Russian Direct Ascent Anti-satellite Testing

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Summary

Over the last several years, Russia has conducted twelve suspected tests of direct ascent anti-satellite (DA-ASAT) systems. One of these tests included the destruction of a target. The publicly-available evidence suggests that Russian DA-ASAT capabilities currently consist of three primary programs—a mobile ground system, an aircraft-carried system, and a missile defense system that may have a DA-ASAT capability. The evidence also suggests that current Russian DA-ASAT systems are not yet operational and are not planned to have the capability to attack targets beyond low Earth orbit (LEO).

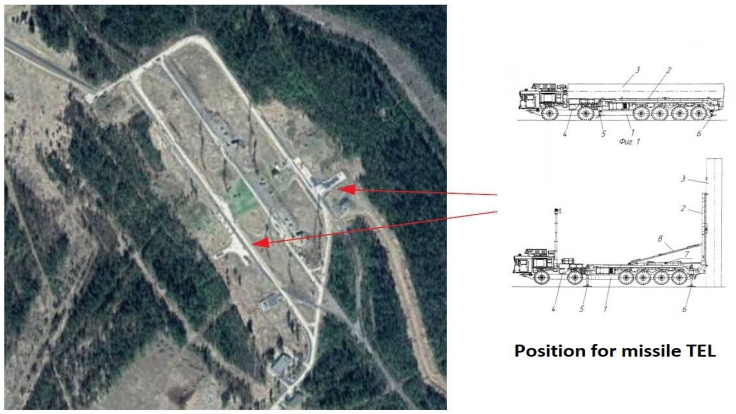
Direct Ascent ASAT Programs

DA-ASATs use a ground, air, or sea-launched rocket to place a kinetic kill vehicle (KKV) on a ballistic trajectory up into space. After separation from the rocket, the KKV uses onboard guidance, navigation, and control systems to identify and track a targeted space object and fine-tune its trajectory to create a hypervelocity collision. DA-ASATs are very similar to midcourse missile defense interceptors, with the difference being the missile defense targets are also on ballistic trajectories. Unlike a co-orbital ASAT, the DA-ASAT KKV itself does not have enough velocity to achieve orbit and any resulting fragments are likewise unlikely to remain in orbit unless they were part of an orbital object that was struck. Though Soviet and subsequently Russian ASAT programs have largely focused on co-orbital systems, with testing dating back to the 1960s, there is also a history of DA-ASAT technology development and fielding.

The 14A042 Nudol (U.S. designation "PL-19")

Designs for the A-135 replacement, the A-235 missile defense system, first surfaced in the mid-1980s. In August 2009, the PVO Almaz-Antey signed a contract with the Russian Ministry of Defense to work on a project called Nudol. Many sources define Nudol as part of the next generation system to replace the exoatmospheric interceptors of the Cold War era A-135 missile defense system, but there is no clear evidence that this is the case.[1] While the Nudol may share some heritage with the A-135, it represents a major departure from older systems through the use of conventionally armed rather than nuclear-tipped interceptors.[2] Additionally, imagery of the Nudol indicates a mobile launch capability but stationary radar. The system appears to be comprised of the 14A042 Nudol rocket, 14P078 command and control system, and 14TS031 radar.[3]

Initial non-flight testing of the Nudol system was successfully conducted in 2014, with the first successful flight test taking place in late 2015.



Commercial satellite imagery of Plesetsk, 2018. Image credit: Defense Blog

Overall, there have been twelve known or suspected flight tests, at least seven of which were likely successful, two unsuccessful, and two additional unconfirmed tests. Sources suggest that early tests only involved the launcher and did not include a kill vehicle.[3] According to U.S. defense officials, the Nudol test in March 2018 was the first time it was fired from the transporter erector-launcher (TEL) it will be deployed with.[5]

On November 15, 2021, Russia conducted an intercept test of the Nudol system. A Nudol launched from Plestesk placed a KKV on an intercept course with Cosmos 1408, a dead Russian military satellite, which was destroyed by the resulting collision. The test was preceded by a Notice to Air Missions (NOTAM) issued on November 13 for November 15-17 that corresponded to the usual re-entry zones for a Nudol launch.[6] As of February 2023, about 300 pieces of orbital debris from the intercept remained on orbit, out of the nearly 1800 cataloged in total.[7]

While Nudol is linked to Russia's missile defense programs, evidence suggests it is being developed for the main purpose of direct-ascent ASAT operations. What little is known publicly about the Nudol flight tests is more suggestive of an orbital ballistic trajectory intercept than a mid-course missile intercept. Not much is known for sure about Nudol's operational capabilities, and available estimates for maximum altitude vary widely from approximately 50 km to nearly 1,000 km. Something in the middle is most likely, based on observations from flight tests as well as third-party analysis of suspected components.[8]

The 78M6 Kontakt (also named "30P6") is an air-launched missile system initially explored by the Soviet Union and seemingly resurrected in recent years. The launch platform was originally intended to be a variant of the MiG-31 designated the MiG-31D.[9] At least six such aircraft were completed in the 1980s, with intent to be fitted with a Vympel-developed ASAT missile dubbed the 79M6 "Kontakt". Two variants of interceptors were planned for deployment: a three-stage interceptor capable of hitting targets at orbits of 120-600 km followed by one capable against altitudes up to 1,500 km.[10] The system was also intended to be capable of deploying with less warning than Soviet co-orbital interceptors[11] and of attacking large numbers of satellites quickly: Soviet documents speak of an operational target of at least 24 satellites within 36 hours.[12] Note this overall mission profile was very similar to the U.S. ASM-135 antisatellite program, which was carried on an F-15 fighter.[13]

MiG-31 carrying new ASAT mock-up, 2018. Image credit: Shipsash

The Kontakt program allegedly became ready for flight-testing around 1991 but was put on hold due to budget cuts in the 1990s. Recent reports from a former MiG test pilot describe several tests in which the missile was successfully launched from a MiG-31D in flight, homed in on a Soviet target, and then did a deliberate near-miss before self-detonating to prevent Americans from discovering it.[12] It is unclear whether such testing ever actually occurred.

There is evidence to suggest Russia is working to bring an updated version of the Kontakt capability online in the near future. In 2009, the Russian Air Force announced the decision to resume the use of the MiG-31 as an ASAT launching platform.[14] In early 2017, a commander in the VKF informed the media that Russia plans to deploy an ASAT missile aboard the MiG-31BM, an additional high-altitude air-to-air interceptor variant of the Foxhound, claiming that "a new missile is being developed for this aircraft capable of destroying targets in near-space….Satellites, for sure…." [14] In mid-2018, photographs showed a MiG-31 carrying what was reportedly a mock-up of a new ASAT missile to replace the Kontakt.[16] More recent information suggests that the MiG-31B activity is linked to the Burevestnik co-orbital ASAT system, as opposed to a renewed version of the Kontakt DA-ASAT. According to three anonymous U.S. government sources, the system was being actively tested with the initial goal of reaching operational readiness in 2022; as of March 2023, it is most likely not. [16]

The S-500 anti-ballistic missile system is the most advanced of Russia's next-generation missile defense capabilities. Relatively little information about the S-500 exists in the public domain, but it appears to include an exoatmospheric interceptor, capable of destroying not only ballistic missiles prior to re-entry but also objects in orbit.[17] Russian officials, in the years following the Chinese and U.S. ASAT and missile defense tests of the late 2000s, began to explicitly discuss the S-500 as serving a dual missile defense-ASAT purpose.[18] The development of dedicated ASATs since then, however, makes this less likely. The system was originally intended to begin production and deployment in 2016 or 2017, but as of 2017 it had not yet completed testing.[19] Russian media report that the S-500 entered production in March 2018, with the system being manufactured at the Almaz-Antey plant in Nizhny Novgorod and missiles in Kirov.[20] Russian Defense Minister Sergei Shoigu had announced that he expected deliveries to begin as soon as 2020, and funding has been guaranteed as part of the State Armament Program 2018-2027.[21] In December 2021, TASS reported that S-550 system was functioning and capable of "hitting spacecraft, ballistic missile reentry vehicles and hypersonic targets." [22]

Operational Status

Given the known testing, it is likely that Russia could field an operational DA-ASAT capability against most LEO satellites within the next few years. This would include satellites performing military weather and ISR functions. Russia would have to wait for such satellites to overfly an area where one of the systems is deployed, but most LEO satellites would do so daily or every few days. Moreover, the potential for an air-launched DA-ASAT capability could dramatically expand the potential launch opportunities. To date, there is no public evidence suggesting Russia is experimenting with or developing DA-ASAT capabilities against satellites in higher orbits such as MEO or GEO, although it is possible given their advanced rocket and guidance technology.

Summary of Known or Suspected Russian DA-ASAT Tests in Space[23]

Date	ASAT System	Launch Site	Payload	Altitude Reached	Result
Aug. 12, 2014	Nudol	Plesetsk	None known	1 km?	Failed shortly after launch
Apr. 22, 2015	Nudol	Plesetsk	None known	0 km?	Failed at launch
Nov. 18, 2015	Nudol	Plesetsk	Interceptor KV?[8]	100 km?	Likely rocket test
May 25, 2016	Nudol	Plesetsk	None known	10km?	Likely rocket test
Dec. 16, 2016	Nudol	"Central Russia" (Plesetsk? Kapustin Yar?)	A-235 Test	100 km?	Likely rocket test
Mar. 26, 2018	Nudol	Plesetsk	Dummy KV?	100 km?	Likely intercept test?
Dec. 23, 2018	Nudol	Plesetsk	Nudol' KV	500 km?	Likely intercept test?
Nov. 15, 2019	Nudol	Plesetsk	Likely KKV	?	?
Apr. 15, 2020	Nudol	Plesetsk	14A042 interceptor	500?	Likely intercept test
Dec. 16, 2020	Nudol	Plesetsk	Unknown	500?	Likely intercept test?
Apr. 2021	Nudol	Plesetsk	Likely KKV	?	?
Nov. 15, 2021	Nudol	Plesetsk	KKV	470 km	Intercepted and destroyed Cosmos 1408

Endnotes

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