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## RUSSIAN TORPEDO ARMAMENT

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Owing to basic performance characteristics, the Russian torpedoes are on a par with their foreign counterparts and even surpass them in terms of reliability and ease of operation.

The modern torpedo is one of the most effective weapons in submarine warfare. Torpedoes constitute the primary armament for multipurpose submarines, self-defense weapons for undersea missile ships and basic antisubmarine armament for surface ships and naval aircraft. Most postwar torpedoes were developed by the St. Petersburg Gidropribor Central Research Institute headed by A.M. Borushko, R.V. Isakov, G.P. Korsakov and others.

Antiship torpedoes. Late in the 1950s surface ships formed the main striking power of the Navy of the USA and other maritime states. To counter these surface ships and harry sea lanes, antiship electric-propelled torpedoes received a large development effort. The first such torpedo that entered service with the Soviet Navy during the postwar period was the ET-46 (1946) developed from the ET-80 first Soviet electric-propelled torpedo. The ET-46 was not a homing torpedo. A study of captured German torpedoes type T-V led to the creation of a domestic homing torpedo whose development has been interrupted by World War II. In 1950, the first Soviet homing torpedo outfitted with a passive seeker and electromagnetic exploder, SAET-50, became operational and in 1961 the SAET-60 antiship electric-propelled homing torpedo with a passive seeker was adopted. The latter was equipped with a silver-zinc battery and boasted a higher speed and longer range, compared with the SAET-50 torpedo. Simultaneously, the MGT-1 400mm homing torpedo with passive seeker was made to protect submarines against surface ships. Its passive acoustic noncontact exploder detonated the charge near the ship propeller. However, the antiship torpedoes were the primary weapons powered by heat engines which featured a higher speed and larger range. They were updated at the same time as the development of electric-propelled torpedoes. The 53-39PM and 53-51 heat torpedoes outfitted with controllers and noncontact exploders became operational in 1949 and 1951, respectively.

Medvedka small-size antisubmarine missile system

Heat and power engineering, involving strong oxidants (oxygen, hydrogen peroxide), was

widely used. In 1956 the 53-56 antiship aimed gyrating oxygen torpedo, provided with a radically new optical exploder was designed. The torpedo with a 400-kg explosive charge could develop a speed of 40 knots.

The 53-57 first heat turbine-driven torpedo, which used hydrogen peroxide as oxidant, was adopted in 1957.

Augmenting the power unit and creating a unique active sonic homing system promoted the 53-61 new antiship torpedo adopted for service in 1961.

In 1965, the 53-65 wakehoming gas-turbine chemical torpedo entered service with the Navy. The torpedo had long kept the speed record. The late 1960s witnessed an oxygen version of the 53-65K torpedo which was extensively employed by the Soviet Navy. The torpedo was exported to many countries.

In the early 1970s, the first 650 mm antiship torpedoes, 65-73 and 65-76, featuring increased range and speed, entered service to outfit multipurpose nuclear-powered submarines.

During the first postwar years, the 45-36AM and 45-56NT 45 mm air-launched heat torpedoes for low-level bombing and 45-36VM and 45-54VT for high-level bombing also received a large development effort.

Simultaneously in 1953, the RAT-52 450mm rocket-propelled antiship torpedo, which developed a speed of up to 70 knots, was adopted for service with maritime aviation. The design innovations allowed the torpedo to memorize the attack heading in dropping.

TEST-71 torpedo

The main foreign fleets started to employ antiship torpedoes during WWII, which was caused by an intensive surface ships campaign of the warring parties in the Atlantic and Pacific Ocean waters. At the same time the first aimed and homing electric-propelled torpedoes were created in Germany, while the U.S. Navy started to employ turbine-propelled torpedoes, and in the mid-1940s - chemical torpedoes.

Many types of antiship torpedoes made during WWII were operational until the mid-1980s. In 1960-1970 the heavy single-purpose antiship and



antisubmarine torpedoes were replaced by multipurpose torpedoes capable of destroying surface ships and submarines. This was dictated by the limited ammunition load of submarines and a variety of missions to be accomplished.

Antisubmarine and multipurpose torpedoes. The underwater threat aggravated by the appearance of missile submarines gave an impetus to the development of domestic and foreign antisubmarine weapons, with torpedoes becoming the main one.

The first passive homing antisubmarine torpedo, SET-53, was adopted by our Navy in 1958. The torpedo was subsequently modified and designated the SET-53M. With a high speed, its range was almost doubled owing to the use of a silver-zinc battery.

#### UMGT-1ME torpedo

In 1956 the SET-65 new generation of active/passive homing torpedo system was put into service and in the 1960-1970s the first telecontrolled torpedoes, TEST-68 and TEST-71, appeared.

Owing to basic characteristics, the Soviet torpedoes were on a par with the American ones.

However, some innovations, telecontrol, in particular, were incorporated in the Mk-37 model 1 and Mk-45 American torpedoes long before, in 1961.

In the early 1960s domestic antisubmarine torpedoes launched from 400mm tubes were created to outfit the first generation nuclear submarines and small submarine chasers. The SET-40 featuring active/passive homing and active acoustic noncontact exploder was the first small-sized antisubmarine torpedo. At the same time efforts were underway to develop air-launched antisubmarine torpedoes. Thus, the AT-1 450mm torpedo was created in 1962 and the AT-2 533mm torpedo with improved characteristics, in 1965. Later only small air-launched torpedoes (VTT-1 and others) were developed.

In 1960-1980, electric-propelled antisubmarine torpedoes and antiship torpedoes powered mostly by heat engines were simultaneously created in the USSR. In the 1970s the development of torpedoes powered by heat engines resulted in the creation of multipurpose torpedoes capable of

destroying both surface and underwater targets.

The first domestic multipurpose torpedo designed for self-defense of submarines was the SET-72 400 mm torpedo adopted for use in 1972. Later on the maritime aviation received the UMGT-1 400 mm antisubmarine torpedo whose characteristics were on a par with the best Western counterparts.

In 1980, the Navy was outfitted with the first USET-80 533mm multipurpose electric-propelled torpedo which surpassed, in terms of the performance characteristics, all NATO electric-propelled torpedoes of this class. These same years witnessed a light 324mm antisubmarine torpedo designated Kolibri.

Intensive development of the Soviet nuclear-powered submarine fleet in 1960-1970 compelled the U.S. Navy to spend huge assets to make a new qualitative leap in the development of torpedo weapons. As a result, in the early 1970s the U.S. nuclear-powered submarines received the first modification of a new-generation Mk-48 torpedo. The torpedo employed a heat engine operating on unitary liquid fuel and developing power thrice as much as that of any other American torpedo. Launched from the American 533mm torpedo tube it became an effective multipurpose torpedo and excluded the need for the development of special purpose antiship torpedoes. Now the modified Mk-48 torpedoes, the last modification being the Mk-48 ADSAR, constitute the backbone of the U.S. Navy torpedo arsenal.

The surface ships and antisubmarine aviation of the U.S. Navy are currently equipped with the small Mk-46 model 5 and Mk-50 torpedoes capable of fighting modern nuclear submarines. Latush torpedo

The harsh economic problems in Russia and the end of the Cold War inevitably affected the development efforts in this sector.

Nevertheless, a number of torpedo versions that meet the best world standards are to be adopted for service and export very soon.

Antisubmarine missiles and torpedo missiles. In Russia several organizations are involved in the development of these weapons: the Novator and Raduga Engineering Design Bureaus, Moscow-based Heat Engineering Institute, Region Research and Production Association and Gidropribor Central Research Institute. The torpedoes designed by the Gidropribor CRI were used as head of torpedo missiles. As earlier in the USA, this type of weapon passed the evolution of simpler antisubmarine missiles whose forebody was a special purpose warhead.

The first domestic unguided ballistic missiles 82R of the Vikhr RPK-1 system with a range of up to 24 km were employed by the Project 1123 antisubmarine cruiser and later, by heavy aircraft cruisers of Projects 1143 and 11433 (1968).

To arm submarines, an antisubmarine missile system, the Vyuga RPK-2,



similar to the U.S. Subroc system, was created in 1969. Its 533mm solid-propellant ballistic missile 81R also featured a range of to 40 km. In the early 1970s large submarine chasers and escort ships received the first Soviet antisubmarine systems, RPK-3, RPK-4 equipped with the 85R cruise missile whose warhead was the AT-2UM 533mm homing torpedo. The advent of the 85RU multipurpose missile of the RPK-5 system with the UMG-1 400mm torpedo as a warhead in 1984 provided for the destruction of both underwater and surface targets at a range of up to 50 km.

In the early 1980s the RPK-6 antisubmarine system started to go into service with submarine and surface ships. In 1984 the RPK-7 antisubmarine missile system, which surpassed considerably the RPK-6 in terms of the performance characteristics was adopted for service with nuclear submarines.

In addition to torpedo missiles and torpedoes, the national submarines are outfitted with unique high-speed antisubmarine missiles (designed in the 1970s) developing a speed of about 200 knots.

Until recently, only nuclear submarines and large surface ships were outfitted with antisubmarine missiles. In the mid-1990s an antisubmarine system designated the Medvedka was created for small submarine chasers.

The aviation is also outfitted with the APR-1, APR-2 and other solid-propellant antisubmarine missiles created in the 1960-1980s.

The American surface ships armed with the ASROC antisubmarine missile system employ a depth charge or a small torpedo as warheads. Modern ships are outfitted with versatile vertical underdeck launchers to launch antiship, air defense and antisubmarine missiles.

The aforementioned weapon development trends and enumeration of types of antisubmarine and antiship weapons testify to the strong emphasis placed in our country on the creation of torpedoes and torpedo missiles, the most effective weapons in underwater warfare.

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The subsequent development of naval forces of the main maritime nations predetermines further development of the national underwater fleet.

During the past few decades the development trends of torpedo weapons have been common to the fleets of all countries. These include:

- developing new homing and guidance systems based on digital computing, use of on-board computers with a large memory capacity and great speed of response which ensures the enhanced reliability and jamming immunity of the systems, decoy discrimination, optimization of target selection, optimized three-dimensional homing (guidance) trajectory:

- increasing the range of homing systems owing to lower operating frequency of the system sensors, abating the self-noise affecting the equipment operation, raising the emission power and using composite signals;

- increasing the range and speed by improving the characteristics of the power unit and propellants, reducing the hydrodynamic drag owing to improved configuration or use of polymeric materials injected in the boundary layer of streamlined shell, setting up forced cavitation conditions;
- increasing the running depth owing to the use of new materials for torpedo cases;
- reducing noisiness owing to the use of up-to-date technologies and propulsion devices;
- enhancing the effectiveness of warheads owing to the use of updating explosive charges and increasing the precision of torpedoes and guiding them to the most vulnerable points of targets, integrating the operation of the homing, guidance systems and noncontact exploder;
- updating the telecontrol systems owing to the use of fiber optics and two-way communication allowing the attacking submarine to receive information on the torpedo trajectory, state of on-board systems, target maneuvering, with all information being displayed in real time on a video terminal interfaced with the computer.

The fleets of many countries are outfitted with underwater weapons developed in Russia. The national research and production base offers considerable scope for replenishment of the Navy arsenal and for arms export.

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