Fact Sheet

X-37B ORBITAL TEST VEHICLE

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SUMMARY

The X-37B Orbital Test Vehicle (OTV) is a technology demonstrator and experimental vehicle which is likely used for testing new reusable space launch vehicle technologies (such as guidance and thermal protection) and on-orbit testing of new sensor technologies and satellite hardware for risk reduction. The X-37B has also been used to deploy small satellites. While it does have some capability for orbital inspection, repair, and retrieval, it is unlikely to perform these functions given its limited payload bay and altitude range. It has near-zero feasibility as an orbital weapons system for attacking targets on the ground.

BACKGROUND

- X-37B is an experimental re-usable spaceplane, similar to the Shuttle but much smaller, completely robotic, and using more advanced technologies.[1]
- X-37B is designed to be launched into space on top of a large rocket, stay on orbit for months to years, and then re-enter and land on a runway. It has thrusters for on-orbit maneuvering and de-orbit, but no engines for powered flight in the air—it is a glider in the atmosphere.
- X-37B started life as a NASA program in 1999, but transferred to DARPA in 2004. DARPA transferred it to the USAF in 2006 after more budget issues.[1]
- Hobbyist tracking indicates the X-37B typically operates at an inclination of 38-54.5 degrees and an altitude of 285 to 400 km (180 to 250 mi).[2]
- The X-37B is an asset of the U.S. Air Force's 3rd Space Experimentation Squadron, located at Schriever Air Force Base, Colorado.[3] However, as of 2020, the USSF's Space Delta 9 is responsible for its launch, on-orbit operations, and landing.[4]

X-37B.
Image credit: U.S. Air Force

X-37B ORBITAL FLIGHT HISTORY

Launch Date	Launch Location	Landing Date	Landing Location	Time on Orbit	Vehicle
Apr. 2010	Cape Canaveral, FL	Dec. 3, 2010	Vandenberg Air Force Base, CA	224 days	OTV-1
Mar. 5, 2011	Cape Canaveral, FL	June 16, 2012	Vandenberg Air Force Base, CA	469 days	OTV-2
Dec. 11, 2012	Cape Canaveral, FL	Oct. 17, 2014	Vandenberg Air Force Base, CA	675 days	OTV-3

Launch Date	Launch Location	Landing Date	Landing Location	Time on Orbit	Vehicle
May 20, 2015	Cape Canaveral, FL	May 7, 2017	Kennedy Space Center, FL	718 days	OTV-4
Sep. 7, 2017	Cape Canaveral, FL	Oct. 27, 2019	Kennedy Space Center, FL	780 days	OTV-5
May 17, 2020	Cape Canaveral, FL	Nov. 12, 2022	Kennedy Space Center, FL	908 days	OTV-6
Dec. 28, 2023	Kennedy Space Center, FL	—	—	—	OTV-7

DEBATE OVER MISSION AND RATIONALE FOR THE X-37B PROGRAM

Official objectives of the X-37B program include "space experimentation, risk reduction and concept of operations development for reusable space vehicle technologies."[5] However, some have questioned the official mission and this has led to speculation about what the "real" mission may be, particularly by Russia and China, with some claiming that it is secretly an offensive weapons platform. The actual activities indicate its mission is likely exactly what the Space Force claims it is.

Over the course of its seven missions, the X-37B has served as a testbed for multiple technologies, including autonomous orbital landing, advanced Hall Effect thrusters,[6] and oscillating heat pipes[7] that have been used operationally in other programs. The X-37B has also served as a research platform and hosted experiments on material exposure and degradation, space radiation on seeds, and microwave power beaming. Multiple cubesats have also deployed on X-37B missions, although it is not always clear if they were deployed as rideshares from the upper stage or from the payload bay of the X-37B itself. Finally, the X-37B's orbit has typically been in line with that of an imagery, surveillance, or reconnaissance (ISR) platform, such as repeating ground tracks and low altitudes.

While there has been much speculation of the X-37B's role for interacting with other satellites on orbit or serving as a weapons platform, there is no evidence to date of this occurring. To date, the X-37B has never approached or rendezvoused with any other known space object and generally orbits far below the vast majority of operational satellites (with the exception of OTV-7, which was spotted by an amateur astronomer in February 2024 in a HEO of 323 x 38,838 km x 59.1 deg inclination). Physics also limits its utility as a space-to-ground weapon. The X-37B's payload bay and available power are very limited. Hyperkinetic weapons dropped from the bay would need to be equipped with thrusters capable of performing a significant de-orbit burn, which is unlikely given the available room. The X-37B itself re-enters like the space shuttle landing at an estimated 200 mph (321 kph),[7] which means it travels in the atmosphere much slower than a nuclear re-entry vehicle on a ballistic arc or a hyperkinetic weapon. Thus it would need to carry conventional explosives to do any significant damage. The X-37B after re-entry would be a slow moving, not-very-maneuverable glide bomb, easy prey for any air defense system along its path to the target.

Artist's rendition of how the X-37B will deploy on orbit, including the solar panels used for electrical power.

Image credit: Boeing

OTV-6 FEATURES

OTV-6 featured a new service module added to the aft of the spacecraft which gave it more room for payloads and experiments.[8] One of these experiments was the satellite FalconSAT-8, built by students at the USAF academy.[9] OTV-6 also tested an on-orbit power beaming system (PRAM), that collected solar power and transforms it into a microwave beam.[10] Russian sources claim that in October 2021, OTV-6 released a small object that spent a day about 200 meters away from OTV-6 before moving away entirely.[11] OTV-6 landed in November 2022 after spending 908 days in orbit, which is a new record for the X-37B.[12]

OTV-7 FEATURES

USSF officials said prior to the launch that tests of the X-37B would include "operating the reusable spaceplane in new orbital regimes, experimenting with future space domain awareness technologies, and investigating the radiation effects on materials provided by NASA."[13]

MANEUVERABILITY OF THE X-37B

There has also been significant speculation over the maneuverability of the X-37B while on orbit. The X-37B does have onboard thrusters that give it a large specific impulse, a measurement of a rocket engine's efficiency, and the X-37B has raised and lowered its orbit fairly often, particularly during OTV-3, OTV-4, and OTV-5, suggesting significant delta-v capability as well. Former Secretary of the Air Force Heather Wilson publicly suggested that the X-37B could also dip down into the atmosphere and use its wings to make unpredictable changes to its orbit.[14] However, orbital positional data compiled by hobbyists show no such changes in orbit. [15]

TRANSPARENCY CONCERNS

Much of the speculation and consternation over the X-37B stems from the project's secretive nature. The mission and activities of the X-37B have long been classified, and the program's budget is currently unknown. The U.S. military openly applauds the program for being a significant success, but does not provide any information about its on-orbit activities. This may indicate they are part of a covert intelligence program, but it may also indicate the testing of offensive technologies or capabilities.

SECRET DEPLOYMENT OF SATELLITES

The X-37B secretly deployed three small satellites during its fifth mission between 2017 and 2019. Although the Air Force stated before launch that OTV-5 would deploy small satellites, it was unclear if they were rideshares deployed from the upper stage or deployed from the X-37B payload bay itself.[16] The actual deployment time of the three satellites was not announced and is still unknown. The three satellites were not included in the public satellite catalog maintained by the U.S. military until after OTV-5 landed and the satellites had decayed from orbit. The United States has not provided any orbital positional information on OTV-5 or the three small satellites it deployed. The United States reported OTV-5 to the United Nations in conformity with the Convention on Registration of Objects Launched into Outer Space on September 17, 2018, one year after launch and on the same timeline as past X-37B flights.[17] The United States registered the deployed satellites in 2020 after OTV-5 landed. This withholding of information raises questions about U.S. commitment to international norms and transparency and confidence building measures, as well as the purpose of these satellites.

ENDNOTES

1. Air Force Space Command, "X-37B Orbital Test Vehicle Fact Sheet," April 17, 2015, http://www.af.mil/About-Us/Fact-Sheets/Display/Article/104539/x-37b-orbital-test-vehicle/.
2. Jonathan McDowell, "Jonathan's Space Report No. 703," October 17, 2017, http://planet4589.org/space/jsr/back/news.703.
3. Space Force, "Next X-37B Orbital Test Vehicle Scheduled to Launch," May 6, 2020, http://www.spaceforce.mil/News/Article/2177702/next-x-37b-orbital-test-vehicle-scheduled-to-launch.
4. Air Force Space Command, "3rd Space Experimentation Squadron Fact Sheet," August 2016, http://www.schriever.af.mil/About-Us/Fact-Sheets/Display/Article/734833/3rd-space-experimentation-squadron/.
5. Boeing, "Boeing-built X-37B Orbital Test Vehicle Successfully Completes 3rd Flight," October 17, 2014, https://boeing.mediaroom.com/2014-10-17-Boeing-built-X-37B-Orbital-Test-Vehicle-Successfully-Completes-3rd-Flight.
6. Jeff Foust, "X-37B lands after record-setting mission," SpaceNews, May 7, 2017, https://spacenews.com/x-37b-lands-after-record-setting-mission/.
7. Craig Covault, "USAF to Launch First Spaceplane Demonstrator," Aviation Week Science and Technology, August 3, 2008, http://bit.ly/cvnkRA.
8. Valerie Insinna, "The Space Force just launched the mysterious X-37B space plane," Defense News, May 17, 2020, https://www.defensenews.com/space/2020/05/17/the-space-force-just-launched-the-mysterious-x-37b-space-plane/.
9. Stephen Clark, "Upgraded X-37B spaceplane rockets into orbit aboard Atlas 5 launcher," Spaceflightnow.com, May 17, 2020, https://spaceflightnow.com/2020/05/17/upgraded-x-37b-spaceplane-rockets-intoorbit-aboard-atlas-5-launcher/.
10. Joseph Revithick, "X-37B's Power Beaming Payload A Reminder Of Potential Orbital Microwave Anti-Satellite Weapons," TheDrive.com, May 19, 2020, https://www.thedrive.com/the-war-zone/33531/x-37bs-power-beaming-payload-areminder-of-potential-orbital-microwaveanti-satellite-weapons.
11. Dmitry Stefanovich, Twitter, December 8, 2021, https://twitter.com/KomissarWhipla/status/1468593293235793924?s=20; Vladimir Kozin, "Cold Star War: The US has Questions for Moscow about Space, Russia has even more Questions for the US," VKP-News, November 29, 2021, https://vpk-news.ru/articles/64859.
12. Stefano D'Urso and David Cenciotti, "Reflecting On The X-37B's Latest Record-Breaking Mission," The Aviationist, December 24, 2022, https://theaviationist.com/2022/12/24/reflecting-on-the-x-37bs-latest-record-breaking-mission/.
13. "Department of the Air Force scheduled to launch seventh X-37B mission," Air Force News Service, November 8, 2023, https:// www.spaceforce.mil/News/Article-Display/ Article/3583347/department-of-the-air-forcescheduled-to-launch-seventh-x-37b-mission/.
14. Oriana Pawlk, "Former SecAF Explains How Secret X-37 Space Plane Throws Off Enemies, Military.com, July 23, 2019, https://www.military.com/daily-news/2019/07/23/former-secaf-explains-how-secret-x-37-space-plane-throws-enemies.html.
15. Marco Langbroek, "X-37B fact and fiction," SatTrackCam Leiden b(log), July 25, 2019, https://sattrackcam.blogspot.com/2019/07/x-37b-factand-fiction.html.
16. Air Force, "Air Force preparing to launch fifth Orbital Test Vehicle mission," August 31, 2017, https://www.af.mil/News/Article-Display/ Article/1296566/air-force-preparing-to-launch-fifth-orbital-test-vehicle-mission/.
17. UNOOSA, "Information Furnished in Conformity with the Convention on Registration of Objects Launched into Outer Space," September 17, 2018, https://www.unoosa.org/oosa/osoindex/data/documents/us/st/stsgser.e859.html.

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