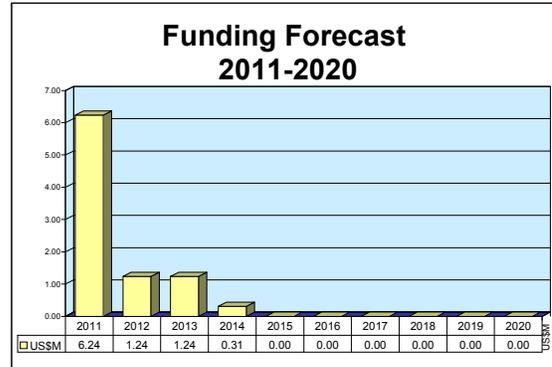


# ASQ-170(V)/AAQ-11(V) (TADS/PNVS)

## Outlook

- TADS/PNVS has been replaced by the M-TADS/PNVS, otherwise known as the Arrowhead, for all U.S. and most international sales
- Very limited sales possible to nations that are not approved for M-TADS/PNVS or as spares
- The U.K. and U.S. have allocated reset and logistics support funding for legacy and modernized TADS/PNVS assemblies



## Orientation

**Description.** The Target Acquisition and Designation Sight/Pilot Night Vision Sensor (TADS/PNVS) is an all-weather electro-optical sighting and targeting system for attack helicopters.

**Status.** Production is near end or has finished, ongoing logistics support.

**Application.** The TADS/PNVS equips the Boeing AH-64A/D Apache attack helicopter.

### Sponsor

U.S. Army Aviation and Missile Command (AMCOM)  
Redstone Arsenal, AL  
USA  
Web site: [www.garrison.redstone.army.mil](http://www.garrison.redstone.army.mil)

**Price Range.** Each system costs approximately \$3.6 million.

## Contractors

### Prime

|  |   |
|--|---|
| <b>Lockheed Martin Missiles &amp; Fire Control - Orlando</b>                     | <a href="http://www.lockheedmartin.com/mfc/">http://www.lockheedmartin.com/mfc/</a> , 5600 Sand Lake Rd, MP 455, Orlando, FL 32819-8907 United States, Tel: + 1 (407) 356-2000, Fax: + 1 (407) 356-2080, Prime  |
| <b>Honeywell Aerospace, Defense &amp; Space Electronic Systems - Minneapolis</b> | <a href="http://www51.honeywell.com/aero/">http://www51.honeywell.com/aero/</a> , 2600 Ridgway Pkwy, Minneapolis, MN 55413 United States, Tel: + 1 (612) 951-6444, Fax: + 1 (612) 951-6516, Second Prime  |
| <b>Northrop Grumman Laser Systems</b>  | <a href="http://www.es.northropgrumman.com">http://www.es.northropgrumman.com</a> , 2787 South Orange Blossom Trail, Apopka, FL 32703 United States, Tel: + 1 (407) 295-4010, Fax: + 1 (321) 354-3848, Email: <a href="mailto:laser-systems@ngc.com">laser-systems@ngc.com</a> , Second Prime |
| <b>Raytheon Network Centric Systems, Command and Control Systems (C2S)</b>       | <a href="http://www.raytheon.com/businesses/ncs/c2s/">http://www.raytheon.com/businesses/ncs/c2s/</a> , 6620 Chase Oaks Blvd, M/S 8529, Building 4, Plano, TX 75023 United States, Tel: + 1 (972) 575-2647, Second Prime  |

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

Contractors are invited to submit updated information to Editor, International Contractors, Forecast International, 22 Commerce Road, Newtown, CT 06470, USA; [rich.pettibone@forecast1.com](mailto:rich.pettibone@forecast1.com)

**ASQ-170(V)/AAQ-11(V) (TADS/PNVS)****Technical Data**

|                          | <u>Metric</u>  | <u>U.S.</u> |
|--------------------------|--|-------------|
| <b>Dimensions</b>        |  |             |
| TADS FLIR diameter       | 22.86 cm   | 9 in        |
| System weight            | 249.43 kg  | 549.4 lb    |
| <b>Characteristics</b>   |  |             |
| Power requirements       | 700 watts DC<br>3.8 kW AC                                      |             |
| <b>Field of regard</b>   |  |             |
| TADS                     | Azimuth $\pm 20^\circ$<br>Elevation $+30^\circ$ to $-60^\circ$ |             |
| PNVS                     | Azimuth $\pm 90^\circ$<br>Elevation $+20^\circ$ to $-45^\circ$ |             |
| <b>Field of view</b>     |  |             |
| TADS day sensor assembly |  |             |
| Day TV image tracker     |  |             |
| Zoom                     | 0.45°  |             |
| Narrow                   | 0.9°   |             |
| Wide                     | 4.0°   |             |
| Direct-view optics       |  |             |
| Narrow                   | 4.0° (16x)   |             |
| Wide                     | 18.0° (3.5x)   |             |
| TADS night sensor        |  |             |
| Zoom                     | 1.6°   |             |
| Narrow                   | 3.1°   |             |
| Medium                   | 10.1°  |             |
| Wide                     | 50.0°  |             |
| PNVS                     | 30° x 40°  |             |

**Design Specifications.** The TADS/PNVS sighting and targeting system provides AH-64 Apache pilots and gunners with an all-weather capability to find, identify, and track targets, and can fire a combination of "smart" weapons in a matter of seconds. The system combines TV, infrared, laser, and direct-view optics to find targets and guide the Apache's weapons from long ranges.

**ASQ-170(V) Target Acquisition and Designation Sight (TADS)** is located in a chin turret and is comprised of an optical telescope, a forward-looking infrared (FLIR) system, a high-definition TV, a laser designator/ranger, a laser, and a TV tracker. The TADS turret can look 120° to either side, 60° down, or 30° up. It is controlled either by the copilot/gunner's sighting fixture or by a crewman's helmet-mounted sight, known as the Integrated Helmet and Display Sighting System (IHADSS).

**AAQ-11(V) Pilot Night Vision System (PNVS)** is mounted above the TADS and contains an independent FLIR imager slaved to the pilot's head movements through his IHADSS. The PNVS can slew 45° down, 20° up, and 90° to either side.

The azimuth gimbal assembly contains part of the direct-view optics path and mechanical azimuth and elevation-drive hardware. The turret is mechanically positioned to line-of-sight commands from the cockpit.

The FLIR sensor is used for night and adverse weather target acquisition and tracking, and also serves as a backup for the PNVS.

Separate from the TADS, the PNVS employs a gimballed FLIR sensor that receives instantaneous positioning commands from an electro-optical tracking system and transmitted by the pilot's head movements, thus providing excellent coordination between pilot and sensor. Primarily, the PNVS is used for navigation in darkness and adverse weather and to maintain terrain avoidance while flying nap-of-the-earth. The IHADSS allows the pilot/gunner to selectively point the TADS, PNVS, and 30mm Chain Gun®. The system is fast and flexible in acquiring targets.

All production line-replaceable units in the TADS/PNVS have built-in test capability to detect and isolate faults in the TADS/PNVS' circuits.

**Operational Characteristics.** The copilot/gunner can view video and FLIR imagery by employing the ORT, a hands-on control unit that is the central subsystem in the copilot/gunner's position (forward cockpit). The ORT is directly connected to the TADS sensor assembly and includes an eyepiece for viewing outside scenes using the direct-view optics, video, or FLIR sensors. The imagery can be displayed on a small cathode ray tube (CRT) directly below the eyepiece,

## ASQ-170(V)/AAQ-11(V) (TADS/PNVS)

overlaid with flight and navigational symbology. The twin handgrips on the ORT contain all the switches and controls needed to operate the TADS. The copilot/gunner can view imagery on a one-square-inch monocular mounted in front of his right eye, part of the IHADSS.

The copilot/gunner's cockpit has CRT displays for tracking, viewing, laser ranging, and designation of targets. There are three tracking modes: manual; automatic, using a laser tracker that detects and locks onto a laser spot, and providing the inputs that drive the TADS turret to track the spot; and the image autotracker offset tracking mode of the ORT. Viewing options are through the day video camera, the night FLIR, or direct-

view optics that provides a "real-world" image of what the copilot/gunner sees. The copilot/gunner has the ability to employ the TADS laser ranger and target designator, both of which can also be used for navigational updates.

The pilot in the aft cockpit uses the IHADSS as well. The PNVS FLIR is slaved to the pilot's line of sight via the IHADSS, and rotates according to the pilot's head movements, with the FLIR imagery relayed to the helmet display. An electro-optical tracking system monitors head movements. The pilot can also view FLIR imagery on a small display on the instrument panel. Both crew members can use either the TADS or the PNVS FLIR system as circumstances require.



AH-64 Apache

Source: Boeing

## Variants/Upgrades

**Improved Detector-Dewar.** An improved detector-dewar common module enhanced the TADS/PNVS thermal imaging capability. Designated the T-637/UA, the detector-dewar is a 180-channel detector, mounted onto a cryogenic mechanical cooler to form the detector/cooler assembly.

The DT-637/UA is a form, fit, function replacement for the existing DT-594/UA detector-dewar, and is replacing the latter as attrition warrants.

**Improved Laser Designator.** As part of the HELLFIRE Optimized Missile System (HOMS) program, the Army is upgrading the TADS/PNVS with a new laser-coded designator designed for HOMS targeting. The HOMS seeker features improved electro-

optics countermeasures against jamming. HOMS is now designated the AGM-114K HELLFIRE II.

**MTDAT.** The Multi-Target Detector and Automatic Tracker was designed to reduce the copilot/gunner's workload by automatically detecting, prioritizing, and tracking up to six targets simultaneously, an improvement over the old system's ability to track a single target after being engaged manually by the crew. MTDAT employs patented geometric arithmetic parallel processor (GAPP) technology to perform real-time analysis of imagery from the TADS IR and TV sensors.

A GAPP-based computer uses thousands of tiny processors working together to study each pixel of the sensor image 30 times per second. Potential targets are detected by using advanced algorithms that compare

## ASQ-170(V)/AAQ-11(V) (TADS/PNVS)

groups of pixels against memory-based features of real targets. The new tracker will automatically alert the crew to objects with a high probability of being targets.

**M-TADS/PNVS.** Known as the Arrowhead, the M-TADS/PNVS adds a new FLIR and laser to the TADS/PNVS, improving targeting and navigation. It

also replaces the direct-view optics with a high-resolution display, improving situational awareness. Integration and testing began during the summer of 2004. It was originally developed for the RAH-66 Comanche, but later switched to the Apache. A separate report covers the Arrowhead.

## Program Review

TADS/PNVS was developed as part of the Advanced Attack Helicopter, and was considered critical to the AAH effort. The first production TADS/PNVS units were delivered in 1983.

TADS/PNVS combined forward-looking direct-vision optics (DVO) and television sensors with a common boresight, and was a substantial improvement over the 1960s- and 1970s-vintage sensors that equipped the AH-1G Cobra. It provided more night flying capability for the AH-64A and full automatic tracking – features lacking in the older system. The sensors in the TADS portion combine search, detection, and tracking features found in no other U.S.-made system.

In 1991, a General Accounting Office (GAO, now Government Accountability Office) report called out numerous reliability problems with the AH-64 attack helicopter, including a decline in the reliability of the TADS/PNVS. The Army initiated a Product Improvement Program to develop several engineering change proposals (ECPs) for the Apache sensor system, correcting deficiencies identified by the GAO and revealed by operational experience during the Persian Gulf War. Enhancements were incorporated to reduce focus-regulator and high-voltage power supply failures, and improve the reliability of the wiring harness and the laser and the quality of the FLIR video. Also, improvements were made to the TADS electric unit.

### *Export Orders Fuel TADS/PNVS Production*

In October 1999, the Pentagon released a notice that Israel had requested the remanufacture of 24 AH-64A Apache helicopters to the -D Longbow configuration. The order would include a variety of systems, including 24 TADS/PNVS units.

In July 2000, Egypt requested the upgrade of 35 AH-64As to the AH-64D Longbow configuration, equipped with TADS/PNVS.

In February 2001, Israel signed a Letter of Offer and Acceptance for nine AH-64Ds via the Foreign Military Sales (FMS) program. The nine helicopters would include eight new-production AH-64Ds, plus one existing Israeli AH-64A converted to the -D model.

In March 2001, the Army authorized Boeing to begin procuring long-lead items for 35 Egyptian AH-64As to be upgraded to the AH-64D configuration. An FMS contract was expected to be finalized, and deliveries were scheduled to begin in 2003.

In August 2001, Singapore signed a Letter of Offer and Acceptance with the U.S. government for 12 additional AH-64Ds. Singapore had already ordered eight AH-64Ds, with deliveries scheduled to begin in 2002.

In August 2001, the Japan Defense Agency (JDA) announced that it had selected the AH-64D as its new attack helicopter to replace Bell AH-1S helicopters in the Japan Ground Self-Defense Force fleet. The JDA, now called the Ministry of Defense, was planning to procure a total of 60 AH-64Ds. Ten AH-64Ds were to be procured by fiscal 2005. Fuji will build the Japanese AH-64Ds.

### *Arrowhead Replaces TADS/PNVS*

TADS/PNVS is being replaced by a modernized version or M-TADS/PNVS, known as Arrowhead. Many of the orders for the TADS/PNVS, development of which began in 2000, were switched to Arrowhead, while orders that had already been fulfilled were upgraded to the Arrowhead.

## Contracts/Orders & Options

(Contracts over \$5 million)

| <u>Contractor</u> | <u>Award (\$ millions)</u> | <u>Date/Description</u>  |
|-------------------|----------------------------|--|
| Lockheed Martin   | 129.7                      | Jan 2003 – Delivery order amount as part of a \$180,005,028 FFP contract for multiple spares for the TADS/PNVS. Was to be completed Jan 2009. (DAAH23-02-D-0321) |

**ASQ-170(V)/AAQ-11(V) (TADS/PNVS)**

| <b><u>Contractor</u></b> | <b><u>Award<br/>(\$ millions)</u></b> | <b><u>Date/Description</u></b>  |
|--------------------------|---------------------------------------|---|
| Lockheed Martin          | 5.1                                   | Dec 2003 – Delivery order as part of a \$688,957,118 FFP contract for multiple spares for the TADS/PNVS. To be completed Mar 2009. (DAAH23-02-D-0321)   |
| Lockheed Martin          | 7.6                                   | Dec 2003 – Delivery order as part of an \$11,163,597 FFP contract for a sight/pilot night vision sensor. Completed Dec 2004. (DAAH23-99-G-103)  |
| Lockheed Martin          | 7.0                                   | Dec 2004 – FFP contract for technical and logistics engineering services for TADS/PNVS. Work was completed in Dec 2005. (W58RGZ-04-G-0017)  |
| Lockheed Martin          | 122.6                                 | Apr 2007 – Contract for logistical support for the AH-64 Apache Modernized and Legacy TADS/PNVS system. Work was completed by Dec 2007. (W58RGZ-07-C-0058)  |
| Lockheed Martin          | 80.66                                 | Dec 2007 – Contract for logistical support for the AH-64 Apache Modernized and Legacy TADS/PNVS system. Work was completed by Dec 2008. (W58RGZ-07-C-0058)  |
| Lockheed Martin          | 89.59                                 | Dec 2008 – Contract for the repair and maintenance of line replaceable units and modules to support the Apache Sensors Flying Hours Program for 2009. Work was completed by Dec 2009. (W58RGZ-07-C-0058)  |
| Lockheed Martin          | 99.3                                  | Dec 2009 – Contract for the repair and maintenance of line replaceable units and modules to support the Apache Sensors Flying Hours Program for 2010. Work was completed by Dec 2010. (W58RG-07-C-0058)   |
| Lockheed Martin          | 7.56                                  | Mar 2010 – FFP contract for reset support to include inspection, refurbishment, and removal of sand, dust and foreign material intrusion to the Apache modernized and legacy TADS/PNVS. Work is estimated to be completed Feb 28, 2011. (W58RGZ-10-C-0023). |
| Lockheed Martin          | 48.7                                  | Dec 2010 – Contract for logistical support of Arrowhead and legacy TADS/PNVS including the repair and maintenance of LRUs and modules to support the Apache sensors flying hours program. Work will be completed by Jun 2011. (W58RGZ-07-C-0058)            |

**Timetable**

| <b><u>Month</u></b> | <b><u>Year</u></b> | <b><u>Major Development</u></b>  |
|---------------------|--------------------|--|
| Mar                 | 1977               | Competitive TADS/PNVS contracts  |
| Apr                 | 1981               | First production contract awarded  |
|                     | 1983               | First production unit delivered  |
| Jul                 | 1986               | First TADS/PNVS-equipped AH-64 squadron activated at Fort Hood, Texas                                      |
| Early               | 1990               | U.S. Army AH-64 procurement plan reduced to 811 aircraft; Egypt and Israel announce buy                    |
| Apr                 | 1992               | AH-64D first flight  |
|                     | 1995               | Sales to the United Kingdom and the Netherlands  |
|                     | 1996               | Initiation of AH-64C and AH-64D Longbow modernization programs   |
| Mar                 | 1997               | Initial Apache AH-64D delivery   |
| Oct                 | 1999               | Israel announces intent to remanufacture 24 AH-64A Apache helicopters into AH-64Ds equipped with TADS/PNVS |
| Jul                 | 2000               | Egypt requests upgrade of 35 AH-64As to AH-64D Longbow with TADS/PNVS                                      |
|                     | FY00               | Start of development of M-TADS/PNVS sensor upgrade   |
|                     | 2002               | Singapore deliveries begin (8)   |
| Late                | 2003               | Start of production of M-TADS/PNVS upgrades; Egyptian deliveries planned to begin                          |
| Sep                 | 2005               | First Arrowhead systems delivered to U.S. Army   |

**ASQ-170(V)/AAQ-11(V) (TADS/PNVS)****Worldwide Distribution/Inventories**

TADS/PNVS started as a U.S. Army program. Customers include Egypt, Greece, Israel, Japan, the Netherlands, Saudi Arabia, Singapore, UAE, the United Kingdom and the United States.

**Forecast Rationale*****TADS/PNVS Phased Out by Arrowhead***

Lockheed Martin delivered the first eight Arrowhead systems for the U.S. Army Modernized TADS/PNVS program in September 2005.

Most new contracts for the AH-64D Apache helicopter include the incorporation of Arrowhead. The TADS/PNVS will only equip Apaches operated by countries for which the United States has not yet approved the sale of Arrowhead. As Arrowhead technology has aged, the U.S. is more willing to sell the Arrowhead system abroad.

There may be limited TADS/PNVS production to fulfill spares requirements; however, most TADS/PNVS systems are being updated with M-TADS/PNVS modules on flight lines.

***Operations and Maintenance Funding - U.S.***

In April and December 2007, Lockheed Martin was awarded contracts for logistical support for U.S. Army AH-64 Apache Modernized and Legacy TADS/PNVS systems. These awards were followed by December 2008, December 2009 and December 2010 contracts to Lockheed Martin for the Apache Sensors Flying Hours

Program. It is believed that a small portion of these funds support TADS/PNVS work. Additionally, in March 2010, Lockheed Martin was awarded a \$7.56 million contract for reset support for TADS/PNVS and M-TADS/PNVS assemblies. The one-year contract includes inspection, refurbishment, and removal of sand, dust, and foreign material intrusions.

***Operations and Maintenance Funding - U.K.***

In February 2010, Lockheed Martin announced that AgustaWestland awarded the company a sustainment and support contract for the TADS/PNVS and M-TADS/PNVS systems on the U.K. Apache AH Mk-1 aircraft. Support under this contract will continue through March 2014. The press release disclosed the overall value of the contract but did not break the award amount down by program.

***Over 25 Years of History***

The first TADS/PNVS unit was fielded in 1983 giving Lockheed Martin more than 25 years of contracts. Production of the TADS/PNVS has either ended or is close to being shut down. Since production levels are so small, this report will be archived in 2012.

**Ten-Year Outlook**

| <b>ESTIMATED CALENDAR YEAR O&amp;M FUNDING (in millions \$)</b>   |                 |      |      |      |      |                 |      |      |             |      |      |       |
|---|-----------------|------|------|------|------|-----------------|------|------|-------------|------|------|-------|
| Designation or Program  | High Confidence |      |      |      |      | Good Confidence |      |      | Speculative |      |      | Total |
|   | Thru 2010       | 2011 | 2012 | 2013 | 2014 | 2015            | 2016 | 2017 | 2018        | 2019 | 2020 |       |
| <b>Lockheed Martin Missiles &amp; Fire Control - Orlando</b>  |                 |      |      |      |      |                 |      |      |             |      |      |       |
| <b>TADS/PNVS &lt;&gt; United Kingdom &lt;&gt; Army</b>  |                 |      |      |      |      |                 |      |      |             |      |      |       |
|   | .93             | 1.24 | 1.24 | 1.24 | .31  | .00             | .00  | .00  | .00         | .00  | .00  | 4.02  |
| <b>TADS/PNVS &lt;&gt; United States &lt;&gt; Army &lt;&gt; Reset Support - Inspection/Removal of Foreign Material</b> |                 |      |      |      |      |                 |      |      |             |      |      |       |
|   | .63             | .13  | .00  | .00  | .00  | .00             | .00  | .00  | .00         | .00  | .00  | .13   |
| <b>TADS/PNVS &lt;&gt; United States &lt;&gt; Army &lt;&gt; Logistical Support</b>                                     |                 |      |      |      |      |                 |      |      |             |      |      |       |
|   | 68.51           | 4.88 | .00  | .00  | .00  | .00             | .00  | .00  | .00         | .00  | .00  | 4.88  |
| <b>Subtotal</b>   | 70.06           | 6.24 | 1.24 | 1.24 | .31  | .00             | .00  | .00  | .00         | .00  | .00  | 9.02  |
| <b>Total</b>  | 70.06           | 6.24 | 1.24 | 1.24 | .31  | .00             | .00  | .00  | .00         | .00  | .00  | 9.02  |