GAO

Testimony

Before the Subcommittee on Aviation, Committee on Transportation and Infrastructure, House of Representatives

AVIATION SAFETY

FAA Has Increased Efforts to Address Runway Incursions

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G A O
Accountability * Integrity * Reliability

GAO-08-1169T

AVIATION SAFETY

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Why GAO Did This Study

Despite a recent reduction in air traffic due to economic factors, congestion on airport runways remains a safety concern. The nation's aviation system is still expected to grow and become more crowded in the coming years, exacerbating concerns about ground safety issues, including runway incursions, which occur when aircraft enter runways without authorization. This statement addresses (1) recent trends in runway incursions, (2) steps taken to improve runway safety, and (3) what more could be done. This statement is based on GAO's November 2007 report issued to this Subcommittee on runway safety. GAO's work on that report included surveying experts on the causes of runway incidents and accidents and the effectiveness of measures to address them, reviewing safety data, and interviewing agency and industry officials. This statement also contains information from FAA on recent incursions and actions taken since November 2007.

What GAO Recommends

In prior work, GAO recommended that FAA take several measures to enhance runway safety, such as updating its national runway safety plan, collecting more complete data on runway incidents, and addressing air traffic controller fatigue. The agency is taking actions to implement them.
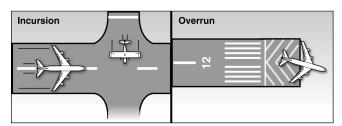
To view the full product, including the scope and methodology, click on GAO-08-1169T. For more information, contact Gerald L. Dillingham, Ph.D., at (202) 512-2834.

What GAO Found

While the number of serious incursions this fiscal year is slightly lower than last year, the rate (measured by the number of incidents per 1 million takeoffs and landings) has increased. The number of serious runway incursions—incidents in which collisions were narrowly or barely avoided—decreased from 24 in fiscal year 2007 to 23 in fiscal year 2008 through September 16, 2008. The rate of serious incursions increased by 5 percent during fiscal year 2008 through September 16, 2008, compared with fiscal year 2007. For all categories of severity, the total number and rate of incursions increased at a slightly slower pace during fiscal year 2008, compared with the prior year. The total number of incursions during the first three quarters of fiscal year 2008 increased by 7 percent and the rate increased by 10 percent, compared with the same period during fiscal year 2007.

During fiscal year 2008, FAA has given higher priority to improving runway safety than it did during the previous 2 years when it did not have a permanent director for its Office of Runway Safety, which it created to lead and coordinate the agency's runway safety efforts. FAA's recent actions to improve runway safety include continuing to deploy and test new technology designed to prevent runway collisions; promoting changes in airport layout, markings, signage, and lighting; and issuing new air traffic procedures.

FAA could further improve runway safety by ensuring the timely deployment of technology, encouraging the development of new technology, and increasing its focus on human factors issues, which aviation safety experts identified as the primary cause of incursions. For example, experts said that technology such as the FAA's planned installation of runway status lights at 22 major airports and the development of an incursion warning system in the cockpit are promising technologies and that increased training for pilots and air traffic controllers could help address human factors issues.

Source: Lincoln Laboratory, Massachusetts Institute of Technology, and GAO.

United States Government Accountability Office

Mr. Chairman and Members of the Subcommittee:

Thank you for the opportunity to testify today on runway safety. Although air traffic has declined as economic factors, among others, have led airlines to reduce service, congestion on the movement areas—runways and taxiways[1]—remains a matter of concern. Since we last testified on runway safety before this Subcommittee, in February 2008, 11 more serious runway incursions—incidents in which collisions were narrowly or barely avoided—have occurred at U.S. airports, including 4 incursions involving commercial aircraft. On August 28, 2008, for example, a SkyWest commuter jet that was landing at the Fresno Yosemite International Airport in California came within 15 feet of colliding with a general aviation aircraft that was still on the runway.

My testimony today focuses on (1) recent trends in runway incursions, (2) steps FAA has taken to improve runway safety, and (3) what more could be done. This statement is based on our November 2007 report and February 2008 testimony on runway safety[2] and is updated with information we gathered in August and September 2008 on recent incursions and actions taken by FAA. Our work on the November 2007 report included surveying experts on the causes of runway incidents and accidents, the effectiveness of measures that are being taken to address them, and additional measures that could be taken. We conducted this work in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Summary

- While the number of serious incursions this fiscal year is slightly less than last year, the rate (measured by the number of incidents per 1 million takeoffs and landings) has increased because of a decline in air traffic

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[1]Taxiways are routes that aircraft follow to and from runways.

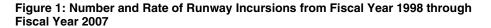[2]GAO, *Aviation Runway and Ramp Safety: Sustained Efforts to Address Leadership, Technology, and Other Challenges Needed to Reduce Accidents and Incidents,* GAO-08-29 (Washington, D.C.: Nov. 20, 2007) and *Runway Safety: Progress on Reducing Runway Incursions Impeded by Leadership, Technology, and Other Challenges,* GAO-08-481T (Washington, D.C.: Feb. 13, 2008).
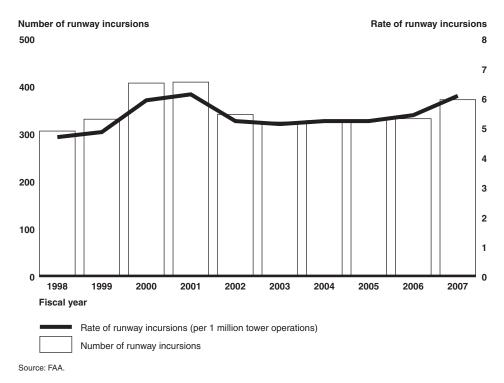
operations. The number of serious runway incursions—incidents in which collisions were narrowly or barely avoided—decreased from 24 in fiscal year 2007 to 23 in fiscal year 2008 as of September 16, 2008. However, the rate of serious incursions increased by 5 percent during fiscal year 2008 through September 16, 2008, compared with fiscal year 2007. For all categories of severity, the total number and rate of incursions increased by 12 percent from fiscal year 2006 through fiscal year 2007, but grew at a slightly slower pace during fiscal year 2008. In fiscal year 2008, FAA started using a new definition of incursions that captures greater numbers of less serious types of runway incidents, but even under the previous definition, the number and rate increased. Using its new definition, FAA had counted 957 incursions during fiscal year 2008 as of September 16, 2008. Under the previous definition, the total number of incursions during the first three quarters of fiscal year 2008 increased by 7 percent and the rate increased by 10 percent, compared with the same period during fiscal year 2007.

- During fiscal year 2008, FAA has given higher priority to improving runway safety than it did during the previous 2 years when it did not have a permanent director for its Office of Runway Safety, which it created to lead and coordinate the agency's runway safety efforts. FAA's recent actions to improve runway safety include continuing to deploy and test new technology designed to prevent runway collisions; promoting changes in airport layout, markings, signage, and lighting; and issuing new air traffic procedures. FAA has now deployed technology at 39 major airports that is designed to provide air traffic controllers with alerts of potential collisions. In addition, the agency recently decided to install runway status lights at 22 of those airports. These lights give pilots a visible warning when runways are not safe to enter, cross, or depart on. This year, FAA also conducted safety reviews at 42 airports that were selected on the basis of incursion data and wrong-runway-departure data. The findings from its reviews were used to improve signage and markings. In addition, FAA began testing a voluntary safety reporting program for air traffic controllers—a program we had recommended that the agency implement. FAA has also made further progress on addressing runway overruns, increasing the percentage of commercial service airports that are in substantial compliance with standards for runway safety areas— unobstructed areas that surround runways to enhance safety in case an aircraft overruns, overshoots, or veers off a runway—from 70 percent in May 2007 to 76 percent in August 2008. Compliance with these standards reduces the chances of aircraft accidents resulting from overruns.

- FAA could further improve runway safety by addressing human factors issues, such as fatigue and distraction, which aviation safety experts

identified as the primary cause of incursions. This could be done by encouraging the development of new technology, revising additional procedures, and adopting best practices. Experts said that a combination of improvements in technology, increased training for pilots and air traffic controllers, and revised procedures could help address these human factors issues. For example, experts said that technology such as FAA's planned installation of runway status lights and the development of an incursion warning system in the cockpit could help address these human factors issues.

The Overall Number and Rate of Incursions Increased This Fiscal Year

Runway safety is a long-standing major aviation safety concern. The prevention of runway incursions, which are precursors to aviation accidents, has been on the National Transportation Safety Board's (NTSB) list of most wanted transportation improvements since 1990 because runway collisions can be catastrophic. The number and rate[3] of incursions reached a peak in fiscal year 2001 and remained relatively constant for the next 5 years. However, from fiscal year 2006 through fiscal year 2007, the overall number and rate of incursions increased by 12 percent and nearly regained the 2001 peak (see fig. 1).

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[3]FAA determines the rate of incursions by calculating the number of incursions per 1 million air traffic control tower operations (takeoffs and landings).

Figure 1: Number and Rate of Runway Incursions from Fiscal Year 1998 through Fiscal Year 2007

Source: FAA.

Note: Table 1 in app. I shows the data for fig.1.

Data for the first three quarters of fiscal year 2008 show that the number of incursions counted increased substantially after FAA adopted a definition of incursions developed by the International Civil Aviation Organization (ICAO), a United Nations specialized agency.[4] Using the ICAO definition, FAA is now counting some incidents as incursions that the agency

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[4]ICAO's definition of an incursion is any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing or takeoff of aircraft. Through September 2007, FAA defined a runway incursion as "any occurrence in the runway environment involving an aircraft, vehicle, person, or object on the ground that creates a collision hazard or results in a loss of required separation when an aircraft is taking off, intending to take off, landing, or intending to land."

formerly classified as surface incidents.[5] Using its new definition, FAA had counted 957 incursions during fiscal year 2008 as of September 16, 2008, 712 of which occurred during the first three quarters.

If FAA had continued using its previous definition, that data would have shown an increase in the number and rate of incursions, with the rate exceeding the earlier peak in 2001. Using the previous definition, FAA would have counted 293 incursions during the first three quarters of fiscal year 2008, compared with 275 for the first three quarters of fiscal year 2007, an increase of 7 percent. Under FAA's previous incursion definition, the overall rate of incursions for the first three quarters of fiscal year 2008 was 6.72 per 1 million air traffic control tower operations, compared with 6.11 for the first three quarters of fiscal year 2007 and 6.1 for fiscal year 2001. Thus, the first three quarters of fiscal year 2008 represent a 10 percent increase in the rate over both the first three quarters of fiscal year 2007 and fiscal year 2001, an earlier peak year for the number and rate of incursions. Figure 2 shows the number and rate of incursions, by quarter, during fiscal year 2007 and during the first three quarters of fiscal year 2008.[6]

[5]Runway incidents that were classified as surface incidents can be serious, including an August 2006 crash of a Comair regional jet in Lexington, Kentucky. That aircraft crashed after taking off on a runway that was too short for the aircraft, killing 49 of the 50 people on board. FAA had defined a surface incident as any event in which authorized or unapproved movement occurs within a movement area associated with the operation of an aircraft that affects or could affect the safety of flight.

[6]The number of air traffic control tower operations declined from 45 million operations during the first three quarters of fiscal year 2007 to 43.6 million during the first three quarters of fiscal year 2008, a decline of 3 percent.
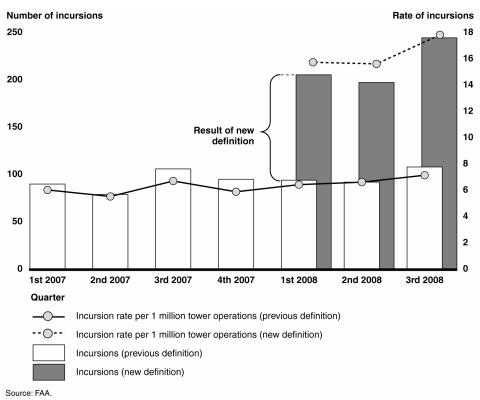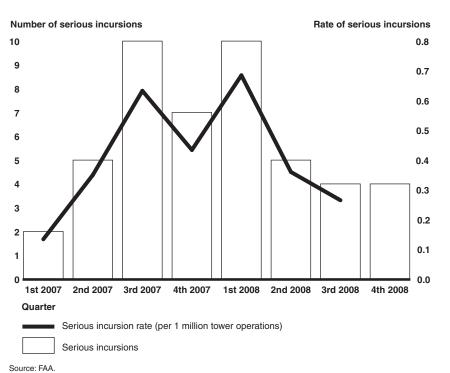
Figure 2: Incursions, by Quarter, during Fiscal Year 2007 and Fiscal Year 2008
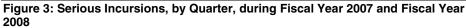

Source: FAA.

Note: Table 2 in app. I provides the data for fig. 2.

From fiscal year 2001 through fiscal year 2007, the number of serious incursions—incidents in which collisions are narrowly or barely avoided—decreased from 53 to 24, or by about 55 percent. The number of serious incursions,[7] which is not affected by FAA's adoption of a new incursion definition, has decreased from 24 in fiscal year 2007 to 23 in fiscal year

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[7]FAA currently classifies the severity of runway incursions into four categories. Category A is defined as a serious incident in which a collision was narrowly avoided; category B, an incident in which separation decreases and there is a significant potential for a collision, which may result in a time-critical corrective or evasive response to avoid a collision; category C, an incident characterized by ample time and/or distance to avoid a collision; and category D, an incident that meets the definition of a runway incursion such as the incorrect presence of a single vehicle, person, or aircraft on the protected area of a surface designated for the landing and takeoff of aircraft, but with no immediate consequences.

2008 as of September 16, 2008,[8] but the rate has increased. The rate of serious incursions for fiscal year 2008 through September 16, 2008 was 0.41 per 1 million tower operations, compared with 0.39 for fiscal year 2007, an increase of 5 percent. The number and rate of serious incursions, by quarter, during fiscal year 2007 and fiscal year 2008 are shown in figure 3.

Figure 3: Serious Incursions, by Quarter, during Fiscal Year 2007 and Fiscal Year 2008

Source: FAA.

Note: The number of serious incursions during the fourth quarter of fiscal year 2008 is through September 16, 2008. The rate of serious incursions for the fourth quarter of fiscal year 2008 is not yet available. FAA's adoption of the ICAO definition of incursions during the first quarter of fiscal year 2008 did not affect the number or rate of serious incursions. Table 2 in app. I provides data for fig.3.

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[8]An FAA official said that an additional potentially serious incursion occurred on September 19, 2008, in Allentown, Pennsylvania, involving a Mesa regional jet and a general aviation aircraft. According to NTSB, the Mesa crew estimated that they missed colliding with the general aviation aircraft by about 10 feet. FAA has not yet formally classified the severity of this incident.

Most runway incursions involve general aviation aircraft. According to FAA, about 67 percent of incursions from fiscal year 2005 through August 2008 involved at least one general aviation aircraft. However, about one-third of the most serious incursions during fiscal year 2002 through August 2008—about 9 per year—involved at least one commercial aircraft. The involvement of commercial aircraft in incursions is of particular concern because they can carry many passengers. For example, on April 6, 2008, a Boeing 777, which was being towed from a maintenance facility at the Dallas-Fort Worth International Airport, entered a runway where an American Airlines MD-80 had just landed, and the two aircraft missed each other by about 25 feet.[9] As of September 16, 2008, there have been 7 serious incursions involving commercial aircraft in fiscal year 2008, compared with 8 in fiscal year 2007. (See table 3 in app. I for additional information about serious incursions involving commercial aircraft during fiscal years 2007 and 2008.) Figure 4 shows the number of serious incursions involving commercial aircraft from fiscal year 2001 through fiscal year 2008.

[9]A Dallas-Fort Worth International Airport official said that since the incident, tug operations crossing active runways have been suspended indefinitely pending a review by the airport and the airline.

Figure 4: Total Number of Serious Incursions and Number of Serious Incursions Involving at Least One Commercial Aircraft, Fiscal Year 2001 through Fiscal Year 2008 to Date

Number of serious incurions

Source: FAA.

Note: Table 4 in app. I provides the data for fig. 4. Fiscal year 2008 data on serious incursions are through September 16, 2008.

In the United States, most incursions have occurred at major commercial airports, where the volume of air traffic is greater. Chicago O'Hare International and Los Angeles International Airports had the most runway incursions from fiscal year 2001 through August 18, 2008, as shown in figure 5.

Figure 5: U.S. Airports that Experienced the Most Runway Incursions from Fiscal Year 2001 through August 2008

Airports

Airport	
Chicago O'Hare	
Los Angeles	
North Las Vegas, NV	
Hartsfield-Jackson Atlanta	
John Wayne-Orange County, CA	
Philadelphia	
Dallas-Ft. Worth	
Boston Logan	
Long Beach-Daugherty Field, CA	
Las Vegas McCarran	
General Mitchell, Milwaukee	
San Francisco	
Ted Stevens Anchorage	
Phoenix Sky Harbor	
Lambert-St. Louis	
Newark Liberty	
Detroit	
Miami	
Cleveland Hopkins	
Teterboro, NJ	

Number of incursions

☐ Serious incursions (categories A and B)

☐ All other incursions (categories C and D)

Source: GAO analysis of FAA data.

Notes: Table 5 in app. I provides the data for fig. 5. The above numbers combine data using FAA's previous definition of incursions from fiscal year 2001 through fiscal year 2007 and the ICAO definition of incursions during fiscal year 2008.

The primary causes of incursions, according to experts we surveyed and some airport officials, are human factors issues, which can include miscommunication between air traffic controllers and pilots, a lack of situational awareness on the airfield by pilots, and performance and judgment errors by air traffic controllers and pilots. According to FAA, in fiscal year 2007, 57 percent of incursions were caused by pilot errors, 28 percent by air traffic controller errors, and 15 percent by vehicle operator or pedestrian errors (see fig.6). Air traffic controller errors are a particular concern because, as we noted in our June 2008 testimony before this

Subcommittee,[10] FAA is hiring large numbers of new air traffic controllers to replace those who are retiring and the proportion of new hires is increasing over time. Our analysis of FAA's hiring and retirement projections indicates that by 2011, up to 59 percent of the controller workforce will have less than 5 years of experience. Newly certified controllers may be less efficient than experienced controllers in handling the high volumes of traffic that occur at large and congested airports, and any loss in efficiency could affect runway safety.
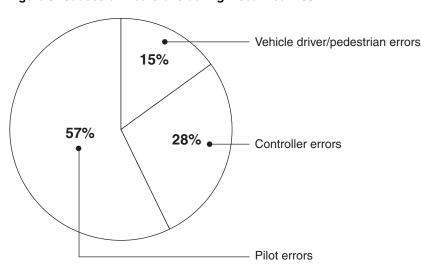
Figure 6: Causes of Incursions during Fiscal Year 2007

Source: FAA.

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[10]GAO, *Federal Aviation Administration: Efforts to Hire, Staff, and Train Air Traffic Controllers Are Generally on Track, but Challenges Remain,* GAO-08-908T (Washington, D.C.: June 11, 2008).

FAA Has Increased Efforts to Oversee Runway Safety, but Collision Risk Remains

During fiscal year 2008, FAA has given higher priority to improving runway safety than it did during the previous 2 years, when the agency did not have a permanent director for its Office of Runway Safety. FAA's recent actions to improve runway safety include continuing to deploy and test new technology designed to prevent runway collisions; promoting changes in airport layout, markings, signage, and lighting; and issuing new air traffic procedures. However, NTSB officials and some aviation safety experts said that the risk of a runway collision is still high.

Efforts to develop and deploy technology have been among FAA's major actions to improve runway safety. To provide ground surveillance on the airfield, FAA has deployed the Airport Movement Area Safety System (AMASS), which uses the Airport Surface Detection Equipment (ASDE-3) radar,[11] at 34 of the nation's busiest airports and is deploying an updated system, the Airport Surface Detection Equipment, Model X (ASDE-X), at 35 major airports. According to its current plans, FAA will complete the deployment of ASDE-X by 2010, and a total of 44 airports will then have AMASS, ASDE-X, or both (see table 6 in app. I). FAA is also testing low-cost surface surveillance systems in Spokane, Washington, and has solicited industry proposals to acquire and install low-cost ground surveillance systems at 6 additional airports that are not scheduled to receive ASDE-3 or ASDE-X. Both ASDE-3 and ASDE-X are designed to alert controllers when they detect a potential collision on the ground. As of August 29, 2008, FAA had commissioned ASDE-X at 13 airports, up from 11 in August 2007. According to FAA, all ASDE-X-commissioned airports now have safety logic, which generates visible and audible signals to air traffic controllers of potential runway collisions. In our February 2008 testimony, we indicated that 2 ASDE-X-commissioned airports did not yet have safety logic. According to FAA, for all future systems, safety logic will be implemented when ASDE-X system is installed.

Despite ongoing efforts, FAA risks not meeting its current plans to complete the deployment of ASDE-X by 2010. FAA plans to finish installing ASDE-X at New York LaGuardia, Memphis International, and Las Vegas McCarran International Airports, where the agency is coordinating the implementation of ASDE-X with the completion of new air traffic control towers, after the fall of 2010. In addition, although it took about 4 years for ASDE-X to be installed at the first 11 airports and ASDE-X was

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[11]AMASS is essentially safety logic, which is designed to detect potential collisions, using ASDE-3 data. This combined technology is usually referred to as ASDE-3/AMASS.

commissioned at 2 airports during the first 11 months of fiscal year 2008, FAA plans to install the system at 19 additional airports by the end of fiscal year 2010. In commenting on whether the 19 remaining installations can be completed on schedule, FAA's ASDE-X program manager said that the installations at all 19 airports have already begun, that the system installations are not done one airport at a time, and that the agency is working hard to push local governments and airports to obtain the needed approvals and leases.

In November 2007, we reported operational difficulties with ASDE-X's alerting functions. For example, some ASDE-X-commissioned airports were experiencing false alerts, which occur when the system incorrectly predicts an impending collision, and false targets, which occur when the system incorrectly identifies something on the airfield, such as an aircraft or vehicle, that could generate a false alert. We reported that the control tower at Hartsfield-Jackson Atlanta International Airport reported the most problems with false alerts and that the control tower at Seattle-Tacoma International Airport reported the most problems with false targets. However, FAA recently provided documentation indicating that the number of false alerts at Hartsfield-Jackson Atlanta International Airport had declined by 84 percent during 2008 and that the number of false alerts at Seattle-Tacoma International Airport had declined by 90 percent after the airport received a software upgrade in March 2008.

Another technology for improving runway safety that FAA recently decided to install at 22 airports is a runway status lights system. This technology, which gives pilots a visible warning when runways are not safe to enter, cross, or depart on, has already been tested and has received positive evaluations at Dallas-Fort Worth International and San Diego International Airports (see table 7 in app. I for a list of airports to receive runway status lights). Proposed legislation[12] to reauthorize FAA would authorize $74 million to acquire and install runway status lights. In November 2007, we reported that 10 of 17 experts we surveyed indicated that FAA's testing of runway status lights was very or extremely effective in addressing runway incursions. In addition, the Department of Transportation's Inspector General reported in January 2008 that runway incursions on the test runway at Dallas-Fort Worth International Airport decreased by 70 percent during the 29 months of testing, compared with

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[12] *FAA Reauthorization Act of 2007*, H.R. 2881, 110th Congress (2007).

the 29 months before testing.[13] In addition, FAA and NTSB officials said that runway status lights prevented a serious incursion from occurring at Dallas-Fort Worth International Airport on May 15, 2008, involving an MD-80 aircraft and a regional jet. According to FAA, the MD-80 aborted its takeoff after seeing the status lights turn red when the regional jet was crossing that runway farther ahead. However, runway status lights need a surface surveillance system such as ASDE-3/AMASS or ASDE-X to operate, making the timely deployment of ASDE-X at the remaining 19 airports even more important.

Still another runway safety technology that FAA is testing is the Final Approach Occupancy Signal (FAROS) at Long Beach-Daugherty Field airport in California. FAROS activates a flashing light visible to aircraft on approach as a warning to pilots when a runway is occupied and hazardous for landing. FAA is also planning to install and evaluate an enhanced version of FAROS at Dallas-Fort Worth International Airport. According to FAA, the additional information on runway traffic provided by FAROS can improve the pilot's situational awareness and help reduce the severity of an incursion. However, nationwide deployment of FAROS is years away. Furthermore, FAA is still testing a low-cost surface surveillance system that already is being used at 44 airports outside the United States. FAA has also offered to provide up to $5 million to test in-cockpit displays that inform pilots where they are located on runways or electronic flight bags, which are electronic display systems that provide pilots with a variety of aviation data. In addition, in the longer term, deployment of the Automatic Dependent Surveillance-Broadcast (ADS-B) system, a satellite-based technology that broadcasts aircraft identification, position, and speed with once-per-second updates, will provide pilots with greater situational awareness and help to keep aircraft at safe distances from each other on the runways.

Besides deploying and testing technology, FAA has taken other actions to improve runway safety, including

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[13]Department of Transportation Office of Inspector General, *FAA's Implementation of Runway Status Lights,* AV-2008-021 (Washington, D.C.: Jan. 14, 2008).

- issuing new air traffic procedures requiring controllers to give explicit instructions to pilots on precise routes to take from the gate to the runway;

- conducting safety reviews at 42 airports based on incursion and wrong-runway-departure data, the findings from which were used to improve signage and markings, as well as implement training programs for airport personnel (see table 8 in app. I for a list of the airports reviewed);

- establishing the Runway Safety Council, consisting of FAA and aviation industry representatives, to analyze the root causes of serious incursions and recommend runway safety improvements; and

- testing a voluntary safety reporting program for air traffic controllers at facilities in the Chicago area—a program we had recommended in our November 2007 report that FAA implement.

In June 2008, FAA also completed an internal review of runway incursions at Boston Logan International Airport with a team of experts from FAA, the airport, and a major airline to identify best practices to prevent incursions. FAA is currently reviewing runway incursions at Hartsfield-Jackson Atlanta International Airport and is planning reviews at 8 additional airports based on the frequency of runway incursions. In addition, FAA plans to work with a contractor to validate the alerting perimeters of AMASS and ASDE-X to ensure that controllers receive warnings in time to act on them and relay the warnings to pilots. Furthermore, according to an FAA official, the agency is drafting a new national runway safety plan, which we recommended in our November 2007 report. In addition, in July 2008, FAA submitted, as requested by this Subcommittee, its first quarterly progress report on how it was handling serious incursions.

Several aviation safety stakeholders, including officials from associations representing airlines and pilots, said that FAA has increased its attention to runway safety during the past year. For example, an official from the Air Transport Association (ATA), which represents the airline industry, said that FAA's level of attention to runway safety is noticeably better than last year, there is more communication, and FAA leadership at the highest levels is focused on the issue. In addition, an official from the Air Line Pilots Association (ALPA) said that the new air traffic procedures requiring controllers to give explicit instructions to pilots on precise routes to take from the gate to the runway were a substantial improvement, resulting in less confusion. However, an official from the

National Air Traffic Controllers Association (NATCA) said that FAA had not made progress in addressing air traffic controller overtime and fatigue issues over the last year. In November 2007, we reported that, as of May 2007, at least 20 percent of the controllers at 25 air traffic control facilities, including towers at several major airports, were regularly working 6-day weeks, which could cause fatigue. We also recommended that FAA develop a mitigation plan for addressing controller overtime. FAA officials said that this year, the agency had offered relocation and retention incentives for controllers, targeting major facilities experiencing high rates of overtime. The officials said that 80 controllers had been selected to receive the relocation bonuses and that 100 controllers had accepted retention bonuses in exchange for 2 more years of service. An FAA official said that it was too early to tell what impact those actions would have on the frequency of overtime. To address controller fatigue issues, FAA officials said that the agency held a summit on the subject in June 2008 and is considering shift scheduling changes for controllers.

In commenting on the voluntary safety reporting program for air traffic controllers being tested in the Chicago area, FAA officials said that since the test program began last month, controllers have submitted about 40 reports, 4 of which involved runway incidents. Senior NATCA officials said that although controllers are participating, some are concerned that FAA will take disciplinary actions against them for reporting safety incidents. However, FAA officials said that it is not agency policy to discipline controllers for reporting incidents through the program except under the circumstances specified in the memorandum of understanding with NATCA involving criminal activity, substance abuse, controlled substances, alcohol, or intentional falsification.

According to FAA, airlines have also taken actions to improve runway safety. For example, FAA indicated that all 112 active air carriers have reported that they (1) provide pilots with simulator or other training that incorporates scenarios from aircraft pushback through taxi and (2) have reviewed cockpit procedures to identify and develop a plan to address elements that contribute to pilot distraction while taxiing. Verification of these actions during FAA's inspections will ensure that these activities are fully implemented.

With the help of FAA funding, several airports have made recent changes to their runways and taxiways to reduce the risk of collisions. In June 2008, Los Angeles International Airport opened a new center taxiway that requires aircraft to reduce speed before exiting. Previously, aircraft used high-speed taxiways in that area of the airfield, resulting in runway

incursions when aircraft did not stop in time before approaching active runways. In our February 2008 testimony, we reported that Los Angeles International Airport had experienced the most runway incursions in fiscal years 2001 through 2007. However, the new taxiway may have been a contributing factor in reducing the number of incursions at Los Angeles International Airport this fiscal year, compared with last year. Using FAA's previous definition of incursions to compare both years, the Los Angeles International Airport had 3 incursions during fiscal year 2008 through September 16, 2008, and none were serious, compared with 8 during fiscal year 2007, including 2 serious ones. When data through August 2008 are included, Chicago O'Hare International Airport has experienced the most runway incursions since fiscal year 2001. In October 2008, Dallas-Fort Worth International Airport plans to open a perimeter taxiway (also called an end-around taxiway) that gives aircraft access to gates without crossing active runways. Crossing active runways is one of the many causes of incursions. In April 2007, Hartsfield-Jackson Atlanta International Airport also opened a perimeter taxiway. According to an airport official, the perimeter taxiway eliminates about 560 runway crossings per day, or about one-third of the airport's total daily runway crossings.

In November 2007, we reported that FAA's Office of Runway Safety had not carried out its leadership role to coordinate and monitor the agency's runway safety efforts. Until FAA hired a permanent director at the senior executive service (SES) level for the Office of Runway Safety in August 2007, that office had been without a permanent director for the previous 2 years. Since a permanent director was hired, the number of full-time staff in the Office of Runway Safety has increased, up to 41[14] as of August 2008 from about 37, including contractors, led by a non-SES-level acting director in May 2007. Although we did not determine what the appropriate level of staffing for the Office of Runway Safety would be, we note that before 2004, when FAA provided a high level of attention to runway safety, the office had 66 full-time staff, including contractors.

NTSB officials and some aviation safety experts said that, despite the numerous actions taken by FAA to improve runway safety, the risk of a runway collision is still high. NTSB officials, for example, cited two nonfatal runway collisions that occurred this year—one at an untowered airport in Pawtucket, Rhode Island, where two general aviation aircraft

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[14]This includes 17 full-time staff, 21 contractors, and the equivalent of 3 staff years that are assigned to other offices, but provide assistance to the Office of Runway Safety.

collided on a runway, substantially damaging both aircraft, and another accident at the airport in Reading, Pennsylvania, where a landing general aviation aircraft collided with a tractor that was at the intersection of a runway and a taxiway, breaking off part of the aircraft's left wing. In addition, an official from the Flight Safety Foundation said that although the probability of a runway collision is very low, the severity of such an accident means that the risk is high. The low probability of a runway collision is supported by the fact that FAA controls the takeoff, landing, and flights of about 50,000 aircraft every day, but the most recent fatal runway collision at a towered airport involving commercial aircraft occurred 14 years ago, in 1994, when a Trans World Airlines MD-82 collided with a general aviation aircraft on a runway at Lambert-St. Louis International Airport, killing 2 people. However, the worst accident in aviation history involved a runway collision, in 1977, when two Boeing 747s collided on a runway in Tenerife, the Canary Islands, killing 583 passengers and crew. Moreover, despite recent reductions in air traffic, by 2025, air traffic is projected to increase two- to threefold, equating to about 100,000 to 150,000 flights a day, making airports even more congested than they are today.

To address runway overruns, FAA and airports have increased the percentage of runways that are in compliance with FAA standards for runway safety areas—unobstructed areas that surround runways to enhance safety in the event that an aircraft overruns, overshoots, or veers off a runway. As of August 2008, 76 percent of 1,015 runways at 561 commercial service airports were in substantial compliance with runway safety area standards, up from 70 percent in May 2007. FAA considers runway safety areas that meet 90 percent of the standards to be in substantial compliance. Increased compliance with runway safety area standards reduces the chances of aviation accidents resulting from overruns. In addition, as of August 2008, the Engineered Materials Arresting System (EMAS), a bed of crushable concrete designed to stop overrunning aircraft, was installed at 35 runway ends at 24 U.S. airports, up from 24 runway ends at 19 U.S. airports during June 2007. Furthermore, as of August 2008, there were plans to install 15 additional EMAS systems at 11 additional airports. (Table 9 in app. I lists the airports with EMAS installations.) In our November 2007 report, we recommended that FAA develop and implement a plan to collect data on runway overruns that do not result in damage or injury for analyses of trends and causes of overruns. In response, FAA indicated that a working group will be established to assess what additional runway overrun data could be collected and to make recommendations by the end of this year.

Addressing Human Factors Issues Could Help Improve Runway Safety

FAA could further improve runway safety by addressing human factors issues, which aviation safety experts identified as the primary cause of incursions. To address these issues, FAA could encourage the development of new technology, revise additional procedures, and adopt best practices. Proposed legislation[15] to reauthorize FAA would support additional efforts to improve runway safety by authorizing $114 million to develop runway incursion reduction programs and to deploy technology.

In November 2007, we reported that, according to experts we surveyed, encouraging the development of a runway incursion warning system in the cockpit would be among the most effective actions that FAA could take to improve runway safety. In addition, in 2000, NTSB recommended, among other things, that FAA require airports to deploy a ground movement safety system to prevent runway incursions and develop a direct incursion warning capability for flight crews. A system that provides a direct warning to the cockpit being developed by Honeywell and the Sensis Corporation, called the Runway Incursion Cockpit Alerting System, is designed to work at airports equipped with ASDE-X and functioning safety logic. A demonstration of the system was conducted with FAA and NTSB officials at Syracuse Hancock International Airport in August 2007. NTSB officials said that FAA could move faster to approve technology that provides runway incursion warnings directly to the cockpit. However, FAA officials said the cockpit warning system would need to be thoroughly reviewed before being approved for use, a process they said could take at least 2 years.

Also to improve runway safety, ATA and ALPA officials suggested FAA could standardize air traffic control phraseology. Future FAA air traffic procedures will cover clearances for runway crossings, takeoffs, and multiple landings and will include the adoption of international phraseology such as "line up and wait" instead of "position and hold." A senior ALPA official said that adopting international standards for air traffic control phraseology could be particularly useful at airports that handle a large volume of foreign airline traffic, such as Los Angeles International Airport. However, senior NATCA officials said they are concerned about FAA's adoption of international taxiing phraseology because of the complexity of handling the high volume of air traffic in the United States. These officials also said that FAA could do more to reduce air traffic controller overtime and take additional actions to address

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[15] *FAA Reauthorization Act of 2007*, H.R. 2881, 110th Congress (2007).

controller fatigue. In the meantime, NATCA plans to start its own fatigue management initiative, according to senior NATCA officials. In addition, a NATCA official said that FAA's focus on reporting the number of serious incursions should not distract attention from less serious incursions, which the official said are also important. A human factors expert we contacted agreed, saying that serious incursions are only the "tip of the iceberg," that less serious incursions can lead to more serious ones, and that the entire scope of incidents should be examined.

Adopting best practices for runway safety, such as ones that FAA has compiled, also could help address human factors issues. These include practices such as conducting runway safety training for controllers, pilots, and airport personnel; checking the accuracy of airport diagrams and updating them as needed; encouraging pilots to turn aircraft lights on during landing and departure; and eliminating distractions in the control tower.

In closing, although FAA has increased its efforts to improve runway safety through a multilayered approach, the current high level of attention must be sustained to reduce the risk of potentially catastrophic runway accidents. Although the number of serious incursions has declined since 2001, the continuing incidence of near collisions involving commercial aircraft and the continuing increase in the overall number and rate of incursions suggest that a significant risk of catastrophic runway collisions still exists. A significant reduction in the number and rate of incursions may not be realized until the development and installation of runway safety technology is complete. Therefore, FAA must continue to provide a high level of attention to further reduce the number of serious incursions and reverse the upward trend in the overall number of runway incursions through the timely deployment of technology, sustained leadership, and other means.

Mr. Chairman, this concludes my prepared statement. I would be pleased to respond to any questions from you or other Members of the Subcommittee.

GAO Contact and Staff Acknowledgments

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Appendix I: Data on Runway Incursions and Deployment of Related Safety Technology

Table 1: Number and Rate of Runway Incursions from Fiscal Year 1998 through the Third Quarter of Fiscal Year 2008

Fiscal year	Number of incursions	Rate per 1 million tower operations
1998	304	4.66
1999	329	4.83
2000	405	5.9
2001	407	6.1
2002	339	5.2
2003	323	5.1
2004	326	5.2
2005	327	5.2
2006	330	5.4
2007	370	6.05
2008 (first 3 quarters) using the Federal Aviation Administration's (FAA) previous definition of incursions	293	6.72
2008 (first 3 quarters) using the International Civil Aviation Organization's (ICAO) definition of incursions	712	16.33

Source: FAA.

Table 2: Number and Rate of Incursions, by Quarter, during Fiscal Year 2007 and Fiscal Year 2008

Quarter and fiscal year	Number of incursions	Incursion rate per 1 million tower operations	Number of serious incursions	Rate of serious incursions per 1 million tower operations
First quarter 2007	90	6.03	2	0.134
Second quarter 2007	79	5.533	5	0.3502
Third quarter 2007	106	6.709	10	0.6329
Fourth quarter 2007	95	5.891	7	0.4341
First quarter 2008, using previous FAA incursion definition	94	6.434	10	0.685
First quarter 2008, using ICAO incursion definition	226	15.744	10	0.685
Second quarter 2008, using previous FAA incursion definition	93	6.62	5	0.36
Second quarter 2008, using ICAO incursion definition	217	15.62	5	0.36
Third quarter 2008, using previous FAA incursion definition	108	7.149	4	0.265
Third quarter 2008, using ICAO incursion definition	269	17.807	4	0.265
Fourth quarter 2008, using previous FAA incursion definition	[a]	[a]	4	[a]
Fourth quarter 2008, using ICAO incursion definition	[a]	[a]	4	[a]

Source: FAA.

Note: Fourth quarter fiscal year 2008 data on serious incursions are through September 16, 2008.

[a]Not yet available.

Table 3: Serious Incursions Involving at Least One Commercial Aircraft from Fiscal Year 2007 through September 16, 2008

Date	Location	Airline(s) and aircraft involved	Number of air passengers
January 5, 2007	Denver International	Key Lime Air Swearingen SW4 and Frontier Airbus A319	50
February 2, 2007	Denver International	United Boeing 737 and snowplow	101
May 4, 2007	Cyril E. King Airport, Charlotte Amalie, VI	American Airlines Boeing 757 and Cessna C208	a
May 6, 2007	Los Angeles International	Skywest Embraer 120 and Virgin Air Airbus A340	a
May 26, 2007	San Francisco International	Republic Airlines Embraer 170 and Skywest Airlines Embraer 120	27
July 11, 2007	Fort Lauderdale-Hollywood International, FL	Delta Air Lines Boeing 757 and United Airlines Airbus A320	172
July 19, 2007	Chicago O'Hare International	United Airlines Boeing 737 and US Airways Boeing 737	a
August 16, 2007	Los Angeles International	WestJet Boeing 737 and Northwest Airlines Airbus A320	296
December 2, 2007	Baltimore-Washington International	US Airways/America West Airbus A320 and Comair Canadair CRJ-100	a
December 6, 2007	Newark Liberty International	Continental Airlines Boeing 737 and Continental Express Embraer E145	a
January 16, 2008	San Diego International	Southwest Airlines Boeing 737 and Hawker H25B	a
April 6, 2008	Dallas-Fort Worth International	American Airlines MD-80 and Boeing 777	a
July 21, 2008	Chicago O'Hare International	American Eagle Embraer E145 and Learjet LJ25	4
July 28, 2008	Cleveland Hopkins International	SkyWest Canadair CRJ-200 and Air Canada Jazz DeHavilland Dash 8	a
August 28, 2008	Fresno Yosemite International	SkyWest Canadair CRJ-200 and Piper Malibu	a

Source: GAO analysis of FAA and National Transportation Safety Board (NTSB) data.

Note: Fiscal year 2008 data through September 16, 2008.

[a]Information not contained in the NTSB incident reports.

Table 4: Total Number of Incursions and Number of Serious Incursions Involving at Least One Commercial Aircraft, Fiscal Year 2001 through September 16, 2008

Fiscal year	Number of serious incursions	Serious incursions involving at least one commercial aircraft
2001	53	26
2002	37	11
2003	32	9
2004	28	9
2005	29	9
2006	31	10
2007	24	8
2008 (through Sept. 16, 2008)	23	7

Source: FAA.

**Table 5: U.S. Airports that Experienced the Most Runway Incursions from Fiscal
Year 2001 through August 2008**

Airport	Number of serious incursions	Number of total incursions[a]
Chicago O'Hare International	9	66
Los Angeles International	10	64
North Las Vegas	5	61
Hartsfield-Jackson Atlanta International	3	61
Philadelphia International	2	49
John Wayne-Orange County, Santa Ana, CA	0	49
Dallas-Fort Worth International	4	47
Boston Logan International	2	44
Long Beach-Daugherty Field, CA	2	41
Las Vegas McCarran International	1	39
General Mitchell International, Milwaukee, WI	2	38
San Francisco International	1	36
Ted Stevens Anchorage International	1	35
Phoenix Sky Harbor International	4	34
Newark Liberty International	4	32
Lambert-St. Louis International	2	33
Detroit Wayne County International	3	30
Miami International	3	30
Cleveland Hopkins International	1	28
Teterboro, NJ	3	26

Source: FAA.

[a]Excludes 30 incursions that FAA had not yet classified as of August 18, 2008. The above numbers
combine data using FAA's previous definition of incursions from fiscal year 2001 through fiscal year
2007 and the ICAO definition of incursions during fiscal year 2008. The number of serious incursions
is not affected by FAA's adoption of the ICAO definition.

Table 6: Airports with Airport Surface Detection Equipment Model 3 (ASDE-3)/Airport Movement Area Safety Systems (AMASS) or Airport Surface Detection Equipment Model X (ASDE-X) or Scheduled to Receive ASDE-X

Airport	ASDE-3/AMASS	ASDE-X commissioned	Scheduled ASDE-X deployment[a]
Baltimore-Washington International	x		April 2010
Boston Logan International	x		July 2009
Bradley International, Windsor Locks, CT		x	
Camp Springs Andrews Air Force Base	x		
Charlotte Douglas International		x	
Chicago Midway			June 2010
Chicago O'Hare International		x	
Cleveland Hopkins International	x		
Covington/Cincinnati Northern Kentucky International	x		
Dallas-Fort Worth International	x		April 2010
Denver International	x		November 2009
Detroit Metro Wayne County		x	
Fort Lauderdale-Hollywood International, FL			April 2009
General Mitchell International, Milwaukee, WI		x	
George Bush Intercontinental, Houston, TX	x		November 2009
Hartsfield-Jackson Atlanta International		x	
Honolulu International-Hickam Air Force Base			May 2010
John F. Kennedy International, New York, NY	x		August 2008[b]

Airport	ASDE-3/AMASS	ASDE-X commissioned	Scheduled ASDE-X deployment[a]
John Wayne-Orange County, Santa Ana, CA			February 2010
Kansas City International	x		
Lambert-St. Louis International		x	
Las Vegas McCarran International	x		April 2011
Los Angeles International	x		September 2008
Louis Armstrong New Orleans International	x		
Louisville International-Standiford Field		x	
Memphis International	x		April 2011
Miami International	x		March 2010
Minneapolis-St. Paul International	x		March 2010
New York LaGuardia	x		October 2010
Newark Liberty International	x		July 2009
Orlando International		x	
Philadelphia International	x		December 2009
Phoenix Sky Harbor International			September 2008
Pittsburgh International	x		
Portland International	x		
Ronald Reagan Washington National	x		June 2010
Salt Lake City International	x		May 2010
San Diego International	x		August 2010
San Francisco International	x		
Seattle-Tacoma International		x	
Ted Stevens Anchorage International	x		
Theodore Francis Green State, Providence, RI		x	

Airport	ASDE-3/AMASS	ASDE-X commissioned	Scheduled ASDE-X deployment[a]
Washington Dulles International		x	
William P. Hobby, Houston, TX		x	

Source: FAA.

Note: Schedule as of August 25, 2008.

[a]Scheduled deployment dates are as of Aug. 25, 2008, and represent when the facility first declares the system ready for conditional use. Once the system is formally accepted by the facility, the system is commissioned. FAA's draft accelerated schedule, shown in this table, targets completing ASDE-X deployment by the fall of 2010, except at New York LaGuardia, Memphis International, and Las Vegas McCarran International Airports, where the agency is coordinating ASDE-X implementation with the completion of new air traffic control towers.

[b]Expected to be commissioned by late September 2008.

Note: As indicated above, 26 airports currently have ASDE-3/AMASS. Eight additional airports (Charlotte Douglas International, Chicago O'Hare International, Detroit Metro Wayne County, Hartsfield-Jackson Atlanta International, Lambert St.-Louis International, Louisville International-Standiford Field, Seattle-Tacoma International, and Washington Dulles International) originally had ASDE-3/AMASS, but the equipment has since been upgraded to ASDE-X.

Table 7: Airports to Receive Runway Status Lights

Airport
Baltimore-Washington International
Boston Logan International
Charlotte Douglas International
Chicago O'Hare International
Dallas-Fort Worth International[a]
Denver International
Detroit Metro Wayne County
Fort Lauderdale-Hollywood International, FL
Hartsfield-Jackson Atlanta International
George Bush Intercontinental, Houston, TX
John F. Kennedy International
Las Vegas McCarran International
Los Angeles International
Minneapolis-St. Paul International
New York LaGuardia
Newark Liberty International
Orlando International
Philadelphia International
Phoenix Sky Harbor International
San Diego International[a]
Seattle-Tacoma International
Washington Dulles International

Source: FAA.

Note: The runway status lights deployment schedule was not yet available as of August 2008.

[a]Currently being tested at these locations.

Table 8: Airports that Received Safety Reviews in 2008

Airport
Adams Field, Little Rock, AR
Albuquerque International Sunport, NM
Boston Logan International
Charlotte Douglas International
Chicago Midway
Chicago O'Hare International
Cleveland Hopkins International
Dallas-Fort Worth International
Daytona Beach International
Dekalb Peachtree, Atlanta, GA
Denver International
Falcon Field, Mesa, AZ
Fort Lauderdale Executive
Fort Lauderdale-Hollywood International
General Mitchell International, Milwaukee, WI
Hartsfield-Jackson Atlanta International
John F. Kennedy International, New York, NY
John Wayne-Orange County, Santa Ana, CA
Kendall-Tamiami Executive, Miami, FL
Lambert-St. Louis International
Las Vegas McCarran International
Long Beach-Daugherty Field, CA
Los Angeles International
Lubbock Preston Smith International
Miami International
Midland International, TX
Nashville International
New York LaGuardia
Norman Y. Mineta San Jose International
North Las Vegas, NV
Orlando International
Philadelphia International
Reno-Tahoe International, NV
Rocky Mountain Metropolitan, Denver, CO
San Antonio International

Airport
San Francisco International
Santa Barbara Municipal, CA
Seattle-Tacoma International Airport
Ted Stevens Anchorage International
Teterboro, NJ
Washington Dulles International
William P. Hobby, Houston, TX

Source: FAA.

Table 9: Airports with the Engineered Materials Arresting System

Airport	Number of systems	Installation date
John F. Kennedy International Airport, New York	2	1996, 2007
Minneapolis-St. Paul International	1	1999
Adams Field, Little Rock	2	2000, 2003
Greater Rochester International, NY	1	2001
Bob Hope, Burbank, CA	1	2002
Baton Rouge Metropolitan	1	2002
Greater Binghamton, NY	2	2002
Greenville Downtown, SCᵃ	1	2003
Barnstable Municipal, Hyannis, MA	1	2003
Roanoke Regional, VA	1	2004
Fort Lauderdale-Hollywood International	2	2004
Dutchess County, Poughkeepsie, NY	1	2004
New York LaGuardia	2	2005
Boston Logan International	2	2005, 2006
Laredo International, TX	1	2006
San Diego International	1	2006
Teterboro, NJ	1	2006
Chicago Midway	4	2006, 2007
Merle K. (Mudhole) Smith, Cordova, AK	1	2007
Charleston Yeager, WV	1	2007
Manchester, NH	1	2007
Wilkes-Barre/Scranton International, PA	1	2008
San Luis Obispo, CA	2	2008
Chicago O'Hare International	2	2008

ᵃGeneral aviation airport.

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