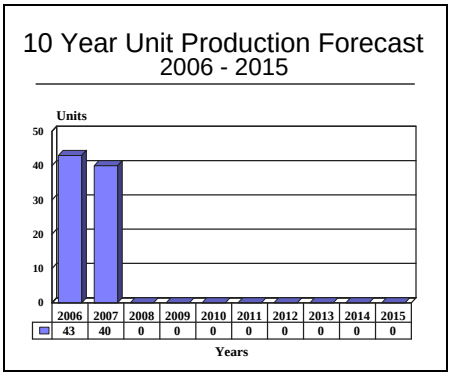
AIM-7 Sparrow - Archived 11/2007

Outlook

- All-new missile production has ceased
- Customer interest is focused on the AIM-120 AMRAAM, not the AIM-7 Sparrow
- No new customer orders have been received. Recent orders have been for RIM-7 SeaSparrow missiles
- Some AIM-7 Sparrows may be upgraded
- The AIM-7 Sparrow did not see action with the U.S. military during Operation Iraqi Freedom



Orientation

Description. Medium-range air-to-air missile.

Sponsor. United States Naval Air Systems Command, Washington, DC.

Status. Modification kits being produced for existing missiles.

Total Produced. Over 69,000 AIM-7 Sparrow missiles of all types have been produced.

Application. Medium-range air-to-air engagements.

Price Range. The USAF FY88/89 budget documents list the unit price for a full-up AIM-7M at $178,247.

Contractors

Prime

Raytheon Missile Systems	http://www.raytheon.com/businesses/rms, 1151 E Hermans Rd, Tucson, AZ 85706 United States, Tel: + 1 (520) 794-3000, Fax: + 1 (520) 794-1315, Prime
Mitsubishi Electric Corp	http://global.mitsubishielectric.com, Tokyo Bldg, 2-7-3, Marunouchi, Chiyoda-ku, Tokyo, 100-8310 Japan, Tel: + 81 3 3218 2111, Fax: + 81 3 3218 2185, Licensee

Subcontractor

Alliant Techsystems - Mission Systems Group, Tactical Systems Division, Allegany Ballistics Laboratory	http://www.atk.com, 210 State Rte 956, Rocket Center, WV 26726-0210 United States, Tel: + 1 (304) 726-5000, Fax: + 1 (304) 726-5183, Email: tactical.systems@atk.com (Mk 58 Mod 2 & Mod 3 Rocket Motor; Mk 58 Mod 2 & Mod 3 Rocket Motor)

Comprehensive information on Contractors can be found in Forecast International's "International Contractors" series. For a detailed description, go to www.forecastinternational.com (see Products & Samples/Governments & Industries) or call + 1 (203) 426-0800.

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AIM-7 Sparrow

Technical Data

	Metric AIM-7M	U.S. AIM-7M
Dimensions		
Missile length	366 cm	12 ft
Missile diameter	20.3 cm	8.0 in
Missile weight	230 kg	508 lb
Finspan	102 cm	40.16 in
Tailspan	81.28 cm	32 in
Performance		
Max speed	Mach 4	Mach 4
Max range	60.98 km	38 mi

Propulsion. Hercules Mk 58 Mod 3 or Aerojet Mk 65 Mod 0 solid-propellant motor, which provides a propulsion impulse of 138.6 kN/sec (30,800 lb/sec). Hercules is now manufacturing the Mk 59 Mod 4 and Mod 5. Alliant Techsystems is the current contractor for the Sparrow rocket motor.

Control & Guidance. This missile uses semi-active radar guidance, with the launch aircraft providing target illumination. The Raytheon semi-active Doppler radar homing system incorporates a small solid-state seeker. A newer monopulse seeker is incorporated in the AIM-7M. The aerodynamic control surfaces are electro-hydraulically actuated. Some components are from Moog.

Launcher Mode. The AIM-7 is fired from recessed mountings in the aircraft's fuselage. The aircraft applications include the F-4, F-14, F-15, F-16, F-18, F-20, and F-104.

Warhead. The AIM-7M uses a new 40-kilogram (88-lb) WDU-27/B blast-fragmentation warhead in a WAU-17/B warhead section activated by proximity fuze or contact fuze. The Sparrow is equipped with the Mk 33 Mod 0 safety-arming device.

AIM-7 SPARROW

Source: USAF

Variants/Upgrades

A large number of Sparrow versions have been developed since the 1950s, ranging from the AIM-7A to the new AIM-7P and AIM-7R. The following provides a brief listing of these systems:

AIM-7A. Originally the AAM-N-2 Sparrow I, this was an early 1950s version of Sparrow manufactured by Sperry Gyroscope that used radar-beam guidance and had an effective range of 5 miles.

AIM-7B. Originally the AAM-N-3 Sparrow II, this was also produced in the 1950s, but it was manufactured by McDonnell Douglas and employed an active-radar guidance system provided by Westinghouse. The missile airframe had much greater volume than its predecessor. The program was terminated in 1956.

AIM-7C. Originally the AAM-N-6 Sparrow III, Raytheon began development of the Sparrow III in 1956; it was the first variation to use continuous-wave semi-active radar homing.

AIM-7D. Originally the AAM-N-6A for the Navy, the semi-active radar homing AIM-7D was introduced soon after the C version; its improvements included a prepackaged liquid motor also produced by Raytheon.

AIM-101. This is the USAF designation for the AIM-7D.

AIM-7E. Originally the AAM-N-6B for the Navy, this was an improved AIM-7D developed in the 1960s by Raytheon and was used extensively in Vietnam. It led to the development of the NATO SeaSparrow, the RIM-7H.

AIM-7E-2. An improved variant of the 7E providing better maneuverability and dogfighting capability.

AIM-7F. This missile incorporated solid-state electronics, described in the **Program Review** section.

AIM-7G. Equipped with a new seeker, possibly with better resistance to electronic countermeasures, but it never went beyond the prototype stage.

AIM-7M. Solid-state electronics, described in the **Program Review** section.

AIM-7P. An advanced actuation system, described in the **Program Review** section.

AIM-7R. An advanced dual-mode seeker equipped missile, described in the **Program Review** section.

Aspide. An Italian multirole missile based on the AIM-7.

Sky Flash. A British air-to-air missile based on the AIM-7.

RIM-7 NATO SeaSparrow. Also known as the SeaSparrow and the NATO SeaSparrow, this is a surface-to-air version of the AIM-7 Sparrow. (See separate report in Tab C.)

Program Review

Background. The AIM-7 Sparrow is a semi-active, radar-homing air-to-air missile with all-weather operational capability. It can also be used against airborne targets from shipboard mountings. (See the "RIM-7 SeaSparrow/NATO SeaSparrow" report in Tab C.)

Medium-Range Missile for Combat Aircraft

The Sparrow had its beginnings in 1946 in Project Hot Shot, which was funded by the U.S. Navy's Bureau of Aeronautics. In 1951, Sperry Corporation had a contract for the full-scale engineering development of the missile, which was designated XAAM-N-2 Sparrow I. It first flew in 1953, just as the Sparrow II program (originally under Douglas Aircraft) was getting under way. Sparrow I was a beam-riding missile slaved to the launch aircraft's radar. Sparrow II (XAAM-N-3) used fully active radar. Fitting an active radar seeker into a 20.32-centimeter (8-in) diameter missile with the existing electronic technology was an extremely difficult proposition, and Sparrow II was eventually terminated. In 1955, Raytheon began developing Sparrow III with semi-active radar homing. The missile has been in continuous development, and it is the standard missile of its type in the free world today.

AIM-7/F-16 Integration. Due to the widespread use of the F-16, General Dynamics accelerated the certification of the AIM-7 on board the Fighting Falcon. The Sparrow has been integrated with the F-16A/B as part of the U.S. Air Force's Air Defense Fighter (ADF) program. This capability would also be retrofitted to the F-16C/D fighter. Sources indicated a heavy demand for the AIM-7 on the F-16s sold on the export market. The certification program was essentially completed in late 1987. Other modifications to the F-16 include the addition of a continuous-wave illuminator, a new unit of the APG-66 fire control radar, and antenna and wiring for the enhanced missile remote interface unit.

The first launch of the AIM-7 from an F-16A was conducted at Edwards AFB in October 1988. The program used the AIM-7F and -7M for the demonstrations. The launch was part of the testing program for an all-weather medium-range missile for the U.S. Air Force. The tests were followed by a U.S. Navy launch at Point Mugu, California. A total of 13

AIM-7 separation firings were scheduled to take place in the F-16A/B Air Defense Fighter test program. The Sparrow completed its certification tests for the F-16C in June 1989. The F-16 was to be configured to carry two AIM-7 and two AIM-9 missiles, and there is room for four additional AIM-9s on the outer stations.

The first USAF F-16 ADFs were delivered in 1989. The first kits were shipped to the USAF Ogden Air Logistics Center, Hill AFB, Utah, in fall 1988, for installation in the first 270 ADFs. These aircraft would be flown by the 12 National Guard and regular USAF interceptor squadrons that are assigned to air defense missions.

Only Egypt and Bahrain were known to have purchased the AIM-7 to equip the F-16, although a number of countries were said to be interested in this option. Egypt was quite anxious to receive the F-16/AIM-7 capability for its 40 Block 30 aircraft in 1991, and it also wanted its 40 Block 40 fighters to have this capability. Bahrain, which would also receive this upgrade package, operates 16 (12/4) F-16C/D Fighting Falcons.

Upgrading Fighters to Accept New Missiles

Under a proposal put forth by six F-16 operator nations (Egypt, Pakistan, Venezuela, Thailand, Singapore, and Indonesia), approximately 140 early-version A/B fighters would undergo modifications to make the aircraft almost identical to the U.S. Air Force's F-16 ADF.

Some European countries had also shown interest in the integration program, although the modification necessary for installation of the AIM-7s would be baseline for all F-16s manufactured in 1988. These potential customers included Greece and Turkey, which would modify their fleets of F-16C/D fighters. The program for the F-16C/Ds would include providing missile guidance via a pulse-Doppler illuminator, which would be part of the Westinghouse APG-68 radar. The first test-firing of an AIM-7 from an F-16C/D took place early in 1989.

All NATO F-16s are expected to receive the operational capabilities upgrade that will make AIM-7 integration easy.

Downing Aircraft from the South Atlantic to the Middle East

Combat Success. Unlike the AIM-9, Sparrow did not get any combat successes in the Falklands War; Harrier and Sea Harrier aircraft cannot mount the AIM-7. However, during the 1982 Lebanon War, an Israeli F-15 destroyed a MiG-25 with an AIM-7F. In mid-1984, Royal Saudi Air Force F-15s shot down two Iranian F-4 aircraft over the Persian Gulf with Sparrow missiles.

During Operation Desert Storm, the United States and Allied forces used the Sparrow air-to-air missiles in engagements against the Iraqi Air Force. Air-to-air kills with the Sparrow included Mirage F.1, MiG-21, MiG-23, MiG-25, MiG-29, Su-7, and Su-17 aircraft.

Missile Models. Over 60,000 examples of Sparrows have been produced in several production models. This air-to-air missile family includes the following systems: AIM-7A, -7B, -7C, -7D, -7E, -7F, -7G, -7M, -7P, and -7R. The AIM-7M features a larger motor than earlier versions (for increased range), and its heavier warhead is mounted forward of the wings, rather than aft as on previous models. Upgraded electronics are also employed. The -7M incorporates increased end-game maneuverability for evasive targets.

AIM-7F Sparrow. The AIM-7F was introduced in 1977, and has a solid-state guidance and a more powerful motor. This version's rocket motor has a more powerful boost-sustain capability, with a combination of high speed and terminal energy. Through 1980, Raytheon/General Dynamics delivered some 9,140 guidance and control packages for Sparrow missiles. Although Raytheon was the original manufacturer, General Dynamics was brought in as a second source in 1977. Production of AIM-7F stopped in 1981. A total of 4,000 of the missiles would be retrofit with the advanced monopulse seeker developed for the AIM-7M.

FY81 and FY82 congressional testimony indicated that both USAF/USN program directors/managers advocated an increased buy of -7 variants in the early 1980s to meet inventory shortfalls. Apparently, peacetime training requirements (1 to 2 missiles per year, per crew) exceeded normal procurement during the late 1970s. Congress was presented with a FY81 add-on for an additional 1,500 -7F missiles to meet this shortfall. Despite continued budgetary constraints and the advent of the AIM-120, Congress had decided to meet most of the services' continued requests for the AIM-7.

AIM-7M Sparrow. The AIM-7M employs an advanced monopulse seeker, improved performance in electronic counter-countermeasures and clutter environment, an onboard digital computer, improved performance in look-down/shoot-down situations against targets with extremely small radar cross-sections, and a new low-altitude-capable active fuze. The ability to engage multiple targets simultaneously is maintained. Raytheon won the contract for competitive development of the advanced monopulse seeker.

Some reliability problems with the AIM-7M occurred during the joint (USAF/USN) operational test and

evaluation of the missile. After a halt of several months, testing resumed in April 1982 with production line examples. Joint services testing was completed in 1983. Production of the -7M, which had been limited to around 100 missiles per month to reduce the possibility of an expensive retrofit or rebuild program, was in full swing in the early 1980s.

The AIM-7M rate of production has been similar to the AIM-7F. Well over 1,200 missiles per year have been delivered for joint Navy/Air Force requirements from 1982 through 1986 inclusive. The slippage of the AIM-120 AMRAAM program has contributed to this continued high production rate. The earliest optimistic estimate for initial low-rate production of the AIM-120 was thought to be 1986, but it was postponed to 1988. Regardless, the Sparrow AIM-7M would be the first-line, medium-range, air-to-air missile until the AIM-120 is fully operational.

In 1983, the AIM-7M/RIM-7M full-scale production was approved, and an Initial Operating Capability followed shortly thereafter. In June 1983, General Dynamics/Pomona Division received a $108 million contract to begin serial production of 1,344 AIM-7M/RIM-7M missiles for the U.S. Navy and Air Force. The total contract was estimated at $215 million. Production began, and first deliveries were made in 1984.

Upgrade for Sparrow and SeaSparrow

AIM-7P. With the AIM-120 program slipping in schedule and the projected price at about twice that of the AIM-7, the U.S. Defense Department began to explore whether a further product-improved AIM-7 Sparrow version might be a viable option. Studies were positive, and in late 1984, the Navy, through the Naval Weapons Center at China Lake, began a product improvement program for the AIM-7.

The enhancement of the missile's electronic and avionics equipment and the elimination of the troublesome hydraulic actuating system are the main components of this program. When the hydraulic system is eliminated, 25.4 centimeters (10 inches) of space is made available for additional propellant, yielding a higher speed and greater range. The original plan was to replace the hydraulic actuation system with a pneumatic/cold gas system. A tail control system for the missile was also under consideration. Such a system had already been flight tested several times (see AIM-7R entry below). Another possible improvement that was investigated was to add an infrared seeker to the existing guidance system for enhanced terminal guidance.

With the slip in the AIM-120 program, at least a portion of these improvements would be incorporated into new production missiles or retrofitted to those already in inventory. In October 1987, Raytheon was awarded a contract to develop a further enhanced version of the Sparrow, designated AIM-7P. The new version replaces the current onboard computer with one employing the latest in very large scale integration (VLSI) circuit technology. The new technology has the equivalent of 70,000 transistors and includes an enhanced capability against low-flying targets, including anti-ship missiles. The reprogrammable computer doubles both memory and throughput of the AIM-7M. The receiver was also made reprogrammable, providing a 16-fold memory expansion, twice the processor speed, and a capability to receive mid-course uplink information in the same formats used by the AIM-54 Phoenix, AIM-120 AMRAAM, and RIM-66/67 Standard. The technology of the AIM-7P would also be incorporated in the RIM-7 SeaSparrow.

No procurement split can be determined between AIM-7P and RIM-7P missiles, since production is focusing on guidance and control sections in which the mission does not play a determining role. The Navy has contracted for 1,232 AIM/RIM-7P missiles, although most are expected to fulfill the surface-to-air mission requirement (RIM-7P).

AIM-7R. The U.S. Department of Defense finalized its plans for the development of another Sparrow production model, the AIM-7R. In August 1990, it was announced that development was already under way on a RIM-7R, with technology applicable to the air-launched variant. This new missile would differ from its predecessors in that its aft tail fins would perform much of the maneuvering currently done by the system's mid-section wings, allowing the missile to carry either more fuel or more weight. This new AIM-7R is an outgrowth of the Navy's Missile Homing Improvement Program (MHIP).

The MHIP is part of a USN investigation of the possible installation of an infrared sensor within an existing missile's guidance system. This would provide the missile with a dual-mode (radio frequency/infrared) capability. Initially, the MHIP would look at the provision of dual-mode capability to the SeaSparrow and Standard (Block II and III) missiles (see separate "RIM-7 SeaSparrow/NATO SeaSparrow" report in Tab C). Equipped with a dual-mode sensor, the SeaSparrow would be able to improve significantly its end-game guidance.

The joint venture IRISS Company, Pomona, California, was awarded a $117 million contract for work on the Missile Homing Improvement Program. Work would

be performed jointly by the General Dynamics facility in Pomona and the Raytheon plant in Bedford, Massachusetts. The contractor would be tasked to design, develop, test, and evaluate the missile homing improvements for the Standard and Sparrow missiles. This modification program could also involve other changes to the missile.

Like the RIM-7P and AIM-7P, no procurement split had been mentioned, since production focused on guidance and control section kits that can be installed on either type of missile (in which the mission does not play a determining role).

AIM-7 Sparrow Upgrade. The USAF would like to upgrade some 5,000 AIM-7 Sparrow missiles but has yet to receive congressional approval. The service has been attempting to convince Congress to allow the reprogramming of allocated funds. This funding would be spent on improving Sparrow F-1 software with so-called H-build software. The H-build software would provide the Sparrow with avionics and software enhancements to improve communications between the software and missile, upgrade electronic counter-measures (ECM) resistance, and improve intercept geometry and trajectory. But most importantly, the upgrade would lead to a new ECM and multishot potential for Sparrow.

Land-based Versions Developed

Sparrow MSAM. The United States Army Missile Command, Redstone Arsenal, tested a ground-launched version of the Sparrow missile in the Medium Surface-to-Air (MSAM) program. This effort looked at replacements for the MIM-23 HAWK missile. The primary force behind this program was cost, since it is less expensive to modify an existing missile than to build a new one. This MSAM project could be related to the previous Sparrow HAWK program.

Sparrow HAWK. In 1983, Raytheon, in conjunction with the U.S. Marine Corps and U.S. Army Missile Command, began the development of a system that allows the RIM-7 SeaSparrow or AIM-7 missile to be fired from the MIM-23 HAWK launcher. Through mid-1985, the so-called Sparrow HAWK system had been successfully tested several times, and Raytheon displayed the system at the Paris Air Show. As of this writing, the United States is not planning to procure the Sparrow HAWK, and no export procurement interest is known.

With the retirement of the AIM-7 for the active forces, there could be renewed interest in the Sparrow HAWK; however, it is unlikely in these days of constricting military budgets and the need for layered air defense that the United States or other Sparrow users would take advantage of this viable option.

Significant News

Armaments Package for Taiwan's Fighters, Helicopters May Be Significant – Taiwan is considering the purchase of combat fighters and attack helicopters from the United States. These potential purchases are part of Taiwan's effort to enhance its defenses to counter the rising threat from China.

Taiwan may purchase 66 F-16 C/D Block 52 fighters for TWD130 billion ($4 billion). These aircraft would replace older F-5 fighters currently in service and strengthen Taiwan's air defense capabilities. The armaments package that could accompany this fighter purchase could be significant. Additional air-to-air missiles, AIM-9 Sidewinder and AIM-120 AMRAAMs, would be required. Also, Taiwan could request strike missiles for these aircraft. In the past, Taiwan has mentioned an interest in the Joint Air-to-Surface Stand-off Missile (JASSM).

In addition to fighters, Taiwan would like to acquire AH-64 Apache attack helicopters. These helicopters would be part of Taiwan's new army squadron of airborne rangers. The helicopters would come armed with HELLFIRE missiles.

Taiwan is also interested in purchasing eight diesel-electric submarines, 12 P-3C anti-submarine warfare aircraft, and eight batteries of PAC 3 missiles in its FY07 defense budget. (FI, 7/06)

New Push to Sell SAMs to Asian Militaries – Missile manufacturers are hoping to cash in on Asia's need for new air defense missile systems. Many Asian militaries are finally looking to replace obsolete surface-to-air missiles (SAMs).

MBDA and Rafael are competing to provide missiles to India. This missile will meet the Indian Air Force's need for a low-level quick reaction air defense system. Rafael is offering the SPYDER SR (Short Range), which uses ground-

launched versions of the Python 5 short-range and Derby medium-range air-to-air missiles. MBDA is pushing its Vertical Launch MICA. MICA was developed as an air-to-air missile.

Meanwhile, Malaysia, Pakistan, and Singapore want new air defense systems.

Singapore wants to replace its Rapier and I-HAWK SAMs. Rafael, MBDA, Lockheed Martin, Raytheon, and certain Russian firms are preparing bids for the Singapore competition. Lockheed Martin will offer its PAC 3 as a replacement for the HAWKs, while Raytheon will submit its ground-launched AIM-120 AMRAAM as a follow-on to the Rapier.

Singapore is also interested in upgrading its manportable SAMs. Options include the MBDA Mistral 2 or the Russian Igla-S. (*Aviation Week & Space Technology*, 4/06)

Funding

The U.S. Sparrow missile procurement has been concluded. Procurement has shifted toward purchases of modification kits and other components. No new Sparrow production has taken place since 1989. U.S. Sparrow production was focused on the P model, although these kits were primarily used to upgrade RIM-7 missiles.

Contracts/Orders & Options

In August 1997, Raytheon Electronic Systems, Sudbury, Massachusetts, was awarded a $7.6 million modification to a previously received contract (N00019-97-C-0126) for the production of 50 AIM/RIM-7P guidance control sections and accompanying wings and ancillary supplies, 30 vertical launch kits, and 76 AIM/RIM-7M to -7P upgrade kits for NATO (64 percent) and Greece (36 percent). Work was completed in May 2000.

Also in August 1997, Alliant Techsystems Incorporated, Allegany Ballistics Laboratory, Rocket Center, West Virginia, received an $8.2 million firm-fixed-price contract to procure 183 Mk 58 Mod 4 RIM-7P SeaSparrow missile rocket motors for NATO (75), South Korea (47), Turkey (40), and Greece (21), as well as 105 Mk 58 Mod 5 AIM-7P Sparrow missile rocket motors for Singapore (5) and Spain (100). Work was completed in July 2000. Contract Number N00019-97-C-0156

Timetable

Month	Year	Major Development
	1946	Project Hot Shot initiated
	1951	Sparrow I prototype fabricated
	1952	Sparrow II prototype fabricated
Early	1953	First flight tests of Sparrow I begin
	1955	Sparrow II full-scale development begins
	1956	IOC for Sparrow I; Sparrow III development begins
Jul	1956	Sparrow II terminated
Mar	1958	AIM-7C IOC
	1960	Air Force adopted AIM-7C as AIM-101
	1962	Nomenclatures changed
	1964-73	Sparrow used in Southeast Asia
	1969	AIM-7E production begins
	1973	AIM-7E production ends
Oct	1974	DSARC III (full-scale production)
	1976	600 G&C units delivered by Raytheon
	FY77	AIM-7F high-altitude/high-Mach capability demonstrated; warhead effectiveness demonstrated (AIM-7F)
Oct	1977	Full-scale engineering development (monopulse seeker)

AIM-7 Sparrow

Month	Year	Major Development
Jun	1978	IOT&E of AIM-7F
Oct	1978	Contractor demonstration (10 firings) of AIM-7F
Feb-Sep	1979	Joint technical evaluation (40 firings) of AIM-7F
	1979-80	G&C units delivered by Raytheon and General Dynamics
Late	1979	Operational evaluation of AIM-7F takes place
Dec	1979	Low-rate production of AIM-7F begins
	Late 1980-early 1981	IOC of AIM-7F
	1981	IOC of the advanced monopulse seeker; low-rate production of AIM-7M begins
Jan	1983	DSARC full-scale production decision
Feb	1983	IOC of AIM-7M
	1984	AIM-7 product improvement program begins
Oct	1987	Development contract for AIM-7P awarded to Raytheon
	1988	First F-16 equipped with AIM-7 delivered
	1990	AIM/RIM-7P (PIP) production begins
	2005-2007	Production likely to be concluded

Worldwide Distribution/Inventories

The AIM-7 Sparrow has been sold throughout the world. As the Sparrow leaves front-line service with the major powers, it could find its way into the inventories of second- and third-tier powers.

With the opening of **Eastern Europe**, the United States is exporting weapon systems to this formerly communist-dominated region. Various countries have expressed an interest in U.S.-built fighter aircraft and their accompanying air-to-air missiles. Bulgaria, Poland, Hungary, and the Czech Republic have mentioned an interest in the F-16 fighter. Sales to Eastern Europe could generate additional orders for the AIM-7 Sparrow, although these purchases could be fulfilled by units from the existing U.S. inventory.

In October 2005, the **Taiwanese** government has requested the United States provide additional air-to-air missiles for its F-16 fighter aircraft. The U.S. Defense Security Cooperation Agency has notified Congress of a possible foreign military sale to Taiwan of 10 AIM-9M Sidewinder short-range and five AIM-7M Sparrow medium-range air-to-air missiles. Also part of this deal is a request for continuation of a pilot training program and logistics support for F-16 aircraft. The total value, if all options are exercised, could be as high as $280 million.

User Countries. Prior to the revolution, Iran had received some Sparrows (AIM-7Fs) for the 80 Grumman F-14s that had been delivered. Obviously, deliveries of any more missiles are not expected for the foreseeable future. However, we reason that the superiority of the Sparrow (AIM-7F/M) will not be lost on past and future clients. Canada, Egypt, Israel, and Saudi Arabia have received the advanced AIM-7M. The problem as we see it is not the vigorous request for the missile, but whether the U.S. State Department will allow the release of advanced technology.

Identified customers include **Australia** (AIM-7M), **Bahrain** (-7E/M), **Canada** (-7M), the **Republic of China** (on Taiwan, -7E/M), **Colombia** (-7E/F: the F are used as SAMs), **Egypt** (-7E/M), **Greece** (-7M), **Iran** (-7E), **Israel** (-7E/F/M), **Italy** (-7E/M), **Japan** (-7F/M), **Jordan** (-7M); **Kuwait** (-7F), **Malaysia** (-7M), **Pakistan** (-7E/F), **Portugal** (-7E/M), **the Republic of (South) Korea** (-7E/M), **Saudi Arabia** (-7F/M), **Spain** (-7E/F/P), **Singapore** (-7M), **Turkey** (-7E/M), the **United Kingdom** (-7M), the **United States** (-7F/M/P), and **Venezuela** (the AIM-7Fs are used as SAMs).

Forecast Rationale

The AIM-7 Sparrow first saw combat during the Hainan Incident. On April 9, 1965, a flight of F-4B Phantoms from the USS *Ranger* aircraft carrier were on patrol near North Vietnam. These aircraft were engaged by Chinese fighter stationed on Hainan Island.

First Air-to-Air Victory against Chinese Fighter

An F-4B, crewed by Pilot Terence Murphy and RIO Ronald Fegan, downed a Chinese MiG-17 fighter during this fight. This was the first recorded air-to-air kill with

an AIM-7 Sparrow. Unfortunately, Lt Murphy and Ensign Fegan were also lost in the same dogfight – probably by an errant AIM-7 fired by another F-4 Phantom.

Production of the AIM-7 would continue for more than three decades. Twenty-five years after its first victory, the Sparrow was still on combat duty – this time against Saddam Hussein's regime during Operation Desert Storm. Some 26 Iraqi aircraft were confirmed destroyed by AIM-7M Sparrows.

Today, all-new Sparrow production has long since ceased. Some modification kits are still manufactured, but most (if not all) are destined for installation on RIM-7 SeaSparrow missiles.

The arrival of the new AIM-120 AMRAAM undermined demand for the Sparrow. Although phased out by the United States, the Sparrow remains in service overseas, but for how long is open to debate. Customers for U.S.-built combat aircraft are uninterested in purchasing Sparrows, instead insisting on receiving the AIM-120 AMRAAM.

Can AMRAAM Match Sparrow's Long Career?

In the very near future, all Sparrow-related production will end and soon this missile will exit the U.S. inventory. We will have to wait and see if the AIM-120 AMRAAM can duplicate the Sparrow's career success.

Note: *Production is currently dominated by orders for the RIM-7 SeaSparrow. Modification kits can be used on either AIM-7 or RIM-7 missile. Therefore, the forecast could include a small number of air-launched Sparrows. The AIM-7E line includes E-2 units. All Raytheon production lines include RDT&E prototype units.*

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level			Speculative			
Missile	**(Engine)**	**thru 05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**	**15**	**Total 06-15**
RAYTHEON COMPANY													
RIM-7P	MK.58	3744	43	40	0	0	0	0	0	0	0	0	83
Subtotal - RAYTHEON COMPANY		3744	43	40	0	0	0	0	0	0	0	0	83
RAYTHEON/GENERAL DYNAMICS													
AIM-7A	UNSPECIFIED	2016	0	0	0	0	0	0	0	0	0	0	0
AIM-7C	UNSPECIFIED	1989	0	0	0	0	0	0	0	0	0	0	0
AIM-7D	UNSPECIFIED	7465	0	0	0	0	0	0	0	0	0	0	0
AIM-7E	MK.38/52	25205	0	0	0	0	0	0	0	0	0	0	0
AIM-7F	MK.65 OR MK.58	9657	0	0	0	0	0	0	0	0	0	0	0
AIM-7M	MK.65 OR MK.58	15001	0	0	0	0	0	0	0	0	0	0	0
Subtotal - RAYTHEON/GENERAL DYNAMICS		61333	0	0	0	0	0	0	0	0	0	0	0
MITSUBISHI ELECTRIC CORP (Licensee)													
AIM-7F	MK.65 OR MK.58	2661	0	0	0	0	0	0	0	0	0	0	0
AIM-7M	MK.65 OR MK.58	2011	0	0	0	0	0	0	0	0	0	0	0
Subtotal - MITSUBISHI ELECTRIC CORP		4672	0	0	0	0	0	0	0	0	0	0	0
Total Production		69749	43	40	0	0	0	0	0	0	0	0	83