoped-for sustained-transonic speeds did not materialize. The Mk 5 did have the 6-3 wing, along with a set of tiny wing fences for stabilization, giving the Mk 5 more stability than earlier Marks. However, without the leading edge slats, stall speed increased and low-speed aerodynamics deteriorated, and the increased power of the engine ate much more fuel. (Leading edge slats were later retrofitted to Mk 5s.) 370 were built, and partially replaced older Marks in RCAF service. Some 225 were also built for the Luftwaffe, again partially replacing earlier models. By 1962 the last Luftwaffe models had been scrapped, converted to range targets, museum models, or target drones.

The CL-13B Mk 6 was the last and most powerful of the Sabres, able to achieve near-sonic speeds at 6100 meters. This is due to an Orenda 14 engine with 7275 pounds of thrust; for a Sabre, climb rates were off the charts. The Mk 6 used the 6-3 wing, but with leading edge slats. The South Africans operated these at two-squadron strength.

Australian Commonwealth CA-27

For brute firepower in a Sabre, you can't beat the CA-27 with its pair of 30mm Aden autocannons. The engine to be used, the Rolls Royce-Avon RA7, was lighter and shorter than the standard F-86F engine, though much more powerful at 7500 pounds thrust. The air intake had to be increased in size at the front, and furthermore, an auxiliary intake was installed at mid-fuselage, with the intake being faired smoothly into the aircraft underneath. (This was to avoid having to make too large a modification in the cockpit area.) The engine had to be slid more to the rear of the aircraft to maintain the center of gravity, as the Avon weighed 182 kilograms less than the standard F-86F engine and was shorter. This led to mounting instabilities, and the end of the fuselage with its engine mountings had to be made shorter and the mid-fuselage extended. The supports for the exhaust also had to be redesigned, due to the shorter rear engine and the wider exhaust. Despite this, the overall fuselage dimensions were almost identical to the F-86F. Wings were F-40 wings, with the 6-3 profile and leading edge slats.

The original plan was to replace the .50 M3 machineguns with four British-made 20mm autocannons, but this was changed to a pair of 30mm Aden autocannons. By the time all the modifications were made, only 40% of the CA-27 was original.

Before production began, even more changes were made. A self-starter was installed, and the shorter engine allowed for an increase in fuel tankage; in addition, leading edge tanks were added, as on US F-86Fs. Hardpoints for two Sidewinder AAM were added inboard on the wings.

CA-27s saw combat use (mostly air support) during the Malayan Emergency from February of 1959 to July of 1960. They were also added to the SEATO Forces, and participated in the Thailand Crisis. In the 1960s until 1971, they flew combat support missions over Thailand in support of the Vietnam War effort.

Eighteen CA-27s were supplied to the Royal Malaysian Air Force, and they were also flown by the Indonesian Air Force. No. 11 Squadron flew the type until 1978. They then ended their careers as training aids, range targets, and target drones.

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Twilight 2000 Notes: Some 25 examples of these aircraft have been sighted over the US in the Twilight War, mainly in the American West and Southwest, though one noteworthy Sabre has been used extensively as a ground support aircraft by a MilGov unit in Central Florida against New America troops. Canada and Germany are also known to be home to some Sabres. A high-flying Sabre (assumed to be a CA-27) has been sighted through binoculars over Australia, but what its origin is is unknown.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
P-86A	$3,141,510	JP4	806 kg	6.4 tons	1	9	None	Enclosed
F-86A (Early)	$4,340,310	JP4	806 kg	6.4 tons	1	10	None	Enclosed
F-86A (Mid)	$4,917,510	JP4	806 kg	6.4 tons	1	10	Radar Gunsight	Enclosed
F-86A (Late)	$2,835,190	JP4	806 kg	6.4 tons	1	10	Radar Gunsight	Enclosed
RF-86A (Early)	$4,423,900	JP4	806 kg	5.78 tons	1	12	None	Enclosed
RF-86A (Late)	$4,277,470	JP4	805 kg	5.47 tons	1	12	Radar Gunsight	Enclosed
F-86D (Early)	$40,049,740	JP4	813 kg	8.24 tons	1	13	Radar Gunsight, Radar (30 km)	Enclosed
F-86D (Late)	$34,734,980	JP4	813 kg	8.24 tons	1	13	Radar Gunsight, Radar (30 km)	Enclosed
F-86E	$3,256,980	JP4	800 kg	6.61 tons	1	12	Radar Gunsight	Enclosed
F-86F (Early)	$4,157,080	JP4	800 kg	6.61 tons	1	12	Radar Gunsight	Enclosed
F-86F (Late)	$6,540,660	JP4	2.42 tons	6.61 tons	1	13	Radar Gunsight	Enclosed
F-86F Gunval	$6,340,180	JP4	2.42 tons	6.61 tons	1	13	Radar Gunsight	Enclosed
F-86F-40	$7,877,790	JP4	1.31 tons	6.89 tons	1	12	Radar Gunsight	Enclosed
TF-86F	$7,158,580	JP4	2.34 tons	6.67 tons	1	13	Radar Gunsight	Enclosed
F-86H (Early)	$7,734,160	JP4	4.74 tons	6.9 tons	1	14	Radar Gunsight	Enclosed
F-86H (Late)	$8,672,000	JP4	4.74 tons	6.9 tons	1	14	Radar Gunsight	Enclosed
F-86K	$43,213,340	JP4	1.78 tons	7.46 tons	1	14	Radar Gunsight, Radar (30 km)	Enclosed
F-86L	$39,406,040	JP4	1.62 tons	8.24 tons	1	14	Radar Gunsight, Radar (40 km)	Enclosed
FJ-1 Fury	$756,860	JP5	Nil	6.86 tons	1	8	None	Enclosed
FJ-2 Fury	$3,466,910	JP5	800 kg	6.61 kg	1	12	Radar Gunsight	Enclosed
FJ-3 Fury	$7,346,900	JP5	1.82 tons	7.11 tons	1	12	Radar Gunsight	Enclosed
FJ-4 Fury	$7,346,900	JP5	1.36 tons	10.75 tons	1	12	Radar Gunsight	Enclosed
FJ-4B Fury	$7,357,790	JP5	2.72 tons	12.25 tons	1	14	Radar Gunsight	Enclosed
CL-13 Sabre Mk 3	$3,982,960	JP4	800 kg	6.61 kg	1	12	Radar Gunsight	Enclosed
CL-13A Sabre	$4,185,860	JP4	1.08 tons	6.64 tons	1	12	Radar Gunsight	Enclosed

Mk 5								
CL-13B Sabre Mk 6	$4,311,300	JP4	1.08 tons	6.64 tons	1	12	Radar Gunsight	Enclosed
Commonwealth CA-27	$8,215,270	JP4	1.21 tons	7.25 tons	1	12	Radar Gunsight	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
P-86A	912	365 (90)	NA 87 8/4 80/40	1647	1039	14630	FF3 CF4 RF3 W2 T2
F-86A (Early)	992	397 (80)	NA 95 7/4 70/40	1647	1057	14630	FF3 CF4 RF3 W2 T2
F-86A (Mid)	959	384 (80)	NA 92 7/4 70/40	1647	1021	14630	FF3 CF4 RF3 W2 T2
F-86A (Late)	965	386 (80)	NA 93 7/4 70/40	1647	1027	14630	FF3 CF4 RF3 W2 T2
RF-86A (Early)	1120	520 (80)	NA 108 7/4 70/40	1647	1081	14630	FF3 CF4 RF3 W2 T2
RF-86A (Late)	1133	525 (80)	NA 110 7/4 70/40	1647	1036	14630	FF3 CF4 RF3 W2 T2
F-86D (Early)	754	350 (80)	NA 73 7/4 70/40	2556	1024	15118	FF4 CF4 RF3 W2 T2
F-86D (Late)	821	380 (80)	NA 79 7/4 70/40	2556	1118	15118	FF4 CF4 RF3 W2 T2
F-86E	1000	465 (75)	NA 97 7/3 70/35	1647	1100	14387	FF3 CF4 RF3 W2 T2
F-86F (Early)	1072	495 (75)	NA 104 7/3 70/35	1647	1064	14387	FF3 CF4 RF3 W2 T2
F-86F (Late)/Gunval	1072	495 (70)	NA 104 6/3 60/30	1893	1064	14387	FF3 CF4 RF3 W2 T2
F-86F-40	1030	475 (60)	NA 101 5/3 50/25	1893	1064	14387	FF3 CF4 RF3 W2 T2
TF-40F	1063	490 (90)	NA 104 6/4 60/30	2893	3986	15387	FF3 CF4 RF3 W2 T2
F-86H (Early)	1113	513 (70)	NA 109 6/3 60/40	2128	1786	15607	FF3 CF4 RF3 W2 T2
F-86H (Late)	1113	513 (60)	NA 109 5/3 50/25	2128	1786	15607	FF3 CF4 RF3 W2 T2
F-86K	1325	611 (60)	NA 130 5/3 50/25	2128	1710	15119	FF4 CF4 RF3 W2 T2
F-86L	821	380 (60)	NA 79 5/3 50/25	2556	1118	14387	FF4 CF4 RF3 W2 T2
FJ-1 Fury	720	335 (80)	NA 80 8/4 80/40	1760	806	9754	FF3 CF4 RF3 W2

							T2
FJ-2 Fury	1068	495 (75)	NA 119 7/3 70/35	1647	1178	14387	FF3 CF4 RF3 W2 T2
FJ-3 Fury	1096	508 (60)	NA 122 5/3 50/25	2120	1520	15120	FF3 CF4 RF3 W2 T2
FJ-4 Fury	1095	508 (60)	NA 122 5/3 50/25	3816	1520	15120	FF3 CF4 RF3 W2 T2
FJ-4B Fury	1011	469 (60)	NA 113 5/3 50/25	3816	1520	15120	FF3 CF4 RF3 W2 T2
CL-13 Sabre Mk 3	1034	479 (75)	NA 116 7/3 70/35	1647	1178	14398	FF3 CF4 RF3 W2 T2
CL-13A Sabre Mk 5	1110	514 (75)	NA 125 8/4 80/40	1647	1265	15240	FF3 CF4 RF3 W2 T2
CL-13B Sabre Mk 6	1144	530 (60)	NA 129 5/3 50/25	1647	1457	15240	FF3 CF4 RF3 W2 T2
Commonwealth CA-27	1127	522 (60)	NA 127 5/3 50/25	1920	1710	15119	FF3 CF4 RF3 W2 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-86A	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	0	6xM3, Two Hardpoints	1800x.50
F-86A (Early/Mid)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+1	6xM3, Two Hardpoints	1800x.50
F-86A (Late)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+2	6xM3, Two Hardpoints	1800x.50
RF-86A (Early)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+1	4xM3, Two Hardpoints	1200x.50
RF-86A (Late)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+2	2xM3, Two Hardpoints	300x.50
F-86D (Early)	IFF, Long-Range Radio, Radar Compass	740/450m Hardened Runway	+2	24x2.75" FFARs, 2 Hardpoints (Wet Only)	24x2.75" Rockets
F-86D (Late)	IFF, Long-Range Radio, Radar Compass, Inertial Navigation	740/450m Hardened Runway	+2	24x2.75" FFARs, 2 Hardpoints (Wet Only)	24x2.75" Rockets
F-86E/F (Early)	IFF, Long-Range Radio, Radar Compass	740/450m Hardened Runway	+2	6xM3, Two Hardpoints	1800x.50
F-86F (Late)	IFF, Long-Range Radio, Radar Compass	740/450m Hardened Runway	+2	6xM3, Four Hardpoints	1800x.50
F-86F Gunval	IFF, Long-Range Radio, Radar Compass	740/450m Hardened Runway	+2	4x20mm KAA Autocannons, Four Hardpoints	400x20mm
F-86F-40	IFF, Long-Range	740/450m Hardened Runway	+2	6xM3, Six Hardpoints	1800x.50

	Radio, Radar Compass				
TF-86F	IFF, Long-Range Radio, Radar Compass	740/450m Hardened Runway	+2	2xM3, Six Hardpoints	600x.50
F-86H	IFF, Long-Range Radio, Radar Compass	700/400m Hardened Runway	+2	4x20mm KAA Autocannons, Six Hardpoints	800x20mm
F-86K	IFF, Long-Range Radio, Radar Compass, ECM/ECCM 1	700/400m Hardened Runway	+2	4xHS-404 20mm Cannons, Six Hardpoints	540x20mm
F-86L	IFF, Long-Range Radio, Radar Compass, ECM/ECCM 1	700/400m Hardened Runway	+2	24x2.75" FFARs, 2 Hardpoints (Wet Only)	24x2.75" Rockets
FJ-1 Fury	None	700/430m Hardened Runway	0	6xM3, 2 Wingtip Hardpoints (Wingtip Fuel Tanks Only)	1500x.50
FJ-2 Fury	IFF, Long-Range Radio, Radar Compass	740/450m Hardened Runway	+2	4x20mm KAA Autocannons, Four Hardpoints	600x20mm
FJ-3/FJ-4/FJ-4B Fury	IFF, Long-Range Radio, Radar Compass	700/400m Hardened Runway	+2	4x20mm KAA Autocannons, Six Hardpoints	648x20mm
CL-13 Sabre Mk 3/5	IFF, Long-Range Radio, Radar Compass	740/450m Hardened Runway	+2	6xM3, Four Hardpoints	1800x.50
CL-13B Sabre Mk 6	IFF, Long-Range Radio, Radar Compass	700/400m Hardened Runway	+2	6xM3, Four Hardpoints	1800x.50
Commonwealth CA-27	IFF, Long-Range Radio, Radar Compass	700/400m Hardened Runway	+2	2x30mm Aden Autocannons, Six Hardpoints	400x30mm

F-100 Super Sabre

Notes: This post-Korean War jet was known to its pilots as the "Hun." It was one of the first production aircraft to exceed the speed of sound in level flight. Handling problems with early versions of the Super Sabre led to a checkered reputation as a "Widow Maker," but these were quickly rectified by increasing the size of the wing and tail surfaces. (The prototype of the F-100 did kill Joseph McConnell, the top scoring US ace of the Korean War.) These aircraft saw service with the US, France, Turkey, Denmark, and Taiwan, but were retired except as research aircraft by the late 1980s.

The F-100A was designed strictly as an air superiority fighter, but was used primarily as a strike aircraft in Vietnam. It was, as the name suggests, a basic fighter with few bells and whistles. It had a radar warning receiver and a radar gunsight, but no capability for air-to-air refueling. The strike ability was put into the Super Sabre because the new version of the Thunderjet was falling more and more behind schedule.

The F-100C was the first version of the Super Sabre to be manufactured in large numbers. It had a number of modifications and improvements to make it into an effective fighter-bomber, including better hauling ability, more hardpoints, and capability for aerial refueling through a probe mounted under the wing. In addition, fuel tanks were added to the wings to increase the total internal fuel capacity. A new more powerful engine was installed to cope with the increased weight.

The F-100D was the version produced in the most numbers. The idea of the Super Sabre having a secondary air superiority role was abandoned, and for all intents and purposes the F-100D was a strike aircraft. It was a bit more maneuverable. The F-100D was able to use almost all the weapons in the US inventory at the time, and was later modified (while in use by other countries) for other weapons.

The F-100F began as a trainer version of the F-100D. However, at this time, North Vietnamese and Viet Cong antiaircraft ability was becoming more sophisticated, and they were transformed into the first Wild Weasels. They were fitted with the ability to use the various ECM and EW pods that were becoming available, and the rear seat had a special set of threat warning displays. They were also used as FAC aircraft.

Twilight 2000 Notes: A few F-100s remained airworthy, and they were pressed into service late in the Twilight War to replace aircraft losses and provide air support to local forces.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-100A	$346,165	JP4	907 kg	11.34 tons	1	14	None	Enclosed

F-100C	$415,994	JP4	2.27 tons	14.79 tons	1	16	None	Enclosed
F-100D	$493,139	JP4	3.19 tons	15.8 tons	1	16	None	Enclosed
F-100F	$507,912	JP4	2.27 tons	17.75 tons	2	18	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F-100A	2726	682 (130)	NA 170 7/4 70/40	4898	4326	15545	FF3 CF3 RF3 W2 T2
F-100C	2957	739 (130)	NA 185 7/4 70/40	6442	4549	14966	FF3 CF3 RF3 W2 T2
F-100D	2765	691 (120)	NA 173 8/5 80/50	6583	4549	15240	FF3 CF3 RF3 W2 T2
F-100F	2765	691 (120)	NA 173 8/5 80/50	4898	4549	15240	FF3 CF3 RF3 W2 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-100A	RWR	1200/1000m Hardened Runway	+2	4x20mm M39 Autocannons, 2 Hardpoints	800x20mm
F-100C/D	RWR	1200/1000m Hardened Runway	+2	4x20mm M39 autocannons, 7 Hardpoints	800x20mm
F-100F	RWR	1200/1000m Hardened Runway	+2	2x20mm M39 Autocannons, 7 Hardpoints	400x20mm

Lockheed F-104 Starfighter

Notes: Design work on the F-104 began in the mid-1950s; even then, there were growing numbers of pilots and designers who felt that fighters were becoming too big, too heavy, and too sluggish. The brass and politicians felt that they were getting too expensive. The Starfighter was one of the first attempts to reverse this. The design featured short, slanted wings and a long, needle-nosed profile; the unusual design was a signature of Kelly Johnson's Skunk Works. A story (probably apocryphal) says that the first test pilot looked at the XF-104, turned to his superior, and said, "It's a beautiful mockup, sir, but where are the wings?" The Starfighter served briefly and in limited numbers with the US Air Force, but served into the 80s, 90s, and in Italy into the 2000s. Some eighteen countries used the Starfighter at one point; Greece, Taiwan, and Italy still use them in limited numbers. The Starfighter was not more difficult to fly than any other fighter, but it did take some getting used to; new pilots tended to be involved in an inordinate number of crashes, sometimes with fatalities, and the F-104 became saddled with the names Widowmaker and Flying Coffin. Virtually all of these crashes were attributed to pilot error. In the 1970s, 1980s, and 1990s, the Starfighter was a backbone of NATO air power.

XF-104

A few notes on the prototype are in order, though it will not be covered in the charts below. The first design study was given the code name Project 227. The aircraft which would become the XF-104 went through several drawing board iterations and mockups before a flying prototype was built. Lockheed began with an aircraft that had a marked resemblance to the Russian MiG-21; then the nose became solid and housed a radar unit, while the intakes moved to the wing roots. The high set tail which became the standard appeared at this point. Next, the wings were moved a bit higher on the fuselage; the next prototype had a chin-mounted intake and weighed a mere 3.63 tons (!). The next prototype introduced the straight ultrathin wing (though much larger than the Starfighter's eventual wings), with a weight of 6.8 tons empty.

The next design study was known as Project 242. The first proposal had the ultrathin straight wing combined with what would eventually become the Starfighter's trademark short wings. The wings were attached to fuselage-mounted air intakes. The forward canopy was a sharp V-shape. The next proposal had the same vertical tail, but with a low-mounted all-moving horizontal stabilizer. This was quickly moved back to the top of the vertical tail for stability reasons, and the vertical tail became an all-moving stabilator. The next proposal gave the aircraft a coke-bottle fuselage, which increased performance dramatically.

The next design project had the designation L-246. The wing acquired its low aspect ratio, long with a frontal edge sweep of 18 degrees. This did improve lift and high-speed performance, at the penalty of maneuverability; this was considered acceptable on an aircraft which was meant to be an interceptor. The leading edge of the wing was so sharp that felt bumpers had to be attached when on the ground to protect the ground crew. The new wing gave the L-246 a maneuverability potential of +10 to -3 Gs. The thin wings had the potential for a lot of flutter; this was solved by mounting a long, thin 644-liter fuel tanks on each wingtip, which could be replaced by a Sidewinder AAM. The use of boundary layer control increased lift and maneuverability at high speed, removing a potential crash hazard. Leading-edge flaps were added, which were lowered upon landing in concert with the flaps during landing or to increase maneuverability in low-speed maneuvering.

There was no room for fuel in the thin wings, so all fuel was carried internally inside3 the fuselage, in wingtip tanks, or in extra fuel tanks. There was also no space in the wing for wheels to retract into, so the wheels were made to retract forward into the fuselage. The wheels angled themselves automatically to allow proper retraction.

The then-new GE J-79 engine was chosen for the Starfighter; this early version had 9000 pounds thrust or 15000 pounds thrust in afterburner. Unfortunately, the J-79 was not available for two years, so initially Lockheed mounted a Wright J65-W-7 engine in the Starfighter.

A controversial aspect of the prototype and early models was the downward-firing ejection seat. The fear was that the pilot would be hit by the high tailplane upon ejection. This would lead to several unnecessary deaths over time until improved ejection seats allowed for safe upward-firing. A pair of 30mm ADEN autocannons were chosen as close-in armament; Sidewinders would fill the missile complement.

Lockheed was then informed that the USAF had no requirement for an aircraft like the XF-104. They then required a fly-off, against Republic's XF-91 Thunderceptor and North American's NA-212 (which would later become the F-107). The XF-104 was the most ready of the three aircraft and selected for development, but was destined for only limited USAF service as they "had no requirement."

After the trials, the gun armament was changed to the then-new M-61 Vulcan, with the gunsight integrated with the Starfighter's Type K-19 fire control system and AN/APG-34 radar and a computing gunsight.

Flight tests were marred by catastrophic problems when firing the Vulcan, causing anything from engine power-outs to crashes. This was traced to malfunctions in the Vulcan's feed system and rounds which did not have enough velocity, causing the aircraft to run into its own cannon shells when firing at high speed. This was combined with spent shells being sucked into the intakes due to a poor placement of the spent shell chute. The Vulcan would receive its first round of improvements.

All told, all four XF-104s were destroyed during flight tests. None survive today.

YF-104A

In mid-1954, the USAF ordered 17 test aircraft for a more thorough evaluation of the Starfighter. These were designated YF-104A; it was felt that if these aircraft checked out OK, they could apply the lessons learned in the service tests and bring them up to what would be the F-104A standard. At this time, the requirement for the Starfighter to perform interceptor duties was dropped, despite the high climb and level flight speeds.

By the time the YF-104A was ready, the J79 engine was too. The exact engine used was the XJ79-JE-3 turbojet, with 9300 pounds thrust or 14800 pounds in afterburner. The use of this engine meant that the fuselage had to be lengthened by 1.64 meters, as the J-79 was a longer engine. Other changes from the XF-104 included a taller tail, a forward-retracting nose wheel instead of the rear-retracting wheel of the XF-104 (this improved the safety of the downward-firing ejection seat), and a dorsal spine was added to the upper fuselage. Shock cones were added to the intakes. The fire control system was replaced with the AN/ASG-14T1 (no improvement in game terms) and TACAN was added. Two additional fuel cells were added to the fuselage, taking advantage of the increase in length as well as the narrower width of the J79 engine. Two hardpoints were added under each wing and a centerline wet hardpoint was added.

The first flight took place in 1956. Together with the first 35 F-104As, the aircraft were used to evaluate early J79s (such as the J-79-JE-3, -3A, and -3B). The kinks were ironed out of the Vulcan cannon, and the Sidewinder missile effectiveness was tested. The airframe was strengthened. A ventral fin was added to increase stability while supersonic. Some were used to set some new aviation records, most notably climb speed and altitude.

Four of the YF-104As met an ignoble end at QF-104A target drones; all were shot down. One was used by NASA until 1975; this aircraft can be seen in *The Right Stuff* as Chuck Yeager does a high-altitude run. It is now in the National Air and Space Museum. (It did not crash, as it did in the movie; a different NF-104 did. However, Yeager did crash an NF-104, and nearly died.) The other surviving YF-104 is in front of the Chapel at the Air Force Academy. Most of the rest of the YF-104s were converted to the F-104A standard.

F-104A

The F-104A was the first production Starfighter, with 146 delivered to the Air Force. The airframe was strengthened for maneuvering up to 7.33 Gs. Flap-blowing boundary layer controls were added; these also decreased stall speed and landing speed. The fire control radar was replaced by the improved AN/ASG-14T-2. The leading edge and trailing edge flaps could be engaged during low-speed maneuvering to improve turn rates. Speed brakes were added to each side of the fuselage.

A system was installed to warn the pilot of a stall; when near this speed, the stick would shake a little. If the pilot insisted on violating the aircraft's stall speed, the aircraft would automatically force the stick forward.

The first engines for the F-104A were the J79-GE-3 and J79-GE-3A. Both were initially unreliable, leading in some cases to flameouts (and the Starfighter flies like a brick when it is flown deadstick). Other problems with the engines were oil leakage, rough cruising performance, backfires, and ignition failures. The F-104A was grounded for a time in 1958 while these problems were chased down, and it was eventually determined that the variable-thrust afterburner was at fault. As no fix was then available, the F-104A was stuck with two afterburner settings: on and off, essentially limiting the F-104A to Mach 1 or Mach 2.2, with no intermediate speeds.

When the F-104A returned to service in late 1958, it was equipped with the J79-GE-3B. This provided a thrust of 9600 pounds, or 14800 pounds in afterburner. Another change was the replacement of the downward-firing ejection seat with an upward-firing one; this did not occur, however, before several pilots were killed by the downward-firing seat.

Originally, the F-104As were to replace the F-100 Super Sabres of TAC beginning in 1956. Unfortunately, TAC's requirements changed during the development of the Starfighter, and its relatively low range and the inability to carry a decent offensive weapons load meant that TAC lost all interest in the Starfighter and rejected them. This could have been the end of the line for the Starfighter, but the F-102s of the Air Defense Command were heavily showing their age and shortcomings, and delays in delivery meant that the F-106 would not be ready for months, if not years. Therefore, ADC took up the F-104A as an interim aircraft. Nonetheless, out of the 722 Starfighters the USAF was originally going to buy, only 170 F-104As were actually taken into service. The F-104As of the ADC were replaced by the F-101 Voodoo and F-106 Delta Dart, and the F-104As completed their service in the Air National Guard. 20 F-104As were converted to the QF-104A configuration and used as target drones. Three were converted to the NF-104A configuration, with a power auxiliary rocket engine, for use in NASA tests. Two others were assigned to NASA for use as chase planes. However, most F-104As saw further service after the ANG with foreign air forces, including Taiwan, Pakistan, Jordan, and Canada.

The F-104B was a two-seat dual-control combat trainer version of the Starfighter. To provide space for the second seat, the Vulcan cannon was removed, fuel was reduced, and the nosewheel was returned to the rearward retraction. Armament was limited to two wingtip Sidewinders, though the provision for two underwing and two wingtip fuel tanks was retained, or the hardpoints could mount other weapons. The F-104B had no radar, no gunsight, and the AN/ASG-14T-1 fire control system. The vertical tail was larger to compensate for the change in center of gravity. Originally, the F-104B was powered by the J79-GE-3A, but this was later replaced by the J79-GE-3B. If necessary, the F-104B could be used operationally, though in a reduced capability.

F-104C

The F-104C was designed to be a tactical strike aircraft. It was designed specifically to meet TAC's demands, in order to keep the Starfighter alive. TAC, however, felt that the F-104C fit perfectly in between the F-100 and F-105. Originally, 363 F-104Cs were to be put into service, but in the end only 77 were built and then TAC washed its hands of the Starfighter.

The F-104C was powered by the improved J79-GE-7, with 10,000 pounds thrust or 15,800 pounds in afterburner. Previous F-104s could not conduct aerial refueling; the F-104C could be fitted with a fixed but removable refueling probe. (This was another strike against the Starfighter – it used a probe-and-drogue refueling system when the Air Force almost exclusively used plug-in refueling.) The F-104C was intended to deliver tactical nuclear weapons; up to 907 kilograms could be carried on the center pylon. (Though some sources say that this centerline hardpoint could carry a fuel tank, the hardpoint in actuality was not equipped for carrying a fuel tank.) The F-104C retained the AN/ASG-14T-2 fire control system, with the additional ability of night attack, though not all-weather operations. Early in the F-104C's production, the M-61 Vulcan was replaced by the improved M-61A1.

In 1961, Project Grindstone modernized the F-104C to an extent. A special pylon allowed the F-104C to carry an additional two Sidewinders on the centerline; this proved to be unpopular with pilots as it increased drag unduly, pitted the Sidewinders, ruining aerodynamics and the glass seeker heads. The modernized F-104C could carry a larger array of weapons, from bombs to rocket pods.

The updated engine proved to be very troublesome – it was the culprit in some 40 serious mishaps and 24 lost aircraft. This problem was fixed under Project Seven-Up.

The F-104Cs saw limited service in Vietnam, where the North Vietnamese regarded them as dangerous and nasty aircraft to get into a dogfight with. The F-104Cs also flew many close support missions; however, it was discovered in these operations that the F-104C could not carry much of an offensive weapons load due to their small wings, and they had no all-weather combat capability. For some reason, they also flew frequent escort for EF-105F Wild Weasels, despite the fact that they were not equipped with any ECM equipment of their own. (This was remedied under Project Pronto, with the addition of APR-25/26 RHAW ECM/ECCM equipment.)

After mixed service in the active Air Force, the F-104Cs again found themselves in the ANG in 1967.

The F-104D is the two-seat trainer counterpart to the F-104C. It had most of the features of the F-104C; however, the Vulcan cannon again had to be removed. The AN/ASG-14T-2 fire control system was retained, and the F-104D received the same engine improvements and ECM/ECCM equipment later in its career. The F-104D was to an extent modular; it could in about a day be converted back to the F-104C configuration, regaining it's fuel and Vulcan cannon. The F-104D was the last Starfighter to serve with the USAF, and six also served the Taiwanese Air Force.

Foreign Starfighters: The F-104F and Later

For unknown reasons, the designation of F-104E was never used. The next variant was the F-104F, which was a special batch used to train German pilots to fly the Starfighter. For the most part, it was an F-104D, but used the J79-GE-11A engine. The F-104F did not have the advanced fire control system of the F-104G, the F-104G's strengthened airframe, or the Vulcan cannon, and the Luftwaffe did not consider the F-104F to be a combat-capable aircraft. They were withdrawn from service in 1971, ending up in the Boneyard. The F-104F will not be further covered in this entry.

F-104G

In many ways, the F-104G was what the Starfighter should have been from the beginning. The F-104G had all-weather attack capability, and had the advanced Autonetics F15A-41B NASARR fire control system. The NASARR could be switched rapidly from air-to-air to air-to-ground modes – and early form of the F/A-18's capability. A much more powerful radar set was installed; in air-to-air mode, it provided search, acquisition, and automatic tracking and the ability to put the F-104G into lead pursuit mode, then when in range of its missiles, have an automatic missile launch. The NASARR also gave new accuracy to the Vulcan cannon, including an optical line of sight and automatic computation of lead angle. The weapons sight included an advanced FLIR.

In air-to-ground mode, the NASARR gave the pilot the range and lead angle for weapons release, ground mapping, contour mapping for navigation, and TERCOM. The bombing sight could be used for conventional bombs, air-to-ground missiles, conventional and laser-guided bombs, and rockets, whether in a conventional bombing run, toss bombing, or dive bombing.

The NASARR was integrated with an inertial navigation set, giving the pilot the range and direction to his target, whether it is a ground target or an aircraft. The airframe was strengthened to allow it to haul more ordnance. The trailing edge flaps were also strengthened, allowing the F-104G to fly in a 15-degree deflection from his flight path. This allowed for quicker target acquisition as well as a decreased turn radius. Larger fuel cells in the fuselage increased the fuel load the F-104G could carry. Most of the F-104G was the same size as earlier Starfighters, but the F-104G used the larger vertical tail of the F-104B and F-104D, and the power-assisted rudder of the F-104B/D was also installed.

The F-104G was heavier than earlier Starfighters. This led to longer takeoff runs and higher landing speeds. Larger tires were installed to compensate for this. The F-104G used the J79-GE-11A turbojet, with 10,000 pounds thrust or 15,600 pounds in afterburner.

Though Lockheed remained involved with the Starfighter and provided technical assistance, the F-104G was built entirely in Europe, at four plants. The F-104G was eventually used by Germany, Greece, Norway, Turkey, Canada, Belgium, Italy, and the Netherlands. All told, F-104G production accounted for 44 percent of all Starfighters built.

Most of the countries who flew the F-104G also employed the RF-104G photoreconnaissance aircraft, though only 40 were built. For the most part, the RF-104G was similar to the F-104G, but in all but Dutch F-104Gs, the Vulcan cannon was removed along with its ammunition, and a pack of several cameras was installed in place of the gun. The removal of the gun and ammunition gave room for three KS-97A cameras; these aircraft could be identified by a small bulge in the forward fuselage and the fairing covering the gun port. The Dutch retained the Vulcan, with a reduced ammunition load, and carried their cameras in an external ventral pack. In both cases, the RF-104G could conduct armed reconnaissance, though normally weapons were removed to keep the RF-104G light and able to produce a higher-than-normal speed. The RF-104G could be modified back to the F-104G standard, and the F-104G into the RF-104G standard, in a matter of a few hours. The RF-104G retained the electronics of the F-104G as well as the internal fuel load.

Though the F-104F was used to train the initial cadre of German Starfighter pilots, the Europeans regarded the TF-104G as the true trainer version of the Starfighter, as it remained combat capable. As with other two-seat Starfighters, the TF-104G's cannon and ammunition was removed to make room for the rear seat, and fuel capacity was reduced. 48 were built by Lockheed (unlike the other F-104G variants), and distributed to Germany, Italy, the Netherlands, and Belgium. The TF-104G otherwise retained the electronics and ordnance-carrying capacity (except that it has no centerline hardpoint), and remained combat-ready aircraft.

One TF-104G was retained by Lockheed for a time, and used by world-known aviator Jackie Cochran to set several women's speed and altitude records. After these activities, the TF-104G she used was delivered to the Royal Dutch Air Force. Two ex-German TF-104Gs were acquired by NASA after their service with the Luftwaffe, where they were used for high-altitude research, speed research, and as chase planes. The Germans also left six TF-104Gs in the US as Edwards AFB for when they needed more room to train. These F-104Gs carried USAF insignia and tail numbers, even though they were German property.

Canadian Starfighters: The CF-104

The CF-104 was procured to replace the RCAF's elderly Sabre Mk 6s. Three aircraft were considered as replacements for the Sabres: The McDonnell F-4H Phantom II, the Grumman F11F-1F Super Tiger, and the F-104G Starfighter. Three blocs sprang up – the pilots preferred the Super Tiger, the RCAF preferred the Phantom II (though this was shot down early due to costs), but the MoD preferred the Starfighter, and the Starfighter was chosen due to special pricing that Lockheed offered to the Canadians. However, the Canadians elected to build the CF-104 under license in the Canadair facilities. Designations were different, but changed fast – originally, they carried the designation CF-90, then it was changed to CF-111, and finally CF-104. Though for the most part the CF-104 was like its F-104G cousins, they were modified to meet certain RCAF requirements. Unlike the European F-104Gs, the CF-104 was optimized for the nuclear strike role rather than being a dedicated multimission aircraft, but it retained the conventional strike role. The CF-104 was fitted with the R-24A NASAAR, which had air-to-ground elements instead; the RCAF opted not to give CF-104 a dedicated air-to-air role. Nonetheless, the CF-104s retained the ability to carry wingtip Sidewinders. The CF-104s initially deleted the gun and ammunition and put a fuel cell in its place which carried 500 liters, but the cannon was later returned to the CF-104. The landing gear had longer undercarriage and larger tires. The CF-104 routinely carried the external refueling probe. The CF-104 used an engine built by the Canadian firm Orenda, building the J79-OEL-7 turbojet developing 10,000 pounds thrust and 15,800 pounds in afterburner (essentially the same as the J79-GE-7). The CF-104 did not have the airframe strengthening that the F-104G had, and could only carry almost half of the F-104G's warload. 66 were built, but retired to the Boneyard in 1972. By this point, the nuclear delivery requirement had long been dropped, with the CF-104 becoming a straight close support aircraft.

The CF-104 had a secondary job as a reconnaissance aircraft; it could carry on its centerline hardpoint a pod with four Vinten cameras.

The CF-104D was the Canadian equivalent of the TF-104G. They were initially designated CF-113, and then CF-104 Mk II. This gave the RCAF a Starfighter almost equal to the F-104G. When the CF-104D was retired in 1973, they were brought up to full F-104G standard, with the rear seat being removed and the cannon and fuel being restored. Seven went to Denmark, two to Norway, and six to Turkey. The rest ended up in the Boneyard at Davis-Monthan.

Japanese Starfighters: The F-104J

Unlike other countries, the Japanese had in mind the Starfighter as its standard air superiority fighter. The base for the F-104J was the F-104G, but instead of the air-to-ground suite, the F-104J carried a long-range all weather radar which also pointed out bad weather. The NASARR installed in the F-104J was the F-15J-31 fire control suite, with the air-to-ground suite being omitted and extra emphasis given to the air-to-air mode. The F-104J was armed with its cannon and four Sidewinders, two underwing and two on the special fuselage pylon developed for the F-104C. The F-104J had the fuselage strengthening of the F-104G and the ability to fly in an off-angle mode.

The first three F-104Js were built entirely by Lockheed; the rest were built under license by Mitsubishi. The Japanese may be the largest user of the Starfighter, with a force of 178 F-104Js.

The F-104DJ was the two-seat trainer version of the Starfighter employed by Japan, as made obvious by the designation, the F-104DJ was based on the F-104D two-seater. Other than being optimized for the air-to-air role and being equipped with the radar and F-15J-32 NASARR fire control suite, it is identical to the F-104D. The Japanese Starfighters were retired in 1986; however, 22 F-104Js and five F-104DJs were transferred to Taiwan at no cost.

Danish F-104Gs

Most Danish F-104Gs were identical to other F-104Gs; however, the 15 CF-104s and seven CF-104Ds they received after their retirement from the RCAF had extra ECM/ECCM and IRCM modules added, all of which had a longer range than standard F-104Gs and had the additional capability of radio jamming. Two wing hardpoints were also added. They also had a minor role as Wild Weasel aircraft, carrying extra electronic warfare pods and antiradar missiles. They were retired in 1986, with the exception of four F-104Gs which were used to tow targets. The 30 F-104Gs and three TF-104Gs were transferred to Taiwan, at no cost, in 1987.

Italian Starfighters; the F-104S

Initially, the Italians were equipped with F-104Gs and TF-104Gs like the rest of Europe. However, in 1965, the Italians began to modify their F-104Gs to a new standard, designated the F-104S. (Some say the S stands for “Sparrow,” reflecting that the F-104S could use radar-homing missiles; earlier Starfighters could use only heat-seeking missiles.) The engine powering the F-104S was the J79-GE-19, producing 11,870 pounds thrust, or 17,900 pounds with afterburner. Auxiliary doors were fitted to ring the air intakes to increase the airflow to the engine. The fire control system is the NASARR R-21G/H suite, giving the F-104S new combat ability as well as the ability to use medium-range radar-homing missiles and even conduct BVR attacks. When so equipped, the outboard pylons carry Sparrows, while the two other underwing hardpoints carry Sidewinders. Wingtip tanks were standard for the F-104S. Two more hardpoints were added, one under both air intakes; one more was added to each wing. To accommodate an extra fuel cell (500 liters) and added avionics, the cannon and its ammo was deleted and the cannon port faired over. The extra avionics included an air-to-ground radio, improved ECM and IRCM, and a processing unit for the F-104S’s advanced fire control system took the cannon’s place. The F-104S had the structural strengthening of the F-104G, though the added weight of the F-104S reduced the ordnance load somewhat. The F-104S had a total of nine hardpoints, four of them wet. The F-104S is known for its high acceleration; unfortunately, in turns or maneuvers, it bleeds energy quickly as well.

The F-104S gained from the ASA upgrade in late 1984. The radar was replaced with the longer range and cloud-penetrating Fiat R21/M1 radar, which was also adept at finding ground targets and penetrating ground clutter. The radios were changed out for frequency-hopping radios, a type of radio becoming more prevalent in NATO service. An improved IFF was fitted, along with the ability to use AIM-9L all-aspect Sidewinders and the then-new Apside medium/long range RHM. This further cut into the space left by the deletion of the internal cannon. As time went by, miniaturization of electronics meant that the cannon could be restored without reducing the high fuel capacity, albeit with a reduced ammunition load. The F-104S could, in an interception mission, carry two Apsides and four Sidewinders. The F-104S ASA has been given the nickname “Super Starfighter” by some pilots and aviation writers.

Though still used by Italy, the F-104Ss are beyond obsolescence; they will continue to serve, however in diminishing numbers, as the Eurofighter Typhoons come into service.

Because delays with the Typhoon became inordinate, an ASA-M program was started, though few F-104Ss received this update. It basically turned the F-104S into a point-defense interceptor, with the addition of TACAN and a UHF radio and GPS. An improved inertial navigation system was added, and the cannon had all its normal ammunition load restored. The cockpit was revised to give the pilot a better view, including a near-bubble canopy. ECM, ECCM, and IRCM were all improved, and an increased number of flares and chaff was added. The air-to-ground suite was removed, making the F-104S ASA-M a pure interceptor. Engine and design improvements gave the ASA-M more speed, giving it quicker interception, higher acceleration, and a high climb rate. Control surface and airframe strengthening gave it more maneuverability and the ability to take greater G loads.

The Italian Air Force went on to employ 2579 F-104Ss, the world’s largest Starfighter user.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
YF-104A	$14,600,786	JP4	2.18 tons	8.16 tons	1	16	Radar	Enclosed
F-104A	$14,602,222	JP4	2.18 tons	8.16 tons	1	18	Radar	Enclosed
F-104B	$14,600,786	JP4	2 tons	8.08 tons	2	18	Radar	Enclosed
F-104C (Early)	$6,315,983	JP4	3.04 tons	8.83 tons	1	18	Radar, FLIR	Enclosed
F-104C (Late)	$8,609,749	JP4	3.04 tons	8.83 tons	1	20	Radar, FLIR	Enclosed
F-104D (Early)	$6,245,877	JP4	2.79 tons	8.74 tons	2	20	Radar, FLIR	Enclosed
F-104D (Late)	$8,539,643	JP4	2.79 tons	8.74 tons	2	22	Radar, FLIR	Enclosed
F-104G	$10,026,991	JP4	3.01 tons	9.36 tons	1	23	Radar, FLIR	Enclosed
RF-104G	$12,816,743	JP4	3.01 tons	8.67 tons	1	24	Radar, FLIR	Enclosed
TF-104G	$9,956,742	JP4	3.01 tons	9.01 tons	2	23	Radar, FLIR	Enclosed

CF-104 (Early)	$10,147,129	JP4	3.22 tons	9.58 tons	1	25	Radar, FLIR, VAS	Enclosed
CF-104 (Late)	$11,061,929	JP4	3.22 tons	9.58 tons	1	26	Radar, FLIR, VAS	Enclosed
CF-104D (Early)	$10,077,023	JP4	3.22 tons	8.96 tons	2	26	Radar, FLIR, VAS	Enclosed
CF-104D (Late)	$10,991,823	JP4	3.22 tons	8.96 tons	2	26	Radar, FLIR, VAS	Enclosed
F-104J	$14,260,364	JP4	2.81 tons	9.57 tons	1	26	Radar, FLIR	Enclosed
F-104DJ	$14,190,258	JP4	2.41 tons	9.22 tons	2	27	Radar, FLIR	Enclosed
F-104G (Danish)	$9,924,037	JP4	2.73 tons	10.46 tons	1	28	Radar, FLIR	Enclosed
TF-104G (Danish)	$9,853,931	JP4	2.33 tons	10.11 tons	2	29	Radar, FLIR	Enclosed
F-104S	$13,803,889	JP4	3.4 tons	9.83 tons	1	32	Radar, SLAR, FLIR, Weather Radar	Enclosed
F-104S ASA	$14,314,629	JP4	3.29 tons	9.94 tons	1	33	Radar, SLAR, FLIR, Weather Radar	Enclosed
F-104S ASA-M	$10,011,928	JP4	3.3 tons	9.93 tons	1	34	Radar, SLAR, FLIR, Weather Radar	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
YF-104A	4144	1885 (198)	NA 482 4/2 40/20	3396	2913	16825	FF2 CF2 RF2 W2 T2
F-104A	4153	1929 (198)	NA 482 4/2 40/20	3396	2920	16825	FF2 CF2 RF2 W2 T2
F-104B	4195	1948 (198)	NA 487 4/2 40/20	2847	2881	17678	FF2 CF2 RF2 W2 T2
F-104C	5543	2573 (167)	NA 643 5/3 50/30	3017	2895	17678	FF2 CF2 RF2 W2 T2
F-104D	5599	2599 (167)	NA 649 5/3 50/30	2529	2866	17678	FF2 CF2 RF2 W2 T2
F-104G	5847	2720 (216)	NA 670 6/4 60/40	3396	2909	15240	FF2 CF2 RF2 W2 T2
RF-104G	6312	2938 (216)	NA 724 6/4 60/40	3396	2704	15240	FF2 CF2 RF2 W2 T2
TF-104G	6081	3055 (216)	NA 697 6/4 60/40	2847	2793	15240	FF2 CF2 RF2 W2 T2
CF-104	5730	2993 (216)	NA 657 6/4 60/40	3396	2967	15240	FF2 CF2 RF2 W2

							T2
CF-104D	6171	3223 (216)	NA 708 6/4 60/40	2847	2753	15240	FF2 CF2 RF2 W2 T2
F-104J	5718	2660 (216)	NA 655 6/4 60/40	3396	2973	15240	FF2 CF2 RF2 W2 T2
F-104DJ	5506	2562 (216)	NA 631 6/4 60/40	2847	3803	15240	FF2 CF2 RF2 W2 T2
F-104G (Danish)	5525	2570 (216)	NA 633 6/4 60/40	3396	3084	15240	FF2 CF2 RF2 W2 T2
TF-104G (Danish)	5691	2647 (216)	NA 652 6/4 60/40	2847	2992	15240	FF2 CF2 RF2 W2 T2
F-104S	5935	2761 (192)	NA 714 6/3 60/30	3896	2952	17678	FF2 CF2 RF2 W2 T2
F-104S ASA	5870	2731 (192)	NA 706 6/3 60/30	3896	2984	17678	FF2 CF2 RF2 W2 T2
F-104S ASA-M	5987	2786 (188)	NA 720 7/4 70/40	3896	2981	17678	FF2 CF2 RF2 W2 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-104A/YF-104A	IFF, RWR, Flares (8), Chaff (8)	2800/1500m Hardened Runway	+1	20mm M-61 Vulcan, 5 Hardpoints*	725x20mm
F-104B	IFF, RWR, Flares (8), Chaff (8)	2800/1500m Hardened Runway	+1	5 Hardpoints*	None
F-104C (Early)	IFF, RWR, Flares (10), Chaff (10), Auto Track	2500/1350m Hardened Runway	+1	20mm M-61A1 Vulcan, 7 Hardpoints**	725x20mm
F-104C (Late)	IFF, RWR, Flares (12), Chaff (12), ECM/ECCM 1, Auto Track	2500/1350m Hardened Runway	+1	20mm M-61A1 Vulcan, 7 Hardpoints**	725x20mm
F-104D (Early)	IFF, RWR, Flares (10), Chaff (10), Auto Track	2500/1350m Hardened Runway	+1	7 Hardpoints**	None
F-104D (Late)	IFF, RWR, Flares (12), Chaff (12), ECM/ECCM 1, Auto Track	2500/1350m Hardened Runway	+1	7 Hardpoints**	None
F-104G	IFF, RWR, Flares (14), Chaff (14), ECM/ECCM 1, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR	2700/1400m Hardened Runway	+3	20mm M-61A1 Vulcan, 7 Hardpoints*	725x20mm
RF-104G	IFF, RWR, Flares (14), Chaff (14), ECM/ECCM 1, Auto Track, IR Uncage, Look-Down	2700/1400m Hardened Runway	+3	7 Hardpoints*	None

	Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR, 3 Cameras				
TF-104G	IFF, RWR, Flares (14), Chaff (14), ECM/ECCM 1, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR	2700/1400m Hardened Runway	+3	6 Hardpoints****	None
CF-104 (Early)	IFF, RWR, Flares (14), Chaff (14), ECM 1, ECCM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, HUD Interface	2700/1400m Hardened Runway	+3***	20mm M-61A1 Vulcan, 5 Hardpoints*	725x20mm
CF-104 (Late)	IFF, RWR, Flares (14), Chaff (14), ECM 1, ECCM 2, Secure Radios, Inertial Navigation, HUD Interface, TFR	2700/1400m Hardened Runway	+3	20mm M-61A1 Vulcan, 5 Hardpoints*	725x20mm
CF-104D (Early)	IFF, RWR, Flares (14), Chaff (14), ECM 1, ECCM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, HUD Interface	2700/1400m Hardened Runway	+3***	5 Hardpoints*	None
CF-104D (Late)	IFF, RWR, Flares (14), Chaff (14), ECM 1, ECCM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, HUD Interface, TFR	2700/1400m Hardened Runway	+3	5 Hardpoints*	None
F-104J	IFF, RWR, Flares (14), Chaff (14), ECM 1, ECCM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, Multitarget (2)	2700/1400m Hardened Runway	+3***	20mm M-61A1 Vulcan, 7 Hardpoints*	725x20mm
F-104DJ	IFF, RWR, Flares (12), Chaff (12), ECM 1, ECCM 1, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, Multitarget (2)	2700/1400m Hardened Runway	+3***	7 Hardpoints*	None
F-104G (Danish)	IFF, RWR, Flares (14), Chaff (18), ECM/ECCM 2, IRCM 1, Radio Jamming (30 km, Aircraft and Air Defense Radios), Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR	2700/1400m Hardened Runway	+3	20mm M-61A1 Vulcan, 7 Hardpoints*	725x20mm
TF-104G (Danish)	IFF, RWR, Flares (14), Chaff (18), ECM/ECCM 2, IRCM 1,	2700/1400m Hardened Runway	+3	7 Hardpoints*	None

	Radio Jamming (30 km, Aircraft and Air Defense Radios), Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR				
F-104S	IFF, RWR, All-Weather Combat, Flares (14), Chaff (14), ECM/ECCM 2, IRCM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR	2500/1350m Hardened Runway	+4	9 Hardpoints*****	None
F-104S ASA	IFF, RWR, All-Weather Flight, Flares (14), Chaff (14), ECM/ECCM 2, IRCM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR, Multitarget (2)	2500/1350m Hardened Runway	+4	20mm M-61A1 Vulcan, 9 Hardpoints*****	350x20mm
F-104S ASA-M	IFF, RWR, All-Weather Flight, Flares (20), Chaff (20), ECM/ECCM 2, IRCM 2, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, GPS, Multitarget (2), HUD Interface	2450/1325m Hardened Runway	+4******	20mm M-61A1 Vulcan, 9 Hardpoints*****	725x20mm

*Two of these hardpoints are on the wingtips. They may carry only AIM-9 Sidewinders or special wingtip fuel tanks with a capacity of 1382 liters each.
**Two of these hardpoints are on the wingtips. They may carry only AIM-9 Sidewinders or special wingtip fuel tanks with a capacity of 644 liters each.
***Modifier is only +1 for air-to-ground combat.
****Two of these hardpoints are on the wingtips. They may carry only AIM-9 Sidewinders or special wingtip fuel tanks with a capacity of 1382 liters each. This aircraft has no centerline hardpoint.
*****Two of these hardpoints are on the wingtips. They may carry only AIM-9 Sidewinders, ECM or IRCM pods, or special wingtip fuel tanks with a capacity of 1382 liters each. The two intake hardpoints have a limit of 250 kilograms.
******Air-to-Ground modifier is -1.

F/A-18 Hornet

Notes: This aircraft began to replace the A-7 and A-6 in US Navy and Marines service as early as 1991. It is an aircraft able to function effectively as a fighter and ground attack aircraft, and its avionics are able to utilize both air-to-air and air-to ground modes simultaneously. Only the US Navy and Marines use this aircraft from carriers; Australia, Canada, Spain, Kuwait, and Malaysia also use the Hornet, but use them from land bases. One and two-seat versions are available. The pilot has an ejection seat and is capable of in-flight refueling. The two wingtip hardpoints may only be used for air-to-air missiles.

The F/A-18A grew out of the USAF Lightweight Fighter Competition. It was originally known as the YF-17 Cobra, but lost to the F-16 in that competition. The Navy, and especially the Marines, were very interested, however, and picked it up. It has the ability to switch from air-to-air to air-to-ground mode instantly. It also sported advanced avionics.

The difference between the F/A-18A and F/A-18C are largely in the area of avionics, though later versions also have more powerful engines.

The CF-18 is the variant used by Canada. It is essentially an F/A-18A, but has a spotlight on the left side of the forward fuselage. It also has a standard Instrument Landing System in place of the Automatic Carrier Landing System of the US Navy/Marine versions, and no catapult launch equipment. They are not called Hornets; the translation of Hornet into French is Frelon, which is already the name of a helicopter that the Canadians use. The Australians use a similar model called the AF/A-18A; these have no spotlight.

The F/A-18E Super Hornet is not, as implied by the designation, simply a variant of the standard F/A-18; it is pretty much a new aircraft. It was designed to provide a large increase in range, load-carrying ability, defensive capabilities, and avionics. The wing and fuselage have both been greatly enlarged. They have leading edge extensions on the wings, granting better maneuverability and even more lifting ability. Much of the aircraft is constructed of radar-absorbent material (RAM), giving enemy radars a -2 deficit when attempting to detect the Super Hornet with radar or guide radar-homing missiles to it. Cockpit instruments have largely been replaced by multifunction displays.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F/A-18A	$5,685,028	JP5	7.71 tons	25.4 tons	1	38	Radar	Enclosed
F/A-18C (Early)	$6,030,424	JP5	7.71 tons	25.4 tons	1	38	Radar	Enclosed
F/A-18C (Late)	$6,106,464	JP5	7.71 tons	25.4 tons	1	40	Radar	Enclosed
CF-18	$5,686,028	JP5	7.71 tons	25.4 tons	1	38	Radar, WL Spotlight	Enclosed
F/A-18E	$7,068,935	JP5	8.05 tons	29.94 tons	1	44	Radar, VAS	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
F/A-18A/C (Early)/CF-18	3808	952 (100)	NA 238 9/5 90/50	6322	6093	15240	FF6 CF6 RF6 W4 T3
F/A-18C (Late)	4029	1007 (100)	NA 252 9/5 90/50	6322	8910	15240	FF6 CF6 RF6 W4 T3
F/A-18E	3830	958 (95)	NA 239 10/6 100/60	8228	11271	15240	FF6 CF6 RF6 W4 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F/A-18A/C/CF-18	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, Deception Jamming, Auto Track, HUD, IR Uncage, Look-Down Radar, Track While Scan, Target ID, ECM/ECCM 2	615/745m Hardened Runway	+4	20mm Vulcan, 9 Hardpoints	500x20mm
F/A-18E	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, Deception Jamming, Auto Track, HUD, IR Uncage, Look-Down Radar, Track While Scan, Target ID, ECM/ECCM 2	615/745m Hardened Runway	+5	20mm Vulcan, 11 Hardpoints	500x20mm

Lockheed P-38 Lightning

Notes: One of the most important fighters of World War 2, the Lightning was a fast and powerful aircraft responsible for the loss of many an enemy aircraft, and capable of ground attack as well, especially with its powerful internal armament. First conceived in 1937, the Lightning was designed by Lockheed in response to a War Department requirement for a fast, high-altitude interceptor for the Army Air Force. Originally, the engines available were not up to the task, but the twin-engined design helped this problem immensely, and the XP-38 won the contract. However, development and production of the complicated aircraft proved troublesome, and the first production Lightning did not appear until September of 1940.

The original production Lightning, the P-38, was equipped with two supercharged 1150-horsepower engines; the superchargers allowed the high-altitude performance for which the Lightning was famous. The engines were mounted on twin booms, with a fuselage pod between them. The propellers were contra-rotating, to prevent torque. The fuselage pod housed the pilot and the avionics, as well as a plethora of weapons: two .50-caliber machineguns, four .30-caliber machineguns, and a 37mm cannon (with a limited supply of ammunition). 30 of these Lightnings instead had four .50-caliber machineguns, and no .30-calibers, along with the 37mm cannon. There was an armor plate behind the pilot along with an armored fuselage pod, and primitive ballistic glass in the windscreen. These versions were designated P-38A. Use of these versions led to improvements requested by the pilots, such as self-sealing fuel tanks, enhanced armor protection, and a pressurized cockpit; for some reason, the designations “P-38B” and “P-38C” were skipped, and the aircraft with the requested improvements were designated P-38D. The P-38A saw limited combat, but the P-38 and P-38D never did.

The British and French also ordered the Lightning, but they were quite concerned that the superchargers, a new technology at the time, would lead to unacceptable delays. The Lightnings they ordered had no superchargers, and also did not have contra-rotating propellers. Christened the Lightning I, they were delivered in 1942; not surprisingly, they were rejected by pilots; the lack of superchargers severely limited the speed and altitude, and the lack of contra-rotating propellers led to some rather nasty handling characteristics. Pilots referred to the Lightning I as the “Castrated Lightning.” The British and French cancelled their order, and these Lightnings were given over to the Army Air Force, who used them as trainers. These aircraft also never actually saw action.

Various other problems came up during testing, including tail flutter, the wing connections to the fuselage pod, and a few other minor problems. However the most difficult problem, never really solved, was to prove to be a problem with other propeller-driven high-speed designs: compressibility stalling. A discussion of compressibility is beyond the scope of this work, aircraft of this type (including the P-47 and P-51), were actually able to approach transonic speeds in steep dives, something for which they were never designed, and it actually caused stalls which were virtually unrecoverable. The only “workaround” was for the pilot to not get into such a situation in the first place.

The first major version of the Lightning to go to war was the P-38E. This aircraft was largely similar to the P-38 and P-38A, but had improved cockpit instrumentation, hydraulic systems, and electrical systems. Except on early P-88Es (which had hollow steel propellers), the P-38E sported new propellers made from duraluminum. A new longer-ranged radio was installed, and the rather unreliable 37mm Oldsmobile cannon was replaced by a 20mm Hispano-Suiza, along with a larger amount of cannon armament. The arrangement of the four .50-caliber machineguns was changed to reduce the number of jams; while the original symmetrical arrangement looked good, the new non-symmetrical arrangement (where two of the guns stuck further out of the nose than the other two), allowed a better feed chute arrangement. The P-38E was quickly followed by the P-38F; this version had more powerful 1325-horsepower engines, better radios, and hardpoints between the fuselage pod and engines for drop tanks or bombs. Some of these were modified into two seat-trainers by removing the radios and putting in a second seat; however, the instructor’s position was so uncomfortable that training flights were short! Another modified P-38E, the F-4, was a photo-reconnaissance model with the armament replaced by four cameras. The F-4A was the photo-reconnaissance counterpart of the P-38F.

The next variant of the P-38 was the P-38G; this was a minor upgrade of the P-38F with some technical improvements to the engines to make them more reliable. They were also capable to carrying triple-tube “bazooka-type” launchers for M-8 rockets on their hardpoints or on either side of the nose (though the nose mounting was not used much). The next variant was the P-38H, with further uprated 1425-horsepower engines and an improved cannon. In addition, the capacity of the hardpoints was increased. As with earlier models, an F-5A reconnaissance version was based on the P-38G, and an F-5C reconnaissance version was based on the P-38H.

The P-38I designation was never used (to avoid confusion in paperwork with a non-existent P-381), so the next model was the P-38J. The P-38J redesigned the twin booms (which were designed more for looks than functionality anyway), and the coolant reservoirs in the wings were vulnerable to combat damage. Radiators were placed under the front part of the engines, giving the engines a “bearded” appearance setting them apart from earlier models. The space in the wings formerly occupied by coolant reservoirs was now used to carry more fuel. The engines were happier, as were the pilots. A subset of the P-38J, the P-38J-10, had a reshaped armored windscreen for better visibility, and automatic dive brakes to slow the Lightning when approaching the speed at which compressibility would be a problem, and assist in recovery from compressibility stalls if they did occur. One of these models was actually dived to 970 kph and recovered in one piece. The P-38J-25 featured power-assisted ailerons, the first combat aircraft that had them, further increasing stability and somewhat increasing maneuverability. An F-5B reconnaissance version was also built.

The P-38K had disappointing results, so the P-38L was introduced. This version had 1475-horsepower engines, and became the most common version of the Lightning. This version had hardpoints under the outer wings for racks carrying ten 5-inch HVAR rockets under each wing, as well as retaining the two inner wing hardpoints. As such, it was a formidable ground-attack aircraft as well as a powerful fighter. An F-5F reconnaissance version was built, as well as the F-5G; the F-5G has a distinctive bulbous nose housing a more powerful (and larger) camera setup. TP-38L trainers were also built, with that uncomfortable back seat.

There were other stranger variants of the Lightning. The P-38J and P-38L Droop Snoot versions were used as pathfinders for bombers in Europe; they had a glazed nose from which the armament was removed, and a second crewmember was placed (lying down). This crewmember spotted the target through a modified bombsight, and then when the Droop Snoot dropped his bombs, everyone else did as well. This design was superseded by the P-38J and P-38L Mickey designs, which had a rather crude (by modern-day standards) target-finding radar replacing the nose armament, and housed in a larger-than normal nose.

Some 75 P-38Ls were slated to be converted to the P-38M night fighter configuration, known as the Night Lightning; as it was, only four such conversions made it to combat before the end of hostilities. These versions were painted flat black, they had flash cones on their guns, an AN/APS-6 radar pod beneath the nose, and a raised canopy behind the pilot for a radar operator. (This cockpit was still of limited size, and a radar operator of short stature was practically a requirement.) Other such conversions were made, but they were scrapped after World War 2.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
P-38 (Early)	$275,368	AvG	220 kg	6.12 tons	1	4	None	Enclosed
P-38A	$272,304	AvG	220 kg	6.12 tons	1	4	None	Enclosed
P-38D	$275,027	AvG	220 kg	6.2 tons	1	4	None	Enclosed
P-38E	$178,392	AvG	907 kg	6.54 tons	1	4	None	Enclosed
P-38F	$179,412	AvG	907 kg	7.21 tons	1	5	None	Enclosed
P-38G	$181,206	AvG	907 kg	7.17 tons	1	5	None	Enclosed
P-38H	$183,643	AvG	1.45 tons	8.85 tons	1	5	None	Enclosed
P-38J	$190,189	AvG	1.45 tons	7.94 tons	1	7	None	Enclosed
P-38L	$192,090	AvG	1.81 tons	7.94 tons	1	7	None	Enclosed
P-38J Droop Snoot	$166,476	AvG	1.81 tons	7.77 tons	2	8	None	Enclosed
P-38L Droop Snoot	$168,140	AvG	1.81 tons	7.77 tons	2	8	None	Enclosed
P-38J Mickey	$307,399	AvG	1.81 tons	8.27 tons	2	10	Radar	Enclosed

P-38M	$346,180	AvG	1.81 tons	8.19 tons	2	10	Radar	Enclosed
Lightning I	$274,596	AvG	220 kg	5.86 tons	1	4	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor*
P-38/A/D	1300	325 (100)	NA 81 70/40	1476	403	11887	FF3 CF2 RF2 W3 T2
P-38D	1300	325 (100)	NA 81 70/40	1287	403	11887	FF3 CF2 RF2 W3 T2
P-38E/F	1317	329 (100)	NA 83 70/40	1287	403	11887	FF3 CF2 RF2 W3 T2
P-38G	1333	334 (100)	NA 83 70/40	1287	479	11887	FF3 CF2 RF2 W3 T2
P-38H	1340	335 (100)	NA 84 70/40	1287	517	11887	FF3 CF2 RF2 W3 T2
P-38J/J Droop Snoot/Mickey	1400	350 (100)	NA 88 70/40	1703	583	13411	FF3 CF2 RF2 W3 T2
P-38J-25	1400	350 (95)	NA 88 75/45	1703	583	13411	FF3 CF2 RF2 W3 T2
P-38L/L Droop Snoot/Mickey	1380	345 (95)	NA 86 75/45	1703	603	13411	FF3 CF2 RF2 W3 T2
P-38M	1354	339 (95)	NA 85 75/45	1703	603	13411	FF3 CF2 RF2 W3 T2
Lightning I	1333	333 (100)	NA	1476	351	8520	FF3 CF2 RF2 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-38/Lightning I	None	555/670m Hardened Runway	+1	2xM3, 4xM-1919A4, 37mm Oldsmobile autocannon	400x.50, 2000x.30, 15x37mm
P-38A	None	555/670m Hardened Runway	+1	4xM3, 37mm Oldsmobile autocannon	1600x.50, 15x37mm
P-38D	None	555/670m Hardened Runway	+1	4xM3, 37mm Oldsmobile autocannon	1600x.50, 15x37mm
P-38E	None	555/670m Hardened Runway	+1	4xM3, 20mm Hispano-Suiza M-1 Autocannon, 2 Hardpoints	1600x.50, 150x20mm
P-38F	None	555/670m Hardened Runway	+1	4xM3, 20mm Hispano-Suiza M-1 Autocannon, 2 Hardpoints	2000x.50, 150x20mm
P-38G	None	555/670m Hardened Runway	+1	4xM3, 20mm Hispano-Suiza M-1 Autocannon, 6 Hardpoints	2000x.50, 150x20mm
P-38H/J/L	None	555/670m Hardened Runway	+1	4xM3, 20mm Hispano-Suiza M2C Autocannon, 6 Hardpoints	2000x.50, 150x20mm
P-38J/L Droop Snoot	None	555/670m Hardened Runway	+1	6 Hardpoints	None
P-38J/L Mickey	None	555/670m Hardened Runway	+2 (Bombing Only); +1 (Rockets)	6 Hardpoints	None
P-38M	None	555/670m Hardened	+2	4xM3, 20mm Hispano-Suiza M2C	2000x.50,

	Runway	Autocannon, 6 Hardpoints	150x20mm

*The AV of the P-38E to M's forward fuselage pod is 4.

P-40 Warhawk

Notes: This fighter was responsible for holding the line in the Pacific Theatre of World War 2 until 1942, during which time it was practically the only Allied fighter type facing the Japanese. It is most famous for its use in China by Claire Chennault's Flying Tigers, where it had a kill ratio of over 50-to-1. Its weakness was its high-altitude performance; above 4600 meters, subtract 10% of movement, maneuvering, turn, and acceleration ratings for every 500 meters gained. At low altitude, it was valued by Allied pilots for ground attack roles due to its maneuverability and ability to take punishment.

The P-40 was the first model. The US Army Air Corps was looking for a low-altitude fighter, and range was not a requirement. They were basically looking for speed. The P-40 was unusual in that it had a fully retractable tailwheel to reduce drag, and flush riveting to further decrease drag. It was a fast aircraft for its time. The P-40B had an additional machinegun in each wing. With the P-40C, the Warhawk was given self-sealing tanks; however, these tanks could not hold as much fuel. It was also heavier, and an underfuselage wet hardpoint was added.

The P-40D introduced a new engine. In addition, nearly 80 kilograms of armor were added. The fuselage guns were moved to the wings, replacing the .30 caliber guns. (There were also provisions for the mounting of two 20mm autocannons, but this was never actually done.) The P-40E deleted the cannon mounts, and replaced them with two more machineguns in each wing.

The P-40F was the first model actually known as the Warhawk. (Previous models were called either Kittyhawk or Tomahawk.) The P-40F featured a new, more powerful engine. The P-40K had an even more powerful engine. The P-40L was a stripped down version of the P-40F, built to improve speed over the short run. Fuel, ammunition, and armor were removed.

The P-40N was a lightened Warhawk, coupled to a powerful engine; this resulted in a fast Warhawk that became the model with the most production. It was built of lighter materials. The altitude restrictions listed above do not apply to the P-40N.

Twilight 2000 Notes: By 2000, about 30 airworthy Warhawks survive, with all but a few flying in the US.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
P-40	$106,097	AvG	600 kg	3.27 tons	1	4	None	Enclosed
P-40B	$131,838	AvG	600 kg	3.45 tons	1	4	None	Enclosed
P-40C	$136,721	AvG	900 kg	3.66 tons	1	4	None	Enclosed
P-40D	$95,673	AvG	900 kg	3.93 tons	1	4	None	Enclosed
P-40E	$165,968	AvG	900 kg	4.17 tons	1	4	None	Enclosed
P-40F	$167,212	AvG	900 kg	4.24 tons	1	4	None	Enclosed
P-40K	$167,424	AvG	1.2 tons	4.54 tons	1	4	None	Enclosed
P-40L	$161,578	AvG	900 kg	4.13 tons	1	4	None	Enclosed
P-40N	$125,523	AvG	900 kg	4.01 tons	1	4	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor*
P-40	1094	274 (90)	NA 68 8/5 80/50	602	430	9145	FF3 CF3 RF3 W3 T2
P-40B	1126	281 (90)	NA 70 8/5 80/50	602	430	9876	FF3 CF3 RF3 W3 T2
P-40C	1104	276 (90)	NA 69 8/5 80/50	507	430	8992	FF3 CF3 RF3 W3 T2
P-40D	1104	276 (90)	NA 69 8/5 80/50	507	424	8992	FF4 CF3 RF3 W3 T3
P-40E	1158	290 (90)	NA 72 8/5 80/50	507	424	8992	FF4 CF3 RF3 W3 T3
P-40F	1165	291 (90)	NA 73 8/5 80/50	507	479	10485	FF3 CF3 RF3 W3 T2
P-40K	1158	290 (90)	NA 72 8/5 80/50	507	489	10485	FF3 CF3 RF3 W3 T2
P-40L	1178	294 (90)	NA 74 8/5 80/50	390	479	10485	FF3 CF3 RF3 W3 T2

P-40N	1210	302 (90)	NA 76 8/5 80/50	462	442	11582	FF3 CF3 RF3 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-40	None	500/400m Primitive Runway	+1	2xM3, 2xM-1919A4, 2 Hardpoints	600x.50, 1000x.30-06
P-40B	None	500/400m Primitive Runway	+1	2xM3, 4xM-1919A4, 2 Hardpoints	600x.50, 2000x.30-06
P-40C	None	500/400m Primitive Runway	+1	2xM3, 4xM-1919A4, 3 Hardpoints	600x.50, 2000x.30-06
P-40D	Armored Cockpit	500/400m Primitive Runway	+1	2xM3, 3 Hardpoints	1800x.50
P-40E/F/K	Armored Cockpit	500/400m Primitive Runway	+1	6xM3, 3 Hardpoints	1800x.50
P-40L	None	500/400m Primitive Runway	+1	6xM3, 3 Hardpoints	1206x.50
P-40N	Armored Cockpit	500/400m Primitive Runway	+1	4xM3, 3 Hardpoints	1200x.50

*Cockpit AV is 5.

Republic P-47 Thunderbolt

Notes: This World War 2-era fighter, affectionately know to its pilots as the "Jug" due to its shape, was originally produced as a long-range escort for bombers. It proved not to have the range to stay with the bombers on their longer flights, and was replaced in that role by the Mustang. They were found to be incredibly tough aircraft, and used in the ground attack role. There are hundreds of stories about the survivability of the Thunderbolt, ranging from losing half of the wing to flying through brick walls, and yet returning to base. The Thunderbolt was built tough to withstand the stress on the airframe from its massive Allison engine. The Thunderbolt has 12 hardpoints, but 10 of them may only be used for air-to-ground rockets, and two for only bombs or drop tanks. If the rocket hardpoints are occupied, the bomb hardpoints may not be used, and vice versa.

The first combat-ready example of the Thunderbolt was the P-47C. (Lots of problems had to be worked out before the aircraft was combat-ready.) It was a massive aircraft, and required a lot of pilot training and practice before a pilot really became proficient with it. It was also heavily armed and armored. There were few differences externally between the P-47C and P-47D, though the P-47D was the most manufactured model. Internally, the P-47D had a 57-liter tank containing a mixture of alcohol and water that allowed brief bursts of greater speed. (The P-47D is capable of a total of 5 minutes of traveling at a Combat Move of 398.) Wing hardpoints were added (the same hardpoints could be found on P-47Cs, but they were field modifications). Many P-47Ds were outfitted with a bubble canopy to improve pilot visibility.

Most other Thunderbolts were experimental machines, but the P-47N was a long-range model made by extending the wings and putting fuel tanks in them. The engine was also improved, and the P-47N was capable of Combat Move bursts of 423, in the same manner as the P-47D.

Twilight 2000 Notes: By the start of the Twilight War, 25 Thunderbolts remained airworthy, and about 10 were made airworthy after the beginning of the war -- 22 in the US, two in England, and one in Yugoslavia. These aircraft were pressed into the ground attack role, where they served admirably long lives after 2000.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
P-47C	$176,409	AvG	1.13 tons	6.77 tons	1	6	None	Enclosed
P-47D	$315,039	AvG	1.33 tons	7.94 tons	1	8	None	Enclosed
P-47N	$317,441	AvG	1.33 tons	9.39 tons	1	8	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor*
P-47C	1386	346 (105)	NA 87 8/5 80/50	646	741	12802	FF5 CF5 RF4 W4 T4
P-47D	1373	343 (105)	NA 86 8/5 80/50	646	741	12192	FF5 CF5 RF4 W4 T4
P-47N	1472	368 (105)	NA 92 8/5 80/50	1350	918	12192	FF5 CF5 RF4 W4 T4

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-47C	Armored Fuselage	600/500m Hardened Runway	+1	6xM3, 1 Hardpoint	2550x.50
P-47D	Armored Fuselage	600/500m Hardened Runway	+1	8xM3, 12 Hardpoints (see text)	3400x.50

P-47N	Armored Fuselage	700/600m Hardened Runway	+1	8xM3, 12 Hardpoints (see text)	3400x.50

*Cockpit AV is 6.

North American P-51 Mustang

Notes: The P-51 is fast for a propeller-driven aircraft, and capable of excellent maneuvering. It does not carry a large load, however, being designed as a fighter.

The P-51 was the first fighter version. These aircraft went almost entirely to the British. The P-51A was the first fighter model used by the US; they had less guns (the .30 caliber guns being thought to be superfluous), a better engine, and a larger propeller. The P-51B featured the Packard Merlin engine. It was far more powerful than the original engine, and an outstanding performer even at high altitude. The P-51C had an even more powerful Merlin. Many also had the Malcolm Hood bubble canopy.

The P-51D featured the teardrop bubble canopy, allowing almost unobstructed 360-degree vision for the pilot. The number of guns was increased to six. The P-51H was, after the weight-saving programs initiated under the XP-51G and H programs, much lighter than previous Mustang designs. It was consequently the fastest piston-engined aircraft of World War 2. It was distrusted by some of its pilots, however, as being less sturdy than previous Mustangs.

The A-36A Invader was a fighter-bomber variant of the Mustang. (Almost no one called it the Invader, however.) It differed from the Mustang by having a set of large dive brakes to keep the aircraft stable during dive bombing. In addition, two of the six guns were in the nose, and the engine used was different, also. The A-36A had a decent amount of armor and it was much slower than the standard Mustangs. It was not optimized for altitude and had a much lower ceiling.

Twilight 2000 Notes: As of the Twilight War, over 160 examples of the P-51D Mustang were flying, mostly in the United States. These were often pressed into service by local militia groups by rearming them and sending them out on close air support missions.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
P-51	$183,212	AvG	908 kg	3.61 tons	1	4	None	Enclosed
P-51A	$131,515	AvG	908 kg	4.81 tons	1	4	None	Enclosed
P-51B	$135,020	AvG	908 kg	5.09 tons	1	6	None	Enclosed
P-51C	$135,648	AvG	908 kg	5.35 tons	1	6	None	Enclosed
P-51D	$171,367	AvG	908 kg	5.49 tons	1	6	None	Enclosed
P-51H	$168,735	AvG	908 kg	5.22 tons	1	6	None	Enclosed
A-36A	$174,285	AvG	908 kg	4.86 tons	1	6	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
P-51	1206	302 (110)	NA 75 10/6 100/60	965	405	12800	FF3 CF3 RF2 W3 T2
P-51A	1309	328 (110)	NA 82 10/6 100/60	965	442	9555	FF3 CF3 RF2 W3 T2
P-51B	1408	352 (110)	NA 88 10/6 100/60	965	599	12802	FF3 CF3 RF2 W3 T2
P-51C	1392	348 (110)	NA 87 10/6 100/60	965	580	12771	FF3 CF3 RF2 W3 T2
P-51D	1398	350 (110)	NA 87 10/6 100/60	965	580	12771	FF3 CF3 RF2 W2 T2
P-51H	1558	390 (110)	NA 97 10/6 100/60	965	509	12680	FF3 CF3 RF2 W2 T2
A-36A	1139	285 (100)	NA 71 10/6 100/60	965	489	7650	FF4 CF4* RF2 W3 T2

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-51	None	500/400m Hardened Runway	+1	4xM3, 4xM-1919A4, 2 Hardpoints	1260x.50, 1850x.30-06
P-51A/B/C	None	500/400m Hardened Runway	+1	4xM3, 2 Hardpoints	1260x.50

P-51D	None	500/400m Hardened Runway	+1	6xM3, 2 Hardpoints	1880x.50
A-36A	None	500/400m Hardened Runway	+1	6xM3, 2 Hardpoints	1880x.50

*The cockpit of the A-36A has an AV of 5.

AC-130 Spectre

Notes: The AC-47 Spooky was an excellent fire platform, but pilots at the 6th Air Commando squadron in Vietnam felt that the gunship idea could be improved on. Perhaps the most common of these aircraft was based on the C-130 Hercules and JC-130A Hercules. Such an aircraft could carry more and heavier weapons, and be able to possibly patrol the Ho Chi Minh trail and attack trucks and light armor.

AC-130A Spectre

The first such aircraft to be modified was the AC-130A. Original armament was four Miniguns and three M61 Vulcan cannons. The gunsight was similar to that of the Spooky, modified by the new weapons, and addition had image intensification, a long-range IR sensor, and a 20kW WL searchlight. The AC-130A was nicknamed the "Vulcan Express" by the crews for the heavier of their armament. The official name was "Gunship II;" another slang name was the "Super Spooky." Most of the systems of the AC-130A came together in a manner similar to that of the AC-47 – off the shelf components and creative tool use. They began their work in Vietnam in 1967. Later AC-130As carried four miniguns and four Vulcan cannons. The also had a FLIR and SLIR viewer, a precision fire control computer, and an MTI (moving target indicator) radar. A navigation suite was added.

The ninth and later AC-130As were given the Surprise Package modifications, including the replacement of two Vulcans with two 40mm Bofors L/60 autocannons, and two sets of miniguns were deleted. LLTV was also added, SLAR, a BDAR video system was added, and a long range laser rangefinder which could double as a designator was mounted. A Gunner/FLIR operator was given an internal suite, though the pilots sight was retained for quick shots. A similar aircraft, under the Pave Pronto package, primarily allowed the AC-130A to detect the electromagnetic emissions of vehicle starting up or on the move.

AC-130 often carried a pair of self-sealing
drop tanks which carried 757 liters each. The AC-130A was powered by four Allison T-56-A-9D turboprops with 3750 horsepower each.

AC-130E Pave Spectre

Before the initial, Vietnam-era production/modification lines were closed, two more C-130 types were modified: the AC-130E and AC-130H (early version). The AC-130E and AC-130H are more properly known as the Pave Spectres. The first of these, the AC-130E, has all of the electronic and night vision upgrades of late AC-130A – Surprise Package, Pave Pronto, and other small modifications. In addition, the night vision suite was improved in range and resolution. The AC-130E was equipped with ECM, ECCM, IRCM, and scads of flare and chaff dispensers, including two underwing pods (the right ejecting flares, and the left chaff). The ECM and IRCM are generated from underwing pods as well as some internal weapon systems. The fire control, night vision, EW, navigation, and ELINT functions were integrated in a large room in the center of the aircraft; it's these people who actually find the targets and fire the weapons (except for "quick shots" the pilot may make). The AC-130E also has Radio and Radar detectors. The ramp has a large plexiglass fairing in it, allowing an observer wearing NODs to spot some things that the Warfare Suite does not and to do some preliminary BDAR.

At the time of the introduction of the AC-130E, the NVA were supplying weapons like the Shilka, single, double, and quadruple 37mm guns, and single and double 57mm AAA guns, as well as small numbers of SA-7 Strela shoulder-launched SAMs. The higher-ups were looking at the loss rates of the AC-130A and trying to find a weapons the AC-130E could fire that would allow a significant standoff range. This weapon turned out to be old Cold War and World War 2 105mm howitzers, tipped with a massive flash suppressor/counterweight. It could throw a 20-kilogram warhead almost 11,000 meters, and further with some types of shells. Being an old artillery piece, it's barrel is a bit short, but this is advantageous in its method of employment. As SA-7s became a problem, exhaust shrouds were added to the engines; these are removed in areas where SA-7s are not such a problem as the shrouds cut into the AC-130E's fuel consumption.

The AC-130E armament therefore consisted (in its early version) of two Miniguns, two Vulcans, and two Bofors L/60 40mm autocannons. Later, one of the 40mm guns was removed, and the 105mm M1 guns was installed in its place. Still later, the final weapon suite for the AC-130E fitted, and essentially the same as the late version of the AC-130E weapon fit. The Weapon Officer's and pilot's sight were synched up to show the same picture. The LLLTV is essentially an image intensifier on steroids. The Weapon Officer has access to all sights, as does the Navigator, but the Weapon Operator's primary sight is the LLLTV. The SLAR was improved as to detect the small tremors caused by vehicle and foot traffic, and synchs with the laser designator and laser rangefinder. An illumination flare system allows such flares to be ejected from below the aircraft. A ballistic computer ties the entire fire control suite together.

As the engines are more powerful and the airframe more aerodynamically more efficient, armor was able to be added to the fuselage and cockpit. The AC-130Es and Hs often operated with F-4 Phantom IIs and F-105 Thunderchiefs and F-100 Super Sabres carrying laser-guided bombs, illuminated by the AC-130E's laser designator.

AC-130H Gray Ghost

Though the C-130H is basically a C-130E with more powerful engines, the technicians modifying the AC-130H took the opportunity to upgrade the electronics, night vision, and radar on the C-130H. The AC-130H also had the ability to drop ADSID Sensors, which basically measured the micro-movement of the terrain and the unmasked electronic signatures of passing foot, bicycle, and vehicle movement. The sensor has fins and is simply dropped out of the bottom of the aircraft, burying itself into the ground up to the aerials, which look like just more foliage. Wide-band radio jammers were installed to keep the NVA and VC units from communicating. The 40mm and 105mm mounts were redesigned with lighter materials, improving the aircraft's center-of-gravity and lighting the entire aircraft. Some of the Gray Ghosts were later modified into AC-130Us between OIF and the Libya intervention. The rest of the Grey Ghosts were retired to various museums and static displays.

AC-130U Spooky II

The AC-130 U was not built on a C-130 base – it was of course a type of C-130, but it was the first "new build" gunship based on the C-130, and there is no corresponding C-130U aircraft. The C-130U is known as the Spooky II, paying homage to the original AC-47. The AC-130U of course retains its 40mm L/60 Bofors autocannon. The AC-130U replaces the two Vulcans with a pair of GAU-12/U 25mm Gatling Guns, which are harder-hitting, able to use a greater variety of ammunition, and are lighter in weight in its internal mechanism. The M1 105mm howitzer is replaced with an M112 howitzer; this installation also has better recoil dampeners and a lighter carriage, a is able to use a greater variety of ammunition and has a longer range. Unlike previous AC-130s, the AC-130U is pressurized and heated. The fire control suite has been upgraded, and the AC-130U is able to train two of its weapons on two different targets at once. The AC-130U navigates by GPS, with an inertial guidance backup. The heat shields for the engines' exhausts have been redesigned and made standard. Extra armor has been added to the fuselage of the aircraft. A second Bofors autocannon was installed near the rear as an experiment, but the weight of the extra gun installation and ammunition proved to be too much, as well as throwing off the COG. The Spooky II has something called an aperture strike radar, which is sort of a laser rangefinder on steroids for use when SAR mode is being used. The Spooky II also has a fighter radar – a Hughes AESA AN/APQ-180 from the F-15E, able to work against air and ground targets; this provides distance night and weather radar information. The Spooky can use two weapons at once; in addition, the gunner has two laser rangefinders. A new commo suite allows communications between the Spooky II and other aircraft, with ships, and troops or vehicles on the ground. The Spooky II has an integrated capsule in the center of the aircraft (often called by crews "the office") with the Navigator, Fire Control Officer, Electronic Warfare operator, and two Sensor Operators.

The AC-130 has itself an upgraded version, the Plus 4 (or simply +4) upgrade. The weapon mix is a bit different – The Plus 4 is armed with a pair of 30mm Mk 44 Bushmaster II chain guns and the M102 105mm howitzer; however, these Plus 4 may also be armed with two 40mm Bofors L/60 and a 105mm cannon. The plus 4 carries canisters below the wings to carry a small amount of extra chaff and flares, essentially giving Spooky II six more flares and chaff. Electronics have also been upgraded. Only eight of these modified AC-130Us were actually built. Some of the less-thought-of improvements include the ability to use its sensors to make a "fusion ball" – the ability to have the computers use two or more sensors to provide a high-density digital picture which can be transmitted as necessary. The fusion ball is kept aligned by the AC-130U's computers. In addition, recording equipment was made digital, instead of the previous VHS system.

By 2008, the Plus 4 upgrades had been applied to all AC-130U aircraft.

AC-130W Stinger II

The Spooky II is, let's face it, getting long in the tooth. It's still an excellent gunship, but the first ones were designed in the wake of the Vietnam War, and put into service in the 1980s. The AC-130J Combat Spear was to replace the AC-130U, but there have been considerable delays in that program. He AC-130W Stinger II was designed as a stopgap gunship, modified from the base MC-130W Dragon Spear aircraft. The MC-130W had the virtue of having a roll-on, roll-off center capsule that allowed the control capsule of the AC-130W to be easily added to the MC-130W shell, and the appropriate armament added to the aircraft, quickly turning it into a gunship. The AC-130U will therefore soon be retired and replaced by the AC-130W and (eventually) the AC-130J. In addition to mobile fire support, the AC-130W will have the roles of armed overwatch, armed reconnaissance, and close air support for conventional units.

The AC-130W takes the electronics, radar, and night vision packages to the next level. Almost all combat, overwatch, and reconnaissance features are done by the airmen in the combat capsule. Many more functions have been automated, including some elements of gun loading and aiming, resulting in a much smaller crew. The AC-130W has both INS and GPS to ensure that the C-130W can always find its target, without jeopardizing friendlies. The AC-130W is also equipped with an airborne version of a BMS, the Link 16 system.

The AC-130Ws were originally meant to be armed with a Bushmaster III 30mm autocannon and two 40mm Bofors autocannons, as it was felt that the other weapons systems it brings to the party (underwing racks for 12 Small-Diameter Bombs and tubular wing racks to carry ten Viper Strike or eight Griffin standoff missiles) obviated the need for the 105mm Howitzer. However, the troops on the ground wanted,, *no*, *demanded*, the return of the 105mm Howitzer to the gunship platform to the gunship, as the 105 could flatten, destroy, and in general tackle problems that other weapons could not. So the Bofors 40mm cannons were replaced by a single Bushmaster II autocannon and the 105mm howitzer replaced on the AC-130W. In Afghanistan, AC-130Ws have also been seen carrying a pair of 250-pound bombs under each wing with what is apparently a specially-designed JDAM kit.

The Stinger II has a vastly reduced crew – mostly due to automation and most weapons that do not need hands-on for operation.

A nice feature is that the Stinger II can refuel from just about any aircraft – it can use a flying boom or a probe and drogue system.

AC-130J Ghostrider

Being the actual aircraft that the Air Force wanted, and the AC-130W being a sort of stopgap, the AC-130J has most of the features of the AC-130W. The AC-130J is a modified form of the MC-130J Commando II, and will eventually replace the AC-130H, AC-130U, and AC-130W. Like the AC-130W, the AC-130J was not originally going to be armed with the 105mm Howitzer, since the SDB and the Precision Strike Package (which includes the Viper Strike and Griffon missiles) were felt to be enough firepower. However, the troops did not want to lose their "artillery in the sky," and the howitzer was put back. The AC-130J can also carry eight underwing Hellfire or Maverick missiles; they carry these instead of the 250-pound JDAMs of the AC-130W. The 40mm Bofors is also deleted, replaced by two Bushmaster II 30mm autocannons. The AC-130J has two complete fire control suites in the capsule, allowing better use of the two weapons use at once that the AC-130W pioneered. The pilot and fire control officers wear helmets with helmet-mounted cuing systems. However, while the AC-130J can refuel like the AC-130W, it loses the space for buddy refueling tanks. Armor again has been improved, with the cockpit and the capsule being protected by composite armor tiles.

The AC-130J is still considered as being in the testing phase, though it has been combat tested in Afghanistan and Syria since 2019. Reviews have been good, due to the increased array of weapons and greater accuracy of the cannons.

A possible replacement for one of the Bushmaster II autocannons (approximately 2025) is a laser. Now, I've heard energy from these lasers ranging from 60KW to 12 MW, so I took the difference and for purposes of this entry, put a 1 MW laser on the so-equipped AC-130J. Range is 10 km, and it can be used against light armored vehicles, unarmored vehicles, or as a sniper-type weapon, which, at maximum range, could literally sever limbs or heads, or just burn a smoking hole in someone. The AC-130J carrying a laser is projected to also carry a 200 kW APU to power the laser.

An even more likely weapon replacement is a 120mm breech-loaded mortar instead of the 105mm howitzer. (It may be based on Patria's NEMO system, now being tested by the US Army and Marines.) Replacement parts and replacement barrels for the M102 are getting harder and harder to find, with some parts having to be machined from scratch. A change to a modern breech-loaded 120mm more has range and explosive power on par with the 105mm howitzer shell, and also brings a greater variety of shell types.

Aircraft	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
AC-130A Spectre (Early)	$214,472,465	JP5	595 kg	56.34 tons	11	41	FLIR (15 km), SLIR (15 km), Radar (200 km)	Enclosed
AC-130A Spectre (Late)	$289,635,500	JP5	630 kg	57.7 tons	11	41	FLIR (15 km), SLIR (15 km), Radar (200 km), SLAR (40 km)	Enclosed
AC-130E Pave Spectre (Early)	$361,268,835	JP5	585 kg	59.2 tons	14	43	FLIR (20 km), SLIR (20 km), Radar (225 km), SLAR (60 km), LLTV (20 km)	Enclosed
AC-130E Pave Spectre (Late)	$400,493,695	JP5	600 kg	60.11 tons	14	43	FLIR (30 km), SLIR (30 km), Radar (225 km), SLAR (70 km), LLTV (30 km)	Enclosed
AC-130H Gray Ghost	$454,210,510	JP5	640 kg	60.31 tons	14	41	FLIR (35 km), SLIR (35 km), Radar (240 km), SLAR (100 km), LLTV (35 km)	Enclosed
AC-130U Spooky II	$377,928,300	JP5	635 kg	60.31 tons	13	44	FLIR (40 km), SLIR (40 km), Radar (275 km), SLAR (115 km), LLTV (50 km), SAR (40 km)	Shielded
AC-130 Spooky II (Plus 4 1)	$386,541,985	JP5	635 kg	60.26 tons	13	48	FLIR (40 km), SLIR (40 km), Radar (275 km), SLAR (115 km), LLTV (50 km), SAR (40 km)	Shielded
AC-130 Spooky II (Plus 4 2)	$414,759,090	JP5	637 kg	60.33 tons	13	48	FLIR (40 km), SLIR (40 km), Radar (275 km), SLAR (115 km), LLTV (50 km), SAR (40 km)	Shielded
AC-130W Stinger II	$413,535,240	JP5	514 kg	70.31 tons	7	42	FLIR (65 km), SLIR (55 km), Radar (325 km), SLAR (135 km), LLTV (60 km), SAR (55 km)	Shielded
AC-130J	$425,542,650	JP5	522 kg	74.4 tons	7	44	FLIR (65 km), SLIR	Shielded

Ghostrider 1							(55 km), Radar (325 km), SLAR (135 km), LLTV (60 km), SAR (60 km)	
AC-130J Ghostrider 2	$543,903,495	JP5	526 kg	74.83 tons	7	47	FLIR (65 km), SLIR (55 km), Radar (325 km), SLAR (135 km), LLTV (60 km), SAR (60 km)	Shielded
AC-130J Ghostrider 3	$340,607,865	JP5	508 kg	71.82 tons	7	40	FLIR (65 km), SLIR (55 km), Radar (325 km), SLAR (135 km), LLTV (60 km), SAR (60 km)	Shielded

Aircraft	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
AC-130A Spectre (Early)	1630	425 (90)	NA 43 5/3 35/20	24000	3364	10058	FF6 CF4 RF4 W4 T3
AC-130A Spectre (Late)	1489	413 (90)	NA 42 5/3 35/20	24000	3364	10058	FF6 CF4 RF4 W4 T3
AC-130E Pave Spectre (Early)	1617	452 (90)	NA 46 5/3 35/20	24000	3757	9315	FF6 CF4 RF4 W4 T3
AC-130E Pave Spectre (Late)	1604	448 (90)	NA 46 5/3 35/20	24000	3757	9315	FF6 CF4 RF4 W4 T3
AC-130H Gray Ghost	1843	510 (90)	NA 53 5/3 35/20	24000	4239	7610	FF6 CF4 RF4 W4 T3
AC-130U Spooky II	1843	510 (90)	NA 53 5/3 35/20	24000	4239	7610	FF7 CF5 RF5 W4 T4
AC-130 Spooky II (Plus 4 1)	1847	516 (90)	NA 54 5/3 35/20	24000	4239	7610	FF7 CF5 RF5 W4 T4
AC-130 Spooky II (Plus 4 2)	1847	516 (90)	NA 54 5/3 35/20	24000	4239	7610	FF7 CF5 RF5 W4 T4
AC-130W Stinger II	1604	446 (90)	NA 47 5/3 35/20	24000	4392	8859	FF7 CF5 RF5 W4 T4
AC-130J Ghostrider 1	1503	417 (90)	NA 44 5/3 35/20	24000	4347	4535	FF8Cp CF8Cp RF8Cp W5 T4
AC-130J Ghostrider 2	1494	415 (90)	NA 44 5/3 35/20	24000	4347	4535	FF8Cp CF8Cp RF8Cp W5 T4
AC-130J Ghostrider 3	1659	469 (90)	NA 49 5/3 35/20	24000	4347	4535	FF8Cp CF8Cp RF8Cp W5 T4

Aircraft	Combat Equipment	Minimum Landing/Takeoff	RF	Armament	Ammo

Zone					
AC-130A Spectre (Early)	Laser Designator (6 km), RWR, ECM/IRCM 1, Flare/Chaff (40/30), IR Suppression, Secure Radios	1105/800 Primitive Runway	+1	2x GAU-4/A Miniguns, 2xM61 Vulcan Cannons	3000x20mm, 4500x7.62mm, 20xFlares
AC-130A Spectre (Late)	Laser Designator (6 km), RWR, ECM/IRCM 1, Flare/Chaff (40/30), IR Suppression, Secure Radios	1105/800 Primitive Runway	+1	2x20mm M61 Vulcan Cannons, 2x40mm Bofors L/60	3600x20mm, 452x40mm, 20xFlares
AC-130E Pave Spectre (Early)	Laser Designator (9 km), RWR, ECM/IRCM 1, Flare/Chaff (55/45), IR Suppression, Secure Radios, ELINT 1	1105/800 Primitive Runway	+1	2xGAU-4/A Miniguns, 2x20mm M61 Vulcan Cannons, 2x40mm Bofors L/60	7500x7.62mm, 3000x20mm, 452x40mm, 20xFlares
AC-130E Pave Spectre (Late)	Laser Designator (12 km), RWR, ECM/IRCM 2, Flare/Chaff (65/45), IR Suppression, Secure Radios, ELINT 1	1105/800 Primitive Runway	+1	2x20mm M61 Vulcan Cannons, 40mm Bofors L/60, M102 105mm Howitzer	3000x20mm, 452x40mm, 100x105mm, 20xFlares
AC-130H Gray Ghost	Laser Designator (12 km), RWR, ECM/IRCM 2, Flare/Chaff (75/65), IR Suppression, Secure Radios, ELINT 2	1105/800 Primitive Runway	+2	2x20mm M61 Vulcan Cannons, 40mm Bofors L/60, M102 105mm Howitzer, 8xADSID Launchers	3000x20mm, 452x40mm, 100x105mm, 20xFlares, 8xADSID Sensors
AC-130U Spectre II	Laser Designator (15 km), RWR, LWR, ECM/IRCM 2, Flare/Chaff (75/65), IR Suppression, Secure Radios, Satcom Radios, GPS, ELINT 2, Multitarget (2)	1105/800 Primitive Runway	+3	2x25mm GAU-12/A Rotary Cannons, 40mm Bofors L/60, M102 105mm Howitzer, 8xADSID Launchers	3000x25mm, 452x40mm, 100x105mm, 20xFlares, 8xADSID Sensors
AC-130 Spooky II (Plus 4 1)	Laser Designator (15 km), RWR, LWR, ECM 2, IRCM 3, Flare/Chaff (81/71), IR Suppression, Secure Radios, Satcom Radios, GPS, ELINT 2, Multitarget (2)	1105/800 Primitive Runway	+3	2xMk44 30mm Chain Guns, M102 105mm Howitzer, 8xADSID Launchers	4000x30mm, 100x105mm, 20xFlares, 8xADSID Sensors
AC-130 Spooky II (Plus 4 2)	Laser Designator (15 km), RWR, LWR, ECM 2, IRCM 3, Flare/Chaff (81/71), IR Suppression, Secure Radios, Satcom Radios, GPS, ELINT 2, Multitarget (2)	1105/800 Primitive Runway	+3	2x40mm Bofors L/60, M102 105mm Howitzer, 8xADSID Launchers	2994x40mm, 100x105mm, 20xFlares, 8xADSID Sensors
AC-130W Stinger II	Laser Designator (16 km), RWR, LWR, ECM 3, IRCM 3, Flare/Chaff (81/71), IR Suppression, Secure Radios, Satcom Radios, GPS, ELINT 2, Multitarget (2), Link 16	1105/800 Primitive Runway	+4	2xMk44 30mm Chain Guns, M102 105mm Howitzer, 12xGBU-29 SDB, 2xMissile Tubes, 4x250 lb JDAM Racks	4000x30mm, 100x105mm, 12xGBU-29 SDB, 10xViper Strike or 8xGriffin Multipurpose ASMs (or 5xViper Strike and 4xGriffin), 4x250 lb JDAMs, 20xFlares
AC-130J Ghostrider 1	Laser Designator (16 km), RWR, LWR, ECM 3, IRCM 3, Flare/Chaff (81/71), IR Suppression, Secure Radios, Satcom Radios, GPS, ELINT 2, Multitarget (2), Link 16, Helmet-Sight Interface (Pilot, Gunners)	1105/800 Primitive Runway	+5	2xMk44 30mm Chain Guns, M102 105mm Howitzer, 12xGBU-29 SDB Racks, 2xMissile Tubes, 4xHellfire or Maverick Launchers	4000x30mm, 100x105mm, 12xGBU-29 SDB or GBU-53 SDB II, 10xViper Strike or 8xGriffin Multipurpose ASMs (or 5xViper Strike and 4xGriffin), 4x250 lb JDAMs, 4xHellfire or Maverick (or 2xHellfire and

					2xMaverick) 20xFlares
AC-130J Ghostrider 2	Laser Designator (16 km), RWR, LWR, ECM 3, IRCM 3, Flare/Chaff (81/71), IR Suppression, Secure Radios, Satcom Radios, GPS, ELINT 2, Multitarget (2), Link 16, Helmet-Sight Interface (Pilot, Gunners)	1105/800 Primitive Runway	+5	Mk44 30mm Chain Gun, 1MW Laser, M102 105mm Howitzer, 12xGBU-29 SDB Racks, 2xMissile Tubes, 4xHellfire or Maverick Launchers	4000x30mm, 100x105mm, 12xGBU-29 SDB or GBU-53 SDB II, 10xViper Strike or 8xGriffin Multipurpose ASMs (or 5xViper Strike and 4xGriffin), 4x250 lb JDAMs, 4xHellfire or Maverick (or 2xHellfire and 2xMaverick) 20xFlares
AC-130J Ghostrider 3	Laser Designator (16 km), RWR, LWR, ECM 3, IRCM 3, Flare/Chaff (81/71), IR Suppression, Secure Radios, Satcom Radios, GPS, ELINT 2, Multitarget (2), Link 16, Helmet-Sight Interface (Pilot, Gunners)	1105/800 Primitive Runway	+5	2xMk44 30mm Chain Gun, 120mm NEMO Mortar, 12xGBU-29 SDB Racks, 2xMissile Tubes, 4xHellfire or Maverick Launchers	4000x30mm, 80x120mm, 12xGBU-29 SDB or GBU-53 SDB II, 10xViper Strike or 8xGriffin Multipurpose ASMs (or 5xViper Strike and 4xGriffin), 4x250 lb JDAMs, 4xHellfire or Maverick (or 2xHellfire and 2xMaverick) 20xFlares

EA-6B Prowler

The EA-6B, though built on the basic Intruder airframe, is basically a totally different aircraft. It was therefore given a new name – the Prowler – instead of being called the Intruder. The most obvious differences to the observer are the four-seat configuration, with seats for three electronic warfare officers in addition to the pilot, and the large canoe-shaped fairing on the vertical stabilizer of the Prowler, carrying sensors and a special radar set. There are numerous other blisters on the aircraft, mainly for antennas and other sensors. The information from these sensors are fed to a central computer, which is then sent to the EW officers, who read them on large multifunction displays and determine the best way to combat the threat. The Prowler is lengthened almost 1.4 meters to accommodate the extra crewmen. Early versions had no offensive capability, but later the ability to fire antiradar missiles was added. The Prowler generally carries as many as five jamming pods; these pods are equipped with generators powered by small propellers that turn in the slipstream when the aircraft is flying.

There were actually several versions of the Prowler over the years. The first versions used J52-P-8A engines, but these engines were quickly replaced with the more powerful J52-P-408 engines starting with the 22nd Prowler built. Starting with the 29th Prowler, the aircraft was upgraded to the EXCAP (Expanded Capability) model; this version could jam double the number of radar frequencies (a total of eight complete frequency bands), and the jamming sets were more reliable than the earlier versions. The computer was improved, with more memory and more processing power. A tactical electronic intelligence capability was added with the advent of the TERPES (Tactical Electronic Processing and Evaluation System). The EW suite was also equipped with a digital recording system to allow for post-mission analysis. The jamming system was also equipped with EJCU (Exciter Jammer Control Unit) which gave the jammers an additional five frequencies which they could jam.

The ICAP (Improved Capability) version was introduced in 1976, with the building of the 54th Prowler; in addition, 21 earlier Prowlers were upgraded to the ICAP configuration. The workload on the three EW officers was more equally divided (before, the two back-seat EW officers had much more work to do than the front-seat EW officer); communications jamming was given to the front-seat EW officer, while the back-seaters worked solely on radar threats. (In practice, the communications jammers were rarely used, and often not even installed, and the front-seat EW officer served primarily as a navigator.) The surveillance receivers were tuned to drastically improve the response time. A new more powerful radar set was installed. New, higher-capacity chaff dispensers were installed, and some of the radar receivers were replaced with new receivers (which unfortunately proved to be equally unreliable).

The ICAP II version arrived in 1984, with the 99th Prowler built. Most EXCAP Prowlers were also upgraded to the ICAP II configuration, and later virtually all ICAP Prowlers were also upgraded to ICAP II. Major improvements were made to the external jamming pods: before, the pods had to be tuned to a specific frequency range before the aircraft flew and they could not be changed in flight (though several frequency ranges were available, as noted above). ICAP II Prowlers could generate jamming in any one of seven frequency bands, changeable in flight, and two such bands could be jammed simultaneously. In addition, these bands encompassed a wider range of frequencies than earlier models. The computer was again upgraded, with more power and memory. A Carrier Inertial Navigation System (CAINS) was installed; this system could home in on a friendly aircraft carrier, and if necessary, land the Prowler without assistance from the pilot. The threat displays were upgraded to make information much clearer, and potential threat information was pre-programmed into the computer allowing for faster response times. The ICAP II was equipped with a

TACAN link system so that two Prowlers could work together and coordinate their activities. After the 111th Prowler built, ICAP IIs had the ability to employ the HARM antiradiation missile, with the combat system being controlled by the front-seat EW officer. Beginning with the 134th Prowler built, the ICAP IIs were further upgraded to Block 86 standard; this was a relatively minor upgrade, distinguished primarily by two additional radios and new, more reliable antennas for the radios and threat warning receivers. The 170th Prowler built, an ICAP II was the last production Prowler made, in 1991.

This did not stop the upgrade of the Prowlers, however, though subsequent upgrades were made to existing aircraft. The ADVCAP (Advanced Capability) upgrade was cancelled in the 1995 budget, but the Navy still demanded upgrades to the Prowlers to deal with new threats, so the Block 89A upgrades were made, with 125 Prowlers being so upgraded. Computers were again upgraded, as were the radios. GPS was added, as well as an instrument landing system (ILS). High- and low-band radar jammers were improved, widening their range of jammable frequencies as well as the strength of jamming. The EJCU was also improved, and communications jammers were greatly improved to the point where they were actually useful.

The first ICAP III Prowler squadron is expected to be operational in June of 2005, though it is rumored that some ICAP III aircraft have been used in Iraq and Afghanistan. All Prowlers should be ICAP III aircraft by 2010. The ICAP III has greatly increased computer power which allows more storage of data about potential threats as well as a faster response to actual threats, as well as a decreased workload for the crewmen. A new detection system is installed which allows the Prowler to precisely pinpoint the origin of hostile radar sites, providing increased accuracy for the Prowler's antiradiation missiles. The GPS is also linked to the jammers, which allows increased efficiency of jamming; in addition, the computers can pick out the most dangerous threats and either automatically jam them or let the EW officers know what those choices are. (This means that to a limited extent, the computers can take care of threats by themselves if crewmembers are incapacitated or killed.) All four seats use "glass cockpit" technology, where almost all analog instruments are replaced by digital readouts or large multifunction displays. All jammers are increased in strength, frequency agility, and width of frequency bands.

Twilight 2000 Notes: Virtually all the Prowlers used in the Twilight War were in Block 89A configuration, but there were still some ICAP IIs flying, and some training squadrons in the US still had some ICAP-configuration Prowlers, which were later pressed into combat service. There were no ICAP III-configuration Prowlers in the Twilight 2000 timeline.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
EA-6B (Early)	$125,263,050	AvG	6.8 tons	29.48 tons	4	45	Radar (150 km)	Shielded
EA-6B	$146,263,050	AvG	6.8 tons	29.48 tons	4	45	Radar (150 km)	Shielded
EA-6B EXCAP	$149,919,625	AvG	6.8 tons	29.48 tons	4	45	Radar (150 km)	Shielded
EA-6B ICAP	$151,734,025	AvG	6.8 tons	29.6 tons	4	45	Radar (150 km)	Shielded
EA-6B ICAP II (Early)	$155,527,375	AvG	6.8 tons	29.6 tons	4	45	Radar (150 km)	Shielded
EA-6B ICAP II (Late)	$157,082,650	AvG	6.8 tons	29.6 tons	4	45	Radar (150 km)	Shielded
EA-6B Block 89A	$164,090,250	AvG	6.8 tons	29.45 tons	4	45	Radar (150 km)	Shielded
EA-6B ICAP III	$168,192,505	AvG	6.8 tons	29.45 tons	4	45	Radar (150 km)	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
EA-6B (Early)	1904	1410 (185)	NA 130 8/4 40/30	7230	5034	12619	FF 5 CF4 RF3 W4 T3
EA-6B (Others)	2326	1720 (185)	NA 130 8/4 40/30	7230	6174	12619	FF 5 CF4 RF3 W4 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
EA-6B (Early)	Flare/Chaff (80/60) , ECM 2, RWR, All Weather Flight, Deception Jamming (20 km), EW Suite 1	1400/785 Hardened Runway	+1	5 Hardpoints	None
EA-6B/EA6B EXCAP	Flare/Chaff (80/70), ECM 2, RWR, All Weather Flight, Deception Jamming (20 km), EW Suite 1	1400/785 Hardened Runway	+1	5 Hardpoints	None
EA-6B ICAP	Flare/Chaff (80/70), ECM 2, RWR, All Weather Flight, Deception Jamming (30 km), EW Suite 1, Secure Radios	1400/785 Hardened Runway	+1	5 Hardpoints	None
EA-6B ICAP II (Early)	Flare/Chaff (80/70), ECM 2, RWR, All Weather Flight, Deception Jamming (30 km), EW Suite 1,	1400/785 Hardened Runway	+2	5 Hardpoints	None

	Secure Radios				
EA-6B ICAP II (Late)	Flare/Chaff (80/70), ECM 3, RWR, All Weather Flight, Deception Jamming (30 km), EW Suite 2, Secure Radios	1400/785 Hardened Runway	+2	7 Hardpoints	None
EA-6B Block 89A	Flare/Chaff (80/70), ECM 3, RWR, All Weather Flight, Deception Jamming (30 km), GPS, EW Suite 2, Secure Radios	1400/785 Hardened Runway	+3	7 Hardpoints	None
EA-6B ICAP III	Flare/Chaff (80/80), ECM 4, RWR, All Weather Flight, Deception Jamming (35 km), GPS, EW Suite 3, Secure Radios	1400/785 Hardened Runway	+4	7 Hardpoints	None

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S-3 Viking

Notes: The S-3 antisubmarine aircraft was developed to replace the S-2 Tracker, an antisubmarine aircraft which was slow compared to modern aircraft, loud, and had electronics and detection gear which was increasingly ineffective against the Russian submarines of the time. The first operational Viking squadron sailed in 1978, with the S-3A being the first operational type. The S-3A was designed to be an efficient design, not necessarily a high-performance aircraft; though it has good range, it is slow compared to many modern combat aircraft. It is, however, a surprisingly responsive and agile aircraft. The fuselage is relatively short compared to the rest of the aircraft, though it is tall and one can pack a lot into it, especially considering the engines are in pods on the wings. The S-3 has a crew of four: a pilot, co-pilot, and two antisubmarine/attack officers, the SENSO (sensor officer) and TACCO (tactical coordinator). Only the pilot and co-pilot have controls for the aircraft, though all four have ejection seats. The S-3 can be refueled in the air by other aircraft.

The radar in the nose of the aircraft is extremely precise, being one of the first to be able to pick out a submarine's periscope protruding above even rough seas. This radar mode is of relatively short range, but the radar also has modes which allow for a longer ranged, low-resolution maritime search, and an even longer-ranged radar used for navigation, which can pick up coastlines, islands, storm clouds, etc. Other sensors include a retractable FLIR turret under the nose with 3x magnification, radar and radio detectors, a MAD (Magnetic Anomaly Detector) boom which retracts into the tail (used to detect submarines under the water), and tubes under the belly in order to launch up sonobuoys, up to which 60 may be carried; the Viking also has the necessary gear to pick up the transmissions from the sonobuoys. The Sonobuoys themselves may be standard sonobuoys, or special ones which emit smoke, flares, or flashing lights, communicate with submerged friendly submarines (or act as repeaters for surface ship or aircraft communications), homing beacons, or assist in SAR efforts.

The entire ASW suite of the S-3A was tied together by a powerful (for the time) Univac computer, which basically made all the sensors greater than the whole of their parts, by matching information stored in the computer with the information being gathered by the sensors. The S-3A carried several short-range VHF radios and one long-range UHF radio. The S-3A had inertial navigation and a TACAN receiver, as well as Doppler navigation radar, an altitude warning system, and an automatic carrier landing system.

Weapons were carried in an internal bomb bay and two hardpoints on the outer wings able to carry 680 kg each of weapons, countermeasure pods, or extra fuel tanks.

Though conceived in 1981, the first S-3B variants did not actually reach service until 1987. The airframe, engines, and weight are essentially the same as the S-3A; the primary differences are internal. They were all converted from existing S-3A aircraft, with 119 being converted by time the last one was converted in 1994. The radar, FLIR, and the ESM receiver all received upgrades to make them more sensitive and powerful. The sonobuoy receivers were also made more sensitive, an acoustic sensor was added, and the JTIDS (Joint Tactical information Datalink System) was added top the electronics, allowing the S-3B to interface with information from ships, submarines, and JSTARS aircraft, and certain other aircraft with a similar capability. Large-capacity flare and chaff dispensers were added. The S-3B may also use the Harpoon antiship missile, as well as perform air-to-ground attack missions using iron bombs, rockets, or Maverick missiles. The improved radar range gives the S-3B a true stand-off attack capability, especially when using missiles. The S-3B is also capable of buddy refueling, using special fuel tank pods made for the purpose.

The US-3A is a rare "COD" variant of the S-3A; it is basically an S-3 turned into a cargo aircraft. In this role, the combat avionics are removed, and a less-powerful navigation-only radar is installed in place of the standard radar, along with a navigation beacon/receiver. The ASW officers' positions and equipment are removed, though a position for a loadmaster is installed. Up to six passenger seats may be installed. Internal cargo space is small at 7.6 cubic meters, though the hardpoints are retained and may carry cargo pods or drop tanks. The US Navy decided to standardize on the C-2A Greyhound instead, though the Navy did acquire a total of seven US-3As. One was lost in a crash, and the rest had been retired by the mid-1990s.

Another rare variant of the S-3 is ES-3A Sea Shadow; this is a dedicated ELINT platform. In this role, the aircraft has all the ASW gear removed. In its place is a variety of sensors for the conduct of electronic intelligence and eavesdropping operations at long range. The radar was retained, but supplemented by an ISAR (Inverse Synthetic Aperture Radar) system, allowing the Sea Shadow to make good-quality pictures from the radar returns. The computers were greatly upgraded to cope with the information gathered. The Sea Shadow has several automatic SIGINT devices, but they tended to be unreliable and the crew normally used the manual SIGINT devices instead. The bomb bays are faired over, with what were the bomb bays holding electronic equipment instead. The hardpoints are retained, and can be used for drop tanks of buddy refueling tanks. There is a canoe-shaped fairing on top of the fuselage containing sensors and antennas; in all, some 60 antennas were added to the Sea Shadow. The number of crew members was the same, but flight controls were removed from the copilot's position and his role became that of a navigator and ELINT officer. The result, unfortunately, was an aircraft which was substantially heavier and slower than the S-3A, but a reasonably effective ELINT platform – for the time. 16 such conversions were made starting in 1989, but in 1998, the decision was made to remove the Sea Shadows from service rather than upgrade them.

There were several Viking variants which were experimented with, but never got beyond the experimental phase or drawing board. These include tankers, enlarged cargo variants, a proposed replacement for the E-2C Hawkeye known as SeaSTARS, antismuggling variants, and improved versions of the S-3B and ES-3A. One variant known as the Aladdin Viking apparently saw service in Bosnia and may be a reconnaissance variant, but its operations were and are still classified.

The S-3's future is in doubt; the aircraft is considered old, and upgrading it would be expensive. Several upgrades have been proposed, but the only ones approved adds GPS, CAINS, new radios, and better computers. It is quite possible that the S-3 will be replaced by variants of the F/A-18F or the F-35 in the future, and the S-3 retired. Only time will tell.

Twilight 2000 Notes: The ES-3As and US-3As were, of course, not retired, but the late upgrades to the S-3B were never installed either.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
S-3A	$134,645,900	AvG	1.78 tons	23.83 tons	4	40	Radar, FLIR	Shielded
S-3B	$169,099,900	AvG	1.78 tons	24.08 tons	4	40	Radar, FLIR	Shielded
S-3B (Late)	$181,099,900	AvG	1.78 tons	24.09 tons	4	40	Radar, FLIR	Shielded
US-3A	$49,412,900	AvG	6.04 tons	22.57 tons	3+6	32	Radar	Shielded
ES-3A	$235,563,900	AvG	1.36 tons	24.65 tons	4	50	Radar, FLIR	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
S-3A/B/US-3A	2315	1710 (135)	NA 428 7/5 70/50	10983	4958	12190	FF4 CF4 RF4 W4 T3
ES-3A	2085	1540 (135)	NA 385 6/4 60/40	10983	4998	12190	FF4 CF4 RF4 W4 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
S-3A	ASW Equipment, MAD Boom, Sonobuoys (60), Secure Radios, Look-Down Radar, Inertial Navigation	1400m/785m Hardened Runway	+2	Bomb Bay, 2 Hardpoints	None
S-3B	ASW Equipment, MAD Boom, Sonobuoys (60), Secure Radios, Look-Down Radar, Inertial Navigation, Flare/Chaff (60)	1400m/785m Hardened Runway	+3	Bomb Bay, 2 Hardpoints	None
S-3B (Late)	ASW Equipment, MAD Boom, Sonobuoys (60), Secure Radios, Look-Down Radar, Inertial Navigation, Flare/Chaff (60), GPS	1400m/785m Hardened Runway	+4	Bomb Bay, 2 Hardpoints	None
US-3A	Secure Radios, Inertial Navigation	1400m/785m Hardened Runway	None	2 Hardpoints	None
ES-3A	ELINT 4 Suite, Radio Detectors, Radar Detectors, Secure Radios, Inertial Navigation	1400m/785m Hardened Runway	None	2 Hardpoints	None

Consolidated PBY Catalina

Notes: Known to US Navy personnel of World War 2 at "The Cat," the Catalina was developed in response to a 1932 US Navy tender for a long-range flying boat reconnaissance aircraft, to replace the then-current P2Y flying boat. Testing began in February 1935. Adoption came in 1937, with 60 being ordered. The original designation was "P3Y;" however, the Catalina showed promise as a light bomber (and in fact was used sometimes for this purpose in World War 2), and it was redesignated PBY (Patrol Bomber, with the Y being Consolidated's ID in the Navy numbering scheme of the time. Some 28 or the original model were sold to foreign and civilian interests, among them being the Cuban Navy and the *National Geographic* magazine and the New York Museum of Natural History. Later in World War 2, PBY-1s were built under license in Russia, Canada, and Britain. Later models (mostly PBY-4s and 5s were sold to the RZNAF, RAAF, and the Netherlands for use in the Dutch East Indies. The moniker Catalina was actually coined by the British. Consolidated company nomenclature was the Model 28. The PBY was slow, but was a very accurate gun and air munition platform; they were also quite tough. PBYs and their subtypes were responsible for the sinkings of some 50 U-Boats, and an unknown number of Japanese shipping and subs.

XP3Y-1: The Prototype

Though there would be a lot of fixes and modifications to come, the XP3Y-1 set the tone for what would become the PBY-1 (later called the Catalina). The waist blisters, made primarily for observation (from one, one could see almost under the aircraft and above the aircraft is one stretched into the blisters), but they had a ball-and-socket mount for an ANM2, M2, or M3, though in practice these were rarely used until the PBY-5A version. The XP3Y-1 was exceptionally clean aerodynamically. Engines were Pratt & Whitney XR-1830-58 twin wasps with 825 horsepower; these were not supercharged like later PBY engines were.

The biggest problem was a problem test pilots noticed about insufficient directional stability when the rudder was used. It took several months of intensive modifications and testing to resolve this problem. Eventually, a proper rudder design was struck upon and was standardized. After this and a few other modifications, the Navy put in an order for 50 PBY-2s in July 36 – this was two months before the first production PBY-1 example was delivered. The PBY-1 was essentially the same as the final iterations of the XP3Y-1 (redesignated XPBY-1 late in testing). Armament consisted of one ANM2 in a nose turret, and one in the tail; in the prototypes, waist armament was tested, but not usually mounted.

PBY Catalina – Initial Models

Before and after acceptance, the Catalina went through a large series of great and small modifications to make it more amenable to Navy wishes. Most of these modifications centered around the PBY's floats, but the hull was also extended and the rudder given a large, rounded shape. Perhaps the most important upgrade was the replacement of the original 825-horsepower piston engines with 900-horsepower Pratt & Whitney R-1830-64 engines with superchargers for high-altitude operation. This became the PBY-1;

The PBY-2 changed some of the equipment, most notably the radios, to more modern and some longer-ranged AM radios. The major structural change in the PBY-2 is a change in the tail surfaces – on the PBY-1, a slot was cut in the rudder for it to acuate over the elevators. This brought complaints, as certain evasive maneuvers could not be done on the PBY-1. The PBY-2 used cutaways in the elevators, allowing the rudder to swing freely (within the preset limits).

The PBY-3 was essentially the same as the PBY-2 but was powered by 1000-horsepower supercharged engines; the PBY-4 is also the same as the PBY-2,but had 1050-horsepower engines. Armament consisted of wing stores, waist guns, and a tail gun.

The GUBA was a semi-luxury version of the PBY-1, and was in fact the first PBY-1 sold by the Consolidated Corporation. It was sold to Dr Richard Archbold to undertake an exploratory mission to New Guinea. However, before that mission could take place, the Soviets asked for help from the US to help find a missing aircrew who was trying to fly over the North Pole in the shortest period of time (an incredible feat in that day and age). Dr Archbold sold the GUBA to the Russians for cost, and though the Soviets did not find their missing aircrew or any trace of their aircraft, they were impressed with the PBY-1 and decided to keep it in service as a long-range transportation/utility aircraft working in Siberia. It remained a civilian aircraft. The GUBA had a then-new gyroscope, and the rear had two bunks in addition to the three bunks in the tail. The center of the cargo compartment had a large square desk for use as a map table; this had a lamp on an armature and cylindrical slots on the sides of the desk for holding maps. (It is not known if the Russians left the desk in the aircraft after taking it over.) It is otherwise like a 1940s version of the PBY Mobile Home listed below.

All PBYs had three bunks in the extreme tail (in a surprisingly comfortable space), allowing crews to take shifts in the operation of the aircraft. The normal crew consisted of a pilot, co-pilot, radio operator/navigator, two waist gunners/observers, one turret gunner, and one tail gunner/observer. Seats were provided for two passengers, usually a downed aircrew.

PBY-5-6

The PBY-5 was mostly an incremental upgrade – the use of 1200-horsepower engines, two wet hardpoints for extra fuel tanks (the fuel tanks designed for use with the PBY-5 were self-sealing). Some of this batch (of 683) was Lend-Leased to the RAF,(who called it the Catalina IVA) and one went to the US Coast Guard. The Russians also license produced the PBY-5, calling it the GST. (The GST was not built to US Navy specifications – it used Soviet-made engines of 930 horsepower.) The PBY-5 (and the 5A) were normally equipped with ANM2 waist guns, but were also often upgunned to M2 or M3 .40 machineguns.

The PBY-5A, however, was a marked difference from both the PBY-5 and other Catalinas. First, the PBY-5A was amphibious – it had retractable main wheels and a retractable nosewheel, allowing it to use stretches of water and airstrips for takeoff and landing. The first batch of 124 had one ANM2 mounted in the bow; the remainder of the 803 built had two such guns, mounted in a nose turret. Some diversions were made to the Army Air Force, the RAF (as Catalina IIA) and again, one to the Coast Guard. Some were built for the Army Air Forces, designated the OA-10. The PBY-5A had separate brake pedals above the rudder pedals, as the large wings and rudder might require some rudder action on the ground during landing.

The PBY-5R had almost all of its combat gear removed (even some radios), and the interior refurbished into a staff transport. Its base was the PBY-5A, and it retained its amphibious capabilities. The nose turret was removed, but additional windows were added. (And the side blister windows were removed). The PBY-5A used a 3kW APU, powerful enough to start the engines as well as power internal systems when the engines are off. The PBY-6AG is a similar aircraft, but used by the Coast Guard.

The PBY-6A also used the PBY-5A as a base, but had interior, external and wing-mounted equipment for a radar installation, and a place for a radar operator behind the pilot and co-pilot. Instead of the ANM2s, the PBY-6A had a pair of M3 .50-caliber machineguns in the nose turret. The waist blisters had ANM2s, one each. For better water mobility, a tailer fin and rudder was added. Some 175 of this model were built; 21 were transferred to the Soviet Navy. The US Army Air Forces received a number of this version, designating them OA-10B.

Boeing Canada built the PB2B-1 and PB2B-2 for the RAF and RCAF; these were essentially the same as the PBY-5 version with the exception of having Canadian-manufactured components. In addition, the PB2N-2 had the taller horizontal stabilizer of the PBN-1

Nomad variant (below). Most PB2N-2s were given over to the RAF, who called them the Catalina VI. The Canso was a version of the PBY-6A built by Vickers in Canada; it differed from the PBY-6A primarily in its high-efficiency superchargers, giving it a very high service ceiling.

The PBV-1A was a Canadian-built version of the PBV-5A. 150 went to the RCAF (and called the Canso-A) and the US Army Air Force (designated the OA-10A – Not to be confused with the Warthog variant of the same designation). The Canso-A retained the high-efficiency superchargers of the Canso.

Black Cat PBYs

VP84 (Patrol Squadron) and VP63 were designated for night attack/bombing role. They flew at first PBY-5s and soon thereafter late-model PBY-5As. One of the first alterations the crews made to their aircraft was to have them painted matte black on almost all exterior surfaces; they then started to call themselves the "Black Cats." (The interior was largely zinc chromite in color, but the top half of the cockpit, canopy rails, and waist blister rails were also matte black. (Some crews went as far as top paint the barrels of the guns matte black.) Though most PBYs were engaged in patrolling and some light bombing raids or dropping mines, the Black Cats took this to an art form, bombing with as much as 1000-pound bombs, heavy clusters of mines, and even 2.75-inch rockets, in addition to their normal armament. They were known for their accuracy, and this is in part due to the upgraded bombsights they used. They also installed M2 .50-caliber machineguns in the waist blisters, in addition to an ANM2 .30-caliber in the rear tunnel.

The Black Cats were also known for use of an unconventional weapon – they kept empty beer bottles, then urinated in them, corked them, and on attack runs dropping them out of the side hatches and the rear tunnel hatch onto the hapless Japanese.

PBN-1 Nomad

The PBN-1 Nomad was an advanced version of the PBY built by the Naval Aircraft Factory. It had major modifications, including a lengthened bow to allow for a better fit for the nose turret and radar unit. The hull lines were modified with a redesigned step with a no-slip surface, and larger wingtip floats and a revised electrical system, primarily to properly supply power to the radar unit. Some 155 were built, with some going into the Lend-Lease program to the RAF (as the Catalina V) and to the Soviet Navy (as the KM-1). The PBN-1 is otherwise similar to the PBY-5A.

The Naval Aircraft Factory built the Nomad, since introducing the Nomad's modifications to existing production lines would have been too disruptive. The Nomad had a clipper bow, and an "eyeball" turret for a single .50. Two .50s were mounted in the waist blisters, and the nose turret had another pair of .30s, with a third .30 at the ventral hatch at the rear. The lower hull was extended almost 1.5 meters, allowing for greater fuel tankage and better floatation. The wing floats were redesigned to be more aerodynamic; they were longer and more streamlined.

It should be noted that Nomads did not have a rear gun, though the position was retained for observation,

Civilian Catalinas

After World War 2, Catalinas were sold in the US on the Civilian market.

Many of these were converted to flying mobile homes, some able to land on runways. These PBYs usually have small, compact APUs (0.5-2 kW) to power onboard equipment ranging from GPS viewers and mappers to microwave ovens to interior lights. A chilled drinking water tank of 60 liters is installed, sometimes more than one. Amenities such as a toaster oven, separate freezer, and a bar are often installed as well. (The version below is equipped with a 1kW APU.)

Small airlines (such as island hoppers) employed and still employed in some cases, able to seat as many as 10 passengers, the pilots, and a stewardess and a small galley. These airlines are often equipped with GPS as well, along with survival rafts and survival gear. They also tend to have instruments that record the last 30 minutes of voice data in the cockpit and the last 30 minutes of flight information (often called "black boxes," though they are actually bright orange to aid in finding them), The hardpoints often get use to carry baggage pods for the passengers' and crews personal effects, and supplies to replenish the galley.

The Coast Guard and civilian SAR services continued using the PBY after the War, and again some are still in use.

"Puddle jumpers" in wilderness areas such Alaska and Siberia often employ PBYs. These are generally equipped with inertial navigation, as GPS does not work so well in wilderness areas such that they travel. They also have survival shelters and gear, as well as high-efficiency heaters and a small, compact APU. They have some of the longest-range conventional radios, including AM or VLF setups. They will often also have something like a hot plate (primarily for the coffee that such pilots seem to live off) or camp stove (run off an APU instead of propane). The hardpoints general contain pods with survival equipment and the larger baggage of the passengers.

Perhaps the most important use of the PBY are those modified for use as water bombers in firefighting, using the belly fuel tanks to scoop up water, or having pumped in before takeoff. Such PBYs use 3500 liters of their fuel space for water or fire retardant. They use a high-precision version of GPS and mapping, and taxi along a lake to gather water. These PBYs are normally equipped with radios of several types, to communicate with their base, to raise firefighters in the field, and to communicate with disaster relief and firefighting headquarters. Also typically have GPS for navigation and a transponder and transponders so they can be found in the air. They have computers similar to bombsights so they can deliver their load accurately.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
PBY-1	$4,880,862	AvG	1.91 tons	15.63 tons	7+2	25	None	Enclosed

PBY-2	$4,927,530	AvG	1.94 tons	15.72 tons	7+2	25	None	Enclosed
PBY-3	$4,989,712	AvG	1.95 tons	15.85 tons	7+2	25	None	Enclosed
PBY-4	$4,895,876	AvG	1.96 tons	15.91 tons	7+2	25	None	Enclosed
PBY-5	$5,114,326	AvG	1.97 tons	17.1 tons	7+2	25	None	Enclosed
GST	$4,822,433	AvG	1.95 tons	16.77 tons	7+2	25	None	Enclosed
PBY-5A (Early)	$5,114,326	AvG	1.97 tons	17.2 tons	7+2	25	None	Enclosed
PBY-5A (Late)	$7,883,372	AvG	1.98 tons	17.28 tons	7+2	25	None	Enclosed
PBY-5R	$8,283,014	AvG	1.99 tons	20.39 tons	2+4	28	None	Enclosed
Black Cat PBY-5A	$15,175,449	AvG	1.95 tons	17.44 tons	7+2	25	None	Enclosed
PBY-6A	$68,239,723	AvG	1.98 tons	17.66 tons	7+2	34	Radar (45 km)	Enclosed
Canso	$68,239,723	AvG	1.98 tons	17.66 tons	7+2	34	Radar (45 km)	Enclosed
PBN-1	$95,001,071	AvG	1.94 tons	17.94 tons	7+2	34	Radar (60 km)	Enclosed
Civilian PBY Mobile Home	$24,456,880	AvG	988 kg	20.84 tons	2+4	33	Weather Radar (60 km)	Enclosed
Small Airline PBY	$29,807,152	AvG	1.56 tons	18.19 tons	3+10	32	Weather Radar (60 km)	Enclosed
Puddle Jumper PBY	$41,687,881	AvG	1.4 tons	18.02 tons	2+4	30	Weather Radar (60 km)	Enclosed
Firefighting PBY	$56,761,798	AvG	438 kg	17.84 tons	2	29	Radar (60 km), FLIR (30 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
PBY-1	622	173 (30)	NA 36 7/4 35/20	6624	245	3700	FF6 CF5 RF3 W4 T3
PBY-2	673	187 (30)	NA 40 7/4 35/20	6624	267	4938	FF6 CF5 RF3 W4 T3
PBY-3	739	205 (30)	NA 44 7/4 35/20	6624	297	4938	FF6 CF5 RF3 W4 T3
PBY-4	772	214 (30)	NA 46 7/4 35/20	6624	312	4938	FF6 CF5 RF3 W4 T3
PBY-5	819	227 (30)	NA 49 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
GST	664	182 (30)	NA 39 7/4 35/20	6624	277	4938	FF6 CF5 RF3 W4 T3
PBY-5A (Early)	814	226 (30)	NA 49 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
PBY-5A (Late)	811	224 (30)	NA 49 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3

PBY-5R	692	192 (30)	NA 42 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
Black Cat PBY-5A	804	222 (30)	NA 48 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
PBY-6A	794	221 (30)	NA 48 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
Canso	794	221 (30)	NA 48 7/4 35/20	6624	367	6255	FF6 CF5 RF3 W4 T3
PBN-1	792	217 (30)	NA 48 7/4 35/20	7624	367	4938	FF6 CF5 RF3 W4 T3
Civilian PBY Mobile Home	677	188 (30)	NA 42 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
Small Airline PBY	772	224 (30)	NA 46 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
Puddle Jumper PBY	779	216 (30)	NA 47 7/4 35/20	6624	367	4938	FF6 CF5 RF3 W4 T3
Firefighting PBY	786	218 (30)	NA 47 7/4 35/20	3124	367	4938	FF6 CF5 RF3 W4 T3

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
PBY-1/2/3/4/5	None	200m/200m Water	None	2xANM2 or M3 (Waist), ANM2 (Tail), 4 Hardpoints	5000x.30-06 or 2500x.30-06 and 1500x .50, 10 Hand Flares
PBY-5A (Early)/GST	None	200m/200m Water – 400m/500m Primitive Runway	None	AN/M2 Machinegun (Turret). 4 Hardpoints	12 Hand Flares, 5000x.30-06
PBY-5A (Late)	None	200m/200m Water – 400m/500m Primitive Runway	None	2xAN/M2 Machineguns (Turret). 4 Hardpoints	15 Hand Flares, 5000x.30-06
Black Cat PBY-5A	None	200m/200m Water – 400m/500m Primitive Runway	+2	2xANM2 Machineguns (Turret), 2xM2 Machineguns (Waist), ANM2 Machinegun (Rear), 4 Hardpoints	7500x.30-06, 4000x.50, 15 Hand Flares
PBY-6A/Canso	RWR	200m/200m Water – 400m/500m Primitive Runway	+1	2xM3 Machineguns (Turret). 2xAN/M2 (Waist), 4 Hardpoints	5000x.50,,2500x.30-06, 15 Hand Flares
PBN-1	RWR	200m/200m Water –	+1	M3	7500x.50, 7500x.30-

		400m/500m Primitive Runway		Machinegun, 2xAM/M2 (Turret), 2xM3 (Waist), 4 Hardpoints	06, 15 Hand Flares
Civilian PBY Mobile Home/Small Airline/Puddle	Transponder, TACAN, GPS	200m/200m Water – 400m/500m Primitive Runway	None	4 Hardpoints	None
Small Airline PBY	Transponder, TACAN, GPS	200m/200m Water – 400m/500m Primitive Runway	None	4 Hardpoints	None
Puddle Jumper PBY	Transponder, TACAN, GPS	200m/200m Water – 400m/500m Primitive Runway	None	4 Hardpoints	None
Firefighting PBY	Transponder, TACAN, GPS	200m/200m Water – 400m/500m Primitive Runway	+2	4 Hardpoints	3500 l Water or Flame Retardant.

Douglas AC-47 Spooky

Notes: The aerial gunship aircraft was the brainchild of a USAAF LTC named GC McDonald, who came up with idea late in World War 2. McDonald felt that such a gunship could be useful in combating Japanese soldiers when they were hiding in the terrain or when a base or base camp was found. McDonald also came up with the concept of the "pylon turn" now used by all such aircraft-based gunships. However, he never came up with a satisfactory way to aim the weapons; his idea was to have the pilot used the wing as a guideline to aim. The idea was tested using a C-47 and found workable, but was World War 2 was ending and the project was dropped. It was not picked up again until 1961, when the US Air Force found that providing close air support needed not only overwhelming firepower, but a relatively slow and stable gun platform. This need was underscored by the difficulty in providing close air support to the scattered Special Forces camps and fortified villages which constituted US involvement in Vietnam at the time. The wheels turned slowly, however, and limited funding for developing a gunship was not received until 1963. In 1964, after the Gulf of Tonkin Incident, the gunship project went on the high burner. The aircraft was still based on the C-47 (the D model, specifically). At first, the AC-47D was to have the designation "FC-47D," since there was already an electronic warfare version of the C-47 called the AC-47; however, after the Pentagon realized that the designation made no sense (and after loud protects from the Fighter Mafia), the former AC-47 was redesignated and the new gunship designated the AC-47D. More popular names for the AC-47D included its official moniker of Spooky, and the name it was given by the troops, "Puff the Magic Dragon," or just "Puff." "Dragonship" is also a name that troops called the AC-47D, again from the Puff the Magic Dragon name. The Spooky was introduced in limited numbers in 1963 and officially deployed in 1965, but by 1969 the Air Force felt that they were too old and vulnerable, and they were replaced for a short time by AC-119G and later by the various models of the AC-130. Despite their large shoes, only 20 AC-47Ds were actually employed by the US Air Force, though a small amount of other countries around the world copied the concept, and some are still flying now (most notably in the hands of the Columbian Air Force, where they are called by the popular name of *Avion Fantasma*, or "ghost ship.")

The AC-47D was heavily modified from the original C-47D for its role as a gunship. The AC-47D was fitted with three M-134 Miniguns firing out of the port side of the aircraft. The guns could be fired so that they produced a single cone of fire, the apex of which could be from 75 to 300 meters away from the aircraft; they could also be fired in a spread about 50 meters across. The Miniguns, as installed on the AC-47D, had a selectable rate of fire (either 3000 or 6000 rounds per minute); at the most extreme ROF fire from each Minigun, the AC-47D could fire its full complement of ammunition in 1.5 seconds. These Miniguns used improvised mounts made from SUU-11A/A Minigun pods; these caused a lot of vibration of the AC-47D and fed from 200-round belts in cans (which had to be constantly reloaded by the crew), but were good for a first effort. Later, these were replaced by GAU-2B/A Miniguns which were designed to be door guns on helicopters and were more suited to the task. The GAU-2B/A fed from 400-round bins, but were more easily aimed. Finally, the AC-47Ds received the MXU-470/A Miniguns, which fed from large 8000-round drums that used linkless feed. After experimentation, the Miniguns were carried at a primary attitude of 12 degrees downward, so that the pilot did not have to fly the AC-47D so greatly banked, and could maintain an attitude that allowed him to keep more lift on the airplane. One Minigun fired out of the widened rear door, and the other two out of the two windows in front of the door, just behind the wing.

Crew consisted of the pilot/gunner, copilot, and one tender for each gun. The pilot fired the guns on a support mission by banking the aircraft over to the port and flying in a circle above the target, a maneuver called a "pylon turn," a term borrowed from aircraft racing. On the window on the pilots left side was mounted a Mk 20 gunsight, taken from A-1 Skyraiders that had been taken out of service or too badly damaged to be fixed. A trigger button (also salvaged from A-1 Skyraiders) was added to the pilot's control yoke. (Pilots also found that even drawing a crude grease pencil mark on the window could produce reasonably accurate fire if there wasn't time to use the Mk 20 sight.) Early experience found the Spooky to be vulnerable when in their pylon turns, so ballistic armor curtains (made from a more up-to date version of the material of Vietnam-era flak jackets) was added to the left side of the aircraft, from just behind the cargo door to under the pilot's left window. On AC-47s that mounted the MXU-470/A Miniguns used armored ammunition bins. The AC-47D also carried a bin of flares that were used to illuminate targets at night; soon, this bin received armor plating as well. These flares were simply hand-tossed out of the cargo door by one of the gun tenders after setting the flare for the proper time/altitude of when it would start to burn. (In game terms, one of these flares has the equivalent illumination radius and burn time as an ILLUM round from a 105mm howitzer.)

Other new equipment added to the Spooky included more precise navigation equipment and extra radios allowing it to contact ground troops on 4 frequencies at once, FAC aircraft in the vicinity, and a very long-range radio to give communications with its home airfield or higher echelons of command. Some AC-47Ds converted later by other countries have ballistic curtains made from either flexible Kevlar or Kevlar plates, and have more modern radios and up-to-date navigation equipment.

Though also designated AC-47D, the first four AC-47Ds received temporary armament due to a shortage of Miniguns in Vietnam. Their armament consisted of ten .30-06-firing AN/M2 machineguns, including four firing from the cargo door and others studded up and down the left side. This was a temporary measure, and these Puffs were retrofitted with Miniguns in late 1965, after the other 16 modified C-47s were converted into the AC-47D configuration. This configuration with the plethora of machineguns were very problematic – the guns used were old and tended to jam with distressing regularity (though never all ten at once) and they fed from ammo cans holding 100 rounds, keeping the gun tenders busy. There was no provision for aiming, and they did not have flexible mounts. The mountings of the guns also required a steep left bank to get all of them on target, and there was still a rather wide field of fire (as much as 200 meters across), defeating the Spooky's purpose of delivering concentrated fire. The US military's supply chain (of any branch of service) were not set up to supply the large amounts of .30-06 ammunition the gunships needed; sometimes, these Spookies had to go out with partial ammunition loads.

The five Columbian AC-47s in service today are based on the Basler BT-67 updated version of the C-47. (See US Cargo Aircraft.) These aircraft are further modified by having Hartzell high-speed propellers driving the aircraft. Instead of Miniguns, the Columbian ABT-67s are armed with three M-3M heavy machineguns. The gunsight is updated, including the addition of computer assistance, and the ABT-67 also has a FLIR/Advanced Image Intensification dome under the nose that is slaved to the gunsight. The guns are fed by three linkless feed ammunition chutes traveling from armored ammunition bins. The flare bin is removed, but the ABT-67s have anti-missile flare launchers and chaff ejectors as well as flare ejectors for illumination. (Note: "ABT-67" is *not* an official designation.)

In 1970, the Indonesian Air Force converted a single C-47D (which had formerly been a civilian DC-3) to a gunship configuration. This aircraft is armed with three M-2HBs with QCB kits that are fed using a linkless feed setup as above. This gunship was first used in 1975 during the Indonesian invasion of East Timor, and is still operating CAS missions in East Timor. The engines are said to have been so heavily refurbished that they are almost like new-build engines.

From 1984-85, El Salvador had the use of a pair of AC-47Ds, armed with advanced sighting systems based on early models of the AC-130's gunsights. These AC-47Ds also had advanced light intensification and FLIR equipment. Armament is three M-3M machineguns. Rumors say that these have been replaced with ABT-67s. The El Salvadoran crews of these ABT-67s were trained in the US by USAF pilots, gun tenders, and mechanics, and are quite proficient in their jobs. The rear Thermal Imager is used by crewmen in the rear to observe possible new targets and threats. A more powerful aiming computer was installed. Flare countermeasures and chaff countermeasures are installed.

For a time in the 1980s, the SANDF operated several versions of the ABT-67. One was armed with three M-3M machineguns, one had the standard Miniguns, and one had three 20mm autocannons (known as Dragon Daks in South Africa). These aircraft have since been retired to museums. They have FLIR and an image intensifier slaved to the gunsight. They do not illumination flare capability, but flare and chaff missile countermeasures are installed.

Other countries have or still used the AC-47 or ABT-67; however, I am not certain of their status in these countries. These include Taiwan, Cambodia, Laos, the Philippines, Rhodesia, Vietnam, and Thailand.

Twilight 2000 Notes: Some of these aircraft have been spotted in the United States in the Twilight 2000 timeline in use against New America and Mexican troops, probably taken from boneyards. The Columbians are believed to still have two of their ABT-67 gunships, plus another used for spare parts. The Columbians, however, do not use them much due to lack of fuel. El Salvador still has one of their ABT-67s; again, fuel is the problem. Other rumors say that SANDF is trying to restore at least one gunship to flying status, though again where flying fuel will come from is a problem.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
AC-47D (US Version)	$2,672,445	AvG	900 kg	8.3 tons	5	14	Image Intensification	Enclosed
AC-47D (US Interim Version)	$2,858,015	AvG	925 kg	8.25 tons	5	18	Image Intensification	Enclosed
ABT-67 (Columbian)	$5,225,745	JP4/5/6	1.11 tons	8.99 tons	5	19	Radar (30km) FLIR, Advanced Image Intensification	Enclosed
AC-47D (Indonesian)	$2,805,105	AvG	750 kg	8.45 tons	5	14	Image Intensification	Enclosed
ABT-67 (El Salvadorean)	$6,128,500	JP4/5/6	1.13 tons	8.83 tons	5	22	Radar (40km), FLIR, Advanced Image	Enclosed

							Intensification, Thermal Vision (Rear)	
ABT-67 (SANDF 1)	$2,654,640	JP4/5/6	1.14 tons	8.8 tons	5	17	FLIR, Image Intensification	Enclosed
ABT-67 (SANDF 2)	$2,715,040	JP4/5/6	1.14 tons	8.8 tons	5	17	FLIR, Image Intensification	Enclosed
ABT-67 (SANDF 3)	$2,266,795	JP4/5/6	1.15 tons	8.6 tons	5	18	FLIR, Image Intensification	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
AC-47D (US Version)	552	138 (39)	NA 34 5/3 40/30	1500	723	7070
AC-47D (US Interim Version)	555	139 (39)	NA 34 5/3 40/30	1500	719	7070
ABT-67 (Columbian)	575	144 (37)	NA 35 5/3 40/30	3028	1615	5791
AC-47D (Indonesian)	542	136 (40)	NA 35 5/4 40/30	1500	730	7070
ABT-67 (El Salvadorean)	585	147 (38)	NA 36 5/4 40/30	3028	1601	5791
ABT-67 (SANDF 1/2)	587	147 (38)	NA 36 5/4 40/30	3028	1598	5791
ABT-67 (SANDF 3)	594	149 (37)	NA 37 5/4 40/30	3028	1579	5971

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
AC-47D (US Version)	RWR	600/500m Primitive Runway	+1	3xM-134 or GAU-2B/A or MXU-470/A Miniguns	24000x7.62mm, 45xHand Flares
AC-47D (US Interim Version)	RWR	600/500m Primitive Runway	+1	10xAN/M2 Machineguns	24000x.30-06, 45xHand Flares
ABT-67 (Columbian)	RWR, Secure Radios, Countermeasure Flare/Chaff Dispensers (10 Bundles Each)	400/500m Primitive Runway	+2	3xM-3M Machineguns	29061x.50
AC-47D (Indonesian)	Secure Radios, RWR, ILLUM Flare Dispenser (20 Flares)	600/500m Primitive Runway	+1	3xM-2HB QCB Machineguns	17760x.50, 45xHand Flares
ABT-67 (El Salvadoran)	RWR, Secure Radios, Flare/Chaff Dispensers (10 Bundles Each), HUD, TACAN, Beacon Tracking Radar	400/500m Primitive Runway	+2	3xM-3M Machineguns	29061x.50
ABT-67 (SANDF 1)	RWR, Flare/Chaff Dispensers (10 Bundles Each), TACAN	400/500m Primitive Runway	+1	3xM-3M Machineguns	29061x.50
ABT-67 (SANDF 2)	RWR, Flare/Chaff Dispensers (10 Bundles Each), TACAN	400/500m Primitive Runway	+1	3xMXU-470/A Miniguns	29600x7.62mm
ABT-67 (SANDF 3)	RWR, Flare/Chaff Dispensers (10 Bundles Each), TACAN	400/500m Primitive Runway	+1	3xMG-151/20 Autocannons	3826x20mm

Grumman E-2 Hawkeye

Notes: This aircraft made its debut as the E-2A version in 1964. The E-2 is a naval AWACS-type aircraft, small but powerful in its assigned role. Though it caries no offensive or defensive armament, it is greatly feared by enemy forces due to its powerful search and tracking radars, able to pick up most aircraft, ships, and even some ground forces within a three million cubic mile area in its latest incarnations. The airframe is the same as the C-2 Greyhound cargo aircraft, but the E-2 is distinguished by the numerous aerials on the fuselage, wings and tail, and of course, the large 7.3-meter saucer-shaped radome above its fuselage. (This radome is also airfoil-shaped, allowing it to help provide lift for the aircraft.) The Hawkeye's primary role is that of an AWACS aircraft, but it has secondary functions as a surveillance platform, strike and intercept controller aircraft, search and rescue guidance, and communications relay aircraft. In addition to the US Navy, the E-2 is used by Japan, Israel, Singapore, Taiwan, and France. (It is rumored that Israel has made some unspecified modifications to her Hawkeyes, but what these modifications are is unknown.) All these other countries fly E-2C versions.

The first version to enter service was the E-2A, which arrived in the fleet in 1964, and served until 1967, when it was replaced by the E-2B model. 59 were built in all. The aircraft was sophisticated for the time, with small powerful computers to coordinate all functions of the aircraft and its equipment. The primary system of the E-2A was the ATDS (Airborne Tactical Data System), consisting of automatic detection radar and a memory and datalink system, as well as the aforementioned computers. This was tied to the NTDS (Naval Tactical Data System, which transmits the ATDS data to the flagship, task force, and even to the nearest Naval command headquarters, if necessary and they are in range. The E-2A has five crewmembers: a pilot and copilot, and three operators for the ATDS system. The E-2A is capable of in-flight refueling, but the crewmembers do not have ejection seats; they must bail out manually. A problem of the E-2A was lack of capability of its radar over land; it has a very hard time detecting ground targets or even low-flying aircraft overland.

Though successful in its role, further upgrades were deemed necessary, and work on the E-2B version began quite soon after the E-2A entered service. Upgrades began in 1969. Most E-2Bs were simply modified E-2As, and 51 such modifications were made. The E-2B is distinguished primarily by much more powerful computer with more storage capacity, able to store the profiles of a large amount of enemy aircraft in its memory, as well as control much more of the battle picture. The radar was not given much of an upgrade, and still has the problems of degraded coverage overland.

The E-2C was the big upgrade for the Hawkeye; it resulted in internal changes as well as external physical changes to the aircraft. There were actually several versions of the E-2C, delineated by several upgrade steps both minor and major. The first E-2Cs were designated the Omnibus I Hawkeyes; these aircraft arrived in the early 1970s, and had major upgrades to the radar, computers, IFF, and passive listening/detection devices. The nose had to be altered, as well as the boat tail; in addition, many new antenna fairings appeared on the fuselage, wings, and tail surfaces. Earlier Hawkeyes had a radome which could be raised and lowered about a meter for easier storage of the aircraft on board ships; on the E-2C, the radome was to be lowered for maintenance purposes only. The E-2C is capable of tracking over 600 targets, and controlling over 40 intercepts or strikes. At first these E-2Cs were equipped with an AN/APS-120 radar, but these were replaced with the AN/APS-125 radar in 1978, which finally gave the Hawkeye reliable overland radar detection and control capability. In 1984, the Omnibus II Group 0 modifications arrived; chief among these modifications was again in the radar (the AN/APS-138), which now had the capability to operate in high-jamming and electromagnetic interference environments. It was this model that first attracted the attention of most of the foreign governments which now operate the Hawkeye.

The Omnibus II Group I upgrade, arriving in 1988, was primarily an engine upgrade; the former twin 4600-horsepower turboprop engines were replaced by new 5100-horsepower engines. This was necessary, as the weight of the aircraft increased with every upgrade in electronic performance, as did the power requirements of the electronics and the radar. These engines also have a lower fuel consumption/power ratio. Other improvements were antijam antennas for the radios and sensors, improvements to the avionics cooling system, a better instrument panel for the pilots, better cockpit lighting, and a new AN/APS-139 radar system was installed which doubled the tracking capability of the aircraft. Eighteen new E-2Cs were built to this standard, and the other Hawkeyes in the fleet were later upgraded to this configuration.

The Omnibus II Group II upgrade is a massive aircraft upgrade; not all Hawkeyes have yet been modified to standard, though the goal is to have all E-2Cs up to this standard, if not greater (see below) by 2010. Chief among these upgrades are a new AN/APS-145 radar and associated equipment, tracking systems, and computers. This system gives the Hawkeye a fully automatic tracking and search capability, even overland. The area of radar scanning is increased by 96%, target recognition and tracking by 200%, and targets able to be displayed at once by 1000%. The equipment operators have largely “glass-cockpit”-type displays, including color displays. GPS and satellite communications have been added. The aircraft has a new, more accurate IFF system, able to better detect “false squawks” and pick out enemy aircraft which are the same model as friendly aircraft. The system is also able to detect jamming of the IFF band. The Omnibus II Group II uses the new JTIDS (Joint Tactical Information Display System); this allows the Hawkeye to interface directly with friendly aircraft, ships, and ground units, including Air Force AWACS aircraft. Group II(N) aircraft, a further upgrade of the Group II, adds an improved navigation suite. The Group II(M) aircraft further enhance the multifunction displays of the equipment operators and add an even more powerful computer with more memory. Group II(C) aircraft increase the Hawkeye’s ability to defend itself with more powerful ECM capability; in addition, the pilots have direct access to the satellite communications equipment in the cockpit, and the equipment cooling system is further improved.

The E2C+ is a minor upgrade of the E2C Omnibus II Group II aircraft, characterized primarily by a change to 8-bladed propellers (previous models had four-bladed propellers). These propellers increase engine performance and are quieter than the old propellers, both inside and outside the aircraft. Propellers made of a composite material are also being experimented with, but whether these will be fitted to existing aircraft is unknown at this time. They are, however, lighter and stronger than metal propellers.

Since the E-2 is expected to be serving the US Navy well into the 21st century, more upgrades are planned for the Hawkeye. This program is currently known as Hawkeye 2000. This upgrade calls for a greatly upgraded mission computer, which is also smaller, lighter, and requires less power than earlier E-2C computers. The interface between ships, aircraft in the area of operations, and ground units will be near-total, using the new CEC (Cooperative Engagement Capability). Operational testing began in 2001; whether any have been used in war zones is unknown. France has also expressed interest in Hawkeye 2000, and the administration says that France will get them. Japan and Egypt will not get new Hawkeye 2000s, but they will be given kits to upgrade their existing Hawkeyes. It is believed that Israel is already flying E-2Cs that are up to the Hawkeye 2000 standard, though theirs are an independent development.

Beyond the Hawkeye 2000 upgrades lies the E-2D Advanced Hawkeye. Details on this aircraft are sketchy, but are said to include a two-generation leap ahead in radar capability. Upgrades to increase supportability, maintenance, and readiness are planned. Though the E-2D will look essentially like an E2C from the outside, inside it will be a new aircraft, built from new production rather than modified from existing airframes. The interior layout will be rearranged to reflect the more compact nature of the new computers, ELINT and ECM gear, and associated equipment. A fourth equipment operator will be added to help manage the increased capability. Full "glass cockpit" displays for the equipment operators as well as the pilots will be standard aboard the E-2D. These aircraft are reportedly already being built and tested, but not expected to be in fleet service until 2011. *It should be noted that the stats below for the E-2D are to a large extent educated guesses.*

Twilight 2000 Notes: There are a precious few Omnibus I Group II Hawkeyes flying, but most are Omnibus I Group I aircraft, with a few Omnibus I Group 0 aircraft still hanging on. France and Egypt do not fly the E-2. Israel's Hawkeyes are already up to Hawkeye 2000 standard by the Twilight War, but the US Navy's Hawkeye 2000s were never built, and of course neither were the E-2Ds.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
E-2A	$144,865,500	AvG	750 kg	23.85 tons	5	60	Radar	Shielded
E-2B	$146,314,155	AvG	750 kg	23.85 tons	5	60	Radar	Shielded
E-2C Omnibus I (Early)	$147,777,295	AvG	750 kg	23.85 tons	5	60	Radar	Shielded
E-2C Omnibus I (Late)	$150,476,620	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group 0	$151,981,380	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group I	$171,685,000	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II	$161,637,500	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II(N)	$169,310,000	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II(M)	$171,003,100	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II(C)	$189,573,750	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C+ (All)	$190,203,750	AvG	750 kg	23.85 tons	5	56	Radar	Shielded
Hawkeye 2000	$192,105,785	AvG	750 kg	23.85 tons	5	56	Radar	Shielded
E-2D	$214,715,600	AvG	900 kg	24 tons	6	60	Radar	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
E-2A/B/C (Omnibus I Early)	818	250 (90)	NA 69 5/3 50/30	7450	4768	11275
E-2C (Omnibus I Late/Group 0)	900	260 (90)	NA 72 5/3 50/30	7450	4768	11275
E-2C Omnibus I Group I/Group II	1230	355 (90)	NA 98 5/3 50/30	7450	3255	11275
E-2C+ (All)/Hawkeye 2000	1285	371 (90)	NA 102 5/3 50/30	7450	3404	11275
E-2D	1344	388 (90)	NA 107 5/3 50/30	7450	3578	11275

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
E-2A/B/C Omnibus I (Early)	Advanced IFF, RWR, Short-Range ECM 2, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT 3 Gear	440/795m Hardened Runway	None	None	None
E-2C Omnibus I (Late)/Group 0/Group I	Advanced IFF, RWR, Short-Range ECM 2, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT 3 Gear, Look-Down Radar, Secure Radios	440/795m Hardened Runway	None	None	None
E-2C Omnibus I Group II/E-2C+	Advanced IFF, RWR, Short-Range ECM 2, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT 3 Gear, Look-Down Radar, Secure Radios, Auto Track, GPS, Satcom Gear, Flare/Chaff Dispensers	440/795m Hardened Runway	None	None	None
Hawkeye 2000	Advanced IFF, RWR, ECM 3, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT 3 Gear, Look-Down Radar, Secure Radios, Auto Track, GPS, Satcom Gear, Flare/Chaff Dispensers (16), Deception Jamming	440/795m Hardened Runway	None	None	None
E-2D	Advanced IFF, RWR, ECM 4, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT 4 Gear, Look-Down Radar, Secure Radios, Auto	440/795m Hardened Runway	None	None	None

Track, GPS, Satcom Gear, Flare/Chaff Dispensers (16), Deception Jamming

T-33 Shooting Star

Notes: Initially developed in 1948 as a two-place training variant of the P-80 Shooting Star, the first variants of the T-33 were designated the TP-80C (and later TF-80C, then T-33A). The type was designed for jet transition training – for pilots who were already proficient at flying propeller-driven fighter aircraft to learn how to fly the then-new jet aircraft. The Navy also used a version of the T-33, designated TV-2, then later the T-33B. T-33s served as the basis for an advanced two-seat interceptor, which became the F-94 Starfire. Though primarily used as a trainer by most countries using it, the T-33 was also developed into a reconnaissance platform, used as OPFOR aircraft, drone direction, target towing, drone targets, and ELINT aircraft. The last T-33 in US service, a research aircraft for NASA designated NT-33, was retired in 1997, though some continue to be used in some smaller air forces as trainers. In the 1980s, the Boeing AT-33 Skyfox attack platform, a vastly upgraded T-33C, was pitched to some countries' air forces who were already using the T-33, but this design was ultimately unsuccessful. T-33s have also been somewhat successful in sales to civilians; a noted owner of a civilian T-33 was Michael Dorn, who played LT Worf on several *Star Trek* franchises. Boeing also operated a number of T-33s until 2020, using them as chase planes when testing their airliner aircraft. All told, some 30 countries were equipped with T-33s at some point.

The T-33A

Also known among pilots as the T-Bird, the initial T-33s were P-80C/F-80Cs with a fuselage lengthened by one meter, and the space used for a rear cockpit with a full set of controls for the instructor and emergency cutoff controls that allowed the instructor to take away flight controls from his student. The first such variants retained their air-ground capability, including a reduced load of two M3 machineguns, to allow for ground-attack practice and firing as ground and aerial targets. (These were later omitted as the T-33 became a pure initial trainer.) These were designated TP-80C, and later TF-80C, then T-33A. Only 20 TP-80s were built, being supplanted by the later T-33A. The T-33As and its predecessors were basically straightforward two-seat versions of the F-80A – somewhat heavier, but for the most part operating like the F-80A.

The DT-33A was used as a drone director. Drone director aircraft were used to control drone aircraft in the days before effective ground drone control stations were available, and the rear cockpit had controls for a drone in the air to provide a maneuvering target for training fighter pilots. Sometimes these drones were QT-33As, which are essentially T-33As turned into radio-controlled target drones.

The T-1A/T-33B

The US Navy, having had experience with P-80A/F-80A-based transition trainers (most notably the TO-1 and TV-1), decided to get their own version of the T-33A. This version, the T2V SeaStar, was later redesignated the T-1A, then towards the end of its career the T-33B. This version was suitably modified for carrier landings and takeoffs, with an arrestor hook and generally strengthened airframe, as well as strengthened landing gear and harder tires. The wings were hinged just outside of the wing hardpoints. The T-33B was a bit heavier than the T-33A due to being navalized, but the more aerodynamic nose and different engine (still a variant of the J33) partially made up for this performance-wise.

Canadair CT-133 Silver Star

The CT-133 was a license-produced T-33A, sometimes referred to as the Canadair T-33. They differed from the standard T-33A in being powered by license-produced British Rolls-Royce Nene 10 turbojets instead of Allison J33s. The wingtips also carried fuel tanks almost twice the capacity of those on the T-33A. The CL-133s were not retired from Canadian Forces until 2005, and the Canadians still retain five in flying condition in storage. A noted use of the CL-133 was as the Red Knight aircraft on the Canadian Forces Aerobatic Team. Some 40 CL-133s were sold to Bolivia after refurbishment into AT-33A aircraft in the 1970s; these were later shipped back to Canada in units for a SLEP, with Bolivian AT-33As not being retired until 2007.

The CT-133 was also modified into several other variants. The CE-133 was an EW training aircraft, used to train electronic warfare officers to use their equipment while in a maneuvering aircraft. The CX-133 was used to test several ejection seat types and fittings. The ET-133 was an OPFOR aircraft, the same as a CT-133 but lacking armament and weapon hardpoints. The TE-133 served the same role, but was used by OPFOR units in simulated attacks on ships.

Some other users of CT-133s included France, Greece, Portugal, and Turkey.

The AT-33A

The AT-33A (not to be confused with the AT-33 Skyfox below) was a conversion of the T-33A into an attack aircraft, developed over the period of 1972-1975. These were simply T-33As with the F-80C machinegun complement returned, hardpoints restored, and appropriate bombsights and gunsights added. They were not proceeded with for the most part by the USAF, but were used for a short time as air-to-ground trainers. The AT-33A also proved popular in some foreign countries' air forces.

Some Bolivian AT-33As were actually based on Canadian CT-133s (see above). These retained the Nene engines and larger wingtip fuel tanks, but otherwise had the same equipment as T-33A-based AT-33As.

The AT-33 Skyfox

The AT-33 Skyfox, more properly known as the Boeing Skyfox, is an extensive redesign of the T-33 originally envisioned by Flight Concepts, which was later renamed to Skyfox (hence the name of the aircraft). Even later, the company was bought out by Boeing, with the Skyfox design being marketed to countries still using the T-33 starting in the 1980s and continuing, unsuccessfully until 1997, when the design was dropped. The single prototype was fully restored and placed into the Palm Springs Air Museum in California. The Skyfox was featured as a new US Air Force strikefighter in the third episode of the TV series *Airwolf*.

The Skyfox features a heavily reworked airframe, becoming more streamlined and made of lighter but stronger materials than that of the T-33A. This was coupled to a pair of Garrett TFE731 turbofan engines mounted in external nacelles, replacing the single fuselage-mounted Allison J-33. These two engines are, together, only 60% of the weight of the Allison J33, and also consumed 45% less fuel than the Allison. The turbofans had a power output of 3700 pounds thrust each. Since the fuselage no longer housed the engine, fuel tankage could be increased dramatically, enough so that Boeing felt they could delete the wingtip fuel tanks. This in turn allowed the Skyfox to increase g-loading and maneuverability on the airframe. The hardpoints had increased weight-carrying ability, distributed among four wing hardpoints, two of which were wet. Though it was not implemented on the prototype, Boeing intended to replace the two M3 machineguns with a pair of 20mm M39A2 autocannons on production examples. Each hardpoint could also mount a Sidewinder AAM or two Stinger ATAS missiles. It may be noted that the original Skyfox was based on a CT-133, though this had no effect on the eventual design other than that the CL-133 was newer-build than most T-33As.

The Skyfox was meant to be both a trainer and a light attack aircraft, and was primarily aimed at smaller air forces who already employed the T-33A and AT-33A. The conversions could be put on any T-33 variant, and were of surprisingly low RL cost compared to most new attack jets of its time.

In the end, even though Portugal signed a letter of intent for 20 Skyfoxes, there was little interest from the international marketplace in the Skyfox, and Boeing felt that the cost of gearing up a new production line was not worth the order from Portugal, and in 1997, gave up on the Skyfox.

Twilight 2000 Notes: The T-33 had generally been long out of service in many first-line countries. In several Second and Third-World countries it remained in service, generally upgraded into the AT-33A or RT-33A standard. However, with war clouds closing in, some countries, including the US and Canada, began upgrading their T-33s into the Skyfox standard, with the type becoming a surprising standout ground support aircraft in the latter half of the Twilight War.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
T-33A (Early Production)	$668,310	JP-A	907 kg	6.83 tons	2	10	None	Enclosed
T-33A (Main Production)	$728,560	JP4	907 kg	6.83 tons	2	10	None	Enclosed
T-33B	$728,560	JP5	907 kg	7 tons	2	10	None	Enclosed
CT-133	$745,310	JP4	907 kg	7.63 tons	2	10	None	Enclosed
AT-33A (T-33A-Based)	$1,719,000	JP4	907 kg	7.01 tons	2	11	Image Intensification	Enclosed
AT-33A (CT-133-Based)	$1,758,521	JP4	907 kg	7.81 tons	2	11	Image Intensification	Enclosed
AT-33 Skyfox	$1,488,497	JP4	2.7 tons	9.07 tons	2		FLIR, 2nd Gen Image Intensification, VAS (30 km)	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling	Armor
T-33A (Early Production)	1529	425 (100)	NA 71 5/3 50/30	3350	1219	13716	FF2 CF2 RF1 W1 T1
T-33A (Main Production)	1750	486/569* (100)	NA 81/94* 5/3 50/30	3350	1399	13716	FF2 CF2 RF1 W1 T1
T-33B	1709	475/566* (95)	NA 79/92* 5/3 50/30	3350	1399	13716	FF2 CF2 RF1 W1 T1
CT-133	1738	483 (100)	NA 80 5/3 50/30	3950	1516	14000	FF2 CF2 RF1 W1 T1
AT-33A (T-33-Based)	1706	474/555* (100)	NA 79/92* 5/3 50/30	3350	1399	13716	FF2 CF2 RF1 W1 T1

AT-33A (CT-133-Based)	1695	483 (100)	NA 78 5/3 50/30	3950	1516	14000	FF2 CF2 RF1 W1 T1
AT-33 Skyfox	2117	588 (90)	NA 95 7/4 70/40	2950	1302	15000	FF3 CF3 RF2 W2 T1

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
T-33A (Early Production)	Radios (300 km, 2 km)	820/680m Hardened Runway	+1	2xM3 Machineguns, 2 Hardpoints	450x.50
T-33A (Main Production)/CT-133	Radios (300 km, 2 km), IFF	820/680m Hardened Runway	+1	2xM3 Machineguns, 2 Hardpoints	450x.50
T-33B	Radio (300 km), IFF	820/680m Hardened Runway	+1	2xM3 Machineguns, 2 Hardpoints	450x.50
AT-33A	Secure Radios (300 km, 30 km, 2 km), IFF, Flare Dispensers (10)	820/680m Hardened Runway	+1/+2	6xM3 Machineguns, 2 Hardpoints	1800x.50
AT-33 Skyfox	Secure Radios (300 km, 30 km, 2 km), IFF, ECM/ECCM 1, Flare/Chaff Dispensers (20 Each), Inertial Positioning	780/600m Hardened Runway	+1/+3	2x20mm M39A2 Autocannons, 4 Hardpoints	1146x20mm

*The T-33A, T-33B and AT-33A (except for those that are based on the CT-133) are equipped with a water/alcohol injection system, which increases the speed and acceleration to the figures on the right side of the slash for up to 20 seconds total.

GLOSSARY FOR THE AIRCRAFT SECTION

If I've missed something, please let me know!

GENERAL TERMS

Price: This is the relative value of the aircraft in game terms. It bears no reference whatsoever to the "Real World" value.

Fuel Type: The type of fuel the aircraft may use. Virtually all aircraft use "AvG," which is sort of a game catch-all for Aviation Gasoline, jet fuel, or other such fuels.

Load: This is the maximum amount of cargo, weapons, or other stores the aircraft may carry, whether on hardpoints, in internal weapons bays, or in a cargo hold (depending upon the aircraft).

Veh Wt: This is the weight of the aircraft, with a full load of fuel and base crew, but minus the Load figure above.

Crew: This is the size of the base crew (pilot, co-pilot, and any other essential crew such as navigators, gunners, crew chiefs, etc.) plus the amount of passengers the aircraft may carry. This figure may be listed as a single number, in which case it has only a base crew, or "x+n" in which case it may carry a base crew and passengers.

Mnt: This is the amount of maintenance, in hours, the aircraft must be given per week for the aircraft to perform at the proper levels of performance and with the minimum chance of breakdowns. Failure to give the aircraft this maintenance will detrimentally affect the aircraft, while more maintenance will only help the aircraft perform optimally.

Night Vision: This entry lists the devices that allow the aircraft not only to see targets at night, but also lists any sort of enhanced detection ability it has.

Radiological: This is the amount of protection the aircraft has against chemical, biological, and radiological agents, and is listed as Open, Enclosed, or Shielded.

Tr Mov: This is the Travel Movement of the aircraft – the amount of kilometers the aircraft travels in a four-hour period at cruising speed. This may be increased (see game rules), but at the cost of increased fuel consumption and possible breakdowns and other mishaps.

Com Mov: This is the Combat Movement of the aircraft – the *base* amount of meters the aircraft will travel in a 5-second combat phase. Again, this can be increased, as the cost of increased fuel consumption, possible breakdowns, and mishaps. The number in parenthesis is the stall speed of the aircraft – the minimum speed at which the vehicle may travel and stay in the air without requiring a rather difficult (to say the least) Pilot skill check.

Mnvr/Acc Agl/Turn: Mnvr (Maneuver) has no meaning for aircraft. "Acc" is the maximum possible acceleration of the aircraft, in meters per 5-second combat phase, of which the aircraft is capable. "Agl" is a numerical rating of the agility of the aircraft, sort of a general reference of how maneuverable the aircraft is. This rating is divided by a slash into the agility of the aircraft when it has less than half its maximum Load, and when it has more than half its maximum Load. "Turn" is the amount of degrees the aircraft may turn per 5-second combat phase, and is similarly divided. Both ratings are theoretically open-ended.

Fuel Cap: This is the Fuel Capacity – the amount of liters of fuel the aircraft carries internally.

Fuel Cons: This is the amount of fuel the aircraft consumes in a normal four-hour Travel Movement. It may exceed the aircraft's fuel capacity – in which case, the aircraft cannot keep going for four hours without stopping to refuel, carrying drop tanks, or conducting aerial refueling. Traveling at higher than the aircraft's Travel Movement will increase this figure, as will poor maintenance, conducting combat, using afterburners, etc.

Ceiling: This is the maximum safe height at which the aircraft may travel, in meters. Higher flight may be attempted, at the cost of increasing chances for breakdowns and other mishaps.

Combat Equipment: This entry details the various types of equipment, combat or otherwise, the aircraft is equipped with. These types of equipment will be detailed below.

Minimum Landing/Takeoff Zone: Basically just what it sounds like, this is the minimum runway/open space the aircraft needs to attain flight or land safely. The entry also indicates what sort of runway is needed – Hardened, which means it needs a real runway, road surface, or other hard surface to land and take off from; or Primitive, in which case virtually any sort of flat, open field will do.

RF: Certain aircraft have rangefinders or other aids to allow them to aim their weapons more accurately. This will be indicated by a bonus to the pilot or weapons officer's chance to hit the target, on a d20.

Armament: This indicates not only any sort of internal armament, but the amount of hardpoints the aircraft has available for weapons pylons, drop tanks, or other stores.

Ammo: If the aircraft carries internal guns or cannons, this figure indicates the amount of ammunition and the caliber of ammunition carried.

COMBAT EQUIPMENT TERMS

Active Jamming: This works sort of like those sound-dampening headphones – the active jamming unit broadcasts frequencies which are counter to the enemy radar frequency coming in. This creates an incredible amount of interference on the enemy's radar screen – the screen can literally look fogged over. ECCM will help mitigate active jamming, but active jamming is typically very powerful, and using ECCM against an active jamming aircraft in one difficulty level harder than normal. Active jamming itself makes an aircraft makes an aircraft two levels harder than normal to find on radar, and the same difficulty level is applied when trying to guide a radar-guide missile to it, once a target is found. In an active jamming environment, the friendly aircraft may attempt to break a lock on each phase at one difficulty level easier than normal, and attempt to break radar contact by an enemy radar each phase, at one level easier than normal. Active jamming is pretty advanced technology, requiring a large amount of rather fragile electronics and a lot of electrical power from the aircraft. Active jamming may also be listed as AJM.

All-Weather Flight: Many aircraft are "fair-weather" systems – their effectiveness is severely degraded when the weather turns nasty, or even if there is a lot of cloud cover. (Depending upon the weather, this may result in a one to four-level Difficulty penalty when attempting to use radar or IR detection methods.) Aircraft which are all-weather capable do not have this problem; their electronics are able to sort out targets from clouds, rain, hail, snow, etc., and not have their electronics affected by lightning. (A direct lightning strike on the aircraft is another story altogether…) They are also able to detect major weather systems of a poor nature and plot ways around them (even an all-weather capable aircraft will fly roughly in high winds or things like wind shears, and are subject to lightning strikes).

Armored Cockpit/Fuselage: Some aircraft have an exceptionally-well protected cockpit to protect the crew and therefore help save lives and possibly keep the aircraft flying longer. Aircraft with an armored cockpit are typically protected by stronger metal and plexiglass or extra layers of metal and thicker plexiglass. (This can be carried to extremes; the MiG-21 has such a strong front canopy that it actually obstructs the pilot's forward vision!) Aircraft with an armored cockpit ignore damage from small arms if a cockpit hit is rolled, subtract three-quarters of impact damage if directly hit in the cockpit by cannon fire 20mm or higher, ignore damage to the cockpit from explosive fragments, and take only half damage upon a cockpit hit from explosive concussion.

Some aircraft (like the A-10 Warthog) are incredibly well-protected; they basically have their entire fuselages protected by armor and are listed as having an "armored fuselage." The cockpit is protected as above; however, unless noted, the rest of the fuselage is only half as well protected as the cockpit.

ASW Equipment: As used in these pages, this is sort of catch-all term for the miscellaneous devices which allow an antisubmarine aircraft to do its job – from the computers to various antennae, secondary detectors, and secondary radars.

Auto Track: This is a special function of certain radar sets which allows a cursory 180-degree scan of the skies in front of the aircraft by the radar. When the auto tracking radar finds a target in this 180-degree arc, it automatically begins the lock-on procedure to the nearest enemy target (or the nearest one not giving a satisfactory answer to the aircrafts IFF receiver), unless overridden by the pilot or weapons officer. If not overridden, it may attempt to lock on to the target in the same phase in which the auto tracking radar begins the lock-on procedure. At the pilot's or weapons officer's option, this radar mode may be slaved to another target which has been spotted visually or on a VAS (see below), in effect overriding the auto track's choice of targets. The lock on may also be attempted in the same phase in this case. Information from auto track is often fed to an aircraft's HUD.

Deception Jamming: Deception jamming (or DJM) is a type of ECM which blanks out the real position of the friendly aircraft on enemy radar, and replaces it with one or more false "blips" (radar returns) which may be up to 200 kilometers from the actual friendly aircraft. ECCM can help detect and mitigate these false returns, but this is a more difficult process to do than countering normal ECM, and the presence of deception jamming is more difficult to detect than normal jamming. Unfortunately, deception jamming requires a greater degree of technology than normal ECM, more equipment, and more electrical power from the aircraft using it. Finding an aircraft using deception jamming is "one and a quarter" levels harder than normal – apply a one-level difficulty penalty, then subtract an additional penalty of -2. Once the aircraft using deception jamming is found, it does not affect the guiding of radar-guided missiles, though each minute the pilot, weapons officer, or electronic warfare officer may attempt to cloak the aircraft again in deception jamming.

ECM: ECM, or electronic countermeasures (also known as radar jamming), are electronic signals put out by an aircraft which distort the radar returns delivered to enemy radars. The most common form shows the enemy many targets where there is only one, and depending upon the strength and technology of the ECM emitter(s), this can literally fill the enemy's radar screen with targets which usually look very real and make it extremely difficult to pick out the real one. A subset of ECM is ECCM, or electronic counter-countermeasures (or counter-jamming); this is usually a computer which attempts to help the radar operator, pilot, or weapons officer "clear the screen" and pick out the real target from the fake ones. Most aircraft and ground installations which are equipped with ECM are also equipped with ECCM. Using ECCM to defeat ECM is a task (DIF: Electronics or FOR: Intelligence). ECM makes an enemy aircraft one level harder to detect on radar than normal, and makes breaking lock-ons by enemy aircraft one level easier than normal.

ELINT Suite: This is sort of the intelligence-gathering equivalent of the EW suite below. Aircraft with ELINT (Electronic Intelligence) suites have equipment for intercepting and classifying enemy radar and radio emissions, as well as the ability to eavesdrop on enemy radio broadcasts (and civilian ones, for that matter). Doing so is a task (DIF: Electronics or FOR: Intelligence), and can be affected by enemy ECM.

EW Suite: Aircraft with an EW suite have a computer which coordinates all electronic warfare and defense functions. These aircraft are able to respond in a virtually instantaneous manner to radar threats, whether the signals are generated by a radar site, enemy aircraft, or an incoming missile. Aircraft with an EW suite increase the effectiveness of their ECM (including deception jamming and active jamming) by one level, and increase their chance to break lock-ons by one level. As a by-product of having an EW suite, chaff or flare bundles (whichever is appropriate) will drop automatically if an incoming missile is detected.

Flare/Chaff Dispensers and Chaff Rockets: Flare and chaff dispensers carry countermeasures for heat-seeking and radar-guided missiles respectively. Chaff is also effective against radar itself. Flares, in a game context, come in bundles; the normal load is 6 such bundles in a standard flare dispenser. If the aircraft is capable of carrying more such bundles, this is indicated by a number in parentheses after the notation of "Flare/Chaff Dispensers." A flare bundle actually consists of dozens of brilliant flares, usually based on magnesium, which burn very hot and bright, thus decoying heat-seeking missiles. The flares will also show up quite brightly on night-vision equipment based on IR, light intensification, or thermal technology. A flare bundle will cover an area 250x250x250 meters, and light up the sky in the same manner as a standard artillery flare. The base chance of decoying missiles will depend upon the technology of the missile, but generally gives the heat-seeking missile a two-level Difficulty penalty to track the true target if the missile comes within 4000 meters of the flares and the flares are within its seeker head's field of view (about 30 degrees in front of the missile). The flares remain effective at this level for one combat phase, and at half-effectiveness for one more combat phase.

Chaff consists of foil, usually aluminum-coated plastic, which is cut to roughly the wavelength of the enemy radar. (There are usually several different lengths of chaff within a chaff bundle.) Each bundle has thousands of such strips, and as with flares, they degrade the chance of a radar-homing missile that comes within 4000 meters of the chaff bundle of tracking its target correctly by two Difficulty levels. This lasts at this level for one combat phase, than at half-effectiveness for another combat phase. Chaff can also deter heat-seeking missiles which come within 500 meters of the chaff bundle, due to reflected light; chaff degrades the heat-seeking missile by one Difficulty level for one combat phase. Chaff also creates a false target on radars, for which the enemy pilot, weapons officer, or radar operator must make a roll of AVG:INT to avoid confusing the chaff cloud with a real target. Once the chaff cloud dissipates after two combat phases, he will no longer be fooled.

All aircraft can carry chaff in their speedbrake housings. They cannot carry nearly as much chaff in their speedbrakes as a chaff bundle however, and the pilot has no control as to when the chaff is deployed. The first time the pilot pops his speedbrake(s), the chaff is deployed; this chaff functions at half effectiveness against radar-homing missiles or radars, and only gives heat-seeking missiles a -2 penalty. Enemy radar operators, pilots, or weapons officers need make only an ESY:INT roll, and the resulting cloud lasts for only one combat phase.

Some aircraft (normally large bombers) can carry chaff rockets, usually in their bomb bays. These are rockets which break up when fired, trailing chaff behind them. Chaff rockets have a range of 3 kilometers, travel straight and level for their entire flight, and trail an unusually thick chaff cloud which lasts at full effectiveness for 3 combat phases and half effectiveness for another three combat phases. The parentheses beside the entry for chaff rockets on an aircraft tell how many of these rockets the aircraft can carry.

GPS: An aircraft equipped with GPS (Global Positioning System) equipment can navigate using the constellation of GPS satellites orbiting the earth. This sort of navigation is extremely precise; this precision is classified, but it is generally thought that military GPS receivers can allow the pilot or navigator to locate his position to within one meter, while the best civilian models are generally accurate to within 10 meters. This sort of navigation also does not require the aircraft to make any sort of emissions, so aircraft navigating solely by GPS are very difficult to detect using radio detection gear, radar warning receivers, etc.

HUD/HUD Interface: An aircraft with a HUD (Heads-Up Display) has within the cockpit a special piece of glass or a special mirror which projects certain information onto the forward part of the canopy. This usually consists of the aircraft's speed, altitude, rate of climb or dive, fuel state, and an aiming reticle (often with firing parameters for the chosen weapon). More advanced HUDs may also give the pilot information about the enemy aircraft, such its speed, altitude, angle off, etc. It may also feed the pilot or weapons officer other information, depending upon the other capabilities of the aircraft.

A HUD Interface helps the pilot or weapons officer spot enemy aircraft visually by displaying a box, circle, or other symbol on the canopy telling him where to look for the enemy aircraft(s) his radar is locked on to. This allows him a +2 on his Observation roll to visually spot the target.

IFF: IFF, or Identification Friend or Foe, was one of the first electronic enhancements brought to combat aircraft, the first one appearing during World War 2. It is a simple device which transmits a coded signal that identifies it as a friendly aircraft to other friendly aircraft. This coded signal is normally changed several times per day (sometimes several times per hour) in wartime conditions to prevent it from being imitated by the enemy.

Advanced IFF not only transmits an IFF signal, it can read the IFF signals of enemy aircraft and also block them. Reading enemy IFF signals is a task (AVG: Electronics or DIF: Intelligence), while blocking enemy IFF signals is one level harder than that. Advanced IFF is subject to ECM.

Inertial Navigation: Aircraft with inertial navigation ability are able, before takeoff, register their start point (whether by GPS or standing upon a pre-surveyed point on an airfield or takeoff field for a short period of time) using a computer, then calculate their position by having the computer monitor the altitude, compass heading, and attitude of the aircraft. Inertial navigation is notoriously inaccurate in early examples of the device, but this improves in later designs. It is not, however, as accurate as GPS, which is why more advanced air forces use it less and less these days.

IRCM: Similar in concept to ECM, IRCM (Infrared Countermeasures) devices project beams of heat (often using lasers) which are used to decoy heat-seeking missiles. The beams are not hot enough to damage anything, but do give the pilot, weapons officer, or electronic warfare officer a chance equal to DIF: Pilot, DIF: Electronics, or FOR: INT (whichever is higher) to decoy the missile away from his aircraft. When this occurs, the offending missile goes for the nearest portion of the beam and explodes there (which could conceivably still affect the target), or simply gets confused and goes off on a straight line, through the beam, until it runs out of fuel and momentum and noses over (or acquires another target by accident). There is no "IRCCM" counterpart to ECCM.

IR Masking: Some aircraft, generally by aspects of their design (such as the position of the engine exhausts, extended tailpipes, or other features) are able to reduce their IR signature to an extent. These aircraft reduce the effectiveness of heat-seeking missile fired at them by sort of a "half a difficulty level;" meaning that the missile has a -2 chance of hitting such an aircraft. Detecting the aircraft with infrared sensors of any type is likewise at -2 to the enemy's chances.

IR Uncage: Normally, an IR seeker head has a very limited field of view before launch, about 30 degrees in front of the firing aircraft (or in the case of some aircraft, the direction in which the missile is facing). Aircraft capable of uncaging their IR seeker heads increase the pre-launch field of view to 180 degrees, allowing them much more flexibility in firing them at a target. Aircraft able to uncage their IR seeker heads can also use those seeker heads as sort of a faux FLIR viewer, equal to one of one-half the capabilities of a normal FLIR viewer.

Laser Designator: This is a laser, normally with a beam which is not in the visible light spectrum, which is used to guide laser-guided weapons to their target. These weapons may be launched by the aircraft itself, or by other aircraft, or in some cases, helicopters or ground units. (Different weapons often require a laser designator with a different wavelength of light in order to avoid confusing the weapons. Some designators can be set to emit differing wavelengths of light by the pilot or weapons officer, depending upon the weapon being used. Ground-based weapons, helicopters, and aircraft rarely use the same wavelengths of lasers.)

Laser Spot Tracker: Not an actual designator, the laser spot designator allows the aircraft to sense the laser spot provided by another source, whether on the ground or on another aircraft or helicopter – and thus guide one of its laser-guided weapons to the target so designated.

Look-Down Radar: Normally, aircraft with radar have great difficulty picking out targets on the ground or near the ground – if the crew of an aircraft equipped with normal radar attempts to detect a ground target or target within 350 meters of the ground, the Difficulty level is two levels worse than normal (assuming the friendly aircraft is above or at the same altitude as the target). Aircraft equipped with look-down radar have special computer equipment that negates the ground clutter (radar returns from terrain); the crews of these aircraft do not have the Difficulty penalty mentioned above.

Magnetic Anomaly Detection (MAD): This is a device used by antisubmarine aircraft to detect submarines which are submerged. It does this by detecting the difference between the Earth's natural magnetic field and the disturbance in it created by the submarine (essentially a large mass of metal with its own magnetic signature). The capabilities of MAD devices are highly classified, and I don't know what their detection range is (or even a ballpark figure); if anyone knows anything unclassified about the capabilities of MAD (especially detection range underwater), please let me know.

Multitarget (x): Most aircraft able to lock on to enemy aircraft are only able to lock on to one such target at a time. Aircraft with multitarget capability may lock on to more than one target at the same time, or maintain lock-ons while gaining new lock-ons to other aircraft. They may have as many lock-ons as the number in parentheses beside the "Multitarget" listing, such as Multitarget (4), which means that the aircraft in question may lock on to up to four targets at a time. Such aircraft may also launch heat-seeking missiles at other targets (or the same target as they are locked on to), while maintaining their lock-ons. Normal aircraft cannot do this.

Radar Detector: This is a simple device, a step below an RWR, which simply detects the presence of enemy radars. They are generally paired with an ELINT suite.

Radio Detector: As with the radar detector above, this is a simple device which detects the presence of radio emissions within the range of frequencies desired by the operator. It is also generally paired with an ELINT suite.

Radio Jamming: This is basically the radio equivalent of ECM; it jams radio instead of radar frequencies. Early radar jammers were capable of jamming only a limited range of frequencies, and these often had to be set by hand by ground crews before the aircraft took off. Later radio jammers are capable of jamming a wider set of frequencies, and often these frequency sets can be changed or set while in flight by the pilot or electronic warfare officer. Radio jamming makes radio broadcasts within the jammed frequencies two levels more difficult to get through to the receiving party. If the aircraft crew is able to pick the frequencies it wishes to jam during flight, doing so is an AVG: Electronics or DIF: Intelligence task. Counter-jamming is also possible, in the same manner as ECCM.

RWR: RWR refers to a radar warning receiver. This is a device, usually distinguished by small antennas in blisters on an aircraft, which detects lock-ons by enemy aircraft and missile launches by enemy aircraft or SAMs, and (very) approximately what direction and distance from which they are coming. These devices are usually limited-range radar receivers, IR receivers, or radio interference detectors.

Satcom Radio: This is a radio equipped to use military and/or civilian satellites in order to receive and transmit virtually anywhere on the planet. It’s a setup which generally requires a great amount of power, which is why not every aircraft carries one. Most satcom radios are also secure radios.

Secure Radios: This is a feature which most modern aircraft (and military vehicles, for that matter) have – the ability to encrypt their transmissions so that the enemy will have quite a difficult time listening in. It is not foolproof, however, and depending upon the technology of the aircraft with secure radios, they offer a two to four-level Difficulty penalty to the enemy when trying to intercept the friendly aircraft’s transmissions.

Sonobuoys: A sonobuoy is basically a droppable sonar "pinger" – a device which contains a small sonar emitter which can be used to nail down the position of a submerged submarine. The sonobuoy also has a one-way radio which allows the aircraft which dropped it to listen in on those pings. Sonobuoys may float on the surface of the water, or may be given neutral buoyancy allowing them to float a given distance from the surface, with an antenna reel floating on the actual surface of the water.

Stealth: Stealth is a radar and infrared-defeating configuration for an aircraft. Stealth is generally accomplished by special shaping of an aircraft and the use of RAM (Radar-Absorbent Materials). The shaping in early stealth aircraft is generally done with faceting, where the aircraft’s fuselage is literally comprised of facets instead of being a smooth surface, such as on the F-117A Nighthawk. Later aircraft, such as the F/A-22 Raptor and B-2A use a shape which is comprised of smooth curves with little or no reflecting surfaces. In both cases, the stealth aircraft is devoid of external right-angled surfaces, since these reflect radar the most. Some aircraft, such as the B-1 Lancer, have some small amount of stealth characteristics, whether by accident of design or by early attempts at reducing radar signature.

Stealth characteristics against radar would be of little value if the aircraft could simply be easily picked up by infrared signatures. Therefore, stealth aircraft generally have devices and design features which cool the exhaust and leading edges of the aircraft (front of the wings, nose, intakes, control surfaces, etc.)

In the game entries on this site, stealth aircraft have the effects of their stealth configuration described in the body of the aircraft description. Of course, many or most aspects of stealth design are classified, and some guesses have to be made for game purposes.

Supercruise: The typical aircraft which is capable of supersonic or transonic flight must engage its afterburner to fly at such speeds. (An afterburner is a simple device added on to the rear of the engine which injects fuel into the exhaust of the engine, increasing thrust.) The problem with afterburners is that they consume a fantastic amount of fuel; aircraft which are flying at a Com Mov of more than 1700 at sea level or 915 at altitudes of 6000 meters (other altitudes may be extrapolated from these examples) must triple their fuel consumption when they are flying at such speeds. This works out to Tr Mov of 4900 and 4225, respectively.

Through a combination or more advanced engine design and aircraft design, supercruise-capable aircraft may break this rule to a certain extent; they are able to travel, depending upon their design, at anywhere from Mach 1 to their maximum speed without engaging their afterburner. Generally, most such aircraft are capable of Mach 1.5 or so without using their afterburner, and this is the standard supercruise figure I use in my pages. Aircraft capable of supercruising at more or less speed will be noted by the Tr Move and Com Mov figures, but are generally not explicitly stated as such.

Synthetic Aperture Radar (SAR): Normal radar works by using a quick pulse and waiting for its return to the radar receiver. This yields a position and some other information about the target, but not an extremely accurate picture (often, it is little more than a "blip" on the radar screen). SAR uses radar to make a long, detailed sweep of the target (long in this sense is perhaps 5-10 seconds) to create a radar return that is very detailed and yields comprehensive information about the target. Normally used in reconnaissance (because the best SAR can literally yield returns good enough for photographic-quality detail), it can also be used for pinpointing ground and air targets and gaining precise information about them. The use of SAR gives the radar operator, weapons operator, or pilot a two-level boost in his difficulty level for identifying ground targets, and a one-level boost for identifying airborne targets. The downside is that that the radar signals are one level easier to detect.

Target ID: This couples the radar, FLIR, and/or VAS to a computer which reads the shape, engine heat, radio signatures, heat signatures of the surface of the target, etc., to determine for the crew of the aircraft what kind of target he is facing, i.e. MiG-29 fighter, T-55 tanks, etc. For most aircraft, the Target ID is optimized for enemy aircraft, but some aircraft with look-down radar or designed for the ground attack role may also have their Target ID devices able to identify ground targets. The reading is generally no more than approximate – while the target ID device may identify the target as a MiG-29 Fulcrum, it can’t normally tell if it is a Fulcrum-A, Fulcrum-B, Fulcrum-C, etc.

Terrain-Following Radar: Most aircraft require that their pilots fly them by the seat of their pants while at low altitude, a dangerous endeavor to say the least when in combat or rough terrain. Terrain-following radar, or TFR, is a specialized form of autopilot into which the pilot inputs a desired altitude above ground level (usually to a minimum of 15-45 meters, depending upon how advanced the TFR is), and a computer reads the TFR signals reflected from the ground and keeps the aircraft at that altitude above ground level, more or less, with the exception that the computer will not allow the crew to take so many Gs (whether negative or positive) that they greyout, redout, or pass out.

Track While Scan: Normally, when an aircraft is locked on to a target with its radar, it loses radar contact with all other targets. Aircraft which can track while scanning do not lose contact with other targets when their radar is locked on to a target.

Vectoring In Forward Flight (VIFF): Certain aircraft, such as the Harrier, have the ability to perform vertical or very short takeoffs and landings by vectoring the thrust of their engines through specially designed nozzles around the fuselage (or even the exhaust itself). However, some of these aircraft are also able to do this to a certain extent while in standard flight mode, giving them a slight advantage (and also disadvantages) in a dogfight. This is known as VIFFing. Aircraft able to VIFF may use their lift nozzles to push them into slightly tighter turns, jump up suddenly in altitude (or by inverting, drop suddenly down), jump sideways suddenly in the direction they are banked, or push their noses up or down slightly.

A "VIFF turn" allows the aircraft to increase their turn rate by 50%. Each turn of such VIFFing also decelerates the aircraft by 20%. A "VIFF Popup" (or Drop, if inverted) allows the aircraft to jump up by 50 meters (or drop the same amount) in one combat phase, even if in level flight. A VIFF popup decelerates the aircraft by 20%. A "VIFF Sidestep" requires the pilot to bank in the direction where he wants to slide; he may then use the nozzles to push the aircraft sideways by 50 meters in one combat phase. A VIFF Sidestep decelerates the aircraft by 30%. The pilot may pitch his nose up or down by up to 10 degrees in one combat phase with his nozzles, even while remaining in level flight; this is useful for quick shots at a target, but is a dangerous maneuver. A "VIFF Vertical Pitch" decelerates the aircraft by 20% per 10% of pitch, and has other negative effects (see next paragraph).

Most VIFF maneuvers require the pilot to make an AVG: Pilot (Fixed Wing) roll each combat phase he does such a maneuver. Normal failure at this roll means that the maneuver is not successful; Catastrophic Failure causes the pilot to lose control of his aircraft. Outstanding Success means that the deceleration normally required is cut in half. The VIFF Vertical Pitch maneuver is a special case; this is a DIF: Pilot (Fixed Wing) maneuver at a 10% pitch up or down, FOR if the aircraft is pitched 15-20%, and IMP if the aircraft is pitched at 21-25%. (Any more pitch causes the pilot to immediately make a second roll at a FOR skill level for control of his aircraft.) There is one more disadvantage to VIFFing – any heat-seeking missiles targeted at the VIFFing aircraft get a +2 to hit during that combat phase, and may break their normal rules with regards to angle-off (the angle from which they are normally required to approach an enemy aircraft in order to sense it); they will be able to sense the aircraft from any angle.