Order Code RL31151

CRS Report for Congress
Received through the CRS Web

Aviation Security Technologies and Procedures: Screening Passengers and Baggage

Updated October 26, 2001

Daniel Morgan
Analyst in Science and Technology
Resources, Science, and Industry Division

Aviation Security Technologies and Procedures: Screening Passengers and Baggage

Summary

Following the terrorist attacks on September 11, 2001, there is intense congressional interest in improving the security screening process for airline passengers and their baggage. In the United States, screening is the responsibility of the airlines, which generally contract the work out to screening companies. The Federal Aviation Administration has regulatory authority, deploys security equipment in airports, and conducts research and development on security technology. The current screening process includes technologies and procedures for screening passengers themselves, their carry-on baggage, and their checked baggage. In each of these areas there are technology options for improving the process. A key issue is the performance of screener personnel. Issues of congressional interest include ways to improve screener performance, possibly including federalization; funding and oversight of the security equipment deployment program; and funding and oversight of security technology development efforts. Congress has begun to consider several bills in this area that have been introduced since the September 11 attacks, as well as Administration proposals and actions. This report will be updated as circumstances warrant.

Contents

Recent Congressional Action 1

The Current Screening Process 2

Technology Options 3
- Passenger Screening Technologies 3
- Carry-on Baggage Screening Technologies 4
- Checked Baggage Screening Technologies 4

Screener Performance 4

Congressional Options 5
- Improving Screener Performance 5
- Equipment Deployment 6
- New Technology Development 7

List of Tables

Table 1. FAA Budget for Aviation Security R&D 8
Table 2. Bills to Improve Aviation Security Introduced
Since September 11, 2001 9

Aviation Security Technologies and Procedures: Screening Passengers and Baggage

On September 11, 2001, three U.S. airliners were hijacked and used in terrorist attacks on the Pentagon and the World Trade Center. A fourth hijacked airliner crashed into a field in Pennsylvania. The hijackers were armed with knives, and possibly other weapons, that had been smuggled into the aircraft passenger compartments. As a result of these attacks, there is intense congressional interest in improving the security screening process for airline passengers and their baggage. This report describes current procedures and discusses potential technological solutions, the key issue of screener performance, and some congressional options. Other important aspects of aviation security, such as controlling access to secure areas of airports, hardening aircraft against explosions, and securing cockpits against hijackers, are not addressed in this report. Some of these other aspects are addressed in the CRS *Terrorism Briefing Book*.[1]

Recent Congressional Action

Since the September 11 attacks, numerous bills have been introduced to improve aviation security. The option most frequently addressed is federalization of the screening process. Other provisions include screener training and employment requirements, utilization of screening equipment, and research on improved technologies and procedures. (See **Table 2** at the end of this report). On September 27, 2001, the President announced that he will "work with Congress to put the federal government in charge of airport security and screening services, including the purchase and maintenance of all equipment."[2] On October 11, 2001, the Senate passed S. 1447, the Aviation Security Act. The House of Representatives is expected to take up aviation security legislation during the week of October 29, 2001. For more information on current legislation, see CRS Report RL31150, *Selected Aviation Security Legislation in the Aftermath of the September 11 Attack*.

The following committees have held hearings since the attacks to address aviation security issues: House and Senate Appropriations Subcommittees on Transportation (joint, September 20); Senate Committee on Commerce, Science, and Transportation (September 20); Senate Committee on Government Affairs

---

[1][http://www.congress.gov/brbk/html/ebter1.html]

[2]White House, Office of the Press Secretary, "Enhancing Aviation Safety and Security," September 27, 2001. [http://www.whitehouse.gov/news/releases/2001/09/20010927.html]

(September 25); and House Committee on Transportation and Infrastructure, Subcommittee on Aviation (October 11).

The Current Screening Process

In the United States, the airlines are responsible for screening passengers and their baggage for security purposes. Except at small airports, airlines generally contract with security companies to conduct the screening process. Screening is regulated by the Federal Aviation Administration (FAA). In addition, since 1997, the FAA has had a program to purchase certain security equipment and deploy it in airports for use by the airlines and their security contractors. (See "Equipment Deployment" below.) Airlines remain responsible for most of the cost of security screening, however.

Security screening begins at check-in. First, computer-assisted passenger prescreening (CAPPS) software uses classified criteria to identify certain passengers as "selectees" for more intense scrutiny. In the past, some groups have expressed concern that CAPPS may include discriminatory criteria such as race, national origin, or appearance. The Department of Justice has reviewed the CAPPS criteria and has determined that they do not consider such factors and are not discriminatory. Second, passengers are asked a series of simple questions, such as whether they packed their own bags. Often misunderstood, the purpose of these questions is to prevent "dupe" attacks, in which a terrorist persuades a naive passenger to carry a dangerous item unknowingly.

If a passenger checks baggage, it may be screened for bulk quantities of explosives using x-ray computed tomography equipment similar to that used for medical CAT scans. The availability and cost of this equipment, however, along with the time it takes to screen a bag, do not currently permit its use in all airports, on all flights at airports where it is used, or even on all bags on any given flight. To protect against bombings by terrorists unwilling to commit suicide, the positive passenger-bag matching (PPBM) procedure matches passengers with their checked bags, and bags whose owners do not actually board the aircraft are removed before takeoff. PPBM is used primarily on international flights.

The most familiar part of the screening process may be the security checkpoint at which passengers and their carry-on bags are screened. Passengers themselves are currently screened by walk-through metal detectors. If the detector alarms, screeners use metal-detecting hand wands. Nonmetallic objects, including plastic and ceramic weapons, will generally not be found by either procedure. At the same checkpoints, carry-on bags are screened by equipment that displays an x-ray image of the bag contents. An operator who sees a suspicious object in the image, or whose view is blocked by a concealing object, may hand search a bag as a backup procedure. Nonmetallic objects may be visible in the checkpoint x-ray image, but less clearly than metal items, and operator training has up to now been focused on identifying metal items. Carry-on baggage, especially laptop computers and other items that are difficult to open for inspection, may also be screened with equipment that can detect the chemical signature of trace quantities of explosives. Until the Secretary of

Transportation directed otherwise on September 12, 2001, many small knives, such as pocket knives, had been permitted on board even if detected by security personnel.

Technology Options

Technology options for making the security screening process more effective include technologies for screening passengers, their carry-in baggage, and their checked baggage. The cost of implementing new technologies and the question of who will pay for them are issues of interest to policymakers.

Passenger Screening Technologies

As described above, current technologies for screening passengers are based on metal detection. Equipment is available or under development in two other areas: chemical trace detection, which can indicate whether a passenger has recently handled explosives, and detection of nonmetallic threats, such as ceramic knives and plastic guns. Trace-detecting portals look somewhat similar to walk-through metal detectors and collect vapors and particles from the vicinity of the passenger for chemical analysis. Equipment that can detect nonmetallic threats is based on imaging technology that uses either backscattered x-rays or millimeter waves. Some prisons and other high-security facilities already use some of these technologies.

For airport use on the general public, however, there are public acceptance issues with any of these options. The images displayed by the imaging technologies, as well as showing potential threat items, show the surface of the passenger's body without clothing. (It may be possible for software to block out parts of the image that do not contain potential threat objects.) To collect the required chemical samples, some of the trace-detection technologies use wands that make direct contact with the passenger or air jets that can be felt and may disturb clothing. The capability to detect concealed non-threat objects (such as drugs) may present legal issues regarding unconstitutional search. Exposure of passengers to x-rays may raise health concerns. These acceptance issues have been examined in detail by the National Research Council (NRC).[3]

In a different approach, related in some ways to the CAPPS prescreening system used at check-in, there has been renewed interest since the September 11 attacks in the use of biometrics technology for passenger identification. In this category are technologies based on fingerprints, retina scans, video face recognition, and other techniques that could be used to match passengers against a database of individuals who may pose a threat. Some of these technologies are already used at other types of facilities, and a face recognition system has been installed in the airport in Reykjavik, Iceland, but this would be a new approach for security in U.S. airports. As well as deploying the technology, developing the database against which to make comparisons would be a significant challenge. Civil liberties groups are concerned about the legal implications of these technologies and the associated database.

---

[3]National Research Council, *Airline Passenger Security Screening: New Technologies and Implementation Issues* (National Academy Press, Washington, 1996).

Carry-on Baggage Screening Technologies

The x-ray equipment currently used to screen carry-on baggage can present a cluttered image that makes the operator's task difficult. To assist the operator, some models take two images with x-rays of different energies, which allows them to differentiate among materials and display a combined image that is color-coded by whether an object is metallic, organic, and so on. Some use pattern-recognition software to outline areas of a bag for closer attention by the operator. Some use threat-image projection (TIP) to insert a stored image of a threat object into an actual image of a bag, in order to help the operator stay alert (and to monitor performance).

Despite these techniques, it is difficult to identify nonmetallic objects with the equipment currently used. Two existing technologies may be more capable in this regard. First, some secure facilities already use backscatter x-ray equipment, which creates a positive image from x-rays reflected from an object's surface, rather than a negative image from x-rays transmitted or absorbed in an object's interior. Second, the x-ray computed tomography equipment currently used on some checked baggage can detect explosives and certain other nonmetallic items. Both these technologies, especially the computed tomography type, are more expensive than existing equipment, and computed tomography equipment is also much slower, which would be a logistical challenge at a busy passenger checkpoint.

Checked Baggage Screening Technologies

The main purpose of screening checked baggage is the detection of bombs, since potential hijackers cannot easily retrieve other items from the baggage hold during flight. As noted above, x-ray computed tomography is the main technology in current use. Some other techniques, such as chemical trace detection, are used to a lesser extent (primarily to help resolve alarms). A variety of other technologies have been explored by the FAA, equipment vendors, and others, but none has yet passed the FAA certification requirements, which set standards for detection capability, maximum frequency of false alarms, and throughput rate.[4] (Detection of explosives in checked baggage is the only aspect of screening for which the FAA has established a certification procedure.) In addition, some alternative technologies, particularly those based on nuclear techniques, present significant operational challenges for airport use, such as size, weight, and radiation safety. The main emphasis of FAA development efforts in this area has been improvement in the existing technologies, particularly with regard to speed and cost, to enable screening of more bags in more airports.

Screener Performance

FAA agents periodically test the performance of security personnel by posing as passengers and attempting to carry potentially dangerous objects through airport

---

[4]See, for example, National Research Council, *Detection of Explosives for Commercial Aviation Security* (National Academy Press, Washington, 1993).

checkpoints. In these tests, screeners failed to detect the objects 13% of the time in 1978, 20% of the time in 1987, and even more frequently in the 1990s. Moreover, screener performance declines further as tests become more realistic.[5]

One explanation for these performance levels is that rapid employee turnover leads to a lack of experienced screeners. From May 1998 through April 1999, screener turnover at the 19 largest U.S. airports averaged 126%, and at one airport, it exceeded 400%.[6] Low wages and lack of benefits are the most often cited reason for such rapid turnover. Wages, for example, are often higher at airport fast-food restaurants. Some analysts believe that other factors are equally important, including the monotonous nature of the job, the stress of dealing with passengers who are concerned about being late for their flights, and management issues.

In addition to turnover, a variety of human factors affect screener performance. These include individual aptitude for the required tasks, sufficiency and effectiveness of training, and individual ability to remain alert and vigilant for very rare events. FAA initiatives such as pre-employment aptitude testing, computer-based training, and threat-image projection technology are designed to address these issues.

Congressional Options

In responding to the September 11 attacks, Congress may consider actions in at least three areas: improving screener performance, the FAA security equipment deployment program, and the FAA security equipment research and development (R&D) program.

Improving Screener Performance

Following the September 11 attacks, congressional attention has focused closely on the screener performance issue. It was widely noted in congressional hearings and in the press that most other countries place the responsibility for security with the government or the airports, not with the airlines as in the United States.[7] Based partly on this fact and partly on the belief that a more unified approach would improve coordination and funding, many analysts and policymakers have proposed federalization of the screening process. (For a list of bills that address this option and others, see **Table 2**. The term federalization means different things in different proposals, including making screeners FAA employees, making them employees of the Federal Protective Service, and making FAA responsible for screening but permitting screeners to be employed by contractors.) An early cost estimate for

---

[5]General Accounting Office, *Aviation Security: Terrorist Acts Illustrate Severe Weaknesses in Aviation Security*, GAO-01-1166T (September 20, 2001), p. 6. Test results since 1987 cannot be given here because they have been designated as sensitive security information.

[6]Ibid., p. 7.

[7]For further discussion of security operations in other countries, see ibid., p. 8, and General Accounting Office, *Aviation Security: Long-Standing Problems Impair Airport Screeners' Performance*, GAO/RCED-00-75 (June 2000).

federalization was $1.8 billion per year, including wages for 28,000 full-time employees, but the detailed assumptions built into this number were not immediately known.[8] Others suggested creation of an independent security organization, such as a government-owned corporation. Still others emphasized raising standards for performance and training over organizational questions. The Administration plan released on September 27, 2001, called for screening and other security operations to be performed by a combination of federal and nonfederal personnel, managed by uniformed federal personnel.[9] Based on a survey of airline and airport security officials, the General Accounting Office has found a consensus that several different options could improve screener performance, but that those surveyed disagree about whether other operational criteria would be improved, unchanged, or made worse.[10]

The status of pending FAA security regulations may also be of interest as the Congress considers the issue of screener performance. Revised security regulations for airlines (14 CFR 108) were published in the *Federal Register* on July 17, 2001, and are scheduled to take effect on November 14, 2001. In addition, proposed regulations for certification of screening companies (14 CFR 111) were published in the *Federal Register* on January 5, 2000. The Airport Security Improvement Act of 2000 (P.L. 106-528) required that the FAA issue a final rule on certification of screening companies by May 31, 2001. Following some delays, the final rule was nearly ready for release at the time of the September 11 attacks. In light of the attacks, it has been put on hold and is being reexamined. The Congress may decide to consider whether further changes in these regulations are needed, either to strengthen them in light of the September 11 attacks or as part of broader organizational changes in the security system.

Equipment Deployment

The September 11 attacks may intensify congressional interest in funding and oversight of the FAA program for deployment of security equipment. This program was begun in 1997, as directed by provisions in the Omnibus Consolidated Appropriations Act of 1997 (P.L. 104-208) and the Federal Aviation Reauthorization Act of 1996 (P.L. 104-264). Previously, airlines had been exclusively responsible for purchasing and deploying their own security equipment. (They remain responsible for some types of equipment and for maintenance and operating costs of equipment purchased by the FAA.) The deployment program is conducted by the Security Equipment Integrated Product Team (SEIPT), which includes members from airlines, airports, and contractors as well as the FAA. Under the deployment plan developed by the SEIPT, equipment is typically deployed first in the largest, busiest airports (known as Category X airports), followed by smaller airports (Categories I through IV). The FY2002 budget requested $97.5 million for purchase of equipment, plus

---

[8]Caroline E. Mayer, "Federalization of Airport Security Draws Debate," *Washington Post*, September 20, 2001.

[9]White House, Office of the Press Secretary, "Enhancing Aviation Safety and Security," September 27, 2001. [http://www.whitehouse.gov/news/releases/2001/09/20010927.html]

[10]General Accounting Office, *Aviation Security: Vulnerabilities in, and Alternatives for, Preboard Screening Security Operations*, GAO-01-1171T (September 25, 2001).

$2.5 million for related personnel and other expenses. Appropriations bills passed by the House and Senate before the September 11 attacks (H.R. 2299 and S. 1178) both provided the requested amount. There may be congressional interest in accelerating or modifying the deployment program.

In considering the equipment deployment program, Congress may seek to compare the security enhancement provided by different options. For example, at any given funding level, what would be the most effective balance among new equipment for screening checked baggage, for screening carry-on baggage, and for training screeners? Until recently, there has been little evaluation of the security system's effectiveness at the system level, as opposed to the effectiveness of individual technologies and procedures. A 1999 NRC report recommended development of a "total architecture for aviation security" to permit measurement of the security enhancement of the integrated system, both in its current configuration and in alternative configurations. The report noted that "the urgent need for immediate action"—a sense of urgency that is again felt in the wake of the September 11 attacks—had understandably resulted in equipment and procedures being implemented rapidly without regard to overall architecture. It nevertheless concluded that the total architecture concept is essential to a successful security system.[11]

New Technology Development

The FAA has a research and development program to develop new security technologies. Located at the William J. Hughes Technical Center in Atlantic City, New Jersey, this program conducts testing and evaluation and contracts with companies and universities to conduct research and development on new technologies. There are four program areas:

- explosives and weapons detection, to improve the performance, speed, and cost of detection equipment;
- human factors, to optimize the interface between security equipment and its human operators so that the combined system is most effective;
- aircraft hardening, to reduce or eliminate aircraft structural damage caused by the detonation of bombs hidden in baggage; and
- airport security technology integration, to improve the integration of security equipment into the airport operating environment.

The requested budget for this program in FY2002 is $50.3 million, somewhat below the FY2001 level but roughly comparable with other recent years (see **Table 1**). The House appropriations bill passed before the September 11 attacks (H.R. 2299) reduced the request to $44.5 million, citing concerns about FAA management. The Senate appropriations bill passed before the September 11 attack (S. 1178) increased the request to $55.3 million to provide $5 million for development of pulsed fast neutron analysis, a technology for detection of explosives in cargo.[12] In

---

[11]National Research Council, *Assessment of Technologies Deployed to Improve Aviation Security: First Report* (National Academy Press, Washington, 1999).

[12]The National Research Council is evaluating the practicality of using pulsed fast neutron (continued...)

light of the attacks on September 11, Congress may decide to expand the budget for the aviation security R&D program. In addition, since the program's primary emphasis up to now has been on detection of explosives, the Congress may consider increasing the emphasis on other threats, such as knives, guns, and other weapons that might be used by hijackers.

Table 1. FAA Budget for Aviation Security R&D
($ in thousands)

Program Area	FY1998 Enacted	FY1999 Enacted	FY2000 Enacted	FY2001 Enacted	FY2002 Request
Explosives and Weapons Detection	34,200	41,700	37,605	42,512	38,438
Human Factors	5,540	5,282	5,256	5,134	5,163
Aircraft Hardening	2,000	2,000	5,001	4,297	4,640
Airport Security Technology Integration	2,485	2,708	2,285	2,457	2,084
TOTAL	44,225	51,690	50,147	54,400	50,325

[12](...continued)
analysis for cargo and baggage screening. Its report is in preparation.

Table 2. Bills to Improve Aviation Security Introduced Since September 11, 2001

(as of October 26, 2001)

Number	Title	Sponsor	Provisions Specifically Related to Screening
H.R. 2895	Aviation Security Enhancement Act of 2001	Lipinski	federalization, limit on carry-on baggage
H.R. 2898	Federal Airports Security Enhancement Act	Traficant	federalization
H.R. 2906	Emergency Aviation Security Act of 2001	Baker	
H.R. 2913	Aviation Security Improvement Act of 2001	Quinn	federalization
H.R. 2951	Aviation Security Act	Ganske	federalization, screener training and employment
H.R. 2957	Secure Aviation Employment and Training Enhancement Act of 2001	Castle	
H.R. 3029	Baggage Screening Act	Inslee	expanded screening
H.R. 3056	Flight Deck and Aircraft Integrity Enhancement Act of 2001	Traficant	
H.R. 3064	Airline Security Act of 2001	Baca	passenger profiling
H.R. 3067	[to give hiring priority to workers who lost jobs as a result of attacks]	Harman	
H.R. 3101	Aviation Security Technology Enhancement Act	Matheson	equipment
H.R. 3110	Transportation Security Enhancement Act of 2001	Oberstar	federalization, screener training and employment
H.R. 3150	Secure Transportation for America Act of 2001	Young	federalization, screener training and employment
H.R. 3165	Aviation Security Act, II	Ganske	federalization, training, equipment, research, reports
S. 1421	Emergency Aviation Security Act of 2001	Hutchison	
S. 1429	Airport and Seaport Terrorism Prevention Act	Edwards	federalization, screener training, screening equipment
S. 1444	Federal Air Marshals and Safe Sky Act of 2001	McConnell	
S. 1447	Aviation Security Act	Hollings	federalization, training, equipment, research, reports
S. 1461	Airline Passenger Safety Enhancement Act of 2001	Durbin	federalization
S. 1473	[to provide for enhancement of security at airports in the United States]	Johnson	federalization
S. 1515	[to provide for enhanced security with respect to aircraft]	Kohl	screening program requirements
S. 1544	[to give hiring priority to workers who lost jobs as a result of attacks]	Kennedy	