A Boeing C-17 Globemaster III fires decoy flares in flight. The flares are designed to redirect missiles away from the aircraft if it comes under attack.

Big Issue, Big Problem?
MANPADS

3

INTRODUCTION

In November 2002, an Israeli passenger aircraft, flying out of Mombasa, Kenya, came under fire from two surface-to-air missiles. Although the missiles missed their target, the event sent waves through the international media and launched another round of a long-standing debate—a debate since reinvigorated by strikes on civilian and military aircraft in Iraq. The weapon used was a Soviet designed SA-7, one of a variety of light weapons commonly called man-portable air defence systems, or MANPADS. MANPADS are small, light, missile-launching weapons designed to be fired by an operator on the ground against a target in the air.

MANPADS are small, light, missile-launching weapons designed to be fired by an operator on the ground against a target in the air.

MANPADS have been the focus of unprecedented media attention since 2002. A symptom of recent attacks, public alertness to the threat they pose to civilian aircraft is arguably greater than ever before. Much of this attention centres on the fear of terrorist attacks, although MANPADS have been, and still are, used primarily in war zones. Against a backdrop of often-conflicting reports, this chapter attempts to clarify some of the basic trends in MANPADS production, stockpiling, transfer, and use, and in the measures taken to control their proliferation. Many of the findings add to those already reported, while others cast doubt on prior claims and figures cited. The following are some of the chapter's key findings:

- MANPADS are proliferating more widely and recent models are sophisticated enough to defeat many existing countermeasures.
- There are probably fewer than 100,000 complete systems in existence, but many older models may still be operational, contrary to some conservative shelf-life estimates.
- Not all states in possession of MANPADS police proliferation adequately, and the latest generation of MANPADS is proliferating at least as widely as older models.
- At least 13 non-state groups possess MANPADS. Some of these groups are considered terrorist organizations, although their ability to use MANPADS effectively may be in question.
- Much current speculation overplays the importance of MANPADS to date, but it has been key in prompting much-needed action from the international community.
- International measures to control proliferation are gaining support but are embryonic and late in coming.

This chapter is based on information obtained from open public sources. These include a number of MANPADS field manuals, which were obtained from the Internet. The chapter addresses the following questions:

- What are the trends in MANPADS production and transfer?
- What is the scale of global stockpiles of MANPADS and who is in possession of them?

- How easy is it for non-state groups to use MANPADS and are current fears justified?
- What initiatives are in operation to protect against MANPADS proliferation and use?

MANPADS have been in existence for nearly 40 years. Since the Cold War, the number of companies producing MANPADS has diminished, although in the last two decades the number of countries hosting their production has increased. Around 15 companies and consortia in more than 15 countries currently produce MANPADS. On the whole, production is confined to countries with well-developed defence industries, although some new cases indicate that this trend is unlikely to continue. MANPADS are in the arsenals of around 105 states. Many states that produce and stockpile MANPADS have poor records of stockpile security. Collapsed states, transfers to warring factions, and a lack of stockpile security are thought to be responsible for stockpiles in the hands of at least 13 non-state groups, some of which are considered terrorist. Whether all of these actors can use their MANPADS is questionable because of the training and maintenance needed to operate them, but knowledge is perhaps harder to police than the weapons themselves. Current speculation undoubtedly overestimates the number of MANPADS in existence, their longevity, and the ease with which they can be used. Yet proliferation, in terms of production and the number of states using MANPADS, in conjunction with increasingly sophisticated technology, suggests a significant potential problem. In truth, such exaggerated speculation has served a purpose, for it is, in no small part, responsible for a number of international initiatives, some more promising than others, that have been launched since 2002. MANPADS may thus be one of the few small arms and light weapons issues whose politicization has not followed a widespread loss of life and infrastructure, but only if the international community continues to act. MANPADS are a big issue with the potential to be a big problem.

CHARACTERISTICS AND TECHNOLOGIES

The technology involved in producing even the oldest models of MANPADS far surpasses the technology required to produce most types of small arms and light weapons. MANPADS offer an anti-aircraft capability that before their invention could be found either in less technologically advanced and often bulkier weapons such as light anti-aircraft guns or in far larger missile systems. They are by no means homogeneous, and some MANPADS are larger than others and mounted on substantial pedestals; however they can certainly be classified as light weapons, as the 2003 Wassenaar definition suggests:

a) surface-to-air missile systems designed to be man-portable and carried and fired by a single individual; and
b) other surface-to-air missile systems designed to be operated and fired by more than one individual acting as a crew and portable by several individuals (Wassenaar, 2003, §1.1).

Thus, factors of technology, not size, have often led to their placement alongside large conventional weapons in analyses of the national weapons inventories of states (IISS, 2003; SIPRI, 2003). Yet in practice they have not been included in major arms control initiatives, such as the Conventional Armed Forces in Europe (CFE) Treaty. Nor have they been prominent in the debate on small arms and light weapons—as is true of many light weapons. In short, their technology places them in the realms of major weapons systems, while their size defines them as light weapons. As a consequence they have, to date, occupied a grey area in between.

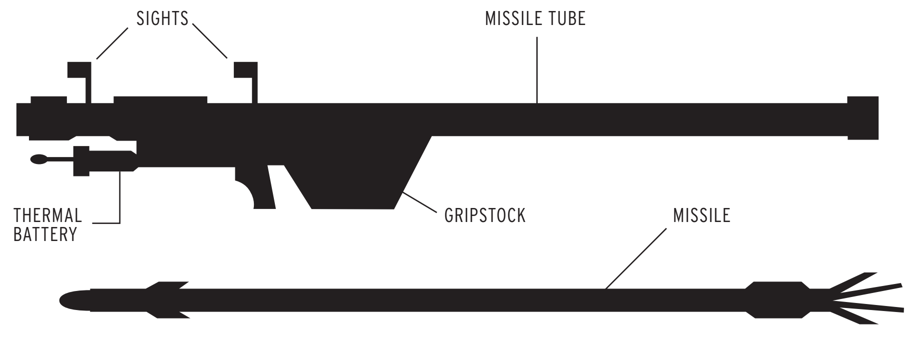
Another feature of the MANPADS debate in the media is that it is punctuated by inconsistency in reporting, in terms both of technological capability—particularly their shelf-life (see Box 3.1)—and of the names assigned to various systems. Lay persons are thus confronted with a plethora of designations, as Table 3.1 briefly illustrates.

Table 3.1 Selected Soviet/Russian MANPADS designations

US Dept. Defense	NATO	USSR/Russian	Manufacturer	Missile
SA-7	Grail	Strela-2	9K32	9M32
SA-16	Gimlet	Igla-1	9K310	9M313
SA-18	Grouse	Igla	9K38	9M39

Most MANPADS comprise a tube-like launcher, out of which is fired a rocket-propelled guided missile. These single-use missile tubes are fitted to a reloadable 'gripstock' (see Figure 3.1) or pedestal launcher. MANPADS also feature a battery to power the electronics of the weapon and often a coolant unit to cool the missile's sensors. Most missiles use either an infrared (IR) guidance system, which acquires a target by contrasting the heat signature from an aircraft's engine or exhaust tube with the temperature of the surrounding sky—so called fire-and-forget missiles—or a method of operator guidance, whereby the user's commands are conveyed to the missile via radio signal and, in recent years, along a laser beam.

Figure 3.1 Main elements of a MANPADS: Soviet SA-7b



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

The former method is more common and as this means of acquisition is 'passive'—that is, it does not rely on the launcher emitting energy (sending a signal to the missile)—such weapons are difficult to detect and greatly feared by aviators (*National Defense*, 2003). Nevertheless, in the hands of trained operators, the latter method may offer greater accuracy as the operator is able to guide the missile to its target, irrespective of countermeasures.

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Nicaraguan soldiers parade Russian-made SA-7 MANPADS during the celebration of the army's 24th anniversary in Managua in September 2003.

MANPADS are becoming increasingly sophisticated.

MANPADS are becoming increasingly sophisticated. The latest models offer greater range, greater flexibility in launching against targets, more chance of hitting the target, and greater destructive effects upon doing so. First-generation MANPADS, such as the Soviet SA-7 and the US FIM-43 Redeye, relied on the passive IR guidance system. These weapons were somewhat limited because they had to be launched from behind an aircraft in order for their sensors to 'lock on' to the heat from its exhausts. They were also constrained by the range at which they could engage an aircraft—generally fewer than 5,000 metres. The latest MANPADS technology (see Table 3.2) has improved upon this, utilizing more sophisticated IR seekers that can target an aircraft head-on or direct the missile to strike the body of an aircraft rather than the exhaust alone. These later MANPADS are broadly classified as 'second generation' because their technology is better and their range exceeds that of their predecessors. Many now use a combination of energy seekers, operating on both the IR and ultraviolet (UV) spectrums. Others follow a laser beam with which the operator illuminates the target. These newer MANPADS can engage aircraft at ranges of up to 6,000 metres. The probability of destroying aircraft has also increased with proximity fuses, which detonate close to the target, thus eliminating the need for a direct hit. The combined results of these improvements are that MANPADS can now be operated from a greater number of positions, to greater ranges, and with a far greater chance of hitting crucial parts of the target, such as the fuselage or fuel tanks.

MANPADS PRODUCTION

In contrast to most other small arms and light weapons, the production of MANPADS is currently limited to a small number of manufacturers (PRODUCERS). This is a function both of barriers to production imposed by the technology involved and of measures taken by some states to limit the proliferation of MANPADS technology. Prospects for their long-term manufacture have been called into question by envisaged developments in kinetic energy weapons, but this is an extremely long-term view, and MANPADS are likely to remain in production for a number of years to come (Forecast International, 2003a), potentially by a greater number of companies.

At present, at least 15 companies and consortia produce MANPADS in more than 15 countries. The number of companies producing MANPADS has declined in recent decades because of an unprecedented number of company mergers and acquisitions following the end of the Cold War. Yet, while production was previously limited to the United States, the USSR and its satellites, Western Europe, and China, states such as Egypt, North Korea, and Pakistan have been producing copies of existing MANPADS since the 1980s. In the last decade states, including Singapore and Vietnam, have acquired government licences to produce Chinese and Russian systems. Thus, while the majority of states producing MANPADS have well-developed military industries, the case of Vietnam illustrates that states gaining either technology or manufacturing licences in the future—albeit for assembly rather than for complex manufacturing—may not possess such advanced military industries. The technology factor seems so far to have prevented more widespread production of MANPADS, because very few of the second tier of countries mentioned above have developed MANPADS themselves and, as a consequence, MANPADS-manufacturing states have a fair degree of control over the proliferation of production. Whether they exercise control is a matter of debate.

Currently 15 companies and consortia produce MANPADS in more than 15 countries.

The vast majority of states that have recently begun producing MANPADS have acquired the technology from Russia or China. The production of US- and European-derived MANPADS appears to be confined to NATO counties and Switzerland, with the exception of the Swedish RBS, which is assembled in Pakistan (SIPRI, 2002). Western states at present appear to exercise tighter control over the flow of weapons and technology than some of their counterparts, for two reasons. First, MANPADS producers tend to be some of the biggest participants in the defence industry. The majority of these large firms are located in the West, and technological gains afforded by mergers or acquisitions are greatest with other Western companies rather than with relatively technology-poor developing country firms (Forecast International, 2003a). Second, the nature of the product has ensured that only select companies are allowed to receive Western technology by way of acquiring licences to produce. For example, in 1988 the United States awarded a licence to the Stinger Project Group (SPG), a consortium of seven states comprising Germany, the Netherlands, Belgium, Norway, Greece, Turkey, and Italy. The arrangement has permitted the manufacture of a preordained number of missiles and guarantees that Stingers are not to be sold to non-SPG countries (Redstone Arsenal, 2003; NISAT, 1999). For the most part, Western production technology is closely guarded. In the past decade, however, a number of countries have acquired licences to produce second-generation MANPADS. Pakistan now manufactures the Chinese QW-1 under the designation Anza 2 and has assembled the Swedish RBS-70 since 1988. Singapore and Vietnam have recently acquired licences to produce the Russian SA-16 (SIPRI, 2003; Pyadushkin, 2003). Future moves such as these will increase not only the number of potential suppliers of MANPADS but also the number of people with knowledge of MANPADS production technology.

MANPADS producers have a fair degree of control over the proliferation of production. Whether they exercise control is a matter of debate.

There is some debate about the future utility of MANPADS for Western armies, but demand appears to ensure continued production for some time (Forecast International, 2003a). Conversely, the future utility of MANPADS is likely to be far higher for developing states' armed forces, which may value MANPADS as a relatively cheap alternative to larger anti-aircraft systems. Because ever more sophisticated designs have improved the capabilities of MANPADS, they are now arguably more attractive for any actor desiring the capability to destroy aircraft in the air. MANPADS are consequently a growth area at present in the international arms market (Gander, 2003). In the past 15 years or so, a number of companies have developed new systems or started production of existing designs. The Thales Air Defence Starstreak is a laser-guided

Table 3.2 MANPADS producers and basic specifications

Country	Designation	Producer	Guidance	Range*	Mass-produced since	Derivatives, copies, and licensed production		
						Country	Designation	Producer
China	HN-5	CPMIEC (exporter)	Passive IR homing	4,200m	–	Pakistan	Anza	AQ Khan Research Labs.
						N. Korea	HN-5	State factories
	QW-1 / QW-2	CPMIEC	Passive IR homing	6,000m	1994		Anza 2	AQ Khan Research Labs.
France	Mistral	Matra BAe Dynamics	Passive IR homing	6,000m	1988			
Japan	Type 91	Toshiba	IR and Image Matching	5,000m	1991			
Russia/CIS	SA-7	State Factories	Passive IR homing	4,200m	1968	China	HN-5	C.P.M.I.E.C.
						Egypt	Ayn as Saqr	Saqr
						Romania	CA-94M	R.E.I.G.
	SA-14	State Factories	Passive IR homing	5,500m	1978	Bulgaria	SA-14	V.M.Z.
	SA-18	KBM**	Passive IR homing	5,200m	1983			
	SA-16 Igla	KBM**	Passive IR homing	5,000m	1986	Bulgaria	Igla-1E	V.M.Z.
						N. Korea	Igla-1E	State factories
						Poland	Grom	OBR Skarzysko
						Singapore	Igla-1E	
						Vietnam	Igla-1E	
	SA-16 Igla-S	KBM**	Passive IR homing	5,000m	2001			
Sweden	RBS-70 / RBS-70 MKII	Saab Bofors	Laser Beam Riding	7,000m	1977	Pakistan	RBS-70	State factories
UK	Blowpipe	Short Brothers (now Thales)	Operator-guided	4,000m	1968			
	Javelin	Short Brothers	Laser Beam Riding	5,500m	1985			
	Starburst	Short Brothers	Laser Command Link	6,000m	1990			
	Starstreak	Short Brothers	Laser Beam Riding	7,000m	1993			
United States	FIM-43 Redeye	General Dynamics	Passive IR homing	5,500m	1967			
	FIM-92 Stinger	Raytheon***	Passive IR/ UV homing	5,000m	1981	Germany Switzerland	Stinger Stinger	Stinger Project Group Stinger Project Group

* Range given is the slant range: the 'line-of-sight' distance between two points, not at the same level, relative to a specific datum.
** Design and export: KBM; Missile and launcher production: V. A. Degtyaryov Plant; homing device production: LOMO.
*** Previously manufactured by General Dynamics.

Sources: Foss (2001); Richardson (2002, 2003); Karniol (1999); Army-Technology (2003); Pyadushkin (2003) missile claimed to be almost impossible to jam, unlike jammable fire-and-forget SAMs such as the Stinger (Foss, 2003). Nevertheless, older designs, such as the SA-16, the Stinger, and the Mistral, still dominate the market. Matra BAe Dynamics' 15-year-old Mistral is expected to remain the market leader in the next decade, with a market share far in excess of its publicity in the media, in contrast to weapons such as the Stinger and SA-7 (Forecast International, 2003a).

STOCKPILES

Certain studies have reported that there are about 500,000 MANPADS in existence (BASIC, 2003; FAS, 2004; Kuhn, 2003). Table 3.3 indicates this estimate may be inflated because it appears to count missiles alone (see Figure 3.1). Single missiles are often included as separate items in accounting—the opposite of transfers information in which complete systems are more frequently reported than missiles. The number of entire weapons systems (launchers complete with missiles) will be much lower than these figures suggest. This is an important distinction because only entire systems can be used. Owing to the fact that figures are not available for a number of systems included in Table 3.3—notably China's HN-5—missile stockpiles are certainly well in excess of 500,000. Applying a ratio of five missiles per launcher—a conservative estimate based on deployment trends (US, Department of the Army, 1984)—suggests 100,000 complete systems in existence. Given that a number of missiles are produced for non-MANPADS systems, the true figure is probably a little lower—under 100,000.

There are about 100,000 complete MANPADS systems in existence.

Around 105 states stockpile MANPADS (IISS, 2003). Table 3.3 demonstrates that it may be the more sophisticated weapons that are the most widespread (in 93 countries, as opposed to 73 for the less sophisticated). A large number of older weapons are in the arsenals of states with poor records of stockpile security, particularly in the case of first-generation MANPADS, of which the SA-7 is the most prolific, accounting, for example, for 23 out of the 29 African states in possession of MANPADS (Forecast International, 2003b; IISS, 2003). Yet a number of second-generation MANPADS are also in widespread use, including the Russian SA-16, the US FIM-92 Stinger, and the French Mistral. All of these weapons appear in regions where conflict is widespread. Nonetheless, there appears to be a great disparity in MANPADS technology according to the industrial development of states, as noted above.

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US Marines and Iraqi police officers discover dozens of boxes of Russian-made SA-16 MANPADS hidden in the garden of a Baghdad school in April 2003.

Many states that produce and stockpile MANPADS have poor records of stockpile security.

Worryingly, however, disparities in technology do not appear to correlate with problems of stockpile security. In truth, weapons lost from the world's weakest states may never go reported, but recent high-profile cases have implicated second-generation producers, such as Russia, in cases of stockpile leakage.

Table 3.3 MANPADS: Approximate number of missiles produced and in service, by country of origin and type*

Country	Designation	Total produced	Countries in service
1st generation			
China	HN-5	–	5
Russia	SA-7 (Strela 2M)	175,000**	59
US	FIM-43 Redeye	85,000	4
UK	Blowpipe	2,000**	7
Total known		**262,000+**	**75**
2nd generation			
France	Mistral	15,000	23
Japan	Type 91 and Type 92	3,000	1
Sweden	RBS-70 / RBS-70 MKII	18,000	12
China	QW-1 / QW-2	–	1
Russia	SA-18	11,000	7
	SA-16	30,000	20
UK	Javelin	16,000	6
	Starburst	10,000+	4
	Starstreak	9,000	1
US	FIM-92 Stinger***	84,000	18
Total known		**196,000+**	**93**

* Not all may be for shoulder-launch configuration
** Based on number of launchers multiplied by a reasonable estimate of 5 missiles per launcher.
*** Not all may be complete units

Note: A number of countries stockpile both 1st and 2nd generation MANPADS.
Sources: Total produced: Forecast International (2003b); Gething (1998); O'Halloran and Foss (2002); Zaloga (1989); Astronautix (2003a, 2003b).
Countries in service: IISS (2003). Thanks to Siemon Wezeman for much valued advice on the number of missiles per launcher.

MANPADS may be in the hands of more than 13 guerrilla and terrorist groups worldwide.

A number of other sources of MANPADS are of concern. The United States has long been troubled by the loss of Stingers in Afghanistan, and collapsed states appear to be one of the greatest potential sources of MANPADS proliferation. By December 2002, coalition forces in Afghanistan had retrieved a number of MANPADS of various types (Lapan, 2002; Bolkcom, Elias, and Feickert, 2003, p. 7). Iraq is also a recent case in point. If a MANPADS was indeed used in the November 2003 attack on a US helicopter in Iraq, then it is likely to have come from stockpiles of the former Iraqi army.

So too may the one that struck a civilian cargo plane in Baghdad the same month. Reflecting this possibility, coalition forces have been offering a USD 500 bounty for each system handed in (Bonner, 2003). Estimates vary greatly as to the number of MANPADS at large in Iraq, from 1,500 to 5,000, but numbers are perhaps not the most important aspect (Hordern, 2003). According to some accounts, MANPADS are in the hands of at least 13 non-state groups globally, although reported cases of their use are few (Hunter, 2001). Two crucial factors may dictate whether these weapons are likely to be used in the future: the knowledge needed to operate them and the continued functioning of the weapons themselves.

FACTORS GOVERNING USE

The proliferation of knowledge

The proliferation of MANPADS knowledge is at least as important an issue as the number of stockpiled weapons. The November 2002 Mombasa attack reportedly failed because the weapons were fired too close to their intended target (Kuhn, 2003). Launch sequences require extensive training, which is often not readily available outside of state armed forces. Although systems vary, the firer of an IR-guided MANPADS must first acquire the target; then activate the battery or battery/coolant unit, which powers the missile seeker; allow the IR sensor to lock on to the target and the missile gyro to start spinning; and only then launch the missile. The process can take more than ten seconds, and if it is rushed the missile will not lock onto the target (Gander, 2003). The process is similar for operator-guided missiles, although there is no seeker to cool. In both cases, the firer must be aware of the capabilities of the weapon and, in particular, the angles and minimum and maximum ranges at which it can be used. Countries employing MANPADS usually have a range of training devices and simulators which allow many simulated firings before an operator may ever use a MANPADS in combat (US, Department of the Army, 1984). These practices are not known to be available to non-state groups. If more trained operators become available, errors, such as may have happened in Mombasa, will be less likely to occur. The disbanding of the Iraqi army has undoubtedly meant a number of soldiers trained in the use of MANPADS are now unemployed and seeking an alternative career.

The proliferation of MANPADS knowledge is at least as important an issue as the number of stockpiled weapons.

Another issue is the shelf-life of weapons. To date, this issue has centred on the Stinger in the United States, although it seems likely to become an issue of international concern. MANPADS contain sophisticated components, which may become damaged and inoperable with age, poor storage, or misuse. These components include the explosive warhead, guidance electronics, and the batteries used to power them. The proliferation of knowledge may certainly solve some of these problems, but operational life will continue to be governed by inbuilt characteristics. Yet the question remains: just how short is that life?

Shelf-life

There is some debate over the shelf-life of MANPADS, with a number of officials and specialists claiming that weapons such as the Afghan War-era Stingers are unlikely to function today due to material determinants, such as deterioration of the propellants, batteries, and coolant units. Nevertheless, there is some evidence that MANPADS may be more durable than has been speculated. MANPADS are designed for use in harsh environments. Their propellants and coolants are reported to be serviceable after nearly 30 years of storage (Kuhn, 2003). They are issued in protective cases—often featuring in-built environmental monitors, such as hygrometers—that are designed to protect them from the elements up until the last minutes before firing. British Blowpipe missiles recently found in Afghanistan were still stored in these cases (Gall, 2003). Storing MANPADS successfully and for an extended period of time may be less of a problem than has been previously thought. One related debate focuses on the extent to which battery power limits the operational lives of illicitly acquired MANPADS (see Box 3.1). The outcome of this debate will be determined by the longevity of the batteries and the ability to replace batteries should they fail. A battery is required for pre-flight operation and for spinning the gyros prior to launch (Blackman, 1985). If the battery ceases to function, the weapon cannot be used.

The propellants and coolants used inside MANPADS are reportedly serviceable after nearly 30 years of storage.

Box 3.1 MANPADS batteries: A short shelf-life?

Most MANPADS feature a thermal battery, which differs from other types of batteries in that the electrolyte—which holds the electrical charge—exists as a non-conducting set, which is activated only on command. Once the battery is activated it has a life of just several minutes, and must be discarded and replaced immediately after use.

This characteristic has two functions. On the one hand, it ensures that anyone using a MANPADS to engage successive targets must have a ready supply of batteries. This may be a significant problem for actors that have acquired a weapon through illicit channels. On the other hand, thermal batteries have a far greater shelf-life and durability than other batteries, raising concerns that systems in the hands of non-state actors may remain operational for long periods of time. US government reports have claimed that Stinger batteries have a 'shelf-life of at least ten years, with a reliability rate of 98 per cent to 99 per cent' (Kuperman, 2001). However, Eagle Picher, the maker of batteries for the Stinger missile system and supplier to US government agencies since 1982, claims: 'Established storage life is on the order of 20 years, and much longer periods are projected. Most external environments can be expected to have little or no effect on the unactivated battery. The battery is excellent for applications involving extended storage under uncertain conditions' (Eagle Picher, 2003). The precise storage life of a battery is impossible to determine and depends on environmental conditions, but if manufacturers are willing to claim a period of 20 years—and given that most military systems are 'over-engineered'—it is probable that a fair margin of error is built into this figure.

With these functions in mind, anyone wanting to use a MANPADS must first know whether the system is operable. US Army *Stinger Team Operations Field Manual No. 44-18-1,* which is published on the Internet, provides the following detailed guidelines for determining whether the battery coolant unit (BCU) in the Stinger MANPADS is operational:

- Check the color of the heat-sensitive indicator. It should be pink. If not, discard the BCU.
- Check the holes over the burst disc diaphram. If the silver foil has been ruptured, discard the BCU.
- Check the BCU housing to insure that it is *not* cracked. If so, discard the BCU (US, Department of the Army, 1984).

Whether this level of detailed information is available for other MANPADS is unclear, but SA-7s recovered in Afghanistan in 2003 reportedly were found with detailed instructions (Silverstein and Pasternak, 2003).

If, on the other hand, the battery is found to be inoperative, the potential user is faced with two options: to locate another one, or to improvise a new power supply for the system. The first option may be facilitated by the fact that MANPADS are designed to be fired a number of times. For example, the Stinger is field-transported in a box including three to five BCUs—offering multiple firings with functional BCUs or increasing the likelihood of successful firing if one or more are damaged (US, Department of the Army, 2000). If another battery is unavailable, the user can attempt to adapt another power source to the weapon. This is not easy. One crucial feature of thermal batteries is that they are custom manufactured for acute voltage, start time, and configuration requirements—in short, batteries have to be tailored to the requirements of the weapon (*Molecular Expressions,* 2003). This is complicated further by the fact that most modern MANPADS, such as the Stinger, Mistral, SA-14, and SA-16, combine a battery and coolant unit in one, dictating the manufacture of a complex module.

It is probable that the 'Afghan' Stingers are nearing the end of their operational lives rather than non-functioning, as some authors have claimed. Whether other MANPADS will remain functional is unclear, but depends on whether their users have the means to repair or retrofit parts successfully. It is worth noting that the MANPADS fired in Mombasa were of 1978 vintage (United Nations, 2003c)—around seven years older than the 'Afghan' Stingers—and the miss was reportedly caused by user error rather than a technical fault (Kuhn, 2003).

TRANSFERS

The authorized transfer of MANPADS appears to be better documented than for most other transfers of small arms and light weapons. This is because transfers are politically sensitive and involve very large sums of money. However, this is not to say transfers are transparent—many states have MANPADS in their inventories and yet give no public documentation to explain from whom or how they acquired them. The illicit transfer of MANPADS is less clear, but its market dynamics appear distinct from the transfer of other small arms and light weapons.

The authorized transfer of MANPADS appears better documented than the majority of other categories of small arms and light weapons; the illicit transfer is less clear.

Authorized transfers

As Table 3.4 illustrates, recent, known authorized transfers for the most part feature second-generation MANPADS. The table is a snapshot of recent transfers and, while by no means exhaustive, demonstrates that the value of sales is higher than that of other types of small arms and light weapons, though the quantities involved are small. For example, the case of US exports of Stinger missiles to Greece, Italy, and the UK, at USD 89 million, is approximately the value of France's combined small arms exports and imports for 2000, while the Russian USD 48 million sale of SA-16s to Malaysia comprised only 40 launchers and 382 missiles (Small Arms Survey, 2003, p. 103; Malaysia, 2002). However, it is often difficult to establish just how many missiles are transferred in those cases reported, as data often refer only to complete weapons systems with an unspecified number of missiles. To complicate matters further, certain missiles, such as the Stinger and SA-16, can form part of major conventional weapons systems rather than MANPADS, as a USD 31 million sale of Stingers to Lithuania illustrates. This deal reportedly involved only eight missile launchers but, crucially, these were in multi-barrelled vehicle-launch format and consequently not MANPADS, although the missiles themselves may have been identical (*Jane's Defence Weekly*, 2002).

Table 3.4 Selected authorized transfers of MANPADS since 2001

Supplier (system)	Recipient(s)	Value (USD)	No. systems ordered	Year of delivery
Russia (SA-18)	India	32-50m	2,500	2001-2
Pakistan (Anza 1)	Malaysia	12.8m	100	2002
Russia (SA-16)	Malaysia	48m	70	2002
Russia (SA-16)	Vietnam	64m	48	2001-2*
Russia (SA-18)	Mexico	2.14m	50	2002
UK (Starstreak)	S. Africa	85m	-	2001-2
US (Stinger)	Greece, Italy, UK	89m	1007	2003-4

* Includes transfer of production licence.

Sources: SIPRI (2003); Foss (2003); Malaysia (2002); Brooke (2000)

While second-generation MANPADS make up the majority of declared transfers, a number of states produce MANPADS of a lower value. Lower-value MANPADS are likely to feature heavily in transfers between states with a poor record of transparency. The Soviet SA-7 is in service in the greatest number of countries (see Table 3.3), some of which are known for their lack of export transparency. These missiles may also feature prominently in re-export. A UN Panel of Experts report cites one possible source for the SA-7s used in the Mombasa attack of 2002 as an Eritrean government transfer to Somali faction leader Hussein Aideed in 1998, although by November 2003 the Eritrean government had yet to verify this information (United Nations, 2003c, § 129). Moreover, from 1982 to 1994 China is thought to have exported between 2,858 and 5,500 pieces of its SA-7 derivative, the HN-5, to states including Afghanistan, Cambodia, Myanmar, and North Korea (Byman and Cliff, 1999). These states are hardly transparent: none currently reports to UN Comtrade (UN Comtrade, 2003), and Cambodia at least is known to have 'lost' weapons from its national inventory in 2003 (Lyall, 2003; Agence France Presse, 2003), as may have North Korea (Karniol, 1999).

Lower-value MANPADS are likely to feature heavily in transfers between states with a poor record of transparency.

Illicit transfers

The illicit transfer of MANPADS does not display the same market dynamics as that of the majority of small arms and light weapons, but their small size makes them as easy to conceal as their low-tech counterparts. Their illicit transfer is known to be widespread and governed by utility and cost, but the actual scale of trade is unclear, although transfers are probably confined to well-established non-state groups (Hunter, 2001).

The lightness and compact size of MANPADS make them highly portable on the battlefield, but this quality also makes them extremely easy to transfer illegally and discreetly within and between states. The Russian SA-7, for instance, weighs around 14kg (missile tube and launcher)—far less than most heavy machine guns—and is only 1.49m in length (O'Halloran and Foss, 2002). A weapon of this size fits easily into the boot of a car, into a golf bag, or within bundles of produce small enough to be carried on the back of a person or animal (Zeller, 2003). Perhaps because of this, most illicit transfers have become known only after a weapon has been used against an aircraft (Hunter, 2001). Of these, the implicated sources have been, directly, Central Africa, the Horn of Africa, and East Asia, and, indirectly, the United States, Russia, and China.

Most illicit transfers become known only after a weapon has been used against an aircraft.

For many actors, MANPADS have little to no utility. They are ineffective tools for crime, coercion, or personal security. MANPADS are a specialist weapon; those that have been uncovered or intercepted appear either to have been safely stored for future use or sale, or to be en route to another location (*Moscow Times*, 2003, *Time Magazine*, 2003). One likely implication is that, as these weapons require considerable knowledge to operate, they are more likely to be requested for a specific purpose than transported to a conflict area in the hope of securing sales.

Many weapons, including FIM-92 Stingers in Afghanistan and Angola, are a legacy of the Cold War, but weapons are still finding their way from relatively peaceful states to conflict zones and have yet to be used. Of particular concern at present are those thought to be in the hands of groups loosely described as under the umbrella organization of al Qaeda.

Box 3.2 A tale of two missiles

The weapons used in the November 2002 Mombasa attack were Soviet-era SA-7s, reportedly produced at the VA Degtyarev Plant in Kovrov, Russia, in 1978 (Kuhn, 2003). While the launchers were produced in Russia, the missiles used were produced in Bulgaria in 1993 and sold as part of a larger consignment to Yemen in 1994. From Yemen, it is believed the missiles were smuggled either directly to Somalia, by a Mogadishu arms dealer in early 2003, or as part of three consignments from the Eritrean government to a Somali faction in 1998. In either case, the MANPADS then entered Kenyan territory by sea (United Nations, 2003c).

Other groups are also believed to have received weapons recently. Among these are the Revolutionary Armed Forces of Colombia (FARC), for which one potential source of weaponry is thought to be a drugs-for-arms pipeline extending between Russia and Colombia (Bolkcom, Elias, and Feickert, 2003, p. 9). Other recipients include

Lebanon's Hezbollah, which is thought to have received weapons from the Afghan mujahideen (Withington, 2003); the Palestinian Authority, thought to have received weapons transported in fishing vessels via Egypt (Hunter, 2001); and the Liberation Tigers of Tamil Eelam (LTTE), who were reported to have received SA-16 missiles diverted from a transfer from North Korea to Vietnam by black-market traders. The LTTE are further known to have acquired SA-7s and HN-5s in Cambodia (Karniol, 1999). Cambodia also appears to have been the origin of six MANPADS systems allegedly smuggled into Thailand in September 2003 (Lyall, 2003; Agence France-Presse, 2003). *Jane's Intelligence Review* outlines 13 non-state groups confirmed to be in possession of MANPADS, with a further 14 groups reported to possess them (Hunter, 2001).

The groups so far implicated in MANPADS transfers appear to be among the better-funded non-state organizations and have established international procurement and smuggling networks through which to acquire weapons.

The FARC, Hezbollah, and the LTTE are among the non-state groups believed to have received MANPADS.

Box 3.3 Blowback: The Stinger missile debate

Although MANPADS represent the most sophisticated of light weapons and are synonymous with modern military technology, significant international concern over their proliferation and misuse predates that of most other small arms and light weapons. In the mid-1980s, the United States Central Intelligence Agency, in conjunction with Pakistani Inter-Services Intelligence, played a key role in supplying and training the Afghan mujahideen with a variety of MANPADS to speed the defeat of the Soviet army. Foremost among these was the FIM-92 Stinger—then the very latest generation of MANPADS in service with the US army (Kuperman, 1999; Yousaf and Adkin, 2001).

'Blowback' is a US intelligence term used to describe an unexpectedly negative policy outcome. The Stinger debate encapsulates this phenomenon perfectly. It is estimated that, of the approximately 1,000 Stingers transferred, from 200 to 600 were never returned to the United States. Between 16 and 30 were transferred illicitly to Iran, and the rest apparently remain at large, although they may be unserviceable (Lumpe, 1994; Saleem, 2001). During the course of the 20-year debate, the focus of concern over Stinger proliferation has turned from the Soviet Union to the number of disparate terrorist groups linked to the Afghan mujahideen—a microcosm of changing US security concerns.

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A guerrilla soldier aims a Stinger missile at passing aircraft near an isolated rebel base in Afghanistan's Safed Koh Mountains in 1988.

Because the Stinger is claimed to have shot down around 250 Soviet aircraft in Afghanistan, it is synonymous with Western military might and concerns over its proliferation have long endured. Although the mujahideen were well trained in using Stingers, a somewhat condescending view prevails to the effect that, if the mujahideen could use them, any non-state group can do so, and this has helped fuel fears over terrorist acquisition of the weapon. Ease of use is probably overestimated, but is no guarantee of security in the future.

The Stinger debate indicates not only the long-term and negative legacies of transfer decisions but also that the spread of technology and training is as much an aspect of small arms control as the weapons themselves. It is no surprise that Stinger rhetoric has 'resurged' in much of the debate surrounding initiatives to control the proliferation of MANPADS post-11 September 2001.

MEASURES TO CONTROL MANPADS

Recent fuel for debate

In the years since 2001, concomitant events have demonstrated the threat from MANPADS in a number of different theatres, both civilian and military, and have created common ground among states that rarely cooperate on small arms control. These events have raised issues of the vulnerability of civilian aircraft and their military counterparts, the seemingly widespread proliferation of weapons—notably to non-state groups (including terrorists)—and the problems that occur when stockpiles are freed from state control. Given the long history of MANPADS transfers, this recent momentum is late in coming, but may spur the international community into action.

In May 2002, shortly before the failed attack in Mombasa, an SA-7 launcher was found near the Prince Sultan Airbase in Riyadh, Saudi Arabia. The weapon was later traced through its serial number to the same batch as that used in the attack in Mombasa (Creedy, 2003). To compound matters, in July 2003 at least eight SA-7 launchers were stolen from a naval arsenal in Bolshiye Izhory, near St Petersburg (*Moscow Times*, 2003), and, in August 2003, a British man was arrested and charged with attempting to sell up to 50 Russian 'Igla SA-18' shoulder-launched missiles to an FBI informant in the United States (*Time Magazine*, 2003). These cases demonstrated that MANPADS were not confined to state arsenals and were available on the international illicit arms market.

The threat to civilian airliners has the potential to affect the citizens of all states travelling on major air routes.

Another series of events has involved the use of MANPADS against the aircraft of major military powers. In Chechnya, MANPADS have brought down a number of Russian helicopters; in one incident, nine soldiers, including the deputy commander of the 58th Army, were killed (Agency WPS, 2003). More recently, coalition involvement in Iraq has further highlighted the threat of MANPADS. On 2 November 2003, a US helicopter was destroyed by what is widely believed to have been a MANPADS, with the loss of 20 lives—at that time the largest loss of life suffered by US forces in Iraq in a single attack (Schrader and Rubin, 2003). Later that month, an SA-14 missile struck a civilian cargo plane flying out of Baghdad, setting the wing on fire, although not preventing it from landing with the crew unharmed (Kirby, 2003; Daly, 2003; Wall and Hughes, 2003).

The threat to civilian airliners has the potential to affect the citizens of all states travelling on major air routes. This, and the fact that the armed forces of two of the world's largest and most influential states—the United States and Russia—have also recently been the targets of MANPADS on the battlefield, has widened debate in the past years and provides an opportunity for the establishment of effective future controls on the proliferation of MANPADS and their technology.

The defensive option: protection of the target

Civilian planes have been hit by MANPADS in an estimated 29–40 incidents between 1975 and 1992, with the total number of dead estimated at between 500 and 760 (Bayles, 2003; *National Defense*, 2003; Shaffer, 1993; Bolkcom, Elias, and Feickert, 2003). Many of these losses have occurred in war zones (*Aerospace America*, 2003). Nonetheless, since the 1978 and 1979 attacks on two Air Rhodesia planes, which killed scores of people, there have been relatively few attacks on civilian aircraft (*Time Magazine*, 2003). However, international concern has increased in recent years and progressively more actors, including politicians and the International Air Transport Association (IATA), are proposing action against MANPADS (*U.S. Newswire*, 2003; Fiorino, 2003).

IATA in particular is preparing a detailed study of MANPADS and the threat they pose to civilian aircraft. The association is also evaluating a diverse set of strategies designed to mitigate the danger of an attack.

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US Senators Charles Schumer and Barbara Boxer and Representative Steve Israel hold a US-made FIM-43 Redeye MANPADS during a news conference in Washington, DC, in February 2003. Their proposed legislation would equip civilian aircraft with anti-missile protection devices similar to those currently used on military transport aircraft.

Following the Mombasa attack, Israel's El Al was the first airline to experiment with installing missile countermeasures on some of its aircraft (*BBC Monitoring International Reports,* 2003). The Israeli Ministry of Defence reportedly selected Elta Electronic Industries' decoy flare system for selected aircraft, at a cost of around USD 1 million per aircraft (Dror, 2003). A similar idea has been mooted in the United States, with congressional advocates, most notably Democratic Senator Barbara Boxer, promoting the idea of equipping the Civil Reserve Air Fleet (CRAF)—leased to fly troops and cargo in emergencies—with countermeasures (*Aviation Week,* 2003). Equipping the world's airline fleets with countermeasures will prove costly. The Chief Executive Officer of Australia's Qantas Airlines estimated it would cost the company AUD 442 million (more than USD 320 million) to install countermeasures on its fleet of 129 Boeing aircraft (Goodenough, 2003; Qantas, 2003). In response to congressional pressure, in January 2004 the US Department of Homeland Security commissioned three companies to explore ways of protecting civilian airliners against attack by adapting existing military technology. One or more of the companies may be invited to produce a system, although the process is expected to take up to 24 months, which means that no defences will be operational until at least 2006 (Waterman, 2004).

The success of countermeasures is likely to depend on two factors: whether missile launches can be detected and, if so, whether the missiles can be diverted from their targets.

Even if airlines, and ultimately passengers, are willing to invest this amount in their security, the success of countermeasures is likely to depend on two factors: whether missile launches can be detected and, if so, whether the missiles can be diverted from their targets. In built-up areas, such as those surrounding international airports, background heat makes detecting a launch extremely difficult (Creedy, 2003). Should a launch be detected, the primary defence against MANPADS has so far been the ejection of flares designed to confuse the IR or UV targeting system of the missile when the flare passes through its field of view; newer methods include the use of IR transmitters—known as IR countermeasures (IRCMs)—to create fields of IR energy designed to confuse a missile's sensors (Bolkcom, Elias, and Feickert, 2003). The majority of the more cost-effective proposed countermeasures for civilian aircraft involve using flares or, at most, IR transmitters. These may be effective against first-generation MANPADS, but are impotent against second-generation operator-guided weapons. In this case, the only option is some form of energy emission—such as laser countermeasures—which are more effective than flares but may be much more expensive. For example, BAe has proposed a laser-jamming system for airliners, with an estimated cost, on the basis of a minimum of 1,000 units purchased, of USD 1 million (Laurenzo, 2003). A number of cheaper, more practical recommendations have recently been made. Perhaps the most important has been the idea of 'inerting' wing fuel tanks, which often ignite and make a MANPADS engine strike more effective, by replacing potentially explosive fumes in fuel tanks with nitrogen-enriched air (NASA, 2003). The hope is that, in large airliners with multiple engines, this measure would make aircraft better able to continue flying after a strike. Inerting fuel tanks would reportedly be more cost-effective, at an estimated USD 200,000 per aircraft, than active countermeasures, while also improving airline safety generally (*Air Safety Week,* 2003a). These measures notwithstanding, the case of the cargo plane struck in Baghdad stands as testament to the durability of large aircraft (*Air Safety Week,* 2003b).

The proactive option: Controlling proliferation

Despite the current focus on airline defences, other measures to control MANPADS have centred primarily on two initiatives: preventing the spread of weapons and retrieving weapons that have found their way into undesirable hands. Only since mid-2003 have international initiatives been launched to address both issues. Prior to this, the most notable initiatives were made by the United States, primarily in response to the Stinger debate in US politics and the press but arguably also because of recent military intervention and the threat posed to one of the United States' most powerful assets—its air force. The result is international interest in countering the threat of MANPADS, which has gathered momentum as states, or groups of states, have been made aware of the immediacy of the dangers posed to their interests.

Initially, in response to the loss of a number of Stingers in Afghanistan, the US government established bilateral regulations forcing recipients of US MANPADS to accept rigorous controls over any MANPADS that were purchased from the United States. Recipients were required to provide proof they had received the missiles and to submit to periodic inspections to verify their status. Furthermore, the Stinger Project Group (SPG) was set up to administer joint procurement of MANPADS for selected NATO countries. The Project established strict conditions whereby group members are permitted to export Stingers only to SPG countries (*Redstone Arsenal,* 2003).

Both of these US-led measures centred on reducing the potential for MANPADS technology to fall into the hands of potential enemies of the United States. However, given that the debate in which these measures originated was concerned primarily with non-state actors, there was always a fear that missiles already in the hands of such actors could be used against the West. Consequently, the first Bush administration set up a reward system to aid recovery of Stingers from the Afghan War. The fund at the disposal of the scheme was later increased in 1993, under the Clinton administration, to USD 55 million (Wright and Broder, 1993)—with offers of between USD 80,000 and 150,000 per missile reported in the early 1990s (Lumpkin, 2001; CNN, 1999). The programme was either still in existence or revived following the overthrow of the Taliban in 2001, possibly as part of the Office of Weapons Removal and Abatement (WRA, 2003; Burns and Turner, 2002). To date, it is not clear whether any Stinger missiles have been returned, but coalition forces have been very active in both Afghanistan and Iraq searching for MANPADS and other weapons.

Other members of the international community were slower to act on the subject of MANPADS, and initially did so only with US prompting. In 1998, one of the first international efforts to control MANPADS was launched under the direction of US Secretary of State, Madeleine Albright, when she stressed, before the UN Security Council, the need for an international agreement to impose tighter controls on the export of shoulder-fired missiles (Albright, 1998a, 1998b). Although initially unpromising, by December 2000 talks in the 33-state Wassenaar Arrangement led to participants agreeing that they would, in future, require end-user certification for all MANPADS exports and prohibit re-transfers to third parties without prior consent (Boucher, 2000). This initiative was furthered in December 2003 and, according to Kenneth Brill, US Ambassador to the UN's International Atomic Energy Agency, the tightening of controls was 'comprehensive', including stricter export reporting, closer controls over inventories, and technical developments to make the weapons more difficult to fire (Charbonneau, 2003).

In Chechnya, MANPADS have brought down a number of Russian helicopters.

In Russia, the threat from MANPADS has taken a different form, but has been no less influential on policy-making. Kremlin concern stems from the repeated use of SA-18s and similar weapons to down Russian aircraft in Chechnya (Myers, 2002). In November 2002, Defence Minister Sergey Ivanov urged the CIS and Baltic states to halt the flow of Igla (SA-16/18) missiles to the region (*BBC World Edition*, 2003). Initially there was strong disagreement on the proposal for mutual notification of transfers of former Soviet missiles, apparently due to commercial concerns. However, pressure from Moscow prevailed (*Associated Press Worldstream*, 2003; White House, 2003). In July 2003 Ukraine became the first to yield and an agreement by 11 CIS members—all except Turkmenistan—was completed a few months later (Bellaby, 2003; *Interfax*, 2003; Agency WPS, 2003). Russia has also faced pressure from both Israel and the United States. Israel has long feared MANPADS could end up in the hands of Lebanon's Hezbollah, and this prompted Moscow to terminate a deal which would have supplied Syria with Russian SA-18s (*Russia Reform Monitor*, 2002).

MANPADS are also a threat to a number of other Western countries. The danger to civilian airliners has been highlighted by the Mombasa attack and fears over terrorist threats to airliners in general. In June 2003, at the Organization for Security and Co-operation in Europe (OSCE) Annual Review Conference, the French delegation proposed using the OSCE Document on Small Arms and Light Weapons as a springboard for additional steps against the illicit trade in MANPADS (OSCE, 2003). That same month, the G8 countries expressed a determination to 'curb terrorist threats against mass transportation' and agreed to implement the following steps as part of an action plan to prevent the acquisition of MANPADS by terrorists:

- To provide assistance and technical expertise for the collection, secure stockpile management, and destruction of MANPADS surplus to national security requirements;
- To adopt strict national export controls on MANPADS and their essential components;
- To ensure strong national regulation of production, transfer, and brokering;
- To ban transfers of MANPADS to non-state end-users; MANPADS should only be exported to foreign governments or to agents authorized by a government;
- To exchange information on uncooperative countries and entities;
- To examine the feasibility of development for new MANPADS of specific technical performance or launch control features that preclude their unauthorized use;
- To encourage action in the International Civil Aviation Organization (ICAO) Aviation Security (AVSEC) Working Group on MANPADS (G8, 2003).

To date, most international measures have not dealt with weapons already beyond the control of state armed forces.

The Group also agreed to exchange information on national measures related to the implementation of the steps and to review the progress at the G8 summit in 2004.

The growing salience of the issue was confirmed by two international initiatives in late 2003. On the 21 October, an initiative at an Asia-Pacific Economic Cooperation (APEC) meeting in Bangkok, instigated in large part by the United States, resulted in a non-binding pledge to strengthen national controls on the production, export, and stockpiling of MANPADS. The move has brought China into the process; it is not a member of either the Wassenaar Arrangement or the G8 and yet is an important producer of MANPADS (*Arms Control Today*, 2003). A new international initiative then came to fruition on 8 December 2003, when the United Nations General Assembly approved a resolution expanding the Register of Conventional Arms which, while not shedding light on stockpiled MANPADS, should enhance transparency in future transfers (United Nations, 2003a; Wurst, 2003). MANPADS have been added to Category VII of the Register, entitled 'Missiles and Missile Launchers', as an exception to the fact that there is no specific category for surface-to-air missiles (United Nations, 2003b). To date, most international measures have not dealt with those weapons already beyond the control of state armed forces. In October 2003, in the run-up to the APEC meeting, Bangkok police held training seminars for around 5,000 taxi drivers, who were shown a missile system and what it looked like when stored in a golf bag (Zeller, 2003). The move followed reports that the Thai police were looking for six contraband MANPADS smuggled into Thailand from Cambodia (Lyall, 2003). Current international concern appears to be leading to better control over the export of MANPADS. With regards to missiles that are unaccounted for, the only available measures appear to be vigilance, recovery where possible, and perhaps some form of costly defence.

PROSPECTS FOR CONTROLLING MANPADS

To date, MANPADS have been used infrequently in conflict situations and even less frequently against civilian targets. Factors that have controlled their proliferation and use include the small number of producers manufacturing and exporting them and the training needed to operate them. The impact of both factors seem set to fade; yet hope lies in gathering international initiatives to stop the proliferation of MANPADS. The current bout of media attention may have exaggerated the threat of MANPADS, but it has done much to raise international awareness of a threat with the potential to become more acute.

The total number of MANPADS producers is limited but has increased in the post-Cold War environment, as has the number of countries in which production occurs. Older MANPADS technology will probably become more widespread as technology diffuses, and so too may the knowledge required to maintain and operate MANPADS, as suggested by a number of developments. Advances in communications—especially on the Internet—allow detailed operating materials to be disseminated to a potentially worldwide readership. Even if efforts are made to control this, it must be assumed that the information is already in the hands of interested parties. Another factor is the availability of trained operators. Ex-mujahideen fighters from Afghanistan have long been feared for their training in the use of MANPADS, but there are a host of states that could potentially contribute skilled operators to the illicit market. As indicated above, MANPADS may not have as short a shelf-life as had been generally assumed. The sensible storage of weapons is certainly not beyond the capacity of most organized terrorist groups. It has long been known that many groups are technologically adept, and safely storing a MANPADS is probably not dissimilar in principle to storing a modern personal computer.

In principle, safely storing a MANPADS is not unlike storing a modern personal computer.

Against these trends, however, the international community appears to be in a position to institute some essential controls on the export of MANPADS. The fact that Russia and China have been party to discussions is an important step forward, but is no guarantee of action. Past experience seems to indicate that the likelihood of initiatives coming to fruition may depend, unfortunately, upon whether the threat of MANPADS continues to be confirmed in the form of actual attacks.

As for defensive measures against MANPADS, there is no single, adequate form of protection that can encompass all eventualities or is affordable to all parties concerned—as is the case with most small arms. It appears that civilian airliner defences may be adopted by the world's wealthier states but, unless measures are instituted now to prevent the latest generation of MANPADS eventually finding their way out of government stockpiles, such efforts to enhance security may be ineffective.

Security from MANPADS will be increased only if proliferation is checked and those states in possession of MANPADS can secure, or can be helped to secure, their own stockpiles. As for those MANPADS already on the illicit market, limiting the further transfer of knowledge and training through planned security sector reform appears the most sensible precaution. MANPADS remain a big issue with the potential to become a big problem.

3. LIST OF ABBREVIATIONS

APEC	Asia-Pacific Economic Cooperation
AVSEC	Aviation Security
BCU	Battery coolant unit
CFE	Conventional Armed Forces in Europe
CRAF	Civil Reserve Air Fleet
FARC	Revolutionary Armed Forces of Colombia
IATA	International Air Transport Association

ICAO	International Civil Aviation Organization
IR	Infrared
IRCMs	Infrared countermeasures
LTTE	Liberation Tigers of Tamil Eelam
MANPADS	Man-portable air defence system
OSCE	Organization for Security and Co-operation in Europe
SPG	Stinger Project Group
UV	Ultraviolet

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