United States General Accounting Office

GAO

Report to the Ranking Minority Member, Subcommittee on Transportation and Related Agencies, Committee on Appropriations, U.S. Senate

November 1992

AVIATION SAFETY

New Regulations for Deicing Aircraft Could Be Strengthened

GAO/RCED-93-52

GAO

United States
General Accounting Office
Washington, D.C. 20548

Resources, Community, and
Economic Development Division

B-250933

November 18, 1992

The Honorable Alfonse M. D'Amato
Ranking Minority Member, Subcommittee on
Transportation and Related Agencies
Committee on Appropriations
United States Senate

Dear Senator D'Amato:

On March 22, 1992, USAir Flight 405 crashed on takeoff in a snow storm at LaGuardia Airport, killing 27 people. The accident—which may have been caused by ice on the aircraft's wing[1] —raised questions about whether the Federal Aviation Administration's (FAA) regulations sufficiently address the actions that airlines must take when ice is present.

In April 1992, the Subcommittee on Transportation and Related Agencies, Senate Committee on Appropriations, held a hearing to examine FAA's regulations governing airlines' ground operations during icing conditions. At the hearing, FAA stated that it would issue new regulations for airlines to implement by October 1, 1992. Accordingly, you asked us to (1) determine FAA's progress in developing these new regulations, (2) describe the manner in which the new regulations address safety concerns, and (3) identify any areas needing improvement.

Results in Brief

Within 6 months following the USAir Flight 405 accident, FAA issued interim final regulations that more strictly govern airlines' ground operations during icing conditions. This was a significant accomplishment, because the rulemaking process can sometimes take as long as 7 years. Airlines must implement these new regulations by November 1, 1992. However, FAA will accept additional comments on the new regulations through April 15, 1993, and use this information to make changes as needed.

To address safety concerns, the regulations require more thorough procedures for inspecting aircraft and removing ice before takeoff. These procedures incorporate guidance on the length of time deicing and anti-icing fluids are effective in keeping aircraft free of ice. Previously, the regulations stipulated only that aircraft could not take off if ice, frost, or

[1]The National Transportation Safety Board plans to issue a final determination in February 1993 on the probable cause of the accident.

snow were adhering to critical surfaces, but no specific procedures were required. The new regulations detail the information and training airlines should provide their personnel to ensure safety during icing conditions.

Notwithstanding the added precautions provided by the new regulations, several areas need improvement:

- First, the regulations allow pilots to check for ice from inside all aircraft except hard-wing turbojets with rear, fuselage-mounted engines after the deicing/anti-icing fluids are no longer effective. FAA believes that such checks will ensure safety because, under the new regulations, pilots will be better informed and more cautious. In our view, however, the potential for misjudgment exists. Obstructed views, distance, and poor lighting can make it difficult, if not impossible, to detect ice from inside an aircraft. Furthermore, FAA's own documents recognize that the only definitive method of detecting ice is to closely inspect an aircraft's exterior.
- Second, the new regulations do not apply to commuter airlines. FAA exempted these airlines because ice has caused only one commuter aircraft accident during takeoff in the last 20 years. Nevertheless, ice can be hazardous for these aircraft. Commuter pilots reported five incidents over the last 4 years in which they aborted flights during or immediately after takeoff because ice had caused difficulty in controlling the aircraft.
- Third, FAA could be more proactive by verifying that airline personnel have received and understood the initial training material on the new regulations and that they follow the new procedures this winter. Over the last 10 years, information FAA distributed on the hazards of ice did not reach all pilots, according to surveys by the Air Line Pilots Association (ALPA). Furthermore, according to the National Transportation Safety Board (NTSB), its most significant finding in accidents caused by ice was that pilots did not fully understand the dangers of ice.

Background

The Federal Aviation Act of 1958 requires FAA to regulate airlines in a manner that promotes safety. FAA promotes safety by issuing regulations airlines must meet to operate commercial aircraft. At the time of the USAir Flight 405 accident, FAA regulations prohibited takeoff if ice, frost, or snow were adhering to wings or other critical aircraft structures. Pilots were ultimately responsible for determining any icing problems before takeoff and could do so from inside an aircraft.

Ice on critical structures—wings, tail, engines, upper fuselage, and other components—can severely degrade an aircraft's performance. For

example, ice formations only 1/8 inch thick or less can reduce wings' lifting ability and increase wind resistance. Such changes can cause an aircraft to suddenly depart from its flight path with no warning to the pilot. According to FAA, the final assurance of a safe takeoff rests in confirming that the aircraft is free of ice.

Airlines generally apply two types of chemical fluids to keep aircraft free of ice. Deicing, or Type I, fluid removes ice. Anti-icing, or Type II, fluid prevents ice formation. These fluids have a limited period of effectiveness, referred to as holdover time. Specifically, holdover time is the estimated time before ice can form on an aircraft after it has been treated with Type I or Type II fluid. Holdover time varies according to the type of fluid and weather conditions. Appendix I shows the holdover times approved by FAA. According to FAA officials, airlines can submit more conservative holdover times for FAA's approval.

FAA Quickly Issued New Regulations

FAA has sometimes taken as long as 7 years to develop regulations. However, following the USAir Flight 405 accident the agency acted quickly to issue new regulations governing airlines' ground operations during icing conditions.

First, on May 28 and 29, 1992, FAA held the International Conference on Airplane Ground Deicing. Over 800 people from 20 countries attended, including representatives from airlines, airline associations, crew member associations, and aircraft manufacturers, as well as airport operators, air traffic controllers, and scientific experts on weather, deicing fluids, and deicing equipment. Participants discussed the dangers posed by ice, examined possible solutions, and recommended ways to improve airlines' ground operations during icing conditions. According to FAA, the conference's two major recommendations were that (1) critical aircraft surfaces must be kept free of ice, frost, and snow and (2) airlines should have a program to ensure that aircraft are free of ice before takeoff. The conference focused on aircraft with more than 30 passenger seats.[2]

Second, FAA developed new regulations, basing them on its review of accidents during takeoff that involved ice and on information presented at

[2]The three basic types of commercial airlines include air carriers, commuters, and air taxis. Under FAA's regulations, air carriers operate aircraft having more than 30 passenger seats, while commuters and air taxis operate aircraft having 30 passenger seats or fewer. Commuters provide scheduled passenger service of at least five round-trips per week, while air taxis provide on-demand service. The new regulations do not apply to commuters or air taxis.

the conference. FAA published the new regulations in a Notice of Proposed Rulemaking on July 23, 1992, with a 15-day comment period.

Third, FAA published interim final regulations and proposed implementation guidance to airlines on September 29, 1992. Domestic airlines that operate aircraft having more than 30 passenger seats must implement FAA's new regulations by November 1, 1992. FAA will accept additional comments on the new regulations through April 15, 1993, and use this information to make changes as needed. FAA's regulations do not apply to foreign airlines. However, at a September 1992 meeting of the International Civil Aviation Organization, the FAA Administrator urged other countries to consider reviewing and revising their deicing procedures to ensure the public's safety.

New Regulations Require Stricter Inspection Procedures

As under the previous regulations, FAA's interim final regulations prohibit aircraft from taking off if ice, frost, or snow is adhering to the exterior and give pilots ultimate responsibility for determining whether the aircraft is clean. In addition, though, the regulations require specific safety procedures stipulating when and how to check for and remove ice during ground operations. The required procedures differ depending on whether the airline has implemented an aircraft ground deicing and anti-icing program (deicing program) approved by FAA field inspectors. These programs are intended to ensure that pilots have the information, training, and ground support they need to decide whether takeoff would be safe.

Airlines that have an approved deicing program must follow strict safety procedures when ice is expected to adhere to an aircraft before takeoff. Specifically, ground personnel must first apply deicing and/or anti-icing fluid and inspect wings and other critical surfaces. Before the holdover time expires, the aircraft must be checked for ice. The flight crew may perform this check from inside the aircraft. If no ice is seen, the flight may depart. If ice is detected, the aircraft must be deiced again.

If the holdover time expires, the aircraft must be either cleaned again or checked within 5 minutes of takeoff. In the latter case, hard-wing turbojets with rear, fuselage-mounted engines must be checked from outside and touched. According to FAA officials, this safety precaution is being required because most accidents caused by ice during takeoff have involved these types of aircraft. All other aircraft may be checked from either inside or outside.

Airlines that have an approved deicing program were also to develop initial training material, based on FAA's guidelines, to teach airline personnel their new responsibilities by November 1, 1992. Plans for recurrent, or ongoing, training are under way for next year.

Airlines that choose not to have a deicing program or whose program has not been approved by FAA must inspect an aircraft's wings and all other critical surfaces from outside within 5 minutes of takeoff during icing conditions. If ice is found, the aircraft must be cleaned.

FAA Could Strengthen Its Deicing Requirements

Although the interim final regulations add several significant safety precautions, they have two weaknesses: They allow most aircraft to be checked for ice from inside after the holdover time has expired, and they do not apply to commuter airlines. In addition, FAA has developed no special procedures to verify that airline personnel have received and understood the initial training guidance explaining their responsibilities under the new regulations this winter season.

Checking Aircraft for Ice From Inside After the Holdover Time Expires May Be Ineffective

For all aircraft other than hard-wing turbojets with rear, fuselage-mounted engines, the new regulations permit checking for ice from inside after the holdover time has expired.[3] Such a check, made within 5 minutes of takeoff, is allowed only if enough critical surfaces can be seen and the check can effectively determine that the aircraft is free of ice. FAA's documents state that the only definitive method of detecting ice is to closely inspect an aircraft's exterior. However, FAA officials maintain that allowing a check from inside these aircraft is safe because, with the detailed guidance provided under the deicing programs, pilots will be more cautious and better informed. The guidance explains, among other things, the factors that cause ice to form, the critical surfaces that need to be checked, and the signs indicating that deicing or anti-icing fluid has lost its effectiveness.

FAA officials said that they were reluctant to require that all aircraft be either deiced again or closely inspected from outside for two reasons. First, to date most accidents caused by ice during takeoff have involved hard-wing turbojets with rear, fuselage-mounted engines. Second, flights could be unnecessarily delayed because holdover times are only preliminary. FAA plans to refine holdover times as more experience is

[3]As of the end of March 1992, about 140 aircraft in the 25 major airlines' fleets (about 3 percent) were hard-wing turbojets with rear, fuselage-mounted engines.

gained. FAA officials had no data on how extensive the delays would be since the regulations have just been implemented.

According to FAA officials, one major airline is requiring that all its aircraft, including those that are not hard-wing turbojets with rear, fuselage-mounted engines, be checked from outside after the holdover time has expired. However, at least two deicing programs approved by FAA allow pilots to check for ice by looking only at the wings and engines from inside the cabin after the holdover time has expired. One deicing program, for example, specifies the best position in the cabin to use to check the wings and engines. Pilots may use the condition of these surfaces, as determined from inside, as the basis for judging the condition of other critical surfaces.

However, allowing pilots to check for ice in this way leaves open the potential for misjudgment. Ice can be difficult to detect from inside an aircraft. Even on visible surfaces, ice can be difficult to see if it is clear or present in only minute amounts. At night, wing and other aircraft lights may not provide sufficient illumination. In testimony before NTSB on the USAir Flight 405 accident, ALPA stated that detecting ice from inside an aircraft can be nearly impossible. The Flight 405 co-pilot stated that he and the pilot had checked the aircraft's wings from the cockpit just before takeoff and saw no ice. By takeoff, the holdover time had expired, according to the manufacturer's information. According to NTSB, ice on the aircraft's wing is being considered as a factor in the accident.

Also, the condition of some critical surfaces may not represent the condition of others. In the Air Florida accident in 1982, for example, snow on the aircraft's wings and engines melted as the result of heat from another aircraft's engines and subsequently froze. Other factors, such as wind direction, can result in ice formation on one critical surface but not on another. Ice on any critical surface can degrade an aircraft's performance.

Aircraft manufacturers advocate a conservative approach to safety after the holdover time has expired. For example, Fokker and McDonnell Douglas believe that by far the safest course of action is to require that all aircraft be deiced again. In a recent article, a Boeing official advised flight crews not to attempt takeoff after the holdover time has been exceeded.

Despite Risk, New Regulations Do Not Apply to Commuter Airlines

Ice poses hazards during takeoff for commuter aircraft as well as for larger aircraft. Consequently, FAA's safety regulations prohibit commuter aircraft from taking off if ice, frost, or snow is adhering to the exterior. Pilots are allowed to determine any icing problems from inside commuter aircraft, although, according to FAA officials, not all critical surfaces can be seen from inside. Nevertheless, FAA officials said that the new regulations were not applied to commuter airlines for two reasons: (1) Ice has caused only one commuter aircraft crash during takeoff over the last 20 years. (2) Because of the structure and design of commuter aircraft, as opposed to larger aircraft, it is easier to check for ice from inside. In the spring of 1993, FAA plans to consider whether commuter airlines need stricter regulations governing ground operations, but it has set no deadline for a final determination.

Both NTSB and ALPA have urged FAA to apply the new regulations to commuter airlines. NTSB stated that a deicing program approved by FAA was important because commuter pilots take off more frequently and are generally less experienced than air carrier pilots. NTSB also stated that commuter airlines operate some aircraft with wings on top of the fuselage—aircraft in which inspection for ice from inside is difficult or impossible because critical parts cannot be seen. ALPA stated that commuter airlines should be subject to the new regulations because the aircraft they operate, like larger aircraft, are required to be clean before takeoff.

As demonstrated by five incidents reported by pilots over the last 4 years, existing regulations do not always ensure that commuter aircraft are free of ice before takeoff. In these incidents, the pilots had difficulty controlling the aircraft because of ice and had to abort the flights during or immediately after takeoff. In one case, the pilots had difficulty during takeoff because of ice on the tail. The pilots regained control and returned to the airport. Before takeoff, the pilots had checked for ice from the ground but were unable to see all critical surfaces. Because the pilots saw no ice, the aircraft was not deiced. In another case, the pilot had to abort takeoff when the aircraft control wheel began to jerk. The pilot had checked the aircraft from outside before taking off after a snow storm. He saw no ice or snow but was unable to see from his position on the ground all critical surfaces, including parts of the tail. When the aircraft returned to the airport, it was checked again. Frozen snow was discovered on the tail.

FAA Is Taking No Extra Steps This Winter to Verify That Airline Personnel Are Trained

Under FAA's new regulations, initial training for all flight crew members and ground personnel responsible for implementing airlines' deicing programs had to be completed by November 1, 1992. Because of the large number of people that had to be trained (for example, about 19,000 American Airlines and about 10,000 United Airlines employees) in a short time (about 1 month), the regulations' training requirement could be satisfied for this winter season if airline personnel simply received their initial training material. No classes or testing was required.

FAA has provided guidelines to its inspectors explaining how to evaluate airlines' deicing programs, including their training components, for approval. However, FAA's guidelines allow inspectors discretion in deciding how often to monitor to determine if airline personnel are properly carrying out their responsibilities during icing conditions. Since deicing aircraft involves numerous complex variables pertaining to equipment, weather, fluids, human factors, and aircraft design, special followup on training this winter is crucial. Followup is also essential because in the past key airline personnel did not receive or follow FAA's guidance on inspecting and deicing aircraft.

FAA's Advisory Circular 20-117 is a case in point. Issued in December 1982 in response to the January 1982 Air Florida crash, the circular explained the hazards of ice and procedures for inspecting and deicing aircraft. FAA recommended that airlines make this guidance available to pilots but did not require airlines to certify that employees had received or understood the circular.

Following the circular's issuance, several accidents involving icing problems occurred during takeoff, including a November 1987 Continental Airlines crash. Consequently, FAA became concerned that misconceptions existed about the effects of ice on an aircraft's performance. FAA reissued Advisory Circular 20-117 to ensure that airline personnel were fully aware of its contents. FAA also held an Aircraft Ground Deicing Conference in September 1988 to disseminate information on icing to the aviation community.

In comments to FAA on the new regulations, ALPA raised concerns about the distribution of Advisory Circular 20-117. ALPA stated that the circular had not been incorporated into airlines' training programs as FAA intended. According to two surveys conducted by ALPA—one in 1991 and one following the Flight 405 accident—some pilots, including USAir pilots, were unfamiliar with FAA's guidance.

According to NTSB, its most significant finding in accidents caused by ice was that pilots did not fully understand the potential dangers of ice. For example, the flight crew involved in the February 1991 crash on takeoff of a Ryan International Airlines jet had not received training or educational material on the specific dangers of even minute amounts of ice on DC-9 aircraft. Ice on the wing caused the accident.

Conclusions

FAA's interim final regulations are a positive step toward ensuring safe ground operations for aircraft during icing conditions. These new regulations require important safety precautions that could help prevent accidents caused by ice when aircraft take off. However, additional actions could further ensure safety.

At present, the regulations allow pilots to check certain aircraft from inside to judge whether ice has formed after the holdover time has expired. FAA believes that this requirement is sufficient to ensure safety because, under the new regulations, pilots will be better trained and more cautious. However, no matter how careful pilots are, they can misjudge. After the holdover time has expired, ice can form on any critical surface, including those not visible from inside the aircraft. The only definitive method of checking for ice, as FAA has stated, is to closely inspect an aircraft's exterior. FAA believes that inspections from outside could cause significant delays, but it could not provide us with any supporting data. In our view, the safest approach would be for the interim final regulations to require that all aircraft be closely inspected from outside or deiced after the holdover time has expired, as one major airline plans to do. FAA could then fully assess the impact of this requirement before deciding what, if any, changes to this approach should be considered.

Safety would also be improved by making commuter airlines subject to more stringent regulations governing ground operations during icing conditions. In particular, such regulations could help avoid incidents like those described in this report in which the presence of ice endangered takeoff. Close inspection of all critical surfaces from outside is as important for commuter aircraft as for other passenger aircraft because from inside not all critical surfaces are visible and ice can be difficult to detect.

As FAA recognizes, the public's safety will be ensured only if key airline personnel are trained to implement the new regulations. The initial training required under the regulations, for example, will help pilots to

correctly interpret FAA's approved holdover timetables. In the past, though, new guidance issued by FAA did not reach all pilots. In addition, because no classes or testing was required before the new regulations were implemented, FAA could take some additional actions now to ensure that airline employees have received and understood the initial training material and that they follow the new guidance this winter.

Recommendations

To improve the safety of airlines' ground operations during icing conditions, we recommend that the Secretary of Transportation direct the Administrator, FAA, to do the following:

- Amend the interim final regulations to require that if the holdover time has expired, the critical surfaces for all aircraft be (1) closely inspected from outside or (2) deiced.
- Strengthen the existing regulations governing commuter airlines to ensure that their aircraft are free of ice on takeoff.
- Develop a method to determine whether airline pilots and ground personnel have received and understood the initial training material explaining their responsibilities and develop more specific guidelines for monitoring the implementation of the regulations this winter.

Agency Comments

As requested, we did not obtain written comments on a draft of this report. We did, however, discuss the findings and recommendations with FAA's Director, Flight Standards Service, FAA's Manager, Air Transport Division, and other Department of Transportation officials, who generally agreed with the information presented. We incorporated their views where appropriate.

FAA officials agreed to consider our last two recommendations but, for the reasons mentioned in the report, disagreed with our recommendation that all aircraft be closely inspected from outside or deiced when the holdover time has expired. Nevertheless, we believe that these added safety precautions are prudent. By monitoring its experience with this more cautious approach during the interim period, FAA will be in a better position to assess the impact of the requirement and to judge what refinements, if any, would be appropriate.

FAA officials said that field inspectors have been provided training on evaluating airlines' deicing programs for approval. Also, FAA is providing

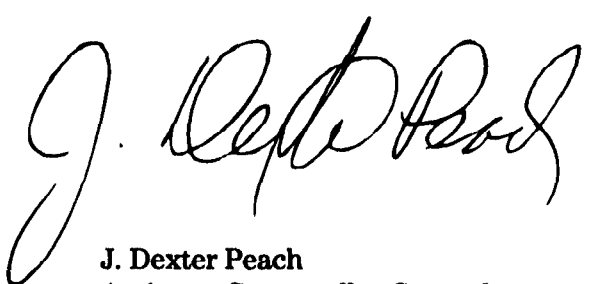
an easy reference guide to about 50,000 pilots explaining the hazards of ice and procedures for using deicing and anti-icing fluids.

Our work was conducted between May and October 1992 in accordance with generally accepted government auditing standards. Appendix II discusses our objectives, scope, and methodology in detail.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will provide copies of this report to the Secretary of Transportation; the Administrator, FAA; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

Our work was performed under the direction of Kenneth M. Mead, Director, Transportation Issues, who can be reached at (202) 275-1000. Other major contributors to this report are listed in appendix III.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

Contents

Abbreviations

ALPA	Air Line Pilots Association
FAA	Federal Aviation Administration
GAO	General Accounting Office
NTSB	National Transportation Safety Board

FAA's Approved Holdover Times

Figure I.1: FAA's Table for Holdover Times for Type I Fluids

CAUTION! THIS TABLE IS FOR USE IN DEPARTURE PLANNING ONLY AND IT SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

Freezing Point of Type I fluid mixture used must be at least 10°C (18°F) below OAT.

OAT		Approximate Holdover Times Anticipated Under Various Weather Conditions (hours:minutes)				
°C	°F	FROST	FREEZING FOG	SNOW	FREEZING RAIN	RAIN ON COLD SOAKED WING
0 & above	32 & above	0:18-0:45	0:12-0:30	0:06-0:15	0:02-0:05	0:06-0:15
below 0 to -7	below 32 to 19	0:18-0:45	0:06-0:15	0:06-0:15	0:01-0:03	CAUTION! Clear ice may require touch for confirmation
below -7	below 19	0:12-0:30	0:06-0:15	0:06-0:15		

THIS TABLE DOES NOT APPLY TO OTHER THAN SAE OR ISO TYPE I FPD FLUIDS.

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER.

Legend

FPD = Freezing Point Depressant
ISO = International Organization for Standardization
OAT = Outside Air Temperature
SAE = Society of Automotive Engineers

Figure I.2: FAA's Table for Holdover Times for Type II Fluids

CAUTION! THIS TABLE IS FOR USE IN DEPARTURE PLANNING ONLY AND IT SHOULD BE USED IN CONJUNCTION WITH PRETAKEOFF CHECK PROCEDURES.

OAT		Type II Fluid Concentration Neat-Fluid/Water [% by Volume]	Approximate Holdover Times Anticipated Under Various Weather Conditions (hours: minutes)				
°C	°F		FROST	FREEZING FOG	SNOW	FREEZING RAIN	RAIN ON COLD SOAKED WING
0 and above	32 and above	100/0	12:00	1:15-3:00	0:25-1:00	0:08-0:20	0:24-1:00
		75/25	6:00	0:50-2:00	0:20-0:45	0:04-0:10	0:18-0:45
		50/50	4:00	0:35-1:30	0:15-0:30	0:02-0:05	0:12-0:30
below 0 to -7	below 32 to 19	100/0	8:00	0:35-1:30	0:20-0:45	0:08-0:20	CAUTION! clear ice may require touch for confirmation
		75/25	5:00	0:25-1:00	0:15-0:30	0:04-0:10	
		50/50	3:00	0:20-0:45	0:05-0:15	0:01-0:03	
below -7 to -14	below 19 to 7	100/0	8:00	0:35-1:30	0:20-0:45		
		75/25	5:00	0:25-1:00	0:15-0:30		
below -14 to -25	below 7 to -13	100/0	8:00	0:35-1:30	0:20-0:45		
below -25	below -13	100/0 if 7°C (13°F) Buffer is maintained	A buffer of at least 7°C (13°F) must be maintained for Type II used for anti-icing at OAT below -25°C (-13°F). Consider use of Type I fluids where SAE or ISO Type II cannot be used.				

THIS TABLE DOES NOT APPLY TO OTHER THAN SAE OR ISO TYPE II FPD FLUIDS.

THE RESPONSIBILITY FOR THE APPLICATION OF THESE DATA REMAINS WITH THE USER.

Legend

FPD = Freezing Point Depressant
ISO = International Organization for Standardization
OAT = Outside Air Temperature
SAE = Society of Automotive Engineers

Objectives, Scope, and Methodology

The Ranking Minority Member, Subcommittee on Transportation and Related Agencies, Senate Committee on Appropriations, asked us to (1) determine the Federal Aviation Administration's (FAA) progress in developing new regulations governing airlines' ground operations during icing conditions, (2) describe the manner in which the new regulations address safety concerns, and (3) identify any areas needing improvement. To meet these objectives, we performed work at FAA headquarters, in Washington, D.C., and field offices in Kentucky and Virginia. We interviewed headquarters managers responsible for developing the new regulations and field inspectors responsible for approving airlines' deicing programs. We also interviewed National Transportation Safety Board (NTSB), Air Line Pilots Association, airline, and airport officials.

In addition, we reviewed FAA's policies, procedures, and documents on ground operations for aircraft during icing conditions. We participated in working groups at FAA's International Conference on Airplane Ground Deicing and analyzed information presented at the conference. We also reviewed FAA's proposed and interim final regulations for ground operations during icing conditions and analyzed the comments on the proposed regulations. We attended FAA's training for field inspectors on deicing and procedures to be used in approving airlines' deicing programs.

Furthermore, we attended NTSB's hearing on the USAir Flight 405 accident and analyzed the testimony and documentary evidence provided at the hearing. We reviewed information from FAA's Aviation Reporting Program on incidents caused by ice. These reports, submitted voluntarily, may not have been corroborated by FAA or NTSB.

Major Contributors to This Report

Resources, Community, and Economic Development Division, Washington, D.C.

John H. Anderson, Jr., Associate Director
Mary Ann Kruslicky, Assistant Director
Roy K. Judy, Assignment Manager
Charles R. Chambers, Evaluator-in-Charge

Ordering Information

The first copy of each GAO report is free. Additional copies are $2 each. Orders should be sent to the following address, accompanied by a check or money order made out to the Superintendent of Documents, when necessary. Orders for 100 or more copies to be mailed to a single address are discounted 25 percent.

U.S. General Accounting Office
P.O. Box 6015
Gaithersburg, MD 20877

Orders may also be placed by calling (202) 275-6241.

United States
General Accounting Office
Washington, D.C. 20548

Official Business
Penalty for Private Use $300

First-Class Mail
Postage & Fees Paid
GAO
Permit No. G100