

FLIGHT TESTS FOR AEGIS BALLISTIC MISSILE DEFENSE

** The matrix below is a summary of the major flight tests in the Navy's Aegis Ballistic Missile Defense system. The Aegis BMD system has made eight intercepts out of ten attempts. The most recent flight test intercept occurred on April 26, 2007. However, the primary cause of the one flight test failure - the new guidance control system, the Solid Divert and Attitude Control System (SDACS) – still is not being used in its most advanced mode, which may affect its maneuverability against more demanding targets.**

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Flight Test Number	Date	Intercept?	Notes
Control Test Vehicle-1A (CTV-1A)	Sept. 24, 1999	n/a	This test was the first launch of the SM-3 missile, which showed a successful second and third stage separation and flight endurance – once it launched (it actually was supposed to be launched on Sept. 23, but did not fire due to a computer error; the test had to be repeated the following day).
FTR-1 (the first risk reduction flight and the second flight overall in the Aegis LEAP intercept (ALI) test series)	July 14, 2000	n/a	The third stage of the SM-3 failed to separate. An errant interrupt signal was transmitted to the missile that caused it to fail immediately after launch. The software, which had been used in an earlier test without problems, had to be re-coded.
Flight Test Round-1A; a repeat of FTR-1 (third flight test of nine scheduled)	Jan. 25, 2001	n/a	This test was conducted to evaluate the SM-3's airframe stability and control through a nominal kinetic warhead separation. The test launch achieved third-stage separation, third-stage motor burn, and attitude control through nominal KW separation.
Flight Mission (FM)-2	Jan. 25, 2002	Yes	This fly-by test was not intended to be an intercept: its objective was to evaluate the SM-3's fourth-stage kinetic warhead guidance, navigation and control. The SM-3 was launched by the USS Erie Aegis cruiser against an Aries target missile, which has been reported as having been five times longer and a third wider than any medium-range ballistic missile that the SMD is being designed to shoot down. It was the first fully operational SM-3 with a live solid divert and attitude control system to

			steer the kinetic warhead into the target.
FM-3	June 13, 2002	Yes	In this designated intercept test, an SM-3 launched from the USS Erie Aegis cruiser successfully intercepted an Aries ballistic missile target. This was the fifth of nine planned developmental tests. FM-3 only intended to show that a Navy interceptor can hit a ballistic missile target; FM-3 did not attempt to demonstrate lethality. To be "killed", certain types of enemy missiles must be hit at the right spot for a hit to also be a kill. This will be attempted on FM-4.
FM-4	Nov. 21, 2002	Yes	FM-4 marked the first time a Navy theater test target was intercepted during its ascent phase. An SM-3 missile was launched from the Aegis cruiser USS Lake Erie to counter an Orbital Sciences Test Target Vehicle that was launched from the Pacific Missile Range Facility in Kauai, Hawaii. The SM-3 missile had an altitude of 93 miles at the time of impact; because of this, its flight time was shorter by about a minute and a half. FM-4 demonstrated the SM-3's ability to switch its aimpoint while in flight to increase its accuracy, according to Raytheon program officials. FM-4 was the first of six planned flight tests to develop an emergency sea-based short- and medium-range ballistic missile defense capability.
FM-5	June 18, 2003	No	FM-5 was supposed to demonstrate the Block 2004 system's solid divert and attitude control system (SDACS) and its ability to achieve a lethal aim point shift in an ascent phase scenario; it failed at both. The attitude control system had been reengineered, so this was its first flight test. Another new addition for the testing program was a package on the Aries target missile that MDA officials hoped would allow for a more thorough post-test assessment of the attempted interception. In FM-5, an Aries target missile was launched from the Pacific Missile Range Facility in Kauai, Hawaii; two minutes later, an SM-3 interceptor was launched from the USS Lake Erie Aegis cruiser. The mock warhead was deployed and the guidance system was activated, but an interception did not occur and both missiles fell

			<p>into the Pacific ocean. The malfunction may have resulted from a crack in the diverter ball that regulates gas flow in the SDACS. The SDACS has three solid propellant sections. The first pulse (the sustain pulse) may have overheated the warhead enough so that one of the other pulses (pulse one and two) cracked the diverter ball. Because of this problem, the first five SM-3 interceptors deployed by Oct. 1, 2004, will have their SDACS pulse one and pulse two disabled.</p>
FM-6	Dec. 11, 2003	Yes	<p>FM-6 was designed to demonstrate the Block 2004 system's solid divert and attitude control system (SDACS) and its ability to achieve a lethal aim point shift in an ascent phase scenario. While an interception did occur, the SDACS was tested in a different mode than the one in which it will be deployed. This flight test has been portrayed by the Missile Defense Agency as part of the SM-3's "more complex, stressing, and operationally realistic ballistic missile engagement scenarios." However, FM-6 was a modified, less difficult version of FM-5, which was held in June 2003 and a failure. FM-5's problem has been traced to the SDACS that was used for the first time in that test. Specifically, the SDACS was being used in pulse mode, which probably created the cracked piece which resulted in the malfunction that caused the intercept failure. FM-6 used the new SDACS but in a sustain mode, with no additional pulses being used (which is not how it is designed to work out in the field). FM-6 saw a Standard Missile (SM)-3 interceptor (off of the Lake Erie near Kauai) intercept an Aries target at the speed of 3.7 kilometers per second and at an altitude of 137 kilometers.</p>
Flight Test Maritime 04-1 (formerly FM-7)	Feb. 24, 2005	Yes	<p>During Flight Test Mission (FTM) 04-1, a target was launched from the Pacific Missile Test Range in Kauai, followed one minute later by a Standard Missile (SM)-3 Block 1 interceptor from the <i>USS Erie</i>, an Aegis cruiser which was situated about 100 miles from Kauai. Two minutes after that, an intercept was reported. The interceptor again used only the sustain pulse mode of its guidance control</p>

			<p>system, the SDACS. FTM 04-1 was the first for the initial operational variant of the Aegis BMD system and used a “no-notice” launch for the target missile. During this scenario, the Aegis crews are put on alert, like they would be during a time of heightened hostilities, but they do not know exactly when the test target will be launched. FTM 04-1 had been originally scheduled to be tested in summer 2004; likewise, it did not include a target with a separating warhead, as first planned by program officials.</p>
FTM-04-2 (formerly FM-8)	Nov. 17, 2005	Yes	<p>A medium-range target missile with a separating warhead was launched from the Pacific Missile Range Facility. The target had a range of 620 to 1,860 miles. It was intercepted by an SM-3 at an altitude over 100 miles. This was the first time a separating target was used. According to the DOT&E report, “Recent ground tests of the SM-3 third-stage rocket motor surfaced problems with thrust performance for certain fly-out scenarios. Also during ground tests of the redesigned kinetic warhead maneuvering system, the highest pulsed thrust mode failed to consistently perform to specification. This maneuvering system was redesigned in FY05 an attempt to address past problems with thrust response. These thrust anomalies could lead to additional design changes.”</p>
FTM-04-3 (formerly FM-9)	4QFY06	TBD	<p>FTM-04-3 was cancelled, as a missile defense official claimed that “After FTM 04-2, we learned enough that FTM 04-3 objectives had essentially been met.” Instead, MDA will focus on future flight tests.</p>
Joint Control Test Vehicle (JCTV)-1	March 8, 2006	N/A	<p>This was the first test of a Japanese-designed nosecone for the U.S.-designed SM-3 interceptor, and comes after nearly six years of cooperative effort by the two countries. This new nosecone opens up so that the SM-3 missile doesn’t have to maneuver around when it is ready to launch its kinetic kill vehicle. JCTV-1 used a simulated target.</p>
FTM-10 (FTM-06-1/FM-10)	June 22, 2006	Yes	<p>In this test, a medium-range target with a separating warhead was intercepted by an SM-3 Block 1A missile at an altitude of roughly 100</p>

			<p>miles. It was launched from the <i>USS Shiloh</i>, instead of the usual <i>USS Lake Erie</i>. FTM-10 is notable as the first time another country's ship – Japan's Aegis destroyer <i>Kirishima</i> – participated in such an exercise. According to the FY 06 budget justification documents, it was to attempt the intercept of multiple targets using SM-3 Block I and IA missiles in separate engagements; this did not happen.</p>
FTM-11 (FTM-06-2/FM-11)	Dec. 7, 2006	No	<p>The test failed abruptly when <i>USS Lake Erie</i>'s incorrectly-set fire control prevented the interceptors from launching. The test was based from the Pacific Missile Range Facility in Hawaii, and was scheduled to have an SM-3 interceptor hit a ballistic missile target and an SM-2 interceptor hit a surrogate aircraft target. The <i>USS Hopper</i> and the Royal Netherlands Navy's <i>TROMP</i> tracked the targets, both of which dropped into the Pacific Ocean without incident.</p>
FTM-11b	April 26, 2007	Yes	<p>This was a repeat of the failed FTM-11 test. During FTM-11b, the <i>USS Lake Erie</i> launched an SM-3 Block 1A against a short-range unitary ballistic missile target, and an SM-2 Block IIIA against a "target with characteristics similar to a hostile high performance aircraft." The ballistic missile target was launched from PMRF facility, while the air-breathing target was launched from a Navy aircraft. The SM-3 Block 1A target was destroyed at an altitude of approximately 100 miles. According to the MDA, "The test also demonstrated the effectiveness of engineering, manufacturing, and mission assurance changes in the solid divert and attitude control system (SDACS);" however, it is not clear whether the system was used in multipulse mode, which had caused a flight test failure the last time it was used in June 2003.</p>
FTM-11a	4QFY07	TBD	<p>This test will attempt to demonstrate an operationally realistic engagement. "Minimal" data will be provided to the AEGIS cruiser prior to the test. It is unclear whether or not an intercept is a primary goal of the test. Details appear in the Test and Targets section of the FY 08 budget but not in the Aegis BMD section.</p>

FTM-12 (FTM-06-3/FM-12)	Previously scheduled for 3QFY07 (in FY 07 budget)	TBD	This test was in the FY 07 budget justification documents but does not appear in the FY 08 version. It may have been renamed as FTM-11a (above) or have been cancelled.
FTM-13 (FTM-06-4/FM-13)	1QFY08	TBD	The FY 08 budget contains contradictory information about this test. The Aegis BMD section claims that the test will involve the simultaneous engagement of two short-range ballistic missiles (SRBMs). The Test and Targets section, on the other hand, describes the test as an intercept attempt of “a unitary exo-atmosphere ballistic missile targets [sic].”
JFTM-2	1QFY09	TBD	This test will demonstrate the lethal intercept of an exo-atmospheric “Group ‘B’ MRBM target.” The interceptor will be launched from a Japanese destroyer.
FTM-14 (FTM-08-1/FM-14)	Previously scheduled for 3QFY08 (in FY 07 budget)	TBD	This test does not appear in the FY08 budget documentation.
FTM-15 (FTM-08-2/FM-15), Block 2008	2QFY09	TBD	This test will be a “zero-pulse” mission, which is a specific setting of the interceptor’s third-stage rocket designed to increase the missile’s capability against short range threats. However, it has yet to be successfully flight tested since being added as part of the new Block 2006 suite of capabilities. The target in this test will be a SRBM.
FTM-16 (FTM-08-3/FM-16)	3QFY09 (moved up from 3QFY10)	TBD	In this test, an interceptor will attempt to destroy a MRBM target. This test appears in the Aegis BMD section of the FY08 budget, but not in the Test and Targets section.
FTM-17 (FTM-08-4/FM-17?)	3QFY10 (moved up from 3QFY11)	TBD	This test will apparently involve the simultaneous intercept of one “Group B” and one “Group C” MRBM target in a “multi-warfare environment.” This test appears in the Aegis BMD section of the FY08 budget, but not in the Test and Targets section.
FTM-18	3QFY11	TBD	The test will involve both a “developmental” intercept of an IRBM target and an “operational” test of a MRBM target, again in a “multi-warfare environment.” This test appears in the Aegis BMD section of the FY08 budget, but not in the Test and Targets section.

FTM-19	3QFY12	N/A	This is scheduled to test the SM-3 Block IIA interceptor and will involve a simulated target only. This test appears in the Aegis BMD section of the FY08 budget, but not in the Test and Targets section.
FTM-20	2QFY13	TBD	This test will use the Block IIA interceptor against a "Group C" MRBM target. It is unclear what the "Group C" designation refers to. This test appears in the Aegis BMD section of the FY08 budget, but not in the Test and Targets section.
FTM 10-1	1QFY10	TBD	The FTM-10 test series is a residual from the FY 06 budget justification documents, but they do not show up in more recent budget justification documents. It is unclear if they have been pushed back farther, eliminated, or renamed.
FTM 10-2	3QFY10	TBD	
FTM 10-3	1QFY11	TBD	
FTM 10-4	3QFY11	TBD	

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FTM-12 - FTM-20: *FY 2008, Missile Defense Agency (MDA) Exhibit R-2A RDT&E Project Justification*, February 2007

FTM-15: Ronald O'Rourke, "Sea-based Missile Defense – Background and Issues for Congress," Congressional Research Service, Updated April 27, 2007.

FTM 10-1- FTM 10-4: *MDA FY 2006/2007 Budget Estimates*, February 2005