Fact Sheet

U.S. DIRECT ASCENT ANTI-SATELLITE TESTING

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SUMMARY

While the United States does not have an operational, acknowledged direct ascent anti-satellite (DA-ASAT) system, it does have operational midcourse missile defense interceptors that have been demonstrated in an ASAT role against a satellite in a very low orbit. The United States has developed dedicated DA-ASATs in the past, both conventional and nuclear-tipped, and likely possesses the ability to do so in the near future should it choose so.

DIRECT ASCENT ASAT PROGRAMS

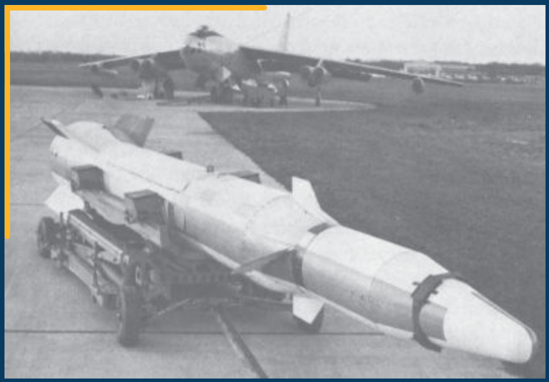
DA-ASATs use a ground, air, or sea-launched rocket to place a kinetic kill vehicle (KKV) on a ballistic trajectory up into space. After separation from the rocket, the KKV uses onboard guidance, navigation, and control systems to identify and track a targeted space object and fine-tune its trajectory to create a hypervelocity collision. DA-ASATs are very similar to midcourse missile defense interceptors, with the difference being the missile defense targets are also on ballistic trajectories. Unlike a co-orbital ASAT, the DA-ASAT KKV itself does not have enough velocity to achieve orbit and any resulting fragments are likewise unlikely to remain in orbit unless they were part of an orbital object that was struck.

COLD WAR BEGINNINGS

The initial anti-satellite capabilities came as final tests of already existing anti-ballistic missile (ABM) weapons, which have inherent ASAT capabilities. In the late 1950s and early 1960s, the United States tested many air-launched ballistic missiles (ALBM) as part of efforts to defend against Soviet ICBMs. At the end of the testing period, the final ALBM tests of the Bold Orion and High Virgo were used to validate the feasibility of destroying a satellite with ballistic missile technology. [1] These tests led to development of the first DA-ASAT program built from the Nike Zeus anti-ballistic missile. Around the same time, the U.S. Navy had the NOTSNIK, HiHo, and Satellite Interceptor Program (SIP) efforts also under development and testing.[2]

Nike Zeus

The Nike Zeus ASAT Program was developed out of anti-ballistic missile testing of the Nike Zeus system and later came to be known as Program 505. In 1962, Secretary of Defense Robert McNamara created Project Mudflap out of the Nike Zeus program in order to counter the Soviet Fractional Orbital Bombardment System (FOBS), a plan to place nuclear warheads in orbit that could be deorbited over the United States. In May 1963, a modified Zeus B missile successfully intercepted an Agena D rocket stage in orbit marking a key success of the program's new capability and extension to Kwajalein Atoll[2]. Testing continued over the course of the early 1960s and eventually gave way to Program 437 which would extend through the remainder of the decade.



Bold Orion missile and B-47 aircraft.
Image credit: Wikimedia Foundation

Program 437

Similar to Program 505, Program 437 was developed from ABM technology but replaced the Nike Zeus with a Thor missile allowing for longer-range capabilities[3]. Program 437 could target satellites orbiting as high as 1,300 kilometers in altitude and used a 1.4-megaton W49 nuclear warhead with a likely kill radius of eight kilometers4. It was tested about 10 times over its history with rocket bodies and other space debris to assure the missile could pass within the kill radius without destroying the object and creating unnecessary debris. It remained operational on Johnston Atoll until the early 1970s and was formally terminated in 1975.[5]

ASM-135

The ASM-135 was an air-launched missile developed in response to growing concerns about Soviet satellites being used to track and target U.S. and allied ships during conflict[6]. The program was authorized by the Carter Administration in 1976 and was designed as a missile launched from a modified F-15A in a supersonic zoom climb to intercept targets in LEO[7]. Five flight tests occurred in the mid-1980s[8], the most famous of which was an intercept test on September 13, 1985, that destroyed the Solwind P78-1 satellite[9]. The ASM-135 had an estimated operational range of 648 km, a flight ceiling of 563 kilometers, and speed of over 24,000 km/h[10]. The missile incorporated an infrared homing seeker guidance system and three rocket stages including two types of solid propellant rocket engines and an LTV-produced interceptor equipped with 63 small rocket motors for fine trajectory adjustments and attitude control[11]. The U.S. Air Force had planned to deploy an operational force of 112 ASM-135 missiles and 20 modified F-15s[12]. However, only fifteen ASM-135 missiles were ultimately produced, five of which were used in flight tests, and only a few F-15 airframes were modified to support its use. In 1988, due to a mix of budgetary, technical, and political concerns, the Reagan administration canceled the program.

RECENT OPERATIONS

Over the past few years, the United States has grown increasingly concerned about threats to its space systems and the need to deal with adversary space capabilities during a future conflict. The United States has created the U.S. Space Force and re-established U.S. Space Command to focus on space warfighting. To date, this focus has not resulted in any new publicly acknowledged DA-ASAT programs[13]. The United States currently has two operational midcourse missile defense systems that have latent DA-ASAT capabilities: the ground-based interceptors (GBIs), part of the Ground-based Midcourse System (GMD), and the ship-based Standard Missile 3 (SM-3) interceptors, part of the Aegis system. Of the two, only the SM-3 has been demonstrated in a DA-ASAT role. In 2008, U.S. Operation Burnt Frost used an SM-3 Block IA interceptor fired from an Aegis Cruiser to destroy an ailing U.S. reconnaissance satellite at an altitude of 240 km.[14] Three SM-3 missiles had a “one-time software modification” to enable them to intercept the satellites[15], but it is impossible for an adversary to verify whether any additional SM-3 interceptors have been modified for ASAT capability. The SM-3 and GBI interceptors represent a potentially large and flexible DA-ASAT capability that could be used against adversary military satellites in LEO in a future conflict.

Summary of Known or Suspected U.S. DA-ASAT Tests in Space

Date	Interceptor	Launch Site	Target	Altitude Reached	Debris Created [16]	Result
Sep. 1959	High Virgo	Unknown	None	12 km	0	Unknown results due to loss of telemetry, failed test
Oct. 1959	Bold Orion	Unknown	Explorer VI	200 km	0	Successful test, passed within 6.4 kilometers of target
Oct. 1, 1961	SIP	San Nicolas Island	None	Unknown	0	Successful rocket test
Oct. 5, 1961	HiHo	F4H-I	None	Unknown	0	Rocket failure
Mar. 26, 1962	HiHo	F4H-I	None	Unknown	0	Rocket Failure
May. 5, 1962	SIP	San Nicolas Island	None	Unknown	0	Successful rocket test
Jul. 26, 1962	HiHo	Unknown	None	1,600 km	0	Successful rocket test
Dec. 17, 1962	Nike Zeus	WSMR	None	160 km	0	Successful intercept of designated point in space
Feb. 15, 1963	Nike Zeus	Kwajalein	None	241 km	0	Successful intercept of designated point in space
Mar. 21, 1963	Nike Zeus	Kwajalein	None	-	0	Unsuccessful attempt to intercept simulated satellite target
Apr. 19, 1963	Nike Zeus	Kwajalein	None	-	0	Unsuccessful attempt to intercept simulated satellite target
May. 24, 1963	Nike Zeus	Kwajalein	Agena D	Unknown	0	Successful close intercept
January 4, 1964	Nike Zeus	Kwajalein	None	146 km	0	Successful intercept of a simulated satellite target
Feb. 14, 1964	Program 437	Johnston Island	Transit 2A Rocket Body	1,000 km	0	Success (passed within kill radius)
Mar. 1, 1964	Program 437	Johnston Island	Unknown	674 km	0	Success (primary missile scrubbed, backup missile passed within kill radius)
April 21, 1964	Program 437	Johnston Island	Unknown	778 km	0	Success (passed within kill radius)
May. 28, 1964	Program 437	Johnston Island	Unknown	932 km	0	Failed (missed intercept point)
Nov. 16, 1964	Program 437	Johnston Island	Unknown	1,148 km	0	Successful Combat Test Launch (passed within kill radius)

Date	Interceptor	Launch Site	Target	Altitude Reached	Debris Created [16]	Result
Apr. 1, 1965	Nike Zeus	Kwajalein	None	Unknown	0	-
Apr. 5, 1965	Program 437	Johnston Island	Transit 2A Rocket Body	826 km	0	Successful Combat Test Launch (passed within kill radius)
June-July 1965	Nike Zeus	Kwajalein	None	Unknown	0	Four test intercepts, of which three were successful
Jan. 13, 1966	Nike Zeus	Kwajalein	None	Unknown	0	Successful intercept with simulated target
Mar. 31, 1967	Program 437	Johnston Island	Unknown piece of space debris	484 km	0	Successful Combat Evaluation Launch (passed within kill radius)
15-May-68	Program 437	Johnston Island	Unknown	823 km	0	Successful Combat Evaluation Launch (passed within kill radius)
Nov. 21, 1968	Program 437	Johnston Island	Unknown	1,158 km	0	Successful Combat Evaluation Launch (passed within kill radius)
Mar. 28, 1970	Program 437	Johnston Island	unknown satellite	1,074 km	0	Success (passed within kill radius)
Jan. 21, 1984	ASM-135	aircraft	None	1,000 km	0	ASM-135 missile fired from F-15 fighter, successful missile and control system test
Nov. 13, 1984	ASM-135	aircraft	Star	1,000 km	0	Failed test
Sep. 13, 1985	ASM-135	aircraft	Solwind	555 km	285	Successful test, created 285 pieces of trackable orbital debris
Aug. 22, 1986	ASM-135	aircraft	Star	1,000 km	0	Successful test in tracking
Sep. 29, 1986	ASM-135	aircraft	Star	1,000 km	0	Successful test in tracking
Feb. 20, 2008	SM-3	USS Lake Erie	USA 193	270 km	174	Successful test

ENDNOTES

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4. Curtis Peebles, “High Frontier: The U.S. Air Force and the Military Space Program,” Air Force History and Museums Program, 1997, https://books.google.com/books/about/High_Frontier.html?id=cMgdYypcPc8C.
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8. Ibid.
9. The four other tests include: a successful missile test without the MHV on January 21, 1984; a failed missile test directing MHV at a star on November 13, 1984; and two successful flight tests directing MHV at a star on August 22, 1986, and September 29, 1986. Gregory Karambelas and Sven Grahn, “The F-15 ASAT Story,” http://www.svengrahn.pp.se/histind/ASAT/F15ASAT.html; Raymond Puffer, “The Death of a Satellite,” Air Force Flight Test Center History Office, archived from web in 2003, https://web.archive.org/web/20031218130538/http://www.edwards.af.mil/moments/docs_html/85-09-13.html.
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12. “ASAT Overview,” Vought Heritage Website, archived from web in 2007, https://web.archive.org/web/20070131173354/http://www.vought.com/heritage/products/html/asat.html.
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14. “Space Security Index 2019,” Space Security Index, 2019, http://spacesecurityindex.org/ssi_editions/space-security-2019/; “Navy Missile Hits Dying Spy Satellite, Says Pentagon,” CNN, February 21, 2008, http://www.cnn.com/2008/TECH/space/02/20/satellite.shootdown/.
15. Jeff Schogol, “Navy Downs Spy Satellite, Destroyed Fuel Tank,” Stars and Stripes, February 22, 2008, https://www.stripes.com/migration/navy-downs-spy-satellite-destroyed-fuel-tank-1.75321.
16. Verified by data compiled from the public U.S. military satellite catalog at https://space-track.org.

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