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Anti-tank Guided Weapons

Anti-tank guided weapons (ATGWs) are small missile-launching systems. They differ from unguided rocket launchers, such as the RPG-7, because their missiles are designed to be steered, or 'guided', to a target after launch (i.e. during flight). These weapons are traditionally designed to disable armoured vehicles, but particularly over the last decade or so, producers have developed variants intended for use against other targets, such as hardened bunkers and buildings. The first ATGWs were created when advances in armour made traditional direct-fire anti-tank guns and rocket launchers less effective. Moreover, ATGWs offer soldiers the ability to engage targets from greater distances with increased accuracy than is possible with unguided anti-tank light weapons. ATGWs have an effective range of up to 8,000 m (five miles) and armour penetration of around 1,000 mm (3.3 feet) (Jane's, 1985, pp. 49–69; 2007, pp. 445–509). However, each generation of weapon varies greatly in terms of its guidance, lethality and portability.

Three distinct generations of ATGWs have been developed since the 1950s, with changes to the guidance system largely determining the generation. Broadly speaking, initially these weapons were wire-guided, but subsequent weapons first supplemented or replaced manual manipulation with radio waves and lasers, and later introduced infrared (IR) technologies that enhanced target acquisition. Concurrent with changes to these weapons' navigation systems were improvements to their range and payload. Whereas first-generation ATGWs might effectively engage a target at 1,500 m and penetrate 500 mm of armour, third-generation systems are effective at distances up to 8 km and can penetrate up to 1 m of armour (Jane's, 2007, pp. 445–509).

Spike

First-generation ATGW missiles were guided to the target after launch by a wire in the rear of the missile that was connected to the firing unit. The operator often used a joystick to manually control the direction of the projectile. Early launchers were as simple as a disposable transport box that was either placed on the ground or mounted on a vehicle. This system was known as the manual command to line-of-sight (MCLOS) system (Jane's, 2007, pp. 445–509). During the Second World War the Germans employed the X-7, the first MCLOS system (Gander, 2000, pp. 136–52). The French SS-10 and German Cobra, both modelled on the X-7, were the first ATGWs available for export, although they remained in production for only a short time (Jane's, 1975, p. 743; 1985, p. 51). In 1963 the 9K11 Malyutka, also known as the AT-3 (US designation) or Sagger (NATO codename), became the first man-portable Soviet ATGW.[1] The Malyutka/AT-3 was widely exported and subsequently widely copied. China, for example, developed a series of 'Red Arrow' missiles in the 1970s and 1980s based on this weapon (upgrading the guidance systems and payloads along the way) (Jane's, 2009).[2] A drawback of first-generation models, independent of their relative effectiveness, was that the gunner had to remain in the same position while the warhead was in flight. If the target was not effectively neutralized or if there were other forces within range of attack, the ATGW operator was quite vulnerable.

Second-generation systems, known as semi-automatic command to line-of-sight systems (SACLOS), saw significant improvements in performance. After the missile is launched, the operator keeps the sight on the target, whereby automatic guidance commands are sent to the missile via wire, radio, or laser-beam-riding technology. SACLOS missiles outperform first-generation systems with accuracy rates exceeding 90 per cent. Moreover, SACLOS missiles reach effective ranges of between 2,500 and 5,500 m with warhead armour penetration of up to 900 mm, almost twice the range and payload of first-generation models (Jane's, 2007, pp. 445–509). The United States introduced the tube-launched, optically

US Marines fire a tube-launched, optically tracked, wire-guided missile (TOW) during an exercise at Fort Pickett, United States. 30 March 1998. © AFP PHOTO/DOD/T.A. POPE

tracked, wire-guided missile (TOW) in 1968. By 2009 more than 660,000 TOW missiles and 15,000 launchers had been procured, making the system the most widely deployed of all ATGWs (Gander, 2000, p. 140; Jane's, 2009). France and Germany jointly began producing the Missile d'infanterie léger antichar (MILAN, infantry light anti-tank missile) shortly thereafter.

Despite advances made in SACLOS models, operators were still vulnerable to counter-attack due to their immobility. Third-generation guidance systems ameliorated this threat by having a passive IR seeker installed on the nose of the missile to lock on and reach the target automatically. The seeker functions by continuously comparing target data taken before launch to what the seeker sees using pattern recognition algorithms and manoeuvring the missile appropriately. In recently designed missiles it is most often a photographic-like image.[3] Unlike wire-guided and laser-beam-riding missiles, IR technology enables the operator to reposition or reload immediately. First developed in the 1980s, these 'fire-and-forget' (FaF) guidance systems allow the operator to retreat immediately after firing.[4] The most notable of these weapons is Israel's Spike. The full series of Spike missiles consists of the Spike Medium Range (MR), Spike Long Range (LR), and Spike Extended Range (ER), with maximum ranges of 2,500, 4,000, and 8,000 m, respectively (Jane's, 2009). Other IR ATGWs include the Indian Nag and the US- and British-manufactured Javelin. Maximum range varies considerably. Whereas maximum ranges are typically between 4,000 and 8,000 m (Jane's, 2007, pp. 445–509), some models have shorter firing ranges to suit current environments of combat (FI, 2007a). Moreover, IR models tend to be lighter and collapsible (i.e. capable of being broken down into lighter and smaller component parts) for transportability. These developments allow soldiers increased versatility in urban spaces. For example, these systems have been employed in Afghanistan and Iraq, where manoeuvrability is limited due to fighting in buildings and at close quarters, in comparison to prior military engagements in Vietnam and Latin America.

The costs of ATGWs vary considerably. The basic TOW and MILAN, as well as other SACLOS missiles, are reportedly priced at around USD 10,000 apiece. Third-generation systems that use IR guidance missiles cost many times this amount (FI, 2007b).[5] While data on unit costs for some systems is available, little is known about the price of many ATGWs. Even when it is possible to obtain information on values for certain contracts, a missile's or launcher's specific price is hard to calculate. Licensing agreements under which unit costs will change over time add to the incertitude (see Box 1).

In 2007 more than 30 countries have fully or partially produced ATGWs. Seven of these countries were fully manufacturing ATGWs with FaF guidance systems. Many of the countries that produced MCLOS systems have chosen to cease production for a variety of reasons: an obsolete design with low hit probability, gunner

Box 1 Licensing agreements and offsets: the case of the Spike in Poland

Israel has exported Rafael's Spike ATGW to several countries since Singapore first purchased the system in 1999. Since then, Rafael has received several additional orders, including for sales to Finland, the Netherlands, Poland and Spain. Between 2000 and 2009 at least 432 missiles, launchers, and complete systems were imported. This figure remains relatively low, because several of these purchases have included licensed production and offset agreements. For instance, the December 2003 deal between Poland and Israel for PLN 1.487 billion (USD 512 million) covered the sale of 2,675 missiles and 264 launchers with substantial local manufacture involved. The Israeli manufacturer provided initial materials for the missile, with the Polish company ZM Mesko and Polish partners responsible for producing numerous components. Up to ten companies are to be involved. The missiles' warheads, rocket engines (launch booster and sustainer), and launch tubes are among the parts to be made in Poland. All told, 70 per cent of the missile is to be manufactured in Poland. Rafael will supply the thermal imager, firing post, tripod, and simulators. Under the offset agreements, ZM Mesko will deliver 2,000 warheads and motors to Rafael. ZM Mesko will also be able to use some technologies received from Rafael to improve or develop other indigenous projects.

Sources: Holdanowicz (2004; 2007); Jane's (2005); Small Arms Survey (2011)

An Israeli school bus damaged by a second-generation Kornet missile fired by Hamas. 7 April 2011. © REUTERS/Baz Ratner

vulnerability, a limited ability to penetrate modern armour, and sufficient stockpiles to satisfy demand. Roughly half of the systems produced are essentially copies of another country's design such as the 9K11 Malyutka (AT-3 Sagger), TOW, and Spike. As of 2007 roughly 14 countries produced ATGWs with technology acquired from six technology-owning countries, either with or without a formal licence. Most licensing agreements include offsets, which are supplementary arrangements to compensate the purchaser in some fashion—either directly in terms of the item in question, or indirectly involving some other good or service (Small Arms Survey, 2007, p. 12).

As with man-portable air defence systems (MANPADS), ATGWs are to be found in the stocks of a great number of states. By one account, more than 100 countries have such weapons in their inventories (FI, 2007a). More than half of these states' arsenals are believed to possess mostly the less sophisticated and less able MCLOS systems. The international community has expended more energy and greater resources on destroying MANPADS—both outside state control and state holdings—than it has ATGWs.

Non-state armed groups also possess ATGWs, but apparently not (yet) third-generation models. At least nine such actors reportedly possess (or have possessed) first-generation MCLOS systems (Small Arms Survey, 2008, pp. 32–33). In recent years, several groups are understood to have obtained second-generation SACLOS models. Hezbollah, for instance, reportedly received, among other models, hundreds of 9K111 Fagots (AT-4 Spigots) and 9P133 Kornets (AT-14 Spriggans) from Iran and Syria (Wezeman et al., 2007, p. 410). In October 2009 Somali militiamen fired a Russian model 9K115 Metis (AT-7 Saxhorn) at African Union forces in Mogadishu (UNSC, 2010, para. 158). In April 2011 Hamas fired a Russian model laser-beam-riding 9P133 Kornet (AT-14 Spriggan) at a bus in Israel (CNN, 2011). Free Syrian Army rebels looted the same type of missiles from government stocks in early 2012 (*Daily Star*, 2011). That said, whether the result of tighter controls or limited demand, research suggests that fewer of these groups own ATGWs than possess MANPADS.

ATGWs will continue to be developed to fulfil their initial anti-armour function, but comparatively greater emphasis will be laid on ways to engage other fortified targets. The focus primarily will be on increased portability (e.g. reduced weight and smaller sizes), technical sophistication (e.g. non-line-of-sight targeting), and cost effectiveness. ■

Notes

1 While the Malyutka/Sagger was deployed on several platforms, the AT-3's predecessors—the AT-1 Snapper (3M6 Schmel) and AT-2 Swatter (3M11 Fleyta)—were *only* launched from armoured vehicles or helicopters.

2 The most recent models of the Red Arrow—and their numerous variants—have little in common with their predecessors.

3 Author correspondence with Richard Jones, consulting editor, *Jane's Infantry Weapons Yearbook*, 16 March 2011.

4 A new generation of guidance, the predicted line of sight, consists of a FaF system in which the trajectory of the missile is calculated *prior* to launch (Jane's, 2001, p. 415).

5 The significant increase in ATGWs' costs—combined with the complexity of learning how to operate these advanced systems—have resulted in procurers' growing reliance on simulators for training purposes. Author correspondence with Richard Jones, 16 March 2011.

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Authors: Eric G. Berman and Jonah Leff

Copy-editing: Alex Potter (fpcc@mtnloaded.co.za)

Design and layout: Richard Jones (rick@studioexile.com)

Contact details

Small Arms Survey
Graduate Institute of International and Development Studies
47 Avenue Blanc, 1202 Geneva
Switzerland

t +41 22 908 5777
f +41 22 732 2738