

*FLIGHT TESTS FOR GROUND-BASED MIDCOURSE MISSILE DEFENSE*

\*\* The matrix below is a summary of the major flight tests in the Missile Defense Agency's ground-based midcourse missile defense system.\*\*

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Test No.	Date	Intercept?	Notes	Decoys
IFT-1A	June 24, 1997	n/a	Non-intercept fly-by to assess the performance of the Boeing-built EKV seeker, collect target phenomenological data, and evaluate (post-test) target-modeling and discrimination algorithms. The target cluster consisted of 10 objects: one mock warhead, one bus (the stage of the missile which releases the warhead and decoys), and eight decoys. Boeing was not chosen as the NMD EKV contractor.	Eight decoys: three that were conical in shape, like the warhead, and five spherical balloons. One balloon was large – 2.2 meters in diameter – and had a brighter IR signature than the mock warhead. The two medium-sized balloons were about as bright as the mock warhead; they did not deploy as expected and were not reliable parts of the testing program. The two small balloons were released via a canister and were much dimmer than the mock warhead.
IFT-2	Jan. 16, 1998	n/a	Non-intercept fly-by to assess the performance of the Raytheon-built EKV seeker, collect target phenomenological data, and evaluate (post-test) target-modeling and discrimination algorithms. The target cluster consisted of 10 objects: one mock warhead, One bus (the stage	The same decoy set used in IFT-1A was also used in IFT-2.

			of the missile which releases the warhead and decoys), and eight decoys. Raytheon was chosen as the NMD EKV contractor.	
IFT-3	Oct. 2, 1999	Yes	<p>Element test of the EKV, not an end-to-end system test, which relied on a surrogate booster vehicle and range assets to define the “deployment basket” and deliver the EKV to that location. Once deployed, the EKV operated autonomously to intercept the mock RV. Due to a malfunctioning Inertial Measurement Unit (IMU), which normally is used to position the EKV for the intercept, a backup method of locating the target had to be exercised. The EKV called upon its “step-stare” capabilities (which are used only during off-nominal circumstances) to extend its field of view since the target was not where anticipated. After executing that procedure, the EKV acquired its target. In a background test parallel with the EKV flight test, the BMC3 and other elements functioned as planned. The XBR is still in development, so a Ground Based Radar Prototype (GBR-P) is used in its stead. Because the radar is in a position where it cannot completely track the missiles, a Global Positioning System (GPS) receiver on the mock</p>	<p>The only decoy used in IFT-3 was the large balloon from IFT-1A and IFT-2. It had an IR signature six times higher than that of the mock warhead. Because the decoy was so much brighter than the mock warhead, the EKV saw it first. Once the EKV realized that the balloon’s IR signature did not match up with the target data it had received prior to the test, the interceptor shifted to the nearby target.</p>

			warhead emitted location data; a C-band transponder beacon was used as a backup.	
IFT-4	Jan. 18, 2000	No	First end-to-end system test (intercept attempt) using NMD prototype elements (except the IFICS) and range assets to approximate the objective system. The EKV was again successfully delivered by a surrogate booster and separated into the deployment basket. The failure to intercept is directly traceable to the cryogenic cooling system of the EKV, which failed to cool the IR sensors down to their operating temperatures in time because of an obstructed cooling line. Again, because of the GBR-P's limited tracking abilities, a GPS receiver and a backup C-band radar beacon on the mock warhead emitted location data.	The only decoy used was the single large balloon from the previous tests. Smaller balloons originally had been planned to be a part of IFT-4, but were dropped in an attempt to simplify the test (partially because of the Welch panel recommendations).
IFT-5	July 8, 2000	No	Second end-to-end system test (intercept attempt) using NMD prototype elements and range assets to approximate the objective system. The IFICS served as the communication link between the BMC3 and EKV. The failure to intercept was the direct result of the EKV not separating from the surrogate booster due to an apparent failure in the 1553 data bus in the booster. A C-band transponder on the	The only decoy used was the large balloon from previous tests. It did not inflate properly, causing MDA officials to decide to use a different decoy in the future.

			mock warhead gave off location information; its data was compared against its GPS receiver to determine its accuracy.	
IFT-6	July 14, 2001	Yes	<p>This test was a repeat of IFT-5. The prototype X-Band radar (XBR) used in IFT-6 could not process all the information it was receiving quickly enough, causing it to falsely report that the interceptor had missed its target. If that had happened in a non-test situation, more interceptors would have been needlessly launched at the target to ensure a hit. The kill was confirmed by sensors on a satellite, a 747 jet, and ground stations – backups that will not be available to the fully-developed XBR. A C-band beacon on the mock warhead produced most of the target location data. Starting in IFT-6, a glitch was identified in the GMD's exoatmospheric kill vehicle (EKV)'s target position estimation data, which is used to monitor and track the target during its flight so that the EKV can make an intercept. According to MDA spokesperson Lt. Col. Rick Lehner, the recurring glitch "never interfered with the effectiveness of the EKV," and could have been attributed to "degraded EKV inertial measurement unit output data." MDA believed the anomaly to</p>	<p>One large decoy balloon was used. This one was 1.7 meters in diameter, so it was slightly smaller than the large balloon used earlier as a decoy. This new decoy still had an IR signature much brighter (approximately three times) than that of the mock warhead.</p>

			have been caused by electromagnetic interference into test-unique cabling. This cabling was also used in IFT-7, IFT-8, and IFT-9	
IFT-7	Dec. 3, 2001	Yes	<p>The only variable changed from IFT-6 was the target booster: instead of Lockheed Martin's Multi-Service Launch System, Orbital's Target Launch Vehicle was used. The target set, a modified Minuteman ICBM carrying a mock warhead and a single decoy, did not change. It was not a substantive modification of the test configuration. Again, as in IFT-5 and IFT-6, the mock warhead's C-band beacon produced most of the target location data. IFT-7 was designed to see how well the systems elements would integrate, in addition to attempting to intercept the target missile. Critics noted that interceptor received a wealth of targeting information prior to the test and questioned its operational realism.</p>	There was only one decoy in IFT-7, and it was the same one that was used in IFT-6.
IFT-8	March 15, 2002	Yes	<p>Again, the kill vehicle was given prior information to guide it to the target, which may well have been appropriate for an early level of testing but certainly does not indicate a realistic operational test. The system still depends on a C-band transponder beacon emitting location data in</p>	Three decoy balloons (one large, two small) were used to increase the difficulty of determining the target's location; however, critics pointed out that the infrared signals of the balloons differed from that of the mock

			order to find the mock warhead. At the time of IFT-8, the Pentagon had planned on holding at least 20 more tests which were to be completed at a pace of roughly one every four months. This has not happened as promised.	warhead. The large balloon had a much larger infrared signature than that of the mock warhead, whereas the two small balloons had much smaller signatures.
IFT-9	Oct. 14, 2002	Yes	The Aegis SPY-1 radar was used for the first time in a national missile defense capacity. It tracked the target missile in-flight, and the information it gathered was passed to the GMD's battle management system but was not used to achieve the intercept. Also, a C-band transponder on the mock warhead provided early flight trajectory and location data. IFT-9 was originally planned to take place in August 2002, but was twice delayed. First it was postponed for about a week while program officials scrambled to fix a leak in the kill vehicle's helium tank. Then it was delayed because of problems with the seals of an engine nozzle on the booster rocket.	IFT-9 is said to have included the same three decoy balloons (one large, two small) in its target cluster as were used in IFT-8, but the specifics are unknown as MDA classified decoy details in May 2002.
IFT-10	Dec. 11, 2002	No	IFT-10 failed when the Raytheon-built exoatmospheric kill vehicle (EKV) did not separate from its booster rocket, a modified Minuteman ICBM that was being used as a surrogate until a more advanced booster rocket could be developed. The problem was created when	The increase in target complexity over the entire GMD flight test program has been much slighter than originally planned; for example, IFT-7 initially was to include a tumbling RV, but problems with the GMD technology have

			<p>a pin broke that should have activated a laser to release the boost vehicle's restraining units, causing the boost vehicle to remain with the EKV. The failure to separate precluded the EKV from attempting an intercept of the target missile. The pin came apart from excessive vibrations related to the removal of a piece of insulating foam by the subcontractor to make monitoring the system easier. IFT-10's failure caused Boeing and Raytheon to forfeit much of the award fees. This was the first night test of the GMD flight test program, but because the intercept failed, the objective of IFT-10 to demonstrate the ability to intercept a target at night was not achieved. Also incorporated into the test process for the first time were the radars of the Theater High Altitude Area Defense system and the Airborne Laser, both of which were used to track the target missile after its launch. IFT-10 was the last flight test with the surrogate booster rocket. A nearly year-long pause was given to the testing program so that a new booster could be brought into the program and new hardware could be installed in the Ft. Greely site.</p>	<p>prevented that target type from being a part of any test target clusters so far. This lag in target complexity, especially when combined with the test delays after IFT-10, has hindered MDA's ability to demonstrate the GMD technology's targeting discrimination capabilities in more realistic test scenarios.</p>
IFT-11 and IFT-12	Cancelled	N/A	The MDA announced in January 2003 that it would	

			cancel these tests so that it could instead focus on developing the GMD system's booster rocket. Overall, the MDA has cancelled nine out of 20 flight tests scheduled in the next five years so it can meet the Bush administration's deadline of starting an initial missile defense deployment in 2004. These cancellations prompted a report from the non-partisan General Accounting Office warning that the MDA is "in danger of getting off track early and impairing the effort over the long-term."	
IFT-13	Cancelled	N/A	The MDA cancelled IFT-13 – a flight intercept test – so that it could focus on developing a new booster rocket for the GMD system. Instead, the test has been split into three booster development tests, IFT-13A, -13B, and -13C.	
IFT-13A	N/A	N/A	Lockheed Martin's test, IFT-13A, has been indefinitely delayed due to explosions at its rocket fuel mixing plant in the summer and fall of 2003. Right now, MDA is planning on using only the Orbital version in its initial deployment but may use the Lockheed Martin rocket for later deployments. It may be used in FTG 04-1 (BV+RRF/13a/16b/IFT-1/b), which is scheduled for 4QFY05.	
IFT-13B	Jan. 26,	N/A	This system-level test of the	

	2004		Orbital Sciences' boost vehicle launched the rocket carrying a simulated EKV from Kwajalein Atoll against a simulated target coming from Vandenberg AFB, Calif. IFT-13B was not an intercept attempt. Included in this test was the latest version of the GMD program's fire control software, which is being built by Northrop Grumman and which performed as expected in this test. IFT-13B was the second test of Orbital Sciences' booster; the first was Booster-Verification (BV)-6, successfully held in August 2003.	
IFT-13C	Dec. 15, 2004	No. The interceptor failed to leave the silo.	In this test, the new Orbital Sciences booster was supposed to fly from Kwajalein and hit a target coming out of Kodiak, Alaska. While the target flew as planned, the booster failed to leave the ground. The system shut itself down 23 seconds before launch. According to Lt. Gen. Trey Obering, the head of the MDA, this was due to a "very minor glitch" in the software. He stated that the failure arose when a routine pre-flight test showed that there were too many electronic messages being missed in the interceptor's communications bus, but that this was the designers' fault for having set the bar too high for an acceptable level of missed messages.	

			<p>However, there are many other problems with the 1553 communications bus being used for the GMD system, which is regarded by some as being incapable of processing messages at a rate that is fast enough for the GMD system to work effectively. IFT-13C officially was slated to be a target “fly-by,” but program officials had hoped that an intercept would occur since both a live target and live EKV were used. IFT-13C was originally supposed to have been held in December 2003, but a pre-flight ground-inspection determined that there were serious flaws in the EKV’s circuitry that could affect the divert and attitude control system. This pushed back the test several times so that the electronic unit in question could be replaced.</p>	
IFT-14	Feb. 13, 2005	No. The interceptor failed to leave the silo.	<p>This test was a planned intercept attempt. As in IFT-13C, Orbital Sciences’ booster, carrying Raytheon’s production kill vehicle, was supposed to fly from Kwajalein and hit a target coming out of Kodiak, Alaska. And, also as in IFT-13C, while the target flew as planned, the booster failed to leave the ground. This time, however, the system shut itself down just a few seconds before launch. This failure has been traced</p>	

			to the arms that hold the interceptor up in the silo: apparently, they did not contract all the way, so the software that monitors the launch's progress aborted the mission. It is unclear whether this problem affects the other GMD interceptors that have already been fielded.	
IFT-15	May be cancelled? Unknown (had been planned for fall or winter 2004)	N/A	This test may have been cancelled. If it is held, it should not be confused with IFT-15A, which is simply a radar characterization flight. In IFT-15A, the target missile would be launched from Kodiak, Alaska. IFT-15, as planned by MDA officials, was supposed to have been a fully integrated flight intercept test with the target coming from Kodiak and the interceptor from Kwajalein.	
FT 04-2a/b (CMCM-1a/b)	2QFY05	N/A	This series of radar certification flights, part of the Block 2004 effort, goes by FT 04. CMCM means that it's a critical measurements and countermeasures test. These "are dedicated flight tests which provide a venue for risk reduction for BMDS Block Testing, addressing phenomenology, countermeasures, and counter-countermeasures requirements, and providing critical measurements to support developmental and validation of algorithms, modeling and simulation,	

			discrimination, and new technology demonstrations.” CMCM-5, -7, and -9 have been cancelled.	
FT 04-3 (MRT)	2QFY05	N/A	This radar certification test will use an MRT, or Medium Range Target.	
FT 04-1 (formerly IFT-16a)	3QFY05-2QFY06	N/A	Originally intercept attempt IFT-16, then changed to radar characterization flight test IFT-16A, now this is called FT 04-1. It will be a radar certification flight and will test the upgraded early warning radar at Beale AFB, Calif.	
FT 04-4 (CMCM-2)	4QFY05	N/A		
FT 04-5	4QFY05-3QFY06	N/A	This will be a radar certification test including Cobra Dane and a Long Range Air Launch Target (LRALT).	
FTG 04-1 (BV+RRF/13a/16b/IFT-1/b)	4QFY05	TBD	The tests for the GMD program have been renamed to better emphasize the block development in which MDA has organized its programs. This series of intercept flight attempts are part of the Block 2004 program. Originally, IFT-13a was to use the Lockheed Martin boost rocket; it is unclear whether that is still the case.	
FTG 04-2 (IFT 1/c)	1QFY06	TBD		
FTG 04-3 (IFT 2/a)	Unknown	TBD	Date not given, but the test is mentioned in the 2006/2007 budget documents.	
FTG 04-4a/b (formerly IFT-17/18)	Unknown	TBD	Date not given, but the test is mentioned in the 2006/2007 budget documents.	

FT 06-1 (GMD RCF3)	1QFY06	N/A	This series of radar certification tests supports the Block 2006 BMDS system's development. FT 06-1 is GMD RCF3 (radar certification flight).	
FT 06-2	2QFY06	N/A	This will include Japanese Cooperative JFM-1 in its test configuration.	
FT 06-3 (CMCM-3)	3QFY06	N/A		
FTG 04-5 (IFT-19/2d)	1QFY06	TBD	IFT-19 had been cancelled in earlier MDA test schedules, but some variant of it seems to have been revived.	
FTG 06-1a/b (formerly IFT-20/21)	4QFY06	TBD	IFT-20 had been cancelled in earlier MDA test schedules. Now FTG 06-1a/b is the first intercept flight test attempt for MDA's Block 2006 capability and will be a salvo mission.	
FTG 06-2 (formerly IFT-22)	1QFY07	TBD	.	
FTG 06-3a/b (formerly IFT-23/24)	2QFY07	TBD	IFT-23/24 were supposed to be multiple simultaneous engagements, so these may be as well.	
FT 06-4 (CMCM-4)	3QFY07	N/A	This will be a risk reduction flight for the MKV program.	
FT 06-5	Unknown		Not mentioned in the 2006/2007 budget documents.	
FT 06-6 (GMD RCF-4)	1QFY07	N/A		
FTG 06-4 (formerly IFT-25)	4QFY07	TBD	IFT-25 had been cancelled in earlier MDA flight test schedules.	
IFT-27	Cancelled		This cancellation dates back to earlier MDA flight test schedules.	
IFT-28	Cancelled		This cancellation dates back to earlier MDA flight test schedules.	
IFT-29	Fall 2007	TBD	Unclear which flight test	

			this is under the new naming system.	
IFT-30	Fall 2008	TBD	Unclear which flight test this is under the new naming system.	
FTG 06-5 (BV+RRF/16b)	1QFY08	TBD	This will be a risk reduction flight of the BV+ booster.	
FT 08-2 (CMCM-6)	2QFY08	N/A	This series of radar certification flight tests supports the Block 2008 BMDS system's development.	
FT 08-3	Unknown		This test was not mentioned in the 2006/2007 budget documents.	
FTG 08-1(formerly IFT-26)	2QFY08-1QFY09	TBD	This series of intercept flight intercept tests supports the Block 2008 BMDS system's development.	
FTG 08-2	3QFY08-2QFY09	TBD		
FTG 08-3a/b	4QFY08-3QFY09	TBD	This intercept attempt will be a salvo mission.	
FT 08-1	1QFY09	N/A		
FTG 08-4	1QFY09-4QFY09	TBD		
FT 08-4 (CMCM-8)	2QFY09	N/A		
FTG 08-5	3QFY09-2QFY10	TBD		
FTG 08-6	4QFY09-3QFY10	TBD		
FTG 10-1	1Q-4QFY10	TBD	This series of intercept flight intercept tests supports the Block 2010 BMDS system's development.	
FTG 10-2	3QFY10-2QFY11	TBD		
FTG 10-3a/b	4QFY10-3QFY11	TBD	This flight intercept attempt will be a salvo mission.	
FTG 10-4	1Q-4QFY11	TBD		
FTG 10-5	1Q-4QFY11	TBD		
FTG 10-6a/b	1Q-	TBD	This flight intercept attempt	

	4QFY11		will be a salvo mission.	
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Sources:

IFT-1A – IFT-5: *DOT&E FY 00* report; “Decoys and discrimination in intercept test IFT-8,” *DOT&E Report in Support of National Missile Defense Readiness Review*, aka “The Coyle Report,” Aug. 10, 2000; Union of Concerned Scientists Technical Working Paper, March 14, 2002

IFT-6: “Crucial radar failed missile defense test. Military: Although initially called a success, the system's trial run on Saturday had a troubling glitch, some analysts say,” *Los Angeles Times*, July 18, 2001; “Decoys and discrimination in intercept test IFT-8,” Union of Concerned Scientists Technical Working Paper, March 14, 2002

IFT-7: “Missile defense hits three out of five,” *Space & Missile*, Dec. 6, 2001; “BMDO using new target booster for missile defense test,” *Defense Daily*, Nov. 27, 2001; “Decoys and discrimination in intercept test IFT-8,” Union of Concerned Scientists Technical Working Paper, March 14, 2002

IFT-8: “Missile defense hit clears way for more complexity in countermeasures,” *Defense Daily International*, March 22, 2002; “Kill vehicle scores a hit with proponents of missile defense. Weapons: The Pentagon says the successful tests may restore credibility to the program,” *Los Angeles Times*, March 26, 2002; “Decoys and discrimination in intercept test IFT-8,” Union of Concerned Scientists Technical Working Paper, March 14, 2002

IFT-9: “US carries out successful missile defense test over Pacific,” *Agence France Presse*, Oct. 15, 2002; “The target set for missile defense intercept test IFT-9,” Union of Concerned Scientists Technical Working Paper, Oct. 11, 2002; “Helium leak in missile defense interceptor pushes back test,” *Aerospace Daily*, Aug. 14, 2002; “MDA delays GMD flight test to replace damaged interceptor nozzle,” *Defense Daily*, Aug. 21, 2002

IFT-10: “MDA reports EKV failed to separate from booster in GMD flight test,” *Defense Daily*, Dec. 12, 2002; “Overhauls Ground-Based Midcourse Test Plan To Prove More Than Hit-To-Kill,” *Defense Daily*, May 15, 2003; “Boeing Loses Bonus After Raytheon Warhead Fails in Missile Test,” *Bloomberg.com*, June 9, 2003

IFT-11/12: “Pentagon cancels two missile intercept tests, saving \$200 million,” *Associated Press*, Jan. 8, 2003; “Rush to field missile defense may ‘impair’ program, GAO says,” *Bloomberg.com*, June 3, 2003; “Missile Defense: Knowledge-Based Practices Are Being Adopted, but Risks Remain,” GAO-03-441, April 2003

IFT-13 and -13A: “MDA Reports Tight Schedule For New Booster Development and Test,” *Defense Daily*, May 19, 2003; “GMD booster verification test planned for mid-December,” *Aerospace Daily*, Dec. 2, 2003; “Year Of The Missile Shield: If all goes as planned, the US on Oct. 1 will throw the switch on its first true ballistic missile defense,” *Air Force Magazine*, January 2004; “Rapid Fire,” *Aviation Week & Space Technology*, Jan. 5, 2004

IFT-13B: “ATK backs test of Ground-Based Midcourse Defense System,” *Advanced Materials & Composites News*, Feb. 16, 2004; “GMD successfully conducts flight test with new booster,” *Aerospace Daily*, Jan. 28, 2004; “MDA carries out successful booster Integrated Flight Test,” *Defense Daily*, Jan. 28, 2004

IFT-13C: “‘Minor’ software glitch is cited in missile failure: program official calls problem easily correctable,” *Washington Post*, Jan. 13, 2005; “Ready or Not: Missile defense fielding nears, but critics remain skeptical of its effectiveness,” *Aviation Week & Space Technology*, June 28, 2004; “Interceptor repairs completed; missile defense test delayed,” *Defense Daily*, April 22, 2004

IFT-14: “Interceptor missile test fails,” *Los Angeles Times*, Feb. 15, 2005; “Ground equipment likely at fault in incomplete GMD test,” *Defense Daily*, Feb. 15, 2005; “U.S. missile defense again fails key test,” *Washington Post*, Feb. 15, 2005; “Rocket fails to launch in test run,” *New York Times*, Feb. 15, 2005; “Tester: GMD making progress, but not operationally ready,” *Aerospace Daily & Defense Report*, March 16, 2005

IFT-15: “GMD test cancellation delays test of upgraded radar,” *Aerospace Daily*, May 14, 2003

IFT-16: “U.S. plans Pentagon cancels three more intercept tests,” *Global Security Newswire*, April 21, 2003; “GMD test cancellation delays test of upgraded radar,” *Aerospace Daily*, May 14, 2003

IFT-27 – IFT-30: *MDA RDT&E, Defense-Wide Budget Documentation, FY 2004 Budget Request*, February 2004

FT 04-2 (CMCM-1) - FTG 10-6a/b: *MDA FY 2006/2007 Budget Estimates*, February 2005