

Automation and Autonomy in Loitering Munitions Catalogue (v.1)

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This catalogue has been created in conjunction with the *Loitering Munitions and Unpredictability: Autonomy in Weapon Systems and Challenges to Human Control* report published in May 2023. It provides information on the technical details, development history, and use of autonomy and automation in a global sample of 24 loitering munitions.

This catalogue has been constructed using a range of open-source material. This includes: (1) brochures, factsheets and other marketing material published by weapons manufacturers; (2) press releases and factsheets published by defence ministries; (3) media reports from reputable international news and defence outlets; (4) existing catalogues of weapons with autonomous and automated features; and (5) open-source intelligence presented on social media sites such as Twitter.

A detailed explanation of our case selection and research approach can be found in the fourth section of our accompanying report. Three methodological challenges should be kept in mind when reading our catalogue:

1. There are gaps in the information which is publicly available on the technical design details and use of autonomy and automation in loitering munitions. We have neither observed the real-world testing and development of these weapons nor used them. As with other existing databases, our entries should thus be read as being more of an indicative rather than definite description of loitering munition development practices.
2. Autonomy is a contested and politicised notion which has meant different things, to different actors, at different times. A review of the available open-source information on the use of “autonomy” to support mobility and targeting functions in loitering munitions can present vague and, at times, even contradictory findings.
3. The weight given to the publicly available information on the technical capabilities of loitering munitions must be qualified by uncertainties regarding the Rules of Engagement under which these systems are operated. Whilst the systems included in our catalogue may have latent

automated and autonomous features, we cannot claim to know whether these capabilities have been fielded.

Where possible, we have included an image of each of the 24 loitering munitions which make up our catalogue. When we have been unable to find any information about a particular system, we have marked the relevant section of the catalogue with NDA: No Data Available.

All references are provided as URLs and were accessible online as of 05/01/2023.

Spotted an error? Contact Us!

This catalogue has been made open access so that, if any of the information included in this document is incorrect, it can be corrected. If you spot an error in this catalogue, and would like to inform us of it, we can be reached at Thomas.watts@rhul.ac.uk

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Contents

Anti-radiation systems	4
Chien Hsiang	4
Harpy	6
Harop	9
Anti-armour systems	12
Devil Killer	12
Fire Shadow.....	14
Hero-120	16
Lancet-3	19
Phoenix Ghost.....	23
SkyStriker	25
Switchblade 600.....	27
WS-43	29
Anti-personnel systems	31
Alpagu	31
Battlehawk	33
CH-901 Rainbow (FH-901)	35
Drone 40	37
Fire Cardinal	39
Hero-30	41
Kargu-2.....	44
KUB-BLA.....	47
Orbiter 1K.....	50
ROTEM L.....	53
Spike Firefly	55
Switchblade 300.....	57
Warmate	61

Anti-radiation systems

Chien Hsiang	
System image¹	
System manufacturer	The National Chung-Shan Institute of Science and Technology (NCSIST) (Taiwan)
System user(s)	Taiwan
System range	Range: 1000km. ² Operational endurance: 5 hours. ³
Launch	Platform weight: NDA Wingspan: 2m. ⁴ Launch method: vehicle mounted canisters. ⁵ Delivery method(s): As showcased at the 2019 Taipei Aerospace and Defense Technology Exhibition, up to 12 Chien Hsiang's can be carried in a specially designed "modular trailer-based launcher". ⁶ The Chien Hsiang can also be launched from ground-based launchers or from launchers installed onto warships. ⁷
Payload	Sensors: electro-optical and infrared camera(s); ⁸ radio-frequency seeker. ⁹ Warhead: high-explosive warhead. ¹⁰
Platform variant(s)	NCSIST is reportedly developing a decoy variant of the Chien Hsiang. ¹¹
Development status	The Chien Hsiang is scheduled to enter service with the Taiwanese military sometime after 2025. ¹²
Development	The Chien Hsiang was first displayed at the 2017 Taipei Aerospace and Defense

¹ Kenchen945, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons: https://commons.wikimedia.org/wiki/File:Launcher_of_Chien_hsiang_loitering_munition.jpg

² <https://focustaiwan.tw/sci-tech/202211150026>

³ <https://focustaiwan.tw/sci-tech/202211150026>

⁴ <https://en.newizv.ru/news/2022-11-21/new-taiwanese-drone-can-attack-alone-and-in-a-group-390977>

⁵ <https://www.shephardmedia.com/news/uv-online/tadte-2019-taiwans-harpy-enters-series-production/>

⁶ <https://www.janes.com/defence-news/news-detail/tadte-2019-taiwans-ncsist-rolls-out-indigenous-anti-radiation-loitering-munition>

⁷ <https://www.janes.com/defence-news/news-detail/tadte-2019-taiwans-ncsist-rolls-out-indigenous-anti-radiation-loitering-munition/>

⁸ <https://www.taiwannews.com.tw/en/news/3800110>

⁹ <https://project2049.net/wp-content/uploads/2020/06/Watching-Over-the-Taiwan-Strait-Easton-Stokes-Yang-Lee-Ferland-P2049-200630.pdf>, p.24.

¹⁰ <https://www.uasvision.com/2019/08/20/b-taiwan-anti-radiation-loitering-munition/>

¹¹ <https://www.thedefensepost.com/2022/11/18/taiwan-radar-killing-suicide-drones/>;

<https://www.taiwannews.com.tw/en/news/4725375>

¹² <https://www.thedefensepost.com/2022/11/18/taiwan-radar-killing-suicide-drones/>;

<https://focustaiwan.tw/sci-tech/202211150026>

history	<p>Technology Exhibition.¹³ A “production-ready version” of this platform was shown at the same event in 2019.¹⁴ The Chien Hsiang is described as “a near-copy” of the Harpy anti-radiation loitering munition manufactured by Israel Aerospace Industries.¹⁵ NCSIST have “declined to comment on whether the Harpy influenced the [Chien Hsiang’s] design or if IAI provided assistance”.¹⁶ NCSIST officials describe the similarities between the Harpy’s and Chien Hsiang’s design as being “coincidental”.¹⁷</p> <p>This platform is being developed by NCSIST: “Taiwan’s main research and development agency responsible for developing technology and creating a national independent defence capability”.¹⁸ In 2019, Taiwan Air Force’s Air Defense and Missile Command allocated approximately \$2.5 billion for a five year programme intended to develop the Chien Hsiang.¹⁹ According to NCSIST, the Chien Hsiang entered production in late 2019.²⁰ They planned to build 104 of these platforms over the subsequent six years.²¹ In November 2022, it was reported that 104 Chien Hsiang platforms were scheduled to be delivered to the Taiwanese military by 2025.²²</p>
Target type	<p>The Chien Hsiang’s is designed to detect and destroy enemy radar and air-defence systems.²³ Commentators highlight the Chien Hsiang’s potential use to attack Chinese S-400 air defence systems in the case of a potential war between the two countries.²⁴ NCSIST have released promotional material depicting the platform attacking what appears to be a Chinese aircraft carrier task force.²⁵</p>
Autonomous and automated features	<p>Autonomous attack: Analysts describe the Chien Hsiang as a “‘Fire-and-Forget’ all-weather, day/night autonomous weapon system”.²⁶</p> <p>Human control over targeting: Analyst suggest that the Chien Hsiang could possibly operate without a human in-the-loop.²⁷ As with other anti-radiation weapons such as the IAI Harpy, the Chien Hsiang can possibly detect and attack enemy radar signals which meet certain prespecified radio frequencies without direct human supervision.²⁸ According to media reports, the Chien Hsiang “has the capability to abort an attack when the radiating source switches off and resume circling over the target”.²⁹</p> <p>Autonomous flight: According to NCSIST officials, if the Chien Hsiang loses the radar signal of a designated target, then the platform can loiter for a distance of over 500km in case it reactivates.³⁰ The Chien Hsiang is possibly installed with some autopilot capability.³¹</p>

¹³ <https://defence-blog.com/taiwan-develops-new-compact-loitering-guided-weapon/>

¹⁴ <https://www.janes.com/defence-news/news-detail/tadte-2019-taiwans-ncsist-rolls-out-indigenous-anti-radiation-loitering-munition>

¹⁵ <https://defence-blog.com/taiwan-develops-new-compact-loitering-guided-weapon/>

¹⁶ <https://www.shephardmedia.com/news/uv-online/ncsist-display-new-loitering-munition/>

¹⁷ <https://www.uasvision.com/2019/08/20/b-taiwan-anti-radiation-loitering-munition/>

¹⁸ <https://www.asianmilitaryreview.com/2019/10/taiwans-defence-innovation-on-show/#:~:text=NCSIST%20Taiwan%20main%20research%20and,future%20weapons%20development%20and%20production>

¹⁹ <https://www.taiwannews.com.tw/en/news/3727728>

²⁰ <https://www.taiwannews.com.tw/en/news/3800110>

²¹ <https://www.taiwannews.com.tw/en/news/3800110>

²² <https://www.thedefensepost.com/2022/11/18/taiwan-radar-killing-suicide-drones/>

²³ <https://defence-blog.com/taiwan-develops-new-compact-loitering-guided-weapon/>

²⁴ <https://www.taiwannews.com.tw/en/news/3800110>

²⁵ <https://alert5.com/2019/08/14/taiwan-has-release-a-video-of-its-chien-hsiang-anti-radiation-suicide-drone/>

²⁶ <https://defence-blog.com/taiwan-develops-new-compact-loitering-guided-weapon/>

²⁷ <https://www.thedrive.com/the-war-zone/taiwan-shows-off-its-radar-killing-kamikaze-drones>

²⁸ <https://www.thedrive.com/the-war-zone/taiwan-shows-off-its-radar-killing-kamikaze-drones>

²⁹ <https://alert5.com/2019/08/14/taiwan-has-release-a-video-of-its-chien-hsiang-anti-radiation-suicide-drone/?msclkid=051044d2b60d11ec8f40fdf03b7a9218>

³⁰ <https://focustaiwan.tw/sci-tech/202211150026>

³¹ <https://www.thedrive.com/the-war-zone/taiwan-shows-off-its-radar-killing-kamikaze-drones>

Harpy	
System image ³²	
System manufacturer	Israel Aerospace Industries (Israel)
System user(s)	Israel; China, ³³ India; ³⁴ South Korea; ³⁵ Turkey. ³⁶
System range	Range: 200km. ³⁷ Operational endurance: 9 hours. ³⁸
Launch	Platform weight: 114kg. ³⁹ Wingspan: 2.41m. ⁴⁰ Launch method: vehicle mounted canister launchers. ⁴¹ Delivery method(s): The Harpy's launch canisters can be installed onto ground vehicles including trucks. ⁴²
Payload	Sensors: radio-frequency seeker. ⁴³ Warhead: high-explosive warhead. ⁴⁴
Platform variant(s)	Mini Harpy: The Mini Harpy was unveiled at the 2019 Aero India Exhibition. ⁴⁵ Promotional material depicts the Mini Harpy as conducting reconnaissance and strike missions against a range of targets including radar systems and ground vehicles. ⁴⁶ According to Boaz Levy - general manager and executive vice-president of IAI Systems, Missiles and Space Group - the Mini Harpy was designed to attack "fast-moving targets that 'blink' for a few seconds at a time". ⁴⁷ The Mini-Harpy can be

³² Jastrow, Public domain, via Wikimedia Commons
https://upload.wikimedia.org/wikipedia/commons/1/15/Paris_Air_Show_2007-06-24_n25.jpg

³³ <http://www.indiandefencereview.com/news/loitering-munitions-advantage-plus/>;
<https://nationalinterest.org/blog/reboot/chinas-quest-loitering-munitions-aka-suicide-drones-168566>;
<https://www.israeldefense.co.il/en/node/28716>; <https://www.theguardian.com/world/2005/jun/13/usa.israel>;
<https://www.aljazeera.com/news/2005/6/26/israel-said-to-scrap-china-arms-deal>; <https://www.flightglobal.com/iai-sells-harpy-drones-to-china/45569.article>

³⁴ <https://www.shephardmedia.com/news/uv-online/indian-army-loiters-intent/>

³⁵ <https://www.flightglobal.com/south-korea-deploys-anti-radar-uav/30191.article>;
https://journals.sagepub.com/doi/pdf/10.1177/2347798917700767?casa_token=B0NSOPc4gEIAAAAAA:xZnNEdoda9Fv5-mYeV0tn7LmzMOArlgZ1--IIC_ZMsVvX0B9f3WTecElqTjy5YCl_A-VMioLE1E2xg, p.177.

³⁶ <https://nationalinterest.org/blog/buzz/ultimate-weapon-war-no-one-talking-about-42497>;
<https://setav.org/en/assets/uploads/2020/07/A65En.pdf>, p.100.

³⁷ <https://www.iai.co.il/p/harpy>

³⁸ <https://www.iai.co.il/p/harpy>

³⁹ [https://odin.tradoc.army.mil/mediawiki/index.php/Harpy_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/Harpy_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

⁴⁰ [https://odin.tradoc.army.mil/mediawiki/index.php/Harpy_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/Harpy_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

⁴¹ <https://www.youtube.com/watch?v=AyKXUfOubH0>; https://defense-update.com/20060403_harpy.html

⁴² <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>; <https://www.iai.co.il/p/harpy>

⁴³ <https://www.iai.co.il/p/harpy>

⁴⁴ <https://www.iai.co.il/p/harpy>;

[https://odin.tradoc.army.mil/WEG/Asset/Harpy_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/WEG/Asset/Harpy_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

⁴⁵ <https://www.iai.co.il/iai-unveils-new-loitering-munition-mini-harpy>

⁴⁶ <https://www.youtube.com/watch?v=cBmhJ-jrzc&t=2s>

⁴⁷ <https://www.janes.com/defence-news/news-detail/iai-announces-new-mini-harpy-loitering-munition>

	<p>launched from ground vehicles, helicopters, and warships.⁴⁸ It is equipped with both a radio-frequency seeker and electro-optical/infrared camera(s).⁴⁹ IAI describe this platform as “combining” design features from both its Harop and Harpy loitering munitions.⁵⁰ It is advertised for use by ground units and special operations forces,⁵¹ and can reportedly “perform the targeting either fully autonomously, when using the anti-radiation seeker against emitting targets, or through [human-in-the-loop] guidance, when using the [electro-optical/infrared] sensor against non-emitting targets”.⁵²</p> <p>Harpy NG (Next Generation): The Harpy NG was first shown at the 2016 Singapore Air Show.⁵³ Its development was prompted by the proliferation of more advanced air defence systems.⁵⁴ Like the original Harpy variant, the Harpy NG can conduct suppression of air defence operations.⁵⁵ The Harpy NG incorporates two major design changes: an improved aeronautical design which increases its range and operational endurance; and a more sophisticated radio-frequency seeker which widens the range of detectable radar frequencies.⁵⁶ If the platform is unable to locate its operator designated target, the Harpy NG can be programmed to attack a secondary target or ditch in a designated area.⁵⁷</p>
Development status	The Harpy reportedly remains in service with several air forces. ⁵⁸ The newer Mini-Harpy and Harpy NG variants may also be in service with the Israeli military.
Development history	Development work on the Harpy, which some describe as the “first loitering munition”, ⁵⁹ began sometime during the 1980s. The platform was developed to counter the proliferation of sophisticated air defence systems. ⁶⁰ The Harpy has since undergone multiple design upgrades including improvements to the platform’s range and accuracy, ⁶¹ in addition to the development of a datalink to facilitate remote target designation. ⁶²
Target type	The Harpy is an anti-radiation weapon. It is principally designed to detect and attack radar and air defence systems. ⁶³
Autonomous and automated features	<p>Autonomous attack: IAI describe the Harpy as an “autonomous weapon for all weather”.⁶⁴ After arriving at its designated “loitering area”, the platform is designed to search for prespecified radio frequencies.⁶⁵ If a match is found, the Harpy can home-in on and destroy the emitting signal without immediate operator supervision.</p> <p>Human control over targeting: IAI advertise the Harpy as being “[f]ully [a]utonomous”,⁶⁶ and a “Fire and Forget autonomous weapon”.⁶⁷ Promotional material</p>

⁴⁸ <https://www.iai.co.il/iai-unveils-new-loitering-munition-mini-harpy>
⁴⁹ <https://www.flightglobal.com/military-uavs/aero-india-iai-launches-new-mini-harpy-loitering-munition/131485.article>
⁵⁰ <https://www.iai.co.il/iai-unveils-new-loitering-munition-mini-harpy>
⁵¹ <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>
⁵² <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>
⁵³ <https://www.israeldefense.co.il/en/content/iai-unveils-new-members-its-loitering-munitions-family>
⁵⁴ <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>
⁵⁵ https://defense-update.com/20160215_loitering-weapons.html;
⁵⁶ <https://www.israeldefense.co.il/en/content/iai-unveils-new-members-its-loitering-munitions-family>;
<https://www.ynetnews.com/articles/0,7340,L-4767278,00.html>; https://defense-update.com/20160215_loitering-weapons.html
⁵⁷ <https://www.ynetnews.com/articles/0,7340,L-4767278,00.html>
⁵⁸ <https://www.globalsecurity.org/military/world/israel/harpy.htm>
⁵⁹ <https://aviationweek.com/defense-space/loitering-munitions-meeting-challenge-time-sensitive-targets>;
<https://nationalinterest.org/blog/buzz/ultimate-weapon-war-no-one-talking-about-42497>
⁶⁰ <https://www.youtube.com/watch?v=AyKXUfOubH0&t=61s>
⁶¹ <https://www.flightglobal.com/iai-upgrades-harpy/2354.article>
⁶² <https://www.flightglobal.com/iai-develops-harpy-with-datalink-add-on/35309.article>; <https://www.flightglobal.com/iai-faces-compensation-claim-over-harpy-work/58480.article>
⁶³ <https://www.iai.co.il/p/harpy>
⁶⁴ <https://www.iai.co.il/p/harpy>
⁶⁵ <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>; <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>
⁶⁶ <https://www.iai.co.il/p/harpy>
⁶⁷ <https://www.iai.co.il/p/harpy>

describes the platform as being designed, once activated, to autonomously detect and destroy enemy radar systems.⁶⁸ The Harpy is installed with an “[a]bort attack in case of target shut down” functionality.⁶⁹ If an enemy radar system is switched off, the Harpy automatically aborts its strike, and the platform re-enters its “loiter pattern”.⁷⁰

In the case of the Mini Harpy, promotional material released by IAI depicts its operator as using a ground control station to monitor the live video-feed collected by the platform’s electro-optical camera(s) and being required to authorise strikes.⁷¹ According to IAI, the platform can be operated both autonomously and with a human-in-the-loop, with the latter mode “provid[ing] operators with control up to the last moment, including cessation of attack at any stage” in the second mode.⁷² The Mini Harpy is described as being “programmed before launch to fly to a designated loiter area, with the operator checking its status enroute and taking control for the target search”.⁷³ If the radio-frequency seeker detects a target, the electro-optical sensor can be “cued” to give the operator an opportunity to visually inspect the target and approve an attack.⁷⁴

Autonomous flight: According to IAI, the Harpy is programmed “to perform autonomous flight to a pre-defined ‘Loitering Area’” within which the platform then loiters.⁷⁵ Early promotional footage describes the Harpy as “navigating autonomously” toward its designated loitering area.⁷⁶

⁶⁸ <https://www.youtube.com/watch?v=AyKXUfOubH0&t=61s>

⁶⁹ <https://www.iai.co.il/p/harpy>

⁷⁰ <https://www.iai.co.il/p/harpy>; <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>

⁷¹ <https://www.youtube.com/watch?v=cBmhJ-jrzrc&t=2s>


⁷² <https://www.iai.co.il/iai-unveils-new-loitering-munition-mini-harpy>

⁷³ <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>

⁷⁴ <https://aviationweek.com/defense-space/loitering-munitions-meeting-challenge-time-sensitive-targets;https://paxforpeace.nl/media/download/Increasing%20autonomy%20in%20weapons%20systems%20-%20FINAL.pdf>, p.8.

⁷⁵ <https://www.iai.co.il/p/harpy>

⁷⁶ <https://www.youtube.com/watch?v=AyKXUfOubH0&t=61s>

Harop	
System image⁷⁷	
System manufacturer	Israel Aerospace Industries (Israel)
System user(s)	Israel; Azerbaijan; ⁷⁸ India; ⁷⁹ Morocco; ⁸⁰ Turkey; ⁸¹ Unnamed Asian country. ⁸²
System range	Range: 200km. ⁸³ Operational endurance: 9 hours. ⁸⁴
Launch	Platform weight: 135kg. ⁸⁵ Wingspan: 3m. ⁸⁶ Launch method: vehicle mounted canister launcher(s). ⁸⁷ Delivery method(s): The Harop's launch system can be integrated onto ground vehicles as well as warships. ⁸⁸
Payload	Sensors: electro-optical and infrared camera(s). ⁸⁹ Warhead: high-explosive warhead. ⁹⁰

⁷⁷ Julian Herzog, CC BY 4.0 <<https://creativecommons.org/licenses/by/4.0/>>, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/4/41/IAI_Harop_PAS_2013_01.jpg

⁷⁸ <https://www.csis.org/analysis/air-and-missile-war-nagorno-karabakh-lessons-future-strike-and-defense>;
<https://www.middleeasteye.net/news/israel-sells-suicide-drones-azerbaijan-pop-video-reveals>

⁷⁹ <https://www.airforce-technology.com/projects/haroploiteringmuniti/>;
<https://www.theweek.in/news/india/2020/07/14/why-indian-army-is-cying-a-mini-suicide-drone-from-israel.html>;
<https://wiki.nps.edu/pages/viewpage.action?pageId=2818055>; <https://www.flightglobal.com/indian-air-force-orders-harop-loitering-munitions/92817.article>; <https://www.israeldefense.co.il/en/node/47634>

⁸⁰ <https://www.haaretz.com/israel-news/.premium.HIGHLIGHT-israel-aerospace-industries-got-22m-from-morocco-reportedly-for-kamikaze-drones-1.10426146?ts=1638265791692>;
<https://www.middleeasteye.net/news/israel-morocco-arms-deal-signed-suicide-drone>;
<https://thecradle.co/Article/news/4163>;
<https://www.israelhayom.com/2021/12/01/report-morocco-to-pay-22m-for-israeli-drone-tech/>

⁸¹ <http://www.military-today.com/aircraft/harop.htm>; <https://www.shephardmedia.com/news/air-warfare/premium-loitering-munition-finds-libya-highlight-e/>

⁸² <https://www.thedrive.com/the-war-zone/38690/ship-launched-version-of-the-israeli-harop-suicide-drone-will-be-sailing-with-an-asian-navy>;
<https://www.navalnews.com/naval-news/2021/02/iai-to-provide-naval-version-of-the-harop-system-to-an-asian-country/>;
<https://www.janes.com/defence-news/news-detail/iai-secures-contracts-for-loitering-munitions-worth-more-than-usd100-million>

⁸³ <https://www.iai.co.il/p/harop>

⁸⁴ <https://www.iai.co.il/p/harop>

⁸⁵ [https://odin.tradoc.army.mil/mediawiki/index.php/Harop_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/Harop_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

⁸⁶ <https://www.airforce-technology.com/projects/haroploiteringmuniti/>

⁸⁷ <https://archive.ph/20201031230206/https://www.flightglobal.com/israel-special-iais-harop-ups-the-stakes-on-sead-missions/78681.article>;
<https://www.iai.co.il/sites/default/files/2022-10/HAROP%20Brochure.pdf>

⁸⁸ <https://www.iai.co.il/p/harop>

⁸⁹ [https://odin.tradoc.army.mil/mediawiki/index.php/Harop_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/Harop_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV));
<https://theaviationist.com/2022/01/07/iai-loitering-munitions/>

⁹⁰ <https://www.iai.co.il/p/harop>;
<https://www.iai.co.il/successful-flight-demonstrations-harop-loitering-munitions>;
[https://odin.tradoc.army.mil/mediawiki/index.php/Harop_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/Harop_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

Platform variant(s)	<p>Green Dragon: The Green Dragon – also known as the Mini Harop –⁹¹ was first shown at the 2016 Singapore Air Show.⁹² Boaz Levi – IAI Corporate Vice President and General Manager of the Systems, Missiles and Space Group – describes the Green Dragon’s development as forming part of the company’s wider strategy of “bolster[ing] the abilities of small tactical infantry units and Special Ops, with a special emphasis on solving operational problems in urban areas”.⁹³ According to IAI, the Green Dragon is operated with a “[human]-in-the loop” and a wave-off/abort capability.⁹⁴ It has a smaller fuselage than the standard Harop variant, is equipped with electro-optical camera(s) to aid target identification, and has an operational endurance of approximately 90 minutes.⁹⁵ Up to 16 Green Dragons can reportedly be carried in a vehicle-mounted launcher.⁹⁶</p> <p>Maritime Harop: IAI presented the Maritime Harop at the 2017 Defence and Security Exhibition held in London.⁹⁷ It is described as providing an “excellent operational alternative to sea missiles as well as a range of additional uses such as intelligence gathering and allowing the operator to choose the precise timing of the attack”.⁹⁸</p>
Development status	In service with the Azerbaijani, Indian, Turkish and possibly other militaries. ⁹⁹
Development history	<p>IAI reportedly began developing the Harop during the late 1990s.¹⁰⁰ It is sometimes referred to as the Harpy 2 because of the use of similar launcher canisters and ground control stations.¹⁰¹ The platform was first unveiled at the Aero-India 2009 air show.¹⁰² By 2015, IAI had demonstrated this platform to multiple foreign militaries.¹⁰³</p> <p>In 2009, the German army agreed a contract with IAI to purchase an undisclosed number of Harop platforms.¹⁰⁴ As part of a research collaboration between IAI and Rheinmetall Defence, the German military evaluated the possibility of purchasing the WABEP (Weapons System for Standoff Engagement of Individual and Point Targets) system.¹⁰⁵ By the end of 2011, various tests had been completed on the WABEP, which combined the use of the IAI Harop with the KZO aerial surveillance drone manufactured by Rheinmetall Defence.¹⁰⁶ The German military ultimately chose not to purchase this system, however.¹⁰⁷</p>

⁹¹ <https://www.iai.co.il/p/mini-harop>

⁹² <https://www.army-technology.com/projects/green-dragon-tactical-loitering-missile/>; https://www.defenseworld.net/news/15350/IAI_Unveils_Two_Loitering_Weapons_At_Singapore_Airshow_2016#.Yh4sp-jP2UI

⁹³ <https://www.globalsecurity.org/military/world/israel/green-dragon.htm>

⁹⁴ https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=1939

⁹⁵ <https://www.army-technology.com/projects/green-dragon-tactical-loitering-missile/> ; <https://www.iai.co.il/p/mini-harop>

⁹⁶ <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>

⁹⁷ <https://www.iai.co.il/iai-unveils-maritime-harop-operational-loitering-munition-naval-applications>

⁹⁸ <https://www.iai.co.il/iai-unveils-maritime-harop-operational-loitering-munition-naval-applications>

⁹⁹ <https://www.thedrive.com/the-war-zone/40265/the-sound-of-this-nighttime-suicide-drone-strike-is-absolutely-terrifying>; <https://forceindia.net/feature-report/invaluable-assets/>; <https://www.janes.com/defence-news/news-detail/adex-2022-lentatek-working-on-new-kargi-based-loitering-munition>

¹⁰⁰ <https://www.thedrive.com/the-war-zone/4760/meet-israels-suicide-squad-of-self-sacrificing-drones>

¹⁰¹ <http://www.military-today.com/aircraft/harop.htm>; <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>

¹⁰² https://defense-update.com/20090110_harop.html

¹⁰³ <https://www.shephardmedia.com/news/uv-online/iai-shows-harop-loitering-munitions/>

¹⁰⁴ <https://www.flightglobal.com/germany-signs-contract-for-harop-loitering-munition/89307.article>

¹⁰⁵ <https://www.flightglobal.com/rheinmetall-iai-test-unmanned-strike-system/102121.article>

¹⁰⁶ https://www.rheinmetall-defence.com/en/rheinmetall_defence/public_relations/news/archiv/2017/aktuellesdetailansicht_7_912.php;

<https://wiki.nps.edu/pages/viewpage.action?pageId=2818055>; <https://www.ipost.com/defense/israel-germany-jointly-develop-uav-arms-system>; <https://digit.site36.net/2019/09/07/rheinmetall-shows-drone-tank-combination-with-kamikaze-drone/>

¹⁰⁷ <https://dserver.bundestag.de/btp/19/19211.pdf>

	<p>The Harop’s first combat use may have occurred in 2016.¹⁰⁸ During this year, the Azerbaijani military reportedly used the Harop to target Armenian forces.¹⁰⁹ Artsrun Hovhannisyanyan, a spokesman for Armenia's Defence Ministry, told the Russian state-run media agency <i>Ria Novosti</i> that the Azerbaijani military had used the Harop to attack a bus carrying Armenian military volunteers, killing seven. Azerbaijani-operated Harops were also reportedly used to attack Armenian artillery positions and air defence systems during this conflict. The Harop was used in Azerbaijan’s later 2020 war with Armenia to destroy air defence systems. According to Hikmet Hajiyev, an Azerbaijani foreign policy advisor, the Harop had been “very effective[ly]” used against the Armenian military during this conflict.¹¹⁰</p>
Target type	<p>The Harop was designed to search for, and attack, enemy radars and air defence systems.¹¹¹ Unlike the IAI Harpy, the Harop is equipped with electro-optical and infrared camera(s) to facilitate attacks against a wider set of targets, including in urban areas.¹¹²</p>
Autonomous and automated features	<p>Autonomous attack: Analysts describe the Harop as an “air system able to fly, hover, locate, track, and attack targets with no human intervention, for example, by homing in on radar signals”.¹¹³ It is noted to be an “anti-radiation weapon that autonomously homes in on radar emitters”,¹¹⁴ and which uses “autonomous targeting functions”.¹¹⁵ The Harop has been shown in promotional material attacking stationary and moving targets.¹¹⁶</p> <p>Human control over targeting: IAI describe the Harop as an “electro-optically guided attack weapon” designed to operate with a “[human]-in-the-loop”.¹¹⁷ Unlike the IAI Harpy, the Harop’s operator can guide the platform using its two-way data link and electro-optical sensor(s), monitoring its flight path and authorising attacks against operator designated targets.¹¹⁸ As IAI describe it: after arriving at its designated “holding area”, the operator “directs the selected [Harop platform] to the target area and uses the video image to select a target, and to attack it. The HAROP tracks the target and then dives on it, detonating the warhead upon impact”.¹¹⁹ IAI advertise the Harop as being installed with an abort/wave-off capability.¹²⁰</p> <p>Autonomous flight: IAI advertise the Harop as being designed to “autonomously fly to a pre-defined ‘holding area’” where the platform then loiters.¹²¹</p>

¹⁰⁸ <https://www.thedrive.com/the-war-zone/40265/the-sound-of-this-nighttime-suicide-drone-strike-is-absolutely-terrifying>; <https://www.washingtonpost.com/news/checkpoint/wp/2016/04/05/israeli-made-kamikaze-drone-spotted-in-nagorno-karabakh-conflict/>

¹⁰⁹ <https://www.thedrive.com/the-war-zone/38690/ship-launched-version-of-the-israeli-harop-suicide-drone-will-be-sailing-with-an-asian-navy>; <https://www.aljazeera.com/features/2020/10/11/nagorno-karabakh-conflict-ushering-in-new-age-of-warfare>; <https://caspiannews.com/news-detail/us-analyzes-azerbaijani-military-tactics-during-karabakh-war-2020-11-25-37/>; <https://www.jpost.com/middle-east/israeli-drones-in-azerbaijan-raise-questions-on-use-in-the-battlefield-64416>;

<https://jamestown.org/program/tactical-reasons-behind-military-breakthrough-in-karabakh-conflict/>

¹¹⁰ https://www.timesofisrael.com/liveblog_entry/azerbaijan-praises-very-effective-israeli-drones-in-fighting-with-armenia/

¹¹¹ <https://www.forbes.com/sites/pauliddon/2021/04/28/these-israeli-systems-can-give-their-operator-a-decisive-edge-on-the-modern-battlefield/?sh=3ff2e40413df>

¹¹² <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>; <https://www.iai.co.il/successful-flight-demonstrations-harop-loitering-munitions>

¹¹³ <https://www.inss.org.il/wp-content/uploads/2018/11/Antebi.pdf>, p.88.

¹¹⁴ <https://www.jstor.org/stable/pdf/48638213.pdf>, p.16.

¹¹⁵ https://kclpure.kcl.ac.uk/portal/files/110831207/Conference_Reader_FINAL.pdf#page=16, p.20; <https://apps.dtic.mil/sti/pdfs/AD1041804.pdf>, p.31.

¹¹⁶ <https://www.youtube.com/watch?v=9V9mbC-Esmg>

¹¹⁷ <https://www.iai.co.il/p/harop>; <https://www.iai.co.il/drupal/sites/default/files/2019-05/HAROP%20Brochure.pdf>;

<https://www.iai.co.il/successful-flight-demonstrations-harop-loitering-munitions>

¹¹⁸ <https://www.airforce-technology.com/projects/haroploiteringmuniti/>; <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>

¹¹⁹ <https://www.iai.co.il/p/harop>

¹²⁰ <https://www.iai.co.il/p/harop>

¹²¹ <https://www.iai.co.il/p/harop>

Anti-armour systems

Devil Killer	
System manufacturer	Korea Aerospace Industries (South Korea)
System user(s)	NDA
System range	Range: 40km. ¹²² Operational endurance: 4 hours. ¹²³
Launch	Platform weight: 25kg. ¹²⁴ Wingspan: 1.3m. ¹²⁵ Launch method: Multiple Launch Rocket System. ¹²⁶ Delivery method(s): This platform's launch systems can be integrated onto a range of ground vehicles and warships. ¹²⁷
Payload	Sensors: electro-optical camera(s). ¹²⁸ Warhead: high-explosive warhead. ¹²⁹
Platform variant(s)	NDA
Development status	This platform's development appears to have stopped after it failed to secure any orders.
Development history	The Devil Killer's development began in January 2011 as a collaboration between Korea Aerospace Industries, Hanyang University and Konkuk University. ¹³⁰ Its first test flight was completed in September 2011. ¹³¹ The Devil Killer was expected to be ready for deployment by 2015. ¹³² Speaking in February 2014 however, Korea Aerospace Industries senior manager and chief of international marketing Jei Yai Moon remarked that, whilst this platform was ready to enter production, "we do not have a customer yet. We will continue to market it". ¹³³ As of January 2023, the Devil Killer appears to no longer be listed on the Korea Aerospace Industries website. Whilst the platform was mentioned in Korea Aerospace Industries' 2017 annual report, ¹³⁴ it was not included in its 2019 or 2021 annual reports. ¹³⁵ Korea Aerospace Industries have since agreed a series of memorandum of understandings with Israel Aerospace Industries to develop loitering munitions for the South Korean military. ¹³⁶
Target type	According to <i>Korean Times</i> reports, this platform is designed to target "coastal artillery shells, long-range self-propelled anti-aircraft artillery and air-cushion vehicles". ¹³⁷ The South

¹²² <https://battle-updates.com/update/unmanned-systems-update-425/>; <https://thediplomat.com/2012/10/kamikaze-drones-a-poor-mans-cruise-missile/>

¹²³ <https://www.shephardmedia.com/news/uv-online/south-korea-confirmed-be-flying-male-platform/>

¹²⁴ <https://www.flightglobal.com/kai-developing-suicide-combat-uav/107220.article>

¹²⁵ Mark Voskuijl, "Performance analysis and design of loitering munitions: A comprehensive technical survey of recent developments." *Defence Technology* 18, no. 3 (2022): 325-343, p.341; http://www.koreatimes.co.kr/www/news/nation/2012/09/113_120065.html

¹²⁶ <https://twitter.com/Ninja998998/status/1104222827924746240/photo/4>

¹²⁷ <https://asian-defence-news.blogspot.com/2014/02/korea-aircraft-industries-promotes.html>; <https://battle-updates.com/update/unmanned-systems-update-425/>

¹²⁸ <https://www.flightglobal.com/kai-developing-suicide-combat-uav/107220.article>

¹²⁹ <https://thediplomat.com/2012/10/kamikaze-drones-a-poor-mans-cruise-missile/>

¹³⁰ <https://thediplomat.com/2012/10/kamikaze-drones-a-poor-mans-cruise-missile/>

¹³¹ http://www.koreatimes.co.kr/www/news/nation/2012/09/113_120065.html

¹³² <https://www.foxnews.com/tech/south-korea-developing-kamikaze-attack-drone>

¹³³ <https://battle-updates.com/update/unmanned-systems-update-425/>

¹³⁴ http://let.iiec.unam.mx/sites/let.iiec.unam.mx/files/048-KAI-Annual_Report_2017_fin.pdf, p.13.

¹³⁵ <https://www.koreaero.com/EN/Ir/AnnualReport.aspx>

¹³⁶ <https://www.janes.com/defence-news/news-detail/kai-and-iai-sign-deal-to-offer-loitering-munitions-mum-t-systems-to-rok-military>; <https://www.defensenews.com/industry/techwatch/2021/03/05/korean-and-israeli-firms-eye-partnership-to-arm-helicopter-with-kamikaze-drones/>

¹³⁷ http://www.koreatimes.co.kr/www/news/nation/2012/09/113_120065.html

	Korean military’s potential use of the Devil Killer to defend Yeonpyeong Island from North Korean attack has also been suggested in media reports. ¹³⁸
Autonomous and automated features	Autonomous attack: According to a September 2012 <i>Korean Times</i> news report, the Devil Killer can “automatically find what it will strike during its flight”. ¹³⁹ This claim, variations of which are repeated throughout the news coverage given to this platform, ¹⁴⁰ suggests that the Devil Killer is installed with some form of target recognition software.
	Human control over targeting: According to Korea Aerospace Industries, the Devil Killer’s operator “can identify targets through the forward-looking camera image and then commence either a manual or automatic strike”. ¹⁴¹ Its operator can reportedly guide the platform onto its designated target using a two-way video data link. ¹⁴²
	Autonomous flight: The Devil Killer can follow a “programmed route, which is designated with navigation points”. ¹⁴³

¹³⁸ <https://www.foxnews.com/tech/south-korea-developing-kamikaze-attack-drone>

¹³⁹ http://www.koreatimes.co.kr/www/news/nation/2012/09/113_120065.html

¹⁴⁰ <https://www.foxnews.com/tech/south-korea-developing-kamikaze-attack-drone>;

<https://thediplomat.com/2012/10/kamikaze-drones-a-poor-mans-cruise-missile/>

¹⁴¹ <https://www.flightglobal.com/kai-developing-suicide-combat-uav/107220.article>

¹⁴² <https://battle-updates.com/update/unmanned-systems-update-425/>

¹⁴³ <https://www.flightglobal.com/kai-developing-suicide-combat-uav/107220.article>

Fire Shadow	
System manufacturer	MBDA UK (UK)
System user(s)	None
System range	Range: 150km. ¹⁴⁴ Operational endurance: 6 hours. ¹⁴⁵
Launch	Platform weight: 200kg. ¹⁴⁶ Wingspan: 4.8m. ¹⁴⁷ Launch method: rocket assisted rail-mounted catapult. ¹⁴⁸ Delivery method(s): NDA
Payload	Sensors: electro-optical camera(s). ¹⁴⁹ A 2007 MBDA press release describes the Fire Shadow as being designed to “receive real-time target information from a range of sources in a potentially network or info-centric enabled environment” including from ISR platforms. ¹⁵⁰ Warhead: NDA
Platform variant(s)	NDA
Development status	This programme was formally cancelled by the British Ministry of Defence (MOD) as part of its 2017-2018 defence budget at a listed loss of £95 million. ¹⁵¹
Development history	The Fire Shadow was developed as part of the British MOD’s Indirect Fire Precision Attack programme which aimed to “provide the [British] Army with [an] all-weather, 24-hour Indirect Fire System for the precision attack of targets at extended range”. ¹⁵² It was developed by a consortium headed by MBDA UK with contributions from Cranfield Aerospace, Lockheed Martin UK, and Thales UK. ¹⁵³ The Fire Shadow was unveiled at the 2007 Defence and Security Equipment International Exhibition. ¹⁵⁴ A test firing of the Fire Shadow system was completed at the Aberporth range in West Wales in April 2008. ¹⁵⁵ By September 2011, the Fire Shadow had conducted a further two test flights. ¹⁵⁶ According to MBDA UK, “[t]hese achievements pave[d] the way” for the

¹⁴⁴ <https://www.army-technology.com/news/news2440-html/>

¹⁴⁵ <https://www.flightglobal.com/dsci-mbda-advances-fire-shadow-loitering-munition-tests/102088.article;>
https://www.defenseworld.net/news/23041/UK_Scraps_Fire_Shadow_Loitering_Munitions_Program_Incurring_Loss_of_148_Million#.YLc4SqhKjcd; https://defense-update.com/20110914_fire-shadow-afghanistan.html

¹⁴⁶ https://www.huffingtonpost.co.uk/2012/07/20/british-armys-fire-shadow-missile_n_1688508.html;
<https://www.flightglobal.com/mbda-delivers-first-fire-shadow-loitering-weapons/104555.article>

¹⁴⁷ Mark Voskuijl, "Performance analysis and design of loitering munitions: A comprehensive technical survey of recent developments." *Defence Technology* 18, no. 3 (2022): 325-343, 341.

¹⁴⁸ <https://www.flightglobal.com/british-army-to-continue-fire-shadow-missile-trials/106308.article;>
<https://www.flightglobal.com/uks-fire-shadow-loitering-munition-makes-flight-debut/80737.article>

¹⁴⁹ <https://www.aerospace-technology.com/uncategorised/news64248-html/>

¹⁵⁰ <https://www.mbda-systems.com/press-releases/team-lm-launches-fire-shadow-to-meet-uk-mod-loitering-munition-requirement/>

¹⁵¹ https://www.defenseworld.net/news/23041/UK_Scraps_Fire_Shadow_Loitering_Munitions_Program_Incurring_Loss_of_148_Million#.YLc4SqhKjcd;

¹⁵² https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727618/CCS207_CCS031_8104056-1_MOD_ARA_2017-18_-_Web_PDF.pdf, p.145.

¹⁵³ <https://hansard.parliament.uk/Commons/2001-11-12/debates/9d6928b3-3a4e-41ad-9b23-8d89b010db5f/IndirectFirePrecisionAttack;> https://defense-update.com/20110914_fire-shadow-afghanistan.html;
https://defense-update.com/20080521_firesshadow.html

¹⁵⁴ <https://www.mbda-systems.com/press-releases/team-lm-launches-fire-shadow-to-meet-uk-mod-loitering-munition-requirement/>

¹⁵⁵ <https://www.mbda-systems.com/press-releases/team-lm-launches-fire-shadow-to-meet-uk-mod-loitering-munition-requirement/>

¹⁵⁶ <https://www.flightglobal.com/uks-fire-shadow-loitering-munition-makes-flight-debut/80737.article>

¹⁵⁷ <https://www.mbda-systems.com/press-releases/2971/>

	<p>Fire Shadow to enter service with the British Army in 2012.¹⁵⁷ The first tranche of Fire Shadows systems were delivered to the British Army in March 2012 as a “start-up capability for current operations”.¹⁵⁸</p> <p>British Army officials reportedly considered sending the Fire Shadow to support combat operations in Afghanistan in 2012.¹⁵⁹ This deployment did not occur. According to a 2014 National Audit Office report, this was “due to changes in the strategic Operation task”.¹⁶⁰ A later report published by the National Audit Office clarified that “[t]he Senior Responsible Owner took a decision not to deploy the weapon for testing in Afghanistan as the capability was not sufficiently mature”.¹⁶¹</p>
Target type	<p>The Fire Shadow was designed “as a solution for the UK ground forces’ requirement for a low cost, all-weather, 24 hour capability to carry out precision attacks against surface targets which may be difficult to engage and [are] time sensitive”.¹⁶² It was intended to “provide timely, enduring and precise support at appropriate ranges, allowing simultaneous attack in deep, close and rear operations throughout the spectrum of conflict”.¹⁶³ Analysts highlight the Fire Shadow’s potential use to attack enemy air defence systems and missile launchers, as well as conducting irregular warfare operations in urban settings.¹⁶⁴</p>
Autonomous and automated features	<p>Autonomous attack: The Fire Shadow could reportedly attack both static and moving targets.¹⁶⁵</p> <p>Human control over targeting: According to a 2007 MBDA UK press release, the Fire Shadow was designed to operate with a “[human]-in-the-loop”.¹⁶⁶ As they described it: “the weapon always remains under the control of an operator”.¹⁶⁷ MBDA UK claim to have tested this capability during a May 2011 demonstration, noting that the “operator was able to select and successfully engage a representative target”.¹⁶⁸ The Fire Shadow was advertised as being equipped with an abort/wave-off capability which enabled operators to “divert the weapon at the last moment should, for example, non-combatants suddenly appear near the intended target”.¹⁶⁹</p> <p>Autonomous flight: According to a 2011 MBDA UK press release, the Fire Shadow could be flown via waypoint navigation.¹⁷⁰ The platform could also be placed into a “loitering pattern”.¹⁷¹</p>

¹⁵⁷ <https://www.mbda-systems.com/press-releases/2971/>

¹⁵⁸ <https://www.flightglobal.com/mbda-delivers-first-fire-shadow-loitering-weapons/104555.article>; <https://www.thinkdefence.co.uk/2022/11/fire-shadow-loitering-munition/>; <https://www.nao.org.uk/wp-content/uploads/2015/10/Appendices-and-project-summary-sheets.pdf>, p.65.

¹⁵⁹ https://defense-update.com/20110914_fire-shadow-afghanistan.html; <https://www.themanufacturer.com/articles/mbda-prepares-fire-shadow-after-successful-testings/>

¹⁶⁰ <https://www.nao.org.uk/wp-content/uploads/2015/02/The-Major-Projects-Report-2013.pdf>, p.54.

¹⁶¹ <https://www.nao.org.uk/wp-content/uploads/2015/10/Appendices-and-project-summary-sheets.pdf>, p.65.

¹⁶² <https://www.mbda-systems.com/press-releases/team-lm-launches-fire-shadow-to-meet-uk-mod-loitering-munition-requirement/>

¹⁶³ <https://battle-updates.com/update/team-lm-fires-fire-shadow-loitering-munition/>

¹⁶⁴ https://defense-update.com/20080804_fire-shadow-a-persistent-killer.html; <https://www.flightglobal.com/british-army-to-continue-fire-shadow-missile-trials/106308.article>

¹⁶⁵ <https://www.thinkdefence.co.uk/fire-shadow-loitering-munition/>; <https://www.flightglobal.com/mbda-delivers-first-fire-shadow-loitering-weapons/104555.article>

¹⁶⁶ <https://www.mbda-systems.com/polska/press-releases/team-lm-launches-fire-shadow-to-meet-uk-mod-loitering-munition-requirement/>

¹⁶⁷ <https://www.mbda-systems.com/press-releases/team-lm-launches-fire-shadow-to-meet-uk-mod-loitering-munition-requirement/>

¹⁶⁸ <https://www.mbda-systems.com/press-releases/2971/>

¹⁶⁹ <https://www.mbda-systems.com/press-releases/team-lm-launches-fire-shadow-to-meet-uk-mod-loitering-munition-requirement/>

¹⁷⁰ <https://www.mbda-systems.com/press-releases/2971/>

¹⁷¹ <https://www.mbda-systems.com/press-releases/2971/>

Hero-120	
System image ¹⁷²	
System manufacturer	UVision (Israel)
System user(s)	United States; ¹⁷³ Argentina. ¹⁷⁴
System range	Range: 40km. ¹⁷⁵ Operational endurance: 60 minutes. ¹⁷⁶
Launch	Platform weight: 12kg. ¹⁷⁷ Launch method: pneumatic launch canister. ¹⁷⁸ Delivery method(s): UVision Air have collaborated with the Estonian defence company Milrem Robotics to develop a “new operational concept” in which six Hero-120 platforms can be launched from multi-canister launchers installed onto unmanned ground vehicles. ¹⁷⁹ In October 2021, UVision released images showing a LAV-25-series wheeled armoured vehicle equipped with a multi-canister launcher appearing to carry eight Hero-120 platforms. ¹⁸⁰ Rheinmetall, who in October 2021 agreed a strategic partnership with UVision to market UVision loitering munitions to European militaries through its Italian subsidiary RWM Italia S.p.A, ¹⁸¹ have developed a Hero-120 launcher for its Mission Master XT uncrewed ground vehicle. ¹⁸² The United States Marine Corps aims to integrate the Hero-120 onto a range of vehicles including the Light Armoured Vehicle-Mortar (LAV-M), the Long-Range Unmanned Surface Vessel, and the Joint Light Tactical Vehicle (JLTV). ¹⁸³
Payload	Sensors: electro-optical and infrared camera(s). ¹⁸⁴ Warhead: combined anti-armour and fragmentation warhead. ¹⁸⁵

¹⁷² MilleniumAC, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons

¹⁷³ <https://uvisionuav.com/wp-content/uploads/2021/06/OPFM.pdf>; <https://www.janes.com/defence-news/news-detail/hero-120-loitering-munition-selected-for-usmc-opf-m-system-requirement>; <https://www.joint-forces.com/defence-equipment-news/53697-uvision-usa-hero-120-opf-m-at-modern-day-marine>

¹⁷⁴ <https://www.janes.com/defence-news/argentina-buys-uvision-loitering-munitions-from-israel/>

¹⁷⁵ Hero-120 brochure - <https://uvisionuav.com/brochures/>

¹⁷⁶ Hero-120 brochure - <https://uvisionuav.com/brochures/>

¹⁷⁷ Hero-120 brochure - <https://uvisionuav.com/brochures/>

¹⁷⁸ Hero-120 brochure - <https://uvisionuav.com/brochures/>

¹⁷⁹

https://www.defenseworld.net/news/28009/Israeli_Estonian_Firms_Develop_Unmanned_Vehicles_Mounted_Loitering_Munition_Launcher#.Yjn9QefP2Uk

¹⁸⁰ https://www.realcleardefense.com/2021/10/13/first_look_at_the_marines_loitering_munition-armed_lav_798745.html

¹⁸¹ https://uvisionuav.com/wp-content/uploads/2021/11/UVision_Rheinmetall.pdf

¹⁸²

https://www.rheinmetall.com/media/editor_media/rheinmetallag/press/pressearchiv_2022/2022_06_13_eurosatory/06b_Rheinmetall_Eurosatory_2022_Mission_Master_Fire_Support_HERO_120_final.pdf; <https://www.janes.com/defence-news/news-detail/eurosatory-2022-rheinmetall-mission-master-xt-displayed-with-hero-120-loitering-munition>

¹⁸³ <https://www.army-technology.com/projects/hero-family-of-loitering-munition-systems/>; <https://www.janes.com/defence-news/news-detail/hero-120-loitering-munition-selected-for-usmc-opf-m-system-requirement>

¹⁸⁴ Hero-120 brochure - <https://uvisionuav.com/brochures/>

Platform variant(s)	Hero-120SF: In July 2019, it was reported that the Pentagon was seeking permission from Congress to “immediately procure” an undisclosed number of Hero-120 platforms as part of a \$6.9 million contract. ¹⁸⁶ An October 2019 UVision press release confirmed that this platform would be unveiled at the Association of the United States Army's (AUSA's) 2019 exhibition held in the United States, noting that it was “designed to meet the specific requirements of the US Military Forces”. ¹⁸⁷ As of November 2021, the Hero-120SF (Special Force) had completed “extensive trials” involving more than a dozen platforms. ¹⁸⁸ According to analysts, this marked the “beginning of the operational implementation and potential use of this highly effective munition in theatre”. ¹⁸⁹
Development status	The Hero-120 SF has been ordered by the United States Marine Corps as part of its Organic Precision Fires-Mounted system requirement. ¹⁹⁰
Development history	Like the Hero-30, the Hero-120 was first shown at the 2015 Paris Air Show. ¹⁹¹ The platform was demonstrated to a “strategic NATO customer” in February 2020. ¹⁹² In June 2021, the US Marine Corps selected the Hero-120 to meet its Organic Precision Fires-Mounted system requirement. ¹⁹³ This multi-year programme required “incremental upgrades throughout various phases” to the platform. ¹⁹⁴ According to UVision officials, “the Hero-120 system was selected following the completion of a series of rigorous demonstrations, tests, and field user evaluation processes”. ¹⁹⁵
Target type	According to UVision, the Hero-120 is “[i]deal for anti-tank missions, or other strategic objectives”. ¹⁹⁶ The company advertises this platform as being designed to conduct “pinpoint strikes against anti-armor, anti-material and anti-personnel targets including tanks, vehicles, concrete fortifications and other soft targets in populated urban areas”. ¹⁹⁷ As with the Hero-30, UVision advertise this platform for use in urban areas. ¹⁹⁸
Autonomous and automated features	Autonomous attack: UVision advertise the Hero-120 as being capable of tracking moving targets. ¹⁹⁹ Human control over targeting: According to analysts, the Hero-120’s operator can “make course corrections right up until the moment of impact”. ²⁰⁰ The Hero 120 is installed with an abort/wave-off capability which, according to its manufacturer, “allows automatic re-entry into the loitering mode, re-engagement of the enemy or return to the recovery area”. ²⁰¹ The Hero-120 is advertised as being operated in line with "human in the loop"

¹⁸⁵ Hero-120 brochure - <https://uivisionuav.com/brochures/>

¹⁸⁶ <https://www.jpost.com/israel-news/us-department-of-defense-eyeing-israeli-suicide-drone-596083>

¹⁸⁷ https://uivisionuav.com/wp-content/uploads/2021/01/Firstec-and-UVision_110916_FINAL_Updated-Israeli-MOD.pdf

¹⁸⁸ <https://www.prnewswire.com/news-releases/iwtsd-and-mistral-incuivision-air-ltd-successfully-complete-testing-of-the-mlam--sf-loitering-aerial-munition--hero-120sf-301420440.html>

¹⁸⁹ <https://www.prnewswire.com/news-releases/iwtsd-and-mistral-incuivision-air-ltd-successfully-complete-testing-of-the-mlam--sf-loitering-aerial-munition--hero-120sf-301420440.html>

¹⁹⁰

https://www.armyrecognition.com/defense_news_may_2022_global_security_army_industry/uivision_usa_highlights_its_hero-120_opf-m_aerial_loitering_munitions_at_modern_day_marine_2022.html

¹⁹¹ <https://airrecognition.com/index.php/news/airshow/air-show-2015/paris-air-show-2015/paris-air-show-2016/2028-uivision-unveils-comprehensive-range-of-new-smart-loitering-systems-the-hero-family.html>; https://uivisionuav.com/wp-content/uploads/2015/06/UVision-FINAL-15-6-15_f.pdf

¹⁹² <https://www.joint-forces.com/defence-equipment-news/29654-hero-120-loitering-munitions-system-successful-demo>

¹⁹³ <https://www.janes.com/defence-news/news-detail/hero-120-loitering-munition-selected-for-usmc-opf-m-system-requirement>

¹⁹⁴

https://www.armyrecognition.com/defense_news_may_2022_global_security_army_industry/uivision_usa_highlights_its_hero-120_opf-m_aerial_loitering_munitions_at_modern_day_marine_2022.html

¹⁹⁵ <https://www.janes.com/defence-news/news-detail/hero-120-loitering-munition-selected-for-usmc-opf-m-system-requirement>

¹⁹⁶ <https://uivisionuav.com/portfolio-view/hero-120/>

¹⁹⁷ Hero-120 brochure - <https://uivisionuav.com/brochures/>

¹⁹⁸ Hero-120 brochure - <https://uivisionuav.com/brochures/>; https://uivisionuav.com/wp-content/uploads/2021/01/Firstec-and-UVision_110916_FINAL_Updated-Israeli-MOD.pdf

¹⁹⁹ Hero-120 brochure - <https://uivisionuav.com/brochures/>

²⁰⁰ <https://www.thedrive.com/the-war-zone/41219/marines-pick-loitering-munition-to-arm-light-vehicles-and-drone-boats>

²⁰¹ <https://www.shephardmedia.com/news/uv-online/marine-corps-receive-heroes/>

principles, enabling “calculated and pinpoint attacks that are precisely tailored to the timing and conditions of the constantly changing situation”.²⁰²

Autonomous flight: According to UVision, the Hero-120 “employs sophisticated navigation methods”.²⁰³ The Hero series of loitering munitions is advertised as being installed with “sophisticated on board navigation algorithms”,²⁰⁴ in addition to “automated flight to target areas”.²⁰⁵

²⁰²


https://www.rheinmetall.com/media/editor_media/rheinmetallag/press/pressearchiv_2022/2022_06_13_eurosatory/06b_Rheinmetall_Eurosatory_2022_Mission_Master_Fire_Support_HERO_120_final.pdf

²⁰³ Hero-120 brochure - <https://uvisionuav.com/brochures/>

²⁰⁴ Hero-120 brochure - <https://uvisionuav.com/brochures/>

²⁰⁵ <https://www.janes.com/defence-news/news-detail/ausa-2021-uvision-showcases-new-multi-canister-launcher-for-usmc>

Lancet-3

<p>System image²⁰⁶</p>	
<p>System manufacturer</p>	<p>ZALA Aero, part of the Kalashnikov Group which is a subsidiary of the state-owned defence conglomerate Rostec (Russia)</p>
<p>System user(s)</p>	<p>Russia</p>
<p>System range</p>	<p>Range: 40km.²⁰⁷ Loitering time: 40 minutes.²⁰⁸</p>
<p>Launch</p>	<p>Platform weight: 12kg.²⁰⁹ Wingspan: 1m (Lancet-3);²¹⁰ 2.4m (Lancet-3[M]).²¹¹ Launch method: rail-mounted catapult system.²¹² Delivery method(s): A promotional video released by ZALA Aero in December 2021 depicts a Lancet-3 being launched from a rail-mounted catapult installed onto a BK-16E high-speed assault craft.²¹³</p>
<p>Payload</p>	<p>Sensors: optical-electronic camera(s).²¹⁴ The Lancet-3 can reportedly receive targeting information from other reconnaissance platforms such as the Orlan-10 surveillance drone.²¹⁵ Warhead: fragmentation warhead;²¹⁶ anti-armour warhead.²¹⁷</p>
<p>Platform variant(s)</p>	<p>Lancet-1: The Lancet-1 variant can stay in the air for up to 30 minutes (vs up to 40</p>

²⁰⁶ Nickel nitride, CC0, via Wikimedia Commons, <https://upload.wikimedia.org/wikipedia/commons/7/7c/Army-2020-315.JPG>

²⁰⁷ <https://www.ruaviation.com/news/2019/6/25/13741/?h;> <https://www.airrecognition.com/index.php/news/defense-aviation-news/2021/august/7582-russian-defense-ministry-agrees-requirements-to-lancet-combat-drone.html>

²⁰⁸ <https://zala-aero.com/en/production/bvs/zala-lancet-3/>

²⁰⁹ [https://zala-aero.com/en/news/kalashnikov-presented-precision-uav-weapon-system-zala-lancet/;](https://zala-aero.com/en/news/kalashnikov-presented-precision-uav-weapon-system-zala-lancet/)

²¹⁰ <https://www.forbes.com/sites/davidhambling/2022/11/04/russian-videos-reveal-new-details-of-loitering-munitions/?ss=aerospace-defense&sh=3f20ab415dbc>

²¹¹ <https://www.forbes.com/sites/davidhambling/2022/11/04/russian-videos-reveal-new-details-of-loitering-munitions/?ss=aerospace-defense&sh=3f20ab415dbc>

²¹² [https://rostec.ru/news/udarnyy-bespilotnik-lantsset-kope-xxi-veka/;](https://rostec.ru/news/udarnyy-bespilotnik-lantsset-kope-xxi-veka/) [https://www.thedefensepost.com/2022/11/07/russia-ukrainian-patrol-boat-lancet-drone/;](https://www.thedefensepost.com/2022/11/07/russia-ukrainian-patrol-boat-lancet-drone/) <https://rg.ru/2021/12/13/poiavilos-video-ispytaniy-drona-kamikadze-lancet-s-morskogo-nositelia.html>

²¹³ https://english.pravda.ru/news/russia/149863-loitering_munition/

²¹⁴ <https://nationalinterest.org/blog/reboot/russian-drone-swarm-technology-promises-aerial-minefield-capabilities-198640;>

<https://kalashnikov.media/video/technology/kalashnikov-predstavil-vysokotochnyy-udarnyy-bespilotnyy-kompleks-zala-lantsset>

²¹⁵ https://www.ng.ru/nvo/2023-01-12/1_1220_kamikaze.html

²¹⁶ <https://rg.ru/2021/12/13/poiavilos-video-ispytaniy-drona-kamikadze-lancet-s-morskogo-nositelia.html;> <https://zala-aero.com/en/production/bvs/zala-lancet-3/>

²¹⁷ <https://www.forbes.com/sites/davidhambling/2022/12/01/russian-loitering-munition-racks-up-kills-but-shows-limitations/?sh=c252caa5d586>

	<p>minutes for the Lancet-3), carries a lighter warhead (1kg vs 3kg) and has an overall lower take-off weight (5kg vs 12kg) than the Lancet-3.²¹⁸ According to Rostec, both Lancet variants “have the same airframe and are similar in some internal systems”.²¹⁹ They were first shown at the ‘ARMY-2019’ exhibition held in Russia.²²⁰</p> <p>Lancet-3(M): the Russian military claims to have developed an upgraded Lancet-3 variant, reportedly first used in Syria in February 2022.²²¹ In July 2022, the Russian state media quoted a source stating that the Russian military had started using this modernized version of the Lancet for combat operations in Ukraine.²²² The Lancet-3(M), according to reports, is armed with a 5kg warhead and has a range of 60 rather than 40 minutes.²²³ Its aeronautical design has also been modified to improve its manoeuvrability during the terminal stage of an attack.²²⁴ In November 2022, the state news agency RIA Novosti, quoting a Russian military source, listed the Lancet’s formal names as being <i>Izdeliye [Product]-52</i> (Lancet-3) and <i>Izdeliye [Product]-51</i> (Lancet-3[M]).²²⁵ The Lancet-3M was exhibited at the National Defence Management Centre in December 2022.²²⁶</p>
Development status	In service with the Russian military. ²²⁷
Development history	<p>The Lancet-3 was unveiled at the military exhibition ‘ARMY-2019’.²²⁸ According to Russian state media reports, the Lancet-3 was field tested by Russian Special Forces in Syria.²²⁹ In April 2021, the Russian broadcaster <i>Rossija 1</i> released video footage appearing to show the Lancet-3 being used to conduct attacks against a group of militant fighters.²³⁰ At the ARMY forum held in August 2021, Kalashnikov announced that the Russian Ministry of Defence had formalised the technical requirements for this platform.²³¹</p> <p>The Lancet-3 has been extensively used by the Russian military in Ukraine: according to statements made by Rostec officials in June 2022, the platform had “successfully demonstrated their properties in combat conditions”.²³² In August 2022, the president of the Kalashnikov Group Alan Lushnikov claimed that the Russian military had “begun to actively use” the company’s loitering munitions including the Lancet-3.²³³ The Russian Ministry of Defence released the first video</p>

²¹⁸ <https://zala-aero.com/en/production/bvs/zala-lancet-3/>; <https://www.gazeta.ru/army/2021/04/20/13566356.shtml>; <https://rg.ru/2021/12/13/poiavilos-video-ispytaniy-drona-kamikadze-lancet-s-morskogo-nositelia.html>

²¹⁹ <https://rostec.ru/news/udarnyy-besplotnik-lantset-kope-xxi-veka/>

²²⁰ <https://en.topwar.ru/184397-potencial-barrazhirujuschih-boepripasov-semejstva-lancet.html>; <https://kalashnikovgroup.ru/media/besplotnye-letatelnye-apparaty/kalashnikov-predstavil-vysokotochnyy-udarnyy-besplotnyy-kompleks-zala-lantset>

²²¹ <https://ria.ru/20220218/lantset-1773465986.html>

²²² <https://ria.ru/20220721/lantset-1803923300.html>

²²³ <https://armstrade.org/includes/periodics/news/2022/0721/070568601/detail.shtml>, https://aif.ru/politics/world/chto_za_modernizirovannyye_drony-kamikadze_lancet_primenyayutsya_na_ukraine

²²⁴ <https://ria.ru/20220721/lantset-1803923300.html>

²²⁵ <https://ria.ru/20221104/lantset-1829238198.html>

²²⁶ <https://t.me/milinfolive/94672>

²²⁷ <https://tass.com/defense/1462311>; <https://tass.com/defense/1512115>

²²⁸ <https://zala-aero.com/en/news/kalashnikov-presented-precision-uav-weapon-system-zala-lancet/>; <https://kalashnikov.media/video/technology/kalashnikov-predstavil-vysokotochnyy-udarnyy-besplotnyy-kompleks-zala-lantset/>; <https://www.gazeta.ru/army/2021/04/20/13566356.shtml>

²²⁹ <https://tass.ru/armiya-i-opk/11182581>; <https://www.vesti.ru/article/2552094>

²³⁰ <https://www.youtube.com/watch?v=xaYvsjEyqW4&t=9s>; <https://rg.ru/2021/04/17/primenenie-rossijskogo-drona-kamikadze-pokazali-na-video.html>; <https://voi.id/en/news/79902/successfully-carrying-out-mission-in-syria-kamikaze-flying-kalashnikov-drone-zala-lancet-ready-to-undertake-state-trials>

²³¹ <https://www.airrecognition.com/index.php/news/defense-aviation-news/2021/august/7582-russian-defense-ministry-agrees-requirements-to-lancet-combat-drone.html>; <https://sputniknews.com/20210827/flying-ak-47-kalashnikovs-zala-lancet-drone-getting-ready-for-state-trials-after-syria-mission-1083722540.html>

²³² <https://tass.com/defense/1512115>; <https://tass.com/defense/1462311>, <https://iz.ru/1346542/2022-06-08/v-rostekhe-zaiavili-o-primenenii-dronov-kub-i-lantset-v-spetoperacii>

²³³ <https://tass.com/defense/1512115>

	<p>footage depicting the Lancet-3's use in Ukraine in October 2022.²³⁴ The Russian use of these platforms appears to have increased after October 2022.²³⁵ Reports suggest that Lancet-3 platforms were provided to Russian units fighting across eastern and southern Ukraine. Nevertheless, the exact size of the Russian military's Lancet-3 stockpile remains unclear.²³⁶ An analysis of open source intelligence conducted by <i>Oryx</i> analysts suggests that the Lancet-3 has been used to attack a range of Ukrainian targets with varying degrees of accuracy.²³⁷</p>
<p>Target type</p>	<p>Promotional material released by ZALA Aero depicts the Lancet-3 attacking targets including trucks and troop carriers.²³⁸ According to remarks made by Rostec Corporation CEO Sergey Chemezov in 2019, the Lancet-3 was “capable of striking targets in the air, on land, and water”.²³⁹ Open source analysis of the Lancet-3's use by the Russian military in Ukraine suggests that the platform has been used to attack targets including tanks, armoured fighting vehicles, artillery, air defence systems, and radar units.²⁴⁰ In November 2022, RIA Novosti released a video of a Lancet striking a M777 howitzer supplied to Ukraine from the United States.²⁴¹ The same outlet reported that the ZALA Aero training centre digitalised the whole map of Ukraine in order to train operators of Lancet loitering munitions.²⁴² Also in November 2022, a Lancet-3(M) was reportedly used to attack and destroy an Ukrainian Gyurza-M class gunboat.²⁴³</p>
<p>Autonomous and automated features</p>	<p>Autonomous attack: ZALA Aero advertise the Lancet-3 as being “capable of autonomously locating and striking a given target”.²⁴⁴ Analysts describe its use of autonomy in the following terms: “[o]nce launched, it circles a predesignated geographic area until detecting a preselected target type. It then crashes itself into the target, detonating the warhead it carries”.²⁴⁵ Speaking in June 2022, a Rostec spokesperson described the Lancet-3 as being “highly autonomous” and being equipped with an “optical-electronic system that helps independently ferret out and destroy a target”.²⁴⁶ Rostec CEO Sergey Chemezov stated in November 2022 that the Lancet can “autonomously conduct reconnaissance and attack targets”.²⁴⁷ The targeting software used on the Lancet-3 appears to have been principally designed to attack stationary objects.²⁴⁸</p> <p>Human control over targeting: The Lancet-3 is equipped with an optical-electronic</p>

²³⁴ <https://ria.ru/20221013/lantset-1823742763.html>; <https://iz.ru/1409723/2022-10-13/minoborony-vpervye-opublikovalo-video-udara-boepripasom-lantcet-po-vsu>

²³⁵ <https://www.oryxspioenkop.com/2022/11/hit-or-miss-russian-loitering-munition.html>, <https://iz.ru/1413103/2022-10-20/minoborony-pokazalo-video-primeneniia-dronov-lantcet-protiv-tekhniki-vsu>

²³⁶ <https://eurasianimes.com/impossible-to-intercept-russia-claims-its-lancet-kamikaze-drones/>;
<https://www.forbes.com/sites/davidhambling/2022/11/04/russian-videos-reveal-new-details-of-loitering-munitions/?ss=aerospace-defense&sh=3f20ab415dbc>

²³⁷ <https://www.oryxspioenkop.com/2022/11/hit-or-miss-russian-loitering-munition.html>;
<https://www.forbes.com/sites/davidhambling/2022/12/01/russian-loitering-munition-racks-up-kills-but-shows-limitations/?sh=54c061445d58>

²³⁸ <https://www.youtube.com/watch?v=IgGOHvBj9E&t=28s>

²³⁹ <https://www.rt.com/russia/462608-kalashnikov-russian-kamikaze-drone/>

²⁴⁰ <https://www.oryxspioenkop.com/2022/11/hit-or-miss-russian-loitering-munition.html>,
<https://ria.ru/20221108/spetsoperatsiya-1829950636.html>, <https://ria.ru/20221111/svo-1830656465.html>,

<https://iz.ru/1413513/2022-10-21/voennoy-obo-zrevatel-nazval-osobennosti-bes-pilotnika-lantcet>

²⁴¹ <https://ria.ru/20221106/svo-1829416432.html?in=t>

²⁴² <https://ria.ru/20221112/karta-1830991650.html>, <https://ria.ru/20221115/trenazher-1831499767.html>

²⁴³ <https://ria.ru/20221104/lantset-1829204198.html>, <https://www.navyrecognition.com/index.php/naval-news/naval-news-archive/2022/november/12438-russian-loitering-munition-lancet-hits-ukrainian-gyurza-m-class-gunboat-for-first-time.html>

²⁴⁴ <https://zala-aero.com/en/production/bvs/zala-lancet-3/>

²⁴⁵ <https://fortune.com/2022/03/01/russia-ukraine-invasion-war-a-i-artificial-intelligence/>

²⁴⁶ <https://tass.com/defense/1462311>

²⁴⁷ <https://tass.ru/armiya-i-opk/16397293>

²⁴⁸ <https://www.oryxspioenkop.com/2022/11/hit-or-miss-russian-loitering-munition.html>;
https://twitter.com/imp_navigator/status/1591732624095150083;

https://twitter.com/imp_navigator/status/1591726366369906688; <https://www.kommersant.ru/doc/5502371>

	<p>guidance unit and communication module which enables the platform to be manually operated.²⁴⁹ Its sensors generate a live-video feed which enables its operator to visually inspect targets before a strike, providing a ‘human-in-the-loop’ functionality.²⁵⁰ The Lancet-3 can be guided toward a target using GPS coordinates, manually piloted by its human operator, or operated through what is described as the use of “combined technology”.²⁵¹</p> <p>Autonomous flight: Some media reports point to the Lancet-3 utilising an “automatic” flight mode.²⁵² The platform’s operator can programme the GPS coordinates of a location that is to be attacked.²⁵³ The Lancet-3 can be flown without satellite navigation.²⁵⁴</p>
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²⁴⁹ <https://nationalinterest.org/blog/reboot/russian-drone-swarm-technology-promises-aerial-minefield-capabilities-198640>; <https://kalashnikov.media/video/technology/kalashnikov-predstavil-vysokotochnyy-udarnyy-bespilotnyy-kompleks-zala-lantset>;

²⁵⁰ <https://tass.com/defense/1512115>; <https://www.gazeta.ru/army/2021/04/20/13566356.shtml>; <https://tass.ru/armiya-i-opk/11182581>; <https://rostec.ru/news/udarnyy-bespilotnik-lantset-kope-xxi-veka/>; <https://rg.ru/2021/12/13/poiavilos-video-ispytaniy-drona-kamikadze-lantset-s-morskogo-nositelia.html>; <https://kalashnikovgroup.ru/media/bespilotnye-letatelnye-apparaty/kalashnikov-predstavil-vysokotochnyy-udarnyy-bespilotnyy-kompleks-zala-lantset>

²⁵¹ <https://tass.com/defense/1462311>; <https://rg.ru/2021/12/13/poiavilos-video-ispytaniy-drona-kamikadze-lantset-s-morskogo-nositelia.html>; <https://kalashnikovgroup.ru/media/bespilotnye-letatelnye-apparaty/kalashnikov-predstavil-vysokotochnyy-udarnyy-bespilotnyy-kompleks-zala-lantset>

²⁵² <https://en.topwar.ru/159497-barrazhirujuschij-boepripas-zala-lantset.html>

²⁵³ [https://odin.tradoc.army.mil/mediawiki/index.php/ZALA_Lancet-1_Russian_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/ZALA_Lancet-1_Russian_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

²⁵⁴ <https://rostec.ru/news/udarnyy-bespilotnik-lantset-kope-xxi-veka/>; <https://rg.ru/2020/12/07/rossiya-ispytala-v-sirii-drony-kamikadze.html>, <https://jamestown.org/program/russian-uav-technology-and-loitering-munitions/>

Phoenix Ghost	
System image	NDA
System manufacturer	AEVEX Aerospace (US)
System user(s)	US; Ukraine. ²⁵⁵
System range	Range: NDA Operational endurance: 6 hours. ²⁵⁶
Launch	Platform weight: NDA Launch method: the Phoenix Ghost can reportedly take off vertically. It is possible that, like the AeroVironment Switchblade with which this platform is often compared, the Phoenix Ghost is launched via a pneumatic launch canister. ²⁵⁷ Delivery method(s): As with the Switchblade 300, the Phoenix Ghost can reportedly be carried in a soldier's backpack. ²⁵⁸
Payload	Sensors: infrared camera(s). ²⁵⁹ Warhead: anti-armour warhead. ²⁶⁰
Platform variant(s)	NDA
Development status	In service with the Ukrainian military. ²⁶¹
Development history	The US Air Force's 645th Aeronautical Systems Group had begun developing the Phoenix Ghost prior to Russia's February 2022 invasion of Ukraine. ²⁶² The US government has since provided a "steady supply" ²⁶³ of these platforms to the Ukrainian military, with the first tranche of 121 platforms being designated for delivery in April 2022 as part of a \$800 million military assistance package. ²⁶⁴ According to Pentagon officials, the Phoenix Ghost's ongoing development would be "attuned to Ukrainian requirements for unmanned aerial systems of a tactical nature in eastern Ukraine". ²⁶⁵ Speaking in July 2022, a Pentagon official reported "tremendous positive feedback from the Ukrainians" regarding the Phoenix Ghost's performance. ²⁶⁶
Target type	Pentagon officials describe the Phoenix Ghost as having a similar tactical role as AeroVironment's Switchblade 300. ²⁶⁷ Speaking in April 2022, Pentagon spokesperson

²⁵⁵ <https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/?sh=373ed4d6366d>; <https://taskandpurpose.com/news/phoenix-ghost-secretive-loitering-munition-pentagon-sending-ukraine/>

²⁵⁶ <https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/?sh=373ed4d6366d>

²⁵⁷ <https://www.politico.com/news/2022/04/21/mystery-drone-air-force-new-weapon-ukraine-00026970?2;>
<https://www.thedroningcompany.com/blog/the-current-scoop-on-the-phoenix-ghost-drone>

²⁵⁸ [https://www.airforce-technology.com/comment/phoenix-ghost-drone-switchblade/;](https://www.airforce-technology.com/comment/phoenix-ghost-drone-switchblade/)
<https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/>

²⁵⁹ <https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/?sh=373ed4d6366d>

²⁶⁰ <https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/?sh=373ed4d6366d>; <https://www.popsci.com/technology/phoenix-ghost-drone-explained/>

²⁶¹ <https://taskandpurpose.com/news/phoenix-ghost-secretive-loitering-munition-pentagon-sending-ukraine/>

²⁶² [https://www.defense.gov/News/Transcripts/Transcript/Article/3007440/pentagon-press-secretary-john-f-kirby-holds-a-press-briefing/;](https://www.defense.gov/News/Transcripts/Transcript/Article/3007440/pentagon-press-secretary-john-f-kirby-holds-a-press-briefing/)
<https://www.defense.gov/News/Transcripts/Transcript/Article/3023614/pentagon-press-secretary-john-f-kirby-holds-a-press-briefing/>

²⁶³ <https://www.defense.gov/News/Transcripts/Transcript/Article/3103383/senior-defense-official-holds-a-background-briefing/>

²⁶⁴ [https://www.defense.gov/News/News-Stories/Article/Article/3103655/more-himars-phoenix-ghost-drones-bound-for-ukraine/;](https://www.defense.gov/News/News-Stories/Article/Article/3103655/more-himars-phoenix-ghost-drones-bound-for-ukraine/)
<https://www.defense.gov/News/Releases/Release/Article/3006230/statement-on-800-million-in-additional-security-assistance-for-ukraine/>

²⁶⁵ <https://www.defense.gov/News/Transcripts/Transcript/Article/3007440/pentagon-press-secretary-john-f-kirby-holds-a-press-briefing/>

²⁶⁶ <https://www.defense.gov/News/Transcripts/Transcript/Article/3103383/senior-defense-official-holds-a-background-briefing/>

²⁶⁷ [https://www.defense.gov/News/Transcripts/Transcript/Article/3007440/pentagon-press-secretary-john-f-kirby-holds-a-press-briefing/;](https://www.defense.gov/News/Transcripts/Transcript/Article/3007440/pentagon-press-secretary-john-f-kirby-holds-a-press-briefing/)
<https://www.defense.gov/News/Transcripts/Transcript/Article/3008974/senior-defense-officials-hold-a-background-briefing/>

	<p>John Kirby described the Phoenix Ghost as “[p]roviding the same sort of tactical capability that a Switchblade does. Switchblade is a one-way drone if you will, and it clearly is designed to deliver a punch. It's a tactical UAS, and Phoenix ghost is of that same category”.²⁶⁸ Videos posted on social media in August 2022 appear to show a Phoenix Ghost being used to attack a Russian 82mm mortar position.²⁶⁹ Ukrainian sources describe the Phoenix Ghost as having been used to conduct attacks “[i]n the close rear” including against “medium armoured targets”.²⁷⁰</p>
<p>Autonomous and automated features</p>	<p>Autonomous attack: NDA</p> <p>Human control over targeting: According to Pentagon spokesperson John Kirby, the platform can be “used to give you a sight picture of what it’s seeing, of course”.²⁷¹ Whilst this capability is not confirmed by Kirby’s comment, coupled with the platform’s reported use of an infrared camera,²⁷² suggests that the Phoenix Ghost can possibly be operated in-line with human-in-the-loop principles.</p> <p>Autonomous flight: The Phoenix Ghost can reportedly navigate via both waypoint navigation and manual control.²⁷³</p>

²⁶⁸ <https://www.defense.gov/News/Transcripts/Transcript/Article/3008974/senior-defense-officials-hold-a-background-briefing/>;
<https://taskandpurpose.com/news/phoenix-ghost-secretive-loitering-munition-pentagon-sending-ukraine/#:~:text=%E2%80%99CI'm%20gonna%20be%20loath,mean%20it's%20lightweight%20and%20portable.>


²⁶⁹ <https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/>;
<https://twitter.com/RALee85/status/1554192348556451840>

²⁷⁰ <https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/>

²⁷¹ <https://www.aljazeera.com/news/2022/4/22/phoenix-ghost-what-we-know-about-us-new-drones-for-ukraine>

²⁷² <https://www.forbes.com/sites/davidhambling/2022/08/02/has-elusive-phoenix-ghost-loitering-munition-broken-cover-at-last/?sh=373ed4d6366d>

²⁷³ <https://www.technology.org/2022/11/16/phoenix-ghost-in-the-skies-above-ukraine-what-is-this-drone/>

SkyStriker	
System image ²⁷⁴	
System manufacturer	Elbit Systems (Israel)
System user(s)	Azerbaijan, ²⁷⁵ India, ²⁷⁶ Turkmenistan. ²⁷⁷
System range	Operational range: 100km. ²⁷⁸ Operational endurance: 1 hour when equipped with a 10kg warhead; 2 hours when equipped with a 5kg warhead. ²⁷⁹
Launch	Platform weight: 35kg. ²⁸⁰ Wingspan: NDA Launch method: rail-mounted catapult. ²⁸¹ Delivery method(s): The SkyStriker's launch system can be carried by ground vehicles such as trucks. ²⁸²
Payload	Sensors: electro-optical and infrared camera(s). ²⁸³ Warhead: high-explosive warhead; ²⁸⁴ anti-armour warhead. ²⁸⁵
Platform variant(s)	NDA
Development status	In service with the Azerbaijani and Turkmenistani militaries. ²⁸⁶
Development history	Elbit Systems announced the SkyStriker's development in 2016. ²⁸⁷ The platform was first

²⁷⁴ © Boevaya mashina / CC BY-SA 3.0 (via Wikimedia Commons)
https://commons.wikimedia.org/wiki/File:Elbit_Systems_SkyStriker_SIAF-2022.jpg

²⁷⁵ <https://www.ipost.com/israel-news/israels-elbit-systems-sells-azerbaijan-skystriker-suicide-drone-577053>;
<https://www.airrecognition.com/index.php/news/defense-aviation-news/2019-news/september/5465-azerbaijan-tests-skystriker-loitering-munition-uav.html>; <https://economictimes.indiatimes.com/news/defence/army-to-procure-skystrickers-for-balakot-type-missions/articleshow/85896141.cms?from=mdr>; <https://euro-sd.com/2020/06/news/17436/azerbaijan-looking-to-purchase-loitering-munitions-from-israel/>

²⁷⁶ <https://www.israeldefense.co.il/en/node/51795>;
https://www.defenseworld.net/news/30365/Indian_Army_Orders_100_SkyStriker_Loitering_Munitions#_YiY2zP7P2_Ul; <https://www.israeldefense.co.il/en/node/51795>; <https://timesofindia.indiatimes.com/india/army-to-get-100-sky-strickers-for-balakot-type-missions-from-bengaluru/articleshow/85879001.cms>; <https://www.israeldefense.co.il/en/node/51795>

²⁷⁷ <https://www.janes.com/defence-news/news-detail/turkmenistan-parades-new-military-equipment>;
<https://www.oryxspioenkop.com/2022/01/replicating-success-turkmenistans.html>; <https://thediplomat.com/2022/11/dawn-of-the-drone-age-in-central-asia/>

²⁷⁸ <https://www.elbitamerica.com/unmanned-aerial-solutions>

²⁷⁹ <https://elbitsystems.com/landing/wp-content/uploads/2018/07/Sky-Striker.pdf>

²⁸⁰ <https://www.flightglobal.com/military-uavs/elbits-skystriker-to-make-paris-air-show-debut/124371.article>

²⁸¹ <https://twitter.com/ElbitSystemsLtd/status/1562369908264079360>

²⁸² <https://elbitsystems.com/landing/wp-content/uploads/2018/07/Sky-Striker.pdf>;
[https://odin.tradoc.army.mil/mediawiki/index.php/Skystriker_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/Skystriker_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV));
<https://www.airrecognition.com/index.php/news/defense-aviation-news/2019-news/september/5465-azerbaijan-tests-skystriker-loitering-munition-uav.html>

²⁸³ <https://elbitsystems.com/pr-new/elbit-systems-introduces-skystriker/>;
[https://odin.tradoc.army.mil/mediawiki/index.php/Skystriker_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/Skystriker_Israeli_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

²⁸⁴ <https://www.youtube.com/watch?v=nFL0hjeSCsE>

²⁸⁵ <https://www.youtube.com/watch?v=nFL0hjeSCsE>

²⁸⁶ <https://www.oryxspioenkop.com/2022/01/replicating-success-turkmenistans.html>

	shown at the 2017 Paris Air Show. ²⁸⁸ The SkyStriker had entered serial production by July 2017. ²⁸⁹ In a joint venture with Elbit Systems, Alpha Design Technologies Private Limited has manufactured the SkyStriker as part of an order placed by the Indian Army for this platform in 2021. ²⁹⁰ Azerbaijan, which tested this platform in 2019, ²⁹¹ possibly fielded the SkyStriker in its 2020 war against Armenia over the contested Nagorno-Karabakh region. ²⁹²
Target type	Elbit Systems describe the SkyStriker as being designed to provide “direct-fire aerial-precision capabilities to manoeuvrable troops and Special Forces”. ²⁹³
Autonomous and automated features	<p>Autonomous attack: Elbit Systems describe the SkyStriker as a “fully autonomous LM [Loitering Munition] that can locate, acquire and strike operator-designated targets”.²⁹⁴ Promotional material released by the company shows the SkyStriker using a “automatic video tracker” to enable the platform to follow a moving vehicle.²⁹⁵ Its operator is similarly depicted visually inspecting targets before a strike.²⁹⁶ Speaking in 2017, an Elbit Systems official described the process of target selection as “really just dragging and dropping an icon on the screen”.²⁹⁷ The platform can attack moving targets.²⁹⁸ In the context of a strike, the platform “navigates based on its electro-optical ‘lock’ on the target”.²⁹⁹</p> <p>Human control over targeting: According to a 2018 Elbit Systems press release, the SkyStriker’s operator can “abort a strike up to two seconds to impact”.³⁰⁰ The SkyStriker is installed with a “wave-off” strike capability.³⁰¹</p> <p>Autonomous flight: According to Elbit Systems, the SkyStriker “uses autonomous navigation during its cruising and loitering phases”.³⁰² The platform can also be manually piloted.³⁰³</p>

²⁸⁷ <https://www.uasvision.com/2016/09/14/elbit-announces-skystriker-loitering-munition/>

²⁸⁸ <https://elbitsystems.com/pr-new/elbit-systems-2017-paris-air-show/>

²⁸⁹ <https://www.defensenews.com/digital-show-dailies/paris-air-show/2017/06/21/elbit-systems-pitches-skystriker-drone-in-emerging-market-of-loitering-munitions/>

²⁹⁰ <https://defence.capital/2021/09/03/india-army-orders-israeli-origin-kamikaze-drones-from-alpha-design-technologies/>

²⁹¹ <https://www.airrecognition.com/index.php/news/defense-aviation-news/2019-news/september/5465-azerbaijan-tests-skystriker-loitering-munition-uav.html>

²⁹² <https://twitter.com/ralee85/status/1362110396828704772?lang=en>; <https://www.oryxspioenkop.com/2022/01/replicating-success-turkmenistans.html>

²⁹³ <https://elbitsystems.com/product/skystriker/>

²⁹⁴ <https://elbitsystems.com/landing/wp-content/uploads/2018/07/Sky-Striker.pdf>

²⁹⁵ <https://www.youtube.com/watch?v=nFL0hjeSCsE>

²⁹⁶ <https://twitter.com/ElbitSystemsLtd/status/1562369908264079360>

²⁹⁷ <https://www.defensenews.com/digital-show-dailies/paris-air-show/2017/06/21/elbit-systems-pitches-skystriker-drone-in-emerging-market-of-loitering-munitions/>

²⁹⁸ <https://www.defensenews.com/digital-show-dailies/paris-air-show/2017/06/21/elbit-systems-pitches-skystriker-drone-in-emerging-market-of-loitering-munitions/>

²⁹⁹ <https://elbitsystems.com/landing/wp-content/uploads/2018/07/Sky-Striker.pdf>

³⁰⁰ <https://elbitsystems.com/pr-new/elbit-systems-at-farnborough-2018-cots-for-military-platforms-vr-tour-of-iafs-mtc-and-airborne-self-protection/>; <https://elbitsystems.com/pr-new/eurosatory-2018-elbit-systems-to-present-new-networked-and-situational-awareness-capabilities/>

³⁰¹ <https://elbitsystems.com/media/SkyStriker.pdf>; <https://www.defensenews.com/digital-show-dailies/paris-air-show/2017/06/21/elbit-systems-pitches-skystriker-drone-in-emerging-market-of-loitering-munitions/>

³⁰² <https://elbitsystems.com/landing/wp-content/uploads/2018/07/Sky-Striker.pdf>

³⁰³ <https://twitter.com/ElbitSystemsLtd/status/1562369908264079360>

Switchblade 600

System manufacturer	AeroVironment (United States)
System user(s)	United States; Lithuania; ³⁰⁴ Ukraine. ³⁰⁵
System range	Range: 40km. ³⁰⁶ Operational endurance: 40 minutes. ³⁰⁷
Launch	Platform weight: 23kg. ³⁰⁸ Wingspan: NDA Launch method: pneumatic launch canister. ³⁰⁹ Delivery method(s): This platform's launch system can reportedly be installed onto a range of ground vehicles, warships, and aircraft. ³¹⁰
Payload	Sensor: electro-optical and infrared camera(s). ³¹¹ Warhead: anti-armour warhead. ³¹²
Platform variant(s)	According to AeroVironment, the company "is supporting multiple, separate customer requirements for Switchblade 600 variants". ³¹³
Development status	Entering service with the Ukrainian military: in late 2022, a \$2.2 million US Department of Defence contract was awarded for the delivery of an undisclosed number of Switchblade 600 platforms to the Ukrainian military. ³¹⁴
Development history	This platform's development started in 2014. ³¹⁵ Its first live-fire demonstration was conducted in June 2015. ³¹⁶ Presented by AeroVironment as being a "new category of extended range loitering missiles", the Switchblade 600's development was formally announced in October 2020. ³¹⁷ AeroVironment officials have explained that the Switchblade 600 "is capable of addressing a different set of missions and targets vis-à-vis the Switchblade 300". ³¹⁸ The Switchblade 600 has a longer range (40km vs. 10km)

³⁰⁴ <https://www.defensenews.com/unmanned/2022/12/23/lithuania-buys-switchblade-600-drones/>;
<https://www.shephardmedia.com/news/uv-online/lithuania-acquires-switchblade-600/>

³⁰⁵ <https://frontierindia.com/ukraine-to-get-costly-switchblade-600-drones-as-phoenix-ghost-fails-and-cheap-iranian-shahed-136-dominates/>;
https://news.yahoo.com/ukraine-awaits-supplies-switchblade-600-113100171.html?guccounter=1&guce_referrer=aHR0cHM6Ly93d3cuZ29vZ2xILmNvbS8&guce_referrer_sig=AQAAANqlctGAKFRF2TtZ2M0dFpLBgfe3lQ-hTjgnPSBAeIs4tGUwOIEmYGLmI-vaaVmYBY4-A5K2MzVPbTqGX1puoNtn_bsVET_boU7nUSbqNzilWlybd6QMHWSkdNyUcYr3DQ7TdD3ZogZSAr7z5fx0F040y9cxqCnYw_oY74mynu1Y

³⁰⁶ https://www.avinc.com/images/uploads/product_docs/Switchblade_600_Datasheet_07192021.pdf

³⁰⁷ https://www.avinc.com/images/uploads/product_docs/Switchblade_600_Datasheet_07192021.pdf

³⁰⁸ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>

³⁰⁹ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>;
<https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>

³¹⁰ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>;
<https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>

³¹¹ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>;
<https://www.avinc.com/tms/switchblade-600>

³¹² <https://www.avinc.com/tms/switchblade-600>

³¹³ https://www.avinc.com/images/uploads/news/2020_Use_Case_Switchblade_Final.pdf

³¹⁴ https://www.armyrecognition.com/defense_news_september_2022_global_security_army_industry/ukraine_is_close_to_receiving_us_switchblade_600_anti_armor_loitering_munitions.html;
<https://media.defense.gov/2022/Sep/20/2003081481/-1/-1/0/CONTRACTING-FACT-SHEET-16SEPT22-RELEASE-VF.PDF>

³¹⁵ <https://www.edrmagazine.eu/switchblade-600-the-new-medium-range-loitering-munition>

³¹⁶ https://www.avinc.com/images/uploads/news/2020_Use_Case_Switchblade_Final.pdf

³¹⁷ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>;
<https://www.flightglobal.com/military-uavs/aerovironment-unveils-anti-armour-switchblade-600-loitering-munition/140409.article>

³¹⁸ <https://www.defence-and-security.com/features/featureaerovironment--rapidly-deployable-uav-situational-awareness-for-international-defence-forces-with-combined-lethality-8376335/>

	<p>and endurance (40 minutes vs. 10 minutes) than the smaller Switchblade 300. It also carries a larger warhead designed to attack a broader range of targets.³¹⁹ As AeroVironment officials put it, the Switchblade 600 was “the result of working closely with our US DoD customers, who wanted the same features of the Switchblade 300 but with greater effects”.³²⁰</p> <p>The transfer of Switchblade 600 platforms to the Ukrainian military was reportedly considered by American policymakers soon after Russia’s February 2022 invasion of Ukraine.³²¹ It would not be until September 2022, however, that the Pentagon announced a \$2.2 million contract with AeroVironment to deliver this weapon to the Ukrainian military.³²² This delay was a result of the Switchblade 600 having been at the evaluation phase of its development at this conflict’s onset, with the Pentagon having “procured a small number of prototypes for research and development purposes” as of May 2022.³²³</p>
Target type	<p>AeroVironment advertise this platform as being capable of attacking enemy armoured vehicles and soldiers.³²⁴ The Switchblade 600 is designed “to engage and prosecute hardened static and moving light armored vehicles from multiple angles with precise localized effects, while minimizing collateral damage”.³²⁵</p>
Autonomous and automated features	<p>Autonomous attack: Promotional footage depicts the Switchblade 600 as being capable of “locking onto” moving targets.³²⁶ Analysts describe the Switchblade 600 as being installed with “automatic target recognition” software.³²⁷ AeroVironment advertise this platform as being equipped with a “best-in class target acquisition sensor suite”.³²⁸</p> <p>Human control over targeting: AeroVironment advertise this platform as having an “[p]atented wave-off and recommit capability [which] allows operators to abort the mission at any time and then re-engage either the same or other targets multiple times based on operator command”.³²⁹ According to AeroVironment, “required [human]-in-the-loop arming sequence provides positive target confirmation” when strikes are conducted.³³⁰</p> <p>Autonomous flight: This platform can be manually piloted using a portable ground control station which “allows operators to easily train, plan missions and execute flight operations”.³³¹ According to AeroVironment, this “provides operators with an intuitive platform to easily plan and execute missions precisely, while reducing cognitive load”.³³²</p>

³¹⁹ <https://www.defence-and-security.com/features/featureaerovironment--rapidly-deployable-uav-situational-awareness-for-international-defence-forces-with-combined-lethality-8376335/>

³²⁰ edrmagazine.eu/switchblade-600-the-new-medium-range-loitering-munition

³²¹ <https://www.thedrive.com/the-war-zone/tank-busting-switchblade-600-drones-have-not-arrived-in-ukraine>

³²² <https://www.republicworld.com/world-news/russia-ukraine-crisis/us-signs-2-dollars-2-cents-million-contract-orders-switchblade-600-kamikaze-drones-for-ukraine-articleshow.html>; <https://mil.in.ua/en/news/pentagon-ordered-switchblade-600-kamikaze-drones-for-the-ukrainian-armed-forces/>

³²³ <https://www.thedrive.com/the-war-zone/tank-busting-switchblade-600-drones-have-not-arrived-in-ukraine>; <https://www.defensenews.com/pentagon/2022/08/22/delayed-kamikaze-drone-for-ukraine-on-track-for-next-month-pentagon/>

³²⁴ <https://www.avinc.com/tms/switchblade-600>

³²⁵ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>

³²⁶ <https://www.avinc.com/tms/switchblade-600>

³²⁷ <https://www.janes.com/defence-news/news-detail/switchblade-600-loitering-missile-to-equip-us-naval-special-warfare-craft>

³²⁸ https://www.avinc.com/images/uploads/product_docs/Switchblade_600_Datasheet_07192021.pdf

³²⁹ <https://www.avinc.com/tms/switchblade-600>

³³⁰ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>

³³¹ <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>

³³² <https://www.avinc.com/resources/press-releases/view/aerovironment-introduces-family-of-loitering-missile-systems-featuring-new>

WS-43	
System manufacturer	China Aerospace Science and Technology Corporation (China)
System user(s)	China
System range	Operational range: 60km. ³³³
	Operational endurance: 30 minutes. ³³⁴
Launch	Platform weight: 220kg. ³³⁵
	Wingspan: NDA
	Launch method: Multiple Launch Rocket System. ³³⁶
	Delivery method(s): This platform's launch system can be installed onto large ground vehicles including trucks. ³³⁷
Payload	Sensors: infrared camera(s). ³³⁸
	Warhead: high-explosive warhead. ³³⁹
Platform variant(s)	A reconnaissance version of the WS-43 equipped with radar and other surveillance equipment is reportedly being developed. ³⁴⁰
Development status	As of June 2022, the WS-43 was reportedly being evaluated by the Chinese military. ³⁴¹
Development history	The WS-43 platform was first shown at the 2014 China International Aviation and Aerospace Exhibition. ³⁴² Although it is unclear whether the platform was subsequently purchased, Indonesian Army officials watched a demonstration of this platform in October 2016. ³⁴³ By 2017, representatives of China Aerospace Long-March International described the WS-43 as being “ready for the international market”. ³⁴⁴
Target type	According to China Military Drone Alliance – a forum established in 2019 to support Chinese drone exports – the WS-43 can conduct “investigation, blockade and attack” operations. ³⁴⁵ The weight of its warhead (20kg) ³⁴⁶ suggests that it is capable of being used to attack well-armoured enemy vehicles and fortified positions, amongst other targets. The possible development of a radio-frequency seeker for the WS-43 suggests that it can also be used to attack enemy air defence and radar systems. ³⁴⁷
Autonomous and automated features	Autonomous attack: China Military Drone Alliance advertise the WS-43 as having “multiple combat mode[s] and agile combat operation”. ³⁴⁸ It is also described as being

³³³ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>; https://www.sohu.com/a/201471418_464121; <https://baijiahao.baidu.com/s?id=1671171019732561380&wfr=spider&for=pc>; <https://user.guancha.cn/main/content?id=864992&s=fwtjgzww>

³³⁴ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>; <https://baijiahao.baidu.com/s?id=1671171019732561380&wfr=spider&for=pc>; <https://user.guancha.cn/main/content?id=864992&s=fwtjgzww>

³³⁵ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>

³³⁶ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>

³³⁷ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>

³³⁸ <https://www.globalsecurity.org/military/world/china/ws-43.htm>;

<https://baijiahao.baidu.com/s?id=1672075848142565213&wfr=spider&for=pc>

³³⁹ [https://odin.tradoc.army.mil/mediawiki/index.php/WS-43_Chinese_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/WS-43_Chinese_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

³⁴⁰ https://www.sohu.com/a/201471418_464121;

<https://baijiahao.baidu.com/s?id=1671171019732561380&wfr=spider&for=pc>;

<https://baike.baidu.com/item/WS43%E5%B7%A1%E9%A3%E5%BC%B9/16204263?fr=aladdin>

³⁴¹ https://mp.weixin.qq.com/s?__biz=MzU2MjcxNDE2Mw==&mid=2247484757&idx=1&sn=0e15f74816f575dbd0aaff6db9db3037&chksm=fc640609cb138f1f230bb3bdbe76e7516cac409b46c1923d8549bb9833ba00344b3be80ead97&scene=27

³⁴² <https://chinesemilitaryreview.blogspot.com/2014/11/chinese-ws-43-miniature-attack-cruise.html>; <http://defense-studies.blogspot.com/2016/10/indonesian-army-attend-demonstration-of.html>

³⁴³ <https://www.globalsecurity.org/military/world/china/ws-43.htm>

³⁴⁴ <https://www.shephardmedia.com/news/landwarfareintl/lima-2017-china-reveals-loitering-attack-weapon/>

³⁴⁵ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>

³⁴⁶ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>

³⁴⁷ [https://odin.tradoc.army.mil/mediawiki/index.php/WS-43_Chinese_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/WS-43_Chinese_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

³⁴⁸ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>

	<p>equipped with a “networked planning control system and data link system to achieve netting operation, online track planning and other armament coordinated operations”.³⁴⁹ The platform is reportedly capable of attacking both stationary and moving targets.³⁵⁰</p> <p>Human control over targeting: Chinese media reports describe the WS-43 as being installed with a data link which enables its users to monitor the platform’s operation and request additional military support when targets are located.³⁵¹ The WS-43 is equipped with “an infrared imaging guide for terminal guidance”³⁵² and, according to reports, must be manually operated.³⁵³ The WS-43 is generally used to attack targets which have already been identified by other satellite and reconnaissance assets.³⁵⁴</p> <p>Autonomous flight: NDA</p>
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³⁴⁹ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>

³⁵⁰ <https://www.militarydrones.org.cn/ws-43-loitering-munition-system-p00202p1.html>; <https://twitter.com/rajfortyseven/status/533831950440476672/photo/3> ;

<https://chinesemilitaryreview.blogspot.com/2014/11/chinese-ws-43-miniature-attack-cruise.html>

³⁵¹ <https://baijiahao.baidu.com/s?id=1672075848142565213&wfr=spider&for=pc>;

<https://baijiahao.baidu.com/s?id=1748878042353833854&wfr=spider&for=pc>

³⁵² [https://odin.tradoc.army.mil/mediawiki/index.php/WS-43_Chinese_Loitering_Munition_Unmanned_Aerial_Vehicle_\(UAV\)](https://odin.tradoc.army.mil/mediawiki/index.php/WS-43_Chinese_Loitering_Munition_Unmanned_Aerial_Vehicle_(UAV))

³⁵³ https://www.sohu.com/a/201471418_464121

³⁵⁴ <https://baijiahao.baidu.com/s?id=1671171019732561380&wfr=spider&for=pc>

Anti-personnel systems

Alpagu	
System image ³⁵⁵	
System manufacturer	STM Defense Technologies Engineering (Turkey)
System user(s)	Turkey
System range	Range: 10km. ³⁵⁶ Operational endurance: 15 minutes. ³⁵⁷
Launch	Platform weight: 2kg. ³⁵⁸ Wingspan: 1.25m. ³⁵⁹ Launch method: pneumatic launch canister. ³⁶⁰ Delivery method(s): STM note that the Alpagu can be “launched from armed unmanned aerial platforms”. ³⁶¹ This may include the Anka and Aksungur Medium Altitude Long Endurance drones manufactured by Turkish Aerospace Industries. ³⁶² A vehicle mounted launcher capable of housing multiple Alpagu platforms has also been developed. ³⁶³
Payload	Sensors: electro-optical camera(s). ³⁶⁴ Warhead: fragmentation warhead, ³⁶⁵ thermobaric warhead. ³⁶⁶
Platform variant(s)	According to a November 2019 STM press release, the company was “planning larger, more explosive, longer-range, and faster versions of [the] Alpagu”. ³⁶⁷ The development

³⁵⁵ Zinnsoldat, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons https://commons.wikimedia.org/wiki/File:STM_Alpagu_Tactical_Attack_UAV_Kyiv_2019_02.jpg

³⁵⁶ <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>

³⁵⁷ <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>

³⁵⁸ <https://www.stm.com.tr/en/media/press-releases/new-domestic-made-uav-set-join-turkish-arsenal>

³⁵⁹ <https://www.edrmagazine.eu/killer-drones-from-turkey>

³⁶⁰ <https://www.edrmagazine.eu/stm-loitering-munitions-evolve>

³⁶¹ <https://www.stm.com.tr/en/media/press-releases/new-domestic-made-uav-set-join-turkish-arsenal>

³⁶² <https://www.shephardmedia.com/news/air-warfare/alpagu-kamikaze-uav-hits-target/>

³⁶³ https://www.stm.com.tr/uploads/docs/1660293328_tacticalminiavsystems.pdf?

<https://www.stm.com.tr/en/media/press-releases/new-domestic-made-uav-set-join-turkish-arsenal>

³⁶⁴ <https://www.edrmagazine.eu/killer-drones-from-turkey>

³⁶⁵ <https://www.edrmagazine.eu/stm-loitering-munitions-evolve>

³⁶⁶ <https://www.edrmagazine.eu/stm-loitering-munitions-evolve>

³⁶⁷ <https://www.stm.com.tr/en/media/press-releases/new-domestic-made-uav-set-join-turkish-arsenal>

	of these larger Alpagu variants was slated to begin after the first Alpagu platforms had been delivered to the Turkish military. ³⁶⁸
Development status	In service with the Turkish military. ³⁶⁹
Development history	The Alpagu was first shown at the 2017 International Defence Industry Fair, ³⁷⁰ and was later exhibited at the 2019 Defence and Security exhibition held in Thailand. ³⁷¹ It was tested at the Aksaray test range in June 2021, having reportedly entered production in 2017. ³⁷²
Target type	The Alpagu can conduct both reconnaissance and strike operations. ³⁷³ Commentators describe this platform as being intended for use in “asymmetric warfare and anti-terrorism operations”. ³⁷⁴ STM have released promotional material depicting the Alpagu attacking an armed truck. ³⁷⁵
Autonomous and automated features	<p>Autonomous attack: STM advertise the Alpagu as an “[a]utonomous precision strike [weapon] with minimum collateral damage”.³⁷⁶ It is described as utilising “embedded and real-time image processing and deep learning algorithms” to facilitate attacks against stationary and moving targets.³⁷⁷ According to STM, the Alpagu can be installed with “embedded and real-time object tracking, detection and classification” software.³⁷⁸ This platform’s image tracking software was tested at Aksaray Shooting Range in June 2021.³⁷⁹</p> <p>Human control over targeting: STM maintain that strike missions involving the Alpagu are conducted with a human-in-the-loop.³⁸⁰ The platform is advertised as possessing an abort/wave-off capability.³⁸¹</p> <p>Autonomous flight: According to STM, the Alpagu “can operate autonomously or with remote control”.³⁸² The company advertise the platform as being capable of “performing fully autonomous navigation vis STM’s unique flight control system”.³⁸³</p>

³⁶⁸ <https://www.stm.com.tr/en/media/press-releases/new-domestic-made-uav-set-join-turkish-arsenal>;
<https://www.savunmahaber.com/en/alpagu-to-enter-turkish-armed-forces-inventory-this-year/>
³⁶⁹ <https://www.edrmagazine.eu/stm-loitering-munitions-evolve>
³⁷⁰ <https://www.c4defence.com/en/stm-made-alpagu-in-serial-production/>;
<https://www.dailysabah.com/turkey/2017/10/22/turkeys-kamikaze-drone-is-ready-for-action>
³⁷¹ <https://www.stm.com.tr/en/media/news/participation-defense-security-exhibition-thailand-2019>
³⁷² <https://www.c4defence.com/en/stm-made-alpagu-in-serial-production/>;
<https://www.dailysabah.com/turkey/2017/10/22/turkeys-kamikaze-drone-is-ready-for-action>
³⁷³ <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-,Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>
³⁷⁴ <https://www.c4defence.com/en/stm-made-alpagu-in-serial-production/>
³⁷⁵ https://www.youtube.com/watch?v=ue2Xa5dBFM4&ab_channel=DefenseDHD
³⁷⁶ <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-,Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>
³⁷⁷ <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-,Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>
³⁷⁸ <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-,Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>
³⁷⁹ <https://www.shephardmedia.com/news/air-warfare/alpagu-kamikaze-uav-hits-target/>; <https://www.aa.com.tr/en/science-technology/turkeys-new-domestic-made-alpagu-uav-successfully-conducts-test-firing-with-ammunition/2278902>
³⁸⁰ https://www.stm.com.tr/uploads/docs/1660293328_tacticalminiuvsystems.pdf, p.4.
³⁸¹ <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-,Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>
³⁸² <https://www.stm.com.tr/en/alpagu#:~:text=%C2%AE-,Fixed%20Wing%20Loitering%20Munition%20System,autonomously%20or%20with%20remote%20control.>
³⁸³ https://www.stm.com.tr/uploads/docs/1660293328_tacticalminiuvsystems.pdf, p.4.

Battlehawk	
System manufacturer	Textron Defense Systems (United States)
System user(s)	NDA
System range	Range: 5km. ³⁸⁴ Operational endurance: 30 minutes. ³⁸⁵
Launch	Platform weight: 2.5kg. ³⁸⁶ Wingspan: 0.86m. ³⁸⁷ Launch method: pneumatic launch canister. ³⁸⁸ Delivery method(s): Promotional material depicts the Battlehawk being carried and launched by a single operator. ³⁸⁹ Textron aimed to develop a working prototype of a vehicle-mounted launch system for this platform by mid-2014. ³⁹⁰
Payload	Sensors: electro-optical camera(s). ³⁹¹ Warhead: fragmentation warhead. ³⁹²
Platform variant(s)	NDA
Development status	Development work on the Battlehawk appears to have stalled after it failed to win the US Army's Lethal Miniature Aerial Munition System requirement.
Development history	This platform began development in 2011 as the Tactical Remote Aerial Munition and was designed to meet the US Army's Lethal Miniature Aerial Munition System requirement. ³⁹³ The Battlehawk was first shown at the 2012 Special Operations Forces Industry Conference. ³⁹⁴ According to a May 2012 Textron press release, the Battlehawk was tested by the US Army's Rapid Equipping Force at the Energetic Materials Research and Testing Center in New Mexico. ³⁹⁵ These tests involved "several mission scenarios, including non-line-of-sight target prosecution and stand-off attack across a mountain peak". ³⁹⁶ The Battlehawk was scheduled to undergo trials with American Army and Special Force units between September and November 2013. ³⁹⁷
Target type	Textron Defense Systems describe the Battlehawk as a "next generation of precision guided weapon" designed to "provide the customer with an affordable, high accuracy and low collateral damage capability". ³⁹⁸ According to commentators, the Battlehawk is designed to conduct strikes "against personnel and light vehicle targets in irregular environments". ³⁹⁹ Promotional material released by Textron Defense Systems depicts

³⁸⁴ <https://www.uasvision.com/2013/08/19/textron-unveils-battlehawk-loitering-munition/>

³⁸⁵ <https://www.uasvision.com/2013/08/19/textron-unveils-battlehawk-loitering-munition/>

³⁸⁶ <https://dronecenter.bard.edu/files/2017/02/CSD-Loitering-Munitions.pdf>, p.2.

³⁸⁷ Mark Voskuijl, "Performance analysis and design of loitering munitions: A comprehensive technical survey of recent developments." *Defence Technology* 18, no. 3 (2022): 325-343, 341.

³⁸⁸ <https://www.youtube.com/watch?v=ud83-OUg6lA>

³⁸⁹ https://www.youtube.com/watch?v=ud83-OUg6lA&ab_channel=textronsystems

³⁹⁰ <https://www.shephardmedia.com/news/uv-online/ausa-2013-textron-unveils-battlehawk-launcher/>

³⁹¹ <https://investor.textron.com/news/news-releases/press-release-details/2012/Textron-Defense-Systems-BattleHawk-Squad-Level-Loitering-Munition-Excels-During-Rapid-Equipping-Force-Demo/default.aspx>;

<https://aerospaceblog.wordpress.com/2012/05/27/aerovironment-textron-advance-lethal-mini-uass/>

³⁹² <https://www.uasvision.com/2013/08/19/textron-unveils-battlehawk-loitering-munition/>;

<https://www.military.com/defensetech/2012/09/19/textrons-remote-controlled-flying-bomb>

³⁹³ <https://investor.textron.com/news/news-releases/press-release-details/2012/Textron-Defense-Systems-BattleHawk-Squad-Level-Loitering-Munition-Excels-During-Rapid-Equipping-Force-Demo/default.aspx>;

<https://aerospaceblog.wordpress.com/2012/05/27/aerovironment-textron-advance-lethal-mini-uass/>

³⁹⁴ <https://www.army-technology.com/news/newsbattlehawk-army-demonstration/>

³⁹⁵ <https://investor.textron.com/news/news-releases/press-release-details/2012/Textron-Defense-Systems-BattleHawk-Squad-Level-Loitering-Munition-Excels-During-Rapid-Equipping-Force-Demo/default.aspx>

³⁹⁶ <https://investor.textron.com/news/news-releases/press-release-details/2012/Textron-Defense-Systems-BattleHawk-Squad-Level-Loitering-Munition-Excels-During-Rapid-Equipping-Force-Demo/default.aspx>

³⁹⁷ <https://www.shephardmedia.com/news/uv-online/auvsi-2013-battle-lmams-contract-heats/>

³⁹⁸ https://s1.q4cdn.com/535492436/files/doc_downloads/fact_book/Textron-2012-Fact-Book.pdf, p.7.

³⁹⁹ <https://www.army-technology.com/news/newsbattlehawk-army-demonstration/>

	the Battlehawk being used to locate and attack militants who had ambushed a force of patrolling soldiers. ⁴⁰⁰
Autonomous and automated features	Autonomous attack: Early promotional material released for the Tactical Remote Aerial Munition shows the platform “locking on” to and tracking a moving vehicle. ⁴⁰¹ A 2012 Textron Defense Systems press release noted that the Battlehawk’s design had been improved to enable “moving target tracking during terminal guidance maneuvers”. ⁴⁰²
	Human control over targeting: Promotional material released by Textron Defense Systems depicts its human operator as manually selecting the area over which the Battlehawk will loiter. Once the platform is airborne, its operator is then shown designating a target which is to be attacked before selecting to “arm” its warhead and “prosecuting” the strike. ⁴⁰³ According to this promotional material, the human operator can also “wave off” an attack. ⁴⁰⁴
	Autonomous flight: Textron Defense Systems tested this platform’s ability to “execute the operator's pre-programmed flight path”. ⁴⁰⁵ Speaking in 2013, Cathy Loughman, the company’s then senior manager for precision weapons systems, described the Battlehawk as having been designed “so that i[t] doesn’t have to be operated by a pilot”. ⁴⁰⁶

⁴⁰⁰ https://www.youtube.com/watch?v=ud83-OUg6lA&ab_channel=textronsystems

⁴⁰¹ <https://spectrum.ieee.org/textrons-tram-is-the-suicidal-miniuav-youve-always-wanted>

⁴⁰² <https://investor.textron.com/news/news-releases/press-release-details/2012/Textron-Defense-Systems-BattleHawk-Squad-Level-Loitering-Munition-Excels-During-Rapid-Equipping-Force-Demo/default.aspx>

⁴⁰³ https://www.youtube.com/watch?v=ud83-OUg6lA&ab_channel=textronsystems

⁴⁰⁴ https://www.youtube.com/watch?v=ud83-OUg6lA&ab_channel=textronsystems

⁴⁰⁵ <https://investor.textron.com/news/news-releases/press-release-details/2012/Textron-Defense-Systems-BattleHawk-Squad-Level-Loitering-Munition-Excels-During-Rapid-Equipping-Force-Demo/default.aspx>

⁴⁰⁶ <https://www.shephardmedia.com/news/uv-online/auvsi-2013-battle-lmams-contract-heats/>

CH-901 Rainbow (FH-901)	
System image ⁴⁰⁷	
System manufacturer	China Aerospace Science and Technology Corporation (China)
System user(s)	China
System range	Range: 15km. ⁴⁰⁸ Operational endurance: 120 minutes. ⁴⁰⁹
Launch	Platform weight: 9kg. ⁴¹⁰ Wingspan: 1.5m. ⁴¹¹ Launch method: pneumatic launch canister. ⁴¹² Delivery method(s): A multi-canister launcher capable of carrying twelve CH-901 platforms was displayed at the 2018 Zhuhai Air Show. ⁴¹³ In October 2020, the China Academy of Electronics and Information Technology released video footage of what appeared to be a launcher capable of housing forty-eight platforms resembling the CH-901. ⁴¹⁴ The CH-901 can reportedly be launched from under the wings of uncrewed aircraft, ⁴¹⁵ as well as from the 4X4 armoured fighting vehicle used by the Chinese military. ⁴¹⁶
Payload	Sensors: electro-optical camera(s). ⁴¹⁷ Warhead: fragmentation warhead; ⁴¹⁸ anti-armour warhead. ⁴¹⁹

⁴⁰⁷ Mike1979 Russia, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons

⁴⁰⁸ <https://www.militarydrones.org.cn/rainbow-ch-901-suicide-drone-china-price-manufacturer-procurement-portal-p00167p1.html>

⁴⁰⁹ <https://eurasianimes.com/china-unveils-its-own-switchblade-like-kamikaze-drone/>;
<https://baijiahao.baidu.com/s?id=1661328374013494173&wfr=spider&for=pc>; <https://baike.baidu.com/item/CH-901%E5%B0%8F%E5%9E%8B%E6%97%A0%E4%BA%BA%E6%9C%BA%2F%E5%B7%A1%E9%A3%9E%E5%BC%B9/22233199?fr=aladdin>

⁴¹⁰ <https://www.militarydrones.org.cn/rainbow-ch-901-suicide-drone-china-price-manufacturer-procurement-portal-p00167p1.html>;
<https://baike.baidu.com/item/CH-901%E5%B0%8F%E5%9E%8B%E6%97%A0%E4%BA%BA%E6%9C%BA%2F%E5%B7%A1%E9%A3%9E%E5%BC%B9/22233199?fr=aladdin>

⁴¹¹ <https://twitter.com/CavasShips/status/1318216664769531905/photo/1>

⁴¹² <https://www.militarydrones.org.cn/rainbow-ch-901-suicide-drone-china-price-manufacturer-procurement-portal-p00167p1.html>; <https://twitter.com/CavasShips/status/1318216664769531905/photo/1>

⁴¹³ <https://news.dahebao.cn/dahe/appcommunity/1378402>

⁴¹⁴ <https://www.businessinsider.com/china-test-launched-swarm-of-suicide-drones-from-a-truck-2020-10?r=US&IR=T>

⁴¹⁵ <https://www.globaltimes.cn/page/202209/1274963.shtml>

⁴¹⁶ <https://www.thedrive.com/the-war-zone/37062/china-conducts-test-of-massive-suicide-drone-swarm-launched-from-a-box-on-a-truck>

⁴¹⁷ <https://www.popsci.com/china-new-drones-army-hexacopters/#page-2>; <https://baike.baidu.com/item/CH-901%E5%B0%8F%E5%9E%8B%E6%97%A0%E4%BA%BA%E6%9C%BA%2F%E5%B7%A1%E9%A3%9E%E5%BC%B9/22233199?fr=aladdin>; <https://news.dahebao.cn/dahe/appcommunity/1378402>

Platform variant(s)	NDA
Development status	In service with the Chinese military. ⁴²⁰
Development history	Development work on the CH-901 possibly began in 2004 and appears to have evolved through multiple stages. ⁴²¹ The platform was first exhibited at the 2012 Zhuhai Air Show. ⁴²² The CH-901 first flew in 2020 and reportedly achieved initial operational capability in 2021. ⁴²³ Around this time, the CH-901 appears to have been rebranded as the FH-901. ⁴²⁴ In September 2022, a promotional video was released via Chinese state media appearing to depict the FH-901 conducting live fire drills in conjunction with other uncrewed platforms. ⁴²⁵
Target type	According to China Military Drone Alliance – a forum established in 2019 to support Chinese drone exports – this platform can be used by special forces to conduct counter-terrorism missions. ⁴²⁶ The CH-901 may also be used by “amphibious and airborne troops, which cannot always count on conventional air and artillery support”. ⁴²⁷ Analysts describe the CH-901 as being capable of destroying targets as large as American M2 Bradley infantry fighting vehicles. ⁴²⁸
Autonomous and automated features	<p>Autonomous attack: Some Chinese media reports suggest that the CH-901 can “autonomously” attack targets,⁴²⁹ although the technical details of this capability are not disclosed.</p> <p>Human control over targeting: The CH-901 reportedly “has good flight and precise striking capability, providing operators with real-time images...[and] GPS coordinates for information gathering, positioning, identifying or killing targets”.⁴³⁰ Coupled with the CH-901’s use to conduct reconnaissance operations,⁴³¹ this suggests that the CH-901 could be operated with a human-in-the-loop who is capable of visually inspecting targets before a strike.</p> <p>Autonomous flight: Human operators can manually pilot this platform using a portable ground control station.⁴³² Chinese media reports suggest that the CH-901 is capable of automatically returning to its operator.⁴³³</p>

⁴¹⁸ <https://www.globalsecurity.org/military/world/china/ch-901.htm>;
https://www.armyrecognition.com/sofex_2018_official_online_show_daily_news/china_defense_industry_presents_ch-901_suicide_drone_at_sofex_2018.html

⁴¹⁹ <https://www.militarydrones.org.cn/rainbow-ch-901-suicide-drone-china-price-manufacturer-procurement-portal-p00167p1.html>

⁴²⁰ <https://www.popsci.com/china-new-drones-army-hexicopters/#page-2>

⁴²¹ <https://www.shephardmedia.com/news/uv-online/airshow-china-2012-new-uav-designs-unveiled/>

⁴²² <https://baike.baidu.com/item/CH-901%E5%B0%8F%E5%9E%8B%E6%97%A0%E4%BA%BA%E6%9C%BA%2F%E5%B7%A1%E9%A3%9E%E5%BC%B9/22233199?fr=aladdin>

⁴²³ <https://www.deagel.com/Defensive%20Weapons/CH-901/a004040>

⁴²⁴ https://defense-update.com/20220829_fh901.html

⁴²⁵ <https://www.spslandforces.com/experts-speak/?id=935&h=Chinas-FH-901-and-Russias-new-EW-System>

⁴²⁶ <https://www.militarydrones.org.cn/rainbow-ch-901-suicide-drone-china-price-manufacturer-procurement-portal-p00167p1.html>

⁴²⁷ <https://www.popsci.com/china-new-drones-army-hexicopters/#page-2>

⁴²⁸ <https://www.popularmechanics.com/military/a20722/china-mini-drone/>

⁴²⁹ <https://baijiahao.baidu.com/s?id=1661328374013494173&wfr=spider&for=pc>

⁴³⁰ <https://www.globalsecurity.org/military/world/china/ch-901.htm>

⁴³¹ <https://www.militarydrones.org.cn/rainbow-ch-901-suicide-drone-china-price-manufacturer-procurement-portal-p00167p1.html>

⁴³² https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=2356

⁴³³ <https://baijiahao.baidu.com/s?id=1732048732942173305&wfr=spider&for=pc>

Drone 40

System manufacturer	DefendTex
System user(s)	United Kingdom; ⁴³⁴ Ukraine. ⁴³⁵
System range	Range: 20km. ⁴³⁶ Operational endurance: 60 minutes. ⁴³⁷
Launch	Platform weight: 0.2kg. ⁴³⁸ Launch method: rotary power (quadcopter). ⁴³⁹ Delivery method(s): The Drone40 can be launched into flight using a 40mm grenade launcher. ⁴⁴⁰
Payload	Sensors: electro-optical camera(s) and laser designator (when equipped with an ISR payload). ⁴⁴¹ Warhead: fragmentation warhead; ⁴⁴² electronic warfare payload; ⁴⁴³ smoke/flash grenade. ⁴⁴⁴
Platform variant(s)	DefendTex are developing larger Drone40 variants capable of being launched from mortar tubes. These include the Drone81 and Drone155. ⁴⁴⁵
Development status	Possibly in service with the British and the Ukrainian militaries. ⁴⁴⁶
Development history	The Drone40 was developed as a collaboration between DefendTex and the Australian government's Autonomous Systems Collaborative Research initiative. ⁴⁴⁷ The Drone40 was first shown at the Australia Army's 2016 Innovation Day. ⁴⁴⁸ The Drone40 was evaluated by the British Task Group sent in December 2020 to support the United Nations Multidimensional Integrated Stabilization Mission in Mali in December 2020 (Operation Newcombe). ⁴⁴⁹ According to a Ministry of Defence spokesperson, the platform was used to improve the "situational awareness" of British forces and was only to be used to conduct surveillance and reconnaissance operations. ⁴⁵⁰

⁴³⁴ <https://www.thedrive.com/the-war-zone/38909/British-troops-get-small-swarming-drones-they-can-fire-from-40mm-grenade-launchers>

⁴³⁵ <https://militaryleak.com/2022/08/26/australia-to-deliver-300-defendtex-d40-kamikaze-drones-to-ukraine/>

⁴³⁶ <https://www.technology.org/2022/08/23/flying-mines-defendtex-d40-small-but-capable-of-destroying-anything-even-tanks/>

⁴³⁷ <https://www.technology.org/2022/08/23/flying-mines-defendtex-d40-small-but-capable-of-destroying-anything-even-tanks/>

⁴³⁸ https://www.defendtex.com/wp-content/uploads/D40_V10_Product_DataSheet.pdf

⁴³⁹ <https://www.youtube.com/watch?v=yhjFdobJh-4>

⁴⁴⁰ <https://www.defendtex.com/uav/>

⁴⁴¹ <https://www.thedrive.com/the-war-zone/38909/British-troops-get-small-swarming-drones-they-can-fire-from-40mm-grenade-launchers>

⁴⁴² https://www.defendtex.com/wp-content/uploads/D40_V10_Product_DataSheet.pdf

⁴⁴³ https://www.defendtex.com/wp-content/uploads/D40_V10_Product_DataSheet.pdf

⁴⁴⁴ https://www.defendtex.com/wp-content/uploads/D40_V10_Product_DataSheet.pdf

⁴⁴⁵ <https://eurasianimes.com/developed-by-australia-popularized-by-the-uk-us-marines-test-lethal-mini-grenade-drones-that-can-attack-in-swarms/>; https://defense-update.com/20220910_mspo-2022-land-systems-update.html

⁴⁴⁶ <https://www.army-technology.com/news/british-army-drone40/>; <https://www.thedrive.com/the-war-zone/38909/british-troops-get-small-swarming-drones-they-can-fire-from-40mm-grenade-launchers>

⁴⁴⁷ https://www.armyrecognition.com/defense_news_august_2022_global_security_army_industry/australia_to_offer_300_defendtex_d40_kamikaze_drones_to_ukrainian_army.html

⁴⁴⁸ <https://militaryleak.com/2022/08/26/australia-to-deliver-300-defendtex-d40-kamikaze-drones-to-ukraine/>; <https://www.australiandefence.com.au/defence/land/british-army-takes-australian-drone-to-mali>

⁴⁴⁹ <https://eurasianimes.com/developed-by-australia-popularized-by-the-uk-us-marines-test-lethal-mini-grenade-drones-that-can-attack-in-swarms/>

⁴⁵⁰ <https://www.thedrive.com/the-war-zone/38909/British-troops-get-small-swarming-drones-they-can-fire-from-40mm-grenade-launchers>; <https://www.thedrive.com/the-war-zone/38909/British-troops-get-small-swarming-drones-they-can-fire-from-40mm-grenade-launchers>

⁴⁵⁰ <https://www.army-technology.com/news/british-army-drone40/>

	The United States Marine Corps has also evaluated the Drone40, including as part of a July 2021 training exercise held at Camp Lejeune in North Carolina. ⁴⁵¹ In August 2022, the Australian government authorised the transfer of 300 Drone40 platforms to Ukraine to support combat operations against Russia. ⁴⁵²
Target type	The Drone40 is designed to conduct anti-personnel and anti-armour operations. ⁴⁵³ Analysts note the Drone40’s potential use in urban warfare settings. ⁴⁵⁴
Autonomous and automated features	<p>Autonomous attack: Reports suggest that autonomy is used to support targeting functions.⁴⁵⁵ DefendTex CEO Travis Reddy describes the Drone40 as being capable of using its synthetic aperture radar to identify and track objects such as T-72 tanks.⁴⁵⁶ The Drone40 can also be used to attack stationary targets via the entry of GPS waypoints.⁴⁵⁷</p> <p>Human control over targeting: When equipped with an ISR payload, the Drone40’s camera feed can be transmitted back to a human operator via a hand-held control system.⁴⁵⁸ This suggests that this platform can be operated with a human in the loop – a position affirmed by DefendTex CEO Travis Reddy who has publicly stated that the “weapon system will never be autonomous, fully acquire and prosecute target without authorization and confirmation from the human”.⁴⁵⁹</p> <p>Autonomous flight: DefendTex advertise the Drone40 as being equipped with an “autonomous flight” functionality.⁴⁶⁰ This includes a “GPS based autopilot system”.⁴⁶¹ The Drone40 can also navigate using waypoint navigation.⁴⁶²</p>

⁴⁵¹ <https://www.thedrive.com/the-war-zone/41479/marines-train-with-handheld-swarming-drones-that-can-be-fired-from-40mm-grenade-launchers>; <https://www.popsci.com/technology/marines-grenade-drone-40/>

⁴⁵² <https://militaryleak.com/2022/08/26/australia-to-deliver-300-defendtex-d40-kamikaze-drones-to-ukrainia/>

⁴⁵³ <https://www.technology.org/2022/08/23/flying-mines-defendtex-d40-small-but-capable-of-destroying-anything-even-tanks/>

⁴⁵⁴ <https://www.thedrive.com/the-war-zone/38909/British-troops-get-small-swarming-drones-they-can-fire-from-40mm-grenade-launchers>

⁴⁵⁵ <https://www.c4isrnet.com/unmanned/2019/06/05/a-drone-with-a-can-doom-attitude/>

⁴⁵⁶ <https://www.c4isrnet.com/unmanned/2019/06/05/a-drone-with-a-can-doom-attitude/>

⁴⁵⁷ <https://www.c4isrnet.com/unmanned/2019/06/05/a-drone-with-a-can-doom-attitude/>

⁴⁵⁸ <https://www.thedrive.com/the-war-zone/38909/British-troops-get-small-swarming-drones-they-can-fire-from-40mm-grenade-launchers>

⁴⁵⁹ <https://www.c4isrnet.com/unmanned/2019/06/05/a-drone-with-a-can-doom-attitude/>

⁴⁶⁰ <https://www.defendtex.com/uav/>

⁴⁶¹ https://www.defendtex.com/wp-content/uploads/D40_V10_Product_DataSheet.pdf

⁴⁶² <https://www.c4isrnet.com/unmanned/2019/06/05/a-drone-with-a-can-doom-attitude/>

Fire Cardinal

System manufacturer	The National Chung-Shan Institute of Science and Technology (Taiwan)
System user(s)	Unknown
System range	Range: NDA Operational endurance: NDA
Launch	Platform weight: 6kg. ⁴⁶³ Wingspan: 1.2m. ⁴⁶⁴ Launch method: NDA Delivery method(s): NDA
Payload	Sensors: electro-optical and infrared camera(s). ⁴⁶⁵ Warhead: NDA
Platform variant(s)	NDA
Development status	As of 2019, the National Chung-Shan Institute of Science and Technology (NCSIST) had internally funded the Fire Cardinal's development. ⁴⁶⁶ It is unclear whether the platform has since been ordered by the Taiwanese military.
Development history	The Fire Cardinal was first shown at the 2019 Taipei Aerospace and Defense Technology Exhibition. ⁴⁶⁷ NCSIST officials described the platform as being a "testbed" for the development of target recognition and tracking software. ⁴⁶⁸ The Fire Cardinal's design built on the Cardinal series of drones manufactured by the same company. NCSIST began developing the Cardinal II reconnaissance drone in 2009, describing it as possessing a "better payload design, digital data link, and automatic tracking antenna system" than the original Cardinal variant. ⁴⁶⁹ The Cardinal II was first displayed at the Taipei International Aerospace and Defense Industry Exhibition held in August 2013. ⁴⁷⁰ The Taiwanese military ordered five Cardinal II sets for delivery by the end of 2016. ⁴⁷¹
Target type	The Fire Cardinal is described as a "air-to-ground assault" platform. ⁴⁷² As with the NCSIST manufactured Chien Hsiang loitering munition which is also included in this catalogue, the Fire Cardinal is envisaged as being used to oppose a Chinese invasion of Taiwan, "overwhelming" short-range air defences. ⁴⁷³
Autonomous and automated features	Autonomous attack: Speaking to <i>Janes</i> in 2019, a NCSIST spokesperson described the Fire Cardinal as a testbed for "state-of-art object detection and multi-object tracking algorithms which will take us one step further to realising a fully automatic and highly intelligent system". ⁴⁷⁴ The platform is also described as utilising "indigenously developed machine learning/artificial intelligence (AI) algorithms", ⁴⁷⁵ and may also be installed with facial recognition software. ⁴⁷⁶ Human control over targeting: NDA

⁴⁶³ <https://project2049.net/wp-content/uploads/2020/06/Watching-Over-the-Taiwan-Strait-Easton-Stokes-Yang-Lee-Ferland-P2049-200630.pdf>, p.37.

⁴⁶⁴ <https://www.janes.com/defence-news/news-detail/tadte-2019-ncsist-unveils-fire-cardinal-mini-uav>

⁴⁶⁵ <https://alert5.com/2019/08/14/taiwan-unveils-second-suicide-drone-fire-cardinal/>

⁴⁶⁶ <https://www.janes.com/defence-news/news-detail/tadte-2019-ncsist-unveils-fire-cardinal-mini-uav>

⁴⁶⁷ <https://alert5.com/2019/08/14/taiwan-unveils-second-suicide-drone-fire-cardinal/>; <https://www.janes.com/defence-news/news-detail/tadte-2019-ncsist-unveils-fire-cardinal-mini-uav>

⁴⁶⁸ <https://www.janes.com/defence-news/news-detail/tadte-2019-ncsist-unveils-fire-cardinal-mini-uav>

⁴⁶⁹ https://www.ncsist.org.tw/eng/csisdup/products/product.aspx?product_id=268&catalog=41

⁴⁷⁰ <https://www.airforce-technology.com/projects/cardinal-ii-unmanned-aircraft-system/>

⁴⁷¹ https://www.ncsist.org.tw/eng/csisdup/products/product.aspx?product_id=268&catalog=41

⁴⁷² <https://www.janes.com/defence-news/news-detail/tadte-2019-ncsist-unveils-fire-cardinal-mini-uav>

⁴⁷³ <https://www.taiwannews.com.tw/en/news/3800110>; <https://nationalinterest.org/blog/reboot/fire-cardinal-suicide-drone-will-help-secure-taiwan-190535>

⁴⁷⁴ <https://www.janes.com/defence-news/news-detail/tadte-2019-ncsist-unveils-fire-cardinal-mini-uav>


⁴⁷⁵ <https://www.janes.com/defence-news/news-detail/tadte-2019-ncsist-unveils-fire-cardinal-mini-uav>

⁴⁷⁶ https://www.youtube.com/watch?v=LPU1pDpdXp4&ab_channel=%E7%81%AB%E5%8A%9B%E5%B0%B1%E6%98%AF%E6%AD%A3%E7%BE%A9%EF%BC%88%E7%99%BE%E7%A7%91%E9%A0%BB%E9%81%93%EF%BC%89

Autonomous flight: According to analysts, “the Fire Cardinal reportedly does not require human operators and can navigate, engage, and identify targets autonomously”.⁴⁷⁷ The Cardinal II platform is installed with autopilot software and can be flown via way-point navigation.⁴⁷⁸

⁴⁷⁷ <https://project2049.net/wp-content/uploads/2020/06/Watching-Over-the-Taiwan-Strait-Easton-Stokes-Yang-Lee-Ferland-P2049-200630.pdf>, p.22.

⁴⁷⁸ https://www.ncsist.org.tw/ENG/upload/G_Product_Catelog_Images_635697018567099600.pdf

Hero-30	
System image⁴⁷⁹	
System manufacturer	UVision (Israel)
System user(s)	Israel; Argentina; ⁴⁸⁰ Unnamed NATO member (reportedly Greece). ⁴⁸¹
System range	Operational range: 10km. ⁴⁸² Operational endurance: 30 minutes. ⁴⁸³
Launch	Platform weight: 3.5kg. ⁴⁸⁴ Launch method: pneumatic launch canister. ⁴⁸⁵ Delivery method(s): The Hero-30 can be carried by a single soldier. ⁴⁸⁶ Its launcher can be integrated onto ground vehicles and warships. ⁴⁸⁷ In 2015, UVision advertised the UGL-H30 “concept of launcher”: an uncrewed ground vehicle designed to carry four Hero-30 platforms. ⁴⁸⁸ A modular multi-canister launcher capable of carrying two, four, six, or eight Hero-30 platforms was displayed at the Association of the United States Army's (AUSA's) 2021 event. ⁴⁸⁹
Payload	Sensors: electro-optical and infrared camera(s). ⁴⁹⁰ Warhead: fragmentation warhead. ⁴⁹¹
Platform variant(s)	Special force variant: UVision developed a Hero-30 variant to meet the US Army’s Lethal Miniature Aerial Missile System requirement. ⁴⁹² This platform was designed to be lighter

⁴⁷⁹ Reise Reise, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/6/6a/UVision_Hero-30_%282022%29.jpg

⁴⁸⁰ <https://www.janes.com/defence-news/argentina-buys-uvision-loitering-munitions-from-israel/>

⁴⁸¹ <https://twitter.com/RheinmetallAG/status/1565700089099722752>;
https://www.rheinmetall.com/en/rheinmetall_ag/press/news/latest_news/index_34368.php;

<https://www.shephardmedia.com/news/uv-online/uvision-rheinmetall-partnership-gains-first-european-nato-order-for-hero-loitering-munition/>

⁴⁸² Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁴⁸³ <https://uvisionuav.com/portfolio-view/hero-30/>

⁴⁸⁴ [https://uvisionuav.com/portfolio-view/hero-30/#:~:text=Man%2Dpack%20portable%20and%20deployed,Endurance%20\(min\)%3A%2030](https://uvisionuav.com/portfolio-view/hero-30/#:~:text=Man%2Dpack%20portable%20and%20deployed,Endurance%20(min)%3A%2030)

⁴⁸⁵ Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁴⁸⁶ Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁴⁸⁷ Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁴⁸⁸ <https://www.airrecognition.com/index.php/archive-world-worldwide-news-air-force-aviation-aerospace-air-military-defence-industry/defense-security-exhibitions-news/air-show-2015/paris-air-show-2015/paris-air-show-2016/2028-uvision-unveils-comprehensive-range-of-new-smart-loitering-systems-the-hero-family.html>; <https://amosboaz.com/project/soltam-atmos-3/>;
<https://www.shephardmedia.com/news/uv-online/paris-air-show-heads-turned-ugv-concept/>

⁴⁸⁹ <https://www.janes.com/defence-news/news-detail/ausa-2021-uvision-showcases-new-multi-canister-launcher-for-usmc>;
<https://www.edr magazine.eu/uvision-unveils-its-hero-multi-canister-launcher-mcl-adapted-for-launching-all-types-of-hero-loitering-munition-systems-from-a-single-platform>

⁴⁹⁰ Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁴⁹¹ Hero-30 brochure - <https://uvisionuav.com/brochures/>

	<p>than the standard Hero-30.⁴⁹³ In March 2017, a planned live-fire demonstration of this platform to US military officials was reportedly postponed by the requirement for the Lethal Miniature Aerial Missile System to be armed with an American manufactured warhead.⁴⁹⁴ As of March 2021, <i>Breaking Defence</i> reported that Israeli defence sources had claimed that the Hero-30 had been evaluated by the US Army, and was being considered as part of the Lethal Miniature Aerial Missile Systems programme.⁴⁹⁵</p> <p>Maritime variant: UVision have developed a naval variant of the Hero-30. In June 2020, this platform was evaluated by representatives from “a naval force of a major NATO member” as part of a trial which culminated in a simulated attack against “a suicide speedboat”.⁴⁹⁶</p>
Development status	In service with the Israel military. ⁴⁹⁷
Development history	<p>The Hero-30 was first shown at the 2015 Paris Air Show – the same year that the platform was ordered by the special forces of an unnamed country.⁴⁹⁸ UVision demonstrated the Hero-30 to an unnamed Asian military in March 2019.⁴⁹⁹ A May 2020 UVision press release stated that the Hero-30 had been procured by the Israel Ministry of Defence following an “extensive process of evaluation, tests and trials”, and had “already been successfully used in combat operations by various IDF [Israel Defense Forces] forces”.⁵⁰⁰</p> <p>In October 2021, UVision agreed a strategic partnership with the German defence company Rheinmetall and its subsidiary RWM Italia S.p.A to market loitering munitions including the Hero-30 to European militaries.⁵⁰¹ The special forces of an unnamed European NATO member ordered an undisclosed number of Hero-30 platforms in July 2022 as part of this agreement. These platforms, to be manufactured by RWM Italia S.p.A, were scheduled to be delivered by 2023.⁵⁰²</p>
Target type	UVision advertise this platform as being “ideal for anti-personnel missions”. ⁵⁰³ It is described as a “short-range, anti-personnel/anti-material weapon system”, ⁵⁰⁴ and “a high-end alternative to simple mortars”. ⁵⁰⁵ UVision highlight the platform’s potential use in urban warfare settings. ⁵⁰⁶
Autonomous	Autonomous attack: According to UVision, the Hero 30 “has the ability to operate

⁴⁹² <https://www.flightglobal.com/military-uavs/raytheon-uision-honing-hero-30-for-us-army-contest/121355.article>;
<https://breakingdefense.com/2021/07/israeli-loitering-munitions-to-get-us-test-in-october/>;
<https://www.defenceprocurementinternational.com/news/land/uvision-s-hero-30-for-us-army-aerial-missile-system>
<https://www.uavision.com/2016/05/31/raytheon-to-adapt-uision-hero-30-system-for-us-army/>

⁴⁹³ <https://breakingdefense.com/2021/07/israeli-loitering-munitions-to-get-us-test-in-october/>

⁴⁹⁴ <https://www.flightglobal.com/military-uavs/domestic-warhead-switch-to-delay-hero-30-demonstration/123220.article>

⁴⁹⁵ <https://breakingdefense.com/2021/03/us-army-marines-special-forces-eye-israeli-hero-attack-drones/>

⁴⁹⁶ https://uavisionuav.com/wp-content/uploads/2021/01/UVision-successful-Hero-30-naval-trial-approved-22.6.20_Updated-Israeli-MOD.pdf

⁴⁹⁷ https://uavisionuav.com/wp-content/uploads/2020/07/Hero-30-in-IDF-Service_12072020_Final-1.pdf;
<https://www.shephardmedia.com/news/air-warfare/hero-30-enters-service-israel/>;
<https://breakingdefense.com/2021/07/israeli-loitering-munitions-to-get-us-test-in-october/>

⁴⁹⁸ <https://www.airrecognition.com/index.php/archive-world-worldwide-news-air-force-aviation-aerospace-air-military-defence-industry/defense-security-exhibitions-news/air-show-2015/paris-air-show-2015/paris-air-show-2016/2028-uision-unveils-comprehensive-range-of-new-smart-loitering-systems-the-hero-family.html>;
https://uavisionuav.com/wp-content/uploads/2015/06/UVision-FINAL-15-6-15_f.pdf;
<https://www.flightglobal.com/military-uavs/hero-30-uav-gets-special-forces-order/116637.article>

⁴⁹⁹ <https://www.edrmagazine.eu/uvision-has-successfully-demonstrated-the-hero-30-and-the-hero-400ec-lethal-loitering-systems-to-a-strategic-customer-in-asia>

⁵⁰⁰ <https://www.janes.com/defence-news/news-detail/idf-using-uision-mini-loitering-munition>

⁵⁰¹ https://uavisionuav.com/wp-content/uploads/2021/11/UVision_Rheinmetall.pdf

⁵⁰² https://defense-update.com/20220903_rheinmetall-and-uision-awarded-first-order-for-hero-30-loitering-munitions.html

⁵⁰³ <https://uavisionuav.com/portfolio-view/hero-30/>

⁵⁰⁴ Hero-30 brochure - <https://uavisionuav.com/brochures/>

⁵⁰⁵ <https://www.c4isrnet.com/unmanned/2018/06/07/lightweight-loitering-munition-promises-to-be-as-accurate-as-the-human-piloting-it/>

⁵⁰⁶ <https://www.popularmechanics.com/flight/drones/a18032/hero-30-uision-israeli-drone/>;
https://www.rheinmetall.com/media/editor_media/rheinmetallag/events/medien_dvd_2022/loitering_ammunition/B313e052_2_RWM_HERO-30_Manpack_Portable_Loitering_Munition_System_A4_LR.pdf

and automated features	<p>autonomously, semi-autonomously, or manually depending on mission requirements (man-in-the-loop attack capabilities to avoid collateral damage)".⁵⁰⁷ A 2022 brochure published by UVision and Rheinmetall clarifies that whilst the platform has autonomous and semi-autonomous modes, it "always retains the Man-In-The-Loop and requires manual control for the attack to avoid collateral damage".⁵⁰⁸ UVision maintain that the platform is capable of "tracking and lock[ing]-onto" moving targets.⁵⁰⁹ Analysts describe the Hero-30 as using "sophisticated terminal guidance software" which enables the platform to "lock on to evading targets and pursue them automatically".⁵¹⁰</p> <p>Human control over targeting: A 2015 UVision press release announcing the display of the Hero series of loitering munitions at the 2015 Paris Air Show suggests two modes of target designation: the entry of GPS coordinates for attacks against stationary targets; and operator designation which is achieved through the use of the platform's sensors and two-way data link.⁵¹¹ UVision describe the Hero-30 as being equipped with "mission-abort capabilities": "Hero-30 has the ability to abort the attack, go back to loitering mode, and then re-engage the targets when the time is right".⁵¹²</p> <p>Autonomous flight: According to promotional material published by UVision, the Hero-30 can operate "in a completely GPS denied environment".⁵¹³ UVision claim to have tested this capability during a June 2020 demonstration of this platform to a "major" NATO navy.⁵¹⁴ The Hero series of loitering munitions is advertised as being installed with "sophisticated on board navigation algorithms",⁵¹⁵ and "automated flight to target areas".⁵¹⁶</p>
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⁵⁰⁷ Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁵⁰⁸

https://www.rheinmetall.com/media/editor_media/rheinmetallag/events/medien_dvd_2022/loitering_ammunition/B313e052_2_RWM_HERO-30_Manpack_Portable_Loitering_Munition_System_A4_LR.pdf

⁵⁰⁹ https://uvisionuav.com/wp-content/uploads/2021/01/UVision-successful-Hero-30-naval-trial-approved-22.6.20_Updated-Israeli-MOD.pdf

⁵¹⁰ <https://www.popularmechanics.com/flight/drones/a18032/hero-30-uvision-israeli-drone/>

⁵¹¹ https://uvisionuav.com/wp-content/uploads/2015/06/UVision-FINAL-15-6-15_f.pdf


⁵¹² Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁵¹³ Hero-30 brochure - <https://uvisionuav.com/brochures/>

⁵¹⁴ https://uvisionuav.com/wp-content/uploads/2021/01/UVision-successful-Hero-30-naval-trial-approved-22.6.20_Updated-Israeli-MOD.pdf; https://uvisionuav.com/wp-content/uploads/2021/01/UVision-successful-Hero-30-naval-trial-approved-22.6.20_Updated-Israeli-MOD.pdf

⁵¹⁵ Hero-30 brochure - https://uvisionuav.com/brochures

⁵¹⁶ <https://www.janes.com/defence-news/news-detail/ausa-2021-uvision-showcases-new-multi-canister-launcher-for-usmc>

Kargu-2	
System image ⁵¹⁷	
System manufacturer	STM Defense Technologies Engineering (Turkey)
System user(s)	Turkey; Unnamed state (reportedly Azerbaijan). ⁵¹⁸
System range	Range: 5km (10km if installed with an antenna). ⁵¹⁹ Operational endurance: 30 minutes. ⁵²⁰
Launch	Platform weight: 7kg. ⁵²¹ Wingspan: NDA Launch method: rotary power (quadcopter). ⁵²² Delivery method(s): The Kargu-2 can be carried and launched by ground troops. ⁵²³
Payload	Sensors: electro-optical and infra-red camera(s); ⁵²⁴ radio-frequency seeker (reported). ⁵²⁵ Warhead: fragmentation warhead; ⁵²⁶ thermobaric warhead; ⁵²⁷ anti-armour warhead. ⁵²⁸
Platform variant(s)	NDA
Development status	In service with the Turkish military. ⁵²⁹
Development history	The Kargu-2 is “an updated version” of the Kargu drone which was ordered by the Turkish military in 2017. ⁵³⁰ In July 2018, the Kargu-2 was tested at the Mechanical and Chemical Industry Company compound in Kırıkkale, Turkey. ⁵³¹ As of June 2020, the

⁵¹⁷ Armyinform.com.ua, CC BY 4.0 <<https://creativecommons.org/licenses/by/4.0/>>, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/6/69/STM_Kargu.png

⁵¹⁸ <https://www.stm.com.tr/en/media/press-releases/export-kargu-attack-uav-systems-stm-turkeys-manufacturer-tactical-mini-uavs>; <https://euro-sd.com/2021/07/articles/exclusive/23483/kargu-for-azerbaijan/>

⁵¹⁹ <https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav>; <https://www.edrmagazine.eu/stm-loitering-munitions-evolve>

⁵²⁰ <https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav>

⁵²¹ <https://www.airforce-technology.com/projects/kargu-rotary-wing-attack-drone/>

⁵²² <https://www.youtube.com/watch?v=yhjFdobJh-4>

⁵²³ <https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav>

⁵²⁴ <https://www.stm.com.tr/en/media/press-releases/export-kargu-attack-uav-systems-stm-turkeys-manufacturer-tactical-mini-uavs>

⁵²⁵ <https://www.edrmagazine.eu/stm-loitering-munitions-evolve>

⁵²⁶ <https://www.airforce-technology.com/projects/kargu-rotary-wing-attack-drone/>

⁵²⁷ <https://www.airforce-technology.com/projects/kargu-rotary-wing-attack-drone/> ;

<https://www.forbes.com/sites/davidhambling/2020/06/17/turkish-military-to-receive-500-swarming-kamikaze-drones/?sh=71b5b25b251a>

⁵²⁸ <https://www.airforce-technology.com/projects/kargu-rotary-wing-attack-drone/>

⁵²⁹ <https://www.stm.com.tr/en/media/press-releases/export-kargu-attack-uav-systems-stm-turkeys-manufacturer-tactical-mini-uavs>; <https://www.shephardmedia.com/news/air-warfare/african-militaries-show-interest-in-kargu-but-japan-may-remain-elusive/>

⁵³⁰ <https://dsiac.org/wp-content/uploads/2020/10/AD1124409.pdf>, p.9; <https://www.thedrive.com/the-war-zone/34204/turkey-now-has-a-swarming-quadcopter-suicide-drone-that-it-could-export?msclkid=0ae0ee9db1fa11ec80df0bfa3045171>

⁵³¹ <https://www.shephardmedia.com/news/uv-online/stms-kargu-uas-passes-precision-strike-test/>

	<p>Turkish military had ordered at least 500 Kargu-2 platforms.⁵³² A June 2020 STM press release stated that the Kargu-2's development had "benefited greatly from field use".⁵³³ The platform was reportedly used by the Turkish military along the Turkish-Syrian border.⁵³⁴ Following its delivery to the Turkish military in 2018, STM claim that the Kargu-2 has "been upgraded in line with direct feedback from multiple end users".⁵³⁵</p> <p>The Kargu-2 rose to international prominence following the publication of a March 2021 report authored by a United Nations Panel of Experts on Libya regarding the progression of the Libyan Civil War in the period between October 2019 and January 2021. This report suggested that in March 2020 forces affiliated with the Turkish-backed Libyan Government of National Accord may have used the Kargu-2 (and possibly other loitering munitions) to attack militias associated with Khalifa Haftar without immediate human supervision.⁵³⁶ STM officials publicly deny that the Kargu-2 platform was used to conduct "autonomous" attacks in Libya. Speaking in June 2021, STM's then CEO Hakan Guleryuz insisted that "[o]ur homegrown autonomous AI drone technology is mostly used for navigation purposes as well as designating and differentiating humans, animals, vehicles, etc. Therefore, it is not capable of launching fully autonomous attacks on targets".⁵³⁷</p>
Target type	<p>The Kargu-2 is described as "a rotary wing attack drone that has been designed for asymmetric warfare or anti-terrorist operations".⁵³⁸ Analysts describe the Kargu-2's as having the potential to attack a range of targets including "convoys of light vehicles, parked aircraft, radar dishes and sensor systems, ammunition and fuel dumps".⁵³⁹</p>
Autonomous and automated features	<p>Autonomous attack: At one time, analysts described the Kargu-2 as being "used against static or moving targets through its domestically developed built-in real-time image processing capabilities and high-performance navigation and control based on machine learning algorithms".⁵⁴⁰ STM advertise the Kargu-2 as utilizing an "automatic target recognition system",⁵⁴¹ although the technical specifications of this capability do not appear to have been documented.</p>
	<p>Human control over targeting: The language used by STM to advertise the use of automation and autonomy in the Kargu-2 has evolved over time. The catalyst for this shift was the March 2021 publication of the aforementioned UN Report which discussed the craft's purported use during the ongoing Libyan Civil War.</p> <p>Prior to this report's publication, STM appears to have advertised the Kargu-2 as being installed with "both autonomous and manual modes" and utilising "real-time image processing capabilities and deep learning algorithms".⁵⁴² A promotional video released in April 2018 presents the Kargu-2 as being "autonomously fire-and-forget through entry of the target coordinates".⁵⁴³ The Kargu-2 was depicted as using its "real time target</p>

⁵³² <https://www.airforce-technology.com/projects/kargu-rotary-wing-attack-drone/>; <https://www.thedrive.com/the-war-zone/34204/turkey-now-has-a-swarming-quadcopter-suicide-drone-that-it-could-export?msclkid=0ae0ee9db1fa11ec80df0befa3045171>

⁵³³ <https://www.stm.com.tr/en/media/press-releases/aa-tours-state-art-turkish-uav-maker>

⁵³⁴ <https://www.sps-aviation.com/experts-speak/?id=471&h=Turkeys-Swarm-Drones>; <https://www.thedrive.com/the-war-zone/34204/turkey-now-has-a-swarming-quadcopter-suicide-drone-that-it-could-export?msclkid=0ae0ee9db1fa11ec80df0befa3045171>; <https://www.hurriyet.com.tr/ekonomi/ilk-drone-gucu-2020de-41328505>

⁵³⁵ <https://www.stm.com.tr/en/media/press-releases/export-kargu-attack-uav-systems-stm-turkeys-manufacturer-tactical-mini-uavs>

⁵³⁶ <https://documents-dds-ny.un.org/doc/UNDOC/GEN/N21/037/72/PDF/N2103772.pdf?OpenElement>, p.17.

⁵³⁷ <https://www.shephardmedia.com/news/uv-online/turkish-drone-maker-denies-autonomous-strike-capab/>

⁵³⁸ <https://www.suasnews.com/2020/11/kargu-rotary-wing-attack-drone/>

⁵³⁹ <https://www.sps-aviation.com/experts-speak/?id=471&h=Turkeys-Swarm-Drones>

⁵⁴⁰ <https://www.airforce-technology.com/projects/kargu-rotary-wing-attack-drone/>

⁵⁴¹ <https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav>

⁵⁴² <https://en.defenceturk.net/kargu-uav-system/>; <https://www.youtube.com/watch?v=Oqv9yaPLhEk>

⁵⁴³ <https://www.youtube.com/watch?v=Oqv9yaPLhEk>

detection” software to identify and then attack a stationary pick-up truck.⁵⁴⁴ STM was also reportedly developing facial recognition software for the Kargu-2.⁵⁴⁵

More recent promotional material does not refer to the Kargu-2 as using “machine learning algorithms” or as having both “autonomous and manual modes”.⁵⁴⁶ The platform is now explicitly described as being designed to conduct strikes with a “[human]-in-the-loop”.⁵⁴⁷ According to a July 2021 STM press release, for example: “Each mission (both ISR and Precision Strike) is performed under the complete control of the human operators, limiting the platform’s autonomy to navigational purposes only”.⁵⁴⁸ This framing is consistent with the comments made by the company’s CEO Hakan Guleryuz after the publication of the March 2021 UN Report on the Libyan Civil War: “Autonomous technologies are advancing so fast, but we are not there yet. At STM, we always think ethically a human should be involved in the loop”.⁵⁴⁹ The Kargu-2 is similarly advertised as being equipped with an abort/wave-off capability.⁵⁵⁰

Autonomous flight: STM advertise the Kargu-2 as being “capable of performing fully autonomous navigation vis STM’s unique flight control system”.⁵⁵¹ Analysts describe the platform as being able to be operated like a traditional missile by using its GPS navigation system to attack a pre-programmed location.⁵⁵² According to STM CEO Hakan Guleryuz, “[o]ur homegrown autonomous AI drone technology is mostly used for navigation purposes”.⁵⁵³

⁵⁴⁴ <https://www.youtube.com/watch?v=Oqv9yaPLhEk>

⁵⁴⁵ <https://www.hurriyet.com.tr/ekonomi/ilk-drone-gucu-2020de-41328505>; <https://foreignpolicy.com/2021/07/05/killer-flying-robots-drones-autonomous-ai-artificial-intelligence-facial-recognition-targets-turkey-libya/>;

<https://www.forbes.com/sites/davidhambling/2020/06/17/turkish-military-to-receive-500-swarming-kamikaze-drones/?sh=4b381feb251a>

⁵⁴⁶ <https://en.defenceturk.net/kargu-uav-system/>

⁵⁴⁷ <https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav>

⁵⁴⁸ <https://www.stm.com.tr/en/media/press-releases/export-kargu-attack-uav-systems-stm-turkeys-manufacturer-tactical-mini-uavs>

⁵⁴⁹ <https://asia.nikkei.com/Business/Aerospace-Defense/Turkish-defense-company-says-drone-unable-to-go-rogue-in-Libya>

⁵⁵⁰ <https://www.stm.com.tr/en/media/press-releases/export-kargu-attack-uav-systems-stm-turkeys-manufacturer-tactical-mini-uavs>

⁵⁵¹ <https://www.stm.com.tr/en/kargu-autonomous-tactical-multi-rotor-attack-uav>

⁵⁵² <https://www.sps-aviation.com/experts-speak/?id=471&h=Turkeys-Swarm-Drones>

⁵⁵³ <https://www.shephardmedia.com/news/uv-online/turkish-drone-maker-denies-autonomous-strike-capab/>

KUB-BLA	
System manufacturer	ZALA Aero, part of the Kalashnikov Group which is a subsidiary of the state-owned defence conglomerate Rostec (Russia)
System user(s)	Russia.
System range	Range: 40km. ⁵⁵⁴
	Loitering time: 30 minutes. ⁵⁵⁵
Launch	Platform weight: NDA
	Wingspan: 1.2m. ⁵⁵⁶
	Launch method: rail-mounted catapult system. ⁵⁵⁷
	Delivery method(s): ZALA Aero have developed a special launcher that enables the KUB to be launched from naval platforms such as the BK-16 High-Speed Landing Craft, and other warships. ⁵⁵⁸ In August 2021, the company claimed to be developing a deck container launcher designed to launch multiple KUB platforms. ⁵⁵⁹
Payload	Sensors: Electro-optical camera(s). ⁵⁶⁰ The KUB can reportedly be provided targeting information collected by other uncrewed platforms during flight. ⁵⁶¹ Russian state media report that Russian armed forces field reconnaissance drones such as the Orion and the Orlan-10 “in tandem” with loitering munitions including the KUB. ZALA Aero chief designer Alexander Zakharov claims that the KUB can be provided targeting information from the unified tactical level control system and the Sagittarius reconnaissance, control, and target designation complex. ⁵⁶²
	Warhead: fragmentation warhead. ⁵⁶³
Platform variant(s)	Maritime variant: At the 2021 Army Forum exhibition held in Russia, ZALA Aero displayed a full-scale mock-up of a maritime KUB variant. ⁵⁶⁴ This platform reportedly has “the ability to perform missions as part of a guided swarm”. ⁵⁶⁵ It was tested in November 2021. ⁵⁶⁶ Vladimir Lepin, the Kalashnikov Concern General Director, remarked in an August 2022 interview that the KUB is being adapted for launch from high-speedboats and special-purpose ships. ⁵⁶⁷
Development status	In service with the Russian military. ⁵⁶⁸
Development history	The KUB was first presented at the 2019 International Defense Exhibition held in Abu Dhabi. ⁵⁶⁹ ZALA Aero chief designer Alexander Zakharov has claimed that the

⁵⁵⁴ <https://www.19fortyfive.com/2022/04/kub-bla-russia-has-its-own-switchblade-suicide-drone-of-its-own/>;

<https://www.army-technology.com/projects/zala-kyb-strike-drone-russia/>

⁵⁵⁵ <https://zala-aero.com/en/production/bvs/kyb-uav/>; <https://www.army-technology.com/projects/zala-kyb-strike-drone-russia/>

⁵⁵⁶ <https://www.army-technology.com/projects/zala-kyb-strike-drone-russia/>; <https://topwar.ru/194163-v-dvuh-operacijah-boevoe-primeneniye-rossijskih-barrazhirujuschih-boepripasov.html>

⁵⁵⁷ <https://kalashnikovgroup.ru/media/bespilotnye-letatelnye-apparaty/kontsern-kalashnikov-razrabotal-vysokotochnyy-udarnyy-bespilotnyy-kompleks-kub-bla>

⁵⁵⁸ <https://www.janes.com/defence-news/news-detail/army-2021-zala-aero-develops-naval-version-of-kub-uav>

⁵⁵⁹ <https://www.janes.com/defence-news/news-detail/army-2021-zala-aero-develops-naval-version-of-kub-uav>

⁵⁶⁰ <https://en.topwar.ru/188914-barrazhirujuschij-boepripas-kub-bla-ot-zala-aero-poluchil-morskiju-versiju.html>;

<https://regnum.ru/news/it/3453796.html>

⁵⁶¹ <https://eurasianimes.com/russian-troops-step-up-use-of-kamikaze-cuba-drones-frontline/>

⁵⁶² <https://iz.ru/1262096/anton-lavrov/my-sdelali-stavku-na-nanesenie-massirovannykh-udarov>

⁵⁶³ <https://zala-aero.com/en/production/bvs/kyb-uav/>;

<https://www.popularmechanics.com/military/aviation/a26414352/kalashnikov-kub-bla-drone/>

⁵⁶⁴ <https://www.janes.com/defence-news/news-detail/army-2021-zala-aero-develops-naval-version-of-kub-uav>

⁵⁶⁵ <http://navyrecognition.com/index.php/naval-news/naval-news-archive/2021/august/10596-zala-aero-develops-sea-based-kub-uav-kamikaze-drone.html>

⁵⁶⁶ <https://tass.ru/armiya-i-opk/12867427>

⁵⁶⁷ <https://rg.ru/2022/08/30/drony-kamikadze-kub-bla-budut-rabotat-s-korablej-i-katerov.html>,

<https://oborona.ru/product/zhurnal-nacionalnaya-oborona/tochno-i-v-sroki-vypolnyat-gosoboronzakaz-43824.shtml>

⁵⁶⁸ <https://www.forbes.com/sites/davidhambling/2022/07/21/russia-steps-up-kamikaze-drone-strikes/?sh=33e8eb146262>

	<p>KUB’s first flight occurred in 2015.⁵⁷⁰ The platform successfully completed “state tests” with the Russian military and passed the government’s certification tests in November 2021.⁵⁷¹ According to a December 2021 ZALA Aero press-release, the “serial production” of this platform would begin in 2022.⁵⁷²</p> <p>The KUB is believed to have been combat tested in Syria sometime in early 2019.⁵⁷³ In 2020, Rostec Corporation’s CEO Sergey Chemezov was quoted as saying that: “Kalashnikov drones took part in the fighting in Syria. They have proven themselves well, the Defense Ministry is happy to acquire them – not only for reconnaissance, but also for combat”.⁵⁷⁴ Consistent with such claims, a 2022 Kalashnikov Group press release noted that the KUB “already has a successful experience of combat use, confirmed in real conditions”.⁵⁷⁵</p> <p>The Russian military has similarly fielded the KUB in Ukraine. Images published on social media appear to show the wreckage of multiple KUB platforms in the Ukrainian capital of Kyiv.⁵⁷⁶ These images began circulating in March 2022, within weeks of Russia’s full-scale invasion of the country.⁵⁷⁷ The state-run Russian news agency TASS later reported that the KUB had, like the Lancet-3 loitering munition also manufactured by ZALA Aero, been widely used by the Russian military in Ukraine.⁵⁷⁸</p>
<p style="text-align: center;">Target type</p>	<p>ZALA Aero advertise this platform as being “designed to defeat remote ground targets”.⁵⁷⁹ The Russian Ministry of Defence has released footage showing the KUB attacking Ukrainian operated M777 howitzers.⁵⁸⁰ The KUB is also reportedly designed to attack infrastructure facilities.⁵⁸¹</p>
<p style="text-align: center;">Autonomous and automated features</p>	<p>Autonomous attack: The KUB is often described as “incorporate[ing] artificial intelligence visual identification (AIVI) technology for real-time recognition and classification of targets”.⁵⁸² This assertion appears to be based on a 2019 ZALA Aero advertisement for Artificial Intelligence Visual Identification software which utilises AI “to detect and recognize objects by class or type in real time”.⁵⁸³ It is unclear whether this software has actually been integrated into the KUB. ZALA</p>

⁵⁶⁹ <https://zala-aero.com/en/news/new-unmanned-combat-aerial-system-by-zala-aero-kalashnikov-concern//>;
<https://kalashnikovgroup.ru/media/bespilotnye-letatelnye-apparaty/kontsern-kalashnikov-razrabotal-vysokotochnyy-udarnyy-bespilotnyy-kompleks-kub-bla>

⁵⁷⁰ <https://iz.ru/1262096/anton-lavrov/my-sdelali-stavku-na-nanesenie-massirovannykh-udarov>

⁵⁷¹ <https://www.uasvision.com/2022/02/02/russias-loitering-ammunition-kub-e-cleared-for-export/>;
<https://ria.ru/20220125/boepripasy-1769384097.html>

⁵⁷² https://www.armyrecognition.com/defense_news_december_2021_global_security_army_industry/serial_supplies_of_russian_kub-bla_strike_drones_may_begin_in_2022.html, <https://tass.com/defense/1512115>;
<https://www.uasvision.com/2022/02/02/russias-loitering-ammunition-kub-e-cleared-for-export/>

⁵⁷³ <https://topwar.ru/194163-v-dvuh-operacijah-boevoe-primenenie-rossijskih-barrazhirujuschih-boepripasov.html>

⁵⁷⁴ <https://tass.ru/armiya-i-opk/10185991>

⁵⁷⁵ <https://www.thedefensepost.com/2022/01/31/russia-kamikaze-drone-export/>

⁵⁷⁶ <https://defence-blog.com/russia-attacks-ukrainian-capital-with-kalashnikov-kamikaze-drones/>;
<https://twitter.com/RALee85/status/1502550038731497474>

⁵⁷⁷ <https://www.thedrive.com/the-war-zone/44725/proof-of-russia-using-suicide-drones-in-ukraine-emerges>;
<https://twitter.com/ralee85/status/1502550038731497474?lang=en>; https://thebulletin.org/2022/03/russia-may-have-used-a-killer-robot-in-ukraine-now-what/?utm_source=Twitter&utm_campaign=TwitterPost03152022&utm_content=DisruptiveTechnologies_KillerRobotInUkraine_03152022

⁵⁷⁸ <https://tass.com/defense/1462311>

⁵⁷⁹ <https://zala-aero.com/en/production/bvs/kyb-uav/>

⁵⁸⁰ <https://www.globalsecurity.org/military/world/russia/kub-uav.htm>

⁵⁸¹ <https://ria.ru/20220125/boepripasy-1769384097.html>, <https://rg.ru/2022/08/30/bespilotnik-kamikadze-kub-bla-rekomendovali-k-priniatiu-na-vooruzhenie.html>

⁵⁸² <https://www.army-technology.com/projects/zala-kyb-strike-drone-russia/>

⁵⁸³ <https://kalashnikov.media/article/technology/zala-aero-predstavila-novuyu-tekhnologiyu-na-osnove-iskusstvennogo-intellekta>

	<p>Aero’s 2019 fact sheet advertising the AIVI technology does not specify its use on the KUB,⁵⁸⁴ and it is unclear whether the Russian military is capable of using this software in combat.⁵⁸⁵ The KUB is not designed to attack moving targets.⁵⁸⁶</p> <p>Human control over targeting: According to the Kalashnikov Group, this platform can conduct attacks “based on target coordinates, which are set manually or based on an image from a target guidance payload”.⁵⁸⁷ Building on these claims, analysts describe the KUB’s operator as being able to preload images of target profiles (e.g. an American M-ATV [Mine-Resistant Ambush Protected] vehicle or Abrams tank) which the platform then searches for.⁵⁸⁸ Both of these modes point to the KUB being operated in line with human-in-the-loop principles,⁵⁸⁹ whether this is achieved by the operator entering target coordinates or by authorising attacks on objects which meet certain pre-programmed targeting profiles.⁵⁹⁰</p> <p>Autonomous flight: Media reports suggest that the KUB is installed with auto-pilot software that enables the platform to navigate toward a designated area of operation using a global satellite navigation system.⁵⁹¹</p>
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⁵⁸⁴ <https://www.csis.org/analysis/russia-probably-has-not-used-ai-enabled-weapons-ukraine-could-change>

⁵⁸⁵ <https://www.wired.com/story/ai-drones-russia-ukraine/>; <https://insideunmannedsystems.com/russias-war-in-ukraine/>

⁵⁸⁶ <https://www.19fortyfive.com/2022/04/kub-bla-russia-has-its-own-switchblade-suicide-drone-of-its-own/>;

https://twitter.com/imp_navigator/status/1591732624095150083

⁵⁸⁷ <https://zala-aero.com/en/production/bvs/kyb-uav/>, <https://t.me/kalashnikovnews/747>

⁵⁸⁸ <https://www.popularmechanics.com/military/aviation/a26414352/kalashnikov-kub-bla-drone/>;


<https://www.globalsecurity.org/military/world/russia/kub-uav.htm>;

<https://www.popularmechanics.com/military/weapons/a39517660/kamikaze-drones-in-ukraine/>

⁵⁸⁹ <https://twitter.com/HoansSolo/status/1504750094310064129>

⁵⁹⁰ Author response https://thebulletin.org/2022/03/russia-may-have-used-a-killer-robot-in-ukraine-now-what/?utm_source=Twitter&utm_campaign=TwitterPost03152022&utm_content=DisruptiveTechnologies_KillerRobotInUkraine_03152022.

⁵⁹¹ <https://eurasianimes.com/russian-troops-step-up-use-of-kamikaze-cuba-drones-frontline/>

Orbiter 1K	
System image ⁵⁹²	
System manufacturer	Aeronautics Defense Systems (Israel)
System user(s)	Azerbaijan. ⁵⁹³
System range	Range: 100km. ⁵⁹⁴ Operational endurance: 2.5 hours. ⁵⁹⁵
Launch	Platform weight: 13kg. ⁵⁹⁶ Wingspan: 2.9m. ⁵⁹⁷ Launch method: rail-mounted catapult. ⁵⁹⁸ Delivery method(s): The Orbiter 1K's launch catapult can be integrated onto ground vehicles and warships. ⁵⁹⁹
Payload	Sensors: electro-optical and infrared camera(s). ⁶⁰⁰ Warhead: fragmentation warhead. ⁶⁰¹
Platform variant(s)	Orbiter 2: This platform “serves a variety of military missions including intelligence gathering, surveillance, target acquisition, and reconnaissance”. ⁶⁰² It is described as a “mini” drone with a wingspan of approximately 3 meters and a weight of 10.3kg when fully equipped. ⁶⁰³ The Orbiter 2 has an operational endurance of around 4 hours. ⁶⁰⁴ Unlike the Orbiter 1K, this Orbiter variant does not carry an explosive warhead. ⁶⁰⁵ Orbiter 3: The Orbiter 3 is a reconnaissance platform with a greater range and an improved sensor payload. ⁶⁰⁶ This platform first flew in 2010 and was delivered to an unnamed military in 2011. ⁶⁰⁷ In July 2019, Aeronautics announced a \$8 million deal to

⁵⁹² Original author Pibwl, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/e/ef/Aeronautics_Orbiter_UAV.jpg

⁵⁹³ <https://www.oryxspioenkop.com/2021/12/death-from-above-azerbaijans-killer.html>;
<https://www.thedefensepost.com/2018/05/07/azerbaijan-defense-industry-indigenous-opinion/>;
<https://en.armradio.am/2020/09/29/azerbaijani-orbiter-1k-uav-downed-by-armenian-forces/>;

<https://www.defenseworld.net/2019/02/18/azerbaijan-to-acquire-israeli-aeronautics-orbiter-1k-drones.html>

⁵⁹⁴ <https://cp-aeronautics.com/wp-content/uploads/2019/11/Orbiter-1k.pdf>

⁵⁹⁵ <https://cp-aeronautics.com/wp-content/uploads/2019/11/Orbiter-1k.pdf>

⁵⁹⁶ <https://cp-aeronautics.com/wp-content/uploads/2019/11/Orbiter-1k.pdf>

⁵⁹⁷ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

⁵⁹⁸ <https://cp-aeronautics.com/wp-content/uploads/2019/11/Orbiter-1k.pdf>; <https://aeronautics-sys.com/home-page/page-systems/page-systems-orbiter-1k-muas/>

⁵⁹⁹ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

⁶⁰⁰ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

⁶⁰¹ <https://cp-aeronautics.com/wp-content/uploads/2019/11/Orbiter-1k.pdf>

⁶⁰² <https://aeronautics-sys.com/home-page/page-systems/page-systems-orbiter-2-mini-uas/>

⁶⁰³ https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=2056

⁶⁰⁴ https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=2056

⁶⁰⁵ https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=2056

⁶⁰⁶ <https://aeronautics-sys.com/home-page/page-systems/page-systems-orbiter-3-stuas/>

⁶⁰⁷ <https://www.flightglobal.com/pictures-aeronautics-flies-orbiter-3-uav/96943.article>;

<https://www.australiandefence.com.au/news/aeronautics-deliver-first-orbiter-3>

	<p>export the Orbiter 3 to an unnamed country.⁶⁰⁸ The Armenian military claims to have shot down two Azerbaijani operated Orbiter 3s during the 2020 Nagorno-Karabakh war.⁶⁰⁹</p> <p>Orbiter 4: The Orbiter 4 is the largest Orbiter variant and can reportedly be equipped with two different payloads.⁶¹⁰ It is advertised as being Aeronautics Defense Systems’ “most advanced tactical UAS”,⁶¹¹ and as borrowing certain design features from the Orbiter 3.⁶¹² The Orbiter 4 was first shown at the 2016 Azerbaijan International Defence Exhibition (ADEX) held in Baku.⁶¹³ In early 2022, Singapore announced that it had purchased an undisclosed number of Orbiter 4 platforms.⁶¹⁴ The Orbiter 4 can reportedly carry a 12kg payload and can conduct ISR operations over both land and sea.⁶¹⁵</p>
Development status	<p>In service with the Azerbaijani military.⁶¹⁶</p>
Development history	<p>The Orbiter 1K was first unveiled at the 2015 Paris Air Show.⁶¹⁷ Its design was based on the unarmed Orbiter 2 surveillance platform manufactured by the same company.⁶¹⁸ By March 2017, Aeronautics Defence Systems executives claimed that the company was producing “hundreds” of these platforms.⁶¹⁹</p> <p>Aeronautics Defence Systems’ export licence was suspended by the Israeli Government in 2017. This was due to allegations that company executives had used the Orbiter 1K to attack an Armenian Army position during a “demonstration” of this system to the Azerbaijani military in October 2017.⁶²⁰ Media reports suggest this Orbiter 1K platform missed its intended target but injured two Armenian fighters.⁶²¹ Aeronautics Defence Systems deny this allegation, insisting that it “never carries out demonstrations on live targets, and that was true in this case as well”.⁶²²</p> <p>The Azerbaijani military reportedly used the Orbiter 1K during its 2020 Nagorno-Karabakh War against Armenia.⁶²³ Footage posted on social media in October 2020</p>

⁶⁰⁸ <https://www.ipost.com/israel-news/aeronautics-inks-8-million-deal-for-their-orbiter-3-drone-594149>

⁶⁰⁹ <https://www.janes.com/defence-news/news-detail/armenia-claims-azerbaijani-uav-kills>

⁶¹⁰ https://defense-update.com/20210712_orbiter-a-big-family-of-small-uas.html

⁶¹¹ <https://www.navalnews.com/naval-news/2021/05/aeronautics-introduces-orbiter-4-small-tactical-uas-for-maritime-missions/>

⁶¹² <https://www.navalnews.com/naval-news/2021/05/aeronautics-introduces-orbiter-4-small-tactical-uas-for-maritime-missions/>

⁶¹³ <https://www.israeldefense.co.il/en/content/aeronautics-reveals-its-orbiter-4-uas>

⁶¹⁴ <https://www.flightglobal.com/military-uavs/singapore-obtains-orbiter-4-tactical-uav/147768.article>

⁶¹⁵ <https://www.navyrecognition.com/index.php/naval-news/naval-exhibitions/defea-2021-news-official-show-daily/10426-defea-2021-aeronautics-group-displays-maritime-orbiter-4-uas.html>

⁶¹⁶ <https://www.flightglobal.com/military-uavs/loitering-orbiter-1k-on-target-for-first-delivery/121398.article>;

⁶¹⁷ <https://www.airrecognition.com/index.php/archive-world-worldwide-news-air-force-aviation-aerospace-air-military-defence-industry/air-show-2015/paris-air-show-2015/paris-air-show-2016/1792-aeronautics-new-orbiter-1k-kingfisher-muas-to-be-unveiled-at-paris-air-show-2015-2805156.html>; <https://www.shephardmedia.com/news/uv-online/paris-air-show-orbiter-1k-loitering-uav-unveiled/>

⁶¹⁸ <https://www.airrecognition.com/index.php/archive-world-worldwide-news-air-force-aviation-aerospace-air-military-defence-industry/air-show-2015/paris-air-show-2015/paris-air-show-2016/1792-aeronautics-new-orbiter-1k-kingfisher-muas-to-be-unveiled-at-paris-air-show-2015-2805156.html>; <https://www.flightglobal.com/military-uavs/aeronautics-producing-hundreds-of-armed-orbiter-1ks/123233.article>

⁶¹⁹ <https://www.flightglobal.com/military-uavs/aeronautics-producing-hundreds-of-armed-orbiter-1ks/123233.article>

⁶²⁰

<https://www.defenseworld.net/news/24289/Azerbaijan-to-Acquire-Israeli-Aeronautics-Orbiter-1K-Drones#.YLjDqhkjG>; <https://www.defensenews.com/industry/2017/08/30/israeli-drone-maker-says-some-exports-frozen-pending-probe/>; <https://www.thedrive.com/the-war-zone/23270/israeli-company-allegedly-flew-a-suicide-drone-on-a-real-combat-mission-in-azerbaijan>

⁶²¹ <https://www.thedrive.com/the-war-zone/23270/israeli-company-allegedly-flew-a-suicide-drone-on-a-real-combat-mission-in-azerbaijan>

⁶²² <https://armenpress.am/eng/news/964774.html>

⁶²³ <https://mwi.usma.edu/drones-are-proving-to-have-a-destabilizing-effect-which-is-why-counter-drone-systems-should-be-a-key-part-of-us-military-aid-to-partners/>; https://www.francetvinfo.fr/monde/israel/video-haut-karabakh-israel-fournit-bien-des-drones-a-lazerbaïdjan-pour-frapper-des-cibles-armeniennes_4144151.html

	appears to show an Azerbaijani Orbiter-1K platform having crashed in (or having been disabled over) Nagorno-Karabakh. ⁶²⁴
Target type	Aeronautics Defence Systems advertise this platform as being capable of conducting “missions against soft-shell and human targets” and as being designed “[f]or use by special operation forces and infantry”. ⁶²⁵ The Orbiter 1K has maritime applications and, amongst other missions, can be used to support “[n]aval special operations raids”. ⁶²⁶
Autonomous and automated features	Autonomous attack: According to Aeronautics Defence Systems, the Orbiter 1K makes use of “advanced guidance capabilities, to ensure high precision, lethality and low collateral effects”. ⁶²⁷ Media reports discussing this platform describe it as being installed with “a ‘shoot and forget’ mode, but if its planned target – either moving or stationary – is not detected, its ground operator can bring it back to perform a safe landing”. ⁶²⁸
	Human control over targeting: The Orbiter 1K is described as being installed with a “[human]-in-the-loop guidance system whereby the operator is either actively flying or otherwise monitoring the video feeds from the drone and they can see what it sees throughout the mission”. ⁶²⁹ Aeronautics Defence Systems advertise this system as being installed with a wave-off/abort capability. ⁶³⁰
	Autonomous flight: Aeronautics Defence Systems advertise the Orbiter 1K as being equipped with “[a]dvanced autonomous flight modes”. ⁶³¹ It is installed “with an avionics package with automatic flight control guidance”, ⁶³² and an ability to navigate via pre-programmed waypoints. ⁶³³ Aeronautics Defence Systems advertise the Orbiter 1K as being “[f]ully operational in GPS denied areas”. ⁶³⁴

⁶²⁴ <https://twitter.com/ralee85/status/1312757203087044610>; <https://t.me/bagramyan26/19413>

⁶²⁵ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

⁶²⁶ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

⁶²⁷ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

⁶²⁸ <https://www.flightglobal.com/civil-uavs/aeronautics-introduces-orbiter-1k-loitering-munition/116974.article>;
<https://www.ipost.com/israel-news/israeli-defense-company-aeronautics-seals-13m-drone-deal-with-azerbaijan-580928>;
<https://www.airrecognition.com/index.php/archive-world-worldwide-news-air-force-aviation-aerospace-air-military-defence-industry/air-show-2015/paris-air-show-2016/1792-aeronautics-new-orbiter-1k-kingfisher-muas-to-be-unveiled-at-paris-air-show-2015-2805156.html>

⁶²⁹ <https://www.thedrive.com/the-war-zone/23270/israeli-company-allegedly-flew-a-suicide-drone-on-a-real-combat-mission-in-azerbaijan>


⁶³⁰ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

⁶³¹ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/orbiter_1k_v2.pdf

⁶³² <https://aeronautics-sys.com/home-page/page-systems/page-systems-orbiter-1k-muas/>

⁶³³ <https://www.flightglobal.com/military-uavs/aeronautics-producing-hundreds-of-armed-orbiter-1ks/123233.article>

⁶³⁴ https://aeronautics-sys.com/wp-content/themes/aeronautics/pdf/Orbiter_1K_Brochure_EN_web1.pdf

ROTEM L	
System image ⁶³⁵	
System manufacturer	Israel Aerospace Industries (Israel)
System user(s)	Israel; an undisclosed state (IAI advertise the Rotem L as being “used in operations by several of the world’s militaries” ⁶³⁶ and, in February 2021, announced that the Rotem had been sold to an unnamed overseas customer). ⁶³⁷
System range	Range: 10km. ⁶³⁸ Operational endurance: 30 minutes when equipped with a fragmentation warhead; ⁶³⁹ 45 minutes when equipped with an ISR payload. ⁶⁴⁰
Launch	Platform weight: 6kg. ⁶⁴¹ Wingspan: NDA Launch method: rotary power (quadcopter). ⁶⁴²
Payload	Delivery method(s): The Rotem L can be carried and launched by a single operator. ⁶⁴³ Sensors: optical/infrared camera(s); ⁶⁴⁴ “open system architecture” which allows for a variety of different sensors and or warheads to be integrated onto its fuselage including those for the purpose of “communications intelligence” and fire detection. ⁶⁴⁵ Warhead: fragmentation warhead. ⁶⁴⁶
Platform variant(s)	NDA
Development status	Possibly in service with the Israeli military and another unnamed military. ⁶⁴⁷
Development history	The Rotem L’s development was announced in 2016. ⁶⁴⁸ The platform was shown at the Singapore Air Show during that year. ⁶⁴⁹ In 2018, IAI conducted a series of tests involving the Rotem L including simulated strikes against moving targets. ⁶⁵⁰

⁶³⁵ Reise Reise, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/6/63/Rotem_L_%282%29.jpg

⁶³⁶ <https://www.iai.co.il/iai-to-provide-loitering-munitions-to-asian-countries-deals-worth-over-100-million-usd>

⁶³⁷ <https://www.iai.co.il/iai-to-provide-loitering-munitions-to-asian-countries-deals-worth-over-100-million-usd>

⁶³⁸ <https://www.iai.co.il/drupal/sites/default/files/2019-05/ROTEM%20Brochure.pdf>

⁶³⁹ <https://www.iai.co.il/p/rotem>

⁶⁴⁰ <https://www.iai.co.il/p/rotem>

⁶⁴¹ <https://www.iai.co.il/p/rotem>

⁶⁴² <https://www.youtube.com/watch?v=yhjFdobJh-4>

⁶⁴³ <https://www.iai.co.il/p/rotem>

⁶⁴⁴ <https://www.iai.co.il/p/rotem>; <https://www.iai.co.il/iai-to-provide-loitering-munitions-to-asian-countries-deals-worth-over-100-million-usd>

⁶⁴⁵ <https://www.iai.co.il/drupal/sites/default/files/2019-05/ROTEM%20Brochure.pdf>

⁶⁴⁶ <https://www.iai.co.il/sites/default/files/2019-05/ROTEM%20Brochure.pdf>

⁶⁴⁷ <https://www.timesofisrael.com/idf-said-to-look-at-buying-israeli-small-attack-drones/>;

<https://www.defensenews.com/unmanned/2021/02/02/israeli-firm-sells-harop-rotem-kamikaze-drones-to-several-asian-countries/>

⁶⁴⁸ <https://www.popularmechanics.com/military/a20555/the-quadrotor-drone-that-carries-a-warhead/>

⁶⁴⁹ <https://www.shephardmedia.com/news/uv-online/singapore-airshow-iai-showcases-loitering-munition/>

⁶⁵⁰ <https://www.uasvision.com/2018/06/13/iai-completes-successful-demo-of-the-rotem/>; <https://www.jpost.com/israel-news/iai-tests-new-capabilities-of-latest-rotem-suicide-drone-560877>

Target type	The Rotem L is a tactical loitering munition which is designed to “perform squad-level ISR and attack missions”. ⁶⁵¹ As advertised by IAI, it “is capable of lethal precision strikes on stationary and mobile targets”. ⁶⁵² Both IAI and analysts highlight the Rotem L’s potential use in urban combat settings. ⁶⁵³ Promotional material featuring this platform depicts it being used to attack a van. ⁶⁵⁴
Autonomous and automated features	<p>Autonomous attack: Promotional footage depicts the Rotem L as tracking and attacking a range of moving vehicles.⁶⁵⁵ IAI advertise the Rotem as being capable of attacking “stationary and maneuvering targets”,⁶⁵⁶ as well as possessing an autonomous “attack” mode.⁶⁵⁷</p> <p>Human control over targeting: The Rotem L is described as operating with a “[human]-in-the-loop” during target acquisition and engagement.⁶⁵⁸ It is installed with an abort/wave off capability.⁶⁵⁹ According to reports: “If it does not receive an attack authorization, the Rotem can fly back and [be] retrieved safely, have its battery replaced, and immediately deploy on a new mission”.⁶⁶⁰</p> <p>Autonomous flight: The Rotem L is “operated by a single soldier using simple point and click commands on a tablet controller”.⁶⁶¹ IAI advertise the Rotem as utilising an “autonomous flight” capability,⁶⁶² as well as an “obstacle avoidance” function which can be used to navigate in urban environments.⁶⁶³ It is installed with a range of “autonomous modes” including take-off and landing, observation, and an “emergency return home” functionality.⁶⁶⁴</p>

⁶⁵¹ <https://theaviationist.com/2022/01/07/iai-loitering-munitions/>

⁶⁵² <https://www.iai.co.il/p/rotem>

⁶⁵³ <https://www.deagel.com/Cannons%20&%20Gear/Rotem%20L/a003538;> [https://starkaerospace.com/wp-content/uploads/2017/05/ROTEM-L-Brochure.pdf;](https://starkaerospace.com/wp-content/uploads/2017/05/ROTEM-L-Brochure.pdf) https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=1938; https://defense-update.com/20160216_rotem.html

⁶⁵⁴ https://www.youtube.com/watch?v=yhjFdobJh-4&t=21s&ab_channel=IAI

⁶⁵⁵ <https://www.youtube.com/watch?v=yhjFdobJh-4;> https://www.youtube.com/watch?time_continue=94&v=ctZA9jz38zE&feature=emb_title

⁶⁵⁶ <https://www.iai.co.il/p/rotem>

⁶⁵⁷ <https://www.iai.co.il/p/rotem>

⁶⁵⁸ https://defense-update.com/20160216_rotem.html; https://www.militaryfactory.com/aircraft/detail.php?aircraft_id=1938

⁶⁵⁹ <https://www.youtube.com/watch?v=yhjFdobJh-4;> https://www.youtube.com/watch?v=yhjFdobJh-4&t=21s&ab_channel=IAI

⁶⁶⁰ <https://aviationweek.com/defense-space/loitering-munitions-meeting-challenge-time-sensitive-targets>


⁶⁶¹ https://defense-update.com/20160216_rotem.html

⁶⁶² <https://www.iai.co.il/p/rotem>

⁶⁶³ https://defense-update.com/20160216_rotem.html

⁶⁶⁴ <https://www.iai.co.il/p/rotem>

Spike Firefly

<p>System image⁶⁶⁵</p>	
<p>System manufacturer</p>	<p>Rafael Advanced Defense Systems (Israel) in collaboration with the Israeli Defence Force (IDF).⁶⁶⁶</p>
<p>System user(s)</p>	<p>Israel; India (reported).⁶⁶⁷</p>
<p>System range</p>	<p>Operational endurance: 0.5km in urban areas; 1km in more “open” settings.⁶⁶⁸ Operational endurance: 15 minutes (one battery installed); 30 minutes (two batteries installed).⁶⁶⁹</p>
<p>Launch</p>	<p>Platform weight: 3kg.⁶⁷⁰ Wingspan: NDA Launch method: rotary power.⁶⁷¹ Delivery method(s): The Spike Firefly can be carried in a portable canister and deployed by infantry.⁶⁷² It can also be transported via a vehicle-mounted launcher which holds three platforms.⁶⁷³</p>
<p>Payload</p>	<p>Sensors: electro-optical and infrared camera(s);⁶⁷⁴ proximity sensor.⁶⁷⁵ Warhead: fragmentation warhead;⁶⁷⁶ (this warhead can be replaced by an additional battery to double the Spike Firefly’s operational endurance).⁶⁷⁷</p>
<p>Platform variant(s)</p>	<p>NDA</p>
<p>Development status</p>	<p>In service with the Israeli military.⁶⁷⁸</p>
<p>Development history</p>	<p>The Spike Firefly is known as Maoz in Israeli military service. Its design was informed by Rafael’s Spike family of precision guided munitions.⁶⁷⁹ Rafael released details about its</p>

⁶⁶⁵ Swadim, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons

⁶⁶⁶ <https://www.shephardmedia.com/news/landwarfareintl/israel-orders-rafael-spike-firefly-idf-ground-forc/>

⁶⁶⁷ <https://www.army-technology.com/news/indian-army-plans-to-buy-raven-uav-and-spike-firefly-platforms/>;
<https://www.hindustantimes.com/india-news/army-looks-to-acquire-us-aerial-vehicle-to-strengthen-infantry/story-vY4Cn0fZDAofyij2b0LvbN.html>

⁶⁶⁸ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁶⁹ <https://www.army-technology.com/projects/spike-firefly/>

⁶⁷⁰ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁷¹ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁷² <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁷³ <https://www.joint-forces.com/defence-equipment-news/29047-rafael-spike-firefly-munition>;
<https://www.janes.com/defence-news/news-detail/iaav-2020-rafael-integrates-firefly-loitering-munition-with-vehicles>;

https://www.rsgsllc.com/_files/ugd/33b442_a71ad3076a5b42c7b1c40793f5f19fad.pdf

⁶⁷⁴ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁷⁵ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁷⁶ <https://www.overtdefense.com/2020/05/20/israel-buys-rafaels-spike-firefly-loitering-munition/>;

https://www.rsgsllc.com/_files/ugd/33b442_a71ad3076a5b42c7b1c40793f5f19fad.pdf

⁶⁷⁷ <https://www.esdpa.org/rafael-a-new-member-for-the-spike-family/>

⁶⁷⁸ <https://www.shephardmedia.com/news/landwarfareintl/israel-orders-rafael-spike-firefly-idf-ground-forc/>;
<https://www.flightglobal.com/defence/israel-orders-rafaels-spike-firefly-loitering-munition/138229.article>;

<https://defbrief.com/2022/05/10/us-army-trials-israeli-built-spike-firefly-loitering-munition/#:~:text=Rafael%20developed%20Spike%20Firefly%20together,capabilities%20for%20the%20dismounted%20soldier>

	development in 2014. ⁶⁸⁰ The Spike Firefly was first unveiled in 2018. ⁶⁸¹ In May 2020, the IDF ordered an undisclosed number of these platforms. ⁶⁸² In May 2022, it was announced that the US Army had tested and evaluated this platform in a series of exercises conducted as part of its Army Expeditionary Warrior Experiment event. ⁶⁸³
Target type	Rafael advertises this platform as being designed to support “light manoeuvring ground forces” to attack stationary and moving targets. ⁶⁸⁴ According to its manufacturer, the platform has been purposefully designed to attack beyond-line-of-sight targets operating “behind cover” and in urban combat zones. ⁶⁸⁵ The Spike Firefly can also be used to conduct reconnaissance and surveillance operations. ⁶⁸⁶
Autonomous and automated features	Autonomous attack: Promotional footage released by Rafael depicts the Firefly tracking a moving target. ⁶⁸⁷ The platform is advertised as utilising “homing algorithms” and “computer vision” software. ⁶⁸⁸ It is also noted to be equipped with a “[u]nique innovative tracker based on image processing”. ⁶⁸⁹
	Human control over targeting: The Spike Firefly can operate with a human-in-the-loop, with its operator piloting the craft via a portable ground control system. ⁶⁹⁰ The Spike Firefly is equipped with an “[a]bort/wave-off capability”. ⁶⁹¹
	Autonomous flight: According to Rafael, the Spike Firefly can autonomously fly between operator designated waypoints. ⁶⁹² The platform can also be manually piloted by a human operator using a portable control station. ⁶⁹³

⁶⁷⁹ <https://www.rsgsllc.com/firefly>

⁶⁸⁰ <https://www.flightglobal.com/rafael-unveils-hovering-maoz-for-infantry-use/113568.article>

⁶⁸¹ <https://www.c4isrnet.com/unmanned/2020/05/05/israel-acquires-firefly-loitering-munition-for-close-combat/>

⁶⁸² <https://www.janes.com/defence-news/news-detail/idf-acquires-spike-firefly-loitering-munition>

⁶⁸³ [https://www.shephardmedia.com/news/landwarfareintl/us-army-evaluates-rafaels-spike-firefly-loitering-munition/;](https://www.shephardmedia.com/news/landwarfareintl/us-army-evaluates-rafaels-spike-firefly-loitering-munition/)

<https://www.defenseadvancement.com/news/us-army-trials-spike-firefly-loitering-munition/>

⁶⁸⁴ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁸⁵ <https://www.janes.com/defence-news/news-detail/idf-acquires-spike-firefly-loitering-munition>

⁶⁸⁶ <https://nationalinterest.org/blog/buzz/firefly-israels-loitering-munition-or-kamikaze-drone-152771>

⁶⁸⁷ <https://www.youtube.com/watch?v=GLWAz1SIXM>

⁶⁸⁸ <https://www.rsgsllc.com/firefly>


⁶⁸⁹ <https://www.rsgsllc.com/firefly>

⁶⁹⁰ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁹¹ <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁹² <https://www.rafael.co.il/wp-content/uploads/2019/03/FIREFLY.pdf>

⁶⁹³ <https://www.youtube.com/watch?v=XvmKV3gnSCc&t=5s>; <https://www.esdpa.org/rafael-a-new-member-for-the-spike-family/>

Switchblade 300	
System image⁶⁹⁴	
System manufacturer	AeroVironment (US)
System user(s)	United States; United Kingdom; ⁶⁹⁵ Ukraine. ⁶⁹⁶
System range	Operational range: 10km. ⁶⁹⁷ Operational endurance: 15 minutes. ⁶⁹⁸
Launch	Platform weight: 2.5kg. ⁶⁹⁹ Wingspan: 0.7m. ⁷⁰⁰ Launch method: pneumatic launch canister. ⁷⁰¹ Delivery method(s): The Switchblade 300 can be transported in a soldier's backpack. ⁷⁰² AeroVironment advertise a "multipack launcher" which carries six Switchblade ⁷⁰³ platforms. ⁷⁰³ General Dynamics Land Systems has similarly displayed a mock-up of its RX tracked unmanned ground vehicle carrying 50 Switchblade platforms. ⁷⁰⁴ Multiple other launch methods have been tested for this platform including: (1) the launch of an unarmed Switchblade 300 from the back of a US Marine Corps MV-22 Osprey aircraft; ⁷⁰⁵ (2) the launch of a Switchblade 300 from the Airwolf uncrewed platform

⁶⁹⁴ U.S. Army AMRDEC Public Affairs, Public domain, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/7/76/Switchblade_300_launch.jpg

⁶⁹⁵ <https://www.flightglobal.com/military-uavs/uk-to-buy-switchblade-loitering-munition/142944.article>; <https://news.yahoo.com/ukraine-asks-biden-admin-armed-234550236.html?msclkid=c9606180b12911ecbcbdc4d48a53459b>;

<https://defbrief.com/2021/03/17/uk-emerges-as-switchblade-loitering-missile-customer/>

⁶⁹⁶ <https://www.nbcnews.com/politics/national-security/ukraine-asks-biden-admin-armed-drones-jamming-gear-surface-air-missile-rcna20197>;

<https://taskandpurpose.com/analysis/switchblade-attack-drone-ukraine/>;

<https://www.cnb.com/2022/03/30/us-sends-100-killer-drones-called-switchblades-to-ukraine.html?msclkid=a2b90328b12911ec98a557daae7bf3cb>; <https://www.uasvision.com/2022/05/10/first-recorded-use-of-switchblade-300-in-ukraine/>

⁶⁹⁷ <https://www.avinc.com/tms/switchblade>; <https://www.youtube.com/watch?v=zLiOQZnsPc8>

⁶⁹⁸ <https://www.avinc.com/tms/switchblade>; <https://www.youtube.com/watch?v=zLiOQZnsPc8>

⁶⁹⁹ https://www.avinc.com/images/uploads/product_docs/Switchblade_300_Datasheet_220114.pdf

⁷⁰⁰ https://www.avinc.com/images/uploads/product_docs/2022_Product_Catalog.pdf

⁷⁰¹ https://www.avinc.com/images/uploads/product_docs/Switchblade_300_Datasheet_07192021.pdf?msclkid=d1fb54e6acc811ecb20ebba669fe228a

⁷⁰² https://www.avinc.com/images/uploads/product_docs/Switchblade_300_Datasheet_07192021.pdf?msclkid=d1fb54e6acc811ecb20ebba669fe228a

⁷⁰³ https://www.avinc.com/images/uploads/product_docs/MPL_Datasheet_07122021.pdf

⁷⁰⁴ <https://www.thedrive.com/the-war-zone/42755/new-tracked-unmanned-vehicle-bristles-with-a-whopping-50-switchblade-suicide-drones>

⁷⁰⁵ <https://www.washingtonpost.com/news/checkpoint/wp/2015/04/17/marines-launched-a-kamikaze-drone-from-an-osprey-aircraft/>

	manufactured by Kratos; ⁷⁰⁶ (3) the launch of an inert Switchblade 300 from AeroVironment’s JUMP 20 vertical lift drone; ⁷⁰⁷ and (4) the Switchblade 300’s launch from an experimental unmanned surface vessel as part of NATO’s ‘REP(MUS) 21’ [Robotic Experimentation and Prototyping Augmented by Maritime Unmanned Systems] exercise. ⁷⁰⁸
Payload	Sensors: electro-optical and camera(s). ⁷⁰⁹ AeroVironment also advertise a “Switchblade Sensor to Shooter” kit which enables Switchblade operators to receive the targeting information and the real-time video feeds collected by surveillance drones such as the Puma, Raven, and Wasp. ⁷¹⁰ According to AeroVironment employees, if the operators of these platforms “identify a threat, the information and the geolocation information can be passed digitally directly to the Switchblade, which we then task to that target”. ⁷¹¹ Warhead: fragmentation warhead. ⁷¹²
Platform variant(s)	Blackwing: The Blackwing is a reconnaissance platform which was originally developed as part of the Pentagon’s 2013 Advanced Weapons Enhanced by Submarine UAS against Mobile targets (Awesum) programme. ⁷¹³ As described by AeroVironment employees, the Blackwing is “a Switchblade type of a solution, but instead of a warhead, it carries extra batteries for longer flight endurance”. ⁷¹⁴ AeroVironment advertise the Blackwing as being designed to conduct a range of ISR operations. ⁷¹⁵ The platform can be deployed from a variety of ground vehicles and warships including submarines. ⁷¹⁶ In March 2021, the US Navy signalled its intention to order 120 Blackwing platforms for delivery before May 2023. ⁷¹⁷
Development status	In service with the American and Ukrainian militaries. ⁷¹⁸
Development history	The Switchblade can trace its development history to AeroVironment’s work on the US Army’s gun-launched, unmanned air vehicle programme, and DARPA’s later Close Combat Lethal Reconnaissance demonstration programme. ⁷¹⁹ The Block 10

⁷⁰⁶ <https://www.thedrive.com/the-war-zone/42465/kratos-new-airwolf-combat-drone-has-launched-a-switchblade-loitering-munition-in-flight?msclkid=cc52420ab15311ecb0e3c39ebdee6343>; <https://www.avinc.com/resources/av-in-the-news/view/kratos-new-airwolf-combat-drone-has-launched-a-switchblade-loitering-muniti>

⁷⁰⁷ <https://www.avinc.com/resources/press-releases/view/aerovironment-demonstrates-first-ever-switchblade-loitering-missile-integration-for-air-launched-eff>

⁷⁰⁸ <https://www.janes.com/defence-news/news-detail/switchblade-300-fired-from-usv-as-part-of-usuk-sensor-to-shooter-demo>

⁷⁰⁹ https://www.avinc.com/images/uploads/product_docs/Switchblade_300_Datasheet_07192021.pdf?msclkid=d1fb54e6aec811ecb20ebba669fe228a

⁷¹⁰ https://www.avinc.com/images/uploads/product_docs/S2S_Datasheet_220111.pdf

⁷¹¹ <https://www.thedrive.com/the-war-zone/34414/we-talk-killer-drones-and-the-future-of-unmanned-warfare-with-aerovironments-steve-gitlin>

⁷¹² <https://www.edrmagazine.eu/switchblade-300-the-combat-proven-munition>

⁷¹³ <https://www.foxbusiness.com/markets/aerovironments-blackwing-makes-every-submarine-an-underwater-aircraft-carrier?msclkid=a2d795a3b11e11ecac09aa18bad78c96>

⁷¹⁴ <https://www.thedrive.com/the-war-zone/34414/we-talk-killer-drones-and-the-future-of-unmanned-warfare-with-aerovironments-steve-gitlin>

⁷¹⁵

https://www.avinc.com/images/uploads/product_docs/Blackwing_Datasheet_rv4.pdf?msclkid=7908e92bb11e11ec806a918afa36ee65

⁷¹⁶

https://www.avinc.com/images/uploads/product_docs/Blackwing_Datasheet_rv4.pdf?msclkid=7908e92bb11e11ec806a918afa36ee65

⁷¹⁷

<https://navalpost.com/us-navy-submarine-launched-uav-aerovironment-blackwing/#:~:text=AeroVironment%E2%80%99s%20Blackwing%20is%20a%20small%2C%20Unmanned%20Aircraft%20System,ground%20vehicle%20via%20tube%20or%20Multipack%20Launcher%20%28MPL%29.?msclkid=790631dfb11e11ec857fbc933af69d5b>

⁷¹⁸

<https://www.armyrecognition.com/us-american-unmanned-aerial-ground-vehicle-uk/switchblade-300-miniature-loitering-munition-suicide-drone-data-fact-sheet.html>; <https://www.army-technology.com/projects/switchblade-tactical-missile-system/>

⁷¹⁹ https://www.avinc.com/images/uploads/news/2020_Use_Case_Switchblade_Final.pdf

	<p>Switchblade, which is similar in design to the Switchblade 300, was developed in collaboration with the US Army.⁷²⁰ A July 2011 contract issued by the US Army’s Close Combat Weapons Systems programme provided \$4.9 million in funding for the “rapid fielding of this capability to deployed combat forces”.⁷²¹ In December 2011, the Switchblade was demonstrated to a range of US government officials as part of a series of live fire demonstrations.⁷²² By April 2016, an estimated 1,500 Switchblade platforms had been manufactured.⁷²³ The Department of Defence thereafter awarded AeroVironment a series of contracts for work related to the further development, testing, and procurement of the Switchblade 300.</p> <p>Although the Department of Defence has released little information about these deployments, the Switchblade 300 is widely reported to have been used by American special operation forces fighting in Afghanistan.⁷²⁴ According to AeroVironment employees, the US Army first deployed the Switchblade to Afghanistan in 2012.⁷²⁵ US forces also reportedly used the Switchblade as part of its campaign against the Islamic State in Iraq and Syria.⁷²⁶</p> <p>Following the 2022 Russian invasion of Ukraine, the United States authorised the transfer of Switchblade 300s to the Ukrainian military.⁷²⁷ A July 2022 Pentagon factsheet outlined a commitment to provide “over 700” Switchblades to Ukraine.⁷²⁸ In early May 2022, the wreckage of what appears to be a Switchblade 300 was reportedly found in the Kharkiv Oblast.⁷²⁹ Video footage posted on social media in May 2022 appears to show a Switchblade 300 being used to attack a Russian T-72 tank.⁷³⁰</p>
<p style="text-align: center;">Target type</p>	<p>The Switchblade 300 is designed to attack “people or unprotected weapons, like a mortar launcher or exposed machine gun emplacement”.⁷³¹ Media reports describe the Switchblade 300 as an anti-personnel system.⁷³² In the context of its use by the Ukrainian military, the Switchblade 300 has been used to attack a range of “soft” Russian targets such as machine gun positions.⁷³³</p>
<p style="text-align: center;">Autonomous and automated features</p>	<p>Autonomous attack: The Switchblade 300 is advertised as using “feature/object recognition” software.⁷³⁴ It can attack both stationary and moving targets.⁷³⁵ As</p>

⁷²⁰ https://www.avinc.com/images/uploads/news/2020_Use_Case_Switchblade_Final.pdf

⁷²¹ https://www.avinc.com/resources/press-releases/view/u.s._army_awards_av_4.9_million_contract_for_switchblade_agile_munition_sys

⁷²² <https://www.army-technology.com/projects/switchblade-tactical-missile-system/?msclkid=18abe928afb11ec87973f4cce60680c>

⁷²³ https://defense-update.com/20160429_switchblade_block10c.html

⁷²⁴ <https://www.nbcnews.com/politics/national-security/ukraine-asks-biden-admin-armed-drones-jamming-gear-surface-air-missile-rcna20197>; <https://news.yahoo.com/ukraine-asks-biden-admin-armed-234550236.html?msclkid=c9606180b12911ecbcbdc4d48a53459b> ; <https://www.politico.com/news/2022/03/16/us-sends-switchblade-drones-to-ukraine-00017836>; <https://nypost.com/2022/03/16/biden-reportedly-mulling-sending-kamikaze-drones-to-ukraine/?msclkid=c9612307b12911ec944129d1604be1b6>; <https://www.latimes.com/archives/la-xpm-2012-jun-11-la-fi-kamikaze-drone-20120611-story.html>; <https://www.economist.com/science-and-technology/baguette-sized-flying-bombs-are-about-to-enter-service-in-ukraine/21808317>

⁷²⁵ <https://www.thedrive.com/the-war-zone/34414/we-talk-killer-drones-and-the-future-of-unmanned-warfare-with-aerovironments-steve-gitlin>

⁷²⁶ <https://www.nbcnews.com/news/military/kamikaze-drones-new-weapon-brings-power-peril-u-s-military-n1285415>;

<https://www.popularmechanics.com/military/research/a23346/us-upgrading-tiniest-killer-drones/>

⁷²⁷ <https://www.shephardmedia.com/news/uv-online/ukraine-strikes-with-switchblade/>;

<https://www.flightglobal.com/defence/us-support-for-ukraine-includes-20-mi-17s-700-switchblades/149295.article>

⁷²⁸ <https://www.defense.gov/News/Releases/Release/Article/3088006/fact-sheet-on-us-security-assistance-to-ukraine/source/fact-sheet-on-us-security-assistance-to-ukraine/>

⁷²⁹ <https://www.uasvision.com/2022/05/10/first-recorded-use-of-switchblade-300-in-ukraine/>

⁷³⁰ <https://theaviationist.com/2022/05/25/switchblade-ukraine/>

⁷³¹ <https://taskandpurpose.com/analysis/switchblade-attack-drone-ukraine/?msclkid=a2ba545eb12911ecacf73b4a4d755456>

⁷³² <https://www.nbcnews.com/news/military/kamikaze-drones-new-weapon-brings-power-peril-u-s-military-n1285415>

⁷³³ <https://www.shephardmedia.com/news/uv-online/ukraine-strikes-with-switchblade/>

⁷³⁴ https://www.avinc.com/images/uploads/product_docs/Switchblade_300_FutureState_Datasheet_03312021.pdf

⁷³⁵ https://www.avinc.com/images/uploads/product_docs/Switchblade_300_FutureState_Datasheet_03312021.pdf

	<p>described by Steve Gitlin, AeroVironment’s then chief marketing officer: “[o]ur systems already incorporate a certain level of autonomy. For example, with our Switchblade systems one can simply designate a target and the Switchblade will track that target even if it moves, without the operator redirecting it”.⁷³⁶ As Gitlin continued: “[o]nce the operator identifies the threat, be it a sniper or somebody laying wait in ambush, they then designate that target on the control station screen, and the Switchblade then navigates itself in the terminal guidance mode and detonates on to that target”.⁷³⁷</p> <p>Human control over targeting: According to AeroVironment officials, the Switchblade operates with a human in the loop – before an attack, its operator designates a target and arms the platform.⁷³⁸ This process is described as requiring “positive target confirmation”.⁷³⁹ The Switchblade 300 is advertised as being equipped with an abort/wave-off capability which enables the operator to abort an attack if, for example, a civilian enters the combat zone.⁷⁴⁰ Wahid Nawabi, AeroVironment’s President and CEO, has suggested that, in the future, greater levels of autonomy could be integrated into the Switchblade 300 to offset the risk that the platform’s datalink is jammed. According to Nawabi, the Switchblade could be developed to “select targets autonomously with minimal support by human-in-the-loop” – so the operator may do little more than confirm a target located by the smart weapon, requiring only a brief burst of communication rather than continuous control”.⁷⁴¹</p> <p>Autonomous flight: AeroVironment advertise the Switchblade 300 as being “[r]emotely piloted or flown autonomously”.⁷⁴² When operated manually, the platform “provides [its] operator with real-time video and Cursor-on-Target GPS coordinates for information gathering, targeting, or feature/object recognition”.⁷⁴³ Otherwise, the operator “can pre-program the flight path using GPS waypoints and simply launch the aircraft, and the aircraft will fly itself”.⁷⁴⁴ In this way, the Switchblade can be flown via waypoint navigation.⁷⁴⁵</p>
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⁷³⁶ <https://www.defence-and-security.com/features/featureaerovironment--rapidly-deployable-uav-situational-awareness-for-international-defence-forces-with-combined-lethality-8376335/>

⁷³⁷ <https://www.thedrive.com/the-war-zone/34414/we-talk-killer-drones-and-the-future-of-unmanned-warfare-with-aerovironments-steve-gitlin>

⁷³⁸ <https://www.thedrive.com/the-war-zone/34414/we-talk-killer-drones-and-the-future-of-unmanned-warfare-with-aerovironments-steve-gitlin>

⁷³⁹ <https://www.defenseadvancement.com/news/aerovironment-unveils-new-loitering-missile-system/>

⁷⁴⁰ <https://www.nbcnews.com/news/military/kamikaze-drones-new-weapon-brings-power-peril-u-s-military-n1285415>; <https://www.euronews.com/next/2022/05/16/switchblade-drones-what-are-these-kamikaze-weapons-and-how-can-they-help-ukraine>; <https://theaviationist.com/2022/05/25/switchblade-ukraine/>


⁷⁴¹ <https://www.forbes.com/sites/davidhambling/2020/10/01/new-loitering-missile-aims-to-destroy-targets-and-disrupt-industry/?sh=762ba421390f>

⁷⁴² <https://www.avinc.com/tms/switchblade>

⁷⁴³ https://www.avinc.com/images/uploads/product_docs/Switchblade_300_FutureState_Datasheet_03312021.pdf

⁷⁴⁴ <https://www.defence-and-security.com/features/featureaerovironment--rapidly-deployable-uav-situational-awareness-for-international-defence-forces-with-combined-lethality-8376335/>

⁷⁴⁵ https://www.avinc.com/images/uploads/product_docs/Switchblade_300_Datasheet_220114.pdf; <https://taskandpurpose.com/analysis/switchblade-attack-drone-ukraine/?msclkid=a2ba545eb12911ecacf73b4a4d755456>; <https://www.popsci.com/technology/switchblade-drones-explained/>

Warmate	
System image ⁷⁴⁶	
System manufacturer	WB GROUP (Poland)
System user(s)	Poland, Turkey, ⁷⁴⁷ Ukraine, ⁷⁴⁸ India. ⁷⁴⁹
System range	Operational range: 30km. ⁷⁵⁰ Operational endurance: 60 minutes. ⁷⁵¹
Launch	Platform weight: 5.3kg. ⁷⁵² Wingspan: 1.6m. ⁷⁵³ Launch method: pneumatic catapult launcher. ⁷⁵⁴ Delivery method(s): The Warmate's launcher can be installed onto a range of ground vehicles. ⁷⁵⁵ In late 2021, WB Group displayed a canister-launch tube designed to enable the Warmate TL to be launched from uncrewed aircraft and helicopters. ⁷⁵⁶ WB Group is reportedly developing the capacity to launch Warmate TL platforms from Turkish Bayraktar TB2 drones. ⁷⁵⁷
Payload	Sensors: electro-optical and infrared camera(s). ⁷⁵⁸ Warhead: fragmentation warhead; ⁷⁵⁹ anti-armour warhead; ⁷⁶⁰ thermobaric warhead. ⁷⁶¹
Platform variant(s)	Warmate 2: This Warmate variant was unveiled at the 2018 MSPO International Defence Industry Exhibition held in Kielce, Poland. ⁷⁶² It was developed in

⁷⁴⁶ VoidWanderer, CC BY-SA 4.0 <<https://creativecommons.org/licenses/by-sa/4.0/>>, via Wikimedia Commons https://upload.wikimedia.org/wikipedia/commons/e/e3/Warmate_UAV_01.jpg

⁷⁴⁷ <https://www.defenceturkey.com/en/content/wb-group-we-are-ready-to-cooperate-with-turkish-companies-for-3rd-markets-with-turkish-systems-4980>; <https://tvpworld.com/37474331/polish-army-to-receive-100-drones-in-2018>

⁷⁴⁸ <https://rusi.org/explore-our-research/publications/commentary/what-do-uk-weapons-deliveries-add-ukraines-armed-forces>; <https://defence24.com/mspo-2017-polish-strike-drones-headed-to-ukraine>; <https://www.shephardmedia.com/news/uv-online/mspo-2022-first-batch-of-crowdfunded-warmate-loitering-munitions-arrives-in-ukraine/>

⁷⁴⁹ <https://www.thedefensepost.com/2022/06/27/poland-india-loitering-munitions/>; <https://www.overtdefense.com/2022/06/23/polish-warmate-loitering-munitions-delivered-to-indian-army/>;

⁷⁵⁰ <https://www.wbgroup.pl/en/produkt/warmate-loitering-munitions/>

⁷⁵¹ <https://www.wbgroup.pl/en/produkt/warmate-loitering-munitions/>

⁷⁵² <https://docs.tuyap.online/FDOCS/23351.pdf>

⁷⁵³ <https://www.wbgroup.pl/en/produkt/warmate-loitering-munitions/>

⁷⁵⁴ https://www.wbgroup.pl/app/uploads/2017/06/warmate_eng_large_22q2.pdf

⁷⁵⁵ <https://www.wbgroup.pl/en/produkt/warmate-loitering-munitions/>; <https://defence24.com/armed-forces/polish-ministry-of-defence-procures-warmate-loitering-munitions>

⁷⁵⁶ <https://defence24.com/industry/aircraft-borne-variant-of-warmate-tl-loitering-munitions>

⁷⁵⁷ <https://en.topwar.ru/189097-v-varshave-zajavili-o-namerenii-vooruzhit-tureckie-bespilotniki-bayraktar-tb2-polskimi-dronami-kamikadze.html>

⁷⁵⁸ <https://docs.tuyap.online/FDOCS/23351.pdf>

⁷⁵⁹ <https://docs.tuyap.online/FDOCS/23351.pdf>

⁷⁶⁰ <https://docs.tuyap.online/FDOCS/23351.pdf>

⁷⁶¹ <https://www.wbgroup.pl/en/aktualnosci/ordered-delivered/>

⁷⁶² <https://www.shephardmedia.com/news/uv-online/mspo-2018-mighty-warmate-2-revealed/>; https://www.army-technology.com/contractors/data_management/wb-group/pressreleases/wb-group-introduces-topaz-warmate-2-mspo-2018-poland/

	<p>collaboration with the UAE based defence company Tawazun.⁷⁶³ WB Group advertise this platform as “a new and upgraded version” of the Warmate.⁷⁶⁴ The Warmate 2 is launched using a vehicle-mounted catapult, and has a longer range than the standard Warmate variant.⁷⁶⁵ It can be equipped with a high explosive anti-tank warhead in order to attack armoured vehicles.⁷⁶⁶</p> <p>Warmate R: The Warmate R – or reconnaissance – variant is used to conduct intelligence and surveillance operations. Its design is based on the standard Warmate variant and can be equipped with electro-optical and infrared camera(s) in addition to a “laser target highlighter”.⁷⁶⁷ According to WB Group, the Warmate R has a “target lock” capability which can be used to track stationary and moving targets.⁷⁶⁸ The platform is equipped with “an in-built data analysis system” which collects and relays targeting information.⁷⁶⁹</p>
	<p>Warmate TL: The Tube-Launched (TL) Warmate variant was unveiled in May 2019.⁷⁷⁰ This platform is designed so that its wings can be folded into its fuselage, enabling its launch from a canister-tube.⁷⁷¹ According to analysts, the Warmate TL is “fitted with a warhead and guidance unit identical to the standard, portable system”.⁷⁷²</p>
Development status	In service with the Polish military. ⁷⁷³
Development history	The Warmate was first shown at the 2015 Defence and Security Equipment International conference held in London. ⁷⁷⁴ Following orders from two unnamed overseas customers, its serial production began in 2016. ⁷⁷⁵ In November 2017 the Polish Ministry of Defence issued a \$20 million contract to purchase 1,000 Warmate platforms. ⁷⁷⁶ The Polish military received the first of these platforms for testing and evaluation purposes in December 2018. ⁷⁷⁷ The Warmate entered Polish military service in January 2021. ⁷⁷⁸ The platform has also been tested by the Turkish and Ukrainian militaries. ⁷⁷⁹
Target type	WB Group advertise the Warmate as “a good alternative for anti-tank guided missiles with its capability to operate in a significantly larger radius”. ⁷⁸⁰ It is described as having been designed to attack “light armoured vehicles, fortifications and infantry”. ⁷⁸¹
Autonomous and automated features	Autonomous attack: According to WB GROUP, the Warmate is installed with a “[f]ully autonomous attack mode” which can be used “on selected target based on [an] on-board video tracking system”. ⁷⁸² The Warmate 2 is similarly advertised as being capable of “automated targeting and the assessment of a target before finalizing a strike”. ⁷⁸³ The

⁷⁶³ <https://www.shephardmedia.com/news/uv-online/mspo-2018-mighty-warmate-2-revealed/>

⁷⁶⁴ <https://wbgroupamerica.com/wp-content/uploads/2022/08/Warmate-2-ENG.pdf>

⁷⁶⁵ <https://wbgroupamerica.com/wp-content/uploads/2022/08/Warmate-2-ENG.pdf>

⁷⁶⁶ <https://wbgroupamerica.com/wp-content/uploads/2022/08/Warmate-2-ENG.pdf>

⁷⁶⁷ <https://wbgroupamerica.com/product/warmate-r/>

⁷⁶⁸ <https://wbgroupamerica.com/product/warmate-r/>

⁷⁶⁹ <https://wbgroupamerica.com/product/warmate-r/>

⁷⁷⁰ <https://www.janes.com/defence-news/news-detail/wb-group-unveils-warmate-tl-variant>

⁷⁷¹ <https://www.wbgroup.pl/en/produkt/warmate-tl-loitering-munitions-system/>

⁷⁷² <https://www.janes.com/defence-news/news-detail/wb-group-unveils-warmate-tl-variant>

⁷⁷³ <https://www.shephardmedia.com/news/air-warfare/premium-poland-formally-commissions-warmate/>

⁷⁷⁴ <https://www.wbgroup.pl/en/aktualnosci/the-first-sets-of-warmate-in-the-service-of-the-polish-army/?highlight=WARMATE>

⁷⁷⁵ <https://www.flightglobal.com/civil-uavs/warmate-expendable-uav-in-production-for-two-customers/120427.article>

⁷⁷⁶ <https://www.thedefensepost.com/2021/02/22/poland-warmate-kamikaze-drones/>

⁷⁷⁷ <https://www.wbgroup.pl/en/aktualnosci/ordered-delivered/>

⁷⁷⁸ <https://defence24.pl/sily-zbrojne/warmate-oficjalnie-w-sluzbie-news-defence24pl>

⁷⁷⁹ <https://www.thedefensepost.com/2021/02/22/poland-warmate-kamikaze-drones/>

⁷⁸⁰ <https://www.wbgroup.pl/en/produkt/warmate-loitering-munitions/>

⁷⁸¹ <https://www.wbgroup.pl/en/aktualnosci/the-first-sets-of-warmate-in-the-service-of-the-polish-army/?highlight=WARMATE>

⁷⁸² https://www.wbgroup.pl/app/uploads/2017/06/warmate_eng_large_22q2.pdf

⁷⁸³ <https://wbgroupamerica.com/wp-content/uploads/2022/08/Warmate-2-ENG.pdf>

<p>Warmate can be used to attack both stationary and moving targets, being installed with an “[a]utomatic video tracker to support the target aiming”.⁷⁸⁴</p>
<p>Human control over targeting: WB Group describe the Warmate as “being semi-autonomous during a strike”.⁷⁸⁵ Its operator “is shown a video feed, at the ground control station, from the camera mounted on the front of the warhead, and this can be used to assist in directing the aircraft”.⁷⁸⁶ WB Group maintain that “[t]he operator has full control and bears full responsibility” for arming the platform and executing a strike.⁷⁸⁷ Analysts describe the Warmate as a “[human]-in-the-loop control system”.⁷⁸⁸</p>
<p>Autonomous flight: WB group describe the Warmate as being “equipped with control modules ensuring full automation of the majority of flight phases and supporting the operator during targeting”.⁷⁸⁹ It is advertised as possessing a “wide range of autonomous flight modes” including a “fly to coordinate” mode in which the platform follows a pre-programmed route designated by a human operator; a “loiter flight mode” where the platform flies over a designated area; and a “cruise mode” in which the platform flies “in a straight line in the direction that the camera is facing”.⁷⁹⁰ Media reports describe the Warmate’s flight processes as being highly automated.⁷⁹¹</p>

⁷⁸⁴ <https://wbgroupamerica.com/wp-content/uploads/2022/08/Warmate-2-ENG.pdf>; <https://www.thedrive.com/the-war-zone/39353/the-polish-military-is-now-officially-armed-with-the-warmate-suicide-drone>

⁷⁸⁵ <https://docs.tuyap.online/FDOCS/23351.pdf>, p.4.

⁷⁸⁶ <https://docs.tuyap.online/FDOCS/23351.pdf>, p.4.

⁷⁸⁷ <https://www.wbgroup.pl/en/produkt/warmate-loitering-munnitions/>

⁷⁸⁸ <https://www.thedrive.com/the-war-zone/39353/the-polish-military-is-now-officially-armed-with-the-warmate-suicide-drone>

⁷⁸⁹ <https://www.wbgroup.pl/en/produkt/warmate-loitering-munnitions/>

⁷⁹⁰ <https://docs.tuyap.online/FDOCS/23351.pdf>, p.6.

⁷⁹¹ <https://defence24.com/armed-forces/polish-ministry-of-defence-procures-warmate-loitering-munitions>