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Research Notes WEAPONS & MARKETS

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Man-Portable Air Defence Systems (MANPADS)

Man-portable air defence systems (MANPADS) are short-range surface-to-air missile systems[1] intended for attacking and defending against low-flying aircraft. Some are crew-served (known sometimes as CREWPADS), but most are easily handled by a single individual and are shoulder-launched. MANPADS are generally categorized according to their guidance systems: passive infrared (IR) seekers, radio command line-of-sight (CLOS), and laser-beam riders.[2] Initial models of IR-seeking missiles could engage a target at altitudes of around 2,000–3,000 m and from slant ranges[3] of about 4,000 m (Jane's, 2006, pp. 3–50; 1985, pp. 132–37). They were often inaccurate and susceptible to basic countermeasures. Moreover, most could engage aircraft only from behind. Today's most advanced MANPADS can effectively engage aircraft at ranges of up to 8,000 m (5 miles) and from multiple directions (Saab, n.d.).

Initial development of MANPADS began in the 1950s. Anti-aircraft guns from the Second World War were of limited use, and consumed vast quantities of ammunition, against increasingly fast jet aircraft. The United States developed the Redeye—which got its name from the infrared homing device in its nose—over the better part of a decade, and it entered into production in the mid-1960s (Parsch, 2002). The Soviets fielded their own system—the Strela-2 (also known as the SA-7, which is used here, or Grail)—in 1968.[4] Both were 'tail-chase' systems effective only when fired at the target from behind. By the end of the 1960s only these two countries produced MANPADS, although Sweden and the United Kingdom had undertaken research and development of indigenous weapons.

The 1970s saw a significant expansion of the industry. The United States began development of the Stinger missile system in 1972 (Parsch, 2002) and production began in 1979 (Jane's, 2006, p. 43). Work on the Soviet Strela-3 (SA-14 Gremlin) began in 1968, and it entered service six years later in 1974 (Jane's, 2006, p. 30). Like their predecessors, these systems were IR-seeking missiles, but they were able to engage targets from multiple directions (not just from behind). Second-generation IR seekers also achieved a greater effective range and accuracy. The British Blowpipe system was based on radio CLOS technology, while the Swedish RBS-70 uses a laser beam-riding system (Jane's, 1985, pp. 133–34).

Whereas the first 25 years of MANPADS research and development had resulted in just four countries producing weapons, the next 25 years saw this number rise considerably. More than 30 countries have manufactured an entire system, produced important components, or upgraded certain aspects of an existing system such as target acquisition (Small Arms Survey, 2008, pp. 34–35).

Licensed production and reverse engineering (unauthorized copying of existing systems) of mostly early Soviet models largely explain this increase in states' production of MANPADS. The issue of licensing is sensitive and contentious for the Russian Federation and many former Warsaw Pact countries. Moscow claims that current MANPADS systems are being produced illegally in some of these countries. Those accused retort, however, either that no such licence exists or that the models being produced are their own missiles, i.e. that they reflect years of indigenous improvements (Small Arms Survey, 2007, pp. 20–21). For some producers there is no pretence of any licence having existed. In the late 1970s, for example, the Egyptians produced a reverse-engineered copy of the SA-7, called the Ayn-al-Saqr. In 1974 the Egyptian government allegedly supplied Beijing and Pyongyang with a small number of SA-7s in appreciation of their

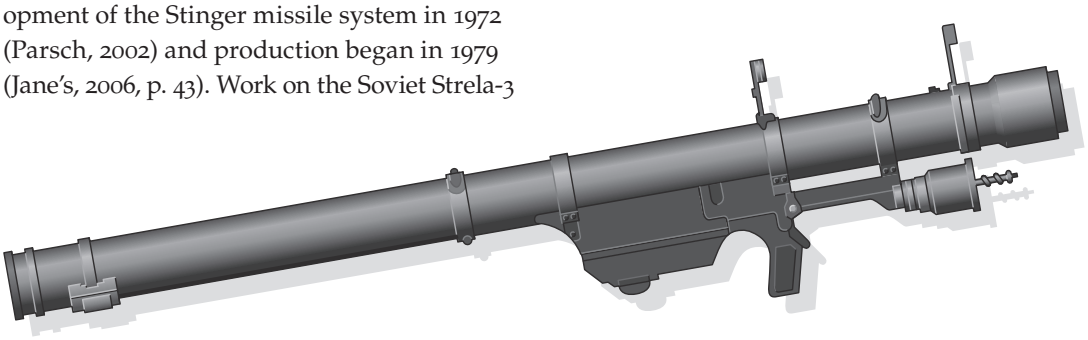
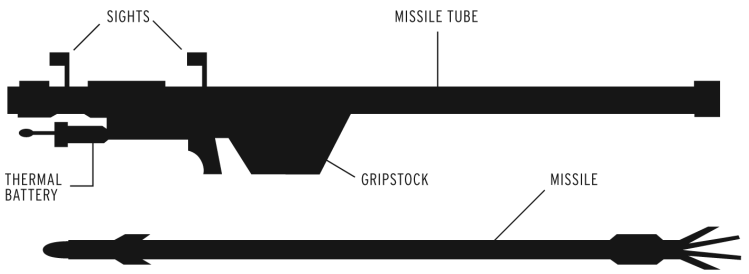


Table 1 **Selected incidents of reported MANPADS attacks on civilian aircraft**

Date dd.mm.yy	Location	Target	Fatalities	Description
12.03.75	Vietnam	Air Vietnam Douglas C-54D-5-DC	26	The passenger airliner, en route from Vientiane, crashed some 350 km (215 miles) northeast of its scheduled destination, Saigon (now Ho Chi Minh City). All passengers and crew members were killed.
03.07.78	Zimbabwe	Air Rhodesia Vickers 782D Viscount	38	An SA-7 missile hit the passenger plane's right wing shortly after take-off from Kariba. The plane crash-landed. Zimbabwe People's Revolutionary Army (ZIPRA) rebels, responsible for the shooting, subsequently killed many of the plane's survivors.
12.02.79	Zimbabwe	Air Rhodesia Vickers 748D Viscount	59	ZIPRA fired on the aircraft with an SA-7 after it left Kariba, hitting the left engine, killing all aboard.
08.11.83	Angola	Angola Airlines Boeing 737-2M2	130	Immediately after taking off from Lubango, the plane crashed. National Union for the Total Independence of Angola (UNITA) rebels claimed credit for downing the plane with a missile. The Angolan government blamed the crash on a technical malfunction.
04.09.85	Afghanistan	Bakhtar Afghan Antonov AN-26	52	The plane was shot down with a surface-to-air missile shortly after take-off from Kandahar.
16.08.86	Sudan	Sudan Airways Fokker F-27	60	The Sudan People's Liberation Army (SPLA) firing a SA-7 brought down the aircraft shortly after take-off from Malakal.
11.06.87	Afghanistan	Bakhtar Alwatana Antonov AN-26	53	The plane was shot down near Khost on its way from Kandahar to Kabul.
08.12.88	Western Sahara	Two T&G Aviation Douglas DC-7CF	5	Two aircraft on the way from Senegal to Morocco were hit (in an engine) with SA-7s while flying at 3,352 metre (11,000 ft) over Western Sahara. One crashed, killing all five aboard. The other managed to land safely in Morocco.
06.04.94	Rwanda	Rwandan government Dassault Falcon 50	12	The plane, carrying the presidents of Burundi and Rwanda, was shot down on approach to Kigali from peace talks in Tanzania.
10.10.98	Democratic Republic of the Congo	Lignes Aeriennes Congolaises Boeing 727-30	41	The plane was shot down with an SA-7 missile shortly after take-off from Kindu.
02.01.99	Angola	Transafrik Lockheed L-100-30 Hercules	9	UNITA shot down the plane some 20 minutes after take-off from Huambo on the way to Luanda. (A Hercules aircraft had suffered a similar fate upon departing Huambo a week earlier, in which 14 people perished.)
28.11.02	Kenya	Arkia Boeing 757-3E7	0	Two SA-7 missiles missed the plane carrying 271 people shortly after take-off from Mombasa.
22.11.03	Iraq	European Air Transport Airbus A300B4-203F	0	An SA-7 missile hit the cargo plane's wing as it climbed past 2,438 m (8,000 ft.). The heavily damaged plane returned to Baghdad safely.
23.03.07	Somalia	Transaviaexport IL-76TD	11	The plane crashed after one of two SA-18 missiles fired by Hizbul Shabaab hit the plane shortly after take-off from Mogadishu
13.08.07	Iraq	Nordic Airways MD-83	0	Pilots of the passenger jet said two missiles were fired at their plane after take-off from Sulaimaniya.

Sources: ASN (2010); Chivers (2007); USDoS (2005; 2008); UNSC (2007, para. 39)



Note: Not all MANPADS follow this design. MANPADS such as the Swedish RBS 70 and the French Mistral are mounted on pedestal launchers.

support during the 1973 Yom Kippur War. Subsequently, both China and North Korea produced their own versions of the weapon (Jane's, 2006, p. 10). There are also reports that the US Stinger has been illegally copied, albeit not as widely as Soviet models.[5]

Later generation IR MANPADS have longer ranges, more effective seekers, and are more resistant to IR countermeasures than their predecessors (Jane's, 2006). Many systems also have larger warheads, with proximity, delay, or grazing fuses, which increase the missiles' lethality, and, in some cases, the types of targets that can be engaged. The Bolide missile, which is compatible with the RBS-70 launcher, is reportedly effective against both air and ground targets (Saab, n.d.).

MANPADS and their missiles were built in large numbers and transferred widely, often without stringent controls or oversight. More than 100 countries—and non-state actors—possess these weapons (Small Arms Survey, 2004, pp. 83-87). Of the 500,000–750,000 MANPADS believed to be in circulation, some 99 per cent are estimated to be in state inventories (GAO, 2004, p. 10). But many governments and regional organizations deem the stockpile management procedures for tens of thousands of these weapons to be wanting (see, for example, Schroeder, 2007). The United States alone has destroyed more than 32,000 MANPADS since 2003 in more than two dozen countries, and has improved security in depots holding thousands more missiles (USDoS, 2010, p. 7; USDoS, 2009). More than 30 non-state armed groups in more than 20 countries are reported to possess—or have possessed—MANPADS (Small Arms Survey, 2008, pp. 32–33), the result of deliberate government policy, seizure on the battlefield, lax export controls, and stockpile mismanagement.

MANPADS are designed to function for many years. A shelf-life of ten or even twenty years is not unheard of. The two SA-7b MANPADS used in the November 2002 attack against the Israeli airliner in Mombasa, Kenya, reportedly comprised critical components manufactured in the 1970s (see, for example, United Nations, 2003, pp. 29–30; Richardson, 2003) (See Table 1 on page 2 for examples of MANPADS attacks on civilian aircraft). Storage conditions can affect the longevity of the system.[6]

Recent advances in MANPADS technology have increased their range, speed, and target sets. New motors, for example, have extended the ranges of systems such as the Swedish Bolide, and increasingly sophisticated proximity fuses allow for more effective engagement of smaller targets, such as UAVs (Jane's, 2009a; Jane's, 2009b).

Other recent advances include the introduction of automated command-and-control systems. Belarus and Israel have developed the Shlem and Red Sky, respectively. These are integrated multiple launch systems that rely on global positioning and infrared technology to reach targets with greater accuracy. One added benefit is that the launch unit is equipped so that the operator can send cues to the launcher from a distance via computer (Gyürösi, 2003; Republic of Belarus, 2009; Jane's, 2010b). ■

SA-7b missile recovered from an arms cache in Iraq, September 2008. Markings on the launch tube indicate that it was manufactured in 1978.

Photo: United States Central Command (released to the Federation of American Scientists in May 2010)

Sourcing

This *Research Note* is based on Eric G. Berman and Jonah Leff, "Light Weapons: Products, Producers, and Proliferation," *Small Arms Survey 2008: Risk and Resilience,* Cambridge: Cambridge University Press, pp. 7–41. It has been updated by Eric G. Berman and Matt Schroeder.

Notes

1 Short-range surface-to-air-missiles generally have maximum ranges of less than 10,000 m. Medium- and long-range surface-to-air-missiles have maximum ranges more than ten times the distance of short-range models.

2 In addition to the three main types of guidance systems identified above, the Chinese produce a version of their QW-3 missile featuring a laser semi-active guidance system (Jane's, 2010a).

3 Slant range is the 'line of sight' distance between the weapon and target (in contrast to the vertical altitude of the target).

4 Strela is Russian for 'arrow'. Moscow designated it the 9K32M, but this text refers to it as the North Atlantic Treaty Organization (NATO) designated SA-7b or Grail, by which it is commonly known. Variants of the weapon are known as the Hongying 5 or HN-5 in China, the Anza in Pakistan, the Ayn-al-Saqr in Egypt, and the CA-94M in Romania.

5 For example, a Greek industrialist affiliated with the licensed production of the Stinger shared proprietary information on the missile with the Soviets (Anastasi, 1987a; 1987b).

6 Thermal batteries used in MANPADS have long shelf-lives, but once activated

to power-up the missile and guidance system, they only function for a period lasting minutes at most.

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