AIRCRAFT

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 Story: This aircraft gained more customers around the world as the Twilight War wore on, before shipping finally stopped.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$357,061	AvG	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 W6 T5

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 2000, 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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$338,029	AvG	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	FF3 CF3 RF2 W2 T2

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 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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$5,114,176	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
2274	569 (170)	NA 142 7/4 70/40	9240	5315	13715

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Secure Radios, Radar Warning Receiver	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.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Pup 100	$25,176	G, AvG	290 kg	776 kg	1+1	2	None	Enclosed
Pup 150	$25,546	G, AvG	290 kg	917 kg	1+2	2	None	Enclosed
Pup 160	$25,616	G, AvG	290 kg	943 kg	1+2	2	None	Enclosed
Bulldog	$30,062	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
Pup 150	600	150 (90)	NA 38 6/3 50/20	170	46	4000
Pup 160	628	157 (90)	NA 39 6/3 50/20	170	49	4000
Bulldog	738	185 (90)	NA 46 6/3 50/20	170	64	4000

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

Canberra

Notes: This is a light bomber still used by Britain, and in limited numbers, Argentina, Peru, and India. It holds the dubious distinction of being the only jet aircraft produced with wooden parts (the forward part of the vertical stabilizer is made of plywood). Most countries using the Canberra use it for reconnaissance or research rather than as a bomber. The Canberra has in internal bomb bay; this bay may carry 2.72 tons of the total weapon load. Its two wingtip hardpoints may only carry drop tanks.

Twilight 2000 Notes: 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.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
Mk 20	$3,678,392	AvG	5.45 tons	11.17 tons	2	32	Radar, FLIR, Image Intensification	Shielded
Mk 21	$3,729,682	AvG	5.45 tons	11.17 tons	2	38	Radar, FLIR, Image Intensification	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
Mk 20	1409	353 (105)	NA 88 7/4 70/40	10500	3342	14630
Mk 21	1776	444 (105)	NA 111 7/4 70/40	10500	4236	14360

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Both	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, Laser Designator	1020/805m Hardened Runway	+3	4x20mm M-39 autocannons, internal weapon bay, 10 hardpoints	1600x20mm

Hunter

Notes: This jet is a mid-1960s relic that is still in wide use by Lebanon. 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 Notes: 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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$712,318 (S/-)	AvG	2.54 tons	8.35 tons	1	14	None	Enclosed

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

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

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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$143,630	AvG	1.2 tons	4.02 tons	2	6	None	Enclosed

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

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

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	$238,884	AvG	3.18 tons	11.59 tons	3+30, or 27 paratroops, or 18 stretchers	14	None	Enclosed
C-23B	$245,893	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
C-23A	698	174 (80)	NA 44 6/3 60/30	2235	881	3500
C-23B	723	181 (80)	NA 45 6/3 60/30	2351	1050	3500

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 Merril'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	$61,152	AvG	555 kg	1.62 tons	3+10	12	None	Enclosed
DH-89A Rapide	$62,285	AvG	562 kg	1.62 tons	3+10	12	None	Enclosed
DH-89 Mk 4 Rapide	$62,382	AvG	569 kg	1.62 tons	3+10	12	None	Enclosed
DH-89 Mk 5 Rapide	$61,754	AvG	555 kg	1.64 tons	3+10	10	None	Enclosed
DH-89C Rapide	$67,451	AvG	555 kg	1.66 tons	3+10	12	None	Enclosed
DH-89B Dominie	$42,206	AvG	1.19 tons	1.5 tons	3+10 or 8 Paratroopers	11	None	Enclosed
DH-89B Dominie (Special Ops Fit)	$192,377	AvG	893 kg	1.65 tons	3+4 or 3 Paratroopers	15	None	Enclosed
DH-89A Dominie (Special Ops Fit, Extra Fuel)	$192,590	AvG	706 kg	1.9 tons	3+4 or 3 Paratroopers	16	None	Enclosed
DH-89 Mk I Dominie	$43,943	AvG	1.17 tons	1.6 tons	4+4	13	None	Enclosed
DH-89	$107,293	AvG	595 kg	1.89 tons	3+4	15	None	Enclosed

Mk II Dominie								
DH-89D Dominie (Medical)	$45,842	AvG	595 kg	1.53 tons	4+4 Stretchers*	10	None	Enclosed
DH-89C Dominie	$46,806	AvG	1.16 tons	1.52 tons	3+10 or 8 Paratroopers	10	None	Enclosed
DH-88 Comet	$41,948	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
DH-89 Rapide	872	219 (73)	NA 52 4/2 40/20	249	56	5090
DH-89A Rapide	892	224 (66)	NA 53 4/2 40/20	249	57	5090
DH-89 Mk 4 Rapide	913	229 (60)	NA 54 4/2 40/20	249	57	5090
DH-89 Mk 5 Rapide	872	219 (60)	NA 52 4/2 40/20	249	57	5090
DH-89C Rapide	862	215 (60)	NA 51 4/2 40/20	249	65	6108
DH-89B Dominie	915	230 (66)	NA 55 4/2 40/20	249	55	5090
DH-89B Dominie (Special Ops Fit)	853	209 (66)	NA 50 4/2 40/20	249	61	5090
DH-89A (Dominie Special Ops Fit, Extra Fuel)	806	202 (66)	NA 48 4/2 40/20	381	63	5090
DH-89 Mk I Dominie	858	216 (60)	NA 52 4/2 40/20	249	58	5090
DH-89 Mk II Dominie	732	184 (70)	NA 44 4/2 40/20	249	69	5090
DH-89D Dominie (Medical)	897	225 (60)	NA 54 4/2 40/20	249	56	5090
DH-89C Dominie	903	227 (60)	NA 54 4/2 40/20	249	64	6108
DH-88 Comet	1074	266 (60)	NA 64 4/2 40/20	249	64	5090

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
DH-89/DH-89A/DH-89A Mk 4 & Mk 5/DH-89C Rapide	2xLong-Range Radios, Magnetic Compass, Kitchenette	200/350 Unimproved Runway	None	None	None
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	200/350 Unimproved Runway	None	None	None

	Spotlight, RDF, Magnetic Compass					
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.

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
$206,984	AvG	1.59 tons	3.41 tons	2	6	None	Enclosed

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

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

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
$273,948	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	$530,858	AvG	4.82 tons	17.27 tons	3+41, or 35 paratroops, or 24 stretchers	16	Radar	Enclosed
DHC-5A	$533,919	AvG	5.68 tons	18.6 tons	3+41, or 35 paratroops, or 24 stretchers	18	Radar	Enclosed
DHC-5D	$539,489	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

JH-7A

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 2000 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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$8,519,038	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

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

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	$502,920	AvG	4.5 tons	16.58 tons	1	24	None	Enclosed
J-8I	$1,896,705	AvG	4.5 tons	17.58 tons	1	26	Radar	Enclosed
J-8E	$3,563,476	AvG	4.5 tons	17.58 tons	1	26	Radar	Enclosed
J-8II	$3,389,450	AvG	4.5 tons	17.8 tons	1	28	Radar	Enclosed
J-8IIM	$3,694,447	AvG	4.5 tons	19.6 tons	1	30	Radar	Enclosed
J-8II Block 2	$3,421,326	AvG	4.5 tons	17.7 tons	1	28	Radar	Enclosed
J-8IID	$3,755,788	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	200x23mm

				Hardpoints	
J-8IIM	RWR, Flare/Chaff Dispenser, ECM, 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, HUD	755/540m Hardened Runway	+2	2xType 23-III Autocannons, 5 Hardpoints	200x23mm
J-8IID	RWR, Flare/Chaff Dispensers, HUD Interface, ECM, 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
$3,318,109	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, 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	$2,606,323	AvG	1.5 tons	11.3 tons	1	20	Radar	Enclosed
Q-5A	$2,606,323	AvG	1.5 tons	11.3 tons	1	20	Radar	Shielded
Q-5I	$2,628,878	AvG	2 tons	11.83 tons	1	24	Radar	Enclosed
Q-5IA	$2,708,541	AvG	2 tons	11.88 tons	1	24	Radar	Enclosed
Q-5II/B	$2,788,204	AvG	2 tons	11.88 tons	1	24	Radar	Enclosed
Q-5III	$2,892,035	AvG	2 tons	11.4 tons	1	24	Radar	Enclosed
Q-5K	$3,347,781	AvG	2 tons	12 tons	1	26	Radar, Image Intensification	Enclosed
Q-5M	$3,671,532	AvG	2 tons	12 tons	1	26	Radar, Image Intensification	Enclosed
Q-5E/F	$3,793,541	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	+1	2xType 23-2K	200x23mm

		Runway		Autocannons, 8 Hardpoints	
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	760/500m Primitive Runway	+3	2xType 23-2K Autocannons, 10 Hardpoints	200x23mm
Q-5E/F	Flare/Chaff Dispensers, RWR, HUD, IR Uncage, ECM, Laser Rangefinder	760/500m Primitive Runway	+4	2xType 23-2K Autocannons, 12 Hardpoints	200x23mm

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

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$69,300	AvG	272 kg	3.18 kg	2	4	None	Enclosed

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

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

L-39/L-159 Albatros

Notes: 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 cannons, 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	$118,208	AvG	1 ton	3.7 tons	2	6	None	Enclosed
L-39ZA	$159,577	AvG	1 ton	3.7 tons	1	6	None	Enclosed
L-159	$254,590	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
L-39ZO/ZA	1392	348 (110)	NA 87 7/4 70/40	1405	1684	12000
L-159	2246	562 (110)	NA 141 7/4 70/40	1602	2674	12000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
L-39ZO	None	450/400 Hardened Runway	+1	6 Hardpoints	None
L-39ZA	Flare/Chaff Dispensers, Radar Warning Receiver	450/400m Hardened Runway	+2	6 Hardpoints, 23mm autocannon	300x23mm

L-159	Flare/Chaff Dispensers, Radar Warning Receiver, HUD, ECM	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
$90,328	AvG	135 kg	3.13 tons	2	4	None	Enclosed

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

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	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 listed above. 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	$3,557,292	AvG	4.2 tons	13.7 tons	1	22	Radar	Enclosed
Mirage 50	$4,347,002	AvG	4.88 tons	14.7 tons	1	24	Radar	Enclosed

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Mirage 5	All-Weather Flight, Radar Warning Receiver	700/800m Hardened Runway	+2	2x30mm DEFA Autocannons, 7 Hardpoints	600x30mm
Mirage 50	All-Weather Flight, Radar Warning Receiver, IR Uncage, HUD	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
$7,454,658	AvG	6.3 tons	10.7 tons	2	16	Radar	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
4837	1209 (120)	NA 302 9/5 90/50	3780	6892	18300

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

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	$5,013,216	AvG	2.1 tons	12 tons	1	18	Radar	Enclosed
French	$5,703,599	AvG	2.1 tons	12.4 tons	1	18	Radar	Shielded

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

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, Target ID, Laser Designator, Look-Down Radar	825/415m Hardened Runway	+4	2x30mm DEFA Autocannons, 5 Hardpoints	500x30mm

Mirage IIIE

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	$2,453,801	AvG	4 tons	10.2 tons	1	18	Radar	Enclosed
Mirage IIIC (Early)	$2,456,098	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIIC (Late)	$2,604,952	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIICJ	$2,606,632	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIICZ	$2,870,716	AvG	4 tons	11.7 tons	1	18	Radar	Enclosed
Mirage IIIE	$3,191,328	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. It had not fully replaced the earlier fighters in most of those countries by the Twilight War, however. 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
$4,957,828	AvG	6.3 tons	17 tons	1	26	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
4890	1222 (120)	NA 306 9/5 90/50	3950	4740	20000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM, Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (4)	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
F-1C	$5,344,003	AvG	4 tons	16.2 tons	1	24	Radar	Enclosed
F-1CT	$5,744,803	AvG	4 tons	16.2 tons	1	26	Radar	Enclosed
F-1E	$5,740,069	AvG	4 tons	16.3 tons	1	24	Radar, FLIR	Enclosed
F-1A	$2,385,671	AvG	5 tons	15.2 tons	1	24	FLIR	Enclosed
F-1S	$5,816,641	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

(All)	4670	1168 (120)	NA 292 8/4 80/40	4100	3842	20000

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	670/600m Hardened Runway	+3	2x30mm DEFA, 7 Hardpoints	270x30mm
F1A	Flare/Chaff Dispensers, Radar Warning Receiver, IR Uncage, HUD Interface, ECM	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
$7,954,172	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 Autocannons, 14 Hardpoints	125x30mm

*The Rafale is Supercruise capable.

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

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 a-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	$503,657	AvG	2.5 tons	8 tons	2	10	FLIR	Enclosed
Alpha Jet A	$1,654,181	AvG	2.5 tons	8.09 tons	1	12	FLIR	Enclosed
Alpha Jet ACAS	$1,695,173	AvG	2.5 tons	8.11 tons	1	12	FLIR	Enclosed
Alpha Jet 2	$1,753,226	AvG	2.55 tons	9.02 tons	1	12	FLIR	Enclosed
Alpha Jet Lancier	$5,638,074	AvG	2.55 tons	10.34 tons	1	16	FLIR, Radar	Enclosed

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

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	550/495m Hardened Runway	+2	5 Hardpoints	None
Alpha Jet ACAS	Radar Warning Receiver, ECM, Inertial Navigation	550/495m Hardened Runway	+3	5 Hardpoints	None
Alpha Jet 2	Radar Warning Receiver, ECM, Inertial Navigation, HUD	550/495m Hardened Runway	+3	5 Hardpoints	None
Alpha Jet Lancier	Radar Warning Receiver, ECM, Inertial Navigation, HUD, Flare/Chaff Dispensers, IR Uncage, Laser Designator	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	$3,134,601	AvG	3.8 tons	12 tons	1	20	Radar	Shielded
Italian	$3,092,492	AvG	3.8 tons	12.95 tons	1	20	Radar	Shielded

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Brazilian	Flare/Chaff Dispensers, ECM, Secure Radios, All-Weather Flight, Radar Warning Receiver	1178/982m Hardened Runway	+3	2x30mm DEFA, 7 Hardpoints	400x30mm
Italian	Flare/Chaff Dispensers, ECM, Secure Radios, All-Weather Flight, Radar Warning Receiver	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	$4,244,842	AvG	6 tons	14.06 tons	1	30	Radar	Enclosed
Late Model	$4,746,773	AvG	6 tons	14.06 tons	1	34	FLIR, Radar	Enclosed

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Early Model, USMC	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning	450/16m (VSTOL) or 450/505m (Conventional) Primitive	+2	25mm GAU-12/A, 9	300x25mm

	Receiver	Runway		Hardpoints	
Early Model, Non-USMC	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver	450/16m (VSTOL) or 450/505m (Conventional) Primitive Runway	+2	2x25mm ADEN, 9 Hardpoints	200x25mm
Late Model	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, 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	$167,643	AvG	3.08 tons	5.7 tons	2	8	None	Enclosed
Hawk 100	$497,845	AvG	3 tons	9.1 tons	2	12	FLIR	Enclosed
Hawk 200	$1,725,575	AvG	3 tons	9.1 tons	1	12	Radar, FLIR, Image Intensification	Enclosed

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Hawk 50	None	550/495m Hardened Runway	+1	5 Hardpoints	None
Hawk 100	Radar Warning Receiver, Laser Designator	550/495m Hardened Runway	+3	5 Hardpoints	None
Hawk 200	Radar Warning Receiver, Flare/Chaff Dispensers, Laser Designator	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
$440,552	AvG	2.8 tons	11.08 tons	2	11	None	Enclosed

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

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 and in Indian attacks on Kashmir and Kurdistan. 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	$918,610	AvG	4.76 tons	15.7 tons	1	20	None	Enclosed
Mk 811 Engines	$928,417	AvG	4.76 tons	15.7 tons	1	20	None	Enclosed
Mk 106 Engines	$955,412	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
Mk 804 Engines	3398	850 (140)	NA 212 8/4 80/40	4200	4720	13700
Mk 811 Engines	3524	881 (140)	NA 220 8/4 80/40	4200	4899	13700
Mk 106 Engines	3874	969 (140)	NA 242 8/4 80/40	4200	5393	13700

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	Flare/Chaff Dispensers, Radar Warning Receiver, Secure Radios, Laser Designator	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
$167,427	AvG	943 kg	4.33 tons	2	10	None	Enclosed

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

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
$6,395,577	AvG	9 tons	27.95 tons	2	36	Radar, FLIR, Thermal Imaging	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
4676	1169 (130)	NA 292 9/6 90/60	8000	4316	19800

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff Dispensers, Radar Warning Receiver, Deception Jamming, HUD, IR Uncage, TFR, Look-Down Radar, Track While Scan, Laser Designator, ECM	760/500m Hardened Runway	+4	2x27mm autocannons, 9 hardpoints	400x27mm

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	$1,562,727	AvG	16 tons	51 tons	3+93 or 64 paratroopers	46	Radar	Enclosed
C-160D	$2,379,600	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
(All)	1030	258 (120)	NA 64 2/1 30/15	19000	2162	7925

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
$522,418	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
890	223 (105)	NA 56 4/2 40/20	2820	1288	10000

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

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 and has an availability rating of (-/-). 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, Deception Jamming	700/300m Hardened Runway	+5	27mm Mauser Autocannon, 13 Hardpoints	300x27mm

*The Typhoon is Supercruise capable.

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
$3,172,720	AvG	4.2 tons	13.5 tons	1	22	None	Enclosed

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

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
None	700/800m Hardened Runway	+3	2x30mm DEFA Autocannons, 7 Hardpoints	600x30mm

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 die 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	$230,351	AvG	2.5 tons	6.8 tons	2+24, or 16 paratroops, or 12 stretchers	10	None	Enclosed
Arava 202	$232,770	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
Arava 201	652	163 (80)	NA 41 6/4 60/40	1450	547	7620
Arava 202	663	166 (80)	NA 41 6/4 60/40	2365	603	7620

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

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
(Both)	4880	1220 (155)	NA 305 9/5 90/50	3360	2306	22860

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

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	$195,463	AvG	680 kg	5.5 tons	1	10	None	Enclosed
G.91T	$158,756	AvG	480 kg	6.05 tons	2	10	None	Enclosed
G.91Y	$540,923	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
G.91R	2150	538 (120)	NA 134 6/3 50/25	1610	2224	13100
G.91T	2048	512 (120)	NA 128 6/3 50/25	1610	2224	12190
G.91Y	2076	519 (120)	NA 130 6/3 50/25	3200	3620	12500

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	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	$104,763	AvG	1.81 tons	5.22 tons	2	8	None	Enclosed

MB-326K	$220,448	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
MB-326GB	1734	434 (110)	NA 108 7/4 70/40	2700	1513	11890
MB-326K	1770	442 (110)	NA 111 7/4 70/40	2880	1777	14325

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	$157,343	AvG	2.04 tons	5.9 tons	2	8	None	Enclosed
MB-339C	$422,611	AvG	1.81 tons	6.35 tons	2	10	None	Enclosed
MB-339K	$555,359	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
MB-339A	1634	409 (110)	NA 102 8/4 80/40	2880	1777	14325
MB-339C	1634	409 (110)	NA 102 8/4 80/40	2880	1777	14325
MB-339K	1854	464 (110)	NA 116 8/4 80/40	3030	1777	14325

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

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	$679,537	AvG	9.4 tons	28 tons	3+46 or 40 paratroops or 24 stretcher cases	56	Radar	Shielded
C-27J	$1,678,196	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
C-27A	974	244 (120)	NA 61 4/2 40/20	12000	2473	7620
C-27J	1000	250 (120)	NA 62 4/2 40/20	12000	3674	7620

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
$4,741,019	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
$2,218,757	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

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
$3,497,247	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
$8,150,749	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, Auto Track, HUD, IR Uncage, Track While Scan, Multitarget (2), Target ID, Laser Designator	800/530m Hardened Runway	+4	20mm Vulcan, 9 Hardpoints	750x20mm

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	$848,191	AvG	1 ton	4.4 tons	2	10	Radar	Enclosed
Upgraded	$970,711	AvG	1 ton	4.4 tons	2	10	Radar	Enclosed

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Standard	Radar Warning Receiver, Flare/Chaff Dispensers	440/400m Hardened Runway	+2	23mm Autocannon, 4 Hardpoints	200x23mm
Upgraded	Radar Warning Receiver, Flare/Chaff Dispensers, HUD, Helmet Sight Interface, ECM, Inertial Navigation	440/400m Hardened Runway	+3	23mm GSh-23-2 Autocannon, 4 Hardpoints	200x23mm

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
$5,007,888	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, IRCM, IR Uncage, HUD, Multitarget (3), Target ID, Look-Down Radar, GPS	600/700m Hardened Runway	+4	25mm GAU-12/A Autocannon, 5 Hardpoints	400x25mm

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
$2,435,114	AvG	3 tons	21.2 tons	3	26	Radar	Enclosed

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

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

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)	$705,102	AvG	4 tons	20.3 tons	1	28	None	Enclosed
Flogger-D (Late)	$808,909	AvG	4 tons	20.4 tons	1	28	None	Enclosed
Flogger-J	$3,724,147	AvG	4 tons	16.3 tons	1	30	Radar, Image Intensification	Enclosed

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff	RF	Armament	Ammo

		Zone			
Flogger-D (Early)	Radar Warning Receiver, Flare/Chaff Dispensers	700/500m Hardened Runway	+2	GSh-6-30 Autocannon, 7 Hardpoints	260x30mm
Flogger-D (Late)	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers	700/500m Hardened Runway	+3	GSh-6-30 Autocannon, 7 Hardpoints	260x30mm
Flogger-J	All Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, Laser Designator, ECM	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
$551,377	AvG	2.5 tons	13.5 tons	1	22	None	Enclosed

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

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff Dispensers, Radar Warning Receiver	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	$570,914	AvG	4.25 tons	19.5 tons	1	28	None	Enclosed
Fitter-F	$4,103,365	AvG	4.25 tons	19.5 tons	1	30	Radar	Enclosed

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

(Both)	2800	700 (110)	NA 175 7/4 70/40	6360	4645	15200

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Fitter-D	Flare/Chaff Dispensers, Radar Warning Receiver	905/950m Hardened Runway	+2	2x30mm autocannons, 9 hardpoints	300x30mm
Fitter-F	Flare/Chaff Dispensers, Radar Warning Receiver, 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
$5,576,740	AvG	8 tons	36 tons	2	52	FLIR, Radar	Shielded

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

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Flare/Chaff Dispensers, Radar Warning Receiver, Deception Jamming, Active Jamming, HUD, TFR, Laser Designator, 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, and was greatly feared by Allied armor crews during the Twilight War. 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	$919,387	AvG	4.4 tons	18.6 tons	1	32	None	Enclosed

Su-39	$3,123,018	AvG	4.4 tons	19.2 tons	2	34	Radar, FLIR	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
Su-25	1888	472 (100)	NA 118 6/3 60/30	6600	8853	7000
Su-39	1888	472 (100)	NA 118 6/3 60/30	7000	8853	7000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Su-25	Flare/Chaff Dispensers, Radar Warning Receiver, Laser Designator, Armored Fuselage	1200/600 Primitive Runway	+3	AO-17A 30mm-2 Autocannon, 8 Hardpoints	250x30mm
Su-39	Radar Warning Receiver, Flare/Chaff Dispensers, ECM, HUD, Target ID, Laser Designator, IR Suppression, Armored Fuselage	1200/600 Primitive Runway	+4	GSh-30-6 Autocannon, 8 Hardpoints	400x30mm

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
$10,671,072	AvG	8 tons	44.36 tons	2	29	Radar, FLIR, Image Intensification	Shielded

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

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

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	$22,261,938	AvG	9 tons	75.8 tons	6	51	Radar, RLR	Shielded
Tu-16RM-2	$26,845,278	AvG	2.72 tons	74.19 tons	6	55	Radar, RLR	Shielded
Tu-16Ye	$28,154,480	AvG	1.5 tons	72.6 tons	6	57	Radar, RLR	Shielded
Tu-16P	$28,256,828	AvG	1 ton	72.6 tons	6	55	Radar, RLR	Shielded

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Tu-16A	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers (80), ECM	1675/2045m Hardened Runway	+2	2x23mm Autocannons (Front, Rear, Belly, Dorsal), Bomb Bay	6000x23mm
Tu-16RM-2	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers (80), ECM, Still Cameras (5), Video Cameras (3), Look-Down Radar, Synthetic Aperture Radar	1675/2045m Hardened Runway	+2	2x23mm Autocannons (Front, Rear, Belly, Dorsal), 2 Hardpoints	6000x23mm
Tu-16Ye	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers (80), ECM, Radar Detectors, Radio Detectors, ELINT gear, Recording Gear, Still Camera, Video Camera	1675/2045m Hardened Runway	+2	2x23mm Autocannons (Front, Rear, Belly, Dorsal), 2 Hardpoints	6000x23mm
Tu-16P	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers (300), ECM, Deception Jamming, Chaff Rockets (20), Corridor Chaff Pods (2), IRCM	1675/2045m Hardened Runway	+2	2x23mm Autocannons (Front, Rear, Belly, Dorsal), 2 Hardpoints	6000x23mm

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	$27,458,467	AvG	12 tons	84 tons	4	51	Radar, RLR	Shielded
Blinder-C	$48,303,608	AvG	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
Blinder-A	3002	750 (135)	NA 188 3/2 30/20	(A) 51480	10438	13300
Blinder-C	3002	750 (135)	NA 188 3/2 30/20	128705	10438	13300

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Blinder-A	All-Weather Flight, Flare/Chaff Dispensers (20), Radar Warning Receiver	1445/1765m hardened Runway	+2	23mm Autocannon (R), Bomb Bay	1000x23mm
Blinder-C	All-Weather Flight, Flare/Chaff Dispensers (20), Radar Warning Receiver, Sonobuoys (100), Look-Down Radar, Deception Jamming, 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	$19,933,665	AvG	24 tons	125 tons	4	67	Radar, RLR	Shielded
Tu-22M2	$24,101,245	AvG	24 tons	126 tons	4	70	Radar, RLR, MAD	Shielded
Tu-22M3	$29,406,846	AvG	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

Tu-22M1	3574	894	NA 223 5/3 50/30	87000	27680	13000
Tu-22M2	3874	969	NA 242 6/4 60/40	87000	29986	13000
Tu-22M3	3974	994	NA 248 6/4 60/40	90000	30555	13000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Tu-22M1	All-Weather Flight, Flare/Chaff Dispensers (30), Radar Warning Receiver, ECM, 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 Dispensers (30), Radar Warning Receiver, ECM, Terrain Following Radar, Laser Designator, Auto Track, Chaff Rockets (8), IRCM, Inertial Navigation	1390/1700m Hardened Runway	+3	2x23mm Autocannons (Rear), Bomb Bay, 6 Hardpoints	2000x23mm
Tu-22M3	All-Weather Flight, Flare/Chaff Dispensers (30), Radar Warning Receiver, ECM, Terrain Following Radar, Laser Designator, Auto Track, Chaff Rockets (8), IRCM, 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
$36,407,972	AvG	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
4416	1104 (120)	NA 276 4/2 40/20	196045	53031	15500

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

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
$301,968	AvG	3 tons	9.5 tons	2	14	None	Enclosed

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

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, Flare/Chaff Dispensers	495/450m Hardened Runway	+2	7 hardpoints	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	$7,837,618	AvG	20 tons	61 tons	5+91 or 60 paratroopers	59	Radar	Enclosed
An-12BK	$7,930,457	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
An-12	1554	389 (130)	NA 97 4/2 40/20	29350	4707	10200
An-12BK	1360	340 (130)	NA 85 4/2 40/20	29350	5821	10200

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	$104,560	AvG	570 kg	3.63 tons	2+9 or 7 paratroopers	6	None	Enclosed
An-28	$127,844	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
An-14	444	111 (70)	NA 28 5/3 50/30	770	213	5000
An-28	863	216 (70)	NA 54 5/3 50/30	880	704	5000

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
$19,381,673	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
$358,948	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
1080	270 (110)	NA 68 2/1 40/20	5200	2194	7500

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
$392,292	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
1053	263 (100)	NA 66 3/2 40/20	4327	3799	9400

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, but had not nearly supplanted that aircraft by the Twilight War. 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
$13,163,109	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
$3,130,596	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 is one of the primary transports of Russia, 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	$37,569,914	AvG	52 tons	170 tons	7+148 or 124 paratroopers or 78 stretchers	74	Radar	Enclosed
Il-76MF	$43,382,000	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

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	$229,634	AvG	500 kg	6 tons	1	8	None	Enclosed
MiG-15bis	$250,179	AvG	500 kg	6.06 tons	1	8	None	Enclosed
MiG-15P	$1,172,945	AvG	500 kg	6.8 tons	1	12	Radar	Enclosed
MiG-15ISh	$321,659	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	$231,997	AvG	501 kg	6.09 tons	1	10	None	Enclosed
MiG-17P	$1,194,220	AvG	501 kg	6.5 tons	1	14	Radar	Enclosed
MiG-17F	$275,400	AvG	501 kg	6.09 tons	1	10	None	Enclosed
MiG-17PF	$1,276,580	AvG	501 kg	6.5 tons	1	14	Radar	Enclosed
MiG-17PFU	$1,168,432	AvG	501 kg	6.42 tons	1	12	Radar	Enclosed
F-5	$296,650	AvG	501 kg	6.11 tons	1	10	None	Enclosed
Mideast Modification	$293,760	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 Runway	+1	3x23mm NR-23 Autocannons, 2 Hardpoints	150x23mm
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	$276,504	AvG	1.68 tons	8.9 tons	1	12	None	Enclosed
MiG-19P	$1,349,320	AvG	1.68 tons	9.1 tons	1	14	Radar	Enclosed
MiG-19SF	$391,289	AvG	1.68 tons	8.9 tons	1	16	None	Enclosed
MiG-19PF	$1,427,912	AvG	1.68 tons	9.1 tons	1	18	Radar	Enclosed
MiG-19PM	$1,441,434	AvG	1.68 tons	9 tons	1	18	Radar	Enclosed
F-6	$403,911	AvG	2.78 tons	10 tons	1	16	None	Enclosed
J-6I	$1,441,275	AvG	1.68 tons	13 tons	1	28	Radar	Enclosed
J-6II/IV	$1,538,606	AvG	1.68 tons	13.1 tons	1	28	Radar	Enclosed
J-6III	$1,587,912	AvG	1.68 tons	13.1 tons	1	28	Radar	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 Receiver	760/500m Hardened Runway	+2	4 Hardpoints	None
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	$1,247,775	AvG	1 ton	8.5 tons	1	16	Radar	Enclosed
MiG-21PF	$1,197,530	AvG	1 ton	8.44 tons	1	16	Radar	Enclosed
MiG-21PF (Impvd)	$1,313,420	AvG	1 ton	8.63 tons	1	16	Radar	Enclosed
MiG-21FL	$1,228,592	AvG	1 ton	8.44 tons	1	16	Radar	Enclosed
MiG-21PFM	$1,354,137	AvG	1 ton	9.08 tons	1	16	Radar	Enclosed

MiG-21M	$1,368,527	AvG	1.25 tons	9.66 tons	1	16	Radar	Enclosed
MiG-21PFMA	$1,313,420	AvG	1.25 tons	9.59 tons	1	16	Radar	Enclosed
MiG-21MF	$1,451,448	AvG	1.25 tons	9.87 tons	1	16	Radar	Enclosed
MiG-21bis-A	$1,519,087	AvG	1.25 tons	10.1 tons	1	16	Radar	Enclosed
MiG-21bis-B	$1,535,266	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	$2,848,428	AvG	3 tons	17.72 tons	1	36	Radar, VAS	Enclosed
MiG-29SD	$3,016,275	AvG	3 tons	17.72 tons	1	36	Radar, VAS, FLIR	Enclosed
MiG-29S	$3,147,379	AvG	4 tons	19.7 tons	1	36	Radar, VAS, FLIR	Enclosed
MiG-29SE	$2,844,864	AvG	3 tons	17.72 tons	1	38	Radar, VAS	Enclosed
MiG-29S2	$3,089,193	AvG	4.01 tons	19.7 tons	1	38	Radar, VAS, FLIR	Enclosed
MiG-29SM	$5,789,161	AvG	4.01 tons	19.7 tons	1	33	Radar, VAS, FLIR	Enclosed
MiG-29K	$3,328,254	AvG	4 tons	19.7 tons	1	38	Radar, VAS, FLIR	Enclosed
MiG-29M	$7,744,220	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
MiG-29B/SD/SE	4800	1200 (100)	NA 300 10/6 100/60	4300	8525	18000
MiG-29S	4800	1200 (100)	NA 300 10/6 100/60	4376	8525	18000
MiG-29S2/SM	4800	1200 (100)	NA 300 10/6 100/60	4616	8525	18000
MiG-29K	5189	1297 (100)	NA 324 10/6 100/60	6419	9283	18000
MiG-29M	5189	1297 (100)	NA 324 10/6 100/60	4980	9283	18000

Vehicle	Combat Equipment	Minimum	RF	Armament	Ammo

		Landing/Takeoff Zone			
MiG-29B	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispensers, ECM, 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, 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, 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, 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, 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, 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, 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, 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	$12,902,666	AvG	6 tons	30 tons	1	39	Radar	Enclosed
Su-30	$13,692,625	AvG	6 tons	31 tons	2	39	Radar	Enclosed
Su-30M/MK	$13,672,106	AvG	8 tons	33 tons	2	39	Radar, FLIR	Enclosed
Su-33	$13,409,181	AvG	6.5 tons	30 tons	1	39	Radar, FLIR	Enclosed
Su-35	$17,945,596	AvG	8 tons	34 tons	1	42	Radar, FLIR, VAS, RLR, RLIR	Enclosed
Su-37	$18,922,554	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, 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, 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-	All-Weather Flight. RWR, Flare/Chaff	670/550m Hardened	+3	GSh-301 30mm-3	150x30mm

30/30MK	Dispensers, ECM, Deception Jamming, Auto Track, HUD Interface, Look-Down Radar, IR Uncage, Track While Scan, Secure Radios	Runway		Autocannon, 10 Hardpoints	
Su-33	All-Weather Flight. RWR, Flare/Chaff Dispensers, ECM, 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, 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, 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	$5,088,273	AvG	1.36 tons	13 tons	1	30	Radar, FLIR	Enclosed
Yak-38U	$5,146,649	AvG	1.36 tons	13.3 tons	2	30	Radar, FLIR	Enclosed
Yak-38M	$5,120,803	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

Yak-41 Freestyle

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-41, but few, if any were sold outside of Russia.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$5,758,765	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, 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

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	$287,900	AvG	1.84 tons	6.3 tons	2	8	None	Enclosed
Cannon-Armed	$295,223	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
(Both)	1612	403 (100)	NA 101 6/3 60/30	1730	1905	12800

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

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	$329,540	AvG	2.82 tons	8 tons	3+18 or 16 paratroops	12	None	Enclosed
C.212-200	$369,272	AvG	3.16 tons	9 tons	3+18 or 16 paratroops	12	None	Enclosed
C.212-300	$624,158	AvG	3.26 tons	9.19 tons	3+18 or 16 paratroops	14	Radar, FLIR	Enclosed
C.212-400	$756,265	AvG	3.95 tons	11.14 tons	3+25 or 25 paratroopers of 14 stretchers	14	Radar	Enclosed
SH-89	$1,137,259	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, 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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$1,197,111	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

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	$110,352	AvG	1 ton	4.02 tons	2	8	None	Enclosed
FJ44-1C Engines	$116,714	AvG	1.05 tons	4.02 tons	2	8	None	Enclosed
J85-GE-3 Engines	$142,296	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
Aubisque Engines	1540	385 (100)	NA 96 8/5 40/30	1000	1454	12200
FJ44-1C Engines	1614	403 (100)	NA 101 8/5 40/30	1000	1598	12200
J85-GE-3 Engines	1882	470 (100)	NA 118 8/5 40/30	1000	2180	12200

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

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-35C. 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	$2,556,011	AvG	1.7 tons	10.09 tons	1	18	Radar	Enclosed
J-35D	$2,678,396	AvG	2.2 tons	11.86 tons	1	22	Radar	Enclosed
J-35F	$4,101,406	AvG	2.5 tons	12.07 tons	1	26	Radar	Enclosed
J-35F-2	$4,947,103	AvG	2.5 tons	12.07 tons	1	28	Radar, FLIR	Enclosed
J-35J	$5,409,952	AvG	2.9 tons	12.27 tons	1	30	Radar, FLIR	Enclosed
F-35	$3,286,504	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	30mm 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	$3,826,723	AvG	3.6 tons	17 tons	1	26	Radar	Enclosed
AJ-37	$3,944,515	AvG	6 tons	18 tons	1	26	Radar, FLIR	Enclosed
AJS-37	$4,391,580	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 Interface, IR Uncage, Look-Down Radar, Track While Scan	600/350m Primitive Runway	+3	30mm KCA Autocannon, 7 Hardpoints	150x30mm
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	$4,476,358	AvG	4.68 tons	12.5 tons	1	24	Radar	Enclosed
JAS-39C	$4,730,140	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

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
$39,556	AvG	1 ton	2.7 tons	2	4	None	Enclosed

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

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

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
$43,251	AvG	1 ton	3.2 tons	2	4	None	Enclosed

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

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

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
$3,396,741	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

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	$290,049	AvG	1.55 tons	4.76 tons	1	8	None	Enclosed
AD-1Q	$5,251,131	AvG	1.4 tons	4.81 tons	2	11	None	Enclosed
AD-2	$292,362	AvG	1.71 tons	4.76 tons	1	9	None	Enclosed
AD-2Q	$7,221,924	AvG	1.4 tons	4.81 tons	2	11	None	Enclosed
AD-3	$292,362	AvG	1.71 tons	4.86 tons	1	9	None	Enclosed
AD-3N	$3,971,538	AvG	1.46 tons	5.86 tons	2	13	Radar, WL Searchlight	Enclosed
AD-3W	$29,840,588	AvG	1.56 tons	5.48 tons	2	15	Radar, WL Searchlight	Enclosed
AD-4	$535,434	AvG	1.68 tons	4.9 tons	1	9	None	Enclosed
AD-4B	$552,753	AvG	1.68 tons	4.93 tons	1	11	None	Shielded
AD-4N	$5,531,153	AvG	1.43 tons	5.9 tons	2	13	Radar, WL Searchlight	Enclosed
AD-4Q	$7,464,996	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, WL Searchlight	Enclosed
AD-4N (Stripped)	$333,886	AvG	1.79 tons	4.79 tons	1(2)	8	None	Enclosed
AD-5	$874,978	AvG	2.13 tons	5.58 tons	1(2)	8	None	Enclosed
AD-5N	$5,870,697	AvG	1.88 tons	6.68 tons	2	13	Radar, WL Searchlight	Enclosed
AD-5W	$57,477,478	AvG	1.98 tons	7.3 tons	2	13	Radar, WL Searchlight	Enclosed
AD-5Q	$19,101,939	AvG	2.04 tons	6.95 tons	4	13	Radar	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	$7,992,767	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
AD-1/AD-1Q	999	200 (45)	6/4 30/20	1400	924	7925
AD-2/AD-2Q	1098	220 (40)	5/3 32/15	1440	1112	7925
AD-3/AD-	1109	222 (40)	5/3 33/15	1440	1112	7925

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

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

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

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	$1,318,657	AvG	3.59 tons	10.23 tons	1	18	Radar	Shielded
A-4B/Q/S	$1,419,574	AvG	3.59 tons	10.23 tons	1	18	Radar	Shielded
A-4C/P	$1,465, 367	AvG	3.59 tons	10.23 tons	1	18	Radar	Shielded
A-4E	$1,613,332	AvG	4.5 tons	11.14 tons	1	18	Radar	Shielded
A-4F/K	$3,211,715	AvG	4.5 tons	11.14 tons	1	20	Radar	Shielded
A-4G	$3,038,053	AvG	4.5 tons	11.14 tons	1	18	Radar	Shielded
A-4H	$3,258,797	AvG	4.5 tons	11.14 tons	1	22	Radar	Shielded
A-4M	$4,044,171	AvG	4.76 tons	11.14 tons	1	26	Radar	Shielded
A-4N/Y	$4,021,941	AvG	4.76 tons	11.14 tons	1	26	Radar	Shielded

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

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	Radar Warning Receiver, Flare/Chaff Dispensers, TFR	1000/600m Hardened Runway	+1	2x20mm Mk 12 Autocannons, 2 Hardpoints	200x20mm
A-4E/G	Radar Warning Receiver, Flare/Chaff Dispensers, TFR, ECM	1000/600m Hardened Runway	+1	2x20mm Mk 12 Autocannons, 4 Hardpoints	200x20mm
A-4F/K	Radar Warning Receiver, Flare/Chaff Dispensers, TFR, ECM, DJM	1000/600m Hardened Runway	+2	2x20mm Mk 12 Autocannons, 4 Hardpoints	200x20mm
A-4H	Radar Warning Receiver, Flare/Chaff Dispensers, TFR, ECM, DJM, IR Masking	1000/600m Hardened Runway	+2	2x30mm DEFA Autocannons, 4 Hardpoints	200x30mm
A-4M	Radar Warning Receiver, Flare/Chaff Dispensers, TFR, ECM, DJM, Laser Designator	1000/600m Hardened Runway	+3	4x20mm Mk 12 Autocannons, 5 Hardpoints	400x20mm
A-4N/Y	Radar Warning Receiver, Flare/Chaff Dispensers, TFR, ECM, DJM, Laser Designator	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 radar warning receiver 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	$6,858,191	AvG	8.17 tons	26.58 tons	2	38	Radar	Shielded
A-6C	$8,047,949	AvG	8.17 tons	26.78 tons	2	38	Radar, FLIR, Image Intensification	Shielded
A-6E	$9,704,795	AvG	8.17 tons	27.4 tons	2	40	Radar, FLIR, Image Intensification	Shielded
A-6E/TRAM	$11,188,091	AvG	8.17 tons	27.4 tons	2	38	Radar, FLIR, Image Intensification	Shielded
A-6F	$12,146,506	AvG	8.55 tons	27.5 tons	2	40	Radar, FLIR, Image Intensification	Shielded
EA-6A	$23,442,450	AvG	6.8 tons	24.77 tons	2	40	Radar	Shielded
KA-6D	$6,966,950	AvG	9.5 tons	26.6 tons	2	35	None	Shielded

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff	RF	Armament	Ammo

		Zone			
A-6A/B	Flare/Chaff Dispensers, ECM, RWR, All Weather Flight	1400/785 Hardened Runway	+2	5 Hardpoints	None
A-6C	Flare/Chaff Dispensers, ECM, RWR, All Weather Flight, Inertial Navigation	1400/785 Hardened Runway	+3	5 Hardpoints	None
A-6E	EW Suite, Secure Radios, Flare/Chaff Dispensers, ECM, 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 Dispensers, ECM, Radar Warning, Deception Jamming, All-Weather Flight, Laser Designator, Inertial Navigation	1400/785 Hardened Runway	+4	5 Hardpoints	None
A-6F	EW Suite, Secure Radios, Flare/Chaff Dispensers, ECM, Radar Warning Receiver, Active Jamming, All-weather Flight, HUD, IR Uncage, Track While Scan, Terrain Following Radar, Laser Designator, Inertial Navigation	1400/785m Hardened Runway	+5	7 Hardpoints	None
EA-6A	Flare/Chaff Dispensers, ECM, RWR, All Weather Flight, Deception Jamming	1400/785 Hardened Runway	+1	5 Hardpoints	None
KA-6D	Flare/Chaff Dispensers, 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 Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
A-7A	$27,385,439	AvG	6.8 tons	14.49 tons	1	27	Radar (Weather Only)	Enclosed
A-7B	$30,050,735	AvG	6.8 tons	13.52 tons	1	27	Radar (Weather/Bombing Only)	Enclosed
A-7C	$29,957,340	AvG	6.8 tons	17.24 tons	1	30	Radar	Enclosed
A-7D	$30,981,759	AvG	6.8 tons	17.24 tons	1	30	Radar	Enclosed
A-7E	$31,479,759	AvG	6.8 tons	17.24 tons	1	31	Radar, FLIR, Image Intensification	Enclosed
TA-7C/EA-7L	$33,197,156	AvG	6.8 tons	18.41 tons	2	32	Radar	Enclosed
TA-7C/EA-7L (Allison Engine)	$34,193,071	AvG	6.8 tons	18.41 tons	2	32	Radar	Enclosed

A-7K	$38,875,606	AvG	6.8 tons	18.44 tons	2	34	Radar, FLIR, Image Intensification	Enclosed
A-7H (Upgraded)	$24,873,869	AvG	6.8 tons	16.67 tons	1	34	Radar	Enclosed
TA-7H (Upgraded)	$31,211,005	AvG	6.8 tons	16.96 tons	2	34	Radar	Enclosed
A-7P	$24,203,234	AvG	6.8 tons	16.49 tons	1	32	Radar, FLIR, Image Intensification	Enclosed
A-7F	$40,060,838	AvG	8.16 tons	21.06 tons	1	34	Radar, FLIR, Image Intensification	Enclosed

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

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

Each), Secure Radios, RWR, All Weather Flight, Laser Designator, ECM (-5), IRCM (-2)	Hardened Runway	Gatling Gun, 8 hardpoints	

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 and South Korea.

The A-10 N/AW (or A-10B) is a version of the A-10 that addresses the A-10's greatest shortcoming, the lack of night attack capability. The A-10 NAW has night vision and terrain-following radar for treetop navigation.

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.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
A-10A	$1,042,518	AvG	7.26 tons	22.68 tons	1	32	None	Shielded
A-10B N/AW	$2,425,613	AvG	7.26 tons	24.15 tons	1	40	FLIR, Radar, Image Intensification	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
(Both)	1412	353 (90)	NA 88 9/6 50/40	4850	8094	10700

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	Armament	RF	Ammo
A-10A	Flare/Chaff Dispensers, IR Suppression, Laser Designator, HUD, Armored Fuselage	440/400m Primitive Runway	GAU-8 Autocannon, 11 Hardpoints	+3	1174x30mm
A-10B N/AW	Flare/Chaff Dispensers, IR Suppression, Laser Designator, Terrain Following Radar, HUD, Armored Fuselage	440/400m Primitive Runway	GAU-8 Autocannon, 11 Hardpoints	+3	1174x30mm

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	$572,612	JP4	2.13 tons	5.44 tons	2	10	None	Enclosed
A-37B	$585,068	JP4	2.67 tons	6.8 tons	2	10	None	Enclosed
OA-37B	$2,060,454	JP4	2.64 tons	6.94 tons	2	12	FLIR	Enclosed
A-37E	$2,528,757	JP4	2.64 tons	7.07 tons	2	14	FLIR, Weather Radar	Enclosed
A-37F	$2,702,077	JP4	2.48 tons	7.21 tons	2	17	FLIR, Weather Radar	Enclosed
Tebuan	$6,424,600	JP4	2.5 tons	7.45 tons	2	13	FLIR, Weater Radar, Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
A-37A	1242	248 (90)	NA 62 8/5 40/30	2000	1449	12730
A-37B	1448	290 (80)	NA 70 9/5 30/20	2000	1698	12700
OA-37B	1420	284 (75)	NA 69 9/5 30/20	2000	1733	12700
A-37E	1567	312 (65)	NA 76 9/5 30/20	2200	1919	13970
A-37F	1567	312 (65)	NA 76 9/5 30/20	2500	2119	13970
Tebuan	1575	314 (90)	NA 77 9/5 30/20	2000	1929	13970

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	550/495m Primitive Runway	+2	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm
A-37E	IFF, Secure Radios, Laser Designator,	440/396m Primitive Runway	+2	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm

A-37F	Flare/Chaff (16 each), ECM (-2) IFF, Secure Radios, Laser Designator,	330/200m Primitive Runway (& STOVL Characteristics)	+3	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm
Tebuan	Flare/Chaff (16 each), ECM (-2) IFF, RWR, Secure Radios, Flares/Chaff (16 Each), ECM (-2), Laser Designator	550/495m Primitive Runway	+3	SUU-11/A Minigun, 8 Hardpoints	1600x7.62mm

AC-130U Spectre

Notes: This aircraft is a development of a number of Vietnam-era experiments with arming transport aircraft for ground attack purposes. The AC-130U is a development on the C-130 Hercules airframe, and is heavily armed with weapons on stabilized mounts. All weapons fire from the left side of the aircraft, and weapons are computer-synchronized to fire at the same aiming point, or they may be aimed independently at different targets. The aircraft has no ejection seats, but is capable of in-flight refueling.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$20,959,144	AvG	1.4 tons	63.6 tons	14	64	FLIR, SLIR, Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1288	322 (90)	NA 81 5/3 35/20	24000	5512	9315

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Laser Designator, ECM/IRCM, Flare/Chaff Dispensers, IR Suppression, Secure Radios	1105/800 Primitive Runway	+4	2x20mm Vulcan, 40mm Bofors L70, 105mm Howitzer	3600x20mmVul, 480x40mm, 24x105mm

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)	$25,052,610	AvG	6.8 tons	29.48 tons	4	45	Radar	Shielded
EA-6B	$29,252,610	AvG	6.8 tons	29.48 tons	4	45	Radar	Shielded
EA-6B EXCAP	$29,983,925	AvG	6.8 tons	29.48 tons	4	45	Radar	Shielded
EA-6B ICAP	$30,346,805	AvG	6.8 tons	29.6 tons	4	45	Radar	Shielded
EA-6B ICAP II (Early)	$31,105,475	AvG	6.8 tons	29.6 tons	4	45	Radar	Shielded
EA-6B ICAP II (Late)	$31,416,530	AvG	6.8 tons	29.6 tons	4	45	Radar	Shielded
EA-6B Block 89A	$32,818,050	AvG	6.8 tons	29.45 tons	4	45	Radar	Shielded
EA-6B ICAP III	$33,638,501	AvG	6.8 tons	29.45 tons	4	45	Radar	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
EA-6B (Early)	1904	1410 (185)	NA 130 8/4 40/30	7230	5034	12619
EA-6B (Others)	2326	1720 (185)	NA 130 8/4 40/30	7230	6174	12619

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
EA-6B (Early)	Flare/Chaff Dispensers, ECM, RWR, All Weather Flight, Deception Jamming, EW Suite	1400/785 Hardened Runway	+1	5 Hardpoints	None
EA-6B/EA6B EXCAP	Flare/Chaff Dispensers, ECM, RWR, All Weather Flight, Deception Jamming, EW Suite	1400/785 Hardened Runway	+1	5 Hardpoints	None
EA-6B ICAP	Flare/Chaff Dispensers (16/16), ECM, RWR, All Weather Flight, Deception Jamming, EW Suite,	1400/785 Hardened Runway	+1	5 Hardpoints	None

	Secure Radios					
EA-6B ICAP II (Early)	Flare/Chaff Dispensers (16/16), ECM, RWR, All Weather Flight, Deception Jamming, EW Suite, Secure Radios	1400/785 Hardened Runway	+2	5 Hardpoints	None	
EA-6B ICAP II (Late)	Flare/Chaff Dispensers (16/16), ECM, RWR, All Weather Flight, Deception Jamming, EW Suite, Secure Radios	1400/785 Hardened Runway	+2	7 Hardpoints	None	
EA-6B Block 89A	Flare/Chaff Dispensers (16/16), ECM, RWR, All Weather Flight, Deception Jamming, GPS, EW Suite, Secure Radios	1400/785 Hardened Runway	+3	7 Hardpoints	None	
EA-6B ICAP III	Flare/Chaff Dispensers (16/16), ECM, RWR, All Weather Flight, Deception Jamming, GPS, EW Suite, Secure Radios	1400/785 Hardened Runway	+4	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	$6,110,375	AvG	11 tons	36.74 tons	2	32	Radar, FLIR, Thermal Imaging, Image Intensification	Shielded
F100-PW-290 Engines	$6,485,568	AvG	11 tons	36.74 tons	2	37	Radar, FLIR, Thermal Imaging, Image Intensification	Shielded

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(Both)	Secure Radios, Chaff/Flare Dispensers, Radar Warning Receiver, ECM, Deception Jamming, Auto Track, HUD, IR Uncage, Look-Down Radar, TFR, Track While Scan, All Weather Flight, Target ID	2800/1055m Hardened Runway	+4	20mm Vulcan, 13 Hardpoints	950x20mmM61

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 radar warning receiver 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	$527,542	AvG	6.35 tons	23.97 tons	1	22	None	Shielded
F-105D (Early)	$1,662,712	AvG	6.35 tons	23.85 tons	1	28	Radar	Shielded
F-105D (Late)	$1,695,613	AvG	6.35 tons	23.97 tons	1	28	Radar	Shielded
F-105D (T-Stick II)	$1,742,713	AvG	6.35 tons	23.97 tons	1	28	Radar	Shielded
EF-105F	$1,900,057	AvG	5.68 tons	25.09 tons	2	32	Radar	Shielded
EF-105G	$2,058,613	AvG	5.68 tons	25.09 tons	2	36	Radar	Shielded

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

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)	Radar Warning Receiver, Flare/Chaff Dispensers	1400/950m Hardened Runway	+2	20mm Vulcan, 5 Hardpoints, Internal Bomb Bay	1000x20mm
F-105D (T-Stick II)	Radar Warning Receiver, Flare/Chaff Dispensers	1400/950m Hardened Runway	+3	20mm Vulcan, 5 Hardpoints, Internal Bomb Bay	1000x20mm
EF-105F	Radar Warning Receiver, Flare/Chaff Dispensers, ECM	1400/950m Hardened Runway	+2	20mm Vulcan, 5 Hardpoints	1000x20mm
EF-105G	Radar Warning Receiver, Flare/Chaff Dispensers, ECM, Deception Jamming, Active Jamming	1400/950m Hardened Runway	+3	20mm Vulcan, 5 Hardpoints	1000x20mm

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
$19,878,459	AvG	2.27 tons	23.81 tons	1	48	Radar, FLIR	Shielded

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

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Radar Warning Receiver, Flare/Chaff Dispensers, ECM, IRCM, HUD, Look-Down Radar, Target ID, Terrain Following Radar	1200/1500m Primitive 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 M-2HB MG pods and 70mm rocket pods on the four free hardpoints.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$1,311,061	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
930	233 (120)	NA 58 7/4 45/35	930	472	7620

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
GPS, Flare/Chaff Dispensers, 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	$227,021	AvG	1.63 tons	6.55 tons	2+4	8	None	Enclosed
OV-10D	$549,054	AvG	2.4 tons	6.6 tons	2	10	FLIR, Passive IR	Enclosed

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

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

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	$26,929,180	AvG	1.78 tons	23.83 tons	4	40	Radar, FLIR	Shielded
S-3B	$33,819,980	AvG	1.78 tons	24.08 tons	4	40	Radar, FLIR	Shielded
S-3B (Late)	$36,219,980	AvG	1.78 tons	24.09 tons	4	40	Radar, FLIR	Shielded
US-3A	$9,882,580	AvG	6.04 tons	22.57 tons	3+6	32	Radar	Shielded
ES-3A	$47,112,780	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
S-3A/B/US-3A	2315	1710 (135)	NA 428 7/5 70/50	10983	4958	12190
ES-3A	2085	1540 (135)	NA 385 6/4 60/40	10983	4998	12190

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 Dispensers (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 Dispensers (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 Suite, Radio Detectors, Radar Detectors, Secure Radios, Inertial Navigation	1400m/785m Hardened Runway	None	2 Hardpoints	None

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	$130,000	AvG	1.59 tons	5.66 tons	2	10	None	Enclosed
T-2B	$158,126	AvG	1.59 tons	6.19 tons	2	12	None	Enclosed
T-2C	$156,206	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
T-2A	1165	291 (100)	NA 73 6/3 60/30	2065	1508	10000
T-2B	1761	440 (100)	NA 110 6/3 60/30	2065	2672	12320
T-2C	1728	432 (100)	NA 108 6/3 60/30	2065	2627	12320

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	None	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	$31,136	AvG	408 kg	1.25 tons	2	4	None	Enclosed
T-34A/B	$31,298	AvG	427 kg	1.32 tons	2	4	None	Enclosed
T-34C	$35,136	AvG	534 kg	1.95 tons	2	4	None	Enclosed

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

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
(All)	None	600/500m Primitive Runway	None	4 hardpoints	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
$1,015,813	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
$96,792,118	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	$742,856	AvG	1.43 tons	8.24 tons	2+8	16	None	Shielded
C-21A	$742,856	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	$31,362	AvG	4.1 tons	7.7 tons	3+28 or 20 paratroopers	8	None	Enclosed
C-47B	$32,583	AvG	4 tons	8.1 tons	3+28 or 20 paratroopers	10	None	Enclosed
C-53B	$33,291	AvG	3.1 tons	8.2 tons	3+21 or 15 paratroopers	8	None	Enclosed
SC-47A/SC-117A/HC-47D	$130,148	AvG	3.6 tons	8.7 tons	5	11	Searchlight	Enclosed
XC-47A	$35,025	AvG	3.81 kg	8.86 tons	3+28 or 20 paratroopers	9	None	Enclosed
C-53B (Winterized)	$38,570	AvG	2.81 tons	8.7 tons	3+21 or 15 paratroopers	9	None	Enclosed
EC-47N/P	$2,427,986	AvG	1.48 tons	8.84 tons	11	13	Searchlight, Radar (30 km)	Enclosed
VC-47A	$43,570	AvG	1.75 tons	8.3 tons	3+14	10	None	Enclosed
VC-47B	$45,791	AvG	1.75 tons	8.3 tons	3+14	12	None	Enclosed
VC-117A/C/C-47L/C-47M	$47,734	AvG	1.73 tons	8.35 tons	3+14	11	None	Enclosed
VC-117B/C-47R	$49,955	AvG	1.73 tons	8.35 tons	3+14	13	None	Enclosed
XCG-17	$13,806	N/A	6.8 tons	5 tons	2+40	2	None	Enclosed
RC-47D	$569,957	AvG	1.55 tons	8.7 tons	6	10	Searchlight, Radar (20 km)	Enclosed
EC-47Q	$2,428,353	AvG	1.5 tons	8.84 tons	11	13	Searchlight, Radar (30 km)	Enclosed
BT-67 (Standard)	$475,977	JP4/5/6	4.63 tons	8.44 tons	3+32 or 23 paratroopers	11	Radar (30 km)	Enclosed
BT-67 (Cargo/Passenger)	$517,686	JP4/5/6	3.1 tons	8.57 tons	3+10	12	Radar (30 km)	Enclosed

BT-67 (Arctic Fit-Out, Standard)	$479,640	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)	$520,019	JP4/5/6	3 tons	8.97 tons	3+10	13	Radar (30 km)	Enclosed
Super DC-3	$55,642	AvG	4.7 tons	8.86 tons	2+30	8	None	Enclosed
Turbo Three	$43,628	JP4/5/6	5.13 tons	8.43 tons	3+28 or 20 paratroopers	9	None	Enclosed
Tri-Turbo-Three	$54,676	JP4/5/6	6.41 tons	8.8 tons	3+28 or 20 paratroopers	10	None	Enclosed
Li-2G	$37,649	AvG	4.3 tons	7.9 tons	3+28 or 20 paratroopers	8	None	Enclosed
Li-2T	$165,590	AvG	3.3 tons	8.9 tons	6+22 or 15 paratroopers	10	None	Enclosed
Li-2D	$166,574	AvG	3.3 tons	8.9 tons	6+28 or 20 paratroopers	10	None	Enclosed
Li-2DB	$177,473	AvG	2.1 tons	9.2 tons	6+14 or 10 paratroopers	10	None	Enclosed
Li-2R	$123,730	AvG	1.8 tons	8.58 tons	8	12	Searchlight	Enclosed
Li-2V	$38,870	AvG	4.2 tons	8.3 tons	3+28 or 20 paratroopers	10	None	Enclosed
Li-2VV	$241,777	AvG	1.26 tons	9.68 tons	6	11	None	Enclosed
Li-2NB	$250,857	AvG	1.26 tons	9.68 tons	6	11	None	Enclosed
L2D2-1	$28,902	AvG	4.1 tons	7.45 tons	3+28 or 20 paratroopers	8	None	Enclosed
L2D3	$31,362	AvG	4.34 tons	7.83 tons	3+28 or 20 paratroopers	8	None	Enclosed
L2D3-1a	$32,686	AvG	4.34 tons	7.83 tons	3+28 or 20 paratroopers	8	None	Enclosed
L2D4	$76,343	AvG	2 tons	8.1 tons	3+14	11	None	Enclosed
L2D4-1	$62,394	AvG	4.14 tons	8.03 tons	3+28 or 20 paratroopers	9	None	Enclosed
L2D5	$67,150	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	3000x7.62mm

					max), 2 Hardpoints (6x82mm Rockets only), 1 Hardpoint (No Weapons; Wet); Dorsal Turret with ShKAS; 2xWaist Guns with ShKAS	
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 Only; 3xWet)	None
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	$1,431,857	AvG	6.81 tons	27.22 tons	3+62 or 43 paratroopers or 30 stretchers	32	Radar	Enclosed

C-123K	$1,709,018	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	$4,609,338	AvG	17.04 tons	56.33 tons	4+92 or 64 paratroopers	34	Radar	Enclosed
C-130B	$4,704,709	AvG	18.41 tons	61.22 tons	4+92 or 64 paratroopers	36	Radar	Enclosed
C-130E	$4,973,728	AvG	19.09 tons	69.75 tons	4+92 or 64 paratroops	38	Radar	Enclosed
C-130H	$5,200,457	AvG	19.09 tons	69.75 tons	4+92 or 64 paratroops	38	Radar	Enclosed
C-130J	$5,345,729	AvG	19.09 tons	69.75 tons	4+92 or 64 paratroops	38	Radar	Enclosed
C-130J-30	$5,389,037	AvG	19.96 tons	74.39 tons	3+128 or 92 paratroopers	39	Radar	Enclosed
MC-130E	$14,975,309	AvG	7.24 tons	69.75 tons	9+53 or 26 paratroopers	54	Radar, FLIR	Enclosed
MC-130H	$15,053,462	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	$25,161,118	AvG	32.14 tons	143.6 tons	5+154, or 123 paratroopers, or 80 stretchers	52	Radar	Enclosed
C-141B	$25.683,513	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	$994,921	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	$1,079,497	AvG	5.69 tons (up to 4.5 tons of that slung)	23.21 tons	3+14	32	Radar	Enclosed
MV-22	$2,221,813	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, Flare/Chaff Dispensers	(VTOL) 50m (STOL) 150m Primitive Runway	+2	20mm Vulcan, M-2HB (Rear), 4 Hardpoints	1000x20mm, 900x.50BMG
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

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 XF-4H-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 radiocompass, 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 it's 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. 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 shoots 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-4Ss 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 despite 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 2000 (Engine Upgrade)		JP4	16.77 tons	28.03 tons	2	35	Radar, VAS	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
F-4B	3428	686 (130)	NA 206 7/4 50/30	7518	3677	18898
F-4C	3038	609 (130)	NA 179 7/4 50/30	7518	4151	17099
F-4D	3038	548 (130)	NA 179 7/4 50/30	7518	4151	17023
F-4E/F-4EJ/Kurnass (Upgraded)	2734	493 (130)	NA 161 6/4 40/20	7548	4608	18974
F-4G	2621	473 (130)	NA 155 6/4 40/20	7548	4806	18974
F-4J	2983	538 (130)	NA 176 6/4 40/20	7548	4220	16672
F-4N	2637	476 (130)	NA 156 7/4 50/30	7257	4773	15239
F-4S	2983	538 (130)	NA 176 6/4 40/20	7548	4220	16672
FG.1 (F-4K)	3445	621 (130)	NA 203 6/4 40/30	7022	4134	18300
FGR.2 (F-4M)	3814	687 (130)	NA 225 6/4 40/30	7022	3733	18531
F-4EJ Kai	2720	491 (130)	NA 160 7/4 50/30	7548	4631	18974
F-4F	3226	582 (130)	NA 190 6/4 40/20	7548	3885	18974
F-4F (MLU)	3207	579 (130)	NA 189 6/4 40/20	7548	3908	18974
F-4F/ICE	3031	547 (130)	NA 179 6/4 40/20	7548	4135	18974
Kurnass 2000	2480	496 (130)	NA 162 6/4 40/20	7548	4561	18974
Kurnass 2000 (Engine Upgrade)	4050	730 (130)	NA 239 6/4 40/20	7548	4840	16500

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-4B	All-Weather Flight, Flare/Chaff Dispensers (10 Each), ECM (-3)	1200/800m Hardened Runway	+1	9 Hardpoints	None
F-4C	All-Weather Flight, Flare/Chaff Dispensers (10 Each), ECM (-3)	1200/800m Hardened Runway	+1	9 Hardpoints	None
F-4D	All-Weather Flight, RWR, Flare/Chaff Dispensers (10 Each), ECM (-3)	1200/800m Hardened Runway	+2	9 Hardpoints	None
F-4E/F-4EJ	All-Weather Flight, RWR, Flare/Chaff Dispensers (10 Each), ECM (-2), 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 (-7), 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 (-4), 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 (-5), 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 (-4), 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 (-4), 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 (-4), 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 (-4), 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 (-3), 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 (-5), 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
F4U-1	1262	316 (80)	NA 79 9/5 90/50	662	700	11310
F4U-1A/1C/1D	1342	336 (80)	NA 84 9/5 90/50	662	786	11250
F4U-4/4C/7	1436	359 (80)	NA 90 9/5 90/50	662	868	12649
F4U-5/5N	1512	378 (80)	NA 95 9/5 90/50	662	951	13400
AU-1	766	192 (70)	NA 48 7/4 70/40	662	748	5944

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F4U-1/1A/1D/4	None	560/500m Hardened Runway	+1	6xM-2HB, 8 Hardpoints (see text)	2350x.50BMG
F4U-1C/4C/5/5N	None	560/500m Hardened Runway	+1	4x20mm M-2 Autocannons, 8 Hardpoints (see text)	480x20mm
F-4U-2	None	560/500m Hardened Runway	+1	5xM-2HB, 8 Hardpoints (see text)	1950x.50BMG
AU-1	Armored Fuselage	560/500m Hardened Runway	+1	4x20mm M-3 Autocannons, 10 Hardpoints (see text)	924x20mm
F4U-7	None	560/500m Hardened Runway	+1	4x20mm M-3 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	$313,698	AvG	2.81 tons	9.38 tons	1	10	None	Enclosed
F-5C	$323,204	AvG	2.81 tons	9.38 tons	1	10	None	Enclosed
CF-5	$338,842	AvG	2.81 tons	9.7 tons	1	12	None	Enclosed
NF-5	$463,723	AvG	2.81 tons	9.7 tons	1	12	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
F-5A/C	2960	740 (130)	NA 185 7/3 70/30	2207	2380	15392

CF-5	3019	755 (130)	NA	189	7/3	70/30	2207	2511	15392
NF-5	3019	755 (130)	NA	189	8/4	80/40	2207	2511	15932

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-5A	None	745/900m Hardened Runway	+1	2x20mm M-39 Autocannons, 7 Hardpoints	275x20mm
F-5C	RWR	745/900m Hardened Runway	+1	2x20mm M-39 Autocannons, 7 Hardpoints	275x20mm
CF-5	RWR	595/720m Hardened Runway	+2	2x20mm M-39 Autocannons, 7 Hardpoints	275x20mm
NF-5	RWR, Flare/Chaff Dispensers	595/720m Hardened Runway	+2	2x20mm M-39 Autocannons, 7 Hardpoints	275x20mm

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	$1,023,675	AvG	3.18 tons	11.19 tons	1	14	Radar	Enclosed
Taiwanese	$1,160,781	AvG	3.18 tons	11.33 tons	1	15	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc	Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
(Both)	3994	998 (130)	NA	250 9/6 90/60	2563	1225	15789

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-5E	Flare/Chaff Dispensers, Radar Warning Receiver	615/745m Hardened Runway	+2	2x20mm M-39A2, 7 hardpoints	560x20mm
Taiwanese	Flare/Chaff Dispensers, Radar Warning Receiver, Laser Designator	615/745m Hardened Runway	+2	2x20mm M-39A2, 7 hardpoints	560x20mm

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, 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	$7,256,366	AvG	4.81 tons	33.72 tons	2	50	Radar, VAS	Shielded
F-14A (Iran)	$7,131,256	AvG	4.81 tons	33.72 tons	2	48	Radar, VAS	Shielded
F-14A+	$7,370,556	AvG	4.81 tons	34.02 tons	2	50	Radar, VAS	Shielded

F-14D	$7,980,000	AvG	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
F-14A (Both)	4941	1235 (110)	NA 309 8/5 80/50	9028	7602	16764
F-14A+	5103	1276 (110)	NA 319 8/5 80/50	9028	9079	16794
F-14D	4941	1235 (100)	NA 309 9/6 90/60	9028	12357	17679

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 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.

The F-15B is a two-seat trainer version of the F-15A.

The F-15C is the current version of the F-15 air superiority fighter. It is also a capable strike aircraft, though not so much as its cousin, the Strike Eagle. In the Israeli air force, the F-15C has a 40-to-1 kill ratio. The F-15C can carry conformal FAST packs; these packs can carry up to 3214 liters of fuel or the equivalent in sensors, ECM/IRCM devices, or reconnaissance gear.

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	$8,485,252	AvG	7.26 tons	29.94 tons	1	54	Radar	Enclosed
F-15C	$8,876,701	AvG	7.26 tons	29.94 tons	1	42	Radar	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
F-15A	5280	1320 (130)	NA 330 10/7 100/70	6776	7721	19812
F-15C	5280	1320 (130)	NA 330 10/7 100/70	7836	7721	19182

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-15A	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispenser, ECM, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, Multitarget (2)	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	940x20mm
F-15C	All-Weather Flight, Radar Warning Receiver, Flare/Chaff Dispenser, ECM, Auto Track, HUD, IR Uncage, Look-Down Radar, Track While Scan, Multitarget (2), Target ID, Deception Jamming	2800/1055m Hardened Runway	+3	20mm Vulcan, 9 Hardpoints	950x20mm

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 it’s 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 clocks 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 Sufa

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 Sufa 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 Sufa has been modified to use Israeli weapons. The Israelis have developed their own conformal fuel tanks for use with the Sufa, which hold 1730 liters each. The upgrades turn the Sufa into what some have called an "F-16C++." The Sufa 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 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	JP5	4.83 tons	17.01 tons	1	21	Radar	Shielded
F-16A (Block 15OLU)	$37,260.763	JP5	5.58 tons	17.11 tons	1	21	Radar	Shielded
F-16A (Block 15 ADF)	$35,847,998	JP5	5.58 tons	17.46 tons	1	23	Radar, WL Spotlight (Right)	Shielded
F-16A (Block 20)	$39,005,485	JP5	5.58 tons	17.82 tons	1	24	Radar	Shielded
F-16C (Block 25)	$38,317,886	JP5	5.58 tons	17.95 tons	1	27	Radar	Shielded
F-16C (Block 30)	$40,154,197	JP5	5.58 tons	18.11 tons	1	28	Radar	Shielded
F-16C (Block 32)	$40,121,060	JP5	5.58 tons	18.03 tons	1	28	Radar	Shielded
F-16C (Block 40)	$41,101,477	JP5	5.58 tons	18.44 tons	1	28	Radar, FLIR	Shielded
F-16C (Block 42)	$42,048,757	JP5	5.58 tons	18.52 tons	1	28	Radar, FLIR	Shielded
F-16C (Block 50)	$42,064,128	JP5	5.58 tons	18.52 tons	1	29	Radar, FLIR	Shielded
F-16C (Block 52)	$42,020,093	JP5	5.58 tons	18.44 tons	1	29	Radar, FLIR	Shielded

F-16CJ (Block 50D)	$50,940,670	JP5	5.58 tons	18.87 tons	1	33	Radar, FLIR	Shielded
F-16CJ (Block 52D)	$50,896,634	JP5	5.58 tons	18.75 tons	1	33	Radar, FLIR	Shielded
F-16C (Block 50+)	$42,274,449	JP5	5.58 tons	18.61 tons	1	29	Radar, FLIR	Shielded
F-16C (Block 52+)	$42,230,193	JP5	5.58 tons	18.53 tons	1	29	Radar, FLIR	Shielded
F-16E (Block 60)	$42,025,945	JP5	5.58 tons	18.61 tons	1	29	Radar, FLIR	Shielded
F-16I Sufi	$55,502,105	JP5	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
F-16A (Blocks 1-15)	4409	2402 (120)	NA 179 10/5 100/50	3160	2410	15240
F-16A (Block 15 OLU)	4364	2386 (115)	NA 177 10/4 100/40	3160	2434	15240
F-16A (Block 15 ADF)	4924	2434 (115)	NA 169 10/4 100/40	3160	2473	15240
F-16A (Block 20)	4211	2294 (115)	NA 170 10/4 100/40	3160	2526	15240
F-16C (Block 25)	4620	2517 (110)	NA 188 10/6 100/60	3160	2526	16764
F-16C (Block 30)	4700	2560 (110)	NA 150 (164) 10/6 100/60	3160	2412	16764
F-16C (Block 32)	4602	2407 (110)	NA 187 (307) 10/6 100/60	3160	2536	16764
F-16C (Block 40)	4615	2513 (110)	NA 148 (189) 10/6 100/60	3160	2455	16764
F-16C (Block 42)	4505	2356 (110)	NA 183 (232) 10/6 100/60	3160	2589	16764
F-16C (Block 50)	4521	2444 (110)	NA 148 (243) 10/6 100/60	3160	2406	16764
F-16C (Block 52)	4633	2504 (110)	NA 147 (189) 10/6 100/60	3160	2465	16764
F-16CJ (Block 50D)	4435	2397 (120)	NA 180 (229) 10/6 100/60	3160	2452	16764
F-16CJ (Block 52D)	4554	2461 (120)	NA 148 (330) 10/6 100/60	3160	2507	16764
F-16C (Block 50+)	4498	2432 (110)	NA 182 10/6 100/60	3160	2418	16764
F-16C (Block 52+)	4610	2491 (110)	NA 151 10/6 100/60	3160	2477	16764
F-16E (Block 60)	4521	2444 (110)	NA 183 10/6 100/60	3160	2406	16764
F-16I Sufi	4517	2383 (100)	NA 183 9/5 90/50	3160	2579	16764

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 (-2), 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 (-2), 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 (-2), 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 (-2), 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 (-2), 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 (-4), ECCM (+3), IRCM (-4)	800/530m Hardened Runway	+4	20mm Vulcan, 11 Hardpoints	515x20mm
F-16C (Block 30/32)	Flare/Chaff Dispensers (64 Each), RWR, Auto Track, HUD Interface, IR Uncage, Look-Down Radar, ECM (-5), ECCM	800/530m Hardened Runway	+4	20mm Vulcan, 11 Hardpoints	515x20mm

	(+5), IRCM (-5)				
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 (-5), ECCM (+1) IRCM (-5), 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 (-8), ECCM (+4) IRCM (-7), 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 (-9), ECCM (+7) IRCM (-8), 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 (-11), ECCM (+8) IRCM (-9), Laser Designator	750/500m Hardened Runway	+5	20mm Vulcan, 11 Hardpoints	515x20mm

F-20 Tigershark

Notes: This was the ultimate evolution of the F-5E Tiger. The Tigershark is a Tiger with a more powerful engine, combat slats, added fuel, and extra avionics. It was a relatively cheap way for many poorer countries to equip themselves with a reasonably modern aircraft. The two wingtip hardpoints may only be used for air-to-air missiles or drop tanks.

Twilight 2000 Notes: production of this aircraft commenced shortly before the Twilight War to equip the air forces of many Third World and some First World countries (such as Taiwan). Production continued during the Twilight War, and many of these aircraft were sent to US Air National Guard units to quickly beef up numbers and replace combat losses.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$2,200,738	AvG	3.63 tons	11.93 tons	1	24	Radar	Enclosed

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
5145	1286 (110)	NA 322 10/6 100/60	2563	4045	16764

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
Auto Track, HUD Interface, All Weather Flight, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Radar Warning Receiver, Flare/Chaff Dispensers	550/700m Hardened Runway	+3	2x20mm M-39 Autocannons, 7 Hardpoints	560x20mm

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, included 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
$16,181,585	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
6960*	1160 (95)	NA 290 11/8 110/80	15350	21038	19812

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, Multitarget (4), Laser Designator	1150/1450m Hardened Runway	+5	20mm Vulcan Autocannon, 6 Weapon Bays, 4 Hardpoints	950x20mm

*The Raptor is supercruise capable.

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 1947, 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 advance 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.

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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 M-3 versions of the M-2HB, 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-96, 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 othe radar range. At first, the .50 M-3s 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 M-24A1s (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 effecting 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 M-3s 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 (M-39) 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 MiGs, 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 M-3 machineguns, but these were later replaced with 20mm Cannon with the -5s (T-160s or M-39s, 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 it's 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 M-3 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 it's origin is is unknown.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
P-86A	$314,151	JP4	806 kg	6.4 tons	1	9	None	Enclosed
F-86A (Early)	$434,031	JP4	806 kg	6.4 tons	1	10	None	Enclosed
F-86A (Mid)	$491,751	JP4	806 kg	6.4 tons	1	10	Radar Gunsight	Enclosed
F-86A (Late)	$283,519	JP4	806 kg	6.4 tons	1	10	Radar Gunsight	Enclosed
RF-86A (Early)	$442,390	JP4	806 kg	5.78 tons	1	12	None	Enclosed
RF-86A (Late)	$427,747	JP4	805 kg	5.47 tons	1	12	Radar Gunsight	Enclosed
F-86D (Early)	$4,004,974	JP4	813 kg	8.24 tons	1	13	Radar Gunsight, Radar (30 km)	Enclosed
F-86D (Late)	$3,473,498	JP4	813 kg	8.24 tons	1	13	Radar Gunsight, Radar (30 km)	Enclosed
F-86E	$325,698	JP4	800 kg	6.61 tons	1	12	Radar Gunsight	Enclosed
F-86F (Early)	$415,708	JP4	800 kg	6.61 tons	1	12	Radar Gunsight	Enclosed
F-86F (Late)	$654,066	JP4	2.42 tons	6.61 tons	1	13	Radar Gunsight	Enclosed
F-86F Gunval	$634,018	JP4	2.42 tons	6.61 tons	1	13	Radar Gunsight	Enclosed
F-86F-40	$787.779	JP4	1.31 tons	6.89 tons	1	12	Radar Gunsight	Enclosed
TF-86F	$715,858	JP4	2.34 tons	6.67 tons	1	13	Radar Gunsight	Enclosed
F-86H (Early)	$773,416	JP4	4.74 tons	6.9 tons	1	14	Radar Gunsight	Enclosed
F-86H (Late)	$867,200	JP4	4.74 tons	6.9 tons	1	14	Radar Gunsight	Enclosed
F-886K	$4,321,334	JP4	1.78 tons	7.46 tons	1	14	Radar Gunsight, Radar (30 km)	Enclosed
F-86L	$3,940,604	JP4	1.62 tons	8.24 tons	1	14	Radar Gunsight, Radar (40 km)	Enclosed
FJ-1 Fury	$75,686	JP5	Nil	6.86 tons	1	8	None	Enclosed
FJ-2 Fury	$346,691	JP5	800 kg	6.61 kg	1	12	Radar Gunsight	Enclosed
FJ-3 Fury	$734,690	JP5	1.82 tons	7.11 tons	1	12	Radar Gunsight	Enclosed
FJ-4 Fury	$734,690	JP5	1.36 tons	10.75 tons	1	12	Radar Gunsight	Enclosed
FJ-4B Fury	$735,779	JP5	2.72 tons	12.25 tons	1	14	Radar Gunsight	Enclosed
CL-13 Sabre Mk 3	$398,296	JP4	800 kg	6.61 kg	1	12	Radar Gunsight	Enclosed
CL-13A Sabre Mk 5	$418,586	JP4	1.08 tons	6.64 tons	1	12	Radar Gunsight	Enclosed
CL-13B Sabre Mk 6	$431,130	JP4	1.08 tons	6.64 tons	1	12	Radar Gunsight	Enclosed
Commonwealth CA-27	$821,527	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
P-86A	912	365 (90)	NA	87	8/4 80/40	1647	1039	14630
F-86A (Early)	992	397 (80)	NA	95	7/4 70/40	1647	1057	14630
F-86A (Mid)	959	384 (80)	NA	92	7/4 70/40	1647	1021	14630
F-86A (Late)	965	386 (80)	NA	93	7/4 70/40	1647	1027	14630
RF-86A (Early)	1120	520 (80)	NA	108	7/4 70/40	1647	1081	14630
RF-86A (Late)	1133	525 (80)	NA	110	7/4 70/40	1647	1036	14630
F-86D (Early)	754	350 (80)	NA	73	7/4 70/40	2556	1024	15118
F-86D (Late)	821	380 (80)	NA	79	7/4 70/40	2556	1118	15118
F-86E	1000	465 (75)	NA	97	7/3 70/35	1647	1100	14387
F-86F (Early)	1072	495 (75)	NA	104	7/3 70/35	1647	1064	14387
F-86F (Late)/Gunval	1072	495 (70)	NA	104	6/3 60/30	1893	1064	14387
F-86F-40	1030	475 (60)	NA	101	5/3 50/25	1893	1064	14387
TF-40F	1063	490 (90)	NA	104	6/4 60/30	2893	3986	15387
F-86H (Early)	1113	513 (70)	NA	109	6/3 60/40	2128	1786	15607
F-86H (Late)	1113	513 (60)	NA	109	5/3 50/25	2128	1786	15607
F-86K	1325	611 (60)	NA	130	5/3 50/25	2128	1710	15119
F-86L	821	380 (60)	NA	79	5/3 50/25	2556	1118	14387
FJ-1 Fury	720	335 (80)	NA	80	8/4 80/40	1760	806	9754
FJ-2 Fury	1068	495 (75)	NA	119	7/3 70/35	1647	1178	14387
FJ-3 Fury	1096	508 (60)	NA	122	5/3 50/25	2120	1520	15120
FJ-4 Fury	1095	508 (60)	NA	122	5/3 50/25	3816	1520	15120
FJ-4B Fury	1011	469 (60)	NA	113	5/3 50/25	3816	1520	15120
CL-13 Sabre Mk 3	1034	479 (75)	NA	116	7/3 70/35	1647	1178	14398
CL-13A Sabre Mk 5	1110	514 (75)	NA	125	8/4 80/40	1647	1265	15240
CL-13B Sabre Mk 6	1144	530 (60)	NA	129	5/3 50/25	1647	1457	15240
Commonwealth CA-27	1127	522 (60)	NA	127	5/3 50/25	1920		

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-86A	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	0	6xM-3, Two Hardpoints	1800x.50
F-86A (Early/Mid)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+1	6xM-3, Two Hardpoints	1800x.50
F-86A (Late)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+2	6xM-3, Two Hardpoints	1800x.50
RF-86A (Early)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+1	4xM-3, Two Hardpoints	1200x.50
RF-86A (Late)	IFF, Long-Range Radio, Radar Compass	740/430m Hardened Runway	+2	2xM-3, 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	740/450m Hardened Runway	+2	6xM-3, Two Hardpoints	1800x.50

	Compass					
F-86F (Late)	IFF, Long-Range Radio, Radar Compass	740/450m	Hardened Runway	+2	6xM-3, 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 Radio, Radar Compass	740/450m	Hardened Runway	+2	6xM-3, Six Hardpoints	1800x.50
TF-86F	IFF, Long-Range Radio, Radar Compass	740/450m	Hardened Runway	+2	2xM-3, 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 (-1), ECCM (-1)	700/400m	Hardened Runway	+2	4xHS-404 20mm Cannons, Six Hardpoints	540x20mm
F-86L	IFF, Long-Range Radio, Radar Compass, ECM (-1), 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	6xM-3, 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	6xM-3, Four Hardpoints	1800x.50
CL-13B Sabre Mk 6	IFF, Long-Range Radio, Radar Compass	700/400m	Hardened Runway	+2	6xM-3, Four Hardpoints	1800x.50
Commonwealth CA-27	IFF, Long-Range Radio, Radar Compass	700/400m	Hardened Runway	+2	2c30mm Aden Autocannons, Six Hardpoints	400x30mm

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-86A	$257,768	AvG	907 kg	6.4 tons	1	8	None	Enclosed
F-86D/L	$545,857	AvG	907 kg	9.1 tons	1	12	Radar	Enclosed
F-86E	$252,683	AvG	907 kg	7.41 tons	1	8	None	Enclosed
F-86F	$264,618	AvG	907 kg	7.41 tons	1	8	None	Enclosed
F-86F-40	$283,519	AvG	1.81 tons	7.42 tons	1	8	None	Enclosed
F-86H	$298,937	AvG	1.99 tons	11.02 tons	1	10	None	Enclosed
F-86K	$379,363	AvG	1.81 tons	9.15 tons	1	12	None	Enclosed
FJ-2	$262,951	AvG	907 kg	7.41 tons	1	8	None	Enclosed
FJ-3	$332,029	AvG	1.36 tons	9.54 tons	1	12	None	Enclosed
FJ-4	$332,977	AvG	1.36 tons	10.75 tons	1	12	None	Enclosed
FJ-4B	$415,708	AvG	2.72 tons	12.7 tons	1	12	None	Enclosed
CL-13 Mk 5	$271,719	AvG	907 kg	8.02 tons	1	10	None	Enclosed
CL-13 Mk 6	$287,421	AvG	907 kg	7.72 tons	1	10	None	Enclosed
CA-27	$288,060	AvG	1.18 tons	8.46 tons	1	12	None	Enclosed

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
F-86A/E	2173	543 (100)	NA 136 8/4 80/40	1647	2323	14630
F-86D/L	2218	887 (100)	NA 222 8/4 80/40	2309	2327	15118
F-86F	2202	550 (100)	NA 138 8/4 80/40	1647	2631	15118
F-86-40/FJ-2	2202	550 (90)	NA 138 9/5 90/45	1637	2631	15118
F-86H	2214	554 (90)	NA 138 9/5 90/45	2127	2780	15484
F-86K	2214	554 (90)	NA 138 9/5 90/45	2309	2327	15118
FJ-3	2179	545 (90)	NA 136 9/5 90/50	1647	3409	15118
FJ-4/4B	2176	544 (90)	NA 136 9/5 90/50	2471	3432	15118
CL-13 Mk 5	2398	600 (90)	NA 150 8/4 80/40	1647	2821	14630
CL-13 Mk 6	2272	568 (90)	NA 142 9/5 90/50	1647	3241	16764
CA-27	2240	560 (90)	NA 140 9/5 90/50	1601	3342	16764

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-86A/E/F/CL-13	None	700/430m Hardened Runway	+1	6xM-2HB, 2 Hardpoints	1800x.50BMG
F-86D/L	None	700/430m Hardened Runway	+2	24xFFAR Rockets, 4 Hardpoints	None
F-86F	None	700/430m Hardened Runway	+1	6xM-2HB, 4 Hardpoints	1800x.50BMG
F-86H	None	700/430m Hardened Runway	+2	4x20mm T-160 Autocannons, 4 Hardpoints	800x20mm
F-86K	None	700/430m Hardened Runway	+2	4x20mm M-24 Autocannons, 4 Hardpoints	496x20mm
FJ-2	None	700/430m Hardened Runway	+1	4x20mm Mk 12 Autocannons, 2 Hardpoints	600x20mm
FJ-3/4/4B	None	700/430m Hardened Runway	+1	4x20mm Mk 12 Autocannons, 6 Hardpoints	600x20mm
CA-27	None	700/430m Hardened Runway	+1	2x30mm Aden Autocannons, 4 Hardpoints	324x30mm

F-100D 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. 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	AvG	907 kg	11.34 tons	1	14	None	Enclosed
F-100C	$415,994	AvG	2.27 tons	14.79 tons	1	16	None	Enclosed
F-100D	$493,139	AvG	3.19 tons	15.8 tons	1	16	None	Enclosed
F-100F	$507,912	AvG	2.27 tons	17.75 tons	2	18	None	Enclosed

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

F-100A	2726	682 (130)	NA	170	7/4	70/40	4898	4326	15545
F-100C	2957	739 (130)	NA	185	7/4	70/40	6442	4549	14966
F-100D	2765	691 (120)	NA	173	8/5	80/50	6583	4549	15240
F-100F	2765	691 (120)	NA	173	8/5	80/50	4898	4549	15240

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-100A	RWR	1200/1000m Hardened Runway	+2	4x20mm M-39 Autocannons, 2 Hardpoints	800x20mm
F-100C/D	RWR	1200/1000m Hardened Runway	+2	4x20mm M-39 autocannons, 7 Hardpoints	800x20mm
F-100F	RWR	1200/1000m Hardened Runway	+2	2x20mm M-39 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	JP5	2.18 tons	8.16 tons	1	16	Radar	Enclosed
F-104A	$14,602,222	JP5	2.18 tons	8.16 tons	1	18	Radar	Enclosed
F-104B	$14,600,786	JP5	2 tons	8.08 tons	2	18	Radar	Enclosed
F-104C (Early)	$6,315,983	JP5	3.04 tons	8.83 tons	1	18	Radar, FLIR	Enclosed
F-104C (Late)	$8,609,749	JP5	3.04 tons	8.83 tons	1	20	Radar, FLIR	Enclosed
F-104D (Early)	$6,245,877	JP5	2.79 tons	8.74 tons	2	20	Radar, FLIR	Enclosed
F-104D (Late)	$8,539,643	JP5	2.79 tons	8.74 tons	2	22	Radar, FLIR	Enclosed
F-104G	$10,026,991	JP5	3.01 tons	9.36 tons	1	23	Radar, FLIR	Enclosed
RF-104G	$12,816,743	JP5	3.01 tons	8.67 tons	1	24	Radar, FLIR	Enclosed
TF-104G	$9,956,742	JP5	3.01 tons	9.01 tons	2	23	Radar, FLIR	Enclosed
CF-104 (Early)	$10,147,129	JP5	3.22 tons	9.58 tons	1	25	Radar, FLIR, VAS	Enclosed

CF-104 (Late)	$11,061,929	JP5	3.22 tons	9.58 tons	1	26	Radar, FLIR, VAS	Enclosed
CF-104D (Early)	$10,077,023	JP5	3.22 tons	8.96 tons	2	26	Radar, FLIR, VAS	Enclosed
CF-104D (Late)	$10,991,823	JP5	3.22 tons	8.96 tons	2	26	Radar, FLIR, VAS	Enclosed
F-104J	$14,260,364	JP5	2.81 tons	9.57 tons	1	26	Radar, FLIR	Enclosed
F-104DJ	$14,190,258	JP5	2.41 tons	9.22 tons	2	27	Radar, FLIR	Enclosed
F-104G (Danish)	$9,924,037	JP5	2.73 tons	10.46 tons	1	28	Radar, FLIR	Enclosed
TF-104G (Danish)	$9,853,931	JP5	2.33 tons	10.11 tons	2	29	Radar, FLIR	Enclosed
F-104S	$13,803,889	JP5	3.4 tons	9.83 tons	1	32	Radar, SLAR, FLIR, Weather Radar	Enclosed
F-104S ASA	$14,314,629	JP5	3.29 tons	9.94 tons	1	33	Radar, SLAR, FLIR, Weather Radar	Enclosed
F-104S ASA-M	$10,011,928	JP5	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
YF-104A	4144	1885 (198)	NA 482	4/2 40/20	3396	2913	16825
F-104A	4153	1929 (198)	NA 482	4/2 40/20	3396	2920	16825
F-104B	4195	1948 (198)	NA 487	4/2 40/20	2847	2881	17678
F-104C	5543	2573 (167)	NA 643	5/3 50/30	3017	2895	17678
F-104D	5599	2599 (167)	NA 649	5/3 50/30	2529	2866	17678
F-104G	5847	2720 (216)	NA 670	6/4 60/40	3396	2909	15240
RF-104G	6312	2938 (216)	NA 724	6/4 60/40	3396	2704	15240
TF-104G	6081	3055 (216)	NA 697	6/4 60/40	2847	2793	15240
CF-104	5730	2993 (216)	NA 657	6/4 60/40	3396	2967	15240
CF-104D	6171	3223 (216)	NA 708	6/4 60/40	2847	2753	15240
F-104J	5718	2660 (216)	NA 655	6/4 60/40	3396	2973	15240
F-104DJ	5506	2562 (216)	NA 631	6/4 60/40	2847	3803	15240
F-104G (Danish)	5525	2570 (216)	NA 633	6/4 60/40	3396	3084	15240
TF-104G (Danish)	5691	2647 (216)	NA 652	6/4 60/40	2847	2992	15240
F-104S	5935	2761 (192)	NA 714	6/3 60/30	3896	2952	17678
F-104S ASA	5870	2731 (192)	NA 706	6/3 60/30	3896	2984	17678
F-104S ASA-M	5987	2786 (188)	NA 720	7/4 70/40	3896	2981	17678

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 (-2), ECCM (+2), 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 (-2), ECCM (+2), Auto Track	2500/1350m Hardened Runway	+1	7 Hardpoints**	None
F-104G	IFF, RWR, Flares (14), Chaff (14), ECM (-3), ECCM (+2),	2700/1400m Hardened Runway	+3	20mm M-61A1 Vulcan, 7 Hardpoints*	725x20mm

	Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR				
RF-104G	IFF, RWR, Flares (14), Chaff (14), ECM (-3), ECCM (+2), Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation, TFR, 3 Cameras	2700/1400m Hardened Runway	+3	7 Hardpoints*	None
TF-104G	IFF, RWR, Flares (14), Chaff (14), ECM (-3), ECCM (+2), 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 (-3), ECCM (+4), 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 (-3), ECCM (+4), Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, 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 (-3), ECCM (+4), 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 (-3), ECCM (+4), 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 (-4), ECCM (+3), 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 (-2), ECCM (+2), Auto Track, IR Uncage, Look-Down Radar, Track While Scan, Target ID, Secure Radios, Inertial Navigation,	2700/1400m Hardened Runway	+3***	7 Hardpoints*	None

	Multitarget (2)				
F-104G (Danish)	IFF, RWR, Flares (14), Chaff (18), ECM (-5), ECCM (+4), IRCM (-3), 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 (-5), ECCM (+4), IRCM (-3), 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	7 Hardpoints*	None
F-104S	IFF, RWR, All-Weather Combat, Flares (14), Chaff (14), ECM (-3), ECCM (+3), IRCM (-3) 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 (-4), ECCM (+4), IRCM (-4), 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 (-5), ECCM (+5), IRCM (-5), 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	AvG	7.71 tons	25.4 tons	1	38	Radar	Enclosed
F/A-18C (Early)	$6,030,424	AvG	7.71 tons	25.4 tons	1	38	Radar	Enclosed
F/A-18C (Late)	$6,106,464	AvG	7.71 tons	25.4 tons	1	40	Radar	Enclosed
CF-18	$5,686,028	AvG	7.71 tons	25.4 tons	1	38	Radar, WL Spotlight	Enclosed
F/A-18E	$7,068,935	AvG	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
F/A-18A/C (Early)/CF-18	3808	952 (100)	NA 238 9/5 90/50	6322	6093	15240
F/A-18C (Late)	4029	1007 (100)	NA 252 9/5 90/50	6322	8910	15240
F/A-18E	3830	958 (95)	NA 239 10/6 100/60	8228	11271	15240

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	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	615/745m Hardened Runway	+5	20mm Vulcan, 11 Hardpoints	500x20mm

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 20mm, 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
P-38/A/D	1300	325 (100)	NA 81 70/40	1476	403	11887
P-38D	1300	325 (100)	NA 81 70/40	1287	403	11887
P-38E/F	1317	329 (100)	NA 83 70/40	1287	403	11887
P-38G	1333	334 (100)	NA 83 70/40	1287	479	11887
P-38H	1340	335 (100)	NA 84 70/40	1287	517	11887
P-38J/J Droop Snoot/Mickey	1400	350 (100)	NA 88 70/40	1703	583	13411
P-38J-25	1400	350 (95)	NA 88 75/45	1703	583	13411
P-38L/L Droop Snoot/Mickey	1380	345 (95)	NA 86 75/45	1703	603	13411
P-38M	1354	339 (95)	NA 85 75/45	1703	603	13411
Lightning I	1333	333 (100)	NA	1476	351	8520

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-38/Lightning I	None	555/670m Hardened Runway	+1	2xM-2HB, 4xM-1919A4, 37mm Oldsmobile autocannon	400x.50, 2000x.30, 15x37mm
P-38A	None	555/670m Hardened Runway	+1	4xM-2HB, 37mm Oldsmobile autocannon	1600x.50, 15x37mm
P-38D	Armored Fuselage	555/670m Hardened Runway	+1	4xM-2HB, 37mm Oldsmobile autocannon	1600x.50, 15x37mm
P-38E	Armored Fuselage	555/670m Hardened Runway	+1	4xM-2HB, 20mm Hispano-Suiza M-1 Autocannon, 2 Hardpoints	1600x.50, 150x20mm
P-38F	Armored Fuselage	555/670m Hardened Runway	+1	4xM-2HB, 20mm Hispano-Suiza M-1 Autocannon, 2 Hardpoints	2000x.50, 150x20mm
P-38G	Armored Fuselage	555/670m Hardened Runway	+1	4xM-2HB, 20mm Hispano-Suiza M-1 Autocannon, 6 Hardpoints	2000x.50, 150x20mm
P-38H/J/L	Armored Fuselage	555/670m Hardened Runway	+1	4xM-2HB, 20mm Hispano-Suiza M-2C Autocannon, 6 Hardpoints	2000x.50, 150x20mm
P-38J/L Droop Snoot	Armored Fuselage	555/670m Hardened Runway	+1	6 Hardpoints	None
P-38J/L Mickey	Armored Fuselage	555/670m Hardened Runway	+2 (Bombing Only); +1 (Rockets)	6 Hardpoints	None
P-38M	Armored Fuselage	555/670m Hardened Runway	+2	4xM-2HB, 20mm Hispano-Suiza M-2C Autocannon, 6 Hardpoints	2000x.50, 150x20mm

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 Kittlyhawk 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
P-40	1094	274 (90)	NA 68 8/5 80/50	602	430	9145
P-40B	1126	281 (90)	NA 70 8/5 80/50	602	430	9876
P-40C	1104	276 (90)	NA 69 8/5 80/50	507	430	8992
P-40D	1104	276 (90)	NA 69 8/5 80/50	507	424	8992
P-40E	1158	290 (90)	NA 72 8/5 80/50	507	424	8992
P-40F	1165	291 (90)	NA 73 8/5 80/50	507	479	10485
P-40K	1158	290 (90)	NA 72 8/5 80/50	507	489	10485
P-40L	1178	294 (90)	NA 74 8/5 80/50	390	479	10485
P-40N	1210	302 (90)	NA 76 8/5 80/50	462	442	11582

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-40	None	500/400m Primitive Runway	+1	2xM-2HB, 2xM-1919A4,2 Hardpoints	600x.50, 1000x.30-06
P-40B	None	500/400m Primitive Runway	+1	2xM-2HB, 4xM-1919A4, 2 Hardpoints	600x.50, 2000x.30-06
P-40C	None	500/400m Primitive Runway	+1	2xM-2HB, 4xM-1919A4, 3 Hardpoints	600x.50, 2000x.30-06
P-40D	Armored Cockpit	500/400m Primitive Runway	+1	2xM-2HB, 3 Hardpoints	1800x.50
P-40E/F/K	Armored Cockpit	500/400m Primitive Runway	+1	6xM-2HB, 3 Hardpoints	1800x.50
P-40L	None	500/400m Primitive Runway	+1	6xM-2HB, 3 Hardpoints	1206x.50
P-40N	Armored Cockpit	500/400m Primitive Runway	+1	4xM-2HB, 3 Hardpoints	1200x.50

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 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
P-47C	1386	346 (105)	NA 87 8/5 80/50	646	741	12802
P-47D	1373	343 (105)	NA 86 8/5 80/50	646	741	12192
P-47N	1472	368 (105)	NA 92 8/5 80/50	1350	918	12192

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-47C	Armored Fuselage	600/500m Hardened Runway	+1	6xM-2HB, 1 Hardpoint	2550x.50
P-47D	Armored Fuselage	600/500m Hardened Runway	+1	8xM-2HB, 12 Hardpoints (see text)	3400x.50
P-47N	Armored Fuselage	700/600m Hardened Runway	+1	8xM-2HB, 12 Hardpoints (see text)	3400x.50

P-51D Mustang

Notes: The P-51D 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
P-51	1206	302 (110)	NA 75 10/6 100/60	965	405	12800
P-51A	1309	328 (110)	NA 82 10/6 100/60	965	442	9555

P-51B	1408	352 (110)	NA	88	10/6	100/60	965	599	12802
P-51C	1392	348 (110)	NA	87	10/6	100/60	965	580	12771
P-51D	1398	350 (110)	NA	87	10/6	100/60	965	580	12771
P-51H	1558	390 (110)	NA	97	10/6	100/60	965	509	12680
A-36A	1139	285 (100)	NA	71	10/6	100/60	965	489	7650

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
P-51	None	500/400m Hardened Runway	+1	4xM-2HB, 4xM-1919A4, 2 Hardpoints	1260x.50, 1850x.30-06
P-51A/B/C	None	500/400m Hardened Runway	+1	4xM-2HB, 2 Hardpoints	1260x.50
P-51D	None	500/400m Hardened Runway	+1	6xM-2HB, 2 Hardpoints	1880x.50
A-36A	Armored Cockpit	500/400m Hardened Runway	+1	6xM-2HB, 2 Hardpoints	1880x.50

B-1B Lancer

Notes: This heavy bomber was originally designed in the mid-1970s to replace the B-52 in the long-range bombing role. Rapidly escalating costs eventually led to its cancellation under the Carter administration, but the program was reinstated under the subsequent Reagan presidency, where more development was done that led to the B-1B variant. Later, the Lancer was modified for use with conventional weapons; previously, the B-1B was capable of delivering only cruise missiles and nuclear-equipped SRAMs. The B-1B has stealth characteristics; it was not designed for stealth deliberately, but is rather a consequence of its design that it presents a radar-cross-section only 1% of the size of the B-52 it was designed to replace. Detection or guidance attempts by radar are one level more difficult than normal. In addition to a large amount of chaff bundles and flares, the B-1B carries 10 chaff rockets; these are fired from the aircraft and spread chaff behind them for a distance of 9 kilometers. They have the equivalent of three ECM devices and two IRCM devices to jam a wide range of transmissions and emissions.

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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$76,972,805	AvG	34.02 tons	216.37 tons	4	58	Radar, SLAR, RLR, FLIR, LIDAR, Image Intensification	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
2648	662 (130)	NA 166 5/3 50/30	130000	21604	15250

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
All-Weather Flight, Flare/Chaff Dispensers (50), Chaff Rockets (10), ECM, IRCM, IR Suppression, Deception Jamming, Active Jamming, Terrain-Following Radar, Track While Scan, Laser Designator, Inertial Navigation, GPS, Radar Warning Receiver, Secure Radios, Satcom Radio, Target ID, Look-Down Radar, Synthetic Aperture Radar	1800/2200m Hardened Runway	+4	3 Bomb Bays, 20mm Vulcan (Rear)	2000x20mm

B-2 Spirit

Research on this aircraft began in the late 1970s, but its existence was not confirmed until the late 1990s (except for President' Carter's slip of the tongue). They take a different approach to stealth than the F-117A Nighthawk, using a totally smooth and rounded design with almost no protruding surfaces to reflect radar. In addition, the exhaust is routed through cooling channels and thermal bricks to drastically lower the IR signature. This means that whether the enemy is trying to detect the B-2 or trying to guide a weapon to the B-2 by radar, the attempt is four levels more difficult than it would be against a conventional aircraft. If using IR means, the attempts are 3 levels harder than normal. These attempts are two levels easier in any phase that the B-2's bomb bay doors are open. In addition, the B-2 is liberally equipped with ECM, IRCM, DJM, and AJM features that make the aircraft even more difficult to detect and intercept. 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. 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.

Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
$181,050,240	AvG	18.14 tons	152.64 tons	2	47	Radar, SLAR, RLR, FLIR, LIDAR, Image Intensification	Shielded

Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
1528	382 (140)	NA 96 4/2 40/20	93000	31388	16000

Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo

All-Weather Flight, Flare/Chaff Dispensers (60), Chaff rockets (12), ECM, IRCM, Deception Jamming, Active Jamming, Terrain-Following Radar, Track While Scan, Laser Designator, Inertial Navigation, GPS, Radar Warning Receiver, Secure Radios, Satcom Radio, Target ID, Look-Down Radar, Synthetic Aperture Radar	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 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 surface, 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-52J", 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-52K."

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, Radar, Bombing Radar	Shielded
B-52B	$186,844.635	JP5	20.57 tons	200.89 tons	6+1	176	Weather Radar, Radar, Tail Radar, Bombing Radar	Shielded
RB-52B	$1,265,960,000	JP5	2.57 tons	45.44 tons	8+1	186	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar	Shielded
B-52C	$187,226,535	JP5	20.57 tons	200.89 tons	6+1	176	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar	Shielded
B-52D	$166,228,788	JP5	20.57 tons	200.89 tons	6+1	180	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar	Shielded
B-52D (Big Belly)	$182,851,667	JP5	26.79 tons	207.11 tons	6+1	186	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar	Shielded
B-52E	$232,960,809	JP5	19.2 tons	200.89 tons	6+1	181	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar	Shielded
B-52F	$286,089,129	JP5	22.32 tons	217.68 tons	6+1	124	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran	Shielded
B-52G	$211,325.360	JP5	22.32 tons	217.68 tons	6+1	124	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran	Shielded
B-52H	$247,281,408	JP5	22.32 tons	217.68 tons	6+1	125	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded
B-52H-1	$231,749,000	JP6	22.32 tons	217.68 tons	6+1	130	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FIR	Shielded
B-52H-2	$292,749,000	JP6	22.32 tons	217.68 tons	6+1	132	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded
B-52H-3	$492,189,088	JP6	22.32 tons	217.68 tons	6+1	135	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded
B-52H-4	$448,399,872	JP6	22.32 tons	217.68 tons	6+1	136	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded
B-52H-5	$457,750,528	JP6	22.32 tons	216.02 tons	5+1	138	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded
B-52H-6	$683,145,600	JP6	22.32 tons	216.02 tons	5+1	140	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded
YB-52J	$798,529,728	JP-6	20.09 tons	221.41 tons	6+1	153	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded
YB-52K	$683,187,264	JP-6	22.32 tons	211.73 tons	6+1	140	Weather Radar, Radar, Tail Radar, Bombing/Mapping Radar, Doppler Radar, Loran, Advanced FLIR	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
B-52A	1960	914 (169)	NA 122 4/2 60/50	134761	7316	15420

B-52B	1838	857 (169)	NA	114	4/2	60/50	134761	9857	14417
RB-52B	1838	857 (169)	NA	114	4/2	60/50	134761	9857	14417
B-52C	1894	942 (169)	NA	125	4/2	60/50	135139	9857	13960
B-52D	1894	942 (169)	NA	125	4/2	60/50	135139	9857	13960
B-52D (Big Belly)	1879	934 (169)	NA	124	4/2	60/50	135139	9936	13960
B-52E	1894	942 (169)	NA	125	4/2	60/50	135139	9857	14082
B-52F	1894	942 (169)	NA	130	4/2	60/50	157295	9857	14234
B-52G	1974	982 (169)	NA	135	4/2	60/50	181853	10277	14326
B-52H/B-52H-1	1992	920 (170)	NA	127	5/2	70/40	1133481	12291	14539
B-52H-2/3/4	2070	1992 (160)	NA	175	5/2	70/40	1133481	12291	14539
B-52H-5/6	2091	2012 (155)	NA	177	5/2	70/40	1133481	11062	14539
YB-52J	2039	1962 (140)	NA	173	6/4	80/35	1133481	11339	14539
YB-52K	2099	2020 (160)	NA	178	5/2	70/40	1133481	10620	15993

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	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, 563 Flares), RWR, ECM (-5), 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, 563 Flares), RWR, ECM (-6), 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, 563 Flares), RWR, ECM (-7), ECCM (+6), 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, 580 Flares), RWR, ECM (-8), ECCM (+6), Radio Jamming (1 Level), 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, 600 Flares), 10 Chaff Rockets, RWR, ECM (-8), ECCM (+7), Radio Jamming (1 Level), 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, 600 Flares), 10 Chaff Rockets, RWR, ECM (-8), ECCM (+7), Radio Jamming (1	2200/2600m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	20mm M-61 Vulcan, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double	1242x20mm

	Level), Magnetic Compass, Gyrocompass, Secure Radios, VLF/LR Radios Secure Radios, TFR, Inertial Navigation			Bomb Bay	
B-52H-1/2/3/4	All Weather Flight, Flare/Chaff Dispensers (75 Chaff, 600 Flares), 10 Chaff Rockets, RWR, ECM (-8), ECCM (+7), Radio Jamming (1 Level), Magnetic Compass, Gyrocompass, Secure Radios, TFR, Inertial Navigation, GPA	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, 600 Flares), 10 Chaff Rockets, RWR, ECM (-9), ECCM (+8), Radio Jamming (1 Level), Magnetic Compass, Gyrocompass, Secure Radios, VLF/LR Radios Secure Radios, TFR, LRTV, 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, 600 Flares), 10 Chaff Rockets, RWR, ECM/Stealth Skin (-11), ECCM (+8), Radio Jamming (1 Level), Magnetic Compass, Gyrocompass, Secure Radios, VLF/LR Radios Secure Radios, TFR, LRTV, Inertial Navigation, GPS	2000/2400m Hardened Runway	+3 (Bombing) or +3 (Tail Gun)	20mm M-61 Vulcan, 2xExtra Large Hardpoints, 2 Wet Hardpoints, Double Bomb Bay	1242x20mm

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.

The F-111A was the first model. It 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-11A 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 F-111B was to be a naval interceptor version of this aircraft (the Phoenix missile was in fact originally designed for the F-111B), but this version was cancelled. 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. The F-111D has different engines, a flight computer that controls the swing wing and other flight functions, improved air-to-air capability, and a glass cockpit.

The F-111E, though later in the letter designation, came before the F-111D. It was a stopgap model, produced for use in Vietnam because the advanced avionics of the F-111D were not yet fully tested. The bombing system and ECM suite are better than the F-111A, but it is otherwise an A model.

The F-111F is an advanced D model. It has more powerful engines, and an advanced avionics suite including the Pave Tack system, which is an array of sensors, designators, and vision devices that grant great accuracy in bombing. No F-111Fs were lost in combat until late in the Twilight War.

The FB-111A is a strategic bomber variant of the F-111. It was supposed to bridge the gap between the B-52 and B-58 and the B-1, but the B-52 soldiered on and the B-58 left service. It has a longer fuselage and wings increased in span by over 2 meters, both to increase cruise range and allow the mounting of more hardpoints. The avionics were slightly better than that of the F-111E, but not as advanced as the F-111F. In addition, navigation and computing power was greater. The F-111G is an FB-111A converted to the tactical bombing role, with improved attack and avionics systems.

The EF-111A Raven replaced the EB-66 electronic warfare aircraft. It is a conversion of the F-111A, with the addition of advanced electronic warfare systems. It does not carry weapons, and its hardpoints may mount electronic warfare equipment or drop tanks only.

Vehicle	Price	Fuel Type	Load	Veh Wt	Crew	Mnt	Night Vision	Radiological
F-111A	$5,491472	AvG	13.64	44.93	2	50	Radar	Shielded

			tons	tons				
F-111C	$5,625,410	AvG	13.64 tons	45.03 tons	2	52	Radar	Shielded
F-111D	$6,334,823	AvG	13.64 tons	45.44 tons	2	52	Radar	Shielded
F-111E	$5,527,943	AvG	13.64 tons	45.04 tons	2	52	Radar	Shielded
F-111F	$7,263,572	AvG	14.23 tons	45.36 tons	2	48	Radar, (With Pave Tack) FLIR, Image Intensification	Shielded
F-111G	$7,466,306	AvG	17.05	53.2 tons	2	56	Radar	Shielded
FB-111A	$6,719,712	AvG	17.05 tons	54.21 tons	2	58	Radar	Shielded
EF-111A	$6,295,842	AvG	13.64 tons	40.39 tons	2	60	Radar	Shielded

Vehicle	Tr Mov	Com Mov	Mnvr/Acc Agl/Turn	Fuel Cap	Fuel Cons	Ceiling
F-111A/C/D/E, EF-111A	4650	1162 (105)	NA 291 5/3 50/35	19089	7689	20117
F-111F	5330	1333 (105)	NA 333 5/3 50/35	19089	13760	18290
FB-111A/F-111G	4650	1162 (105)	NA 291 5/3 50/35	18964	7861	15320

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
F-111A	All Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, TFR	1400/1105m Hardened Runway	+1 or +2	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay	2084x20mm (Optional)
F-111C	All Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, TFR	1400/1105m Hardened Runway	+2	20mm Vulcan (Optional), 8 Hardpoints, Internal Bomb Bay	2084x20mm (Optional)
F-111D	All Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, TFR, HUD Interface, Track While Scan, Auto Track	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay	2084x20mm (Optional)
F-111E	All Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, TFR	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay	2084x20mm (Optional)
F-111F	All-Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, HUD Interface, Auto Track, Track While Scan, TFR, (With Pave Tack) Laser Designator	1400/1105m Hardened Runway	+3, (With Pave Tack) +4	20mm Vulcan (Optional), 6 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
F-111G	All Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, TFR, Auto Track, Track While Scan	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 8 Hardpoints, Internal Bomb Bay	(Optional) 2084x20mmM61
FB-111A	All Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, TFR	1400/1105m Hardened Runway	+3	20mm Vulcan (Optional), 8 Hardpoints, Internal Bomb Bay	2084x20mm (Optional)
EF-111A	All Weather Flight, Flare/Chaff Dispensers, Radar Warning Receiver, ECM, TFR, Deception Jamming, Active Jamming, Radio Jamming, Chaff Rockets (4), HUD Interface	1400/1105m Hardened Runway	None	6 Hardpoints	None

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)	$534,489	AvG	900 kg	8.3 tons	5	14	Image Intensification	Enclosed
AC-47D (US Interim Version)	$571,603	AvG	925 kg	8.25 tons	5	18	Image Intensification	Enclosed
ABT-67 (Columbian)	$1,045,149	JP4/5/6	1.11 tons	8.99 tons	5	19	Radar (30km) FLIR, Advanced Image Intensification	Enclosed
AC-47D (Indonesian)	$561,021	AvG	750 kg	8.45 tons	5	14	Image Intensification	Enclosed
ABT-67 (El Salvadorean)	$1,225,700	JP4/5/6	1.13 tons	8.83 tons	5	22	Radar (40km), FLIR, Advanced Image Intensification, Thermal Vision (Rear)	Enclosed
ABT-67 (SANDF 1)	$530,928	JP4/5/6	1.14 tons	8.8 tons	5	17	FLIR, Image Intensification	Enclosed
ABT-67 (SANDF 2)	$543,008	JP4/5/6	1.14 tons	8.8 tons	5	17	FLIR, Image Intensification	Enclosed
ABT-67 (SANDF 3)	$453,359	JP4/5/6	1.15 kg	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 or 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 squaks” 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 II Group II Hawkeyes flying, but most are Omnibus II Group I aircraft, with a few Omnibus II 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	$28,973,100	AvG	750 kg	23.85 tons	5	60	Radar	Shielded

E-2B	$29,262,831	AvG	750 kg	23.85 tons	5	60	Radar	Shielded
E-2C Omnibus I (Early)	$29,555,459	AvG	750 kg	23.85 tons	5	60	Radar	Shielded
E-2C Omnibus I (Late)	$30,095,324	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group 0	$30,396,276	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group I	$34,337,000	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II	$32,327,500	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II(N)	$33,862,000	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II(M)	$34,200,620	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C Omnibus I Group II(C)	$37,914,750	AvG	750 kg	23.85 tons	5	52	Radar	Shielded
E-2C+ (All)	$38,040,750	AvG	750 kg	23.85 tons	5	56	Radar	Shielded
Hawkeye 2000	$38,421,157	AvG	750 kg	23.85 tons	5	56	Radar	Shielded
E-2D	$42,943,120	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, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT Gear	440/795m Hardened Runway	None	None	None
E-2C Omnibus I (Late)/Group 0/Group I	Advanced IFF, RWR, Short-Range ECM, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT 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, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT 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, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT Gear, Look-Down Radar, Secure Radios, Auto Track, GPS, Satcom Gear, Flare/Chaff Dispensers, Deception Jamming	440/795m Hardened Runway	None	None	None
E-2D	Advanced IFF, RWR, ECM, Short-Range Radio Jamming, Track While Scan, Target ID, ELINT Gear, Look-Down Radar, Secure Radios, Auto Track, GPS, Satcom Gear, Flare/Chaff Dispensers (16), Deception Jamming	440/795m Hardened Runway	None	None	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	$148,232	AvG	300 kg	4.3 tons	2	8	None	Enclosed
G-3	$156,587	AvG	360 kg	4.82 tons	2	8	None	Enclosed
J-1	$293,321	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
G-2A	1624	406 (100)	NA 102 6/3 60/30	1560	1106	12000
G-3/J-1	1706	426 (100)	NA 107 6/3 60/30	1560	1330	12000

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
G-2A/G-3	Radar Warning Receiver	515/475m Hardened Runway	+1	2xDShK, 2 Hardpoints	300x12.7mm
J-1	RWR, Flare/Chaff Dispensers	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	$201,590	AvG	1.28 tons	6.3 tons	2	12	None	Enclosed
G-4M	$464,717	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
G-4/G-4M	1680	420 (105)	NA 2105 7/4 70/40	1215	1777	12850

Vehicle	Combat Equipment	Minimum Landing/Takeoff Zone	RF	Armament	Ammo
G-4	Radar Warning Receiver, Flare/Chaff	530/490m Hardened	+2	23mm GSh-23L	250x23mm

	Dispensers	Runway		Autocannon, 4 Hardpoints	
G-4M	RWR, Flare/Chaff Dispensers, HUD, Laser Designator, Inertial Navigation	530/490m Hardened Runway	+2	23mm GSh-23L Autocannon, 4 Hardpoints	250x23mm

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.