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United States General Accounting Office  
Washington, DC 20548

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June 28, 2002

The Honorable Ernest F. Hollings  
Chairman, Committee on Commerce,  
Science, and Transportation  
United States Senate

Subject: Information Concerning the Arming of Commercial Pilots

Dear Mr. Chairman:

Since the terrorist attacks on September 11, 2001, legislation has been enacted to enhance the nation's approach to aviation security. Specifically, the Aviation and Transportation Security Act created the Transportation Security Administration (TSA) and, among other actions, federalized passenger and baggage screening staff at airports and authorized the arming of commercial pilots, subject to the approval of the Under Secretary of Transportation for Security and other conditions.<sup>1</sup> On May 21, 2002, the Under Secretary testified that he would not approve the arming of commercial pilots because he believed they must focus exclusively on flying the aircraft. However, the question of arming pilots remains open because H.R. 4635, introduced on May 1, 2002, would require TSA to establish a program to arm pilots within 90 days of the bill's enactment. On June 19, 2002, the House Transportation and Infrastructure's Subcommittee on Aviation passed an amended version of H.R. 4635 to

- limit the maximum number of pilots participating in this pilot program to 2 percent of the total number of pilots employed by air carriers and
- require that TSA address a number of procedural issues before beginning the selection, training, and deputizing of pilots.

In addition, four other bills, introduced before the Aviation and Transportation Security Act's enactment, include proposals to carry weapons.<sup>2</sup> (See enc. I for more detailed information.)

To facilitate congressional decision-making, you asked us to provide information on (1) reasons for and against allowing pilots to carry firearms in the cockpit; (2) questions to be addressed if pilots were to be armed; and (3) possible alternatives to arming pilots, such as providing them with less-than-lethal weapons. On May 20, 2002, we briefed you

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<sup>1</sup>P.L. 107-71, November 19, 2001.

<sup>2</sup>H.R. 2958, H.R. 2896, H.R. 3171, and S. 1463.

on the results of our work. This report summarizes the information we provided at that time.

To obtain the information you requested, we analyzed a docket of over 7,500 comments that the Federal Aviation Administration (FAA) had received by March 15, 2002, in response to a request for comments, published in the *Federal Register* on December 31, 2001,<sup>3</sup> on whether pilots should be allowed to carry firearms in the cockpit.<sup>4</sup> Our analysis included all comments from airlines, trade associations, unions, other advocacy groups, and aviation security firms and a sample of comments from individuals. In addition, we examined available research studies on the potential risks and benefits of using firearms on aircraft and possible alternatives, such as the use of less-than-lethal weapons. We identified only one study that addressed the use of firearms on aircraft; this study focused on structural damage to aircraft by ammunition and bombs. We also examined a study by the National Institute of Justice, mandated by the Aviation and Transportation Security Act, on the potential use of less-than-lethal weapons on aircraft.<sup>5</sup> To obtain further information, we interviewed industry aviation security experts on the issue of arming pilots with firearms or less-than-lethal weapons. Finally, we reviewed articles and position papers by airlines, industry associations, pilot and flight attendant unions, and other organizations. The detailed results of our analysis appear in enclosures II, III, and IV. We performed our work in accordance with generally accepted government auditing standards in May and June 2002.

## Results in Brief

Without additional research, the potential benefits, risks, and costs of using weapons on aircraft cannot be fully determined. Proponents' and opponents' views on allowing pilots to carry firearms in the cockpit fell into four categories: the potential effectiveness, risk, and cost-effectiveness of their carrying weapons, and the policy issues that would arise if pilots were allowed to carry weapons. For example, proponents saw arming pilots as a last line of defense if other security measures failed, while opponents considered the current security enhancements, such as improved screening and increases in the number of federal air marshals, sufficient. Views also differed on whether arming pilots with firearms would be effective or safe. Proponents maintained that arming pilots would be more cost-effective than other security enhancements, while opponents contrasted the potentially high costs of the risks with the small benefits they anticipated. Finally, views differed on the public policy implications of arming pilots. Proponents cited the potential deterrent value of firearms and past regulatory precedents for arming pilots

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<sup>3</sup>66 *Fed. Reg.* 67620.

<sup>4</sup>According to FAA's analysis, more than 96 percent of the comments favored the arming of pilots. FAA noted that more than 99 percent of the comments were from individuals and pilots and that most of the comments appeared to have been solicited by a few gun advocacy groups. FAA also noted that less than 1 percent of the comments were from organizations, such as industry associations, unions, airlines, public interest groups, or security-related businesses.

<sup>5</sup>For publicly available information on this report, see the testimony of Sarah V. Hart, Director, National Institute of Justice, Office of Justice Programs, before the Subcommittee on Aviation, House Committee on Transportation and Infrastructure, May 2, 2002.

(see enc. I), whereas opponents cited the moral dilemma pilots would face if they were prohibited from using firearms outside the cockpit and passengers or crew members were being threatened in the cabin (see enc. III). Opponents also said that arming pilots would introduce from 10,000 to 100,000 guns into our society. Enclosure II summarizes the reasons for and against arming pilots that we obtained from our analysis of FAA's docket and from our research and interviews.

If pilots were to be armed, a number of questions would need to be resolved, such as (1) who would regulate and oversee pilots' carriage of weapons; (2) what qualifications and training would pilots need to carry weapons; (3) what types of weapons could be carried and how would they be maintained, stored, and transported; (4) what modifications to aircraft would be required; and (5) how much would it cost to arm pilots. FAA raised some of these questions in its request for comments, and some respondents raised additional questions and proposed solutions. Most respondents that addressed these questions were proponents of arming pilots. Yet even these proponents expressed a range of views on critical questions, such as whether pilots' participation would be voluntary, whether the use of firearms would be restricted to defending the cockpit, and where the firearms would be stored between flights. The responses generally attempted to maximize the effectiveness of any program to arm pilots while minimizing its risk to safety and security. Opponents of arming pilots generally did not address these questions or maintained that the questions could not be addressed in a way that would sufficiently mitigate unacceptable risks to safety and security. Enclosure III summarizes these questions.

The National Institute of Justice reviewed the information available on less-than-lethal weapons, as mandated by the Aviation and Transportation Security Act, and identified six general categories—electrical shock, chemical, impact projectile, physical restraint, light, and acoustic.<sup>6</sup> While FAA's request for comments did not identify particular types of less-than-lethal weapons that might be used as alternatives to firearms, most of the comments that FAA received on less-than-lethal weapons and most of the Institute's study focused on electric shock devices, which are already used outside aircraft for law enforcement purposes, such as riot control. Proponents of arming pilots with these devices emphasized their ability to incapacitate an aggressor without posing a lethal risk to others, while opponents noted that recovery from electrical shock takes less than a minute and that the effectiveness of the devices can be limited in a variety of ways. Although one major U.S. carrier has tested electric shock devices onboard aircraft and has found no effects on airworthiness, the Institute regards their effects on aircraft avionics as unknown and favors further testing. Observations on the other less-than-lethal weapons focused primarily on their value as temporary deterrents to aggressors and on the difficulty of controlling their effects. Enclosure IV provides more detailed information on these weapons.

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<sup>6</sup>Weapons in the first three categories already exist. Weapons in the last two categories are currently under development. Because the effects of these less-than-lethal weapons are temporary, physical restraints, which are not considered weapons, are often used in conjunction with them.

In addition to less-than-lethal weapons, we identified other security enhancements that organizations or individuals suggested as alternatives to arming pilots. These included

- providing additional training for pilots in maneuvers that could disable attackers, such as steeply banking the aircraft;
- installing technical improvements that would allow the aircraft to be controlled from the ground if the pilot were disabled or the aircraft were hijacked;
- adding other enhancements to cockpit security, including changes to the design and equipment of aircraft that would (1) limit access to the cockpit by unauthorized personnel, such as the double-door system used by El Al, Israel's national airline or (2) permit the flight crew to monitor cabin activities through the use of video cameras in the cabin; and
- having more armed security or law enforcement officers onboard.

Detailed information was not available on the feasibility or cost of these suggested alternatives.

### **Agency Comments**

We provided the Department of Transportation with a draft of this report for its review and comment. The Department generally agreed that the information in the report fairly presented the range of opinions on the issue of arming pilots. The Department provided technical corrections that we incorporated as appropriate.

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We are sending copies of this report to the Secretary of Transportation and will make copies available to others upon request. If you have any questions about our work, please contact me at (202) 512-2834. Key contributors to this letter were Bonnie Beckett, Michael Bollinger, Elizabeth Eisenstadt, David Goldstein, Heather Krause, Teresa Spisak, and Alwynne Wilbur.

In addition, the report will be available at no charge on the GAO web site at <http://www.gao.gov>.

Sincerely yours,



Gerald L. Dillingham  
Director, Physical Infrastructure Issues.

### **Background Information on Arming Pilots**

In 1961, regulations<sup>1</sup> promulgated by the former Federal Aviation Agency, now the FAA, exempted law enforcement officers and other persons authorized by air carriers, such as pilots and other crew members, from a general prohibition against the carriage of weapons aboard aircraft. In 1975, the FAA changed the provision covering the nation's largest commercial carriers (known as part 121 carriers) to provide that law enforcement officers or crew members, including pilots, could not carry weapons onboard aircraft unless (1) the FAA Administrator, as well as the carrier, authorized the carriage of weapons and (2) the individual successfully completed a course of training in the use of the weapon. On July 21, 2001, FAA limited the carriage of weapons on aircraft to certain law enforcement officers.<sup>2</sup>

Although pilots and other crew members are currently prohibited from carrying weapons onboard aircraft, the Aviation and Transportation Security Act raises the possibility of arming pilots in the future. Specifically, this act authorizes air carrier pilots to carry a firearm in the cockpit if

- the Under Secretary of Transportation for Security approves;
- the air carrier approves;
- the firearm is approved by the Under Secretary; and
- the pilot has received proper training in the use of the firearm, as determined by the Under Secretary.

TSA has issued regulations that will continue to allow the arming of pilots who operate in special situations. Specifically, TSA will continue to allow guns onboard aircraft if they are part of a state-required emergency kit. Alaskan law, for example, provides that certain aircraft must have emergency equipment onboard, including a firearm, in case they make a forced landing at a remote wilderness location.<sup>3</sup> This regulation becomes effective on June 24, 2002.

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<sup>1</sup>These regulations initially responded to hijackings of U.S. aircraft to Cuba.

<sup>2</sup>See 66 *Fed. Reg.* 37330.

<sup>3</sup>49 C.F.R. 1544.103. 67 *Fed. Reg.* 8205, February 22, 2002.

Reasons for and against Arming Pilots

Issue	Reasons presented by those in favor of arming pilots	Reasons presented by those opposed to arming pilots
Need	We need a last line of defense if other security measures fail.	Current security enhancements, such as improved screening, increases in the number of federal air marshals, and cockpit door reinforcement, are sufficient.
Effectiveness	<p>Firearms are a highly effective means of permanently disabling one or multiple attackers.</p> <p>Arming pilots is the best deterrent to hijackers.</p>	Firearms are not sufficiently effective compared with the risks they present. Trained law enforcement officials have only an 18 to 22 percent hit ratio in armed confrontation. The cramped quarters of a cockpit do not lend themselves to success.
Risk	<p>The risk to aircraft integrity, including depressurizing aircraft or damaging vital flight components, is very small.</p> <p>The risk to other people onboard is very small, particularly if the firearms are used only in the cockpit and pilots are well trained.</p> <p>Only when all other measures have failed would the pilot be authorized to use the firearm to protect the cockpit.</p> <p>Pilots are trained to do several tasks at once and would be able to incorporate the use of a firearm into their other tasks.</p> <p>Many pilots have had previous military training in the use of firearms.</p>	<p>The risk to aircraft integrity, including depressurizing the aircraft or damaging vital flight components, is significant.</p> <p>The risk to other people is significant. The firearm could be used against a pilot or other passengers. Violence Policy Center cites statistics that 21 percent of officers killed with a handgun were shot with their own weapon.</p> <p>Accidental weapon discharge and pilot mishandling of the weapon are also risks.</p> <p>Pilots are trained to land aircraft quickly in an emergency, and in an emergency this should be their primary task. Firearms could distract pilots from their critical mission of flying and landing the aircraft.</p> <p>Military training for ground combat differs significantly from what would be needed to defend the cockpit.</p> <p>Generally, law-enforcement officers have serious objections to arming pilots.</p>
Cost-effectiveness	Arming pilots is cost-effective when compared with the cost of expanding the federal marshal program or implementing other security enhancements.	Arming pilots is not cost-effective when compared with the risks it would present and the small likelihood it would be beneficial.

Enclosure II

<p>Policy issues</p>	<p>There is a precedent for arming pilots: FAA authorized the arming of flight crew members in the 1960s.</p> <p>Section 128 of the Aviation and Transportation Security Act permits air carrier pilots to carry a TSA-approved firearm into the cockpit if approved by the Under Secretary for TSA and the carrier, and if the pilot has received proper training.</p>	<p>Arming pilots would introduce 10,000-100,000 guns into our society, contradicting other efforts to discourage the number of firearms in the population.</p> <p>Arming pilots might lead to other transportation workers requesting to carry weapons onboard aircraft. For example, the Maryland Pilots' Association has petitioned to allow ship captains to carry their weapons onboard aircraft when in transit to their ships. In addition, it might lead to requests for the arming of other transportation workers, such as bus or taxi drivers.</p> <p>Many air carriers oppose arming pilots because of concerns about liability, training, and storage of the weapons when not in use.</p>
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Sources: Comments received as of March 15, 2002, on FAA docket 2001-111229, published in the *Federal Register* on December 31, 2001; testimonies on May 2, 2002, before the Subcommittee on Aviation, House Committee on Transportation and Infrastructure, by Sarah V. Hart, Director, National Institute of Justice, Office of Justice Programs, and Henry P. Krakowski, Vice President, Safety, Security, and Quality Assurance, United Airlines; literature search; and interviews with aviation experts and officials from DOT, FAA, and TSA.

**Questions to Be Addressed If Pilots Were to Be Armed**

Topic	Questions
Regulation and oversight	<ul style="list-style-type: none"> <li>• How would protocols be established and enforced?</li> <li>• What entity would decide what types of weapons, ammunition, or aircraft modifications would be required and whether airlines or pilots would have any choice in these matters?</li> <li>• What entity would be responsible for ensuring that only acceptable firearms and ammunition were used on aircraft, and how would it accomplish this?</li> <li>• How would the use of firearms by unauthorized persons be prevented?</li> <li>• What entity would be responsible for establishing protocols for the use of firearms and to minimize risks such as unauthorized use or accidental discharge?</li> <li>• How would the defensive efforts of armed pilots, air marshals, and other law enforcement officers be coordinated?</li> </ul>
Pilot qualifications	<ul style="list-style-type: none"> <li>• What qualifications, if any, would be used to establish which pilots would be permitted to carry firearms?</li> <li>• If carriage of a firearm were authorized, would carriage be at the pilot's discretion?</li> <li>• What background checks or other screening would be required? Would all pilots of commercial airlines be permitted to carry firearms?</li> <li>• Would periodic recertification of pilots be required?</li> <li>• What actions by a pilot, such as the commission of a felony or misdemeanor or the abuse of alcohol or drugs, would trigger an automatic review of the right to carry a firearm?</li> <li>• Would pilots of cargo-only aircraft be permitted to carry firearms?</li> <li>• Would any types of general aviation pilots be permitted to carry firearms?</li> <li>• Would permission to carry firearms first be offered to those pilots with prior military or law enforcement experience?</li> <li>• Would the qualifications for using firearms be integrated into the existing systems for establishing and maintaining airman qualifications, such as pilot certifications and ratings?</li> </ul>
Deputizing of pilots	<ul style="list-style-type: none"> <li>• Would pilots be deputized as law enforcement officers?</li> <li>• What rights would this grant pilots beyond the carriage of weapons in aircraft cockpits?</li> <li>• How would this affect liability issues?</li> </ul>
Training of pilots in the use of firearms	<ul style="list-style-type: none"> <li>• What entity would provide firearms training to pilots?</li> <li>• Would the training require certification?</li> <li>• How extensive would the initial training be and what would it cover?</li> <li>• Would recurrent training be required, and if so, how often and what type?</li> <li>• If the weapon were stored on the aircraft, would training be required for other personnel who had access to the aircraft?</li> </ul>



Enclosure III

Topic	Questions
When and where to use firearms	<ul style="list-style-type: none"> <li>• Under what circumstances would pilots be authorized to use firearms?</li> <li>• Would pilots be restricted to using firearms to defend the cockpit?</li> <li>• If there were two pilots, would one be permitted to use the firearm in the cabin as long as the other remained in the cockpit?</li> <li>• If a pilot had a firearm in the cockpit, would a severe disturbance in the cabin present an unacceptable moral dilemma?</li> </ul>
Type(s) of firearms and ammunition	<ul style="list-style-type: none"> <li>• What type(s) of firearms and ammunition would be most appropriate to meet the dual purpose of maximizing the pilot's ability to permanently disable an attacker while minimizing the risk of damage to the aircraft and other people?</li> <li>• What criteria would be used (e.g., simplicity, caliber, maintenance, reloading) in authorizing types of weapons and ammunition?</li> <li>• Which weapons have the least risk of accidental discharge?</li> <li>• Are the weapons that have been authorized for use by FBI agents or air marshals appropriate for pilots?</li> </ul>
Maintenance of firearms	<ul style="list-style-type: none"> <li>• Who would be responsible for the maintenance and care of the firearms?</li> <li>• What procedures would be required to ensure that the firearm was properly maintained and cared for, and to reduce the possibility of accidental discharge?</li> </ul>
Storage and transportation of firearms	<ul style="list-style-type: none"> <li>• How would firearms be stored to minimize security risks?</li> <li>• Would firearms be stored on the aircraft, at the airport, or with the pilot?</li> <li>• If the firearm were stored on the aircraft or in the airport, what kind of lock and container would be used to ensure security, and how would access be controlled?</li> <li>• If the firearm remained with the pilot, how would the authority be established for the pilot to carry the firearm from home to work or during overnight stays in other cities, states, or foreign countries? Given that it is not uncommon for pilots to cross state lines in their commute between home and the place their work duties begin, how would jurisdictional issues regarding interstate travel with a concealed firearm be resolved?</li> <li>• If the firearm remained with the pilot, how would the firearm be transported through the airport to the aircraft? Would current screening procedures be revised? Would separate screening facilities for pilots be established to facilitate pilots getting through security without delays while minimizing their contact with the public while in possession of a firearm?</li> <li>• How would the security and liability risks associated with each option be addressed?</li> <li>• Are the procedures that have been established for federal air marshals on these matters appropriate for pilots?</li> </ul>
Aircraft modifications	<ul style="list-style-type: none"> <li>• Would aircraft modifications be required for the storage of weapons?</li> <li>• Would aircraft modifications be required to reduce the possibility of damage to key aircraft components caused by a bullet?</li> </ul>

Enclosure III

Topic	Question
International issues	<ul style="list-style-type: none"> <li>• How would pilots handle firearms when flying to or from other countries?</li> <li>• Are the procedures that have been established for air marshals on this matter appropriate for pilots?</li> <li>• Would foreign pilots flying for a foreign air carrier be permitted to carry firearms when flying on routes in the United States?</li> </ul>
Cost	<ul style="list-style-type: none"> <li>• Is arming pilots a cost-effective way to increase aviation security?</li> <li>• How much would it cost to purchase firearms and ammunition for pilots, train pilots, service and maintain firearms, and make any necessary modifications to aircraft?</li> <li>• Would liability concerns raise insurance costs?</li> <li>• What other costs would be involved?</li> <li>• What entity would bear the cost of arming pilots?</li> <li>• Would arming pilots be less expensive than sufficiently expanding the air marshal program?</li> </ul>
Coordination	<ul style="list-style-type: none"> <li>• How would armed pilots coordinate with air marshals and other law enforcement officers on the aircraft to minimize risk and confusion?</li> </ul>

Sources: Comments received as of March 15, 2002, on FAA docket 2001-111229, published in the *Federal Register* on December 31, 2001; testimonies on May 2, 2002, before the Subcommittee on Aviation, House Committee on Transportation and Infrastructure, by Sarah V. Hart, Director, National Institute of Justice, Office of Justice Programs, and Henry P. Krakowski, Vice President, Safety, Security, and Quality Assurance, United Airlines; literature search; and interviews with aviation experts and officials from DOT, TSA, and FAA.

### Less-Than-Lethal Weapons

The National Institute of Justice has identified six general categories of less-than-lethal weapons—electrical shock, chemical, impact projectile, physical restraint, light, and acoustic. Weapons in the first three categories already exist. Weapons in the last two categories are currently under development. Because the effects of these less-than-lethal weapons are temporary, physical restraints, which are not considered weapons, are often used in conjunction with them. The following table provides information, where applicable, on the types of weapons in each category, their benefits and disadvantages, and their readiness for deployment.

<b>Electric shock</b>	<b>Characteristics</b>
Types	<ul style="list-style-type: none"> <li>• Handheld direct-contact weapon: Has two probes that are pressed against an aggressor’s skin or clothing. When the operator presses a switch, the skin contact and pressed switch complete a circuit and the subject receives a debilitating and possibly painful electrical shock.</li> <li>• Dart-firing electrical shocking device: Fires two barbs connected to trailing wires that lead back to the operator; contact with the subject’s skin or clothing completes an electrical circuit, and an electrical discharge automatically results.</li> </ul>
Benefits	<ul style="list-style-type: none"> <li>• Immediately incapacitates an aggressor, who loses control over muscles and nerves and cannot perform coordinated action.</li> <li>• Not likely to kill or maim.</li> <li>• Can be reactivated repeatedly as long as the wires remain attached to the assailant.</li> <li>• Can be used in a confined space, especially if handheld.</li> <li>• Not likely to damage buildings or aircraft fuselages or to ignite standard solids or black gunpowder.</li> <li>• Easier to control than chemicals and less likely to cause damage than blunt instruments, such as beanbag weapons.</li> <li>• Easy to operate—little training needed.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Does not disable an aggressor for long—recovery takes less than a minute.</li> <li>• Highly motivated and trained aggressors may be able to withstand the effects.</li> <li>• Can be used on only one aggressor at a time and requires immediate use of physical restraints.</li> <li>• Can be deflected by a book or dinner tray; may be foiled by thick clothing; may not penetrate soft body armor.</li> <li>• Effectiveness substantially limited if one probe lands on a nonconductive surface (e.g., concrete, asphalt, or wood).</li> <li>• Range of dart version may be too great for the cockpit or inadequate for the cabin.</li> <li>• Sparks can ignite some flammable liquids, vapors, or sensitive explosives.</li> <li>• Requires preventative maintenance—batteries must be fully charged.</li> </ul>

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<b>Electric shock (cont.)</b>	<b>Characteristics</b>
Readiness for deployment	<ul style="list-style-type: none"> <li>• Deployment has begun.</li> <li>• Presently used by three international foreign carriers.</li> <li>• At least one domestic carrier has provided training and another three are moving forward on using these items.</li> <li>• One carrier has tested devices on all types of aircraft it flies and has found no effect on airworthiness and negligible effects on electrical and electronic equipment during testing, and has purchased several hundred devices.</li> <li>• National Institute of Justice considers weapon's effects on aircraft avionics and other critical systems unknown—favors further testing.</li> </ul>
<b>Chemicals</b>	
Types	<ul style="list-style-type: none"> <li>• Tear gas and pepper spray</li> <li>• Anesthetics or calmativive chemicals</li> </ul>
Benefits	<ul style="list-style-type: none"> <li>• Tear gas, pepper spray can limit mobility of an aggressor.</li> </ul>
	<ul style="list-style-type: none"> <li>• Anesthetics or calmativive chemicals could be released, potentially remotely, into the cabin to incapacitate all passengers, including hijackers, until the plane can be safely landed.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Chemicals cannot be adequately controlled in an aircraft and may contaminate pilots and flight attendants, although handheld dispensers of pepper spray offer better control than tear gas.</li> <li>• Some individuals may become more violent in response to the use of these chemicals.</li> <li>• Tear gas and pepper spray have reversible, but not rapidly reversible, effects--problematic if flight crew is affected.</li> <li>• Anesthetics or calmativive chemicals               <ul style="list-style-type: none"> <li>• do not take effect rapidly,</li> <li>• may create unacceptable health risks to infants and persons with upper respiratory problems, and</li> <li>• may prevent other passengers from helping to immobilize or restrain hijackers.</li> </ul> </li> </ul>
Readiness for deployment	<ul style="list-style-type: none"> <li>• Remains under study or development.</li> <li>• Should be tested in multiple aircraft settings before any deployment.</li> </ul>
<b>Impact projectiles</b>	
Types	<ul style="list-style-type: none"> <li>• Rubber bullet or blunt trauma projectile</li> </ul>
Benefits	<ul style="list-style-type: none"> <li>• May be appropriate in the aircraft's cabin, where restrictions on space are less severe and the risk of damage to critical systems or injury to the flight crew are reduced.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Degree of incapacitation varies greatly.</li> <li>• Effect can wear off quickly.</li> <li>• Not designed for use in confined spaces—launched from a pump-action shotgun or a single round tear gas gun that requires two hands to operate.</li> <li>• Large and not designed to be easily carried on a belt or in a pocket.</li> </ul>
Readiness for deployment	<ul style="list-style-type: none"> <li>• Should be tested in multiple aircraft settings before any deployment.</li> </ul>

Enclosure IV

<b>Physical restraints<sup>a</sup></b>	<b>Characteristics</b>
Types	<ul style="list-style-type: none"> <li>• Handcuffs</li> <li>• Nets—also exist in a prototype electrified design</li> <li>• Surface chemicals applied to surfaces to make them extremely slippery or extremely sticky, to impede the movement of an aggressor</li> </ul>
Benefits	<ul style="list-style-type: none"> <li>• Handcuffs and flexible cuffs—common and useful in conjunction with less-than-lethal weapons</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• Nets are probably not adequate to incapacitate a determined and trained hijacker.</li> <li>• Surface chemicals could impede efforts of passengers and crew to subdue hijacker.</li> <li>• Deployment may not be fast enough to be helpful.</li> <li>• Net guns are not practical in the cabin.</li> </ul>
Readiness for deployment	<ul style="list-style-type: none"> <li>• Effect of electrified nets on aircraft electrical systems is unknown—further testing is needed.</li> </ul>
<b>Light</b>	
Types	<ul style="list-style-type: none"> <li>• Bright white lights or lasers can produce a “wall of light” that may deter an aggressor from attacking someone behind the light.</li> </ul>
Benefits	<ul style="list-style-type: none"> <li>• Lower power level could be used to distract or delay the advance of an aggressor and provide time for passengers and crew to protect themselves or restrain the aggressor.</li> </ul>
Disadvantages	<ul style="list-style-type: none"> <li>• May not prevent determined aggressor from using a weapon.</li> <li>• If powerful enough to disable an aggressor, may cause eye damage.</li> </ul>
Readiness for deployment	<ul style="list-style-type: none"> <li>• Still being developed by the Department of Defense with support from the National Institute of Justice.</li> <li>• Should be tested in multiple aircraft settings before any deployment.</li> </ul>
<b>Acoustics</b>	
Types	<ul style="list-style-type: none"> <li>• A sound source produces acoustic energy at audible and inaudible frequencies.</li> </ul>
Benefits	<ul style="list-style-type: none"> <li>• “Ear-splitting” audible sounds halt the advance of an aggressor.</li> </ul>
Readiness for deployment	<ul style="list-style-type: none"> <li>• Still being developed by the Department of Defense with support from the National Institute of Justice.</li> <li>• Should be tested in multiple aircraft settings before any deployment.</li> </ul>

<sup>a</sup>Although not considered weapons, physical restraints are used in conjunction with less-than-lethal weapons.

Sources: Comments received as of March 15, 2002, on FAA docket 2001-111229, published in the *Federal Register* on December 31, 2001; interviews with aviation experts; and testimonies on May 2, 2002, before the Subcommittee on Aviation, House Committee on Transportation and Infrastructure, by Sarah V. Hart, Director, National Institute of Justice, Office of Justice Programs, and Henry P. Krakowski, Vice President, Safety, Security, and Quality Assurance, United Airlines.

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