

FLIGHT TESTS FOR TERMINAL HIGH-ALTITUDE AREA DEFENSE (THAAD)

** The matrix below is a summary of the major flight tests of the THAAD upper tier terminal-phase missile defense system. The THAAD underwent such serious developmental problems that it stopped its testing in 1999 and revamped itself entirely. New flight testing began in December 2005. Since its overhaul, THAAD has made an intercept in four out of five flight test attempts. The latest flight test, FTT-08, was held on Oct. 27, 2007, and resulted in an intercept. According to fiscal year (FY) 2009 budget justification documents, Missile Defense agency (MDA) plans on delivering the first THAAD fire unit between 2QFY09 and 4QFY10 (instead of 3QFY08 and 3QFY09, as had been planned in the previous year's budget request); it will be made up of 24 interceptors, 3 launchers, 1 THAAD radar, and 2 fire control and communications units. The second fire unit will be delivered between 3QFY10 and 4QFY11 (instead of 3QFY09 and 4QFY10, as had been planned in the previous year's budget request), and will have the same components as the first THAAD fire unit. The FY 2009 budget justification shows significant schedule delays, many of which are due to problems with its test targets.**

*Last updated: April 24, 2008
By Victoria Samson, Research Analyst
Center for Defense Information
www.cdi.org*

Flight Test #	Date	Intercept?	Notes
FT-1	April 21, 1995	N/A	Propulsion test, no target. The first of 13 planned flight tests in the demonstration/validation phase of development; this and FT-2 were scheduled to be the only non-intercepts.
FT-2	July 31, 1995	N/A	Kill vehicle control test, no target. It was aborted because the missile was going too fast at burnout. To adjust to its high speed, the missile arced up, bringing it to a point where debris from its planned destruction at the end of the test would have landed outside the test range. This test was supposed to be a dry-run for FT-3, which was supposed to be an intercept attempt. At this point in time, it was expected that development, testing and production of THAAD would cost about \$10 billion and that it would be produced at the end of 1996.
FT-3	Oct. 13, 1995	N/A	Target fly-by. A Storm target was used to gather seeker data. EMD was expected to last four years and cost about \$1.2 billion to \$2 billion; it was thought then that only seven more tests were needed before an EMD decision could be made.
FT-4	Dec. 13, 1995	No	Software error in avionics led to premature kill vehicle fuel consumption. A Storm target was used.
FT-5	March 22, 1996	No	Kill vehicle connector to booster failed at separation. It was the first test involving all components, including the palletized

			load system.
FT-6	July 15, 1996	No	Seeker electronics failure or dewar contamination led to saturation of one half of focal plane array. A Hera target was used. At that point, each THAAD test cost \$2 million.
FT-7	March 6, 1997	No	Kill vehicle battery interface connection was contaminated, preventing operation of DACS thrusters. This was the first test that the THAAD radar took part in. At that point, the User Operational Evaluation Systems (UOES) of THAAD was scheduled to be available by FY 99, while deployment of THAAD was to begin in 2004.
FT-8	May 12, 1998	No	Electrical short circuit due to foreign object debris in thrust vector control caused booster failure. Prior to the test, Pentagon officials tried to lower expectations by saying they would consider the test successful if the missile reached the endgame. Angry with the repeated failures, the Senate voted to cut the FY 99 funding authorization by \$253.9 million, reallocating the resources to black projects. This eliminated the rest of the money authorized in FY 99 to begin an EMD contract with Lockheed Martin. SASC had already cut \$70 million from the THAAD EMD authorization for that year. The House voted to make Lockheed Martin liable for future tests.
FT-9	March 29, 1999	No	Attitude control system nozzle was torn from its bracket. There were four failures: a maneuvering thruster malfunctioned, the thruster's combustion chamber overheated, the telemetry failed and the missile missed the target. The test was also to demonstrate the infrared indium antimonide (InSb) seeker, closed-loop system, and (for the first time) the user operational evaluation system radar performance against the unitary target. Lockheed Martin was penalized \$15 million for the miss.
FT-10	June 10, 1999	Yes	Intercept of Hera class unitary target within the aimpoint region (an area on the mock warhead). At this point, the goal was to field units by 2007. The interception occurred at an altitude of just under 60 miles with both target and interceptor traveling at just under 1 mile/sec.
FT-11	Aug. 2, 1999	Yes	Exoatmospheric intercept of Hera class separating target within the aimpoint region (again, an area on the mock warhead). After, the Pentagon decided to skip attempting a third interception before going into EMD (the contract was awarded June 30, 2000, for \$4 billion). If Lockheed Martin had not achieved an interception, it would have been fined \$20 million.
Block 2004	2004 or 2005	N/A	THAAD had been scheduled to hold a total of four non-intercept exoatmospheric flight tests from 2004 to 2005. However, the explosions at the Pratt-Whitney propellant-mixing plant in the summer and fall of 2003 had a ripple effect

			on the program's testing. The whole program has been moved to the right and is striving toward fielding two fire units to the Army later than anticipated. Hence, the tests have been renamed accordingly.
THAAD Flight Test (FTT)-01	Nov. 22, 2005	N/A	There was no target involved in this test: it was a component-level missile characterization flight. According to Director of Operational Test & Evaluation's report for FY 2005, "This test successfully demonstrated missile egress, booster/KV separation, KV shroud separation, Divert and Attitude Control System operation, and KV control." Also, before this test was held, "MDA took a deliberate approach to pre-test qualification of the missile;" this "discovered and fixed several problems." The test slipped one quarter, in the words of Army Col. Charles Driessnack, MDA's THAAD manager, because "[T]echnical discoveries have delayed completion of interceptor qualification, integration and assembly."
FTT-02 (FT-2)	May 10, 2006	N/A	MDA called this test "successful" in achieving all its objectives. A simulated target was "injected" into THAAD's radar, after which the rest of the system's components operated as they would normally. The only other difference was that when THAAD's missile seeker deployed, it didn't have a target to find. This also marked the first test that used electronic controls: the test preceding it only had mechanical controls.
FTT-03 (FT-3)	July 12, 2006	Yes	A unitary Hera target missile was used in this test, whose primary goal was seeker characterization in the high endo-atmosphere, just inside the Earth's atmosphere. While an intercept was not cited as the main objective of the test, one was achieved. This test, the first fully integrated flight test of the revamped THAAD system, had originally been scheduled for March 2006.
FTT-04 (FT-4)	Sept. 13, 2006	No	FTT-04's primary objective was an intercept, but it had to be stopped due to a faulty missile. It was supposed to use a separating target; instead, the unitary Hera target missile had to be destroyed by safety officers at the White Sands Missile Range (WSMR), N.M., two minutes after it was launched. The Hera missile may have had a panel give way before the first stage could complete burn out, causing the missile to veer off-track. The THAAD interceptor, scheduled to be launched five and a half minutes after the Hera missile, was thus not launched. According to Col. Charles Driessnack, THAAD project manager, data collection during the test makes them believe that the THAAD interceptor "wouldn't have had any difficulty engaging that target." As such, he says that "we're very confident in the system's performance."
FTT-05 (FTT-04-01)	Postponed: 2Q FY 2007	N/A	This non-intercept test originally had been scheduled to be held shortly after FTT-04. It was to be a missile "only" a

	(Summer 2007)		characterization test – no intercept was to be attempted - and was designed to see how THAAD did in the lower atmosphere. Originally, after the failure of FTT-04, this test was scrapped so that the schedule wouldn't slip too much. It is now scheduled to occur sometime in the summer of 2007, and according to the FY 2008 budget justification, will demonstrate booster-kill vehicle separation in a “high dynamic pressure fly-out environment.”
FTT-06 (FTT-06-1/FT-06)	Jan. 27, 2007	Yes	The test resulted in the intercept of a “‘high endo-atmospheric’ (just inside earth’s atmosphere) unitary (non-separating) target representing a ‘SCUD’-type ballistic missile.” The target was launched from naval platform positioned off the Hawaiian island of Kauai. Besides successfully launching the interceptor from the Pacific Missile Range Facility, other primary objectives included: “interceptor seeker characterization (target identification), discrimination and intercept of a non-separating liquid-fueled target; and collection of data including missile aimpoint, ground equipment and radar tracking/target discrimination and hit assessment algorithms, and evaluation of the missile launching procedures and equipment.”
FTT-07 (FTT-06-2/FT-07)	April 6, 2007	Yes	The test “involved the successful intercept of a ‘mid endo-atmospheric’ (inside earth’s atmosphere) unitary (non-separating) target representing a ‘SCUD’-type ballistic missile.” The target launch procedure was very similar to that of FTT-06. The THAAD unit’s command and control system also linked with a “simulated” AEGIS ship via a satellite link with the Navy’s Space and Naval Warfare Systems Command in San Diego. Other completed objectives included “demonstrating the integration of the radar, launcher, fire control, communications and interceptor operations; interceptor seeker characterization (target identification); discrimination and intercept of a non-separating liquid-fueled target; and examining launch procedures and equipment.”
FTT-08 (FTT-06-3/FT-08)	Oct. 27, 2007	Yes	According to the FY 08 budget justification documents, FTT-08 was supposed to demonstrate “Exo Aim point selection & intercept” against a high aspect liquid-fueled target outside the atmosphere. During this test, a “threat-representative” short-range unitary target was intercepted outside the Earth’s atmosphere. A ship off the coast of Hawaii fired the target missile, and minutes later, soldiers with the U.S. Army’s 6th Air Defense Artillery Brigade in Kauai launched an interceptor missile that destroyed its target. According to DOT&E, “the missile was ‘heat-conditioned’ before the test to simulate operations in a hot environment.”
FTT-09 (FTT-06-	2QFY08 – 3QFY08	TBD	This is supposed to be an endoatmospheric intercept of a separating target.

4/FT-09)	(originally, 2QFY08)		
FTT-10 (FTT-06-5/FT-10)	4QFY08-1QFY09 (originally, 4QFY08)	TBD	According to the FY 09 budget justification documents, this test will be a “[s]alvo exo intercept of separating target unconstrained (DT/OT mission).”
FTT-11 (FTT-06-6)	2QFY09-3QFY09 (originally, 1QFY09)	TBD	This will be an exoatmospheric intercept of a “lofted spin-stabilized reoriented separating target.” It was pushed back due to a lack of an appropriate target.
FTT-12 (FTT-08-1)	4QFY09 – 1QFY10 (originally 2QFY09-3QFY09)	TBD	This is supposed to be a dual endoatmospheric intercept of “two complex separating targets.” It was pushed back due to a lack of appropriate targets.
FTT-13 (FTT-08-2)	2QFY10-3QFY10 (originally 3QFY09-4QFY09)	TBD	This test will be an exoatmospheric intercept of a “long range separating high velocity MRBM target.” It was pushed back to due to a lack of appropriate targets.
FTT-14 (FTT-08-3) (DUAL)	3QFY10-4QFY10 (originally 1QFY10-2QFY10)	TBD	This test also will be an exoatmospheric intercept of a “long range separating high velocity MRBM target.” And it too was pushed back due to a lack of appropriate targets.
FTT-15 (FTT-08-4)	Probably cancelled	N/A	FTT-15 did not appear in the FY 09 or FY 08 budget justification documents, but had been in the FY 07 budget justification documents. It appears to have been cancelled.
FTT-16 (FTT-08-5)	Probably cancelled	N/A	FTT-16 did not appear in the FY 09 or FY 08 budget justification documents, but had been in the FY 07 budget justification documents. It appears to have been cancelled.
FTT-17 (FTT-08-6)	Probably cancelled	N/A	FTT-17 did not appear in the FY 09 or FY 08 budget justification documents, but had been in the FY 07 budget justification documents. It appears to have been cancelled.

Sources:

Director, *Operational Test and Evaluation FY 2000 Annual Report* report for FT-1 - FT-11

FT-1: “THAAD in successful maiden test flight,” *Defense Daily*, April 24, 1995

FT-2: “High missile velocity forced abort of THAAD test,” *Aerospace Daily*, Aug. 2, 1995; “Missile test failure won’t slow production,” *Albuquerque Journal*, Aug. 23, 1995 .

FT-3: “THAAD likely to go for intercept in next test,” *Aerospace Daily*, Oct. 18, 1995 .

FT-4: “THAAD misses target in first intercept attempt,” *Aerospace Daily*, Dec. 14, 1995 .

FT-5: “THAAD interceptor again misses target,” *Aerospace Daily*, March 25, 1996 .

FT-6: “THAAD fails third consecutive intercept test,” *Defense Daily*, July 16, 1996.

FT-7: “No intercept in THAAD’s fourth attempt,” *BMD Monitor*, March 7, 1997

FT-8: “Senate cuts funds for THAAD, AMRAAM,” *Armed Forces Newswire Service*, May 15, 1998;

“THAAD fails in fifth intercept try,” *Aerospace Daily*, May 13, 1998.

FT-9: “Army homes on cause of THAAD miss; plans cost ‘incentives,’” *Aerospace Daily*, April 29, 1999;

“Uneasiness grows in hometown of \$ 3.8 billion missile that keeps missing,” *AP*, April 26, 1999

FT-10: "THAAD hits, but Lockheed Martin 'still not out of the woods'," *Defense Week*, June 14, 1999; "Lockheed Martin and the U.S. Army," *Aviation Week and Space Technology*, June 14, 1999.

FT-11: "THAAD at crossroads after intercept," *Aviation Week and Space Technology*, Aug. 9, 1999; "Pentagon defends THAAD move," *Albuquerque Journal*, Aug. 25, 1999 .

Block 2004: "House Armed Services Committee report on the FY 03 Defense Authorization Act," <http://www.defenselink.mil/dodgc/lrs/docs/HR4546-HASCRpt.pdf>, May 3, 2002; "Patriot Games; Overcoming recent test failures will be crucial to US ballistic missile defence plans," *Flight International*, June 11, 2002; MDA RDT&E, Defense-Wide Budget Documentation, FY 2004 Budget Request; "THAAD Passes Critical Design Review, Moves To Flight Testing," *Defense Daily*, Dec. 23, 2003.

FTT-01: *Director, Operational Test and Evaluation FY 2005 Annual Report*, December 2005; "MDA, industry bill second THAAD flight test as a success," *Inside the Army*, May 15, 2006.

FTT-02: Army Col. Charles Driessnack, THAAD Prog. Dir., at the Army Space and Missile Defense Conference, August 2005; "MDA, industry bill second THAAD flight test as a success," *Inside the Army*, May 15, 2006; "MDA pleased with 2nd THAAD flight test," *Aerospace Daily and Defense Report*, May 12, 2006.

FTT-03: "Missile defense achievements; Interview with Obering," *UPI*, Jan. 2, 2006; "Missile Defense Agency's THAAD system intercepts target," *Inside the Pentagon*, July 13, 2006; "MDA, industry bill second THAAD flight test as a success," *Inside the Army*, May 15, 2006.

FTT-04: "THAAD Test Aborts Due To Target Missile Malfunction," *Defense Daily*, Sept. 14, 2006; "THAAD flight test halted at White Sands after target malfunction," *Inside Missile Defense*, Sept. 27, 2006; "THAAD Testing Transitions To Hawaii," *Defense Daily*, Oct. 11, 2006.

FTT-05: "Notes From The AUSA Space And Missile Defense Symposium ," *Inside the Army*, Dec. 11, 2006; "Missile Defense Agency's THAAD system intercepts target," *Inside the Pentagon*, July 13, 2006; "MDA, industry bill second THAAD flight test as a success," *Inside the Army*, May 15, 2006; *FY 2008, Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification*, February 2007.

FTT-06: "Successful Missile Defense Intercept Test Takes Place Off Hawaii," *Missile Defense Agency News Release*, January 27, 2007.

FTT - 07: "Successful Missile Defense Intercept Test Takes Place Off Hawaii," *Missile Defense Agency News Release*, April 6, 2007; "THAAD Goes Another ABM Test," *SpaceDaily.com*, April 9, 2007.

FTT-08: *Director of Operational Test & Evaluation FY 07 Annual Report*, January 2008; *FY 2008, Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification*, February 2007; "Lockheed's THAAD Downs Missile in Test," *Huntsville Times*, Oct. 28, 2007

FTT-09- FTT-14: *FY 2009, Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification*, February 2008

FTT-15 - FTT-17: *FY 2007, Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification*, February 2006