AIR-TO-AIR MISSILES

Firestreak

Notes: Firestreak was an early British heat-seeking missile, roughly analogous to the Sidewinder (though much larger). The testing program started in 1954, and the missile was so successful that for the first 100 launches, the engineers learned practically nothing about any potential weaknesses of the Firestreak. (Later testing revealed an accuracy rating of about 85% when fired within the proper parameters, still a remarkable total.) The Firestreak had been largely replaced by later missiles by 2003, though the few countries still using the Lightning (mostly Saudi Arabia and Kuwait) still had some Firestreaks on hand.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Firestreak	137 kg	Average	IR	Rear Aspect	$7400

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Firestreak	5095	1065	8000	C47 B100	26C	FRAG-HE

Red Top

Notes: The Red Top began as an upgrade to the Firestreak (and was originally called the Firestreak Mk IV). The Red Top was to overcome the narrow angle of acquisition of the Firestreak, as well as to rarrange the components of the Firestreak in a more logical and efficient pattern. Increases in technology allowed a better seeker head and the change in design as well as explosives technology allowed a more lethal warhead. However, by 2003, the Red Top has the same status as the Firestreak; largely in storage except for those countries still using the Lightning.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Red Top	150 kg	Average	IR	All Aspect	$11416

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Red Top	5435	1000	12000	C56 B94	26C	FRAG-HE

Skyflash

Notes: The Skyflash is a development of the AIM-7E2 Sparrow. The homing head has been replaced by one using a more advanced monopulse seeker that increases accuracy and allows the warm-up time for the missile to be decreased from the 15 seconds of the standard AIM-7E2 to less than 2 seconds. This decreases the minimum range and response time. The Skyflash was designed for the British variant of the Phantom II; it was also used by the Viggen and the Tornado. By 2003, Skyflash was largely replaced in Europe by the AMRAAM, and was on its way to replacement in other areas of the world.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Skyflash	193 kg	Average	Radar	All Aspect	$17256

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Skyflash	6795	1600	50000	C54 B106	23C	FRAG-HE

PL-5

Notes: This development of the AA-2 (PL-1) differs primarily in the incorporation of an improved rocket motor with increased range. It has been widely exported.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
PL-5B	148 kg	Difficult	IR	Rear Aspect	$6375
PL-5C	148 kg	Average	IR	Side Aspect	$8375
PL-5E	83 kg	Average	IR	Side Aspect	$7490

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
PL-5B	3350	800	16000	C24 B50	12C	HE
PL-5C	3350	600	21700	C28 B55	12C	HE
PL-5E	3350	600	25100	C24 B70	12C	HE-FRAG

PL-9

Notes: This Chinese missile is also used as a surface-to-air missile (called the DK-9 in that role). Its performance is about equal to the AIM-9M Sidewinder, being one level harder to decoy with flares or countermeasures. It is believed to be developed from the 14-km-range version of the Israeli Python 3, which Israel sold to China in the late 1980s (the Python 3 being developed from the AIM-9L).

Weapon	Weight	Accuracy	Guidance	Sensing	Price
PL-9	115 kg	Average	IR	All Aspect	$7500

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
PL-9	2905	500	15000	C51 B70	17C	HE

Magic R.550

Notes: This is France's standard heat-seeking missile, and is also used by several countries around the world that do business with France such as Algeria, Belgium, and several Middle East countries. It can also be used by helicopters.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Magic I	89 kg	Average	IR	Side Aspect	$7295
Magic II	89 kg	Easy	IR	All Angle	$9370

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Magic I	3775	600	12800	C29 B75	17C	FRAG-HE
Magic II	3775	400	24000	C34 B80	17C	FRAG-HE

Mica

Notes: This is the French counterpart to the AMRAAM, used by France and by countries that conduct frequent arms trade with France, such as Iraq. It is an active homing missile with its own radar unit in the nose to allow it to home in on targets without help from the firing aircraft. The missile is one level harder to decoy with various ECM devices and chaff. There is also an IR homing version of this missile.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Mica RH	110 kg	Easy	Active Radar	All Aspect	$24830
Mica IR	110 kg	Easy	IR	All Aspect	$9400

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Mica	5200	1200	50000	C49 B100	20C	FRAG-HE
	5200	300	32000	C49 B100	20C	FRAG-HE

Super 530

Notes: This French missile comes in two types, a standard radar homing missile and the active homing Super 530D. It is used by many French-built aircraft and other French customers. It is a very fast missile, and is a very heavy missile. It was being replaced by Mica as the century began.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Super 530	275 kg	Average	Radar	All Aspect	$23,680
Super 530D	275 kg	Average	Active Radar	All Aspect	$25,685

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Super 530	5425	2000	37000	C76 B125	32C	FRAG-HE
Super 530D	5425	2000	37000	C101 B144	32C	FRAG-HE

Derby

Notes: Also known as Alto, this is an active homing missile based on the Python. Derby was in development for more than a decade before the first one was possibly fielded in 1998 (this is not confirmed by the IAF). The Derby combines the light weight of the Python with advanced guidance. Though not confirmed, rumors say the Derby has been offered to India, China, South Korea, and the Philippines.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Derby	120 kg	Easy	Active Radar	All Aspect	$45856

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Derby	5945	1100	50000	C48 B100	17C	FRAG-HE

Python-3

Notes: This AAM was the successor to the Shafrir 2 of the late 1970s. The basic form is similar to the Safrir and the Sidewinder, but it has a new seeker head with a wider angle view than most heat-seeking missiles. The fins are large for more agility. It is a fast, yet lightweight missile capable of quick maneuvers to follow its target.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Python-3	120 kg	Average	IR	All Aspect	$9736

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Python-3	5945	600	15000	C34 B70	17C	FRAG-HE

Python-4

Notes: This is an advanced Israeli air-to-air heat-seeking missile. It is well known to Arab pilots as a maneuverable and deadly missile with high resistance to IRCM and decoys (one level more resistant to countermeasures. It may be used in conjunction with a helmet-mounted sight used by some Israeli aircraft. It is an all-angle missile. Its proximity fuze is one of the best in the world.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Python-4	120 kg	Easy	IR	All Aspect	$9736

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Python-4	5945	500	15000	C38 B88	17C	FRAG-HE

Shafrir-2

Notes: Beginning with the AIM-9B Sidewinder as a basis, Israeli designers at Rafael sought to produce a more lethal and accurate missile. The first thing they did was to dramatically increase the diameter of the missile, from 127mm to 160mm. The mechanisms were simplified, and solid-state electronics were used instead of vacuum tubes. The Shafrir-1 did not enter service, but an improved model, the Shafrir-2, did, and it is credited with the destruction of over 200 aircraft in the 1973 Yom Kippur war alone.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Shafrir-2	93 kg	Average	IR	Rear Aspect	$5296

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Shafrir-2	3100	600	6400	C29 B75	17C	FRAG-HE

Aspide

Notes: This missile is externally almost identical to the US Sparrow missile – with good reason. The Aspide was intended to cut into the European market for AIM-7E Sparrow missiles, and whatever other markets it could get into. Internally, the Aspide is very different from the Sparrow. The radar head is improved, with significant ECCM capability, to the point where all decoying attempts against the Aspide are one level harder. It is capable of a look-down, shoot-down intercept. The rocket motor is likewise improved, with the Aspide being capable of Mach 4 speeds. The Italians and the Spanish still use the Aspide, but most European sales went to the new AMRAAM instead.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
Aspide	220 kg	Average	Radar	All Aspect	$23724

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
Aspide	6795	3200	75000	C54 B106	23C	FRAG-HE

AA-1 Alkali

Notes: This was the first Russian air-to-air missile, and is debatable whether it was the first or second AAM to go into service in the world. It was a rather clumsy arrangement; the early form of the missile is a beam-riding missile, with the missile homing on a coded radar beam instead of a standard radar lock-on. The pilot must keep the missile and target in a rather narrow radar beam, and course corrections are transmitted directly to the missile by a radio link. There were at least 6 variants of the Alkali, most can be identified by differing fin shapes; they also had different homing heads and warheads. The last AA-1 was retired from Russian service by 1977, and most other countries soon thereafter, but they can occasionally be encountered under the wings of Third World Aircraft.

Twilight 2000 Notes: In perhaps one of the most unexplainable engagements of the Twilight War, an Albanian MiG-17 managed to down a US F/A-22A Raptor using an AA-1E Alkali.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-1A	91 kg	Formidable	Beam Riding	Rear Aspect	$2248
AA-1B	91 kg	Formidable	Radar	All Aspect	$6232
AA-1C	91 kg	Formidable	IR	Rear Aspect	$4232
AA-1D	83.2 kg	Difficult	Radar	All Aspect	$6200
AA-1E	83.2 kg	Difficult	IR	Rear Aspect	$4448
AA-1F	83.2 kg	Difficult	Radar	All Aspect	$6320

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-1A	1700	2000	6000	C27 B75	22C	FRAG-HE
AA-1B	1700	1600	6800	C34 B80	22C	FRAG-HE
AA-1C	1700	1100	6800	C34 B80	22C	FRAG-HE
AA-1D	1700	1600	8000	C41 B94	22C	FRAG-HE
AA-1E	1700	1100	8000	C44 B94	22C	FRAG-HE
AA-1F	1700	1600	8000	C47 B100	22C	FRAG-HE

AA-2 Atoll

Notes: On 24 September 1958, an AIM-9B Sidewinder missile lodged in the tail of a Chinese MiG-17 without exploding. This missile was taken to the then-Soviet Union and, based on this missile, the Russian's first successful air-to-air missile was developed, the AA-2 Atoll. The missile was also developed into an early radar-homing weapon for all angle attacks.

Twilight 2000 Notes: The Atoll was still in common use in Warsaw Pact countries, Third World nations, and China (where it is known as the PL-1) during the Twilight War.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-2	70 kg	Difficult	IR	Rear Aspect	$3,010
AA-2-2	70 kg	Difficult	Radar	All Aspect	$22,395

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-2	3960	1000	6500	C14 B50	11C	FRAG-HE
AA-2-2	3960	1200	8000	C14 B50	11C	FRAG-HE

AA-3 Anab

Notes: The AA-3 is an early Russian radar homing missile designed with a large warhead to shoot down bombers. It is not a particularly accurate missile and it is vulnerable to countermeasures, but its explosions usually destroy an aircraft. It is produced by China as the PL-2.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-3A	275 kg	Difficult	Radar	All Aspect	$23,505
AA-3B	275 kg	Difficult	IR	Rear Aspect	$12,930

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-3A	4750	1200	19000	C98 B100	35C	HE
AA-3B	4750	1200	19000	C98 B100	35C	HE

AA-6 Acrid

Notes: This huge air-to-air missile was originally designed to be used by MiG-25 Foxbat to shoot down the US B-70 Valkyrie bomber. (It was killed by Congress instead.) The Acrid is so big because of the long-range rocket motor, the large radar kit, and because of the limitations of Soviet technology in the early 1960s when the AA-6 was designed. Early AA-6 missiles didn’t have look-down capability, but the "C" model rectified this. The "B" model is an IR version of the Acrid, but the range is much more limited, again due to the technology of the time. MiG-25s are still sometimes seen with Acrids, but they have mostly been replaced with later technology.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-6A	800 kg	Difficult	Radar	All Aspect	$13352
AA-6B	748 kg	Difficult	IR	Rear Aspect	$10308
AA-6C	748 kg	Average	Radar	All Aspect	$11952

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-6A	6795	3200	50000	C150 B175	53C	FRAG-HE
AA-6B	6795	3200	15500	C150 B175	53C	FRAG-HE
AA-6C	6795	2145	50000	C180 B194	53C	FRAG-HE

AA-7 Apex

Notes: This is one of the standard air-to-air missiles on Russian aircraft, used primarily by the MiG-23, MiG-27, and its variants. There are four variants: The AA-7A basic radar homing missile, the AA-7B heat-seeker, and the AA-7C and AA-7D with extended range.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-7A	320 kg	Difficult	Radar	All Aspect	$23,740
AA-7B	320 kg	Difficult	IR	Rear Aspect	$13,280
AA-7C	320 kg	Average	Radar	All Aspect	$23,750
AA-7D	320 kg	Average	IR	Rear Aspect	$13,280

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-7 R-23R	4750	1500	35000	C73 B85	26C	HE
AA-7 R-23T	4750	800	15000	C73 B85	26C	HE
AA-7 R-24R	4750	1500	50000	C85 B90	26C	HE
AA-7 R-24T	4750	800	21000	C85 B90	26C	HE

AA-8 Aphid

Notes: This former standard Pact heat-seeking missile is still in wide use, both by the former Pact forces and by Third-World countries. It is a wide-aspect missile, able to guide from the side or rear of the target aircraft.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-8A	65 kg	Average	IR	Side Aspect	$13,010
AA-8B	65 kg	Average	IR	All Aspect	$15,010
AA-8C	65 kg	Average	IR	All Aspect	$15,010

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-8A	2600	800	10000	C19 B62	13C	FRAG-HE
AA-8B	2600	800	13600	C23 B68	13C	FRAG-HE
AA-8C	2600	400	13600	C26 B75	13C	FRAG-HE

AA-9 Amos

Notes: This missile was designed to arm MiG-31 interceptors, but was later used on MiG-25s. It was designed to be state-of-the-art (at the time, 1980), used to attack bombers and attack aircraft using low-level penetration techniques, cruise missiles, helicopters, and high-speed aircraft like the SR-71 (a task at which it was never successful). It was also the Soviet Union's first active homing missile, able to guide itself once it closes to 48 kilometers using its own radar.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-9	490 kg	Average	Active Radar	All Aspect	$61008

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-9	7645	4800	160000	C190 B200	50C	FRAG-HE

AA-10 Alamo

Notes: This missile was designed to form the main part of the MiG-29s air-to-air armament. It is a modular missile allowing for upgrades as well as different seeker heads and warheads to be placed on the same basic missile airframe. There are five variants of the Alamo, two heat-seeking, two radar-homing, and one active homing missile. The AA-10 is a high-agility missile able to be used in close in dogfights as well as long-range intercepts.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-10A	254 kg	Average	IR	All Aspect	$10460
AA-10B	253 kg	Average	Radar	All Aspect	$8660
AA-10C	350 kg	Average	Radar	All Aspect	$9136
AA-10D	343 kg	Easy	IR	All Aspect	$19000
AA-10E	349 kg	Easy	Active Radar	All Aspect	$49136

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-10A	6795	1070	80000	C70 B118	28C	FRAG-HE
AA-10B	6795	1600	70000	C70 B118	28C	FRAG-HE
AA-10C	6795	1600	130000	C70 B120	28C	FRAG-HE
AA-10D	6795	1050	120000	C80 B130	28C	FRAG-HE
AA-10E	6795	1600	130000	C80 B130	28C	FRAG-HE

AA-11 Archer

Notes: This is the standard heat-seeking missile of Russian forces and allies. The missile is resistant to jamming (one level harder to decoy) and is very maneuverable. Three versions are available, the standard AA-11A, the longer range AA-11B, and the still longer range AA-11C. It is an all-angle missile, able to engage from any angle, instead of just the rear of the target.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-11A	96 kg	Average	IR	All Aspect	$15270
AA-11B	105 kg	Average	IR	All Aspect	$15320
AA-11C	115 kg	Easy	IR	All Aspect	$15385

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-11A	3665	600	20000	C38 B88	19C	FRAG-HE
AA-11B	3665	600	30000	C44 B94	19C	FRAG-HE
AA-11C	3665	600	40000	C44 B94	19C	FRAG-HE

AA-12 Adder

Notes: This weapon is colloquially known as the AMRAAMski, so similar it is to the AIM-120 AMRAAM missile. It is known for its maneuverability. It is an active radar missile, guiding itself by means of a radar seeker in its head.

Twilight 2000 Notes: This missile was greatly feared by Western pilots during the Twilight War. Luckily, this weapon was not put into production until just prior to the Twilight War and the factories were put out of operation early, so the AMRAAMski was rarely encountered.

Merc 2000 Notes: Budget cuts meant that the AMRAAMski was always in short supply.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AA-12	175 kg	Easy	Active Radar	All Aspect	$25,400

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AA-12	6500	1500	100000	C60 B112	23C	FRAG-HE

R-Darter

Notes: Unlike the other Darter AAMs, the R-Darter (Radar Darter) is a development of the Israeli Derby AAM. The R-Darter uses an active radar seeker head and is highly resistant to countermeasures (one level harder to decoy). It also has home-on-jam ability, something the Derby does not have; the R-Darter can actually home in on a source of jamming signals on a 1D10 roll of 7+ if it has closed to within 20 km of its target and it loses its lock-on due to ECM activity.

Twilight 2000 Notes: This weapon is in extremely short supply; perhaps less than 30 were available at the start of Twilight War hostilities, and very few were produced after that point.

Merc 2000 Notes: R-Darter development slowed to a trickle then stopped altogether in 2002. The South Africans bought Derby missiles from Israel instead.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
R-Darter	118 kg	Easy	Active Radar	All Aspect	$50296

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
R-Darter	6000	1000	50000	C48 B100	17C	FRAG-HE

U-Darter

Notes: The U-Darter (Upgraded Darter) was developed specifically for use by the SAAF for use by their Cheetah aircraft. It can be used by other aircraft and some helicopters, however. The biggest differences are a greater weight and size with an increased lethality warhead and improved guidance features.

Twilight 2000 Notes: Though limited quantities of the U-Darter were available for the Twilight War, most SAAF aircraft were still using the V-3C Darter and earlier missiles.

Merc 2000 Notes: This missile rivaled the Sidewinder and AA-8 for the title of "most-exported air-to-air missile."

Weapon	Weight	Accuracy	Guidance	Sensing	Price
U-Darter	96 kg	Easy	IR	All Aspect	$9728

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
U-Darter	3500	200	10000	C48 B100	17C	FRAG-HE

V-3 Kukri/Darter

Notes: This weapon entered production in 1981 to arm South African Mirages, Impalas, (and later) Cheetahs. It is similar in form to the French R.550 Magic, and is probably simply a domestically-produced version of the Magic with a few improvements and tweaks. The V-3A is the original missile, virtually identical to the Magic; the V-3B is a bit larger, heavier, and more capable; and the V-3C is even larger and heavier.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
V-3A Kukri-A	73 kg	Average	IR	Side Aspect	$7264
V-3B Kukri-B	75 kg	Average	IR	All Aspect	$9264
V-3C Darter	89 kg	Average	IR	All Aspect	$9484

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type

V-3A Kukri-A	3700	300	8000	C21 B68	12C	FRAG-HE
V-3B Kukri-B	4245	300	8000	C21 B70	12C	FRAG-HE
V-3C Darter	3400	200	6200	C37 B88	17C	FRAG-HE

Hughes AIM-4/AIM-26 Falcon

Notes: The Falcon was the first operational air-to-air missile. Though not particularly reliable or accurate in its early iterations, it did provide a valuable technological base for later developments. Development began in late 1946 as a short-range subsonic missile to give bombers a self-defense capability, but quickly changed to a supersonic fighter-launched missile with the designation XAAM-A-2. In 1950, the Falcon became operational, and in 1951, the designation was changed to F-98, and then changed again to GAR-1 in 1955. AIM-4Ds were initially used by F-4D Phantoms in Vietnam, but quickly withdrawn because the visual ROEs imposed in Vietnam made the long minimum range of the Falcon problematic. The missile accelerates quickly, but is none too maneuverable; this limits its effectiveness somewhat. By the early 1970s, the Falcon had largely been replaced by missiles with later technology. The Swedes used a version of the AIM-26B (as the RB-27) for almost two decades after the Falcon had been withdrawn from service elsewhere.

The original GAR-1 (later AIM-4) used radar-homing guidance with a relatively short range. The GAR-1 also has no proximity fuze, meaning that the GAR-1 actually had to strike its target before the 3.4-kilogram warhead would detonate. As the GAR-1 was to be used against large, subsonic bombers, this was not considered a problem at the time. The GAR-1D (later AIM-4A) offered greater maneuverability due to enlarged control surfaces, including separate auxiliary control surfaces at the rear of the primary fins. An improved motor also made it a bit faster than the GAR-1. The GAR-2 (AIM-4B) used the same airframe, but was a heat-seeking missile. The GAR-2A (AIM-4C) had an improved IR seeker. The GAR-2B (AIM-4D) further improved the IR seeker.

The GAR-3 (AIM-4E) was a bit larger, with an improved motor and larger warhead, and with the GAR-3, the name of the missile was changed to Super Falcon. The GAR-3A (AIM-4F) improved the rocket motor further by providing a boost and sustainer motor, as well as improving (slightly) ECM resistance; earlier radar-homing versions were upgraded to this standard. The GAR-4 (AIM-4G) was the heat-seeking variant of the GAR-3A, and also had an improved IR seeker.

The GAR-11 (AIM-26A; officially the Falcon, but often called the Nuclear Falcon) was a very different type of air-to-air missile. It was designed to destroy formations of bombers at once, using a small nuclear warhead. The GAR-11 was developed in 1959, when the radar seeker used in the Falcon was still deemed too inaccurate to ensure bomber destruction; hence the nuclear warhead. The GAR-11 used a radar proximity fuze, but the range was rather short since the GAR-11's warhead was much heavier than the standard Falcon. This meant that the Nuclear Falcon could conceivably put the firing aircraft within range of the EMP, radiation, or even damage or destruction radius of the warhead; the pilot had a shield he could erect over the front of his canopy to prevent flash blinding, but this did not do anything to protect him from anything else.

The GAR-11A (AIM-26B) Super Falcon was developed as a conventional counterpart to the GAR-11, at the same time as the GAR-11. It was much larger and heavier than any of the AIM-4 series, and was radar-homing and triggered by a proximity fuze. The GAR-11A, however, lacked look-down-shoot-down capability, and was primarily used by the Swedes in an improved version.

Twilight 2000 Notes: Increasing numbers of Falcons and Super Falcons were pulled out of storage, particularly in Europe; they were also adapted to a much wider variety of aircraft than they were originally meant for.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AIM-4 Falcon	50 kg	Formidable	Radar	All Aspect	$15256
AIM-4A Falcon	54 kg	Formidable	Radar	All Aspect	$15300
AIM-4B Falcon	59 kg	Formidable	IR	Rear Aspect	$5232
AIM-4C Falcon	61 kg	Difficult	IR	Rear Aspect	$5394
AIM-4D Falcon	61 kg	Difficult	IR	Side Aspect	$7360
AIM-4E Super Falcon	68 kg	Difficult	Radar	All Aspect	$15440
AIM-4F Super Falcon	68 kg	Average	Radar	All Aspect	$15712
AIM-4G Super Falcon	66 kg	Average	IR	Side Aspect	$7398
AIM-26A Nuclear Falcon	92 kg	Average	Radar	All Aspect	$1.5 Million
AIM-26B Super Falcon	119 kg	Average	Radar	All Aspect	$17040

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AIM-4 Falcon	4750	2145	8000	C25 B75	17C	FRAG-HE
AIM-4A Falcon	5095	2145	9700	C25 B75	17C	FRAG-HE
AIM-4B Falcon	5095	1050	9700	C25 B75	17C	FRAG-HE
AIM-4C Falcon	5095	1050	9700	C25 B75	17C	FRAG-HE
AIM-4D Falcon	6800	1030	9700	C30 B80	17C	FRAG-HE
AIM-4E Super Falcon	6800	2100	11300	C30 B80	17C	FRAG-HE
AIM-4F Super Falcon	6800	2100	11300	C30 B80	17C	FRAG-HE
AIM-4G Super Falcon	6800	1000	11300	C30 B80	17C	FRAG-HE
AIM-26A Nuclear Falcon	3400	3220	8000	Special	Special	0.25 Kiloton
AIM-26B Super Falcon	3400	3220	9700	C40 B106	17C	FRAG-HE

Raytheon AIM-7 Sparrow

Notes: Research on what eventually became the AIM-7 began in 1947, when the US Navy asked Sperry to develop a beam-riding version for the standard (at the time) 5-inch HVAR rocket. The 5-inch diameter of the rocket proved to be too small, so it was enlarged to 8 inches. The development proved to be full of problems, so much that the first aerial intercept against a drone did not occur until 1952, and the AAM-N-2 Sparrow I (later called the AIM-7A) did not see fleet service until 1956.

The AIM-7A proved to be a failure. Beam-riding guidance is inaccurate for an aircraft-launched missile, and the AIM-7A was easily confused by ground clutter. In addition, the AIM-7A launch system required that the aircraft's radar be slaved to an optical sight, turning a missile which had decent range (at the time) into a VFR weapon. The AIM-7A was withdrawn after only 3 years, with only 2000 being built.

The AAM-N-3 Sparrow II (later called the AIM-7B) was an early attempt at an active-homing missile, developed by Douglas Aviation. Unfortunately this idea was essentially decades ahead of its time in 1955, and the result was a failure. The US Navy, who originally asked for the Sparrow II to arm it's F5D-1 Skylancer, canceled its participation in the Sparrow II program in 1956. The Canadians then thought the AIM-7B was the perfect armament for the CF-105 Arrow interceptor, and when the CF-105 project died the Sparrow II died its final death. The AIM-7B is not included in the charts below. A version of this missile, the AIM-7B Sparrow IIX, was also designed; this was to be armed with the same nuclear warhead as on the MD-2 Genie version of the AIM-4 Falcon, but it too was cancelled along with the CF-105 project.

The Sparrow III series began in 1955 with the AAM-N-6 (later called the AIM-7C). It was also at this point that Raytheon became the prime contractor for the AIM-7. Perhaps the key change in guidance was that the Sparrow III series homed in on a radar lock-on from the firing aircraft. This can make a missile highly vulnerable to even simple countermeasures, and this was especially true of early-model Sparrow IIIs (countermeasures are one level more effective against the AIM-7C, 7D, and 7E series).

The AIM-7C used a 29.5 kg continuous-rod fragmentation warhead and a solid-rocket motor. Again, only about 2000 were built, due to the imminent introduction of the AAM-N-6a (AIM-7D). The missile body was essentially the same, but internally, the AIM-7D was quite different. The AIM-7D used liquid propellant that was inert until ignition, which increased the range and ceiling. The seeker was improved to allow for higher closing rates of speed (as occurred with head-on shots), and the first ECCM/anti-jamming capability was introduced. The USAF also used the AIM-7D, calling it the AIM-101 at the time and making it the primary armament of the F-4C Phantom II. After the AIM-7E was introduced, many surviving AIM-7Ds were converted to training missiles with inert warheads, and designated ATM-7D.

In 1963, due to the Pentagon's switch to a common nomenclature system, the earlier versions of the Sparrow were redesignated AIM-7. The next version of the Sparrow III series was the AIM-7E. Propellant was changed back to solid fuel, and the engine again increased range. The AIM-7E was also a bit more agile than its predecessors. The AIM-7E was employed extensively in Vietnam, where opinions of its effectiveness depended on the pilot – most pilots reviled the AIM-7E due to numerous failures of the engine to fire, the seeker losing track of the aircraft's lock-on, the fuzes not working, poor maneuverability, and confusion by ground clutter. On the other hand, some pilots, like the ace Steve Ritchie, swore by the AIM-7E, using it for all five of his MiG kills. Most pilots in Vietnam learned quickly to fire the AIM-7E (and AIM-7s in general) in pairs to decrease the chance of failures. These shortcomings led to the introduction of the AIM-7E2 in 1969, with much improved maneuverability, a shorter minimum range, and improved fuzing reliability. The AIM-7E3 further improved the reliability of the fuzing and also improved the motor start system, and the AIM-7E4 was designed for use with aircraft with higher-power radars (such as the F-14, introduced in 1973). Otherwise, for game purposes, the AIM-7E3 and E4 are identical to the AIM-7E2. The AIM-7J is an AIM-7E2 license-built in Japan. The RIM-7E is an AIM-7E adapted for use as a ship-launched SAM; the RIM-7H is the AIM-7E2 adapted for the same role. The primary modification for these missiles are snap-open fins, allowing them to be loaded into box launchers. The various versions of the AIM-7E were the most produced, with almost 30,000 being built.

1972 brought the AIM-7F. The AIM-7F had a greatly-increased range due to a dual-thrust motor that provided a quick boost followed by a sustainer. The guidance and control sections were completely solid-state. This guidance package was also smaller, allowing the use of a 39 kg warhead. With the advent of the AIM-7F, the name of the missile was changed from "Sparrow III" to simply "Sparrow." The AIM-7G was a version of the AIM-7F designed specifically for use with the F-111D, but did not proceed beyond the prototype stage. A RIM-7F version was also built. With the AIM-7F, General Dynamics also began building the Sparrow.

The designations AIM-7H, AIM-7I, AIM-7K and AIM-7L were either skipped or were unsuccessful research models. The AIM-7M designation was chosen for the next iteration of the Sparrow, due to its use of the new monopulse seeker head that allows better performance at low altitude and in high-ECM environments, as well as bringing true look-down-shoot-down capability. The AIM-7M includes a digital computer with re-programmable EEPROM modules. The AIM-7M can operate in a semi-independent manner; once the missile is launched, it uses an autopilot to fly in one of several pre-programmed trajectories, and a lock-on is required only for launch, mid-course update, and terminal guidance. The warhead has also been replaced by blast-fragmentation warhead, rather than pure fragmentation. A RIM-7M version was also produced. The AIM-7N was a prototype improved AIM-7M, but subsequent improvements overtook the program and it was never put into full production.

The AIM-7P appeared in 1987, with an improved guidance module, a computer that uplinks to the pilot for more accurate mid-course and terminal guidance, and an improved look-down/shoot-down capability. ECCM has improved so significantly that countermeasure success is degraded by one level. A RIM-7P version was also built. The AIM-7P is still in production, primarily for the US Navy in its RIM-7P version and for foreign countries that are unable to afford the AIM-120. In addition, Raytheon also upgrades earlier versions of the AIM-7 to the AIM-7P standard for those foreign customers as well as the US military.

The AIM-7Q was essentially a testbed for a new guidance system which used an active-homing head combined with an IR seeker for backup. If the AIM-7Q lost radar contact with the target due to ECM or standard methods of breaking lock-ons, the IR seeker would take over and guide the missile to the target. Conversely, the AIM-7Q could be launched as a heat-seeking missile, using brief pulses of radar to confirm the target. AIM-7Q development apparently ended with no production missiles being fielded.

The final version of the Sparrow was the AIM-7R. The AIM-7R used an AIM-7P-type radar guidance module, but it was paired with an IR seeker used to improve terminal guidance, similar to the AIM-7Q. The onboard computing power was also considerably increased. Range was increased by enlarging the tail surfaces and making them the only control surfaces, allowing for more fuel to be carried. In game terms, countermeasure success is degraded by one level, and if the missile loses lock-on and is within 3 km of its target, a roll is immediately made to regain contact. Though the AIM-7R was set for production, that production was never carried out, due to high development costs and the impending adoption of the AIM-120 AMRAAM missile. The AIM-7R was cancelled in 1996, but as I often do, I included it anyway just for the heck of it.

Twilight 2000 Notes: Sparrows were called into increasing use in the Twilight War as supplies of AMRAAM missiles began to be used up. Most Sparrows used by the United States and NATO in the Twilight War were AIM-7Ps and AIM-7Ms, though some countries were using Sparrows as old as the AIM-7E.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AIM-7A	141 kg	Difficult	Beam Riding	Rear Aspect	$16724
AIM-7C	172 kg	Difficult	Radar	All Aspect	$17416
AIM-7D	200 kg	Difficult	Radar	All Aspect	$17588
AIM-7E	205 kg	Difficult	Radar	All Aspect	$17760
AIM-7E2	205 kg	Average	Radar	All Aspect	$17760
AIM-7F	228 kg	Average	Radar	All Aspect	$17728
AIM-7M	228 kg	Average	Radar	All Aspect	$17768
AIM-7P	225 kg	Easy	Radar	All Aspect	$17768
AIM-7R	230 kg	Easy	Radar/IR	All Aspect	$19036

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AIM-7A	1775	2150	8000	C39 B88	23C	FRAG-HE
AIM-7C	2220	2150	40000	C39 B88	23C	FRAG-HE
AIM-7D	3110	2150	40000	C42 B94	23C	FRAG-HE
AIM-7E	3110	1600	44000	C42 B94	23C	FRAG-HE
AIM-7E2	3110	1070	44000	C47 B100	23C	FRAG-HE
AIM-7F	3550	1600	80000	C54 B106	23C	FRAG-HE
AIM-7M	4500	1600	88000	C60 B112	23C	FRAG-HE
AIM-7P	4500	1200	88000	C75 B125	23C	FRAG-HE
AIM-7R	4500	1200	96000	C75 B125	23C	FRAG-HE

Raytheon AIM-9 Sidewinder

Notes: This was the first AAM to be placed into service, and is perhaps the most plentiful AAM in existence. The designers of the Sidewinder, a small team operating on a shoestring budget when development began at China Lake in 1950, created the first Sidewinder out of almost nothing; the project was drastically underfunded and the designers put a considerable amount of their personal funds into it. They then developed a working homing head and got the design to be taken seriously by the Navy. And the rest is history.

The AAM-N-7 Sidewinder I (later designated the AIM-9A Sidewinder) began low rate initial production for the US Navy in 1955. Only 240 were built, as they were considered field test weapons. The AIM-9A had a small 4.5-kilogram blast-fragmentation warhead with an IR seeker which was not cooled like later models would be. The small warhead was a bit of a problem, since the small size meant it had a kill radius of only 9 meters. The primitive seeker also meant that the AIM-9A could detect targets within a mere 4-degree field of view, and the firing aircraft must be in the "slot" position – directly behind the target. To make matters worse, the AIM-9A, though it could turn at 12G, was limited primarily to non-maneuvering targets due to the extremely narrow field of view, and fuzing could be unreliable. The AIM-9B's seeker had a greatly-improved field of view, but was otherwise the same as the AIM-9A. The AIM-9B became the first air-to-air missile to score a kill in September of 1958, when Taiwanese F-86Fs fired them at a gaggle of Chinese MiG-15s – to a great success. Production of the AIM-9B stopped in 1962, with 80,000 being built. The AIM-9F was the European version of the AIM-9B. The primary difference is a more sensitive CO2-based cooler for the seeker head. Also called the AIM-9B FGW.2, the AIM-9F was built in Germany by BGT.

The AIM-9C was a response to the problems with the AIM-9B, with the US Navy trying another tack with the sidewinder – semi-active radar-homing guidance. The AIM-9C was also thought to be a way for aircraft that could not use the AIM-7 Sparrow, such as the F-8 Crusader, to be able to use radar-homing missiles (and in fact, the Crusader was the only aircraft to actually carry the AIM-9C in service). The AIM-9C, however, was perhaps less reliable than the AIM-9B, and only 1000 were built. Most surviving AIM-9Cs were later rebuilt into AGM-122A Sidearm anti-radar missiles.

The AIM-9D was developed in tandem with the AIM-9C, but used a new IR seeker. This seeker had an even narrower field of vision to reduce interference from environmental background radiation like the Sun, clouds, the ground, etc., and it's more aerodynamic shape allowed for faster speed. The AIM-9D also features a much larger 11.34-kilogram continuous rod warhead providing the fragmentation effect warhead. It was built from 1965-69. The AIM-9G was developed for the US Navy, built from

1970-72. An improved AIM-9D, the AIM-9G improved target acquisition probability by not only allowing the seeker head to use preprogrammed search patterns, but by allowing the seeker head to be slaved to the aircraft's radar for target acquisition purposes. (This is called the SEAM upgrade, for Sidewinder Expanded Acquisition Mode.)

The AIM-9E was the first version of the Sidewinder designed specifically for the US Air Force, though the USAF had already been using earlier versions of the Sidewinder. The AIM-9E was an AIM-9B with an improved seeker with a higher tracking rate and Peltier cooling for the seeker. The AIM-9E2 was a version of the basic AIM-9E with a reduced-smoke motor. The nose of the AIM-9E is longer, and has a conical tip.

The AIM-9H started out as merely an improved AIM-9F for the US Navy, but quickly the improvements added up. The AIM-9H featured solid-state electronics that were more stable and allowed for increased accuracy. The seeker's tracking rate was greatly increased, as the AIM-9H was more agile than any of its predecessors due to its electronic "brain" and the electronic actuators for the fins. Some 7700 were built between 1972 and 1974; though they arrived late in the Vietnam War, the AIM-9H's kill rate was a great improvement over earlier models. The US Navy planned an upgrade for the AIM-9H that would be designated the AIM-9K, but the Navy and Air Force decided to get on the same sheet of music and develop the AIM-9L instead.

The AIM-9J was an improved AIM-9E. The AIM-9J used partial solid-state electronics, an improved motor with a longer burn time, more powerful fin actuators that increased agility, and larger, double-delta canards that further increased agility. It did not, however, quite match the capabilities of the AIM-9H, though it was much less expensive. Most AIM-9Js were made by upgrading AIM-9Bs and AIM-9Es, but new production versions were also built, and designated AIM-9J3. The AIM-9N was at first designated the AIM-9J1, and is an incremental upgrade of the AIM-9J with an improved seeker module (decoying the AIM-9N with flares, natural phenomena, or IRCM is done at a -2 penalty). The rocket motor was also improved for a longer burn time, and the warhead was also somewhat improved. AIM-9Ns were all new production missiles, and many were exported instead of being used by US forces.

The AIM-9L, the first joint-service Sidewinder, was a huge improvement over its predecessors, and based on the AIM-9H. Service began in 1974. It was the first heat-seeking missile that could attack its target from any direction – in addition to homing in on engine exhaust, it could home on the heat of the engines themselves and heat caused by friction on the leading edges of an aircraft. The AIM-9L essentially looked at the heat generated by the entire target rather than by just the tailpipes. The AIM-9L used large-span double-delta canards, solid state electronics, and electrical control actuators, all of which increased accuracy and agility. The seeker used argon-cooled Indium Antimonide, and the fuze was a proximity fuze enhanced by a short-range laser (the AOTD fuze, or Active Optical Target Detector), a much more reliable fuze than on earlier Sidewinders. Warhead weight was about double that of the AIM-9J, but it used more modern explosives and a blast-fragmentation warhead with an annular fragmentation pattern. The AIM-9L was first used in combat by Royal Navy Harriers during the Falklands War, and over 16,000 were built by two companies in the US as well as by Germany and Japan. The AIM-9M is a further development of the AIM-9L, replacing it in production. The AIM-9M has a reduced-smoke motor, an improved guidance module, resistance to countermeasures (decoying the AIM-9M with flares, natural phenomena, and IRCM units is one level more difficult), and generally improved reliability. The blast pattern of the warhead is also somewhat improved, though the warhead is almost identical to that of the AIM-9L. All known Sidewinder kills during Desert Storm were with AIM-9Ms. The AIM-9M began service in 1982. The AIM-9S is an export version of the AIM-9M, with the main difference being that the improved countermeasure resistance is removed.

Originally designed specifically for export, the AIM-9P has found itself in use by the US Air Force in recent years. The AIM-9P is a simpler, less expensive Sidewinder, without many of the advanced electronics and seeker features of the AIM-9L and AIM-9M. There are several flavors of the AIM-9P, depending upon the needs of the receiving country and what the US is willing to let them have; they are all based on the AIM-9B/E/J series, and many are in fact rebuilds. The AIM-9P1 has a laser proximity fuze for increased reliability; the AIM-9P2 adds a reduced-smoke motor to that. The AIM-9P3 adds a more advanced warhead, improved guidance electronics, and faster-actuating control surfaces. The AIM-9P4 replaces the seeker with one based on (but not quite as advanced as) the AIM-9L/M. The AIM-9P5 adds IRCM resistance similar to that of the AIM-9M.

The AIM-9X is the newest Sidewinder, combining the best features of earlier Sidewinders, technology of several advanced experimental versions of the Sidewinder, and a host of new ideas. Development began in 1991, operational deployment began in 2003, and full-rate production began in 2004. The AIM-9X was at first developed by Hughes, but since Raytheon now owns Hughes, the AIM-9X is a Raytheon product. The AIM-9X has the rocket motor and the warhead of the AIM-9M, inside a new airframe; the greatly decreased drag gives the AIM-9X increased speed and range. The fins of the AIM-9X are much smaller than any other Sidewinder; they are there primarily for stability, with steering of the AIM-9X being done by jet vanes (much like thrust vectoring) at the exhaust. The small fins of the AIM-9X allow it to fit inside the weapon bays of the F/A-22 and F-35, but still fit on any standard weapon rail able to take a Sidewinder. The AIM-9X can also interface with the new helmet-mounted sights being fielded on some US and NATO aircraft (the JHMCS). The AIM-9X uses an imaging focal plane array seeker that has a 90-degree off-boresight capability; along with its jet-vane steering, this gives the AIM-9X phenomenal accuracy and agility. The AIM-9X has lock-after-launch capability; the pilot of an aircraft equipped with the AIM-9X and the JHMCS can launch the missile before he has a tone (has acquired the target), then steer the AIM-9X into a position where the missile can acquire the target. It also incorporates an advanced version of SEAM. The resistance to countermeasures is so great that the AIM-9X is two difficulty levels less likely to be thrown off by natural phenomena, flares, or IRCM systems.

Twilight 2000 Notes: The AIM-9X is not available in the Twilight 2000 timeline. The AIM-9S is rare.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AIM-9B	69.2 kg	Difficult	IR	Rear Aspect	$2844

AIM-9C	84 kg	Difficult	Radar	All Aspect	$5540
AIM-9D	88.5 kg	Average	IR	Rear Aspect	$3045
AIM-9E/E2	74.5 kg	Average	IR	Rear Aspect	$2685
AIM-9F	71.9 kg	Average	IR	Rear Aspect	$2685
AIM-9G	86.6 kg	Average	IR	Side Aspect	$8077
AIM-9H	84.5 kg	Average	IR	Side Aspect	$10076
AIM-9J	78 kg	Average	IR	Rear Aspect	$3483
AIM-9L	85.3 kg	Average	IR	All Aspect	$8028
AIM-9M	85.5 kg	Easy	IR	All Aspect	$16032
AIM-9N	78 kg	Average	IR	Rear Aspect	$3804
AIM-9P1/P2	78 kg	Average	IR	Rear Aspect	$3579
AIM-9P3	78 kg	Average	IR	Side Aspect	$5543
AIM-9P4	78 kg	Average	IR	All Aspect	$7543
AIM-9P5	78 kg	Average	IR	All Aspect	$15547
AIM-9S	85.5 kg	Average	IR	All Aspect	$8831
AIM-9X	85.28 kg	Easy	IR	All Aspect	$21134

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AIM-9B/E/E2/F	1775	1600	4200	C7 B28	12C	FRAG-HE
AIM-9C	3550	2100	17700	C18 B62	12C	FRAG-HE
AIM-9D	3550	1600	17700	C18 B62	12C	FRAG-HE
AIM-9G	3550	1500	17700	C18 B62	12C	FRAG-HE
AIM-9H	3550	1500	17700	C18 B62	12C	FRAG-HE
AIM-9J	2665	600	14500	C7 B28	12C	FRAG-HE
AIM-9L	4000	600	22400	C21 B68	12C	FRAG-HE
AIM-9M/S	4200	600	22400	C24 B72	13C	FRAG-HE
AIM-9N	3550	600	19200	C10 B32	12C	FRAG-HE
AIM-9P1/P2	3550	600	21200	C10 B32	12C	FRAG-HE
AIM-9P3/P4/P5	3550	600	21200	C12 B38	13C	FRAG-HE
AIM-9X	5300	300	40000	C24 B72	13C	FRAG-HE

Raytheon AIM-54 Phoenix

Notes: The Phoenix is a sophisticated, costly, and large missile intended for long-range defense of US Navy vessels, and it had a somewhat tortuous history. Development of what became the Phoenix actually began in late 1960, after the US Navy's long-range F6D Missileer interceptor and it's AAM-N-10 Eagle BVR missile was cancelled due to large cost overruns. Hughes Aerospace, then the developer of the missile, then turned to more off-the-shelf technology – an upgrade of the AIM-47 Falcon missile and it's associated fire control system, both of which had been previously developed for use by the abortive USAF YF-12A interceptor version of the SR-71 Blackbird. The upgraded missile and fire control system was to arm the US Navy's projected F-111B. Tests of the AIM-54A began in 1965, but by 1967, the F-111B was itself cancelled. However, by 1968, development of the F-14 Tomcat began, and the fire control system and the Phoenix were incorporated into the Tomcat. Squadron service of the AIM-54A finally began in 1974, almost 15 years after its conception.

In form, the AIM-54A resembles a huge version of the AIM-4 Falcon, but it is a far different beast. The Phoenix has a small radar set in its nose, allowing it to home in on a target with minimal guidance updates from the Tomcat once it has closed to within 72 kilometers. Once the Phoenix has closed to within 18.2 kilometers of its target, the Phoenix no longer needs targeting updates from the Tomcat and it guides itself. (If fired from inside of 18.2 kilometers, the Phoenix immediately goes to active homing mode.) The Phoenix has a limited look-down, shoot-down capability (rough terrain can screw up target acquisition), a huge 60 kilogram blast-fragmentation warhead, and a very long range, due to its intended role of destroying Soviet maritime bombers. The Phoenix has three fuzing systems – radar proximity, IR proximity, and impact – to further reduce a miss due to bad fuzing.

The AIM-54B appeared in US Navy inventories in 1977 – but only for a very short time. What exactly the AIM-54B variant was is uncertain, but it was most likely version to test less expensive manufacturing methods, such as sheet steel for the fins. The AIM-54B was never in official US Navy use, and it is likely that the cost-cutting measures were incorporated into production AIM-54As and the newer AIM-54C.

The AIM-54C began development in 1977, with squadron service starting in 1982. The AIM-64C used primarily digital instead of analog components, and look-down-shoot-down capability was improved to increase reliability over rough land terrain and make it more capable against small cruise missiles and antishipping missiles. Perhaps the most important improvement was it's ECCM system – The AIM-54C is one level harder to decoy than the AIM-54A. The motor was improved, giving the Phoenix increased range and speed.

Several versions of the AIM-54C were put into service as time went by, each having incremental improvements. One of these was an upgraded warhead, with a 20% greater effectiveness. Another set of improvements was aimed at reliability, improving resistance to both the weather at sea and temperature changes as the Tomcat climbs and dives. These versions are often called the AIM-54C+. Later, ECCM capabilities were further improved (making them, in game terms, two levels more difficult to decoy), and the computer aboard the Phoenix was given EEPROM memory and better signal processor software, as well as EMP hardening. This version is referred to as the AIM-54C ECCM/Sealed.

By 2004, the Phoenix was officially retired from fleet service, due to its cost and the fact that the Soviet maritime bomber threat has all but disappeared. The Tomcat itself was retired in 2007, and with it, the only US aircraft capable of using the Phoenix. Rumors say that the Iranians still have a dozen or so operational AIM-54As for its F-14s.

Twilight 2000 Notes: In the Twilight 2000 timeline, the Phoenix managed to bring down most of the Russian maritime bomber fleet within weeks of the start of hostilities, but stocks dwindled very fast, and could never be replenished as quickly as desired. By 2000, 99% of the available stocks had been expended, and facilities for its production had been destroyed.

Merc 2000 Notes: This missile was all but dropped from production by 2000 in favor of the less capable but far less costly AMRAAM.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AIM-54A	453 kg	Average	Active Radar	All Aspect	$48632
AIM-54C	462 kg	Easy	Active Radar	All Aspect	$54639
AIM-54C+	464 kg	Easy	Active/Radar	All Aspect	$56321
AIM-54C (ECCM/Sealed)	464 kg	Easy	Active Radar	All Aspect	$59137

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AIM-54A	6665	3700	134270	C163 B182	25C	FRAG-HE
AIM-54C	7750	3200	148160	C163 B182	25C	FRAG-HE
AIM-54C+	7750	3200	148160	C190 B200	25C	FRAG-HE
AIM-54C (ECCM/Sealed)	7750	2135	148160	C190 B200	25C	FRAG-HE

Raytheon AIM-120 AMRAAM

Notes: The AMRAAM (Advanced Medium-Range Air-to-Air Missile) replaced the AIM-7 Sparrow in the inventories of the US and most of its allies in the late 1980s. The project was begun by Hughes Aviation in the late 1970s, and selected in preference to a Raytheon missile; it has since been bought out by Raytheon. Low-rate initial production began in October of 1988, after a lengthy and trouble-fraught testing period that started in 1981. Full-rate production did not begin until 1991, though after that point, stocks of the AIM-7 Sparrow were replaced by the AMRAAM as quickly as possible on US and NATO aircraft. Sales to other countries followed later in the 1990s. Though AIM-120s were carried by aircraft in Desert Storm, none were fired at enemy aircraft; first kill for the AMRAAM, of a MiG-25, occurred in December of 1992 during Operation Southern Watch, the US patrolling the no-fly zone over Iraq.

The AMRAAM is an advanced, active-homing radar-guided missile with its own radar unit in the nose to allow it to be guided without help from the firing aircraft or ground unit once it's own radar has acquired a fix on the target. This also helps it to resist countermeasures, the missile can actually home in on a source of radar jamming (Accuracy becomes difficult in this case); this is called home-on jam capability. Decoying this missile with various radar countermeasures is two levels harder than normal. The missile, as stated, does require an initial fix from a ground unit or aircraft radar; the missile begins self-guidance after traveling 2 kilometers (2000 meters). The ground unit or aircraft that gives the AMRAAM the initial radar lock-on does not have to be the same as the firing unit or aircraft, as long as a data link exists between the unit or aircraft locking on and the unit or aircraft firing the AMRAAM.

The initial version, the AIM-120A, is still in use by the US and NATO as well as other countries, though many US and NATO aircraft carry later iterations of the AMRAAM. The AMRAAM is capable of being carried on pylons otherwise used only by the AIM-9 Sidewinder, including wingtip launchers such as those on the F-16 and F/A-18. The AIM-120B, first delivered in 1994, uses an improved guidance system, though inside a standard AIM-120A body. The AIM-120C, first delivered in 1996, has as it's primary difference clipped fins; the AIM-120C was designed specifically for carriage inside the F-22 Raptor's weapon bays, though it can and is used by other aircraft. The guidance unit is further upgraded (though not measurable in *Twilight 2000 v2.2* terms). The AIM-120C-4, delivered in 1999, uses an improved warhead. The AIM-120C-5, delivered in 2000, is equipped with a larger, more powerful motor, more miniaturized electronics, and an ECCM upgrade (decoying this version is three levels more difficult than normal). The AIM-120C-5's warhead is also smaller, though it throws a larger fragmentation pattern. It was quickly followed by the AIM-120C-6, which has an improved Target Detection Device (TDD); it only has to travel 1500 meters before its own radar takes over and no longer needs ground or aircraft guidance. The AIM-120C-7 began delivery in 2006; this has increased range, improved ECCM, and an improved seeker (not measurable in *Twilight 2000 v2.2* terms). (This version was requested by the US Navy, who was looking for a partial replacement for the long range they lost with the AIM-54 Phoenix.)

The AIM-120D is in the works; it has a two-way data link so that the firing unit or aircraft can make course corrections if needed (such as if the target maneuvers out of the missiles seeker angle or loses lock due to countermeasures). In addition to radar-homing, the AIM-120D has the assistance of GPS in tracking its target (though GPS is not nearly as effective against a fast-maneuvering target, let alone a moving target; it does give the missile a roll of 10 on a d20 to immediately regain a lost lock-on). The AIM-120D can be fired from High-angle Off BoreSight (HOBS capability); the seeker head has a 120-degree field of "vision."

Range is greatly increased; the rocket engine has been enlarged due to further miniaturization and increased in power due to increases in technology. First delivery was expected for 2007, but the program has slipped quite a bit, and fielding has only just begun.

The AMRAAM is also in advanced testing for use as a SAM. This is known as the SLAMRAAM (Surface-Launched AMRAAM) or sometimes the HUMRAAM (HMMWV-launched AMRAAM) by the US Army and is also being tested by the US Marines. This system uses a quintuple missile launcher on the back of a HMMWV, and uses a small acquisition radar on a separate vehicle or ground tripod. Most of this development has been done with the AIM-120A, though other AMRAAMs can be used; no major modifications to the AMRAAM are necessary. SLAMRAAM was to be fielded starting in 2008, but the project deadline has slipped considerably. The SLAMRAAM has received a designation of RIM-120 in some sources, though this designation is not considered official.

Before this, as early as 1995, a joint US/Norwegian project called CLAWS (Complementary Low-Altitude Weapon System) was tested, launching AMRAAMs from modified HAWK SAM launchers (eight AMRAAMs per launcher), but CLAWS was cancelled in 2006.

The NCADE is a test project which has still to bear fruit; it is an anti-ballistic missile version of the SLAMRAAM. The seeker head is replaced with that of the AIM-9X, with two-way data link capability to enable ground or shipboard units to make course changes if necessary. A second stage is added to the basic AMRAAM to increase range and acceleration. It is intended as a shorter-range solution than missiles such as the Patriot. So far, no project date completion plans have been announced and details are lacking, and it will not be covered further here.

Note that in Dale Brown's book series, the AIM-120C is called the Scorpion. This is not an official designation for the AIM-120C.

Twilight 2000 Notes: In the Twilight 2000 timeline, the AIM-120A and AIM-120B were the primary radar-homing AAMs for the US, NATO, Saudi Arabia, South Korea, and Japan at the start of the war. (They were more and more replaced by AIM-7 Sparrows as stocks of the AIM-120 ran short.) The AIM-120C is a rare version of the AMRAAM, and the AIM-120C-4 was only just entering service at the start of the Twilight War; only the US had them, and perhaps less than 50 were available. No other iterations of the AIM-120 were available in the Twilight 2000 timeline.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AIM-120A	157 kg	Average	Active Radar	All Aspect	$58496
AIM-120B/C	157 kg	Easy	Active Radar	All Aspect	$59081
AIM-120C-4	157 kg	Easy	Active Radar	All Aspect	$59377
AIM-120C-5	157 kg	Easy	Active Radar	All Aspect	$58336
AIM-120C-6	157 kg	Easy	Active Radar	All Aspect	$58920
AIM-120C-7	157 kg	Easy	Active Radar	All Aspect	$60229
AIM-120D	157 kg	Easy	Active Radar	All Aspect	$65873

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AIM-120A/B/C	6700	1000	55000	C59 B114	20C	FRAG-HE
AIM-120C-4	6700	1000	55000	C62 B115	20C	FRAG-HE
AIM-120C-5	7400	1000	70000	C47 B126	20C	FRAG-HE
AIM-120C-6	7400	800	70000	C47 B126	20C	FRAG-HE
AIM-120C-7	7400	800	88000	C47 B126	20C	FRAG-HE
AIM-120D	7400	800	105000	C47 B126	20C	FRAG-HE

AIM-132 ASRAAM

Notes: The ASRAAM (Advanced Short-Range Air-to-Air Missile) was one of the replacements for the AIM-9 in the US and NATO inventory. The missile features a better response by using thrust squibs rather than aerodynamic control surfaces. It began deployment in 1998 to US and NATO aircraft, but budgetary restrictions have severely limited the adoption of the ASRAAM.

Twilight 2000 Notes: These missiles were deployed at a much faster rate in the Twilight 2000 World, and such deployment began in 1996.

Weapon	Weight	Accuracy	Guidance	Sensing	Price
AIM-132	100 kg	Easy	IR	All Aspect	$11680

Weapon	Speed	Min Rng	Max Rng	Damage	Pen	Type
AIM-132	4500	300	18500	C53 B106	18C	FRAG-HE