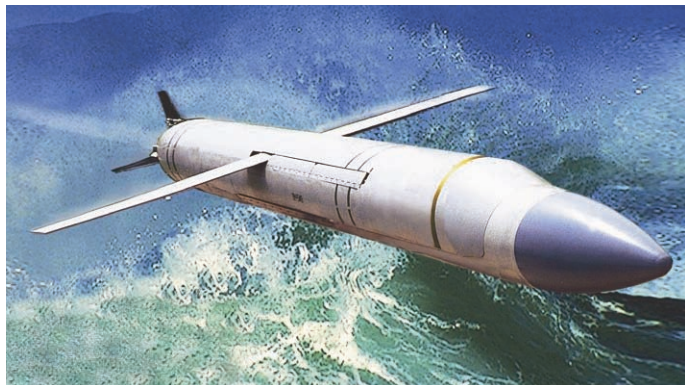


Anti Shipping Missile survey

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Novator 3M54E Club / SS-N-27 Sizzler.

THE ONGOING REGIONAL ARMS RACE ACROSS ASIA HAS BROUGHT to the region potent warfare capabilities, such as late models of the Sukhoi Flanker multirole fighter, AWACS systems, aerial refuelling tankers and other high visibility systems. Lesser known is the proliferation of a range of potent anti-shipping missiles, especially Russian types.

Specialised anti-shipping missiles have been built in all shapes and sizes, reflecting diverse end use and launch platforms. More often, a specific missile type will be available for a range of launch systems, including coastal battery vehicles, surface warships, submarines, maritime patrol aircraft and fighter aircraft.

Ship, submarine and air launched weapons are used primarily for sea control operations and sea lane interdiction, with larger higher performance weapons intended for use against surface combatants, troop/passenger transports, cargo transports, amphibious vessels and tankers. Smaller, lower performance weapons tend to be more often intended for use against landing craft, small surface combatants, and to interdict littoral traffic such as barges and small transports. Coastal defence weapons, launched off trucks and trailers, are almost exclusively intended to deter amphibious forces, with larger weapons planned for use against amphibious ships, and smaller weapons against landing craft.

Propulsion techniques vary across liquid and solid rocket engines, turbojet and turbofan engines plus some ramjet designs in supersonic weapons. Guidance systems are dominated by active radar seekers operating in the upper centimetric bands, although a number of niche weapons employ infrared scanning or imaging seekers.

Flight trajectories for most modern weapons involve a sea skimming terminal phase to hide the weapon in sea surface clutter from discovery by defending radar systems. Most weapons are subsonic, but increasingly supersonic weapons of Russian origin are proliferating in Asia.

The dominant players in the market are the Russians and the US, with smaller nations often developing indigenous weapons to supplement imports. China is now emerging as a potential major player in the market, with a wide range of indigenous weapons built, despite imports of a range of Russian weapons.

Long-term trends in the market remain unclear even though the Russians dominate the current market in terms of technology and diversity of products, with weapons covering the full spectrum of capability and launch regimes. The US remains committed to the legacy Harpoon family of missiles, although proposals for replacements have emerged. The EU has a number of programs, including the well known MBDA Exocet and SAAB/Bofors RBS-15. China

manufactures a wide range of weapons in the YJ series. Dual role land attack capable or specialised land attack variants of many of the weapons have emerged in recent years, mostly exploiting the low cost of satellite navigation receivers. At this time, the growth market for anti-shipping weapons remains the Asia-Pacific, with Russian weapons playing an increasing role in regional inventories.

This survey covers the most important anti-shipping missile types in the current market.

MBDA MM38/AM39/SM39/MM40 EXOCET

The Exocet of Falklands campaign fame remains one of the most widely deployed anti-shipping missiles in current inventories, with nearly thirty nations using the weapon. In this region, Exocets are deployed by Thailand, Malaysia, Indonesia and Pakistan.



Exocet missile launch.

Current Exocets are an evolution of a 1970s technology design, and are available with solid propellant rocket propulsion in the ship/battery launched MM38, the air launched AM39, deployed on fixed and rotary wing aircraft, the encapsulated SM39 deployed on submarines. The latest MM40 Block III departs from tradition, introducing a turbojet engine to extend range to around 100 NMI.

The Exocet can be labelled a 'medium weight' weapon, with launch weights across most variants of around 1,500 lb. It is a subsonic sea skimmer.

In operations, the Exocet has proven effective against smaller surface combatants, less so against larger transports due to its limited warhead size.

SAAB BOFORS RBS-15M/K/F/CD

The RBS-15 is Sweden's contribution to the anti-shipping missile market – introduced during the 1980s in air launched and surface launched variants. The missile is powered by a turbojet engine, with solid rocket boosters for ship and coastal variants, and it employs an active radar seeker. The weapon weighs in at around 1,800 lb at launch.

Variants include the ship-launched RBS-15M, coastal defense RBS-15K, air launched RBS-15F, and an export version labelled the RBS-15CD. To date all operators are in Europe.

ZVEZDA-STRELA/TMC 3M-24/KH-35U URAN

Colloquially known as the 'Kharpunski', the subsonic sea skimming 3M-24/Kh-35U Uran (AS-20 Kayak/SS-N-25 Switchblade) is the Russian equivalent of the Boeing RGM-84/AGM-84 Harpoon. The missile is available in surface launched and air launched versions, the latter using the AKU-58 adaptor. The weapon has been already deployed on the Indian New Delhi class DDG, with reports indicating that China ordered the missile in 2001. Russia deploys the weapon on a range of surface warships,



and on the Tu-142M LRMP aircraft and Ka-28 helicopter. An ARGV-35 active radar seeker is used.

Like the Harpoon, ship launched and coastal defence variants employ a solid rocket booster, with a turbojet sustainer used.

BOEING AGM/RGM/UGM-84 HARPOON

The dominant weapon in the US inventory, and that of most users of US warships and maritime aircraft, is the subsonic sea-skimming turbojet powered Harpoon. This weapon entered service during the late 1970s in the RGM-84A ship launched variant, soon followed by the encapsulated sub launch UGM-84A and air launched AGM-84A. The



latter variant has been integrated on F/A-18 and F-15 variants, P-3 and Nimrod LRMP aircraft, F-111C, F-16C and Fokker F-27/F-50 LRMP aircraft.

The baseline Harpoon was followed in production by the late 1980s Block 1D variant, with additional fuel and ability to loiter and reattack. Shifting roles following the end of the Cold War led to the 'littoral' Block II variant, which incorporated inertial and GPS components from the JDAM bomb kit and SLAM series of land attack weapons. The Block II is considered a dual-role weapon with land attack capability. In maritime operations the GPS/inertial capability aims to improve the missile's ability to reject false targets in littoral and archipelagic environments.

The newest Block III variant adds a datalink to the Block II design to permit midcourse and terminal phase aimpoint updates. It is intended for use on the F/A-18E/F, P-8 MMA and surface warships.

The AGM-84E SLAM, AGM-84H SLAM-ER and AGM-84K SLAM-ER ATA are land attack derivatives of the Harpoon, integrated on US Navy aircraft and the F-15K/SG. These weapons use infrared imaging terminal guidance and have a secondary role in anti-shiping strikes.

CHETA YJ-8/YJ-81/C-801, YJ-82/C-802 AND YJ-83/C-803

China's indigenous equivalents to the Uran, Exocet and Harpoon are the YJ-8 (CSS-N-4 Sardine) family of missiles, available in ship, sub-surface, land and air launch variants.



The basic air launch, rocket powered YJ-8K achieves 27 NMI (50 km) range; the improved YJ-81 cca 43 NMI (80 km), the turbojet YJ-82 (CSS-N-8 Saccade) cca 65 NMI (120 km); and the recently trialed YJ-83 variant around 135 NMI



(250 km). These are the primary weapons of many PLA-N warships, and the FH-7 maritime fighter carrying four rounds.

Comparable in size, weight and lethality to the Uran, Exocet and Harpoon, these are subsonic weapons with sea skimming terminal phase flight.

CHETA YJ-62/C-602

The recently unveiled YJ-62 is a Chinese equivalent to the long defunct BGM/RGM-109B Tomahawk Anti Ship Missile (TASM) and the more recent Russian 3M54 Club



series. Similar in size, launch weight and configuration to its US and Russian equivalents, this radar guided subsonic missile was initially deployed on PLA-N Lanzhou class destroyers. The credited range of 150 NMI is consistent with the turbojet powerplant, putting early variants of this missile in the performance class of the never built AGM-109 MRASM and production 3M-54E1.

Reports have emerged of a land attack variant and air launched variants. The latter would be carried by the H-6M Badger (4 rounds) or the developmental turbofan powered H-6K Badger (6 or 7 rounds), the latter providing a formidable 2,000+ NMI radius sea control capability.

The YJ-62 is likely to become the primary PLA-N anti-shiping missile of domestic origin, as it provides a large airframe with considerable long term growth potential, including significant range improvements with a future turbofan engine.

NOVATOR 3M-54E/3M-54E1 CLUB

The new Novator 3M-54 Club (SS-N-27 Sizzler) family of ship (Club N), submarine (Club S) and air launched weapons has been a major export success for Russian industry. Unlike warship launched Moskit and Yakont variants, the Club was designed from the outset for launch from a 533 mm torpedo tube or a vertical launch tube.

There are three distinct variants of basic missile. The baseline 3M-54E1 and 3M-14E are equivalents to the US Navy's defunct anti-ship TASM and early land attack TLAM Tomahawk missiles. These weapons have a range of 160 nautical miles and are both subsonic. The 3M-54E1 uses an ARGV-54 active radar seeker and Glonass satellite and inertial guidance, the land attack variant 3M-14E Glonass satellite and inertial guidance alone.

The more advanced 3M-54E combines the subsonic cruise airframe of the 3M-54E1/3M-14E with a Mach 2.9 rocket propelled guided payload.

The 3M-54E approaches from under the radar horizon using the radar seeker to detect its target. Once locked on, it discards the cruise airframe, fires its rocket motor, and accelerates to Mach 2.9 at a sea skimming altitude of 15 feet.

All weapons in this family share a common launch system and thus any ship, submarine or aircraft equipped for these weapons can carry an arbitrary mix. India and China have deployed this missile family on Kilo class SSKs, and may also install it on surface combatants. A mockup of an air launched variant for the Su-30MK/Su-34 was displayed at the MAKS-2007 trade show in Moscow.

RADUGA KH-59/59M/D OVOD

A recent addition to the medium weight class of anti-shiping missiles is the subsonic turbojet powered Kh-59MK2, custom built for the PLA-N Su-30MK2 fleet. This weapon is a derivative of the 2,000 lb (920 kg) 62 NMI (115 km) range



Kh-59M/D (AS-18 Kazoo) series stand-off weapon, which itself is a direct equivalent to the AGM-142 missile recently integrated on the RAAF's F-111C. Evolved from an anti-radiation missile, it shares the common Granit 7TM1 optical seeker and Raduga APK-9 Tekon datalink pod with the KAB series guided bombs. The D-model fitted with a thermal imager uses an RDK-300 jet sustainer.

Su-27SKM or Su-30MK2 Flankers fitted for the Kh-59M/MK2 carry two rounds on wing stations 3 and 4, using AKU-58 adaptors, the datalink pod carried on inlet station 9.

ZVEZDA KH-31P/A/MR/MA 'MINI-MOSKIT'

The supersonic Turayev ramjet-powered Kh-31A/MA 'Mini-Moskit' (Izdeliye 77 or AS-17 Krypton) is a radar guided anti-ship derivative of the Kh-31P originally designed as an anti-radiation missile to suppress NATO Patriot and IHawk batteries. The 1,300 lb launch weight Kh-31P entered use in 1988 with an L-111E family interferometric seeker (a range of L-11X seekers now exist for various RF bands). Since the end of the Cold War it has evolved an extended range airframe (Kh-31MP/ Type 2 - 100+ NMI range).



At altitude the Kh-31 achieves Mach 4.5, and at sea level Mach 2.7. The Su-30MK, fitted for the Kh-31 series, can carry up to six rounds on wing stations 3, 4, 11, 12 and inlet stations 9 and 10. Using AKU-58 adaptors, the Su-27SKM carries four rounds on 3, 4, 9 and 10.

The Kh-31 has no equivalent in the Western inventory; the US Navy used it as the MA-31 target drone. The PLA is reported to use this weapon with recent claims of plans for licenced production. It is likely that operational users will launch mixed salvos of the anti-radiation and anti-shipping variants to maximise difficulty for defending warships.

CHETA HY-1/HY-2/HY-4 SILKWORM/SEERSUCKER, C-601/C-611 KRAKEN AND YJ/KD-63

The Chinese Silkworm/Seersucker family of anti-shipping missiles are clones or derivatives of the Raduga P-15/4K-40 Termit (SS-N-2 Styx) anti-ship missile designed during the late 1950s.

The original Styx was powered by an Isayev P-15 liquid rocket rated at 1.213-0.554 tonnes' thrust, using toxic AK-20K/TG-02 propellant, armed with an 1,100 lb (513 kg) shaped charge warhead and fitted with a con-scan active radar seeker. The weapon's first kill was the Israeli warship Eilat in 1967.

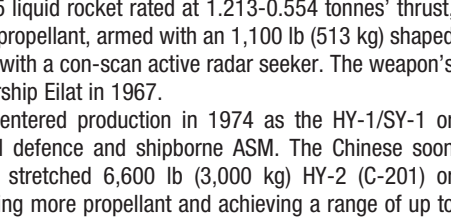
A cloned Chinese Styx entered production in 1974 as the HY-1/SY-1 or CSS-N-1 Silkworm coastal defence and shipborne ASM. The Chinese soon improved the design; the stretched 6,600 lb (3,000 kg) HY-2 (C-201) or CSS-N-2 Seersucker carrying more propellant and achieving a range of up to 73 NMI (135 km). Many derivatives followed, including models with infrared homing seekers, television seekers, monopulse radar seekers and the turbojet powered HY-4.

The air launched YJ-6/C-601 or CAS-1 Kraken entered production during the mid 1980s based on the HY-2 variant, and is carried by naval H-6D Badgers. It was superseded in production by the YJ-61/C-611, with its improved 110 NMI (200 km) range via higher energy propellant.

While the Silkworm/Seersucker is a subsonic sea skimmer, its sheer size adds significant lethality. While it is often not regarded to be a serious threat to surface warships, it has the killing power to be a very effective blockade weapon against civilian shipping and naval transports, or amphibious vessels. The recently revealed KD-63 is a derivative of the air-breathing HY-4 Sadsack. While it retains the delta wing and fuselage shape of the HY-4, it uses a new cruciform tail design, and includes a television / datalink terminal guidance package. It is thus a dual role weapon capable of precision strikes against land and maritime targets. It is carried by the newly designed H-6H Badger variant, replacing the pair of Krakens carried by earlier variants. Range is cited at around 100 nautical miles.

RADUGA 3M-80, 3M-82 AND KH-41 MOSKIT

The heavyweight radar guided Raduga 3M-80, 3M-82 and Kh-41 Moskit (SS-N-22 Sunburn) are all variants of the same 4.5 tonne supersonic rocket-ramjet missile. Carried by the PLA-N's new 956E Sovremennyy Class destroyers, it is credited with a range between 50 and 120 nautical miles. An air launch centreline tunnel adaptor enables Flanker fighters to carry a single round, and this configuration has been displayed on the navalised Su-33 and marketed on the Su-35BM/Su-35-1. Inertial midcourse guidance is supplemented with an Altair active radar seeker.



The Moskit is a supersonic sea-skimmer. It can be programmed to fly a high altitude trajectory at Mach 3, or a sea-skimming trajectory at Mach 2.2. If the sea skimming mode is chosen, the missile will be first detected by a warship under attack when it emerges over the horizon at a distance of about 15 to 25 nautical miles. This provides the defences on the ship with about 25-60 seconds of warning time before impact. The raw speed of the Moskit makes it a challenging target for most shipboard defences.

Recent reports indicate that a new thermobaric warhead has been introduced, intended to provide sufficient blast overpressure to break the back of a large warship or transport.

NPO MASHINOSTROYENIA 3K-55/3M-55/KH-61 YAKHONT/PJ-10 BRAHMOS A/S

The heavyweight supersonic Yakhont, recently licenced by India as the Brahmos A and Brahmos S, is the newest supersonic missile of Russian origin to reach this region.



China is reported to have purchased the baseline 3M-55 for a number of naval vessels.

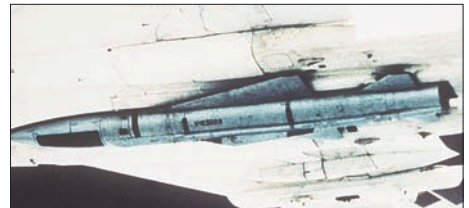
The OKB-52 3K-55/3M-55 Yakhont (SS-N-26) comprises (like the Moskit) a complete family of supersonic rocket-ramjet missiles. Ship, submarine, air and ground launched variants exist.



The missile weighs 3 tonnes at launch and uses a liquid propellant for the ramjet which propels it at speeds between Mach 2.0 and 2.5. The Yakhont typically cruises to the target area at high altitude and then descends for a sea-skimming attack from under the horizon. The distance at which it begins its descent can be programmed before launch, thus determining the achievable range between 65 and 160 nautical miles. Recent materials indicate that up to three rounds can be carried by the Su-30MK/Su-33/Su-35 Flanker variants. The Brahmos has been marketed to Malaysia.

RADUGA KH-22M BURYA

The massive, supersonic Kh-22 (AS-4 Kitchen) was designed during the 1960s for dual role use as a nuclear armed standoff weapon equivalent to the RAF's Blue Steel and as an anti-shipping missile with either radar or anti-radiation seekers.



The Kh-22 remains in service as the primary armament of the RuAF's residual fleet of Tu-22M3 Backfires.

The Kh-22 is a formidable weapon by any measure, powered by an Isayev R-201-300 (S5.33) liquid rocket delivering 83 kN full thrust and 5.9 kN cruise thrust. It is claimed to exceed 4.6 Mach in cruise at 80,000 ft AGL. Cited range varies between 145 NMI (270 km) and 300 NMI (550 km), subject to variant and launch speed/altitude. Russian sources claim the 900 kg shaped charge warhead will blow a five metre diameter hole, penetrating 12 metres deep when impacting a large warship.

Seven variants have been reported to date, and a mid-life upgrade for the APK-22 guidance package has also been recently reported. Nuclear armed variants included a TERCOM system to supplement the inertial unit. If China proceeds with the much speculated upon Backfire purchase (most recent claims are that 12 aircraft have been ordered already), the Kh-22 is likely to be supplied as the basic weapon for the aircraft. The Backfire carries up to three rounds, although typical payloads are one or two, on BD-45K/F adaptors.