

Hypersonic Weapons in Achieving Maritime Superiority

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ABSTRACT:

The article analyzes the possibilities of hypersonic weapons to contribute to the fight for maritime superiority. The development, testing, and adoption of hypersonic weapons by the Russian Federation, the United States, and China will inevitably change the operational concepts. Towards that aim, the author examines weapons launched from sea-, land- and air-based platforms with the ability to engage various naval targets.

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Introduction

Achieving victory in modern warfare requires the joint use of all services and capabilities. Successful combat operations in maritime theaters of war depend on achieving maritime supremacy or maritime superiority.

Maritime Supremacy, according to Russian military theory, is considered as a decisive superiority of one of the parties of the naval (ocean) theater of operations or in a certain part of it, which provides the Navy with favorable conditions to fulfill strategic, operational and combat tasks. In the USA, Maritime Supremacy is defined as *that degree of maritime superiority wherein an opposing force is incapable of effective interference*.¹

¹ DOD *Dictionary of Military and Associated Terms*, As of November 2021, p. 137.

Only the largest naval powers have the ability to achieve Maritime Supremacy. Fleets are usually tasked with achieving and maintaining Maritime Superiority.

Maritime Superiority, according to the US DOD Dictionary of Military and Associated Terms, is defined as *that degree of dominance of one force over another that permits the conduct of maritime operations by the former and its related land, maritime, and air forces at a given time and place without prohibitive interference by the opposing force.*

In the USA, for example, to maintain its global dominance, the Navy leadership released in 2016 a strategy titled “A Design for Maintaining Maritime Superiority,” which is intended to guide the sea service as the world grows more complex (Tadjdeh, 2016, 33).

Both maritime supremacy and superiority are achieved by destroying the groups of the enemy’s naval forces, its bases and control centers, as well as maritime interdiction.

A new class of weapons that have emerged in the last decade, hypersonic weapons, have also played a role in achieving maritime superiority. These are weapons that move at 5 or more times the speed of sound (denoted by Mach or M and equal to 331 meters per second), can maneuver in flight, and carry enough destructive power to attack a number of relatively small targets.

There are two types of hypersonic weapons – hypersonic cruise missiles and hypersonic gliders. The hypersonic cruise missile is powered by an engine and rises to a certain height and reaches a certain speed, mounted on a ballistic missile (in place of warheads) or attached to a supersonic fighter or bomber. The hypersonic glider reaches the upper layers of the atmosphere, mounted on a ballistic missile (in place of the warheads), where it separates from it.

These weapons are also designated as hypersonic maneuvering battle blocks, replacing ballistic missile warheads or attached to aircraft. The speed of hypersonic weapons and their maneuverability, on the one hand, and their protection against detection, on the other, reduce the likelihood of their interception.

The ability to increase the capabilities of weapons, deriving from the employment of hypersonic technology, provokes a new arms race after the Cold War, especially between Russia, China and the United States.

1. Marine-based hypersonic weapons

Russia has developed the 3M22 “Zircon” hypersonic cruise missiles, which are ship-launched, reach speeds from Mach 6 to Mach 8, and can engage naval and ground targets at a distance of 500 to 1,000 km, depending on the launch mode. According to Russia’s TASS news agency, “Zircon” can be launched from vertical launch systems mounted on several types of platforms, including the “Peter the Great” and “Admiral Nakhimov” cruisers, the Project 20380 corvettes, the “Yasen” class Project 885 submarines and Project 22350 frigates. On July 27, 2020, Russia also announced a successful test on the frigate “Admiral Gorshov” (flagship of Project 22350). The same day, President Putin said the Russian Navy

would be armed with hypersonic weapons for nuclear strikes. Earlier, the Russian Ministry of Defense announced that “Zircon” is in the final phase of testing, and according to US intelligence sources, the missile is expected to be operational in 2023 (Tilenni, 2020, 60).



Figure 1: Basic data of the anti-ship hypersonic missile “Zircon.”

Another “Zircon” launch was reported in 2020, which successfully hit a coastal target at a distance of 350 km, and the rocket developed a speed above Mach 8.

In early 2022, the commander of the frigate “Admiral Gorshkov” told the Russian media that “Zircon” is capable of hitting targets at a distance of at least 1500 km (Stavrev, 2022).

Russia is expected to be the first country to adopt underwater hypersonic missiles. Expert Caleb Larson wrote about this at the end of 2020 in the US magazine *The National Interest*.² According to media reports, tests of the “Zircon” from a submarine, after two successful launches in the fall of 2021, will continue in 2024 (Stavrev, 2022).

Submarines with hypersonic missiles are very dangerous as they can stay under water for prolonged periods of time and are very difficult to detect.

In the *United States*, hypersonic weapons have been underestimated for years. It was only after the US Congress expressed interest in deploying hypersonic systems in the short term that resources were set aside for the Pentagon - \$ 2.6 billion for 2020, which has been increased to \$ 3.2 billion for the fiscal year 2021. In addition, each service declares a budget for its own programs: for the Navy - \$ 1 billion for 2021 and \$ 5.3 billion for a 5-year period; for the Land Forces - \$ 801 million for 2021 and \$ 3.3 billion for the 5-year period; for the Air Force - 382 million for 2021 and 581 million for the 5-year period (Tilenni, 2020, 61).

² “Is Russia ahead of the United States in developing hypersonic weapons?” *Aktualno*, November 10, 2020, <https://www.actualno.com>.



Picture 1: “Zircon” hypersonic missile after launch.



Picture 2: “Zircon” hypersonic rocket launch.

What is noticeable is that the budget of the Navy for the development of hypersonic weapons significantly exceeds that of other services.

Since 2018, the Navy is leading a *program for the development of a common gliding body* to be used across the armed services. The glider is being adapted from the Army’s Alternate Re-Entry System, a Mach 6 prototype warhead successfully tested in the past. A *subprogram designed to integrate hypersonic gliders* is also being implemented.

The Navy’s *Conventional Prompt Strike* subprogram aims to pair the glider with a submarine-launched booster system, with Initial Operational Capabilities on a “Virginia” class submarine expected in 2028.

In October 2020, Defense News, citing Robert O’Brien, the U.S. President’s national security adviser, reported that the US Navy plans to equip all destroyers with hypersonic missiles. The newest “Virginia” class submarines and

“Zamwalt” class destroyers will be the first equipped. Later, all three series of “Arleigh Burke” class destroyers will acquire this capability.³

In addition, the American expert David Axe believes that a quieter process is underway in the United States, aimed at creating a faster and more widely applicable transformation of the military capabilities. It is associated with the creation of *faster and more streamlined artillery shells* that can cover greater distances and strike with greater destructive force.

In early 2019, Axe points out that the US Navy has been developing its own *electromagnetic rail gun* since 2012 but has not yet reached the phase of naval testing. However, in early January 2019, the Pentagon leaked information about a test of hypersonic weapons from the Navy in the summer of 2018. During the test, the USS “Dewey” fired 20 *hypersonic projectiles* from its *conventional 5-inch cannon*. The new projectile is more aerodynamic than the old ones and has small propellers and a radar guidance system that helps it aim precisely at the target, at speed seven times that of sound. This is approximately three times the speed that a conventional sea projectile can develop. It is believed that with such range and accuracy, in theory, new projectiles can hit targets on land, at sea, aircraft, and even approaching missiles.

In this regard, it is argued that the choice was deliberate. Later, in 2016, Deputy Secretary of Defense Robert Wark recommended to the President Trump administration to invest in high-speed projectiles instead of electromagnetic rail guns. His motives are that the new shells achieve almost the same effect, but they can be developed faster. In addition, they can arm all existing howitzers and cannons in the Army and Navy (Axe, 2019).

Thus, these American weapons tests, which do not seem so remarkable, do not involve the creation of a new gun or missile but a new, super-aerodynamic projectile that is not nuclear. In addition, this projectile is not so complicated and can be quickly and widely introduced into service.

China, which has interests in the South China Sea and the Indian Ocean, has in recent years allocated significant resources to the development of its Navy but still lags far behind the United States. This is why experts suggest that, at least initially, China will not be interested in developing intercontinental hypersonic missiles capable of hitting the United States but rather in *short-range missiles, mainly to combat ships*. This is confirmed by some Chinese developments - for example, the *ballistic missile DF-21D*, designed to *strike against aircraft carriers* (Raychev, 2019).

Another sphere reported to be of interest and continued testing in China is the development of *electromagnetic rail guns* that can fire *projectiles with hypersonic speeds*. It was first observed in December 2017 on the deck of the landing ship “Haiyang Shan.” In early 2018, such a gun was seen on a Chinese warship sailing in the open ocean.

³ “The United States plans to equip all its destroyers with hypersonic missiles,” *news.bg*, October 22, 2020, <https://www.news.bg>.

The electromagnetic rail gun propels its projectiles by magnetic force, unlike conventional guns, which use a conventional explosive charge.

In March 2018, Chinese state media confirmed the existence of an experimental electromagnetic gun (Axe, 2019).

2. Ground-launched hypersonic weapons with the ability to strike at sea targets

The *Russian hypersonic glider "Avangard"* is launched by Intercontinental Ballistic Missiles (ICBMs) with several warheads (MIRV). It is presented as having unlimited range. In practice, the "Avangard" is a strategic missile complex that uses an ICBM with a gliding warhead (combat block). The hypersonic glider (combat block) is launched into the upper atmosphere with a ballistic missile, where it separates from it and heads towards its target, performing evasive maneuvers along the way.

The first test was performed in 2018 using legacy UR-100 N (SS-19 Stiletto) missiles. The missile fired from the "Dombrovsky" range reached a target located 6,000 km away, at the "Kura" missile test range. According to existing information, the glider reached a speed of Mach 27 (over 32,000 km/h), which could equate to approximately 1800-2000 °C surface temperature of the glider body (Tilenni, 2020, 60).

This hypersonic glider, which is reported to be capable of carrying conventional and nuclear warheads, has been adopted into service and, according to a statement from the Russian Ministry of Defense on December 27, 2019, is on combat duty.⁴ In the future, the "Avangard" will probably be carried by the RS-28 "Sarmat" ICBM (SS-X-30).



Picture 3: Mobile launcher from the "Avangard" complex.

⁴ "Russian hypersonic missiles are already on combat duty," *Club Z*, December 27, 2019, <https://clubz.bg>.

Russian President Putin first announced the “Avangard” complex in 2018 when he unveiled a new generation of Russian weapons. He stated these rockets are virtually invincible and compared the “Avangard” to the development of the first satellite on Earth. The other Russian weapon, also presented by Putin as invincible, is mentioned as a potential carrier of the “Avangard” hypersonic glider - the fifth generation ICBM RS-28 “Sarmat” (with a range of 18,000 km).



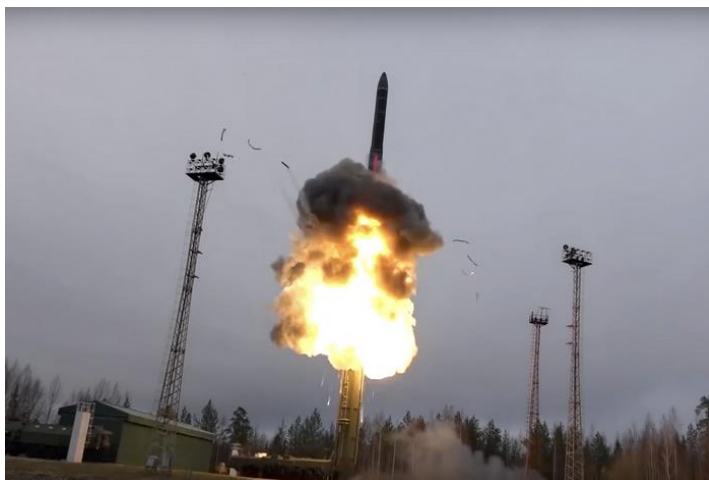
Picture 4: RS-28 “Sarmat” ground-based missile complex with heavy ICBM “Sarmat.”

According to analysts, a nuclear version of a “Sarmat” missile is enough to inflict guaranteed unacceptable damage on the United States. In the non-nuclear version, the missile will become a superweapon, combining the colossal speed of ICBMs and the precision of the maneuvering hypersonic warhead of the “Sarmat,” which reaches a circular error probability of several meters and can hit various ground and sea targets.⁵

In addition, it is expected that the RS-28 “Sarmat,” like some of the existing Russian missiles, such as the R-36M2 “Voevoda,” will have not only combat blocks but also blocks equipped with clusters with numerous penetration aids designed to deceive the enemy and missile defense systems.

In the *United States*, the *Operational Fires Program* is underway under the auspices of the Defense Advanced Research Projects Agency (DARPA). Based on technology from the Tactical Boost Glider, the program aims to develop a *ground launch system* that will enable modern tactical weapons to penetrate the enemy’s air defenses and quickly and accurately strike at Time Sensitive

⁵ Krassimir Ivandzhiyski, “The Hyperwar in hyper stage,” *strogosekretno.com*, June 2017, <https://strogosekretno.com>.



Picture 5: “Avangard” hypersonic missile launch.

Targets (Tilenni, 2020, 62). *Long-range hypersonic weapons for the Army* will enable the common hypersonic glider to be included in mobile ground-based batteries. Flight tests will be conducted until 2023, followed by field combat launches. According to US Secretary of Defense Mark Esper in October 2020, the Pentagon plans to supply hypersonic weapons to the Army by 2023.⁶ It will be able to strike at various ground- and sea-based targets.

In November 2019, US media reported that *China* had once again tested a *DF-41 missile*, the next generation of ICBMs capable of carrying several warheads, including nuclear ones.⁷ It is believed that this missile, with a declared range of 12,000 km will be a system that can carry *conventional or nuclear hypersonic gliders*, which are a threat to all types of targets.

3. Air-launched hypersonic weapons with the ability to strike at sea targets

Russia has also developed the X-47M2 “*Kinzhal*” *hypersonic ballistic missile*, which is launched from the air and can carry nuclear warheads. Its declared features are Mach 10 speed, 2,000 km range, and a weight of 4 tonnes. “*Kinzhal*” is the newest Russian aviation complex, which includes the MiG-31K carrier aircraft and a hypersonic missile. “*Kinzhal*” is an air-launched variant of the surface-to-surface ballistic missiles from the 9K720 “*Iskander*” missile complex. After entering service in December 2017, the system reached Full Operational Capabilities in March 2018 and was deployed in the Southern Military District. A

⁶ “The United States plans to equip all its destroyers with hypersonic missiles,” *news.bg*, October 22, 2020, <https://www.news.bg>.

⁷ “Izvestia”: Russia is developing weapons against hypersonic missiles,” *mediapool.bg*, February 12, 2020, www.mediapool.bg.

launch over the Barents Sea from a MiG-31 based in Olenya (Olenegorsk), Kola Peninsula, suggests a redeployment to the Northern Military District as well (Tilenni, 2020, 60).



Picture 6: “Kinzhal” ballistic missile attached to a MiG-31K fighter.

According to Russia’s Deputy Defense Minister, the “Kinzhal” missile system can destroy large moving naval targets such as aircraft carriers, destroyers, and cruisers.⁸



Picture 7: MiG-31K fighter in flight with “Kinzhal” missile.

⁸ “Russia boasts: “Kinzhal” missile can sink aircraft carriers,” *news.bg*, March 12, 2018, <https://news.bg>.

In addition, in early 2020, it became clear that it is planned that the Russian supersonic strategic missile carriers Tu-160 will also be armed with “Kinzhal” hypersonic missiles, and the development of the project should be completed by the end of 2020. This bomber can carry up to 12 strategic cruise missiles.⁹



Picture 8: Tu-160 long-range bomber.



Picture 9: Tu-22M3 long-range bomber.

⁹ “TASS: Tu-160 will be armed with hypersonic missiles,” February 10, 2020, <https://focus-militarynews.net>

According to other information from the Russian military-industrial complex from July 2018, test launches of hypersonic missiles from the Tu-22M3 long-range bomber are planned, as well.

In the *United States* in 2013, successful tests were conducted of an Boeing X-51 *Wavediver experimental hypersonic missile*, launched by a B-52 bomber and reached Mach 5 speed.



Picture 10: X-51 hypersonic missile under the wing of a B-52 bomber.

The US Air Force, in cooperation with Lockheed Martin as the main contractor, is developing the *AGM-183 Air-Launched Rapid Response Weapon Project*.



Picture 11: An artist's rendition of Lockheed Martin's AGM Air-Launched Rapid Response Weapon (Tilenni, 2020, 60).

AGM-183 is a rapid prototyping project that intends to field an operational weapon in the 2022 timeframe. The weapon is launched from an aircraft with a high initial speed given to it by the carrier. The prototype would reach up to Mach 20 speed for approximately 900 km, and it integrates DARPA's Tactical Boost Glider technology as a payload. The first flight test was successfully conducted in 2019, and the last test under a wing of a B-52 bomber also successfully took place on August 8, 2020.

It is planned that the AGM-183A hypersonic missile will be attached to F-15 fighters (Tilenni, 2020, 61-62).



Picture 12: F-15 fighter.

In 2020, a video of the new (from 2019) *Chinese H-6N bomber* (licensed copy of the Soviet Tu-16), which carried a *new hypersonic cruise missile*, was shown.

For the first time, the bomber was spotted flying with *anti-ship ballistic missiles*. According to information from early 2020, these were the *CH-AS-X-13 air-launch ballistic missiles*, developed on the basis of DF-21D, which can reach hypersonic speeds. The DF-21D is a two-stage ballistic missile, in service with China since 2015, with an estimated range of about 1,500 km.¹⁰

Beijing has also announced successful testing of two *hypersonic glider launch systems*. Of greater interest is *Dongfeng-17 (DF-17)* - a medium-range ballistic missile with a range of 1600 - 2400 km, designed to launch specially designed hypersonic gliders. This missile was shown for the first time in 2019. The first test successfully conducted in 2017 is considered the first hypersonic glider test (Tilenni, 2020, 59-60). In early 2020, the American magazine *The National Interest* reported tests of a *hypersonic missile DF-ZF*, which has reached speeds

¹⁰ "China is developing an air-based ballistic version of the DF-21 missile," *news.bg*, January 14, 2020, <https://wmg.bg>.



Picture 13: Chinese Xian H-6N bomber with a hypersonic cruise missile, October 2020.

above Mach 10. According to annual reports from the Pentagon to Congress, the missile is launched from the DF-17 ballistic missile, which in turn is launched from an aircraft.¹¹

In addition, in early November 2018, during an air show, China showcased a new *ballistic anti-ship missile SM-401*. According to Chinese state media, the new missile is also a hypersonic weapon.¹²

4. Discussion

What has been said so far about hypersonic weapons shows that many of them are designed to hit naval targets, which implies greater opportunities for gaining superiority at sea by countries that possess such weapons. These countries are developing and testing both hypersonic gliders and hypersonic cruise missiles.

The Russian Navy is conducting tests and plans to equip cruisers, corvettes and frigates, and possibly submarines, with hypersonic weapons. The new weapons are expected to be operational in 2023. Hypersonic weapons will be able to strike both conventional and nuclear strikes on naval targets at a distance of up to 1000 km.

In the struggle to gain superiority at sea, Russia can also use long-range hypersonic ground-based weapons that can hit naval targets with high accuracy. Apart from the specific characteristics of the flight trajectory, the counteraction of these weapons is further complicated by the firing of blocks equipped with clusters with numerous penetration aids to deceive the enemy's missile defenses.

¹¹ "For the first time: A Chinese bomber was seen with a new hypersonic missile," *pogled.info*, October 20, 2020, <https://pogled.info>.

¹² "China crushes US in supersonic missiles," *news.bg*, April 25, 2019, <https://news.bg>.

Hypersonic weapons fired from the air, which can destroy large moving marine targets, also have the ability to contribute to maritime superiority. Such weapons have already been adopted in service in Russia.

In the United States, only conventional hypersonic weapons are designed, which suggests that they are more accurate but also require more time to develop. Priority is given to offensive hypersonic weapons (until a concept for building a reliable defense system is defined) and the Navy, which has a significantly larger budget for research and testing than other services. It is planned to equip all destroyers and the latest submarines with hypersonic weapons, but the lag compared to Russia is obvious, since the initial operational capabilities, even with only "Virginia" class submarines, are expected to be achieved in 2028.

The United States is still testing long-range ground- and air-launched hypersonic weapons, which are expected to have the ability to strike at various naval targets.

China is developing its capabilities for gaining superiority at sea, including through the use of hypersonic weapons with a priority on those of short- and medium-range. Hypersonic long-range weapons, which can carry both conventional and nuclear hypersonic blocks, are also being tested. Hypersonic weapons are marine-, ground- and air-launched and are expected to have the ability to strike at various naval targets.

Based on the above, it can be concluded that hypersonic weapons will be crucial for achieving maritime superiority in future armed conflicts. This is confirmed by the fact that in addition to Russia, the United States, and China, programs for the development and testing of hypersonic weapons are being implemented in the UK, Australia, India, Japan, France, Germany, and possibly in other countries.

Conclusions

Tests to date have shown that hypersonic weapons combine the speed of ballistic missiles with the precision of cruise missiles. The high maneuverability of hypersonic weapons at this stage makes it difficult to detect and destroy them. All these characteristics make them highly effective means of destroying various land and sea targets.

The existence of different types of hypersonic weapons – launched from land, air, and sea, requires joint and coordinated use of the armed services in order to achieve the desired effects. The ability of hypersonic weapons to hit small static and moving targets on the ground and at sea allows them to become an important factor in the struggle for maritime superiority.

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