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Contents

Active Electronically Scanned Array (AESA) radar. The 9M96 is an extremely agile two-stage solid-propellant missile and is a 'hit-to-kill' weapon. It is cold-launched and employs inertial guidance as well as a datalink. It has canard wings and uses thrust-vectoring to accomplish extremely high '*g*' manoeuvres (well in excess of 20 *g*). Speeds of up to M5 have also been suggested. The 9M100 is a smaller (2.5 m) long missile with a diameter of 125 mm and a range of around 8 km.

Specifications

	9M96	9M96/2
Dimensions and weights		
Length		
overall	4.75 m (15 ft 7 in)	5.65 m (18 ft 6½ in)
Diameter		
body	240 mm (9.45 in)	240 mm (9.45 in)
Performance		
Range		
max	21.6 n miles (40 km; 24.9 miles)	64.8 n miles (120 km; 74.6 miles)
Ordnance components		
Warhead	24 kg (52 lb) HE blast fragmentation	24 kg (52 lb) blast fragmentation

Status
The naval system is believed to be in production for installation as shown in Table 1: Krepost/Redut-K/Redut-Poliment (9M96): deployment.

Contractor
Almaz-Antey (System).
Fakel Engineering Design Bureau (Missile).

Palma (Palash-Palma)/Palista

Type
Close-in weapon system (CIWS).

Development
Palma (NATO designation CADS-N-2), also referred-to as Palash-Palma, uses the main principles in the Kortik/Kashtan CIWS but is designed for use with SACLOS (Semi-Automatic Command to Line of Sight) missiles, such as the Russian Federation Sosna-R (9M337) and Western systems such as Stinger and Mistral. Development was completed in 2003. Trials were conducted in the Tarantul (Molnya)-class fast attack craft which commenced in 2005. It appears to be intended primarily for the export market and although no formal announcements of export orders have been made, it is expected to be deployed at sea operationally for the first time in a Vietnamese Gepard-class frigate.

An improved system, known as Palitsa, using the AO-18KD gatling gun and the two-stage 57E6 (9M330-2) hypersonic missile integrated with a three-dimensional radar capable of engaging targets at ranges of 20 km and altitudes of 15,000 m is understood to be under development. The missile has a 20 kg warhead. Using a phased array antenna and electro-optics, the system is reportedly capable of engaging up to 10 targets per minute.

Description
Palma is a close-in air defence system (with a limited anti-surface capability) which comprises the Sosna-R hypersonic surface-to-air missile, two six-barrel AO-18KD 30 mm automatic cannon and the 3V-89 elecro-optical multichannel electronic countermeasures resistant fire-control system. The gun ammunition load is 1,500 rounds. The 3S-89 mounting accommodates the 3T-99/Positiv ME 1 target acquisition radar, the fire-control system, up to eight missiles in two modules, and two cannon. The system can engage up to six targets simultaneously depending on the number of firing modules installed. The manufacturer quotes missile flight times at ranges of 5 to 8 km as being 6 to 11.5 seconds. The principal control system is electro-optic with radar back-up.

The Sosna-R missile showing the optical ports for the laser proximity fuze
(Miroslav Gyürösi)
1331822

A model of the Sosna-R missile
(Miroslav Gyürösi)
1331821

40 mm Bofors L/60 (US Mk 1, 2, 3, 52/UK Mk 3, 7, 9/Australian AN/South Korean Daewoo ADS) Specifications table

Wartime mountings

	US Mk 1	US Mk 2	US Mk 3	UK Mk 3	UK Mk 5	UK Mk 7	UK Mk 9
Weight (t) - Empty	4.45–6.76	9.07–11.6	1.03	1.22	6.5	1.42	1.40
Traverse	Nominal 360° in all mountings						
Elevation	–15 to +85/90°	–15 to +85/90°	–6 to +90°[1]	–5 to +90°	–15 to +90°	–5 to +90°	–5 to +90°
Training speed	30°/s	26/30°/s	12°/s[1,]	12°/s	35°/s	35°/s	35°/s
Elevation speed	24°/s	24°/s	25°/s[1,]	25°/s	28°/s	45°/s	45°/s
Crew	4	11	5	3	5	3	3

Note:
[1] Mod 0.

Specifications

Post-war mountings

	AN	ADS Basic	ADS Improved
Weight	1.52 t (empty)	5.9 t	3.7 t
Elevation	–5 to +90°	–15 to +85°	–15 to +85°
Traverse speed	80°/s	30°/s	60°/s
Elevation speed	40°/s	20°/s	60°/s
Crew	3	3	3
Power requirements	440 V 3-phase, 60 Hz	n/k	n/k

Calibre:	40 mm
Length of barrel:	56.25 calibres
Muzzle velocity:	881 m/s (new gun); 850 m/s (mid-life)
Range:	5.5 n miles (10 km) surface/surface, 6,900 m AA nominal (US). Note that US shells self-destruct at distances of 3,700–4,600 m; 5.25 n miles (9.8 km) surface/surface 7,100 m AA nominal (UK). UK shells self-destruct at distances of 3,200–6,400 m
Rate of fire:	60 rds/min (practical),
	120 rds/min (cyclic) for air-cooled weapons;
	80 rds/min (practical),
	160 rds/min (cyclic) for water-cooled weapons
Ammunition:	2.21 kg
Cartridge:	40 × 311 R

Status

Some 20,000 US, 4,000 UK and 435 Scandinavian mountings appear to have been produced but production ceased circa 1950–1955. The US Navy may have converted up to 20 Mk 3 mountings to Mod 7 standard and 20–30 to Mk 52 standard but they are no longer in production. Australia produced 30 AN mountings, while Daewoo may have produced a similar number of its mountings. The weapon is installed in the ships/classes listed in Table 1: 40 mm Bofors L/60: deployment, although it should be noted that some vessels are fitted 'for but not with'.

Contractors

Ordnance Factory, Maribyrnong (AN).
Daewoo Heavy Industries Ltd (ADS).

40 mm Bofors L/70 (SAK 40L/70-315/350/520); Bofors 40 mm Mk 3; SAK 40 L/70 Mk 3; Oto Melara Twin 40L70 (Compact Naval Mount)/106/107/520/564/Daewoo Vespa 40 mm L/70k(T); NADM 330; Fath

Type

Multipurpose cannon.

Development

With the introduction of jet aircraft into military service from 1944 onwards it became clear to AB Bofors (later Bofors Weapon Systems and since September 2000 Bofors Defence AB and from 9 August 2005 BAE Systems Bofors AB) that the 40 mm L/60 weapon would require substantial improvement to meet new threats.

In 1944, Bofors began to examine solutions to the problem and concluded that the weapon itself could meet the challenge with the introduction of a 70 calibre barrel, new ammunition and gyrostabilised reflex sights with integral predictor mechanisms. The prototype was completed in July 1949 and testing was completed in late 1949. The first naval mountings appear to have been sold to the Netherlands for the De Ruyter-class cruisers whose lead ship was commissioned in November 1953. Others were ordered for the Holland- and Friesland-class destroyers. The mounting was also purchased by Sweden as m/48.

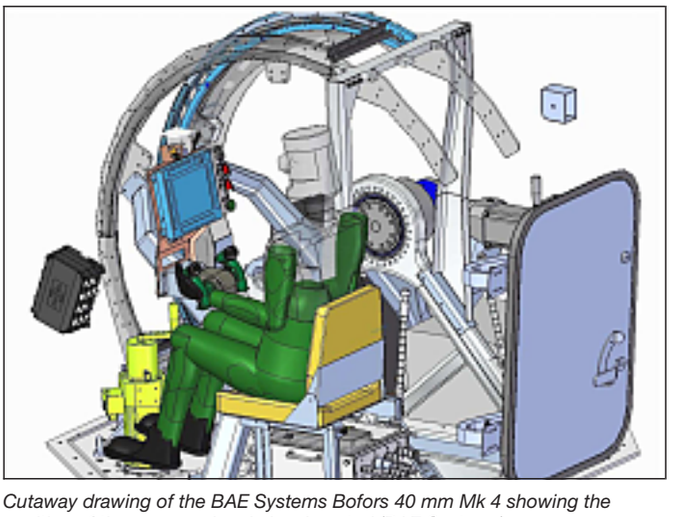
The single 40 mm naval mountings were sold widely (as SAK 40L/70-350 and SAK 40L/70-315) and the Royal Navy planned to purchase them as the Mk 10, with twin Mk 11 and six-barrelled Mk 12 mountings. But in 1957 these plans were abandoned and the Seacat surface-to-air missile was purchased instead. Single naval mountings have been produced under licence in Germany and Spain as well as being reported in Brazil, India and Yugoslavia. During the 1980s enhancements of the 40 mm gun mounting led to a mounting designated SAK 40L/70-600, which has become part of the Trinity system.

In the 1960s Bofors granted a licence agreement to Breda Meccanica Bresciana (later Alenia Difesa Otobreda Division and from December 2001 Oto Melara), which then began producing its own naval mountings, initially with the emphasis upon twin-gun systems of which the first was produced in 1969. Breda appears to have taken the lead in developing improved feeding systems for Bofors guns and the two companies worked closely together to produce the Breda-Bofors System 75.

The improved feeding systems were incorporated by Breda into its Type 70 twin mounting (better known as the 40 L/70 Compact) as well as in Type 520 and 564 single mountings. The Automatic Feed Device (AFD), based upon Breda designs, is also used in new mountings as well as in retrofitted ones. Spain's Bazan (since March 2005 Navantia Systems' FABA factory) also incorporated this technology under licence into the Breda-Bofors 144 Mod 76.

Breda and South Korea's Daewoo appear to have had some form of agreement until 1992. In June 1994, Daewoo began to manufacture its own Vespa twin 40 mm L/70 K (T) mounting for the Korean minelayer *Won San* which was commissioned in September 1997.

By the early 1980s AB Bofors began examining options for upgrading the 40 mm L/70 to meet modern requirements. Its solution was to adopt a triple-path approach based on integrating fire control on the mounting to improve accuracy and lethality. Development of what was originally called SAK 40L/70-600 and later Trinity, began in 1982 with the system unveiled at the Farnborough Air Show in September 1984.



Cutaway drawing of the BAE Systems Bofors 40 mm Mk 4 showing the position of the gunner when in local control (BAE Systems) 1460755

The Bofors SAK 40 L/70-315 (Richard Scott) 1525450

It has a maximum operational depth down to 550 m.

Initially used in French submarines, they have been replaced with more modern weapons including the F 17 and the next generation F 21 torpedoes (see separate entries).

Specifications
See L5 Specifications table.

Status
Some 800 L5s had been manufactured by 1996 when production ceased (see Table 1: L5 torpedoes: deployment).

DCN was awarded a EUR33 million (USD40 million) contract on 30 March 2005, to provide support to keep F17/2 and L5/4 torpedoes in operational status for a period of four years for the French Navy pending the full introduction of the F17 to replace the L5 weapons. The F17 and L5 torpedoes were to be used by the French Navy in operational/warfare scenarios and live firing exercises during that period. The contract ensured the DCN workload at Toulon until 2009 and in 2012/13 it is understood that only weapons for the export market and a limited number for the French surface fleet remain - as shown in the accompanying table. The current status suggests that they remain operational in the two Cassard-class and four George Leygues (Type F 70) DDGHMs as well as the De Grasse (Type F67) DDGHM. They are not fitted in any submarines.

Contractor
DCNS, Paris.

Germany

DM2 A4 SeeHecht/SeaHake Mod4

Type
Anti-surface and anti-submarine heavyweight torpedo.

Development
With the creation of the Bundesmarine (West German Navy) following the Second World War, torpedoes for both submarines and fast attack craft (FAC) were identified as a key objective. Although the first post-war submarines were equipped with the US Mk 37 torpedo and the FACs with the wartime German Type G7a or the British Mk 8 weapons, the ambition was to develop an indigenous long-range, wakeless, wire-guided homing torpedo. A key requirement was for the weapon to be effective in shallow water, particularly the Baltic, which West Germany regarded as their paramount maritime area of interest. Early in 1958 AEG Telefunken (later STN ATLAS now ATLAS Elektronik) began a joint concept study with the Bundesmarine into heavyweight torpedoes. After considering a multirole weapon, it was decided to develop dedicated anti-submarine (ASW) and anti-surface vessel weapons (ASuW) with the two designs having as much commonality as possible.

The DM1 (Deutsches Modell 1) Seeschlange (Sea Serpent) weapon was identified as the priority. Development began in 1960 and it became operational in the 1970s. Progressive improvements resulted in the manufacture of the DM1 Mod in the mid-1970s. Development of the anti-surface vessel weapon, DM2 Seal, was begun by AEG in 1962 and it became operational in 1970. In 1974 it was decided to continue development of DM2 and the DM2 A1 became operational in 1976 for both submarines and FACs. Production of DM1 ceased in 1980, but the DM2 was developed to the DM2 A3 standard with a complementary export version called the SST/SUT (see separate entry). The DM2 A3 continued to be manufactured until 2005. Since then the DM2 A4 has emerged as the most modern option for the German Navy. In the mid-1970s the market demand moved towards dual-purpose weapons and in 1975 AEG began to develop the SUT (Surface and Underwater Target) weapon. The torpedo combined features of the DM1, DM2, and SST4 as well as newly designed components and software. The first sales contract was awarded for these weapons in 1977.

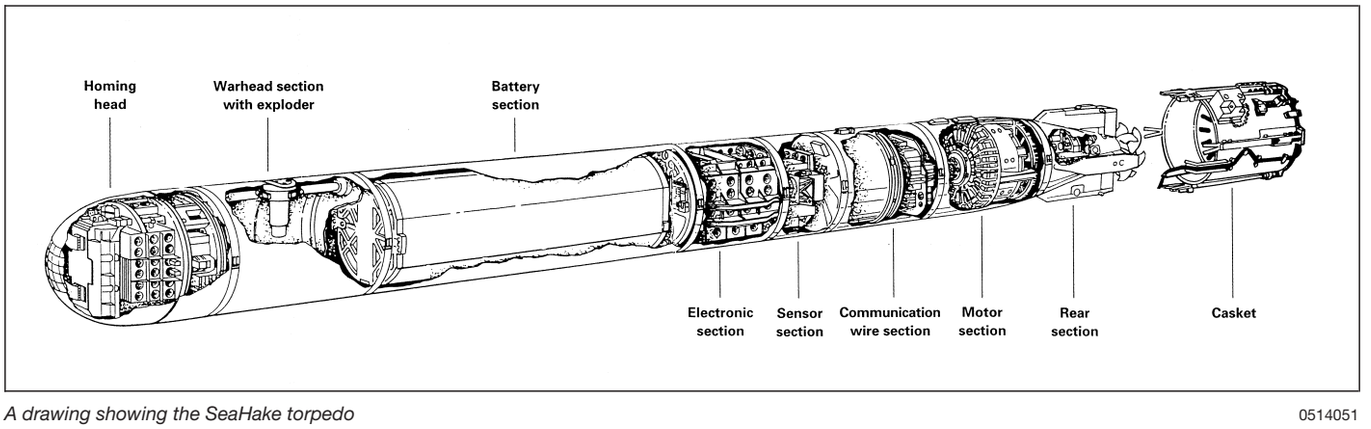
The wire-guided, heavyweight, 21 in (533 mm) acoustic homing torpedoes DM2 A3 and DM2 A4 completely replaced the SEAL/DM2 A1 in the German Navy's inventory. Introduction of the new weapons was undertaken in an incremental fashion to minimise risk and to ensure the availability of proven weapons for the German Navy and export customers on HDW or foreign-designed submarines. German naval philosophy during the Cold War regarded torpedoes as part of the submarine weapons platform but at that time government policy prohibited the export of torpedoes developed specifically for the Bundesmarine. Therefore, in 1968, AEG began developing an export weapon as SST4 (Special Surface Target) (see separate entry) as a derivative of both DM1 and DM2. This torpedo entered production in 1968 and was extensively marketed worldwide alongside the ubiquitous Type 209 submarines.

In 1980 the DM2 A1 Mod entered service and the development continued with a two strand approach. The first involved improved sensor and guidance electronics, while the second saw the introduction of a new propulsion system to improve range and spread. Work on the first stage began in 1985 and, from 1991, DM2 A1 weapons began to be upgraded as DM2 A3 SeeHecht (SeaHake) specifically for the Type 206A submarine upgrade programme. At this point the DM2 A2 was not progressed beyond design concept stage. Development of the improved propulsion was conducted under a Joint Feasibility Programme with France and Italy to examine options for future torpedoes and concluded a preference for an electrical solution.

The development and introduction to service of the Type 212 submarines forced Germany to commence individual development in 1997 of the DM2 A4 with an electrical propulsion system. The warhead section and the exploder were taken from the DM2 A1 but the sensors, fuze and the communication link to the broadside, as well as the entire electronics (command and control) were replaced incorporating contemporary processing and technologies. To meet the increased speed and range requirements for the German Navy over the DM2 A3 a high energy zinc-silver oxide pile battery and a high power, high

SeaHake torpedo (ATLAS Elektronik) 1294879

A DM2 A4 torpedo being loaded in to an Italian Todaro-class (Type 212A) submarine prior to a trial (ATLAS Elektronik) 1294881



A drawing showing the SeaHake torpedo 0514051

EM 52 (T-1)

Type
Rocket propelled rising mine.

Description
The rocket propelled rising mine, EM 52, developed around 1981, closely resembles the first Russian Cluster rising mine. It features a programmable central processor that can accept inputs from acoustic and magnetic sensors and, optionally, pressure sensors. It incorporates a ship counter system (up to a count of 99) which can permit up to 15 actuations before detonation, a delay mechanism of up to 250 days before arming and a self-destruction timer for up to 500 days. There are eight operating modes, which are believed to be mixtures of fuze and logic settings to meet different operational or environmental conditions. The EM 52 can operate in one of three modes: straight rising, vectoring or homing.

The EM-52 is laid by surface vessels and is primarily an anti-surface ship weapon.

Specifications

	EM 52
Dimensions and weights	
Length	
overall	3.7 m (12 ft 1¾ in)
Diameter	
body	450 mm (17.72 in)
Weight	
launch	629 kg (1,386 lb)
Performance	
Depth	
max	200 m (656 ft)
Ordnance components	
Warhead	140 kg (308 lb) RS-211
Fuze	acoustic (passive)
Propulsion	
type	solid propellant

Status
In service. Reports indicate it may also be in service with Iranian forces.

Contractor
Dalian Warship Institute, Dalian.

EM 55

Type
Rocket propelled rising mine.

Description
The EM 55 rocket propelled rising mine closely resembles the first Russian Cluster rising mine. It features a programmable central processor which can accept inputs from acoustic and magnetic sensors and, optionally, pressure sensors. It incorporates a ship counter system (up to a count of 99), which can permit up to 15 actuations before detonation, a delay mechanism of up to 20 days before arming and a self-destruction timer for up to 360 days. Activation is either active or passive acoustic or magnetic, or a combination of any of the three influences. The EM 55 can operate in one of three modes: straight rising, vectoring or homing. The weapon is manufactured in two sizes for deployment by both submarines (533 mm version) and surface ships (450 mm version).

Specifications

Length:	3,500 or 3,350 mm
Diameter:	450 or 533 mm
Weight:	620 or 840 kg
Charge:	130 kg RS-211 or 380 kg
Operating depth:	Case depth: 45 m (max)
Actuation:	Multiple influence – acoustic, seismic, pressure, magnetic. Sophisticated processing and algorithms
Deployment:	Submarine-laid allowing covert deployment from a standoff range up to 13 km
	Possible shore-based launch – ASUW
	Floating launch option from a dedicated towed deployment barge

Status
In service. Reports indicate it may be in service with Iranian forces.

Contractor
Dalian Warship Institute, Dalian.

Finland

Blocker

Type
Insensitive munitions (IM) influence ground sea mine

Development
Blocker influence sea mine was announced by Forcit Oy Finland at DSEI 2013 in London on 12 September.

The company has been involved in the development of commercial and military explosives for over 100 years and over that time Blocker has benefited from the experience gained in commercial and land mine product development and the technologies for production of insensitive munitions. Their use of plastic bonded explosives and development of insensitive munitions commenced in the 1980s. It is believed that the customer base is predominantly in the Baltic region with only nine recorded export sales of IM products in 2009. The company policy however is to expand their market share worldwide.

Description
Blocker is a multi-influence ground mine developed for the existing market by Forcit Oy incorporating 'smart' technologies and mines able to accept a range of customer-programmed algorithms and operating parameters to discriminate between neutral/friendly shipping and threat targets on the basis of the detected signatures.

In common with many sea mine developments there is limited specific details available on the construction and performance characteristics although it is understood to be fitted with three unspecified independent safety systems to prevent inadvertent detonation. Company literature emphasises the certification of the 'extremely' insensitive proprietary Forcit plastic bonded explosive (PBE) with an FPX R1 PBE booster charge, which complies with NATO STANAG 4439. The explosive also qualifies for use under NATO STANAG 4170 and the associated AOP-7 (Manual Of Data Requirements And Tests For The Qualification Of Explosives Materials For Military Use) documents.

Overall the mine weighs 710 kg and contains 550 kg of the PBE and FPX R1 booster charge material. The measured performance is assessed by the manufacturer, with the bubble effect to be the equivalent of 1,260 kg of standard TNT. The physical dimensions are 130 × 90 × 90 cm and it is promoted as having a maintenance free shelf life of 25 years.

Details of the influence fuse activators are vague, but listed as passive acoustic, magnetic, and pressure sensors and an option exists for a wire (fibre optic) remote control for a man in the loop solution. Details of the pre-

Blocker insensitive munition influence mine on display at DSEI 2013
(IHS/Nick Brown) 1516980