BY THE COMPTROLLER GENERAL

Report To The Congress

OF THE UNITED STATES

Safety Standards On Small Passenger Aircraft--With Nine Or Fewer Seats--Are Significantly Less Stringent Than On Larger Aircraft

GAO's analysis of commercial air carrier accident statistics shows that the accident rate for small aircraft--those with nine or fewer passenger seats--is significantly higher than for larger aircraft. Two types of air carriers use small aircraft to provide air service--commuters, which generally provide scheduled service, and air taxis, which generally provide air service on demand. Approximately 44 percent of the commuter fleet and 90 percent of the air taxi fleet consist of small aircraft.

GAO found that the airworthiness standards and operating rules for the small aircraft used by air carriers are significantly less stringent than those for larger aircraft used for the same purpose. The Federal Aviation Administration (FAA), Department of Transportation, establishes these standards and rules for all air carriers operating within the United States.

GAO recommends that the Secretary of Transportation and the Administrator of FAA

--identify the standards and rules that are significantly less stringent for small aircraft;

--prepare cost/benefit estimates for possible upgrades of those standards, working with operators and manufacturers; and

--implement the alternatives that are feasible and cost beneficial.

GAO/RCED-84-2

JANUARY 4, 1984

Request for copies of GAO reports should be sent to:

U.S. General Accounting Office
Document Handling and Information
Services Facility
P.O. Box 6015
Gaithersburg, Md. 20760

Telephone (202) 275-6241

The first five copies of individual reports are free of charge. Additional copies of bound audit reports are $3.25 each. Additional copies of unbound report (i.e., letter reports) and most other publications are $1.00 each. There will be a 25% discount on all orders for 100 or more copies mailed to a single address. Sales orders must be prepaid on a cash, check, or money order basis. Check should be made out to the "Superintendent of Documents".

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON D.C. 20548

B-197116

To the President of the Senate and the
Speaker of the House of Representatives

This report discusses how current federal airworthiness standards and operating rules influence the safety of small air carrier aircraft. We made this review because we were concerned about the safety of the growing numbers of passengers who fly in small air carrier aircraft.

Copies of this report are being sent to the Director, Office of Management and Budget; the Secretary of Transportation; the Chairman, National Transportation Safety Board; the Administrator, Federal Aviation Administration; interested congressional committees; members of Congress; and other interested parties.

Charles A. Bowsher

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

SAFETY STANDARDS ON SMALL PASSENGER AIRCRAFT--WITH NINE OR FEWER SEATS--ARE SIGNIFICANTLY LESS STRINGENT THAN ON LARGER AIRCRAFT

D I G E S T

In the Civil Aeronautics Act of 1938 and the Federal Aviation Act of 1958, the Congress recognized the duty of all air carriers to operate with the highest degree of safety. The Airline Deregulation Act of 1978 provides that, to the maximum extent feasible, air carrier passengers are to receive the same level of safety regardless of the size of the air carrier.

GAO found, however, that paying passengers flying on small aircraft (those with nine or fewer seats) used by the air carriers are not provided with the same level of safety as passengers flying on larger aircraft--those with 10 seats or more. (See p. 9.)

Two types of air carriers use small aircraft--commuters, which generally provide scheduled service, and air taxis, which generally provide service on demand. Approximately 44 percent of the commuter fleet and 90 percent of the air taxi fleet consist of small aircraft. (See p. 5.)

Statistical evidence shows that the level of safety provided to passengers in small aircraft is substantially lower than that provided to passengers in larger aircraft. For example, during the 3-year period 1980-82, the accident rate for air taxi aircraft, per 100,000 hours of operation, was about 18 times higher than the accident rate for larger air carrier aircraft. The accident rate for small aircraft used in commuter operations during the same period was approximately 7 times higher. Of the 300 commuter and air taxi passenger air carrier accidents recorded during 1980-82, 90 percent occurred in small (nine or fewer seats) aircraft. (See pp. 10 to 12.)

FACTORS AND CAUSES RELATED TO SMALL AIR CARRIER ACCIDENTS

GAO found that for a variety of reasons it is difficult to attribute an aircraft accident to

any single cause or factor; and, according to National Transportation Safety Board (NTSB) investigation reports, aircraft accidents generally result from multiple causes. (See p. 13.)

While GAO could not draw a direct link between accidents and specific causes, it was able to categorize air carrier accidents into three major cause/factor areas--personnel (pilots, flight crews, mechanics, etc.), environment (weather, terrain, etc.), and aircraft (airframe, engines, avionics systems, etc.).

GAO recognizes that the Federal Aviation Administration (FAA) has little control over the environment in which the aircraft fly--such as weather and terrain. However, it does have control over (1) the design and construction of the aircraft through its review and certification approval process (airworthiness standards) and (2) the qualifications, training, and experience of the crews who fly and maintain these planes (operating rules). GAO found that both the airworthiness standards and operating rules FAA has established for small air carrier aircraft are significantly less stringent than those it has established for larger aircraft. (See p. 15.)

For example, one of the more significant differences noted in airworthiness standards between large and small aircraft was in aircraft take-off performance following an engine failure. FAA has stated that a fundamental part of the safety level of twin-engine aircraft is the aircraft's ability to sustain an engine failure at any point in its take-off flight path and have sufficient performance capability in the remaining engine to clear obstacles and make a safe landing.

The airworthiness standards for twin-engine aircraft with 20 or more seats ensures this capability--to clear obstacles on take-off even on one engine--while similar standards for smaller twin-engine aircraft--particularly those with nine or fewer seats--do not. Other areas in which GAO noted differences include fuel system design, power-plant fire protection and detection, and electrical system fire and smoke protection. (See p. 17.)

FAA SHOULD USE COST/BENEFIT ANALYSES TO STRENGTHEN SELECTED STANDARDS AND RULES FOR SMALL AIR CARRIER AIRCRAFT

Since the late 1960's, FAA has either studied, proposed, or made numerous changes to both the airworthiness standards and operating rules that govern all air carrier operations. However, GAO's analysis of these various studies, as well as the regulatory modifications--both proposed and implemented--shows that, for the most part, the studies and changes made either specifically excluded or were not considered mandatory for air carrier aircraft with nine or fewer seats. (See p. 24.)

GAO questioned manufacturers, operators, and FAA about the minimal action taken to strengthen airworthiness standards and operating rules for small aircraft used as air carriers. GAO was given two basic responses. First, the small air carrier aircraft plays a relatively minor role in the transportation of passengers in the United States--1 to 2 percent of paying air passengers annually--and second, imposing the highest standards and rules on small air carrier aircraft would increase the cost of these small aircraft and their operations to the point where it would virtually destroy the industry financially. In addition, FAA stated that if the industry were adversely affected, not only would the general public be deprived of needed transportation, but one of the basic purposes of FAA would be thwarted--to promote aviation in this country.

GAO recognizes that small air carrier aircraft only transport 1 to 2 percent of paying air passengers annually. However, this figure represents over 2 million people. (See p. 25.)

GAO also recognizes that some changes in airworthiness standards and operating rules could be very costly, perhaps even affecting the industry's economic viability while providing few safety benefits. Conversely, other changes could be made at acceptable costs with substantial safety benefits to be gained. Cost/benefit analyses would, in GAO's opinion, help determine which standards and rules could or should be changed and the extent to which they could be changed without affecting the economic viability of the industry.

Several Congressional and administrative policies address the cost/benefit issue. They encourage agencies to perform cost/benefit analyses before implementing any proposed regulation that will likely place a significant financial burden on the users.

GAO found that FAA has not prepared any such economic or cost/benefit analysis with regard to modifying the airworthiness standards and operating rules as they apply to small air carrier aircraft. (See p. 26.)

Without such an analysis, the economic burden versus the potential benefits of strengthening landing gears on small aircraft, improving engine-out performance, requiring additional aircrew training, etc., cannot be ascertained.

Approximately 2 million paying passengers are being carried in small aircraft annually and this figure is expected to grow. Therefore, GAO believes FAA needs to identify the standards and rules for small air carrier aircraft that are significantly less stringent than those for larger aircraft and determine the costs versus the benefits of strengthening those standards and rules. (See p. 27.)

RECOMMENDATIONS

GAO recommends that the Secretary of Transportation direct the Administrator, FAA, to

--identify those standards and rules governing small air carrier aircraft (nine or fewer seats) that are significantly less stringent than those applicable to larger air carrier aircraft,

--prepare detailed cost/benefit estimates of the possible alternatives to upgrade those standards and rules that are less stringent, and

--implement those alternatives that are determined to be technologically feasible and cost beneficial.

GAO further recommends that the Administrator seek the cooperation and assistance of aircraft manufacturers and air carrier operators in preparing the cost/benefit estimates.

AGENCY COMMENTS

In a letter dated October 31, 1983, the National Transportation Safety Board advised that it generally concurred with GAO's conclusions and recommendations. NTSB did state, however, that since flight-hour data by aircraft seating capacity for air taxis are not available, GAO would not be able to make a comparison of accident rates between air taxis and the larger air carriers.

GAO acknowledges that reliable flight-hour data by aircraft seating capacity for air taxis are not available. However, GAO was able to obtain an estimate of flight-hour operations for all air taxis. Since 90 percent of the air taxi fleet is comprised of aircraft with nine or fewer seats, GAO made no attempt to distinguish between aircraft size (seating capacity) when computing the air taxi industry's overall accident rate statistics. GAO believes that the statistics presented would not be significantly different even if flight-hour data by seating capacity were available.

NTSB also stated that GAO did not include cargo operations in its accident statistics. GAO chose to include in its review only passenger-carrying aircraft. Excluding the cargo aircraft statistics does not, in GAO's opinion, lessen the significance of either the number of accidents recorded or the accident rates established.

Finally, NTSB stated that the hours-flown estimates used for commuter operations are approximately twice as high as comparable data compiled by the Civil Aeronautics Board (CAB). As explained on p. 7, hours of operation data by seating capacity were only available from the Regional Airline Association. In addition, because the Association collects data annually from each commuter operator, its data base is significantly larger than CAB's. (CAB collects data only from selected commuter operators.) This larger data base accounts for the higher hours of operation.

GAO briefed FAA officials on the contents of the draft report and subsequently provided the Department of Transportation the opportunity

to submit comments on the report. On October 28, 1983, the Department advised GAO that comments on the draft report would not be provided and that the report should be finalized and issued without its comments.

Contents

ABBREVIATIONS

ASEC	Airworthiness Standards Evaluation Committee
CAA	Civil Aeronautics Authority
CAB	Civil Aeronautics Board
DOT	Department of Transportation
FAA	Federal Aviation Administration
GAO	General Accounting Office
IFR	Instrument Flight Rules
NTSB	National Transportation Safety Board
RAA	Regional Airline Association

CHAPTER 1

INTRODUCTION

How safe is it to fly? This question has been asked since the first days of flight. Current statistics show that flying aboard the Nation's commercial air carriers[1] is by far one of the safest means of transportation. During 1982 U.S. commercial air carriers transported about 290 million passengers. However, when a commercial aircraft accident does occur it usually results in a great deal of concern being expressed by the Congress, the public, and the aviation community on just how safe flying is.

Addressing these concerns has always been difficult because of the numerous factors that affect flight safety. Virtually every aspect of aviation, from the design and construction of the aircraft, through the experience and qualifications of the aircrew, to the very environment in which the plane must fly, influences safety.

This report addresses but one aspect of aviation safety, namely:

--Does a higher percentage of air carrier accidents occur in a particular type or size of aircraft?

--If so, what are the factors and causes involved in these accidents?

--What can be done to improve the safety of these aircraft and at what cost?

Under the Federal Aviation Act of 1958, as amended (49 U.S.C. 1301 et seq.), the Federal Aviation Administration (FAA) is responsible for establishing airworthiness standards for the design and construction of aircraft and operating rules that govern aircrew qualifications and training, aircraft maintenance, and flight operations. These standards and rules apply to all air carriers operating within U.S. airspace.

DEVELOPMENT OF AIR CARRIER AIRWORTHINESS STANDARDS AND OPERATING RULES

The Federal Government's involvement with commercial aviation began with the Air Commerce Act of 1926. The impetus for this act was twofold--first, the need to promote air transportation in the

---

[1]Air carriers transport passengers or cargo for a fee.

United States, which had generally fallen behind air transportation in European countries, and second, the need to institute guidelines for air safety. This second issue--safety--grew out of the poor record that was being established by the fledgling aviation industry.

The 1926 act required the Secretary of Commerce to establish safety regulations for both aircraft and airmen and set up and operate the Nation's airways. The first airworthiness standards and operating rules--in comparison to today's complex series of regulations--were simplistic and encompassed all aircraft and airmen. Since most aircraft were small, simply constructed, and generally for private use, only one set of regulations was considered necessary.

To meet the Nation's growing demand for air service, the aircraft industry, during the 1930's, began developing and producing larger planes that were designed specifically for air carrier use. This initial expansion peaked in 1936 with the introduction of the Douglas DC-3--a 21-passenger, 25,000-pound aircraft--the first modern airliner.

As the industry grew and expanded, its poor safety record also continued. Reacting to a series of airline crashes in the late 1930's, the Congress passed the Civil Aeronautics Act of 1938. This act created the Civil Aeronautics Authority (CAA), the forerunner of FAA, and provided the framework for today's airworthiness standards and operating rules.

In the act, the Congress recognized, for the first time, the duty of all air carriers to operate with the highest degree of safety. The act stated:

> "In prescribing standards, rules, and regulations, and in issuing certificates under this title, [CAA] shall give full consideration to the duty resting upon air carriers to perform their services with the highest possible degree of safety in the public interest."

This language was repeated in the Federal Aviation Act of 1958, which established FAA. Also, the Congress directed CAA to regulate air carrier aircraft separately from private-use aircraft.

To meet this mandate, CAA set significantly more stringent airworthiness standards and operating rules for the air carriers. In establishing the regulations, CAA set an arbitrary weight limit of 12,500 pounds as the separation point between air carrier (large) aircraft and private use (small) aircraft. CAA used weight as the distinguishing factor because at that time weight and use of the aircraft were basically synonymous. By 1945 the new standards and operating rules were in place.

SMALL AIRCRAFT DEVELOPED FOR AIR CARRIER USE

The distinction of aircraft on the basis of weight worked well initially. However, between 1945 and 1965, significant changes occurred in the aircraft industry. New technology produced bigger and more sophisticated planes, which in turn required larger airport facilities and a greater marketing base. Because many smaller communities could not support either of these requirements, air carriers began discontinuing their service to them. Yet the demand for air service in small communities remained and grew. To meet this demand, a new air carrier class emerged--the "air taxi."

The first air taxi operators used small aircraft, which because of their size (12,500 pounds or less) had been built under the least stringent airworthiness standards that were intended for private-use aircraft. At that time, CAA did not believe it was necessary to upgrade the airworthiness standards for aircraft used by the air taxis because they generally flew nonscheduled flights, the aircraft usually contained nine or fewer seats, and they operated from small communities with low-density markets. CAA did, however, upgrade the operating rules (aircrew qualifications, training, etc.) for air taxis, making them more stringent than those for private-use aircraft but less stringent than those for the larger aircraft used in air carrier operations.

In the 1960's, the advent of the "jet" into air commerce brought on line still bigger, faster, and more sophisticated aircraft, which in turn further limited the number of communities able to support large air carrier aircraft. The gap between demand and service continued to widen as more and more smaller communities lost their larger air carrier service.

The problem of finding a suitable aircraft to serve the increasing number of low-density markets was finally overcome in the mid 1960's. Until that time, existing aircraft were either too big or too small to profitably provide scheduled passenger service in these markets. Large aircraft, most of which contained more than 20 seats, were either uneconomical to operate in low-density markets or they were served by inadequate airport facilities. On the other hand, smaller aircraft with nine or fewer seats did not, in many cases, provide sufficient seating capacity. Development of the turboprop[2] engine, along with a new airframe that provided 10-19 seats, spawned a third class of air carrier--the commuter. However, like aircraft used by the air

---

[2]The main propulsive force of the engine is supplied by a conventional propeller, driven by a gas turbine as in a jet engine.

taxi operators, the new aircraft used by the commuter air carriers initially weighed less than 12,500 pounds and therefore could be built under the less stringent airworthiness standards developed for private-use aircraft. These aircraft were, however, also subject to the operating rules for air taxis.

FAA now faced a dilemma. The new commuter aircraft was capable of transporting a relatively large number of passengers and yet was designed and constructed to the less stringent safety standards. FAA voiced its concerns over the use of this new class of aircraft in a "Notice of Proposed Rule Making" (a regulatory proposal submitted to the public for comment), which was published in the Federal Register in April 1967. In effect, the Notice said that the airworthiness standards originally established for the small private-use aircraft were not adequate to ensure the safety of passengers in airplanes capable of carrying 10 or more persons. FAA proposed requiring air carriers using 10-19 seat aircraft to meet interim airworthiness standards that were more stringent than those for small aircraft but less stringent than those for large air carrier aircraft. FAA's proposed interim standards became effective in January 1969.

In August 1977 FAA considered further upgrading of the airworthiness standards when it proposed prohibiting the use of 10-19 seat aircraft in air carrier service beyond a certain date unless they met the higher standards for large air carrier aircraft. The air carrier industry opposed FAA's proposal, pointing out that commuter aircraft could not be economically modified to meet the most stringent airworthiness standards. In effect, it said that the stricter standards would virtually destroy the commuter industry financially, thereby depriving the general public of needed transportation.

FAA acknowledged that requiring the highest airworthiness standards would have an adverse economic impact on the industry. Nevertheless, it still believed that some type of higher standards were necessary. Negotiations with the air carrier industry resulted in the continuation and improvement of the interim airworthiness standards for 10-19 seat aircraft that were more stringent than the private-use standards but less stringent than the large air carrier aircraft standards. These interim standards were now based on the aircraft's seating capacity rather than weight.

The latest legislative attempt to ensure commuter air safety occurred when the Congress passed the Airline Deregulation Act of 1978 (Public Law 95-504). Basically, the act directs FAA to impose requirements on commuter air carriers to assure that commuter passengers receive the same level of safety, to the maximum extent feasible, as that provided to passengers on large air

carrier aircraft.[3] Commuter air carriers are defined as those which provide passenger service solely with aircraft having a maximum capacity of fewer than 56 passenger seats.

Concurrent with the passage of the Airline Deregulation Act of 1978, FAA implemented revised air taxi and commuter operating rules. The revised rules made requirements for aircraft with 10-30 seats more stringent than those that had been established for aircraft with nine or fewer seats. These new rules, however, still fall short of the operating rules for larger aircraft. Rules for aircraft with nine or fewer seats were also moderately upgraded; however, they still closely resemble those rules that existed before the 1978 changes; they are not only less stringent than the rules for aircraft with 10-30 seats, but are substantially less stringent than those for larger aircraft.

The initial single set of air carrier airworthiness standards and operating rules implemented in 1945 has now evolved into three separate regulation categories based on either the aircraft's weight and/or seating capacity:

--The most stringent airworthiness standards apply to aircraft with 20 or more seats, and the most stringent operating rules apply to aircraft with 31 or more seats.

--An intermediate set of airworthiness standards applies to aircraft with 10-19 seats and an intermediate set of operating rules apply to aircraft with 10-30 seats.

--The least stringent airworthiness standards and operating rules apply to air carrier aircraft with nine or fewer seats.

NUMBER OF SMALL AIRCRAFT IN THE AIR CARRIER FLEET

In 1982 aircraft with nine or fewer passenger seats consituted about 44 percent of the commuter air carrier fleet (688 of 1,573 aircraft) and made up about 90 percent of the approximately 6,500 air taxis.[4]

---

[3]Congressman John L. Burton, who offered this provision as an amendment to the Airline Deregulation bill, explained to the House that under this provision, "the FAA could not impose burdensome conditions upon commuter airlines that would make it impossible for them to operate but still require them, to the maximum extent feasible, to meet the highest level [of safety] of certificated aircraft." 124 Cong. Rec: 30,695 (1978).

[4]Air taxi data is for 1981 and excludes helicopters.

Of the 18.6 million passengers carried by commuter air carriers during 1982, about 2 million were flown on small aircraft, according to Regional Airline Association (RAA) estimates. No statistics are available on the number of passengers carried by air taxis; however, with 6,500 aircraft available in the fleet, each flying about 400 hours per year on average, the figure could well be in the tens of thousands.

While the air carrier industry as a whole is becoming less dependent on small aircraft, the number of passengers carried by the commuter and air taxi operators is expected to grow. For example, according to FAA forecasts, the commuter industry alone is expected to grow more than 8 percent per year through 1994, from 18.6 million passengers in 1982 to about 42 million passengers in 1994. No growth projections have been made for the air taxi industry; however, no decrease in its operation is expected. The commuter growth, coupled with the need to continue air taxi service to small communities, will ensure that smaller aircraft will remain an integral part of the overall air carrier industry for many years.

OBJECTIVE, SCOPE, AND METHODOLOGY

We made this review to determine whether FAA, in prescribing airworthiness standards and operating rules, is giving adequate consideration to safety in small air carrier aircraft operations. Our review addressed primarily the adequacy of FAA's airworthiness and operational requirements for commuter and air taxi aircraft, particularly those with nine or fewer seats.

We conducted our review at FAA's headquarters in Washington, D.C.; its Transport Aircraft Directorate in Seattle, Washington; its Light Aircraft Directorate in Kansas City, Missouri; its Engine Certification Directorate in Boston, Massachusetts; and its Regional Flight Standards and Aircraft Certification District Offices in Atlanta, Georgia; Boston; Wichita, Kansas; and Seattle. We visited these offices because of their responsibilities for establishing as well as enforcing small air carrier aircraft airworthiness standards and operating rules.

We also contacted small aircraft manufacturers and various national aviation trade associations, including the General Aviation Manufacturers Association, the RAA, and the National Air Transportation Association. We obtained their views and comments on the adequacy of FAA's airworthiness and operational standards for commuter and air taxi aircraft and the impact these standards and rules have on members' operations. We discussed our draft report with officials from these organizations and firms and considered their views in preparing our final report.

We reviewed FAA airworthiness and operational regulations that govern various categories of aircraft and compared and

contrasted the differences. In comparing and contrasting airworthiness and operating regulations, we relied on information gathered during interviews with National Transportation Safety Board (NTSB), industry, and FAA officials and on FAA's own comparative analyses. In addition, we reviewed past and present Federal laws, legislative histories, and FAA's justifications for various proposed or actual rule changes to determine the level at which small air carrier aircraft are required to operate.

To establish safety differences between smaller commuter and air taxi aircraft and larger aircraft, we used safety data provided by the Civil Aeronautics Board (CAB), FAA, NTSB, and RAA. For example, NTSB was able to provide us with overall accident statistics and accident rates per 100,000 hours of operation[5] for the entire civil aviation fleet for the years 1977 to 1982. Hours of operation data, however, were not available by aircraft seating capacity--9 seats or less, 10-19 seats, 20-30 seats, 31 seats or more. To make such an analysis for commuter air carriers--accident rates by aircraft seating capacity--we obtained estimates of commuter hours flown by aircraft seating capacity from RAA. However, the hours-flown data were only available from RAA for the years 1980-82. RAA compiled these estimates annually from a survey of all commuter operators. (CAB collects data only from selected commuter operators. As a result, the number of hours computed by RAA is approximately twice the number of hours of operation computed by CAB.) We reviewed RAA's survey and estimating procedures and consider them reasonable. Using NTSB commuter accident data and RAA estimates of hours flown, we estimated commuter air carrier accident rates by aircraft seating capacity for the 3-year period 1980-82.

We could not obtain reliable flight-hour estimates by aircraft seating capacity for air taxi operators. Since most of the aircraft in the air taxi fleet have nine or fewer seats,[6] we made no attempt to distinguish categories of aircraft on the basis of aircraft seating capacity when computing the air taxi industry's overall accident rate statistics. Therefore, we considered the original data provided by NTSB to be indicative of the air taxi industry when analyzing accident rates by aircraft seating capacity.

In our analysis of causes and factors contributing to air carrier accidents, two different sources of data were used. For example, FAA completed a study of commuter air carrier accident causes and factors using NTSB accident briefs that covered the period 1975-78. Using the same criteria as FAA, we obtained and analyzed NTSB commuter air carrier accident briefs for the period

---

[5]NTSB and FAA consider accidents per 100,000 hours flown to be an acceptable unit of measurement for comparing accident rates.

[6]Using FAA data, we estimate that approximately 90 percent of the air taxi fleet is comprised of small aircraft.

1979-81. However, for the air taxi air carriers, similar NTSB briefs were only available for the period 1976-81. For the purposes of our review and analysis, we considered the time period to be adequate.

In addition to reviewing accident data, we reviewed various FAA and NTSB reports and other reports prepared by professional associations that discussed commuter and air taxi safety and the safety problems associated with current commuter and air taxi aircraft.

We also reviewed the February 17, 1981, Executive Order 12291, which directs agencies, to the extent permitted by law, to prepare a cost/benefit analysis for all proposed rulemaking, and we considered other directives and legislative guidance having cost/benefit considerations affecting FAA. These included FAA documents relating to the valuation of costs and benefits associated with rulemakings and FAA's Economic Analysis of Investment and Regulatory Guide.

On September 21, 1983, our draft report was forwarded to the Assistant Secretary for Administration, Department of Transportation, and the Chairman, NTSB, for comment. The period allowed for comment was 30 days. On October 28, 1983, the Department of Transportation advised us that written comments on the draft report would not be provided and that we should finalize and issue our report. Comments were received from NTSB and are included as appendix II. Our review was performed in accordance with generally accepted government auditing standards except for not obtaining agency comments from the Department of Transportation.

On September 27, 1983, we provided testimony before the Subcommittee on Investigations and Oversight, House Committee on Public Works and Transportation, on the results of our audit work and the data contained in the draft report.

CHAPTER 2

SMALL AIR CARRIER AIRCRAFT EXPERIENCE HIGHER ACCIDENT RATES THAN LARGER AIR CARRIER AIRCRAFT

While the air carrier industry as a whole has achieved an outstanding safety record (1.70 accidents per 100,000 hours flown in 1982), a closer look at the statistics shows a significant difference in accident rates, not only among the three air carrier classes but also among the sizes of aircraft (seating capacity) used by air carriers.

During 1980-82, large scheduled air carriers had only 0.282 accidents per 100,000 hours flown versus 2.53 accidents per 100,000 hours flown by commuter air carriers and 5.02 accidents per 100,000 hours flown by air taxis. Analyzing accident statistics by aircraft seating capacity shows that the accident rate for air taxi aircraft--an estimated 90 percent of the fleet is aircraft with nine or fewer seats--is about 18 times higher than the rate for large scheduled air carriers. A similar analysis of small aircraft used by commuter air carriers shows that their accident rate is about 7 times higher than the large scheduled air carrier rate. Finally, about 90 percent of all commuter and air taxi passenger accidents recorded during the period 1980-82 occurred in small aircraft.

OVERALL SAFETY PERFORMANCE VARIES FOR DIFFERENT CLASSES AND SIZES OF AIRCRAFT

Statistics on air carrier accidents and accident rates for 1977-82 indicate an overall reduction in both the number of accidents and the rate of accidents per 100,000 hours of flying. These same statistics, however, also show that in 1982, even with a significant reduction in the number of accidents, the accident rate per 100,000 hours flown for commuter air carriers was still more than seven times higher than that of large scheduled air carriers. Air taxis, on the other hand, as a separate class of air carrier, did not significantly improve their safety record over the 6-year period, and their accident rate per 100,000 hours of operation is still more than 18 times higher than that of the large scheduled air carriers and nearly 3 times higher than the accident rate for commuter air carriers.

The higher accident rates for commuter and air taxi air carriers is not a new or startling revelation. Historically, as shown below, these two classes of air carriers have always had more accidents than the large scheduled air carriers.

Air Carrier Accident Data[a]
1977-82

	Large scheduled air carriers		Commuter air carriers		Air taxi air carriers	
Year	Accidents	Rate per 100,000 hrs.	Accidents	Rate per 100,000 hrs.	Accidents	Rate per 100,000 hrs.
1977	21	.362	44	3.83	158	4.78
1978	21	.348	61	4.68	198	5.58
1979	24	.358	52	4.44	160	4.34
1980	15	.221	38	3.23	170	4.70
1981	25	.381	33	2.66	155	5.35
1982	16	.232	21	1.72	145	5.09
Total accidents	122		249		986	
Total fatal accidents	21		60		231	
Total fatalities	828		232		620	

[a]Includes cargo flights and helicopters.

Source: NTSB Safety Bulletin 83-1, Jan. 7, 1983

Most large air carriers fly only large aircraft (31 seats or more). In contrast, commuter and air taxi operators fly large aircraft as well as intermediate-size (10-30 seats) and small aircraft. Therefore, to make a more valid comparison among air carrier classes, we believe it is necessary to analyze accident statistics based on aircraft size (seating capacity). To make such an analysis, we obtained data from NTSB on the total number of accidents on passenger-carrying aircraft by aircraft size for both the commuters and air taxis. The following table shows the number of accidents by seating capacity during 1980-82. (Statistics on accidents by seating capacity were not available for years prior to 1980.)

Commuter and Air Taxi Accidents[a] by Aircraft Seating Capacity 1980-82

		No. of passenger seats				
		1-9	10-19	20-30	31+	Total
Commuter	No.	42	24	3	1	70
	Percent	(60.0)	(34.3)	(4.3)	(1.4)	(100.0)
Air taxi	No.	226	2	2	0	230
	Percent	(98.2)	(.9)	(.9)	(0)	(100.0)
Total	No.	268	26	5	1	300
	Percent	(89.3)	(8.7)	(1.7)	(.3)	(100.0)

[a]Cargo flights and helicopters excluded.

Source: NTSB list of accidents by aircraft seating capacity.

As the previous table shows, most commuter and air taxi air carrier accidents--89.3 percent--occurred in small aircraft. The percentage of accidents in small air carrier aircraft, however, is not in proportion to their numbers in the fleet. For example, small aircraft constituted only 44 percent of the commuter fleet in 1982, yet they made up 60 percent of commuter accidents.

To complete our analysis using aircraft seating capacity, we wanted to compare accident rates based on an accepted measure of activity, in this case number of hours flown. We obtained estimates of commuter hours flown, by aircraft size, from RAA. RAA obtained this data from a survey of all commuter operators. Neither FAA nor NTSB could provide us with such estimates. Similar data on air taxi operations were not available from any source. However, because most air taxi aircraft (about 90 percent) are classified as small, we believe that their accident rates, by seating capacity, would not be significantly different from the overall rate shown previously in the table on page 10, which shows an accident rate of 5.09 accidents per 100,000 hours flown.

The following table summarizes our analysis of commuter accident rates by aircraft seating capacity for 1980-82.

Estimated Commuter Air Carrier Accident Rates
By Aircraft Seating Capacity
(Passenger flights only)
1980-82

	Aircraft seating capacity			
	1-9	10-19	20-30	31 or more
Accidents	42	24	3	1
Hours flown	2,104,000	2,754,000	534,000	699,000
Accidents per 100,000 hours	2.00	.87	.56	.14

Source: Accidents--NTSB.
Hours flown--RAA estimates.

As the above table shows, the accident rate for the 20-30 seat aircraft is four times as high as the rate for aircraft with 31 or more seats and the rate for 10-19 seat aircraft is about six times higher. However, for aircraft with nine or fewer seats, the rate climbs rapidly to the point where these small commuter aircraft have an accident rate about 14 times higher than the large commuter aircraft and 7 times higher than the rate for large scheduled air carriers.

To fully understand why smaller air carrier aircraft, especially those with nine or fewer seats, have higher accident rates, it is necessary to examine underlying differences not only in the airworthiness standards and operating rules of the three air carrier classes, but also the environment in which they fly. In chapter 3, we analyze and compare these differences and how they influence small air carrier aircraft safety.

CHAPTER 3

VARIOUS CAUSES/FACTORS ACCOUNT FOR THE LOWER SAFETY PERFORMANCE OF SMALL AIR CARRIER AIRCRAFT

For a variety of reasons it is difficult to attribute an aircraft accident to any single cause or factor. According to NTSB reports, aircraft accidents generally result from multiple causes. Yet, based on the accident statistics, one fact remains clear: Flying in a small air carrier aircraft is definitely less safe than flying in a large one.

How small commuter and air taxi aircraft are used obviously affects the level of safety they can achieve. For example, small commuter aircraft average twice as many take-offs and landings per hour flown as do large air carrier aircraft (most accidents occur during take-offs and landings). Also, commuter and air taxi aircraft serve a significantly larger number of lesser equipped or remote airports than the large aircraft. Finally, small aircraft spend considerably more time operating at lower altitudes, where flying weather is often less than ideal.

The incongruity of this situation, however, is that small aircraft, which are operating potentially under the more hazardous conditions, are being built and operated under FAA's least stringent airworthiness standards and operating rules for air carriers.

MAJOR CAUSES AND FACTORS THAT INFLUENCE AIR CARRIER ACCIDENTS

While we cannot draw a direct link between accidents and specific causes, our analysis of FAA accident data for the period 1975-81 indicates that the causes and factors of air carrier accidents are related to three areas:

--personnel (including pilot and flight crew and other personnel such as mechanics and dispatchers),

--environment (airports, weather, and terrain), and

--aircraft (airframe, powerplant, instruments, and accessories).

Using FAA and NTSB data and our own analyses of these data on 1,327 commuter and air taxi accidents that occurred during 1975-81, we found that about 53 percent of the accident causes and factors were personnel-related, 30 percent were related to the environment, and 14 percent were related to the aircraft. The

remaining 3 percent were classified as miscellaneous or could not be determined. A detailed breakdown of accident causes and factors for commuter and air taxi aircraft for 1975-81 is shown in tables I and II of appendix I.

COMMUTER AND AIR TAXI OPERATING ENVIRONMENT IS A SIGNIFICANT SAFETY DETERMINANT

The higher accident rate of small commuter and air taxi aircraft is due in part to the different environments in which they operate. These differences include more take-offs and landings; operating into less well equipped or remote airports; and flying a higher percentage of time at lower altitudes, where weather conditions are often less than ideal. As a result, small commuter and air taxi aircraft run a significantly higher risk of having an accident than large air carrier aircraft.

More take-offs and landings

Commuter and air taxi operations are characterized by frequent short-distance flights in which large numbers of take-offs and landings are made. This characteristic is significant because most accidents occur during the take-off and landing phase. According to RAA data, the average commuter trip distance made in 1982 was only about 140 miles. An NTSB special study on commuter safety, which was issued in 1980, showed that the average trip time was only about 50 minutes. These figures compare with about 750 miles and 1 hour and 20 minutes flying time per trip for large air carrier aircraft. On the basis of these figures, a commuter aircraft would take off and land twice as many times as a large air carrier aircraft would take off and land.

Our analysis of 123 commuter accidents during the period 1979-81 showed that 76 (62 percent) occurred during take-off or landing. An FAA study of 180 commuter accidents that took place between 1975-78 supports this analysis. It showed that 110 (61 percent) of the 180 accidents occurred during either take-off or landing.

Less well equipped or remote airports

Commuters and air taxis serve many more locations and a wider variety of facilities than large air carriers. For example, the large scheduled air carriers serve about 297 U.S. airports while commuter air carriers serve about 535 facilities. Air taxis, on the other hand, can serve any of the Nation's 15,500 airfields. Many of these locations--some of which may be little more than an unpaved landing strip--do not have the type of landing aids common to large airports.

According to RAA, by 1986 about 99 percent of the airports served exclusively by large scheduled air carriers will have full instrument landing systems while only 63 percent of the airports served exclusively by commuters will be similarly equipped. In contrast, less than 5 percent of the 15,500 airfields open to the air taxi industry had instrument landing systems in 1981.

During 1975-81, about 13 percent of the 3,398 commuter and air taxi accident causes and/or factors related to airport facilities and terrain.

Adverse weather conditions

Commuter and air taxi aircraft generally fly at lower altitudes, where weather conditions are often poor, for longer periods of time than large air carrier aircraft. Because of their relatively short trip distances--about 140 miles per trip--small commuter and air taxi aircraft are not airborne long enough to reach the higher altitudes necessary to fly above bad weather. Large aircraft, on the other hand, generally fly greater distances for longer periods of time and therefore reach the higher altitudes where weather conditions are usually stable. With this capability, large aircraft encounter unstable weather--such as thunderstorms, turbulence, and icing conditions--for relatively short periods of time and then generally only during the ascent and descent phases of the flight.

During 1975-81, about 17 percent of the 3,398 commuter and air taxi accident causes and factors related to weather.

SAFETY REGULATIONS FOR SMALL AIR CARRIER AIRCRAFT ARE LESS STRINGENT THAN THOSE FOR LARGER AIR CARRIER AIRCRAFT

In the Civil Aeronautics Act of 1938 and the Federal Aviation Act of 1958, the Congress recognized the duty of all air carriers to operate with the highest degree of safety (see p. 2). The Congress also provided for regulation of air carrier aircraft separate from private-use aircraft. Although FAA was given a great deal of flexibility in establishing air carrier regulations, there is no indication that size of the air carrier aircraft or its seating capacity should be factors in regulating air carriers. The Airline Deregulation Act of 1978 directed FAA to impose requirements on commuter air carriers to assure that the level of passenger safety would be, to the maximum extent feasible, equivalent to the level of safety provided by larger air carriers (see p. 4).

Today's standards and rules for small air carrier aircraft are significantly less stringent than those for large air carrier aircraft. For example, airworthiness standards for air carrier aircraft with nine or fewer seats are virtually identical to those for private-use aircraft of the same size.

To illustrate how air carrier safety regulations vary depending on aircraft size, the following section discusses and compares selected airworthiness standards and operating rules by aircraft seating capacity.

Airworthiness standards

Airworthiness standards for air carrier aircraft with 9 or fewer seats are significantly less stringent than those for aircraft with 10 or more seats in virtually every critical area analyzed. These areas, to name a few, include aircraft design and construction, fuel system design, aircraft performance, powerplant fire protection and detection, and electrical system fire and smoke protection. Two of the areas--aircraft performance and fire protection--are discussed in detail below.

Aircraft performance

One of the more significant differences noted in our analysis of airworthiness standards between large and small aircraft was in aircraft take-off performance following an engine failure. In a 1980 study comparing these standards, FAA stated that a fundamental part of the safety level of twin-engine air carrier aircraft is the aircraft's ability to sustain an engine failure at any point in its take-off flight path and have sufficient performance capability available in the remaining engine to clear obstacles and make a safe landing.

The airworthiness standards for twin-engine air carrier aircraft with 20 or more seats provides this capability--to clear obstacles on take-off even on one engine--while similar standards for smaller twin-engine aircraft do not. The following table summarizes several of the major differences between the large and small twin-engine aircraft airworthiness performance standards.

Comparison of Small and Large Air Carrier Aircraft Performance Standards

Standard	Passenger seating capacity		
	1-9 seats	10-19 seats	20 or more seats[a]
Ability to clear obstacles after take-off with one engine failed	Not Required	Not Required	Required
Ability to suffer a failed engine before take-off speed and stop on remaining runway	Not Required	Required	Required
Accountability for effects on take-off performance of weight, altitude, temperature, wind, and runway gradient conditions	Not Required	Partially Required (effect of some performance conditions accounted for)	Required
Ability to climb with landing gear extended after engine failure	Not Required	Partially Required ("measurably positive" climb gradient)	Partially Required (specific climb angle required)

[a]Includes all jet aircraft, regardless of number of seats.

To see how often engine failure precipitated an air carrier accident, we analyzed NTSB data on commuter airline accidents for the period 1979-81 and found that 27 of the 123 commuter accidents (21.8 percent) resulted from engine failure. Of these 27 accidents, 23 occurred in aircraft with nine or fewer seats and 15 of the 23 accidents involved twin-engine aircraft. A total of 23 fatalities resulted from the 15 accidents.

Fire protection

Small and large aircraft airworthiness standards also differ considerably in the degree of fire protection required. Small aircraft fire protection standards for engines, fuel systems, and

other aircraft components are considerably less stringent than those for aircraft with 20 or more seats. While interim airworthiness standards for aircraft with 10-19 seats require upgraded fire protection systems, for the most part they are still similar to the less stringent standards for aircraft with nine or fewer seats. The following table compares several fire protection standards for the three aircraft categories.

Comparison of Small and Large Air Carrier Aircraft Fire Protection Standards

	Passenger seating capacity		
Standards	1-9	10-19	20 or more
Crashworthiness standards to reduce chance of fuel tank rupture from collapse of landing gear	Not Required	Partially Required[a]	Required
Protection of aircraft structure from engine fire not contained by engine firewall	Not Required	Not Required	Required
Protection of hoses and connections and shut-off means for any system containing flammable fluids in a fire zone	Not Required	Partially Required[a]	Required
Fire extinguishers for powerplants and other designated fire zones	Not Required	Partially Required[a]	Required
Electrical system fire and smoke protection	Not Required	Not Required	Required

[a]Required for those aircraft designs approved under latest interim standards effective in October 1979. Not required for designs approved under earlier interim standards.

In our analysis of FAA studies, we found numerous references to safety problems that show the need for more stringent fire protection standards. For example, in one study--FAA's Light Airplane Airworthiness Review--eight fatal air taxi accidents were identified over a 3-year period (1977-80) that were attributed to uncontained fires starting in the engines and spreading to the wings of the aircraft.

Design and construction of small aircraft not related to air carrier use

Unlike large aircraft, small aircraft are generally not designed or constructed for air carrier use. For example, the recently certificated Boeing 757 and 767 aircraft were specifically designed from inception for air carrier use. In addition to meeting the most stringent FAA airworthiness standards, the manufacturer incorporated design features into the aircraft that would make them compatible with the environment in which they would be used--altitudes at which they would operate, frequency of take-offs and landings, and airports served. On the other hand, small air carrier aircraft are not only subject to less stringent FAA airworthiness standards, but are not, in most cases, designed as air carrier aircraft. The airworthiness standards and manufacturer's design concepts are geared toward lower use levels characteristic of the general aviation or personal-use environment.

Commuter and air taxi aircraft are generally flown more often than general aviation or personal-use aircraft. For example, the average personal-use general aviation aircraft flies only about 100 hours per year, according to 1981 FAA estimates. Other types of general aviation travel include executive (averaging 300 hours annually) and business (averaging 200 hours annually). Unscheduled air taxi aircraft average about 400 hours per year, while small commuter aircraft averaged about 1,000 hours per year. As noted earlier, commuter and air taxi operations also involve large numbers of take-offs and landings. This operational characteristic results in greater wear and tear on an aircraft used in commuter and air taxi service than would occur on the same aircraft used in general aviation flying.

The relationship between operational characteristics and aircraft design was emphasized during International Trade Commission hearings on domestic and foreign commuter aircraft in September 1981. RAA's Vice President for Operations stated that commuter airlines require aircraft that can last 10-12 years flying 2,500 hours per year and meet 98-99 percent dispatch reliability. The Chief Executive Officer of the Provincetown to Boston Airlines and the President of Henson Aviation (both commuter airline companies) testified that most aircraft used in commuter air carrier service were actually built for general aviation use. Therefore, deficiencies in the aircraft design that would be acceptable for general aviation use were not necessarily acceptable when the aircraft was put into air carrier service. Deficiencies they cited included lower wing-life limits and poorly designed landing gears, baggage and cabin doors, and cabin furnishings and materials.

Despite the greater wear and tear on small aircraft used in commuter and air taxi service, FAA standards do not require manufacturers to design and build small aircraft to reflect the type

of use they will receive in commuter and air taxi service. For example, other than for the wing structure, FAA has not established fatigue life requirements for small aircraft components. It has established fatigue life requirements for all components on aircraft with 20 or more seats and some fatigue and evaluation standards are specified for 10-19 seat aircraft. Fatigue life standards may not be important for a small, personal-use, general aviation aircraft flown less than 100 hours per year and 4,000 hours during its lifetime. However, we believe they are important for a similar aircraft flown 2,500 hours per year in commuter service and 30,000 hours over an average 12-year economic life.

Although FAA standards have not required them to do so, several manufacturers of small aircraft have made changes to their planes as a result of customer requirements. For example, one manufacturer (Cessna Corporation) made significant changes to one of its nine-seat commuter models--the Cessna 402--including redesigning the wing and landing gear. These changes were made to correct weaknesses identified in an earlier model of the same aircraft as a result of its use in air carrier service. Because these changes were not required by FAA standards, there is no assurance that such improvements would be made by other manufacturers of similar model aircraft, or for that matter, by Cessna itself in its other small aircraft that would be used in air carrier service.

Less stringent operating rules

Like its airworthiness standards, FAA's operating rules are also established according to aircraft seating capacity, with the least stringent rules applied to aircraft with nine or fewer seats. Although FAA made changes to the operating rules in 1978, these changes generally affected only commuter and air taxi aircraft with 10 or more seats. Air carriers using aircraft with nine or fewer seats were placed under upgraded rules which, although more stringent than those applicable before 1978, still were significantly less stringent than those applicable to larger air carrier aircraft. Aircraft with 10-30 seats were placed under requirements that closely approximated the most stringent rules for aircraft with 31 seats or more. For example, aircraft with 10 or more seats were placed under a maintenance program similar to that of larger air carriers.

In its 1980 special study of commuter airline safety, NTSB stated that, although the revised rules were a step in the right direction, improvements were still needed in certain areas, including:

--crew duty time restrictions;

--flight crew size, qualifications, and training; and

--flight operations and dispatch procedures.

Although FAA subsequently made some changes to these rules, significant differences still exist. These differences are especially apparent with respect to flight crew size, qualifications, and training. The following table highlights several of the major differences in these rules and how they relate to aircraft seating capacity.

Comparison of Small and Large Air Carrier Aircraft Operating Rules

	Passenger seating capacity		
Rule	1-9	10-30	31 or more
Copilot	Not Required[a]	Required	Required
Flight attendant	Not Required	Required[b]	Required
Captain must have Airline Transport Pilot Certificate	Not Required[c]	Required	Required
Minimum operating experience for Captain in make and model of aircraft	10-15 hours[d]	20-25 hours[e]	20-25 hours[e]
Minimum operating experience for Copilot in make and model	Not Required	Not Required	Required
Specific number of flight crew training hours	Not Required	Not Required	Required[f]

[a]Copilot required for flight under Instrument Flight Rules if approved autopilot not installed.

[b]Not required for 10-19 seat aircraft.

[c]Airline Transport Pilot Certificate required for Captains of multiengine commuter aircraft. Requirement not applicable to multiengine air taxis.

[d]Ten hours for single-engine piston, 15 hours for multiengine piston.

[e]Twenty hours for turboprop, 25 hours for turbojet.

[f]Includes 80 hours of initial ground training, 15 hours of initial flight training (7 for copilot), and 20 hours of annual recurrent ground training.

As the table illustrates, aircraft with 10-30 seats are generally governed by rules that are similar to those of larger air carrier aircraft. Small air carrier aircraft with nine or fewer seats, on the other hand, are subject to significantly less demanding requirements.

The differences between small and large air carrier aircraft operating rules relating to flight crew requirements are significant because the flight crew is the most often cited cause of both commuter and air taxi accidents. For example, in studying 180 commuter accidents between 1975-78, NTSB cited the pilot in 228 (42.9 percent) of the 531 causes and factors. Our analysis of NTSB data for 1979-81 for 608 commuter and air taxi accidents shows that the pilot was cited as a cause or factor in 34.3 percent of commuter aircraft accidents and 40.4 percent of air taxi aircraft accidents.

Flight crew size

FAA operating rules permit commuter and air taxi aircraft with nine or fewer seats to be flown by only one pilot, although a functioning autopilot is required on flights operating under Instrument Flight Rules (IFR).[1] Single-pilot IFR flying is potentially more hazardous due to the effects of high pilot workload associated with high-density air traffic and the aircraft's overall operating environment, according to the 1980 NTSB special study on commuter safety. The study noted that while 70 percent of operators surveyed were authorized to conduct single-pilot IFR flights, many stated that the practice was only marginally safe in many areas. The high pilot workload is compounded by long duty days, tedious airport environments, and other duties required of a commuter pilot, such as flight planning and baggage loading.

Another potential hazard NTSB noted is the lack of a backup pilot if the command pilot is incapacitated. NTSB recommended that FAA tighten its criteria for when single-pilot IFR is authorized for commuter airlines. FAA subsequently modified its criteria; however, it still allows single-pilot IFR if the pilot has at least 100 hours instrument experience in the specific make and model of the aircraft involved.

NTSB reiterated its concerns regarding single-pilot IFR operations following the December 1981 crash of a nine-seat commuter aircraft in Colorado in poor weather. In addition to its previous points in the 1980 study, the Board stated that FAA's existing evaluations of small airplanes during original design approval do

[1]All aircraft must fly under these rules when weather conditions are worse than certain specified minimums.

not adequately assess the interface of pilot, airplane design, and operating environment. In its report on the 1981 accident, the Board noted that although a single-pilot operation is allowed for aircraft with nine or fewer seats, the passenger seating standard has no relevant bearing on pilot workload. The Board recommended closer examination of single-pilot operations. To date, FAA has taken no action on this issue.

Flight crew experience and qualification

Flight crews of small aircraft are subject to less stringent experience and qualifications requirements than crews on larger aircraft. For example, the pilot-in-command of small piston engine aircraft is only required to have 10-15 hours experience in a specific make and model before carrying passengers while pilots of larger turbine aircraft must have 15 hours of initial flight training plus 20-25 hours in each make and model the pilot flies.

Because of the hazards involved in single-pilot operations, in 1980, NTSB recommended that FAA require more multiengine flight experience for commuter captains of smaller aircraft and tighter rules on single-pilot operations. The only modification FAA made, however, was to require 100 hours of experience in a particular make and model if the pilot will be operating under IFR in poor weather conditions. These experience requirements, however, may provide only a bare minimum. For example, in hearings before NTSB and the Congress[2] in 1980, witnesses representing the commuter operators stated that they required far more experience--up to 500 hours minimum multiengine experience or more--for their commuter captains.

Flight crew training

Crew training is also vital to safety. Although both small and large airplane operating rules require pilot training programs, the quality of these programs varies considerably. For example, in various reports NTSB has noted numerous deficiencies in small air carrier training programs, including

--lack of aircraft that can be spared from revenue operations for training purposes,

--lack of dedicated training personnel and classroom facilities,

--high pilot turnover, and

--lack of flight simulators.

---

[2]Hearings before the Subcommiteee on Oversight and Review, House Committee on Public Works and Transportation, in Feb. 1980.

NTSB also noted that the flight training being carried out is often not realistic. For example, flight training is often conducted in an aircraft weighing less than the aircraft actually flown in regular operations. As a result, performance problems typically encountered at higher, more realistic aircraft weights cannot be properly simulated.

The aircraft manufacturers have also continued to emphasize training. For example, Beech, Cessna, and Piper emphasize the importance of proper training concepts in light, twin-engine aircraft to compensate for their poor engine-out performance during emergencies. (See p. 16 for engine-out performance problems.)

We also discussed the adequacy of flight training methods with Flight Safety International, a major provider of contract flight training services to manufacturers and purchasers of new aircraft. Flight Safety officials stated that initial and recurrent flight training is critical to safe air taxi and commuter operations but that many purchasers of new aircraft often cannot afford recurrent flight training. Buyers of used aircraft often receive neither initial nor recurring training in the model aircraft they purchase.

WHAT HAS BEEN AND IS BEING DONE BY FAA TO ADDRESS SAFETY PROBLEMS OF SMALL AIR CARRIER AIRCRAFT?

Since the late 1960's, FAA has either studied, proposed, or made numerous changes to both the airworthiness standards and operating rules that govern air carrier operations as a whole. In each case, according to FAA, the purpose for such action was to reduce air carrier accidents or the potential for such accidents and thereby improve the level of safety to the paying air carrier passenger.

Our analysis of these various studies, and the regulatory modifications--both proposed and implemented--shows that for the most part, the studies and the changes made either specifically excluded or were not considered mandatory for air carrier aircraft with nine or fewer seats.

Major studies made and actions taken by FAA since 1965 to upgrade small air carrier aircraft safety regulations

In December 1965 FAA formed the joint industry/FAA Airworthiness Standards Evaluation Committee (ASEC) to explore the need for revised airworthiness standards. In a December 1966 report, the Committee concluded that new airworthiness standard categories were needed that were more closely related to aircraft use and operating environment. For example, it recommended separate,

higher airworthiness standards for any aircraft carrying paying passengers. The committee noted that small airplanes were not required to comply with many of the air carrier category regulations, even though operators using such aircraft serve the public as air carriers. The committee recognized the need for standards based on use and recommended that FAA formulate more stringent regulations. FAA took no formal action on this recommendation.

FAA also undertook several additional reviews between 1969 and 1978 with the stated purpose of upgrading air carrier standards and rules (see the following table). While major changes were either again proposed or made, the action taken focused on larger air carrier aircraft. The impact on small aircraft appears to be only minimal.

FAA Actions to Upgrade Safety Regulations for Small Air Carrier Aircraft 1969 to Present

1969	Partial upgrading of operating rules for all aircraft with 30 seats or less.
1977	Proposal to establish separate airworthiness standards for aircraft with 60 seats or less. (Never intended for mandatory application to aircraft with nine or fewer seats.) Proposal withdrawn in December 1980.
1978	Major upgrading of operating rules for aircraft with 30 seats or less. (Rule changes for the most part actually applied to aircraft with 10 to 30 seats. Only minor changes made which applied to aircraft with nine or fewer seats.)

In 1983 FAA is again reviewing proposals to establish permanent airworthiness standards for aircraft with 19 seats or less. As with all the previous attempts, however, these new proposals, if approved, will not be mandatory for aircaft with nine or fewer seats.

We asked the various parties involved in small air carrier operations--manufacturers, operators, and FAA--why only minimal reviews have been made to strengthen regulations for small air carrier aircraft. In general, we received two basic responses. First, the small air carrier aircraft plays a relatively minor role in transporting passengers in this Nation--1 to 2 percent of passengers annually--and second, economics. Imposing the highest standards and rules on small air carrier aircraft, according to the various parties, would increase the cost of the aircraft and its operations to the point where the industry would virtually be destroyed financially. In addition, FAA stated that if the industry were adversely affected, it would not only deprive the general public of needed transportation but would also be counter to one of FAA's basic purposes--to promote aviation in this country.

With regard to the small aircraft's role as an air carrier, we pointed out to FAA that while the small aircraft may only carry 1-2 percent of the total number of passengers annually, this figure still represents more than 2 million passengers--a figure sufficiently high, in our opinion, to warrant attention. In addition, we also pointed out that the small air carrier aircraft is involved in about 90 percent of all commuter and air taxi air carrier passenger accidents--again, a figure more than sufficiently high, in our opinion, to cause concern.

Concerning economics, several congressional and administrative policies[3] encourage agencies to perform cost/benefit analyses before implementing any proposed regulations that are likely to place a significant economic burden on the users. A cost/benefit analysis would be appropriate for any changes in the airworthiness standards and operating rules governing small air carrier aircraft. However, we found that FAA has not prepared any such analysis to modify or not modify the airworthiness standards and operating rules as they would apply to small air carrier aircraft.

CONCLUSIONS

While we recognize that FAA has little control over the environment in which aircraft fly--the weather, terrain, etc.--it does, however, have a great deal of control over the design and construction of aircraft through its airworthiness standards and operating rules. While FAA has, since the late 1960's, initiated several studies and made numerous changes to strengthen these regulations that govern air carrier operations as a whole, these studies and changes either specifically excluded or were not considered mandatory for air carrier aircraft with nine or fewer seats.

As previously stated, when we questioned the minimal action taken to strengthen standards and rules of small air carrier aircraft, we were generally given two basic responses. First, the minor role played by small air carrier aircraft in the transportation of passengers in this Nation (1 to 2 percent of annual enplanements) and second, the probability that the costs associated with tightening the standards and rules would destroy the industry.

While the small air carrier aircraft may only carry 1 to 2 percent of the annual enplanements, this still represents over 2 million such enplanements. This figure, in our opinion, is material. Concerning economics, several congressional and

---

[3]Requirements include the Regulatory Flexibility Act of 1980, Executive Order 12291 (Feb. 17, 1981), OMB Interim Regulatory Impact Analysis Guidance (June 13, 1981), and Department of Transportation Order 2100.5 (May 22, 1980).

administrative policies encourage agencies to perform cost/benefit analyses before implementing any proposed regulation that will likely place a significant economic burden on the users.

We recognize that some changes in airworthiness standards and operating rules could be very costly and would provide few safety benefits. Conversely, other changes could be made at acceptable costs with substantial safety benefits to be gained. A cost/benefit analysis would be useful in determining which standards and rules could or should be changed.

We found that FAA has not prepared any such economic or cost/benefit analysis with regard to modifying or not modifying the airworthiness standards and operating rules as they would apply to small air carrier aircraft.

RECOMMENDATIONS

We recommend that the Secretary of Transportation direct the Administrator, FAA, to

- --identify those standards and rules govering small air carrier aircraft (nine or fewer seats) that are significantly less stringent than those applicable to larger air carrier aircraft,

- --prepare detailed cost/benefit estimates of the possible alternatives to upgrade those standards and rules that are less stringent, and

- --implement those alternatives that are determined to be technologically feasible and cost beneficial.

We further recommend that the Administrator seek the cooperation and assistance of aircraft manufacturers and air carrier operators in preparing the cost/benefit estimates.

AGENCY COMMENTS AND OUR EVALUATION

On September 7, 1983, we briefed FAA's Associate Administrator for Aviation Standards on the results of our review, and, subsequently, on September 21, 1983, a draft report was forwarded to the Assistant Secretary for Administration, Department of Transportation, and the Chairman, NTSB, for comment. The period allowed for comment was 30 days. On October 28, 1983, the Department of Transportation advised us that comments on the draft report would not be provided and that we should finalize and issue our report without its comments.

NTSB did provide written comments, and in its letter dated October 31, 1983, told us that it generally concurred with our conclusions and recommendations. NTSB pointed out three instances in which its data differed from ours. NTSB stated that since

flight-hour data by aircraft seating capacity for air taxis (the major users of small aircraft) are not available, we would not be able to make a comparison of accident rates between the air taxi air carriers and the large scheduled air carriers. As a result, we would in fact be reviewing only a very small proportion of the accidents and hours flown in these smaller aircraft (limited to comparing accident rates of small aircraft to the commuter industry).

In our report, we acknowledged that reliable flight-hour data by aircraft seating capacity for air taxis were not available. However, we were able to obtain an estimate of flight-hour operations for the air taxi fleet. We also pointed out that since most of the aircraft in the air taxi fleet (estimated to be about 90 percent) have nine or fewer seats, we made no attempt to distinguish between aircraft size (seating capacity) when computing the air taxi industry's overall accident rate statistics. Therefore, we believe that the statistics presented would not be significantly different even if flight-hour data by seating capacity were available.

NTSB also stated that we did not include cargo operations in our accident statistics. We recognize that the definition of an air carrier includes aircraft used in both passenger and cargo operations. We chose to use a more conservative approach in our review and in the presentation of accident rate data by including only passenger-carrying aircraft in our statistical analysis. Excluding the cargo aircraft statistics does not, in our opinion, lessen the significance of either the number of accidents recorded or the accident rates established. In other words, we believe the data presented is in itself deserving of FAA's attention.

Finally, NTSB stated that the hours-flown estimates used for commuter operations are approximately twice as high as comparable data compiled by CAB. As explained on p. 7, hours of operation by seating capacity were only available from RAA. In addition, because RAA collects data annually from each commuter operator, its data base is significantly larger than CAB's. (CAB collects data only from selected commuter operators.) This larger data base accounts for the higher hours of operation.

COMMUTER AND AIR TAXI

ACCIDENT CAUSES AND FACTORS

The tables in this appendix summarize our analysis of commuter and air taxi accident causes and factors obtained from NTSB for the period 1975-81. NTSB assigns probable cause(s) to all air carrier accidents. In determining probable cause(s) of an accident, NTSB considers all facts, conditions, and circumstances surrounding the accident. Its objective is to identify those cause effect relationships in the accident sequence about which measures can be taken to prevent a similar recurrence. Where two or more causes exist in an accident, each is recorded and no attempt is made to establish a primary cause. Therefore, figures for total causes will exceed the total number of accidents.

The term "factor" is used to denote those elements of an accident that further explain or supplement the probable cause(s). In compiling the data in the following tables, we combined causes and factors in each category to determine the total number of separate instances that a given category was cited in small air carrier accidents for the stated period. The data in table I for commuter accidents during 1975-78 were obtained from a January 1980 FAA study of NTSB accident data that used this same tabulation method. At the time of our review, the latest year for which complete NTSB briefs of commuter and air taxi accidents were available was 1981. Briefs for 1975 air taxi accidents were not available.

Care must be used in interpreting the data in tables I and II. There is a great deal of interrelationship between the various cause/factor categories cited. As a result, direct cause and effect relationships between the data and specific safety problems cannot always be made. For example, as discussed on page 17, about 22 percent of commuter accidents during the period 1979-81 resulted from engine failure. The data in table I, however, show that the powerplant category included less than 7 percent of total accident causes and factors cited during this period. In this example, other causes or factors, such as pilot error, could also result in engine failures--such as the pilot accidentally shutting off the fuel. Thus, safety problems associated with engine failures in small commuter aircraft could indicate the need for both better pilot training and/or better engine-out aircraft performance standards.

Table I

Analysis of Commuter Air Carrier Accidents
Causes and Factors
1975-78 vs. 1979-81

Cause/factor category	Instances in which category cited as cause or factor: 1975-78 No.	1975-78 Percent	1979-81 No.	1979-81 Percent
Personnel:				
Pilot/co-pilot	228	42.9	122	34.3
Other personnel	61	11.5	58	16.3
	289	54.4	180	50.6
Environment:				
Airport/ facilities	37	7.0	26	7.3
Weather	83	15.6	80	22.5
Terrain	28	5.3	14	3.9
	148	27.9	120	33.7
Aircraft:				
Airframe	35	6.6	20	5.6
Powerplant	47	8.8	24	6.7
	82	15.4	44	12.3
Miscellaneous:	12	2.3	12	3.4
Total	531	100.0	356	100.0
No. of accidents	180 (4 yrs.)	-	123 (3 yrs.)	-

Table II

Analysis of Air Taxi Air Carrier Accidents Causes and Factors 1976-78 vs. 1979-81

Cause/factor category	Instances in which category cited as cause or factor: 1976-78 No.	1976-78 Percent	1979-81 No.	1979-81 Percent
Personnel:				
Pilot/co-pilot	695	47.9	428	40.4
Other personnel	107	7.4	106	10.0
	802	55.3	534	50.4
Environment:				
Airport/ facilities	59	4.1	63	5.9
Weather	252	17.4	175	16.5
Terrain	128	8.8	85	8.0
	439	30.3	323	30.4
Aircraft:				
Airframe	73	4.6	77	7.3
Powerplant	86	6.0	98	9.3
	159	10.6	175	16.6
Miscellaneous:	51	3.5	28	2.6
Total	1451	100.0	1060	100.0
No. of accidents	539 (3 yrs.)	-	485 (3 yrs.)	-

APPENDIX II

National Transportation Safety Board

Washington, D.C. 20594

Office of the Chairman

October 31, 1983

Mr. Oliver W. Krueger
Associate Director
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Krueger:

The draft report of the General Accounting Office (GAO) entitled "Small Air Carrier Aircraft have a Significantly Higher Accident Rate than Large Carrier Aircraft" has been reviewed with great interest. We appreciate the opportunity extended to us to comment.

We have examined the report in detail and compared our own data on aviation accidents. We concur, generally, with the conclusions and recommendations which were presented, although we use different methods of accident rate calculation and in some cases differ as to the specific rates. For example, the GAO compared accident rates per flight hour on the basis of 1-9 seat, 10-19 seat, and 20-30 seat aircraft. Since flight-hour data for on-demand air taxis (the major user of 1-9 seat aircraft) are not available on this basis, this comparison can be made only for the scheduled Part 135 operators (commuters). This means that the GAO in fact reviewed only a very small proportion of the accidents and hours flown in these smaller aircraft.

The table displayed on page 11 presents only part of the story. Because the data are represented in terms of percentages of aircraft of various seats and not in rates per flight hour or per operation, the table does not take into account that aircraft with small numbers of passenger seats may be flying both more hours and more seat-miles. Exposure to our mind is a very significant factor in reaching valid conclusions regarding the safety of small air carrier aircraft.

The table displayed on page 12 reflects data for passenger commuter flights only, neglecting cargo operations. Since the safety level afforded by airworthiness regulations is one of the issues being examined and these regulations apply equally whether the aircraft are flown in passenger or in cargo operations, accidents involving cargo operations should have been included as an integral part of the accident rate calculations. It should be noted also that the hours-flown estimates used on this table are approximately twice as high as comparable data compiled by the Civil Aeronautics Board.

The Safety Board does agree with the GAO that rules governing air taxis and commercial operators of small aircraft should be reviewed and analyzed by the Federal Aviation Administration of the U.S. Department of Transportation. Where regulations and standards are less stringent than those applied to operators of larger equipment, economically feasible alternative approaches to increasing the level of safety should be developed and should be required.

The Safety Board has long recognized the value of flight simulator training in the teaching of piloting skills and in the maintenance of those skills. Suppliers of simulator equipment often can provide this training on a contract basis where a certificate holder does not find the purchase of this equipment to be feasible. Simulator equipment is tailored to specific makes and models of aircraft and provides a low-cost, no-hazard training environment for even the most rigorous flight regimes. The use of flight simulators would provide an excellent method for initial training and recurrent training of pilots in emergency and high-performance operations. Encouraging the use of simulators for pilot training will certainly aid the efforts to improve the safety of air taxi operations.

Again, we appreciate the opportunity to review with you this important topic.

Respectfully yours,

Jim Burnett
Chairman

(341047)

27149

AN EQUAL OPPORTUNITY EMPLOYER

UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE,$300

POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE

THIRD CLASS