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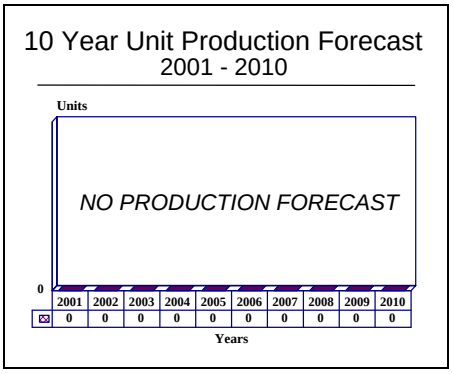
AAS-38/38A/B (NITE Hawk) – Archived 12/2002

Outlook

- NITE Hawk's replacement, the Advance Targeting Forward Looking Infrared (ATFLIR) system, has entered low-rate initial production
- Further production not scheduled
- This report will be archived in the near future



Orientation

Description. Forward-looking infrared (FLIR) targeting system. Improved versions incorporate a laser designator/ranger, laser spot tracker, and infrared search and track (IRST). Also known as NITE Hawk.

Sponsor

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(Laser target designator/ranger)

Status. In service.

Total Produced. An estimated 496 units were produced through 2000.

Application. To date, production units have been installed almost exclusively on F/A-18 platforms.

Flight tests of the NITE Hawk (SC) variant have been performed on F-14, F-15, F-16 and AV-8B aircraft.

Price Range. A 1995 FMS contract for 47 units at US$99 million suggests a unit price of US$2.1 million, in 1995 dollars.

Technical Data

	Metric	US
Characteristics		
Diameter (AAS-38/38A/38B):	33 cm	13 in
Length (AAS-38/38A/38B):	182.88 cm	72 in
Length (NITE Hawk SC):	243.84 cm	96 in
Weight		
AAS-38:	154.36 kg	340 lb
AAS-38A:	172.52 kg	380 lb
AAS-38B:	167.98 kg	370 lb
NITE Hawk SC:	195 kg	430 lb
Field of View		
Narrow:	3º x 3º	
Wide:	12º x 12º	
Field of Regard		
Pitch:	+300º to -1500º	
Roll:	+/-540°	
Stabilization Accuracy:	35 μrad	
Tracking Accuracy:	230 μrad	
Pointing Accuracy:	400 μrad	
Video:	RS-343, 875 lines	
MTBF:	80 hours	
MTTR:	12 minutes	
BIT Coverage		
Continuous:	90%	
Initiated:	95%	

Design Features. The AAS-38 FLIR system is a pod-configured unit mounted at the F/A-18 Sparrow missile station on the port engine nacelle. It consists of 12 separate weapon replaceable assemblies (WRAs) which make extensive use of digital technology for optics control, target auto-tracking, aircraft avionics communication (via a MIL-STD-1553 multiplex bus) and Built-In Test (BIT) functions. AAS-38 WRAs are configured for easy accessibility by flight line personnel, with no special tools required for removal and installation.

The pod is divided into two main areas designated as the forward and aft pod sections. The forward section is composed of three elements: an optics stabilizer, a forward section, and a laser transceiver. The optics stabilizer is a rotating, electromechanically driven, digital servo-controlled-tracking optics subassembly. It receives infrared energy from a target through a zinc sulfide mirror, which was found to offer better optical transmission compared to a conventional germanium receiver window. The subassembly is mounted on the forward end of the pod and provides look-angles between 30° up and 150° below horizontal, with +/-540° of roll freedom. A tracking rate of 75°/sec permits tracking of targets at low altitudes and high speeds. While the in-line design of the optics head precludes looking directly aft, it has the advantage of presenting a small pod frontal area with an associated low aerodynamic drag penalty.

The forward pod section contains an optical train which conditions the optical signal and focuses it on the infrared receiver. Together, the optics stabilizer and the forward section compose the head assembly. The aft section houses the temperature-conditioned FLIR receiver that detects infrared energy and converts it to a visible format, which the pilot views on an 875-line cathode ray tube (CRT) display. In addition, the receiver's image derotation feature controls the proper orientation of the cockpit-displayed thermal image.

The aft section contains the following WRAs: a roll drive motor that rotates the head assembly for line-of-sight tracking, a temperature-control assembly, a

controller-processor, a roll drive power amplifier, a high-speed digital servo control for controlling the optics stabilizer, a laser power supply, and a pod power supply.

The controller-processor assembly implements the target auto-tracking function using a contrast tracker. Using this algorithm, the unit digitizes, processes and updates an image while searching for target intensity changes to execute the tracking function following target acquisition. The FLIR system automatically corrects for any FLIR line-of-sight pointing and FLIR-to-laser boresight errors.

Operational Characteristics. The AAS-38 is designed to provide the attack version of the F/A-18 with day/night and adverse-weather capabilities by providing pilots with a real-time cockpit display of target thermal imagery. The system locates and acquires a target, then automatically tracks it while feeding precise target angle and angle rate data to the aircraft mission computer over a MIL-STD-1553 multiplex databus. The AAS-38 is fully integrated with other aircraft avionics and can be used with other sensors for weapon delivery and navigation.

The auto-track function is activated once a target has been acquired. When this occurs, parallel vertical bars representing the auto-track gate replace the crosshairs. This gate automatically expands (vertically and horizontally) to keep the area of interest centered in the display while the host F/A-18 aircraft maneuvers and approaches the target. Since the optical head can rotate to observe a target after the F/A-18 has passed it, the AAS-38 can be used in a weapon effectiveness assessment role subsequent to an attack. The FLIR can also be used to update the navigation system when flying over a known location.

Variants/Upgrades

NITE Hawk (SC). The AAS-38 was initially developed specifically for the US Navy F/A-18 aircraft. As such it was designed as a conformal unit, thereby limiting its application to this single platform. The NITE Hawk (SC) (self-cooled) system was conceived to provide a more generic interface, thereby expanding the system's application list. The system achieves 90 percent commonality with the AAS-38 FLIR. The NITE Hawk (SC) is functionally similar to the AAS-38 with the exception of the conformal fairing and environmental control modules. Physically it is larger, with a 96 inch length and a weight of 430 pounds. Ten of the unit's 12 weapon-replaceable assembles are common to both systems.

AAS-38A. This version, which incorporates a laser target designator/ranger (LTD/R) subsystem developed by Litton Industries, is used to provide the F/A-18 pilot with the capability for autonomous delivery of laser-guided munitions against surface targets. As previously indicated, the forward section of the pod contains the laser transceiver, which transmits a laser beam to illuminate the target and receive reflected energy from the laser beam to generate extremely accurate ranging data. The supporting laser power supply is located in the aft section of the pod. In addition to self-designation, the laser illumination provided from an AAS-38A-equipped aircraft can be used to direct laser-guided weapons released from aircraft not equipped with a laser target designator, thus enhancing the first-pass attack capability of the strike.

In addition to the LTD/R capability, Lockheed Martin (formerly Loral Aeronutronic) has incorporated various product improvements into the AAS-38A pod. These enhancements include pod boresight G-load compensation software to correct FLIR-to-laser boresight displacement for aircraft maneuvers up to 5 Gs, filtered Coordinate Sightline/Inertial (CSI) transformation data for improved targeting accuracy, and the addition of an air-to-air tracking mode capability.

AAS-38B. This variant adds a laser spot tracker, air-to-air infrared search and track (IRST), and scene track capabilities to the AAS-38 system. The IRST is a major addition to the FLIR system, intended to provide the E/F versions of the Hornet with long-range target detection and tracking capabilities.

Designed to operate in a search-while-track mode, the air-to-air IRST capability provides target detection, range determination, inertial location and movement, real-time target extraction, handoff to the air-to-air autotracker, and scan-slave-on-selected-targets functions. A synthetic display of scanned areas is also presented to the pilot. The laser spot tracker function allows the pod to track targets designated by external laser sources.

This variant also enhances single-target track and BIT functions. The AAS-38B pod maintains all the LTD/R capabilities of the AAS-38A pod while adding the above-listed new capabilities, plus provisions for future growth. Its advanced controller processor (ACP) technology is another improvement.

The major physical change to the B model is a redesigned aft section to accommodate the structural contours of the E/F model Hornet. A US$72 million contract awarded to Loral in July 1992 covered development and initial low-rate production of the first 20 AAS-38B pods for the US Navy.

Program Review

Background. Designed specifically for the F/A-18 Hornet, the AAS-38 is a high-resolution infrared imaging system that provides real-time target information, enabling the pilot to locate, identify, and track ground targets. Using the video display, the pilot can perform high-speed, low-altitude interdiction and close air support missions at night and in visibility reduced by smoke, dust, smog and haze. The system has proven equally effective in an air-to-air environment. Full-scale development began in 1978, and production deliveries to the US Navy began in December 1983.

Laser Target Designator/Ranger. Forward thinking was displayed by the original AAS-38's designers: they included provision for the later addition of a laser designator with a ranging function that would give the F/A-18 an autonomous capability for delivering laser-guided weapons. In 1983, Litton Laser Systems secured a US$2 million contract from Ford Aerospace to supply the Navy with prototype neodymium yttrium aluminum garnet (Nd/YAG) lasers for the AAS-38. The laser target designator/ranger (LTD/R) is a high-power, high-repetition-rate device that Litton had developed over the previous five years as a private venture. The initial contract covered engineering development and the provision of qualification and flight-test examples. Flight testing of the system was completed in 1987.

Second-Source Development. In 1990, Hughes Aircraft (now Raytheon Systems Company) was asked to develop the capability to become a second-source component supplier of the pod system. Up to that year, Loral had been sole-source producer of the AAS-38. Under the terms of the US$44.5 million contract, Hughes was to supply two complete FLIR pods and various quantities of the pod weapon replaceable assemblies (WRAs) equivalent to more than 20 additional pods, together with pertinent technical data, to be used to evaluate/qualify Hughes for producing the pod system. Deliveries were to begin in September 1991, and flight tests were scheduled for early 1994. Design qualification and flight testing were successfully completed in August 1994, whereupon Hughes became the second source for AAS-38 pods and spares.

As AAS-38 second-source supplier, the company has provided both the AAS-38A and its AAR-50 Thermal Imaging Navigation Set (TINS) pod, which forms the second half of the F/A-18C/D night attack package and is installed on the starboard position in place of the older ASQ-173. When integrated with the AAR-50 navigation FLIR and a pair of night vision goggles, NITE Hawk provides the pilot and aircrew with the capability to maintain situational awareness, navigate and avoid terrain, acquire and designate targets, and assess battle damage for deployment of the highly accurate PAVEWAY/GBU-24 precision-guided weapon series on an around-the-clock operational cycle.

Additional Platforms. Although its major platform is the F/A-18C/D, the NITE Hawk is configurable to other platforms. During the 1988 Persian Gulf convoy protection mission, several SH-60B LAMPS III helicopters were modified to carry the AAS-38 pod on the port-side stores station to provide a FLIR capability for these aircraft. IBM provided the interface between the AAS-38 FLIR 875-line video output and the Seahawk's 525-line displays. In addition to this, flight tests of the NITE Hawk (SC) variant have been performed on F-14, F-15, F-16 and AV-8B aircraft.

Performance in Bosnia. NITE Hawk has performed well in bombing missions over Bosnia, according to US Navy personnel. Three US carriers were outfitted with squadrons (two Navy and one Marine Corps) of F/A-18 Hornets, each equipped with NITE Hawk (36 systems total). Squadron commanders highly praised their performance. For Operation Deliberate Force, both the USS *America* and USS *Theodore Roosevelt* relied on NITE Hawk to put their F/A-18s' bombs on target. The mission's restrictive set of targets was well matched by NITE Hawk's ability to prevent collateral damage.

Use of NITE Hawk enabled the F/A-18 pilots to self-designate their targets without the help of other aircraft. This marked an advancement over past methods, those used during the Persian Gulf War against Iraq, for example, in how carrier-based aircraft conduct bombing missions. As explained in the October 2, 1995, issue of *Defense Daily*, these F-18 pilots relied on the Navy A-6 Intruder to designate targets for their laser-guided bombs. Now the A-6s are being phased out of the Navy's inventory, and none are aboard USS *America*. NITE Hawk covers this role.

Lockheed Martin and Sener of Spain announced at the 1999 Paris Air Show that they had a third-generation NITE Hawk Block III system which was available for installation on the F/A-18. Apart from this announce-

ment, no further information on this development, or any other progress on the NITE Hawk system, has been forthcoming. Spain reportedly has abandoned any hopes of procuring the Block III variant of the NITE Hawk system and is currently searching for a new targeting pod for their fleet of EF-18 fighter-bombers. It appears the new Advance Targeting Forward Looking Infrared (ATFLIR) system from Raytheon will be replacing the NITE Hawk system in the F/A-18C, D, E and F.

Funding

Through FY89, approximately $550.9 million in procurement funding was awarded in contracts for the AAS-38 system. Initial procurement funding was provided in FY82, with the first production deliveries entering service in FY84. Specific funding information is no longer broken out for the system.

Recent Contracts

Contractor	Award ($ millions)	Date/Description
Lockheed Martin	10.1	Nov 1996 – Modification to procure four additional AAS-38B Targeting FLIRs for the Royal Malaysian Air Force F/A-18Ds under the FMS program. Completion date was Mar 1998. (N00019-94-C-0039)
Lockheed Martin	15	Mar 1997 – Ceiling-priced order for 24 types of spare parts and seven shipping containers used to support the F/A-18 NITE Hawk pods. Combines purchases for the US Navy (15.3%), and the governments of Switzerland (77.9%) and Malaysia (6.8%) under the FMS program. Completion date was Jan 1999. (N00383-96-G-001A)

Timetable

Month	Year	Major Development
Mar	1978	Full-scale development initiated
Jan	1981	Initial flight tests completed on T-39
Sep	1983	Litton received initial LTD/R developmental contract from Ford Aerospace
Dec	1983	Initial AAS-38 deliveries begun (to US Navy)
	1987	Flight testing of LTD/R completed
Late	1989	Deliveries of AAS-38A LTD/R begun
May	1990	Hughes awarded coproduction capability development contract
Mid	1990	Loral acquired Ford Aerospace
Late	1991	Deliveries of AAS-38A to Australia and Spain completed
Dec	1991	Contract to McDonnell Douglas for incorporation of laser spot tracking into FLIR and LTD/R on F/A-18
Jul	1992	Contract for AAS-38B laser spot tracker pods awarded to Loral
Early	1996	Lockheed Martin acquired Loral
Nov	1996	Most recent FMS contract award for full production systems
Mar	1998	Completion date of last FMS unit-production contract

Worldwide Distribution

Customers of the AAS-38 FLIR system in its various forms include the **US** Navy/Marine Corps (116 AAS-38, +/-254 AAS-38A, 20 AAS-38B), and the air forces of **Australia** (29 AAS-38A), **Spain** (18 AAS-38A), **Kuwait** (16 AAS-38B), **Canada** (13 AAS-38B), **Switzerland** (at least two AAS-38B), and **Malaysia** (four AAS-38B).

Forecast Rationale

Lockheed Martin's AAS-38/38A/B NITE Hawk forward-looking infrared (FLIR) targeting and navigation pod was designed for the F/A-18C/D aircraft. By providing pilots with real-time FLIR thermal imagery, NITE Hawk permits pilots to assess enemy attack force size and identify airborne targets. The NITE Hawk can be fully integrated with the F/A-18s other avionics, allowing data from the AAS-38 to be used for the calculation of weapons release solutions.

With over 450 units produced, the NITE Hawk has had a fairly successful production run. Despite efforts to market an updated third-generation NITE Hawk Block III system, it appears the NITE Hawk is no longer in production. Spain, a main supporter of the Block III variant, apparently has abandoned its intentions of procuring the new NITE Hawk pods for its fleet of EF-18 Hornets.

Newer and more advanced pods, like the Litening and Sniper pods, are winning large orders. NITE Hawk is being directly replaced by Raytheon's Advance Targeting Forward Looking Infrared (ATFLIR) pod. The effective targeting range of the ATFLIR is superior to that of the NITE Hawk by a factor of 3-5. In addition to the AAS-38, the ATFLIR will replace the LDT/Strike Camera and the AAR-50 NAVFLIR. The ATFLIR pod successfully completed its first test flight on an F/A-18 in 1999. Raytheon was awarded a US$21 million contract from Boeing which includes options for the first two years of low-rate initial production (24 units for the first year and 33 for the second). Initial operational capability for ATFLIR is scheduled for early 2002.

With the development of ATFLIR, a market for the AAS-38 NITE Hawk, at least in the US, is not foreseen. All future F/A-18's are presumed to be fitted with the ATFLIR system. Although, there may be a minor market internationally for NITE Hawk upgrades of existing F/A-18s, it is more likely that more advanced systems like ATFLIR will be procured. No further production is being forecast. Barring any new contracts, this report will be archived in the near future.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

			High Confidence Level				Good Confidence Level				Speculative			
Designation	**Application**	**Thru 00**	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**Total 01-10**
AAS-38	Prior Prod'n:	116	0	0	0	0	0	0	0	0	0	0	0
AAS-38A	Prior Prod'n:	300	0	0	0	0	0	0	0	0	0	0	0
AAS-38B	Prior Prod'n:	80	0	0	0	0	0	0	0	0	0	0	0
Total Production		496	0	0	0	0	0	0	0	0	0	0	0