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Annual Review of Aircraft Accident Data
U.S. General Aviation, Calendar Year 2005

Annual Review of Aircraft Accident Data

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Notation 7534G
Adopted May 26, 2009

Annual Review of Aircraft Accident Data

Annual Review of U.S. General Aviation Accident Data 2005

National Transportation Safety Board

490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2009. ***Annual Review of General Aviation Accident Data 2005.*** **Publication Type NTSB/ARG-09/01. Washington, DC.**

Abstract:

A total of 1,670 general aviation accidents occurred during calendar year 2005, involving 1,688 aircraft. The total number of general aviation accidents in 2005 was slightly higher than in 2004, with a 3% increase of 53 accidents. Of the total number of accidents, 321 were fatal, resulting in a total of 563 fatalities. The number of fatal general aviation accidents in 2005 increased 2% from calendar year 2004, and the total number of fatalities increased by 1%. The circumstances of these accidents and details related to the aircraft, pilots, and locations are presented throughout this review.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

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Contents

2005 General Aviation Accident Summary

A total of 1,670 general aviation accidents occurred during calendar year 2005, involving 1,688 aircraft.[1] The total number of general aviation accidents in 2005 was slightly higher than in 2004, with a 3% increase of 53 accidents. Of the total number of accidents, 321 were fatal, resulting in a total of 563 fatalities. The number of fatal general aviation accidents in 2005 increased 2% from calendar year 2004, and the total number of fatalities increased by 1%. The circumstances of these accidents and details related to the aircraft, pilots, and locations are presented throughout this review.

2005 General Aviation Accident Statistics	
General Aviation Accidents	
Total accidents	1,670
Fatal accidents	321
Accident aircraft	1,688
General Aviation Accident Injuries	
Fatal	563
Serious	271
Minor	462
Persons involved in accidents with no injuries	1,746
General Aviation Accident Rate	
General aviation hours flown[a]	23,168,000
All accidents[b]	7.20/100,000 hours
Fatal accidents[b]	1.38/100,000 hours
Accidents per active pilots	2.74/1,000 active pilots
Fatal accidents per active pilots	0.53/1,000 active pilots

[a] Federal Aviation Administration, *General Aviation and Air Taxi Survey, 2005.*

[b] Excludes events involving suicide, sabotage, and stolen/unauthorized use

[1] In this review, a collision between two aircraft is counted as a single accident. The 10 midair collisions that occurred in 2005 involved 20 general aviation aircraft. In addition, 8 ground collisions involved 16 general aviation aircraft.

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Introduction

Purpose of the Review

The National Transportation Safety Board's *2005 Annual Review of Aircraft Accident Data for U.S. General Aviation* is a statistical compilation and review of general aviation accidents that occurred in 2005 involving U.S.-registered aircraft. As a summary of all U.S. general aviation accidents for 2005, the review is designed to inform general aviation pilots and their passengers about trends in general aviation safety and to provide detailed information to support future government, industry, and private research efforts and safety improvement initiatives.

The NTSB drew on several resources in compiling data for this review. Accident data, for example, were extracted from the NTSB's Aviation Accident/Incident Database.[1] Activity data were extracted from the *General Aviation and Air Taxi Activity and Avionics Survey* (*GAATAA Survey*)[2] and from *U.S. Civil Airmen Statistics*,[3] both of which are published by the Federal Aviation Administration (FAA), Statistics and Forecast Branch, Planning and Analysis Division, Office of Aviation Policy and Plans. Additional information was extracted from the *General Aviation Statistical Databook*, published by the General Aviation Manufacturers Association (GAMA).

What Is General Aviation?

General aviation can be described as any civil aircraft operation that is *not* covered under 14 *Code of Federal Regulations* (CFR) Parts 121, 129, and 135, commonly referred to as commercial air carrier operations.[4]

Which Operations Are Included in this Review?

This review includes accidents involving U.S.-registered aircraft operating under 14 CFR Part 91, as well as public aircraft[5] flights that do not involve military or intelligence agencies. Aircraft operating under Part 91 include aircraft that are flown for recreation and personal transportation and certain aircraft operations that are flown with the intention of generating

[1] See appendix A for more details.

[2] FAA: <GAATAA Survey 2005>. Although they are included in the *GAATAA Survey*, data associated with air taxi and air tour operations are not included in this review.

[3] FAA: <US Civil Airmen Statistics>

[4] For a review of accident statistics related to air carrier operations, see National Transportation Safety Board, *Annual Review of Aircraft Accident Data, U.S. Air Carrier Operations, Calendar Year 2005* (Washington, DC: 2009), available at <http://www.ntsb.gov>.

[5] Although the precise statutory definition has changed over the years, public aircraft operations for NTSB purposes are qualified government missions that may include law enforcement, low-level observation, aerial application, firefighting, search and rescue, biological or geological resource management, and aeronautical research.

revenue,[6] including business flights, flight instruction, corporate/executive flights, positioning or ferry flights, aerial application, pipeline/powerline patrols, and news and traffic reporting.

Which Aircraft Are Included in this Review?

General aviation operations employ a wide range of aircraft, including airplanes, rotorcraft, gliders, balloons and blimps, and registered experimental or amateur-built aircraft. The diverse set of operations and aircraft types included within the scope of general aviation must be considered when interpreting the data in this review. The type of aircraft being flown is usually closely related to the type of flight operation being conducted. Jet and turboprop aircraft are commonly used for corporate/executive transportation, smaller single-engine piston aircraft are commonly used for instructional flights, and a variety of aircraft types are used for personal and business flights.

Not included in this review are any accident data associated with aircraft operating under 14 CFR Parts 121, 129, or 135 inside and outside the United States. Also not included are data for military or intelligence agencies, non-U.S.-registered aircraft, unregistered ultralights, and commercial space launches, unless the accident also involved aircraft conducting general aviation operations. Crashes involving illegal operations, stolen aircraft, suicide, or sabotage are included in the accident total, but not in accident rates.[7]

Organization of the Review

The *2005 Annual Review* is organized into four parts:

1. A summary of general aviation accident statistics for 2005, industry markers related to general aviation activity in 2005, and contextual statistics from previous years.

2. An investigation of trends over the past 10 years, providing the context for such accident information as operation types, levels of aircraft damage, and injuries.

3. A discussion of specific accident circumstances, a description of accident occurrences, and a summary of the NTSB's findings of probable cause and contributing factors.

4. In-depth coverage of a special topic important to general aviation safety. The *2005 Annual Review* focuses on flight instruction and associated safety issues.

Graphics are used to present much of the information in this review. For readers who wish to view tabular data or to manipulate the data used in this review, the data set is available online at < http://www.ntsb.gov/aviation/Stats.htm>.

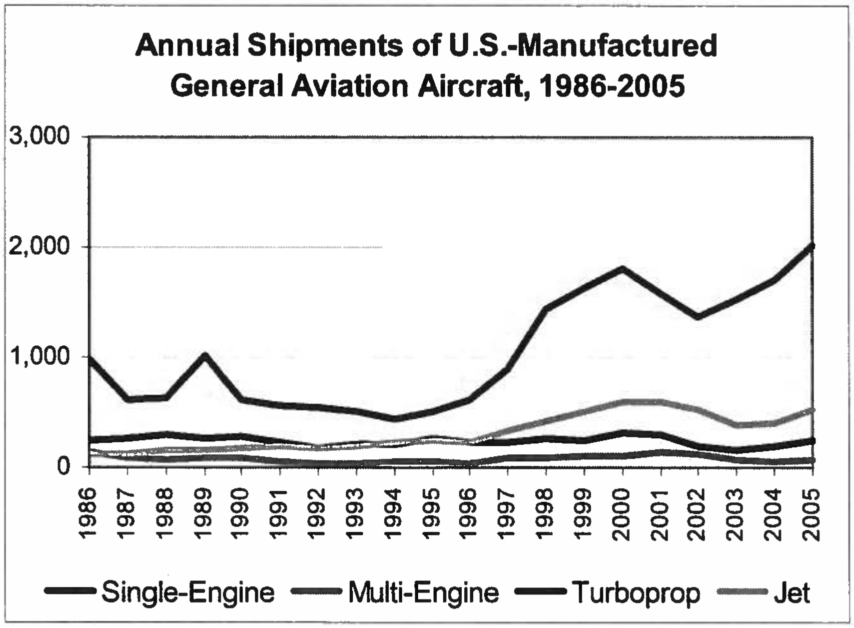
[6] See 14 CFR 119.1.

[7] In 2005, two crashes involved stolen/unauthorized use of aircraft.

The General Aviation Environment in 2005

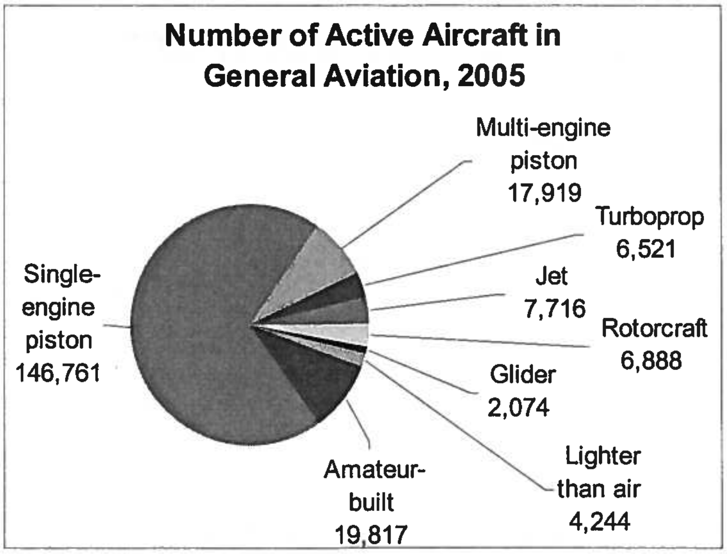
General Aviation Industry Indicators

A theme repeated throughout the annual reviews is that general aviation accident numbers should be interpreted in light of related information, such as aircraft type, type of operation, and operating environment. Because personal and business operations account for the largest percentage of general aviation flying, prevailing economic conditions and/or trends may noticeably affect both the general aviation industry and flight operations. In 2005, the general aviation climate was influenced by generally favorable economic conditions and an increase in general aviation aircraft production.



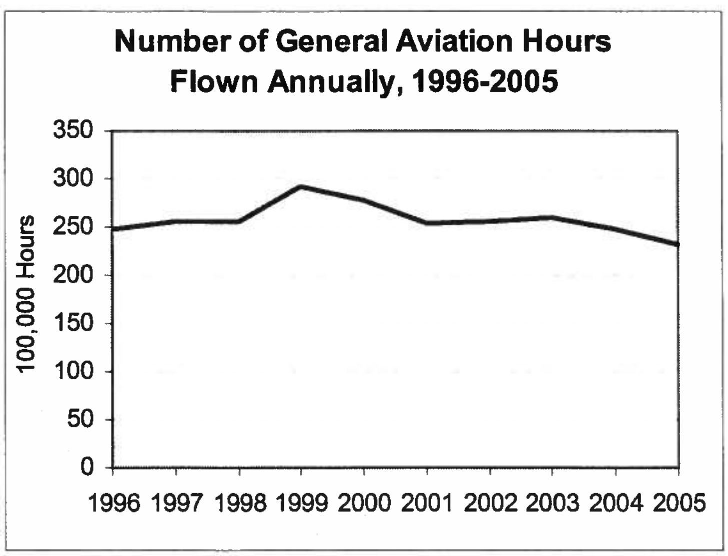
Fleet Makeup

U.S. manufacturers delivered 2,857 new general aviation aircraft in 2005, compared to an estimated 215,837 in service. Single-engine piston aircraft currently have the highest average age of all general aviation aircraft types and account for the largest percentage of the general aviation fleet. As a consequence, any structural or design improvements incorporated into newly manufactured aircraft may not be reflected in the accident record for several years. The safety benefits of improved equipment, such as avionics, are also difficult to track because most new equipment is also available for installation in older aircraft.



General Aviation Activity

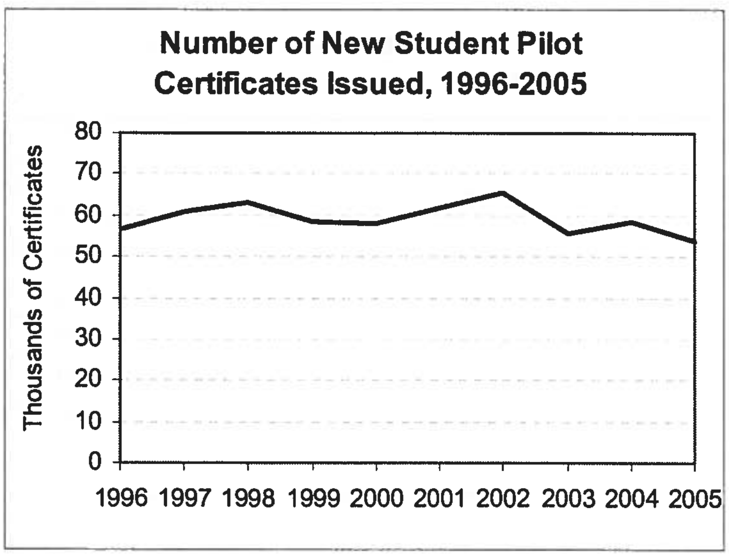
Because general aviation includes such a diverse group of aircraft types and operations, some measure of exposure must be considered to make meaningful comparisons of accident numbers. Flight activity is typically used to normalize accident numbers across different groups, with the level of activity corresponding to the level of exposure to potential accident risk. Total flight hours, departures, and miles flown are common indicators used to measure activity. As the following figure shows, annual general aviation flight hour estimates from 1996 through 2005 peaked in 1999, but were lower after that. In 2005, the estimated number of general aviation flight hours was 23.1 million, slightly lower than in 2004.



Activity data for general aviation are far less reliable than data available for commercial air carriers. Unlike Part 121 and scheduled Part 135 air carriers, which are required to report total flight hours, departures, and miles flown to the Department of Transportation (DOT),[8] operators of general aviation aircraft are not required to report actual flight activity data. As a result, activity for this group of aircraft must be estimated using data from the *GAATAA Survey*,[9] which was established in 1978 to gather information about aircraft use, flight hours, and avionics equipment installations from owners of general aviation and on-demand Part 135 aircraft. General aviation activity data are considered less reliable because a sample of aircraft is selected from the registry of aircraft owners for use in the *GAATAA Survey*, and reporting is not required.

In addition to flight-hour estimates, the number of pilots can be used to establish the level of exposure to risk for various types of general aviation. One available measure of the pilot population is the number of medical certificates issued, which represents an informal census of all active pilots. The number of medical certificates issued indicates that the total number of active U.S. general aviation pilots decreased steadily throughout the early and mid-1990s, from 692,095 in 1990 to 622,261 in 1996.

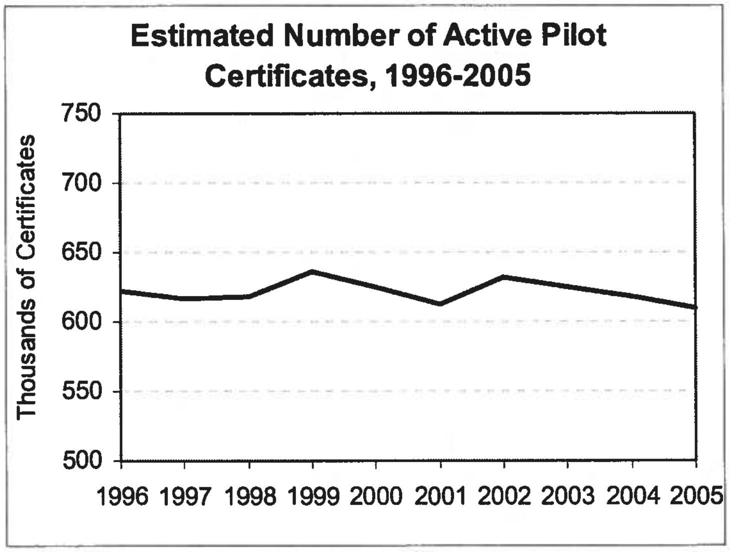
A second measure of the pilot population is the number of certificates issued to new pilots, which represents positive growth in the pilot population. As shown in the figure below, the number of new student pilot certificates fluctuated annually between 1996 and 2005.[10] The total number issued in 2005 came to 53,576, a decrease from the 58,362 issued in 2004. The figure on the next page shows that, between 1996 and 2005, the number of active pilots fluctuated, with an estimated total of 609,737 active U.S. pilots in 2005.



[8] Part 121 operators report activity monthly, and scheduled Part 135 operators report quarterly.

[9] Available at <GAATAA Survey 2005>.

[10] Available at <US Civil Airmen Statistics>.

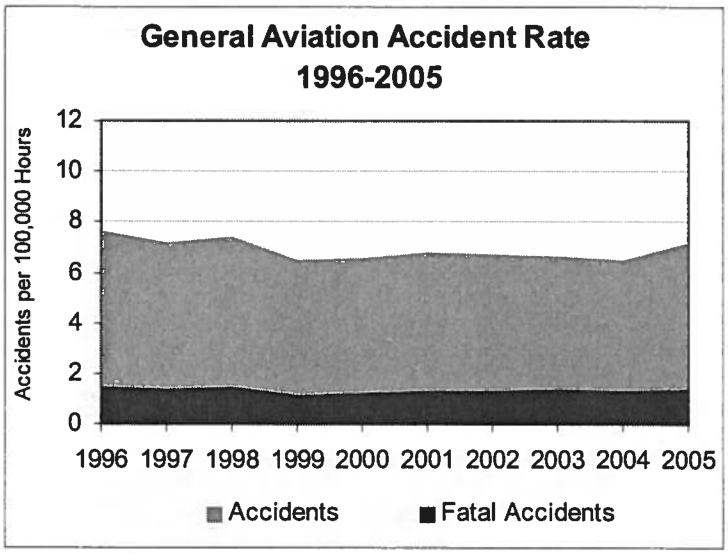


In summary, general aviation indicators—flight hours and the total number of active and newly issued pilot certificates—have fluctuated annually, with little overall change, between 1996 and 2005. Historic estimates of activity should be considered when interpreting the general aviation accident record for 2005 in the context of previous years.

Historical Trends in Accident Data

Accident Rates

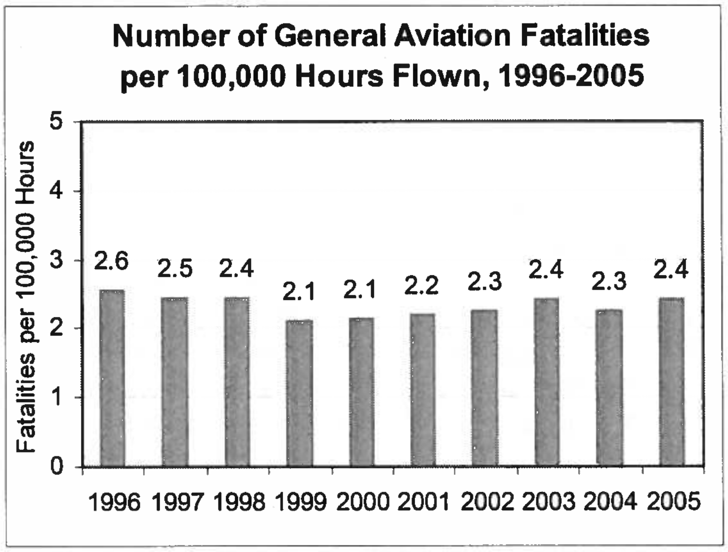
In the last decade, the calculated general aviation accident rate declined overall as annual estimates of general aviation activity increased slightly [11] without a corresponding increase in the number of accidents. The rate of 7.20 accidents per 100,000 hours flown in 2005 was lower than the 7.65 accidents per 100,000 hours recorded in 1996. In fact, the 2005 rate was only slightly higher than that of 2004, which had the lowest rate since the NTSB began reporting general aviation-only annual accident rates in 1975.[12] The 2005 rate of 1.38 fatal accidents per 100,000 flight hours was only slightly higher than the 2004 fatal accident rate of 1.26.



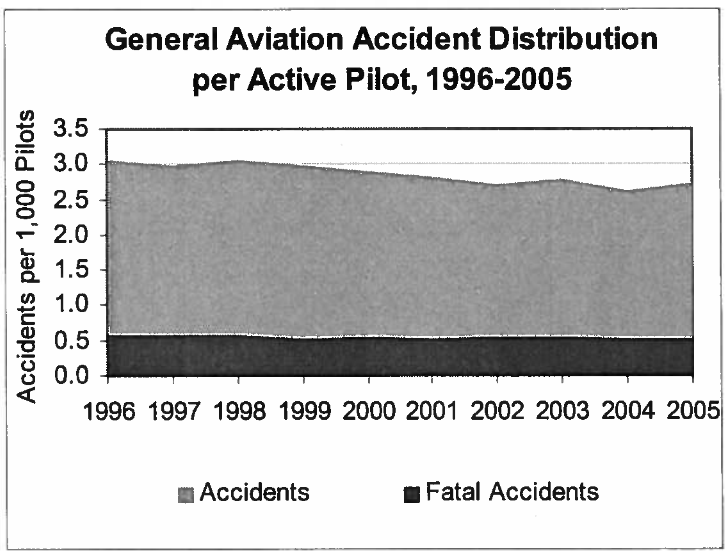
In 2005, accident-related deaths per flight hour were 2.4 fatalities per 100,000 hours flown. The highest annual fatality-per-hour rate occurred in the 10-year period was in 1996 with 2.6 deaths per 100,000 hours flown.

[11] FAA estimates of annual general aviation activity increased noticeably after 1998 due to a change in *GAATAA Survey* methodology that increased the estimated general aviation aircraft population by about 10%. See appendix A of the *GAATAA Survey, Calendar Year 2005,* for an explanation of the changes in survey methodology.

[12] Prior to 1975, scheduled 14 CFR 135 "commuter" and non-scheduled 14 CFR 135 air taxi aircraft operations were included in the NTSB's annual general aviation accident total and rate.



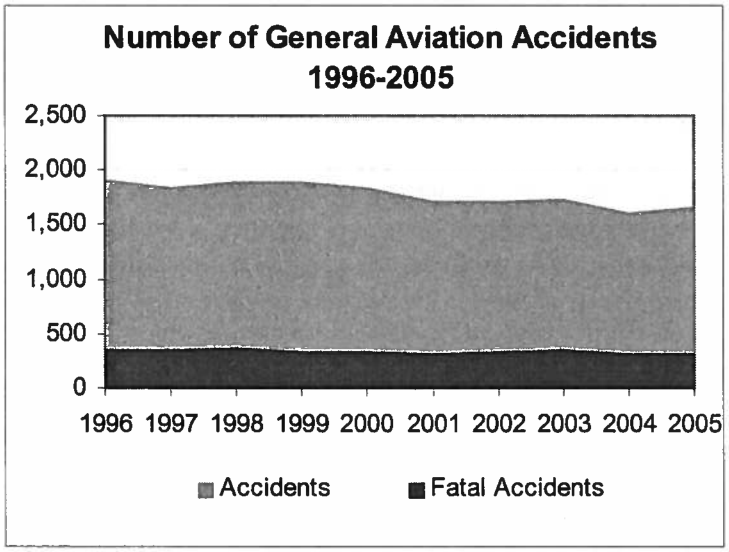
Another measure of accident distribution is the number of accidents per active pilot. Although this measure was considerably more stable from 1996 through 2005 than the per-hour accident rate, it did increase slightly overall. The per-pilot rate in 2005 was only slightly higher than the 2004 rate.



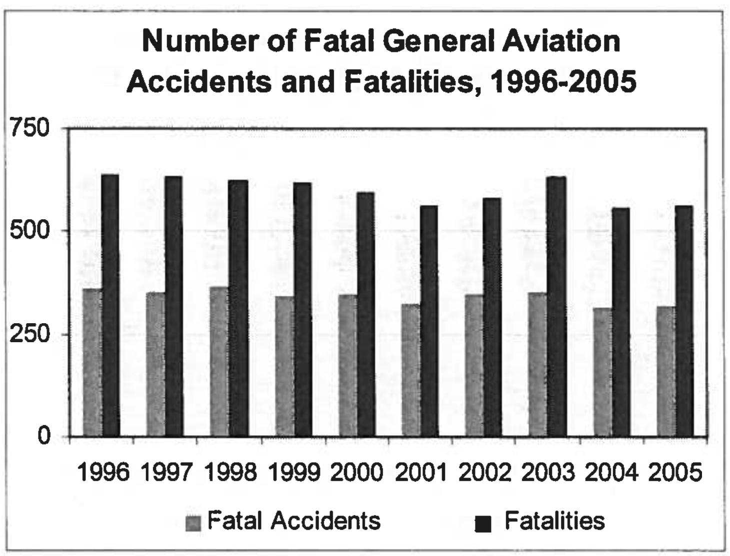
Accident rate calculations based on flight hours require the use of *GAATAA* activity data extrapolated from a relatively small sample of aircraft owners. As a result, the calculated values are accurate only to the extent that the sample represents the larger population of general aviation operators. For this reason, accident rate data presented in this review typically also include raw frequency data for comparison.

Number of Accidents and Fatalities

Despite slight fluctuations year to year, the number of general aviation accidents that occurred annually between 1996 and 2005 declined overall from 1,908 in 1996 to 1,670 in 2005, and the number of fatal accidents decreased overall, from 361 to 321.



The number of general aviation fatalities also exhibited a generally downward trend from a high of 636 in 1996 to 563 in 2005. It should be noted that 2005 continues a generally downward trend in total fatalities for the 10-year period. It should also be noted that the trend reflects a decrease in general aviation flight hours annually following the events of September 11, 2001.



Accident Rate by Type of Operation

General aviation includes a wide range of operations, each with unique aircraft types, flight profiles, and operating procedures. This diversity is evident in the accident record. However, the *GAATAA* flight data allow for only a coarse representation of the many types of general aviation operations. For some types of operations, such as public aircraft flights,[13] no activity data are available. The data presented here include four operational categories selected because they are representative of general aviation and have activity information available. The categories selected as typical of general aviation activity include personal/business flights,[14] corporate flights, aerial application, and instructional flights.

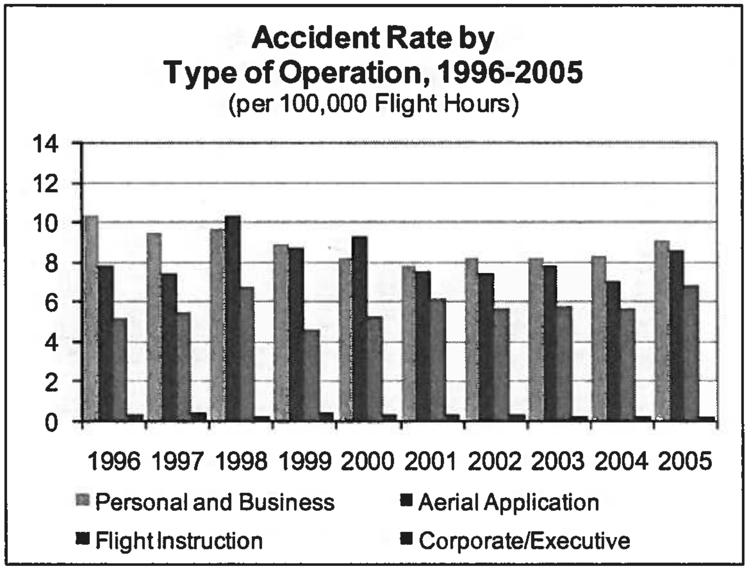
- Personal flights make up the largest portion of general aviation activity and include all flying for pleasure and/or personal transportation. Although similar to personal flights, business flights include the use of an aircraft for business transportation without a paid, professional crew. Personal and business flights are typically conducted in single- and multi-engine piston airplanes, but may include a range of aircraft including gliders, rotorcraft, and balloons.
- Corporate flights include any business transportation with a professional crew and usually involve larger, multi-engine piston, turboprop, and jet airplanes.
- Aerial application includes the use of specially equipped aircraft for seeding and for spraying pesticides, herbicides, and fertilizer. Aerial application is unique because it requires pilots to fly close to the ground.
- Instructional flights include any flight under the supervision of a certificated flight instructor.[15] Instructional flights typically include both dual training flights and student solo flights. Aircraft used for instruction are often similar to those used for personal flying. However, instructional operations are unique because they often involve the repeated practice of takeoffs and landings, flight maneuvers, and emergency procedures.

In 8 of the last 10 years, personal and business flights have had the highest average accident rate, followed by aerial application. The lowest accident rate was for corporate/executive transportation, which for the 10-year period ranked lowest overall each year.

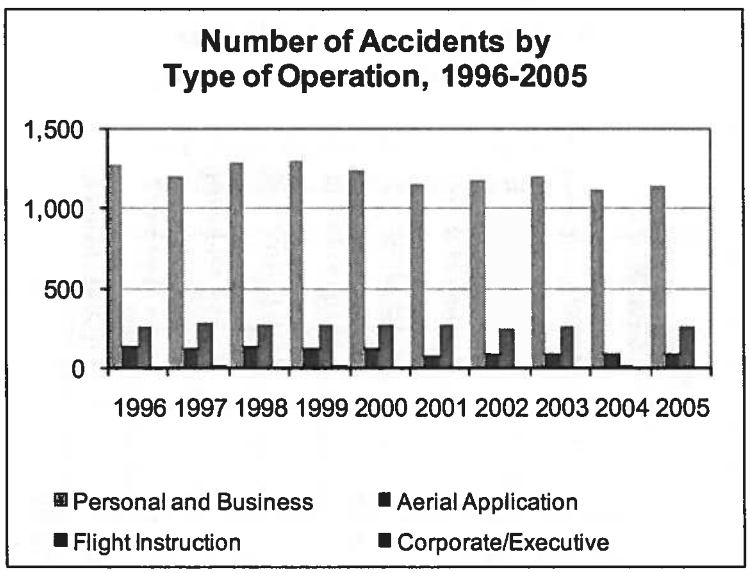
[13] The *2005 Annual Review* data include 11 public aircraft accidents, 3 of which resulted in 1 or more fatalities.

[14] Because of the difficulty of accurately distinguishing between personal and business flying for both the activity survey and the accident record, the rate presented in this review is calculated using combined exposure data (hours flown).

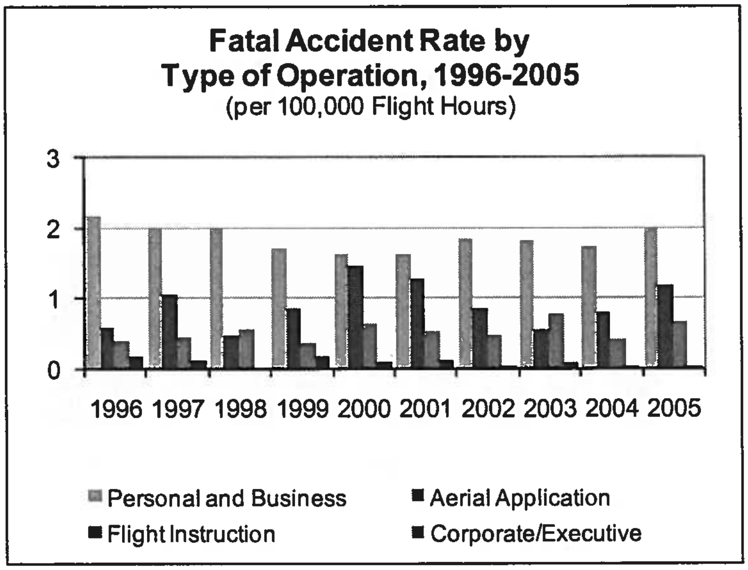
[15] See 14 CFR Part 61, subpart H, for flight instructor certificate and rating requirements.



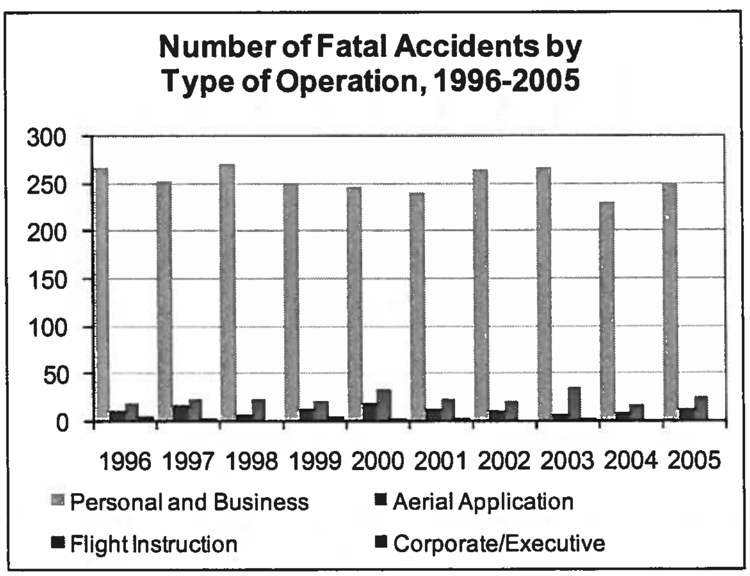
In 2005, the highest proportion of flying time was associated with personal and business operations, which accounted for the largest proportion of accidents, 68% (n = 1,134), a percentage consistent with the 10-year average. Less than 1% of the accidents (n = 7) were corporate/executive operations, 5% were aerial application (n = 88), and 15%, instructional flying (n = 248). Totals for corporate/executive accidents are barely visible when graphed in comparison to accidents involving other types of operations.



Throughout the 10-year period, the combined category of personal/business flights also had the highest fatal accident rate. Except for 2000 and 2001, the rate was typically more than double the rate for any other type of flying.



As shown in the figure above, between 1996 and 2005, an average 253 fatal accidents per year were personal/business flights, compared to an average 23 fatal accidents for instructional flights, 11 for aerial application, and 3 for corporate/executive flights. Differences in the number and rate of fatalities and injuries among types of operation are likely related to the type of aircraft and equipment, the level of pilot training, and the operating environments unique to each type of operation. The number of fatal accidents per year among each type of flight operation exhibits a distribution similar to the number of accidents; personal and business flying accounted for an average 74% of all fatal general aviation accidents and 75% of all fatal injuries for 1996 through 2005.



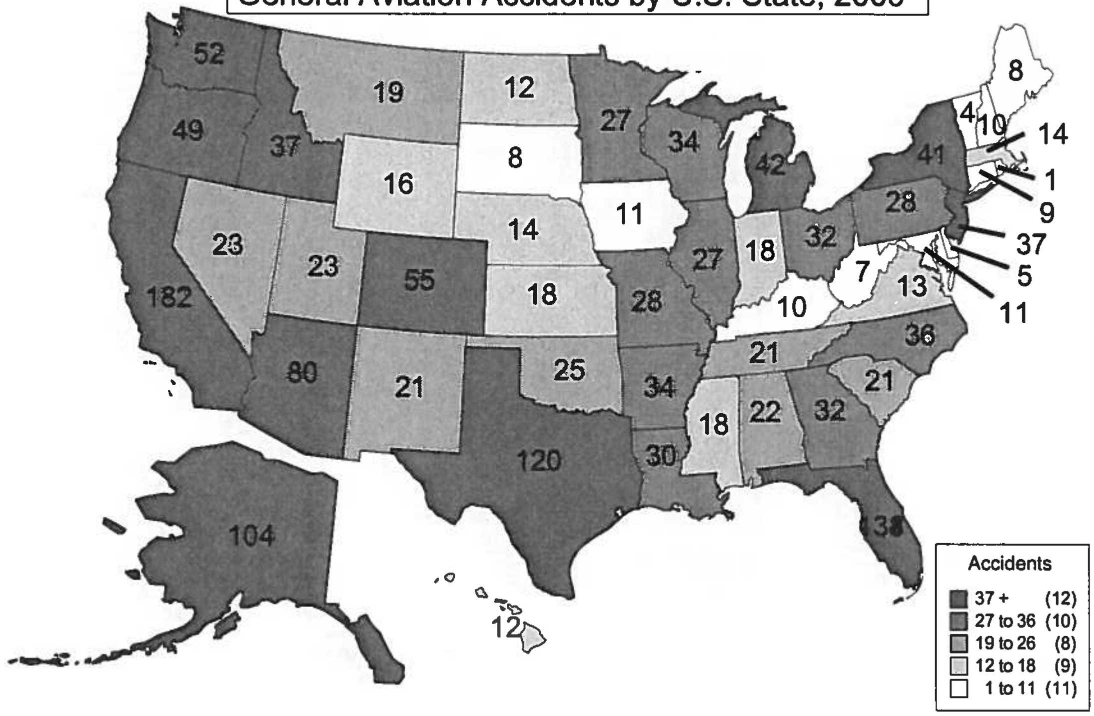
2005 In Depth

Location of General Aviation Accidents in 2005

United States Aircraft Accidents

Geographic location can contribute to general aviation accident totals because of increased activity associated with population density, increased risk due to hazardous terrain, a propensity for hazardous weather, or a concentration of particularly hazardous flight operations. The map below shows state by state the number of all general aviation accidents that occurred within the United States in 2005. Although the specific hourly activity data needed to calculate general aviation accident rates for each state are not available, some assumptions can be made about general aviation activity levels based on the size and population of each state and other factors.

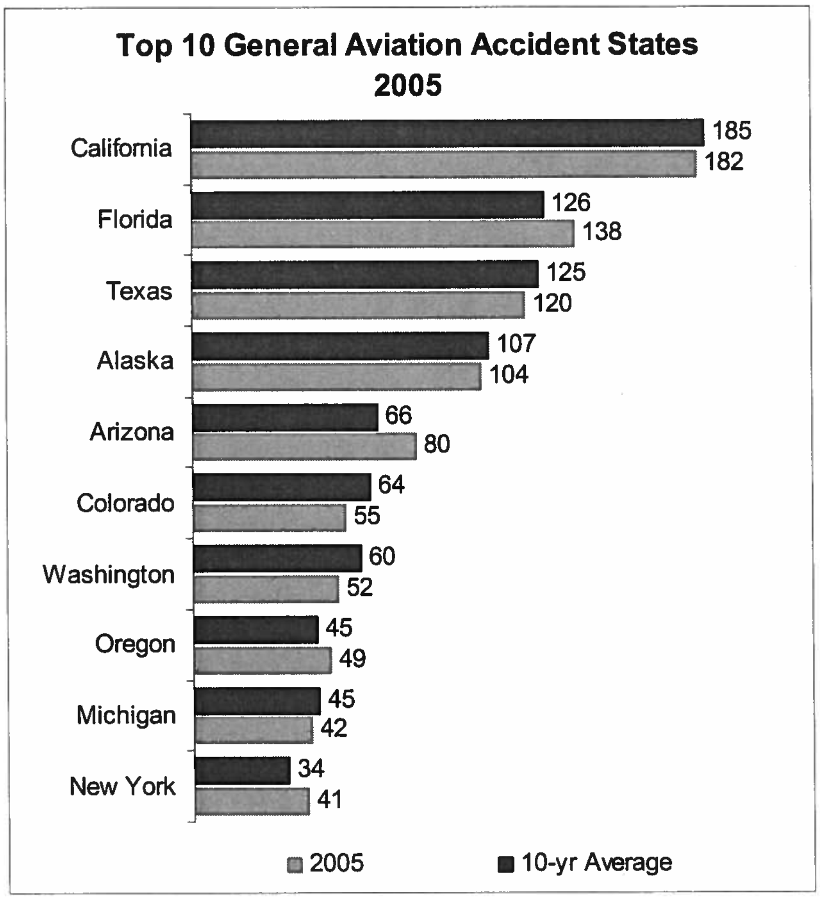
General Aviation Accidents by U.S. State, 2005



For example, California, Florida, and Texas had the greatest number of accidents in 2005. U.S. Census Bureau data[16] indicate that California had the highest state population in 2005, followed by Texas (second), and Florida (fourth). In addition, all three states have warm climates that favor year-round flying, and all three are popular travel destinations that attract general

16 U. S. Census Bureau data are available at <http://factfinder.census.gov/>.

aviation traffic from other states. These states also had the largest numbers of active pilots[17] and active aircraft.[18] These data suggest that the high number of accidents in California, Florida, and Texas are related primarily to a high level of activity. Regional differences that affect general aviation accident numbers may also include hazards unique to the local terrain and weather. For example, the operating environment, infrastructure, and travel requirements in Alaska present unique challenges[19] to aviation that are reflected in the general aviation accident record. After California, Florida, and Texas, Alaska had the most general aviation accidents in 2005. The top 10 states by number of general aviation accidents in 2005 are presented in the next figure along with the 10-year average. Note that many of the state accident totals for 2005 were below historical averages, but the distribution of accidents among states remained similar during the period.



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[17] Available at <US Civil Airmen Statistics>.

[18] Available at <GAATAA Survey 2005>.

[19] For an analysis of aviation safety in Alaska, see National Transportation Safety Board, *Aviation Safety in Alaska,* Safety Study NTSB/SS-95/03 (Washington, DC: 1995). The NTSB is also supporting an ongoing effort to identify and mitigate risk factors specific to aviation operations in Alaska; for details, see <http://www.ntsb.gov/aviation/AK/alaska_stat.html>

Foreign Aircraft Accidents

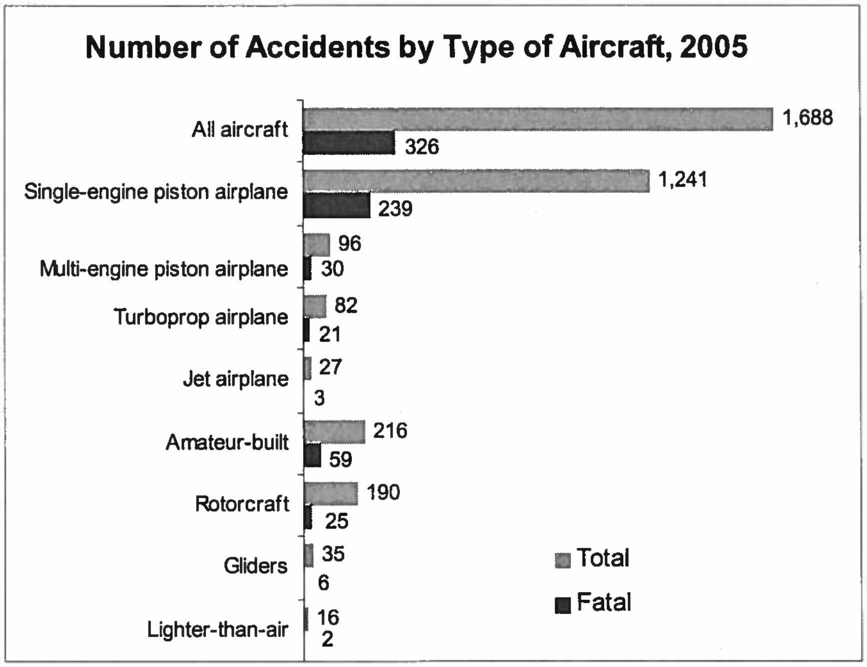
In 2005, U.S.-registered aircraft were involved in 26 accidents outside the 50 United States. Those accidents occurred in 15 different countries and territories, and in the Atlantic and Pacific Oceans. Of those accidents, 18 were fatal, resulting in 44 deaths. As expected, general aviation accidents involving U.S.-registered aircraft outside the United States usually occur in neighboring countries like Canada, Mexico, and the Caribbean island nations, but in 2005, accidents occurred as far away as Italy, South Africa, Mozambique, and Indonesia.

Accidents Involving U.S.-Registered General Aviation Aircraft Outside the 50 United States, 2005

	Number of Accidents	Number of Fatal Accidents	Number of Fatalities
Atlantic Ocean			
Left LaRoma, Dominican Republic enroute to Puerto Rico	1	1	1
Subtotal	**1**	**1**	**1**
Other Locations			
Argentina	1	1	2
Bahamas	2	1	1
Canada	7	6	11
Colombia	1	1	2
Costa Rica	2	2	11
Germany	1	1	3
Guadeloupe	1	0	0
Indonesia	1	0	0
India	1	0	0
Italy	2	1	1
Mexico	2	2	3
Mozambique	1	0	0
South Africa	1	1	5
Turks & Caicos Island	1	1	4
Venezuela	1	0	0
Subtotal	**25**	**17**	**43**
Total	**26**	**18**	**44**

Aircraft Type

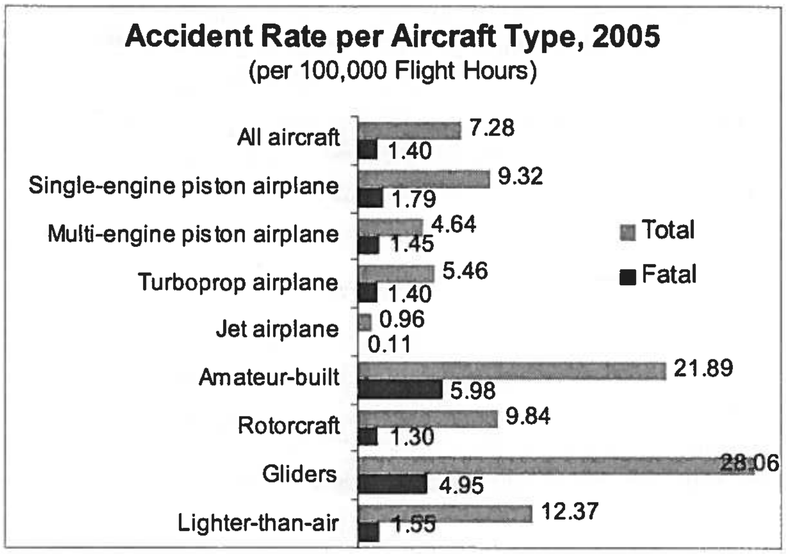
The following figure summarizes the total number of general aviation accidents and fatal accidents occurring in 2005 by aircraft type. Most notable is the large number of accidents involving single-engine piston airplanes, which accounted for 74% of all accident aircraft and 73% of all fatal accident aircraft.



In 2005, the per-aircraft accident rate for all aircraft types was 7.28 accidents and 1.40 fatal accidents per 100,000 hours flown.[20] Among fixed-wing powered aircraft, the rate for single-engine piston airplanes was 9.32 accidents and 1.79 fatal accidents per 100,000 hours flown. Amateur-built aircraft[21] had the highest accident rate among all general aviation aircraft, with 21.89 accidents and 5.98 fatal accidents per 100,000 flight hours. Rotorcraft had the second-highest rate among powered aircraft, with 9.84 accidents and 1.30 fatal accidents per 100,000 hours flown. However, glider operations had the second-highest accident rate overall, with 28.06 accidents and 4.95 fatal accidents per 100,000 hours flown.

[20] Note that the reported rates are per aircraft and differ from per-accident rates because each aircraft is counted separately for collisions. Included in the accident totals, but excluded from the associated rates, are two single-engine piston aircraft crashes with a probable cause attributed to stolen/unauthorized use.

[21] Title 14 CFR 21.191(g) provides for the issuance of a Special Airworthiness Certificate in the experimental category to permit the operation of amateur-built aircraft. Amateur-built aircraft may be fabricated from plans or assembled from a kit, so long as the *major* portion of construction is completed by the amateur builder(s).



Purpose of Flight

The type of operation or purpose of flight can be defined as the reason a flight is initiated. Activity data by purpose of flight are derived from the *GAATAA Survey,* which includes purpose/use categories. Two of these categories, air taxis and air tours, are covered under 14 CFR Part 135 and are therefore not included in this review. Another 12 include the previously mentioned categories of "personal," "business," "instructional," "corporate," and "aerial application," which together accounted for 90% of all general aviation operations during 2005. The remaining 10% are included in other, more specific categories, such as "external load" and "medical use." A limitation of the *GAATAA* activity data is that those categories provide only a coarse representation of the range of possible flight operations. For example, "personal flying" includes but does not distinguish between travel, recreation, or proficiency flying. At the same time, the differences between similar categories like "personal" and "business flying" are not easily identified. Accordingly, the purpose-of-flight information presented in this review is limited to the combined categories of personal and business flying, as well as corporate, instructional, and aerial application flights.

According to the *GAATAA Survey*, most general aviation operations are conducted for personal and/or business purposes. Of the estimated 23 million general aviation hours flown in 2005, more than half—12.5 million—were personal or business flights.[22] Accordingly, a large percentage of general aviation accidents involve personal/business flights. However, personal/business flying is still over-represented in the accident record: although this segment represented about 54% of the general aviation hours in 2005, it accounted for 68% of all general aviation accidents (n = 1,134) and 77% of all fatal accidents (n = 247).

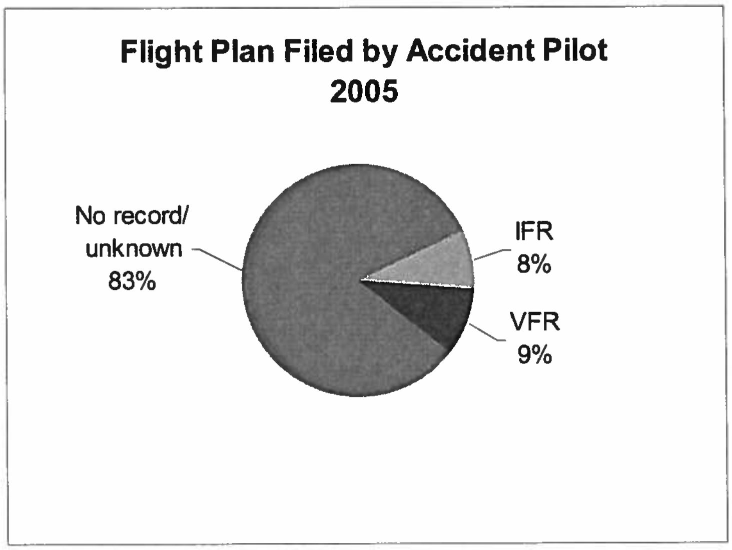
The accident rate for instructional flights is about half that of personal/business flights overall. This relatively low rate is surprising because student pilots could be expected to make

[22] See <GAATAA Survey 2005>.

more mistakes than experienced pilots. Flight instruction accidents were also less likely to be fatal. Only 10% of the flight instruction accidents that occurred in 2005 resulted in fatalities, compared to 22% of personal/business accidents. When compared with the number of hours flown, the fatal accident rate for instructional flights was 0.66 fatal accidents per 100,000 hours flown. The fatal accident rate for personal/business flights remained the highest in general aviation with 1.97 fatal accidents per 100,000 hours flown.

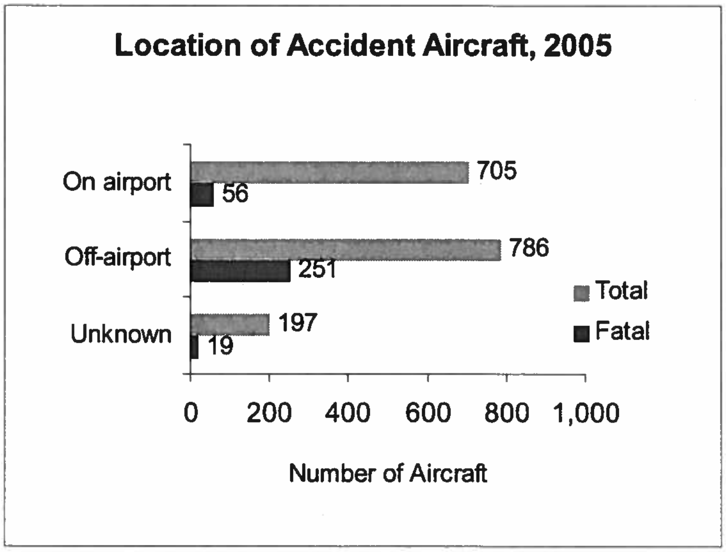
Flight Plan

In 2005, 1,688 pilots were involved in general aviation accidents, and for those pilots, 1,392 (82%) showed no record of filing a flight plan. In most cases, a flight plan is required only for flight under instrument flight rules (IFR). However, pilots operating under visual flight rules (VFR) on point-to-point flights have the option of filing a flight plan, which aids search and rescue efforts if they fail to arrive at their intended destinations.

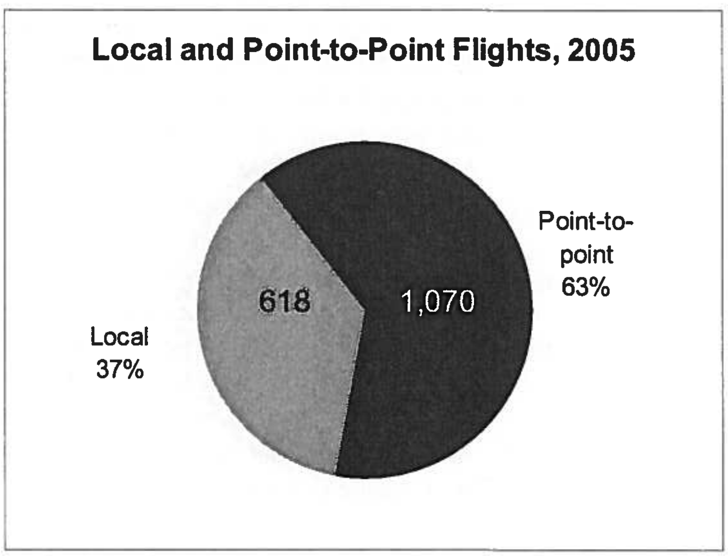


Airport Involvement

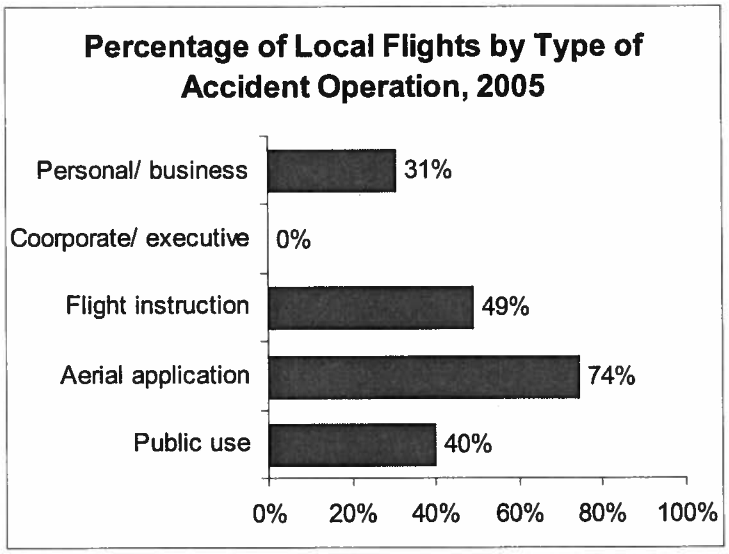
Aircraft accident locations were closely split between those occurring on airport property (42%) and those occurring away from an airport (47%). (The remaining 11% are unknown.) Comparing accident risk based on location is difficult because of the exposure differences between types of operations and types of aircraft. For example, a single-engine piston aircraft used for instructional flights will spend a large percentage of its operating time near an airport while a jet aircraft used for corporate transportation will not. However, a relationship can be observed between the location and severity of accidents. Accidents on or near an airport or airstrip typically involve aircraft operating at relatively low altitudes and airspeeds while taking off, landing, or maneuvering to land. In contrast, accidents that occur away from an airport typically involve the climb, cruise, maneuvering, and descent phases of flight, which typically occur at higher altitudes and higher airspeeds. As a result, these accidents are more likely to result in higher levels of injury and aircraft damage than accidents that occur on an airstrip or near an airport. Most fatal accidents in 2005 (78%) were located away from an airport or airstrip.



Another distinction that can be drawn between flight profiles is between local and point-to-point operations. A local flight is one that departs and lands at the same airport, and a point-to-point flight is one that lands at an airport other than the one from which it departed. Typical local flight operations include sightseeing, flight instruction, proficiency flights, pleasure flights, and most aerial observation and aerial application flights. Conversely, point-to-point flights include any operation conducted to move people, cargo, or equipment from one place to another. Typical point-to-point operations include corporate/executive transportation, personal and business travel, and aircraft repositioning flights. A comparison of the numbers of accident aircraft on local flights with those on point-to-point flights illustrates that the percentages of aircraft on point-to-point flights accounted for more accident aircraft.



The activity data necessary to compare accident rates for local and point-to-point flights are not available. However, a comparison of the percentage of local and point-to-point accident flights conducted for different purposes provides an indirect measure of the types of flying represented in both flight profiles. The following figure shows that most personal/business flights were point to point, while more than half of instructional flights were local.



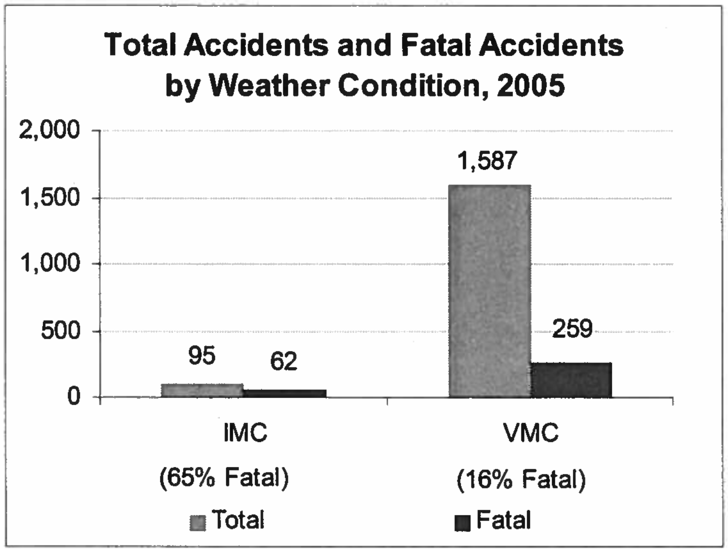
Environmental Conditions

Many hazards are unique to the type of flight operation, type of aircraft, and flight profile, but environmental conditions may be hazardous to all flight operations and all types of aircraft to some degree. Aircraft control, for example, is highly dependent on visual cues related to speed, distance, orientation, and altitude. When visual information is degraded or obliterated because of clouds, fog, haze, or precipitation, pilots must rely on aircraft instruments. Because of the difficulties associated with flying an aircraft solely by reference to instruments, the FAA has established specific pilot, aircraft, and procedural requirements[23] for flight in instrument meteorological conditions (IMC). According to the FAA *Pilot/Controller Glossary*,[24] "instrument meteorological conditions" are defined as "meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minima[25] specified for Visual Meteorological Conditions (VMC)." Weather minima differ based on altitude, airspace, and lighting conditions, but 3 statute miles visibility and a cloud clearance of 1,000 feet above, 500 feet below, and 2,000 feet horizontal distance is typical. The following figure illustrates the percentage of accidents and fatal accidents that occurred in VMC and IMC. A comparison of the percentages of accidents in each weather condition that resulted in a fatality illustrates the hazards associated with flight in IMC. In 2005, only 16% of the accidents that occurred in visual conditions resulted in a fatality, but 65% of accidents in instrument conditions were fatal.

[23] Title 14 CFR 61.579(c), 91.167-193, 91.205(d).

[24] FAA, *Pilot/Controller Glossary*, Washington, D.C., available at <FAA Pilot/Controller Glossary >.

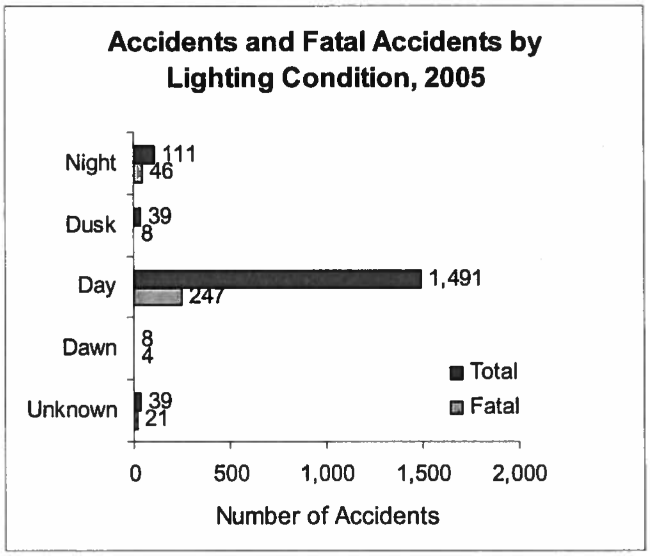
[25] Minima for visual meteorological conditions are specified in 14 CFR 91.155.



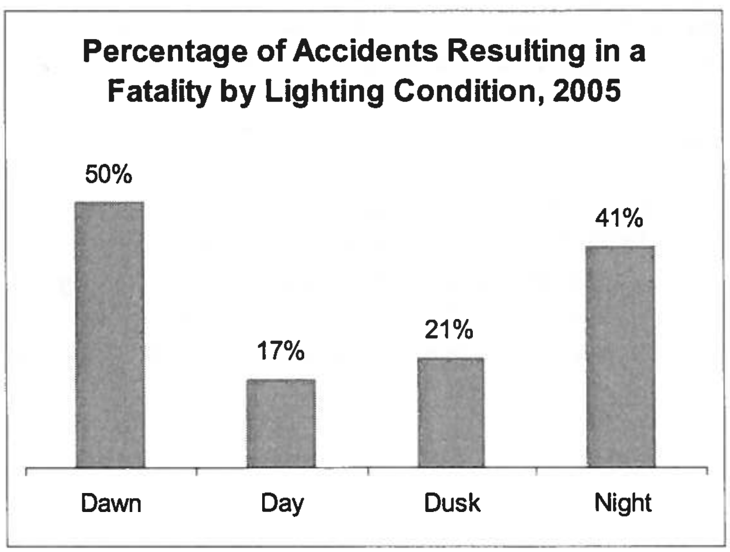
Although instrument conditions were present for only 6% of all accidents, 19% of fatal general aviation accidents in 2005 occurred in IMC. One reason for the disproportionate number of fatal accidents in IMC is that such accidents are more likely to involve pilot disorientation, loss of control, and collision with terrain or objects—accident profiles that typically result in high levels of damage and injury. Instrument conditions may also contribute to accident severity by further complicating situations that might be more easily handled in visual conditions. For example, a forced landing due to an engine malfunction or failure, which might result in minor damage if it occurred in visual conditions, might pose an even greater threat to a pilot flying in instrument conditions because reduced visibility would hinder selection of a suitable landing site.

Lighting Conditions

Lighting conditions can present a similar hazard to pilots because of physiological factors related to night vision, difficulties in seeing potential hazards such as mountains, terrain, and unlighted obstructions, and perceptual illusions associated with having fewer visual cues. The following figure illustrates that, similar to IMC, most accidents occurred in daylight conditions but a larger percentage of the accidents that occurred at night resulted in fatalities.



In fact, accidents that occurred at night were more than twice as likely as daylight accidents to be fatal. Like weather-related accidents, accidents at night are more likely to involve disorientation, loss of control, and/or collision with objects or terrain, resulting in higher levels of injury. The reduction in visual cues at night also hinders pilots from identifying deteriorating weather conditions and further complicates their ability to deal with any aircraft equipment malfunctions.

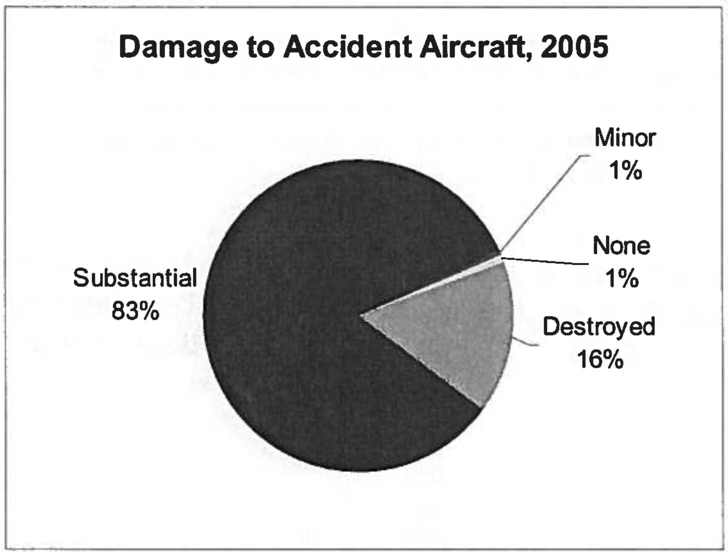


Injuries and Damage for 2005

Aircraft Damage

NTSB investigators record aircraft damage as either "destroyed," "substantial," or "minor." Title 49 CFR 830.2 defines "substantial damage" as "damage or failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component." Although not specifically defined in 49 CFR 830.2, "destroyed" can be operationally defined as any damage in which repair costs exceed the value of the aircraft,[26] and "minor" damage as any damage that is not classified as either "destroyed" or "substantial."

Nearly 8 of every 10 aircraft involved in accidents during 2005 sustained substantial damage, and about 1 in 5 accident aircraft were destroyed. "Minor" and "no damage" classifications together comprised about 1% of accident aircraft.

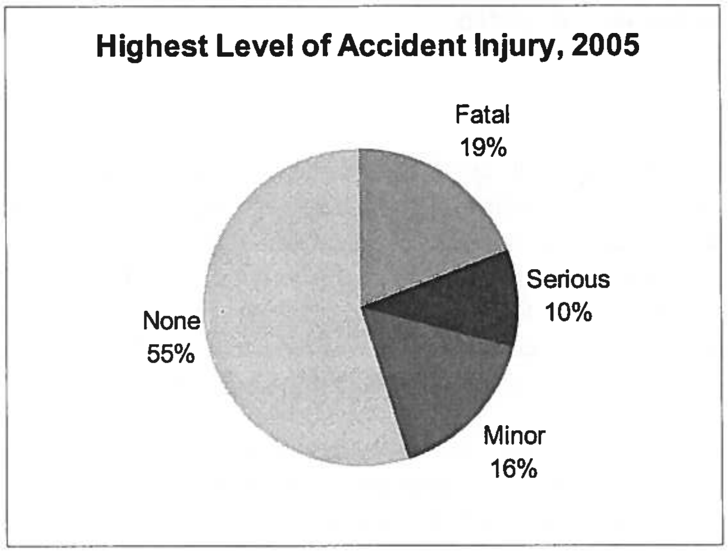


Accident Injuries

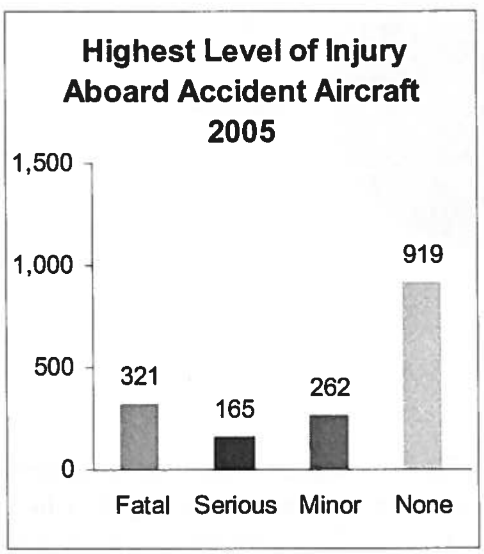
In accordance with 49 CFR 830.2, NTSB investigators categorize general aviation injuries as "fatal," "serious," or "minor." A fatal injury is defined as "any injury which results in death within 30 days of the accident." Title 49 CFR 830.2 also outlines several attributes[27] of serious injury that include, but are not limited to, hospitalization for more than 48 hours, bone fracture, internal organ damage, or second- or third-degree burns. The following figure depicts the percentage of general aviation accidents resulting in each level of injury during 2005. Most notable is the fact that more than half the accidents did not result in injury.

[26] Missing or unrecoverable aircraft are also considered "destroyed."

[27] See appendix B for the complete definition of injury categories.



The following figures illustrate both the number of accident aircraft in each injury category and the corresponding number of persons aboard those aircraft who sustained injuries in each category. Categorization of injury level in an accident is based on the highest level of injury sustained by an occupant of an accident aircraft. Again, most persons who were aboard general aviation aircraft that were involved in accidents sustained no injuries.



Injuries by Role for 2005

The distribution of general aviation accident injuries in 2005 varied with the type of operation and the size of aircraft as indicated below. The number of injuries experienced by any group of persons varied with their level of activity (that is, their exposure to risk). For example, all aircraft have a pilot, but not all have passengers on board.

General Aviation Accident Injuries, 2005

Personal injuries	Fatal	Serious	Minor	None	Total
Pilot	304	151	254	979	1,688
Copilot	15	6	9	49	79
Flight instructor	5	3	6	26	40
Dual student	12	9	11	70	102
Check pilot	2	0	2	3	7
Other crew	9	1	3	16	29
Flight attendant	0	1	0	3	4
Passenger	211	95	172	594	1,072
Total aboard	558	266	457	1,740	3,021
On ground	3	5	4	0	12
Other aircraft	2	0	1	6	9
Total	563	271	462	1,746	3,042

In 2005, 478 passengers suffered some level of injury in general aviation accidents, compared to the 739 pilots and copilots who were injured. Pilots sustained the highest percentage of injuries, suffering 54% of all fatalities, 56% of all serious injuries, and 55% of all minor injuries.

In addition to injuries sustained by persons on board the accident aircraft, 12 persons on the ground sustained injuries as a result of general aviation accidents. For example, the driver and passenger of a sport utility vehicle were fatally injured when an aircraft that was on final approach collided with their vehicle on a public roadway; a ground crewmember assisting in inflating a balloon became entangled in lines and was seriously injured; and a parachutist sustained minor injuries when a pilot approaching to land struck the parachutist.

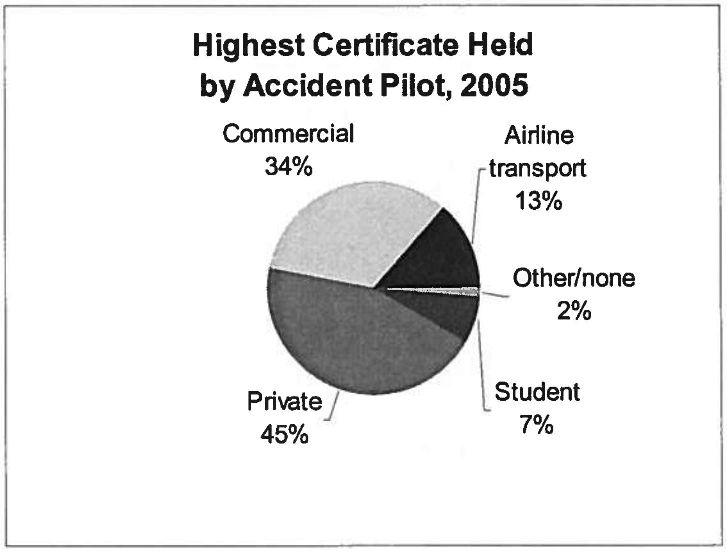
Accident Pilots

Rating

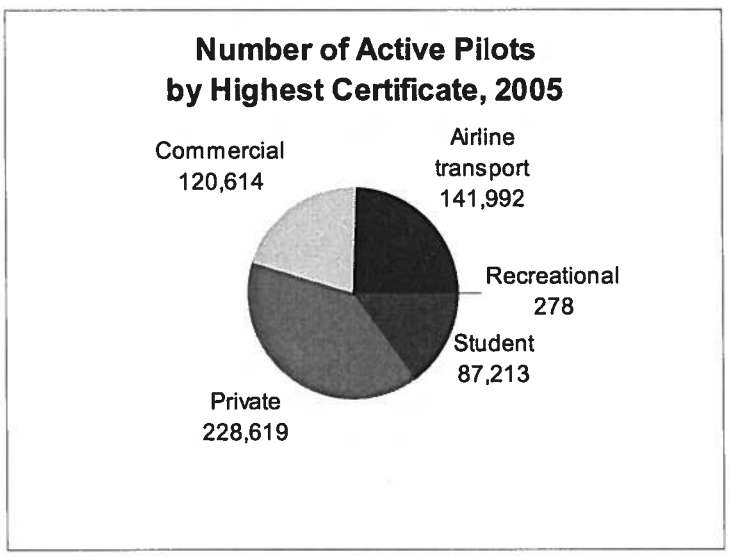
Of the 1,688 pilots involved in general aviation accidents in 2005, the largest percentage held a private pilot certificate.[28] The second-largest percentage held a commercial pilot certificate, which is required for any person to act as pilot-in-command of an aircraft for compensation or hire.[29]

[28] Available at <US Civil Airmen Statistics>.

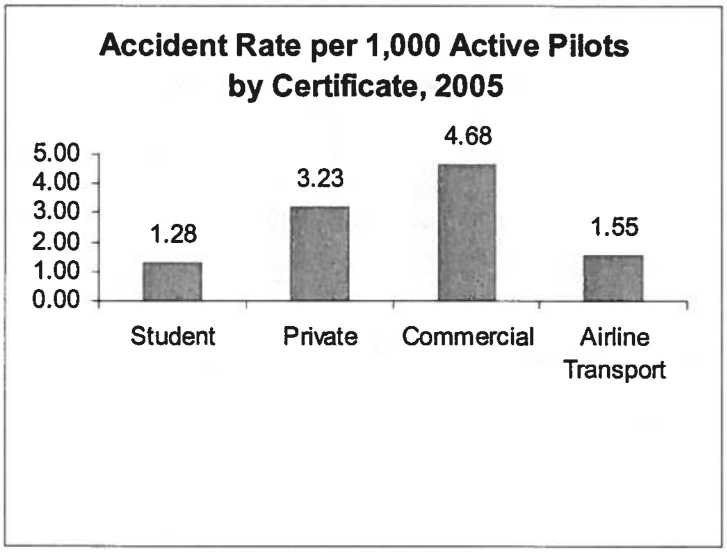
[29] See 14 CFR 61.133 for the privileges granted by a commercial pilot certificate.

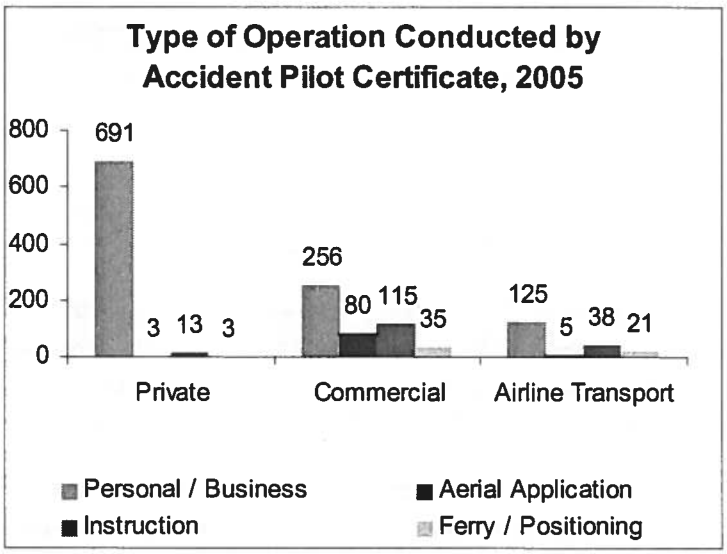


When compared to the number of active pilots in 2005 holding each type of pilot certificate, commercial pilot certificate holders were over-represented among general aviation accidents. Although commercial pilot certificate holders accounted for only 20% of all active general aviation pilots, they were involved in 34% of all general aviation accidents in 2005.



Similarly, the per-pilot accident rate was highest for commercial pilot certificate holders during 2005, with 4.68 accidents per 1,000 active pilots. One possible explanation for the higher numbers of accidents is that commercial certificate holders may be employed as pilots and would therefore be likely to fly more hours annually than student or private pilots. However, 565 commercial pilots involved in accidents during 2005 (45%) were conducting personal flights and were not involved in commercial operations at the time of the accidents.





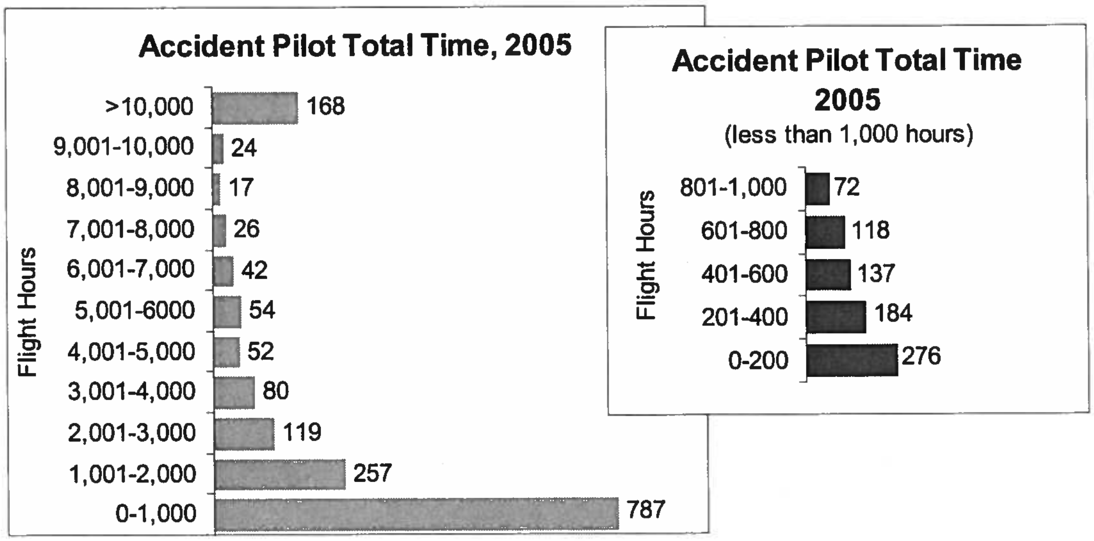
(1,660 of accident pilot records with data available, 2005)

Because annual flight-hour data are not compiled separately for pilots holding each type of certificate, it is not possible to compare activity-based accident rates. The *U.S. Civil Airmen Statistics*[30] also do not include information about the type of operation that certificate holders engage in. Examples of other commercial operations not presented in the figure above include corporate/executive transportation, sightseeing flights, banner towing, and aerial observation.

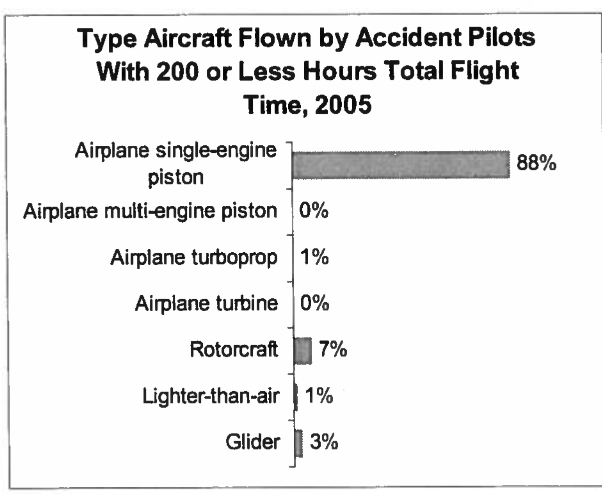
[30] Available at <US Civil Airmen Statistics>.

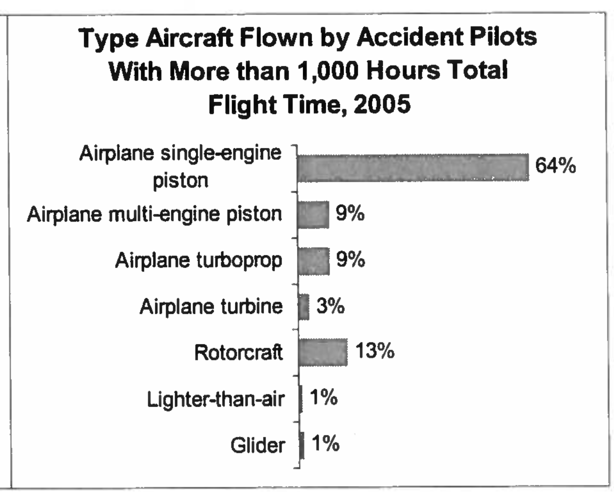
Total Time

For the 1,626 accident pilots for whom total flight experience data are available, 48% were pilots with a total flight time of 1,000 hours or less. The following figure depicts the distribution of experience among accident pilots. The inset focuses on those pilots with less than 1,000 hours. The largest percentage of accident pilots in this group had 200 hours or less of total flight time. When compared to all accident pilots with available data, about 17% of accident pilots had 200 hours of flight experience or less.



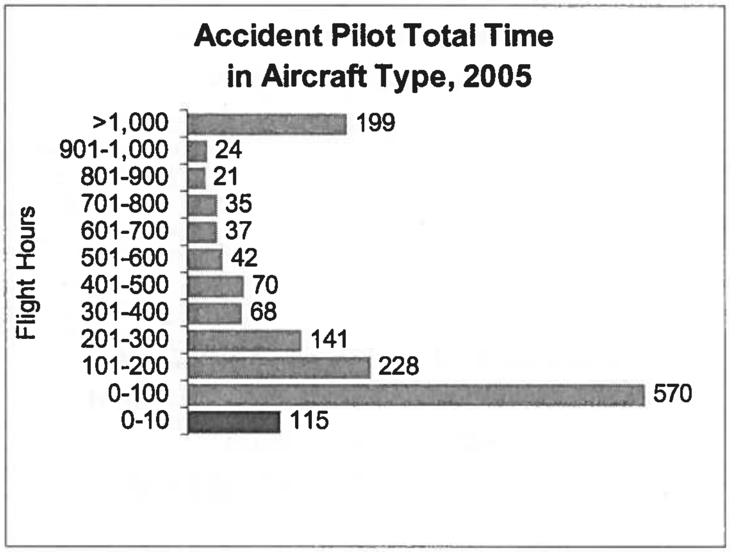
It is not surprising that 9 of 10 accident pilots with 200 hours total flight time or less were flying single-engine piston airplanes. Most accident pilots with more than 1,000 hours were also flying single-engine piston airplanes, but this group also operated a more diverse selection of aircraft—multi-engine piston, turboprop, and turbine-powered airplanes—and more than twice as many rotorcraft.





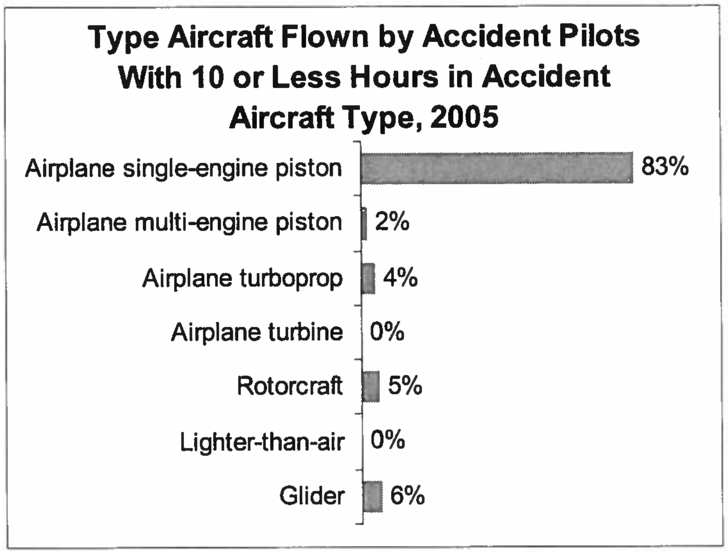
Time in Type of Aircraft

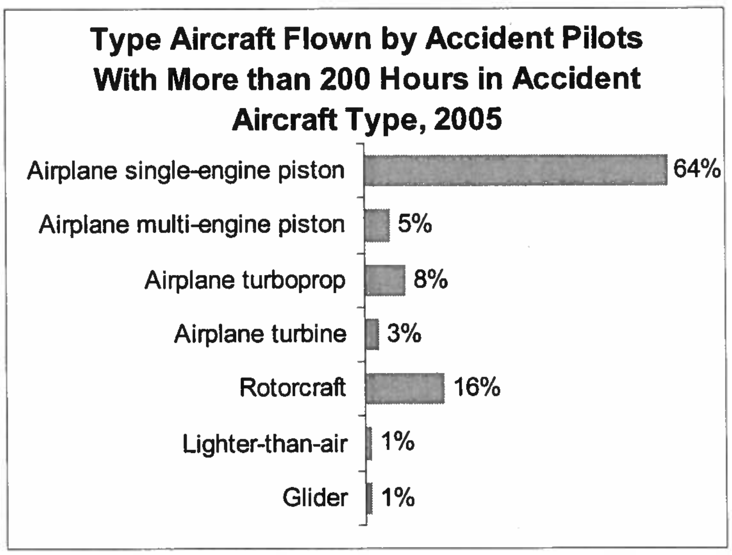
Of the 1,435 accidents in 2005 for which pertinent data are available, 40% involved pilots with 100 hours or less in the accident aircraft make and model. Of those, 115 pilots (8% of all accident pilots for whom data are available) had less than 10 hours in type. Most accident pilots with less than 10 hours of flight time in make and model were flying single-engine piston aircraft.



(1,435 accident pilot records with time in aircraft type information)

Pilots may have low time in type because they are new pilots with low total time or they are experienced pilots who are transitioning to a new aircraft. Two groups of pilots who might be expected to have accumulated significant time in make and model are those who own their own airplanes and fly them often and professional pilots who fly the same aircraft often. A large number of general aviation pilots who own aircraft have single-engine piston airplanes. Helicopters and multi-engine piston, jet, and turboprop airplanes are more likely to be operated by professional pilots. Although not specifically detailed in the figure above, it is particularly worth noting that 47 of the 115 accident pilots in 2005 who had less than 10 hours in the accident aircraft type were operating amateur-built aircraft.



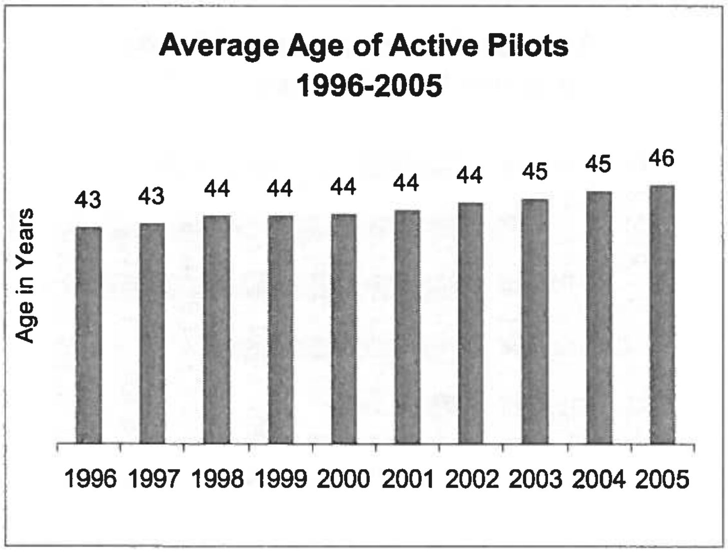


Comparison of these two graphs shows that accident pilots with more than 200 hours in make and model were more likely than pilots with fewer hours in type to be flying rotorcraft or multi-engine piston, jet, or turboprop airplanes.

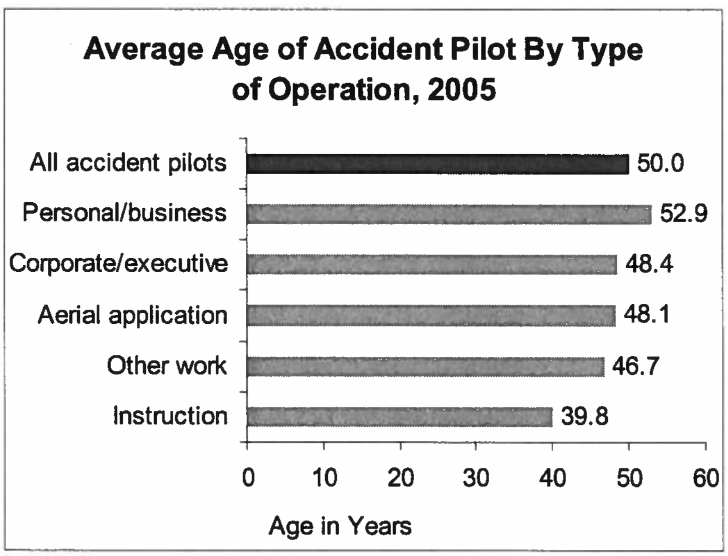
Age

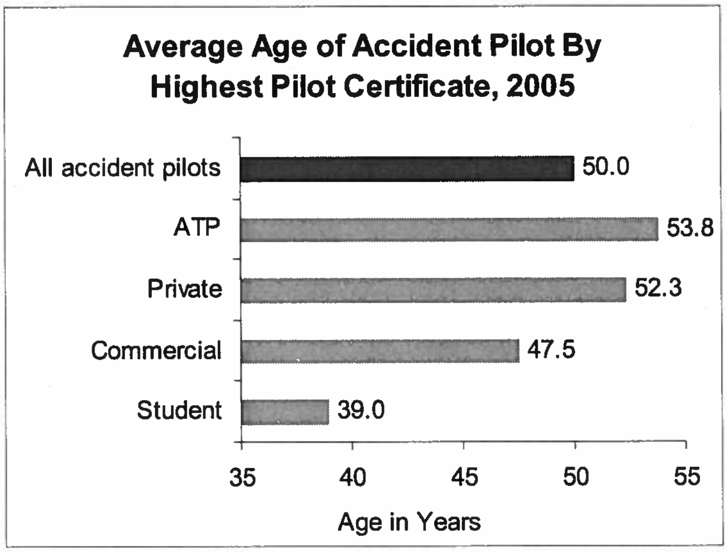
The average age of all active pilots in the U.S. increased steadily from 1996 through 2005 and by 2005 was 46[31] years. In contrast, the average age of general aviation accident pilots was 50. Despite the difference in average age, no meaningful conclusions can be made regarding specific age-related accident risk because FAA flight-hour activity numbers are not available for each age group. Age differences could be the result of activity if opportunities for recreational flying were to increase with age.

[31] Available at <US Civil Airmen Statistics>.



The two figures that follow show the relationship of the accident pilot's age by type of operation and by highest pilot certificate.





Accident Occurrences for 2005

NTSB accident reports document the circumstances of an accident as "accident occurrences" and the "sequence of events." Occurrence data can be defined as *what* happened during the accident. A total of 54 occurrence codes are available to describe the events for any given accident.[32] Because aviation accidents are rarely limited to a single occurrence, each occurrence is coded as part of a sequence (that is, occurrence 1, occurrence 2, etc.), with as many as six different occurrence codes in one accident. For accidents that involve more than one aircraft, the list of occurrences may be different for each aircraft. Of the 1,663 accident aircraft in 2005 for which data are available, 1,329 cited 2 or more occurrences, 733 cited 3 or more, 162 cited 4 or more, and 9 cited 5 or more.

The excerpt from the following brief report, which is for a 2005 accident with three occurrences, illustrates how an accident with multiple occurrences is coded. In this accident, an airplane in cruise flight at 4,000 feet lost oil pressure. The pilot reported the difficulty to air traffic control, was vectored to an airport 10 miles away, and was cleared for the descent. About 2 minutes later, the pilot reported the engine had seized and attempted a forced landing. After gliding over a field and striking trees, the aircraft impacted the ground, and a post crash fire ensued. The pilot was fatally injured. Each of these occurrences was coded in order, as shown.

[32] Two of the codes, "missing aircraft" and "undetermined," do not represent operational events.

Example of Occurrence Findings Cited in an NTSB Accident Brief, 2005

Occurrence #1: LOSS OF ENGINE POWER (TOTAL) MECH FAILURE/MALFUNCTION
Phase of Operation: CRUISE

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT – EMERGENCY

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: DESCENT – EMERGENCY

Occurrence data do not include specific information about why an accident may have happened; the first occurrence can instead be considered the first observable link in the accident chain of events. First occurrences for all 2005 general aviation accident aircraft with sequence of events data available are shown on the next page. To simplify the presentation of accident occurrence data, similar occurrences can be grouped into eight major categories.

Among the eight major categories of first occurrences, the largest percentage of accidents (26%) related to aircraft power. Among the individual occurrences, the most common involved a loss of control in flight (16%), followed closely by loss of control on the ground (13%). Although occurrences involving loss of aircraft control on the ground resulted in only 3 fatal accidents in 2005, loss-of-control occurrences in flight resulted in a total of 98 fatal accidents—more than one-quarter of all fatal accidents and more than twice that of any other single occurrence.

General Aviation Accident First Occurrences, 2005

2005 Accident First Occurrences	Total	Fatal
Collision – In-flight	**222**	**89**
In-flight Collision with Object	104	38
In-flight Collision with Terrain/Water	76	38
Midair Collision	20	10
Undershoot	22	3
Near Collision Between Aircraft	0	0
Noncollision – In-flight	**483**	**147**
Loss of Control - In-flight	270	98
Airframe/Component/System Failure/Malfunction	83	6
In-flight Encounter with Weather	88	38
Abrupt Maneuver	10	5
Vortex Turbulence Encountered	1	0
Altitude Deviation, Uncontrolled	0	0
Forced Landing	1	0
Decompression	0	0
Collision – On-Ground or Water	**95**	**0**
On Ground/Water Collision with Object	33	0
On Ground/Water Encounter with Terrain/Water	44	0
Collision Between Aircraft (Other Than Midair)	10	0
Dragged Wing, Rotor, Pod, Float or Tail/Skid	8	0
Noncollision – On-Ground or Water	**396**	**7**
Loss of Control - On Ground/Water	216	3
Hard Landing	117	1
Overrun	41	2
Nose Over	11	0
Roll Over	6	0
Propeller/Rotor Contact to Person	2	1
Propeller Blast or Jet Exhaust/Suction	0	0
Nose Down	0	0
Ditching	0	0
On Ground/Water Encounter with Weather	3	0

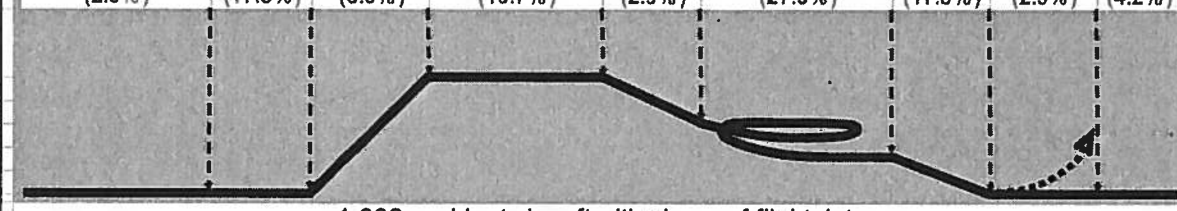
2005 Accident First Occurrences (Cont.)	Total	Fatal
Power Related	**425**	**60**
Loss of Engine Power	187	32
Loss of Engine Power(Total) - Nonmechanical	113	14
Loss of Engine Power(Total) - Mech Failure/Malf	56	8
Loss of Engine Power(Partial) - Nonmechanical	32	4
Loss of Engine Power(Partial) - Mech Failure/Malf	32	2
Propeller Failure/Malfunction	3	0
Rotor Failure/Malfunction	2	0
Engine Tear-away	0	0
Landing Gear	**35**	**2**
Gear Collapsed	11	0
Wheels-up Landing	14	2
Main Gear Collapsed	4	0
Gear Retraction on Ground	3	0
Nose Gear Collapsed	3	0
Complete Gear Collapsed	0	0
Wheels-down Landing in Water	0	0
Tail Gear Collapsed	0	0
Other Gear Collapsed	0	0
	0	0
	0	0
Miscellaneous	**33**	**2**
	23	2
	10	0
	0	0
	0	0
	0	0
	0	0
	0	0
Undetermined	**4**	**2**
Missing Aircraft	0	0
Undetermined	4	2

Phase of Flight

The following illustration displays the percentage of accident aircraft in each phase of flight at the time of the first occurrence. The phase of flight can be defined as when, during the operation of the aircraft, the first occurrence took place. Fifty distinct phases of flight are used to describe the operational chronology of occurrences. To simplify this information, the detailed phases are grouped into the nine broad categories shown. For example, the category "approach" includes any segment of an instrument approach or position in the airport traffic pattern and continues until the aircraft lands on the runway. The upper set of numbers shows the distribution of accidents by each phase associated with each first occurrence, and the numbers in parentheses show the distribution of fatal accidents by each phase associated with each first occurrence.

Accident Aircraft Phase of Flight During First Occurrence, 2005

Standing/Taxi/Other	Takeoff	Climb	Cruise	Descent	Maneuver/Hover	Approach	Go-Around	Landing
4.0%	**18.7%**	**3.2%**	**15.2%**	**3.0%**	**12.3%**	**10.9%**	**2.1%**	**30.7%**
(2.3%)	(17.8%)	(5.5%)	(19.7%)	(2.9%)	(27.5%)	(17.8%)	(2.3%)	(4.2%)

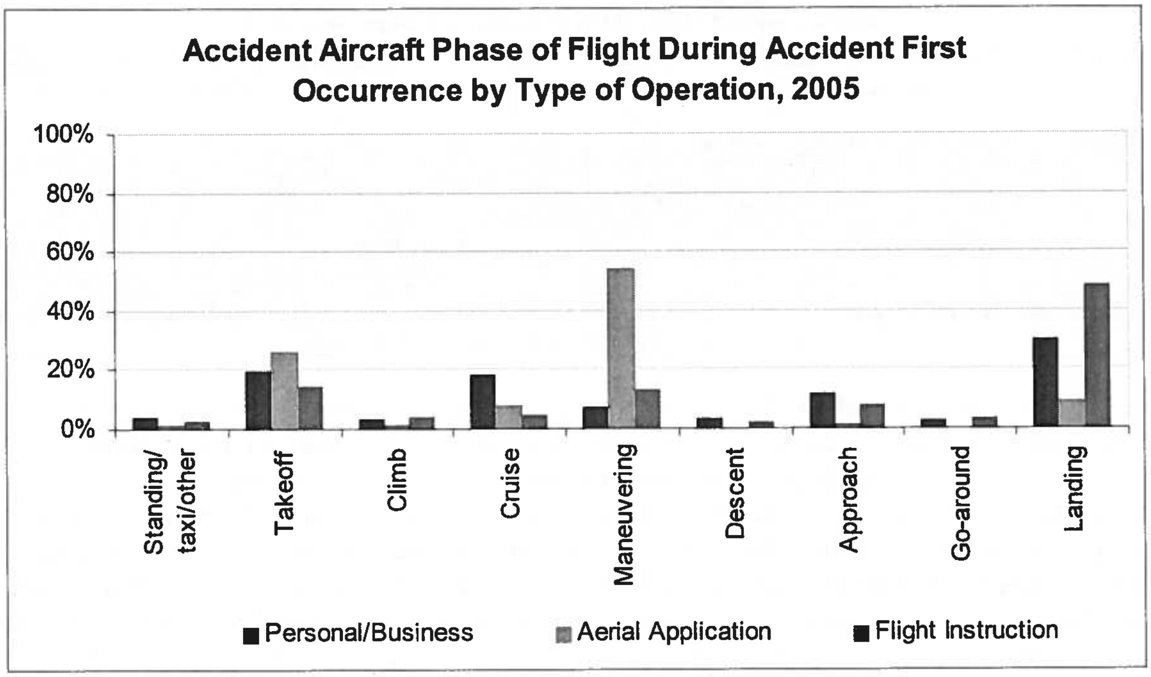


1,663 accident aircraft with phase of flight data

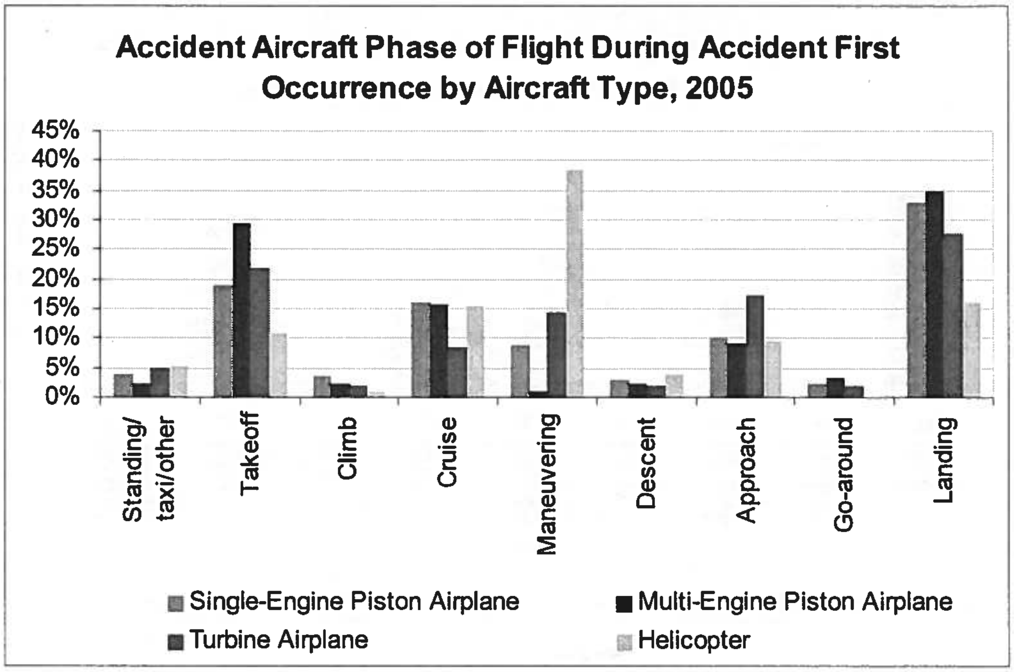
As shown here, about half of all general aviation accidents (49.4%) occurred during either takeoff or landing, despite the relatively short duration of these phases compared to the entire profile of a normal flight. This high number of accidents reflects the increased workload during takeoff and landing when the flight crew must control the aircraft, change altitude and speed, communicate with air traffic control (ATC) and/or other aircraft, and maintain separation from obstacles and other aircraft. Aircraft systems are also stressed during takeoff and landing with changes to engine power settings, the possible operation of retractable landing gear, flaps, slats, and spoilers, and changes in cabin pressurization. In addition, while the aircraft is at low altitude, it is also most susceptible to hazards caused by wind and weather conditions.

Notably, landing accounted for the largest percentage of total accident first occurrences (30.7%) of any single phase but only 4.2% of fatal accident first occurrences. The combination of cruise and maneuvering phases accounted for 47.2% of fatal accident first occurrences, but less than one-third (27.5%) of all accidents. These differences reflect the relative severity of accidents likely to occur during each phase. Accidents during cruise and maneuvering are more likely to result in higher levels of injury and aircraft damage due to higher speeds and altitudes.

The likelihood of an aircraft accident first occurrence during each phase of flight varies by aircraft type and type of operation due to the unique hazards associated with each. For example, flight instruction typically involves a lot of time practicing takeoffs and landings. As a result, about 48% of all first occurrences for 2005 involving instructional flights occurred during landing compared to 30% of personal/business flights and 9% of aerial application flights.



Similarly, accident phase-of-flight differences among aircraft types are the result of the amount of time spent in each phase, aircraft-specific hazards associated with that phase, and the type of operations typically conducted with that aircraft. For example, as the next figure shows, the largest percentage of first occurrences for accidents involving helicopter flights, about 38%, occurred while maneuvering. The percentage of accidents during this phase reflects the hazards unique to helicopters while hovering and during operations that are unique to helicopters, such as carrying external loads. In contrast, the largest percentage of accidents involving single-engine piston aircraft 33% occurred during landing. Further, takeoff accounted for 20% of accidents involving airplanes, but only 11% of accidents involving helicopters.



Chain of Occurrences

An accident's first occurrence and phase of flight during first occurrence indicate how and when an accident begins. However, the entire accident can also be viewed as a chain of all the accident occurrences cited in the order in which they happen. As previously discussed, accident events often include a combination of multiple occurrences, with many possible combinations. For example, of the 1,663 accidents that occurred during 2005 for which occurrence data are available, 405 unique combinations of accident occurrences were cited. The top ten combinations of occurrences for all accidents and fatal accidents are listed in the tables on the next page.

Occurrence chains cited in fatal accidents are similar to those cited for all accidents. Most common is loss of control followed by in-flight collision with terrain or water; almost half of those accidents are fatal. It is important to note that, although hard landing was the most frequent first occurrence in a chain of occurrences in 2005, it accounted for only 4% of all accidents for the year.

A diverse range of events can, in combination, result in an accident. Fatal accidents, however, are more likely to result from an in-flight collision, often preceded by loss of control and/or weather encounters or equipment malfunctions. For example, all of the top ten chains of fatal accident occurrences included an in-flight collision with terrain or object, events that are more likely to result in the high impact forces likely to cause serious injury. In contrast to the severity of these cases, most accidents in 2005 did not involve catastrophic events, and a large number of accidents involved aircraft on the ground that resulted in minor or no injuries.

Chain of Occurrences - All GA Accidents, 2005	
HARD LANDING during LANDING	63
LOSS OF CONTROL - IN FLIGHT during MANEUVERING followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	47
LOSS OF CONTROL - IN FLIGHT during TAKEOFF followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	40
LOSS OF CONTROL - ON GROUND/WATER during LANDING followed by ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER during LANDING	38
LOSS OF CONTROL - ON GROUND/WATER during LANDING followed by ON GROUND/WATER COLLISION WITH OBJECT during LANDING	29
LOSS OF CONTROL - IN FLIGHT during APPROACH followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	28
IN FLIGHT COLLISION WITH TERRAIN/WATER during MANEUVERING	21
LOSS OF CONTROL - ON GROUND/WATER during LANDING followed by ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER during LANDING followed by NOSE OVER during LANDING	20
LOSS OF CONTROL - IN FLIGHT during GO-AROUND followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	18
IN FLIGHT COLLISION WITH OBJECT during MANEUVERING followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	15

Chain of Occurrences - Fatal GA Accidents, 2005	
LOSS OF CONTROL - IN FLIGHT during MANEUVERING followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	32
LOSS OF CONTROL - IN FLIGHT during TAKEOFF followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	15
LOSS OF CONTROL - IN FLIGHT during APPROACH followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	14
IN FLIGHT COLLISION WITH TERRAIN/WATER during MANEUVERING	13
IN FLIGHT ENCOUNTER WITH WEATHER during CRUISE followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during CRUISE	8
IN FLIGHT COLLISION WITH TERRAIN/WATER during APPROACH	7
LOSS OF CONTROL - IN FLIGHT during GO-AROUND followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	7
IN FLIGHT COLLISION WITH OBJECT during MANEUVERING followed by IN FLIGHT COLLISION WITH TERRAIN/WATER during DESCENT	6
IN FLIGHT COLLISION WITH TERRAIN/WATER during CRUISE	6
IN FLIGHT COLLISION WITH OBJECT during APPROACH	5

Most Prevalent Causes/Factors for 2005

Probable Causes, Factors, Findings, and the Broad Cause/Factor Classification

In addition to coding accident occurrences, the NTSB makes a determination of probable cause with the objective of defining the cause-and-effect relationships in the accident sequence. The probable cause could be described as *why* the accident happened. In determining probable cause, the NTSB considers the facts, conditions, and circumstances of the event. Within each accident occurrence, any information that helps explain why that event happened is identified as a "finding" and may be further qualified as either a "cause" or "contributing factor." The term "contributing factor" is used to describe situations or circumstances central to the accident cause. The details of probable cause are coded as the combination of all causes, factors, and findings associated with the accident. Just as accidents often include a series of events, the reason why those events led to an accident may reflect a combination of multiple causes and factors. For this reason, a single accident report can include multiple cause and factor codes, as shown in the following brief.

Example of NTSB Accident Brief, 2005

Occurrence #1: IN FLIGHT ENCOUNTER WITH WEATHER
Phase of Operation: CRUISE

Findings
1. (F) WEATHER CONDITION - CLOUDS
2. (F) WEATHER CONDITION - OBSCURATION
3. (C) VFR FLIGHT INTO IMC - INADVERTENT - PILOT IN COMMAND

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: CRUISE

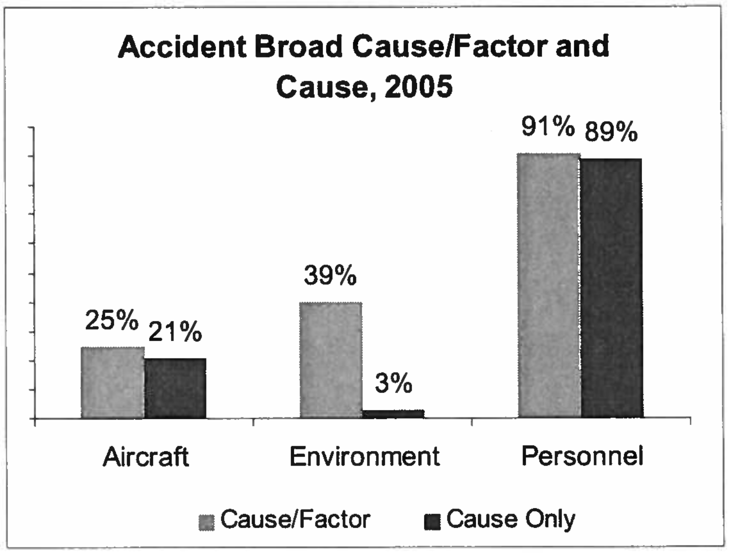
Findings
4. TERRAIN CONDITION - GROUND
5. (C) ALTITUDE/CLEARANCE - NOT MAINTAINED - PILOT IN COMMAND

Findings Legend: (C) = Cause, (F) = Factor

The National Transportation Safety Board determines the probable cause(s) of this accident as follows: the pilot's continued VFR cruise flight into instrument meteorological conditions in mountainous terrain, and his failure to maintain clearance from terrain. A contributing factor was mountain obscuration and clouds.

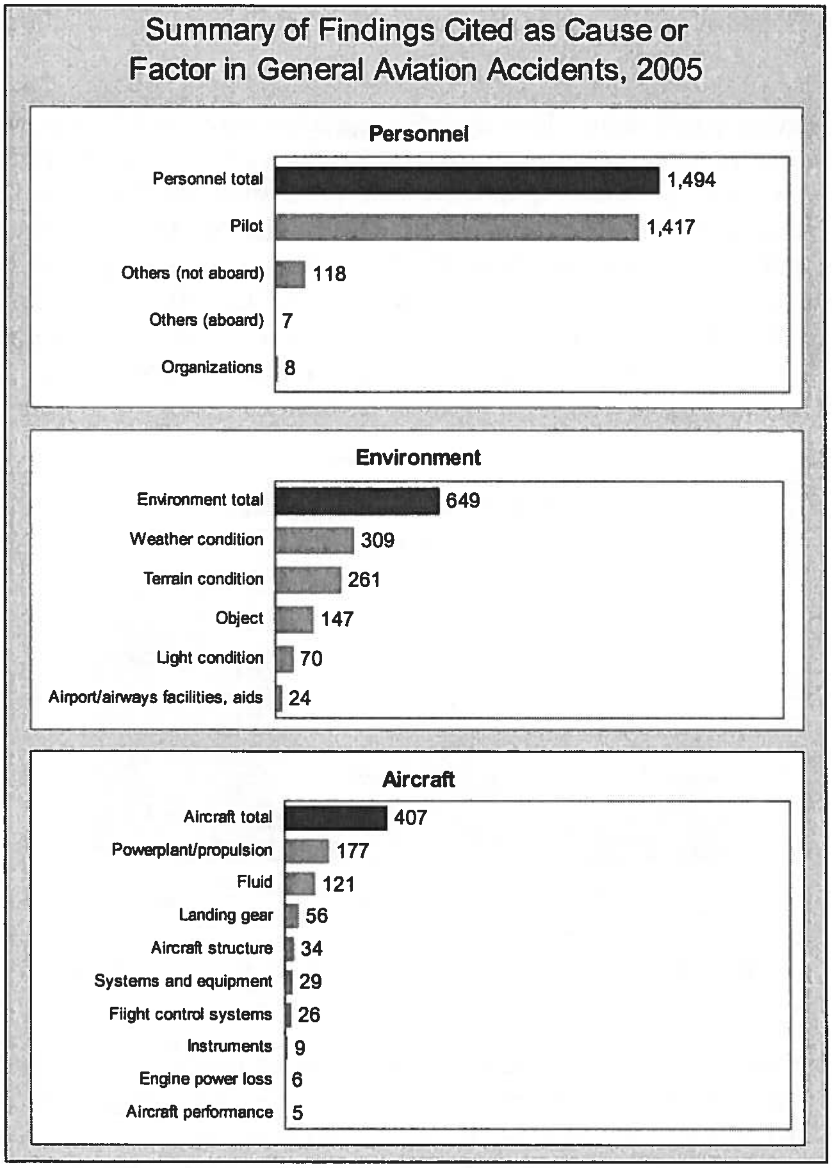
In this accident, which occurred during a cross-country flight, the pilot encountered instrument meteorological conditions (IMC), and the airplane was destroyed after impacting mountainous terrain. According to a pilot flying in the area, there were low clouds with bases between 8,500 to 9,000 feet mean sea level in the area of the accident. Scattered light snow showers were likely in the area, and terrain was mostly obscured above 8,500 feet. In this accident, the pilot's inadvertent flight into IMC and failure to maintain clearance from terrain were cited as causes. Weather was cited as a factor, and terrain condition was cited as the only finding.

To simplify the presentation of probable cause information in this review, the hundreds of unique codes used by investigators to code probable cause can be grouped into three broad cause/factor categories: aircraft, environment, and personnel. The following graph shows the percentage of general aviation accidents that fall into each category. Personnel-related causes or factors were cited in 91% of the 1,646 general aviation accident reports for 2005 for which cause/factor data were available. Environmental causes/factors were cited in 39% of these accident reports, and aircraft-related causes/factors were cited in 25%.[33]



Environmental conditions are rarely cited as an accident cause but are more likely to be cited as a contributing factor. In 2005, only 44 of 649 environmental citations (3% of all causes/factors cited) were listed as a cause, with the remainder listed as contributing factors. For example, rough terrain might be cited as a contributing factor, but not a cause, to explain why an aircraft was damaged during a forced landing due to engine failure. In that case, the origin(s) of the engine failure would be cited as cause, but the terrain would be cited as a factor because it contributed to the accident outcome. As mentioned previously, several hundred unique codes are available to document causes/factors, as summarized in the following figure (1,646 accidents with findings).

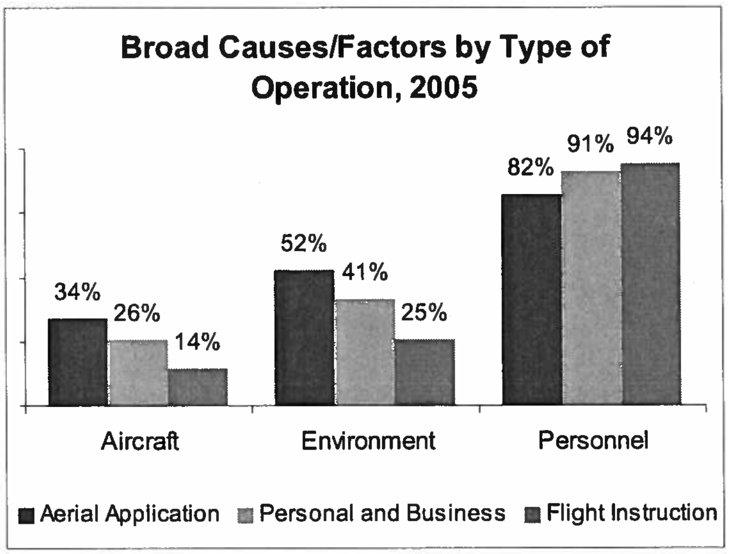
[33] Because the NTSB frequently cites multiple causes and factors for an aircraft accident, the number of causes and factors will result in a sum greater than the total number of accidents.



As this figure shows, most causes and factors attributed to general aviation accidents in 2005 were related to personnel. Much like the pilot and passenger injury differences discussed previously, part of the reason why personnel are cited so often may have to do with exposure to risk. Personnel, and pilots in particular, are associated with every flight. However, potential aircraft and environmental accident causes and factors depend on a range of variables, including the type of flight, type of aircraft, time of day, time of year, and location.

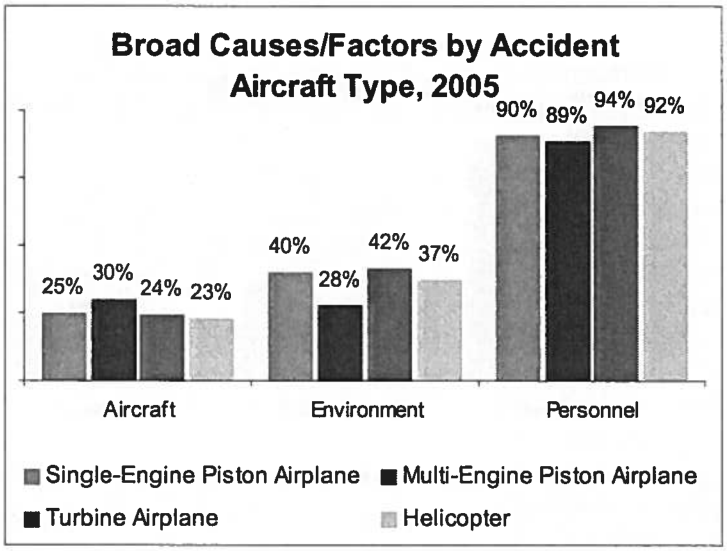
Although the pilot was the most frequently cited individual in the personnel category in 2005, other persons not aboard the aircraft were also cited as a cause or factor in 118 accidents. Such personnel included flight instructors, maintenance technicians, and airport personnel. In the broad category of environmental factors, weather conditions were cited in 309 (19%) of the accidents. Powerplant-related[34] causes/factors, cited in 177 (11%) of all general aviation accidents, were the most commonly cited aircraft factors.

The following graph shows how specific accident causes and factors varied by type of flight operation. For example, personnel were cited in 94% of instructional flight accidents and 91% of personal/business accidents, compared to 82% of aerial application accidents. The high percentage of personnel causes/factors for flight instruction accidents is likely the result of aircraft control and decision-making errors due to students' lower level of skill and ability, as well as the large amount of time practicing maneuvers like takeoffs and landings that are more likely to result in accidents. In contrast, aerial application accidents cited a higher percentage of aircraft causes/factors, most likely because the low altitude flown during spray operations allows few options for recovery in the event of a mechanical failure.



A comparison of the causes/factors cited in accidents involving different types of aircraft reveals similar results as shown in the next figure. The higher percentage of multi-engine piston accidents that cited aircraft causes/factors in 2005 is likely a result of more complex systems as compared to single-engine piston airplanes. Conversely, the high reliability of turbine engines likely contributes to the low percentage of aircraft-related findings for those aircraft. The percentage of environmental cause/factor citations drops noticeably between single- and multi-engine piston airplane accidents, and between multi-engine piston and turbine airplane accidents, mirroring progressive increases in the typical range, performance, and equipment capabilities of the aircraft.

[34] "Powerplant/propulsion" causes and factors include any partial loss or disruption of engine power, as well as the malfunction or failure of any part(s), equipment, or system associated with engine propulsion. "Engine power loss" refers only to the total loss of engine power.



Human Performance

The information recorded in the personnel category refers primarily to *whose* actions were a cause or factor in an accident. However, details about the actions or behavior that may have led to an accident, causal data related to human performance issues, and any underlying explanatory factors are also recorded. The information in these categories can be thought of as *how* and *why* human performance contributed to the accident. For example, if a pilot becomes disoriented and loses control of an aircraft after continuing visual flight into instrument flight conditions, the pilot's inability to maintain control would be cited as a "cause" in the personnel category, and planning/decision-making would likely also be cited in the human performance issues category.

Of the 1,372 accidents in 2005 with a human performance cause or factor, the most frequently cited cause/factor was aircraft handling and control (72%), followed by planning and decision-making (36%) and use of aircraft equipment (11%). Issues related to personnel qualification were cited in about 35% of the 116 accidents with underlying explanatory factors related to human performance. Examples of qualification issues that were cited in the 2005 accident record included lack of total experience, lack of recent experience, and lack of certification.

Human Performance and Explanatory Causes/Factors 2005		
	All Accidents	Fatal Accidents
Human Performance Issues	1,372	275
Aircraft handling/control	990	229
Planning/decision	489	106
Use of aircraft equipment	148	22
Maintenance	87	14
Communications/information/ATC	69	8
Meteorological service	4	4
Airport	1	0
Dispatch	0	0
Underlying Explanatory Factors	116	57
Qualification	41	18
Physiological condition	31	25
Psychological condition	25	8
Aircraft/equipment inadequate	8	1
Institutional factors	8	6
Procedure inadequate	5	4
Material inadequate	2	0
Information	1	0
Facility inadequate	1	0

Weather as a Cause/Factor

Because general aviation aircraft are usually smaller, slower, and more limited in maximum altitude and range than transport-category aircraft, they can be more vulnerable to hazards posed by weather. Adverse wind conditions, precipitation, icing, and convective weather have a greater effect on aircraft that lack the speed, altitude, and/or range capabilities to avoid those conditions. The top three environmental causes/factors cited in general aviation accidents in 2005 were all related to wind: "crosswind," "gusts," and "tailwind." Because aircraft are most susceptible to the effects of wind during takeoffs and landings, the effect of adverse wind was reflected in a high percentage of general aviation accidents that occurred during those phases of flight.

	All Accidents	Fatal Accidents
Weather Condition	309	67
Crosswind	68	1
Gusts	57	6
Tailwind	48	3
High density altitude	33	5
Low ceiling	33	30
Carburetor icing conditions	18	0
Fog	18	10
Downdraft	15	0
Icing conditions	12	5
Clouds	10	7
High wind	10	2
Obscuration	7	7
Windshear	6	0
Rain	6	4
Thunderstorm	5	4
Turbulence	5	2
No thermal lift	5	0
Snow	4	4
Variable wind	3	0
Haze/smoke	3	3
Temperature, high	2	0
Whiteout	2	1
Unfavorable wind	2	1
Dust devil/whirlwind	2	0
Turbulence, clear air (CAT)	1	0
Mountain wave	1	1
Turbulence in clouds	1	0
Thunderstorm, outflow	1	0
Below approach/landing minimums	1	1
Drizzle/mist	1	1
Microburst/dry	1	1
Other	1	0
Lightning strike	1	0

Note: due to the possibility of multiple findings, the sum of causes/factors is greater than the total number of accidents.

As previously discussed, most landing accidents do not result in fatal injuries. Because of the strong association of wind with landing accidents, it is not surprising that most wind-related accidents in 2005 were not fatal. The wind-related weather factors "gusts," "crosswind," and "tailwind" were cited as a cause/factor in 173 accidents, but only 10 of those accidents were fatal. Among fatal general aviation accidents, the three most frequently cited weather factors were related to conditions that resulted in reduced visibility, including "low ceiling," "fog," and "clouds." Accidents under conditions of low visibility typically involve either loss of aircraft control and/or collision with obstacles or terrain, both of which are likely to result in severe injuries and aircraft damage.

Focus on General Aviation Safety: Instructional Flight

This section includes statistical data and a discussion of general aviation operations involving flight instruction and associated safety issues. This section is not meant to be an exhaustive discussion of all safety concerns related to flight instruction, but rather a discussion of an issue important to general aviation. The figure below provides a summary.

General Aviation Instructional Accident Statistics, 2005	
All General Aviation Accidents	
Total Accidents	1,670
Fatal Accidents	321
Accident Aircraft	1,688
Instructional Flight Accidents	
Total Accidents	247
Accident Aircraft	247
Instructional Flight Accidents by Injury Level	
Fatal	24
Serious	15
Minor	30
None	178
Number of Accident Injuries	
Fatal	46
Serious	25
Minor	51
Persons aboard with no injuries	315
Instructional Flight Accident Aircraft Damage	
Destroyed	18
Substantial	229
Minor	0
None	0

Historical Record of Instructional Accidents

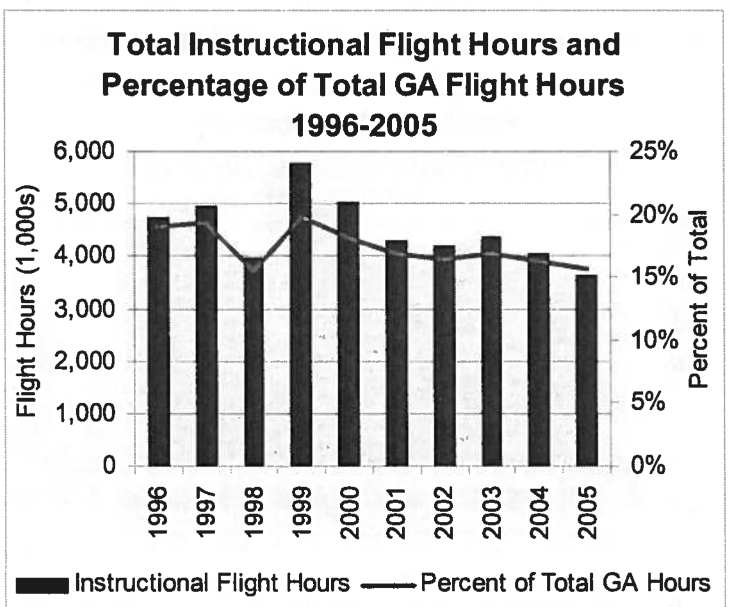
During the 10 years between 1996 and 2005, an average 14% of general aviation accidents involved instructional flight operations. Estimates of general aviation flight activity from the *GAATAA Survey* indicate that during the same period, an average of 4,500,000 of the hours flown in general aviation each year—or 17% of the general aviation total—involved flight instruction. Also during the same time period, an average of 13,700 aircraft, or 7% of the active general aviation fleet, was reported to have been used primarily for flight instruction.

What Is the Definition of Instructional Flight?

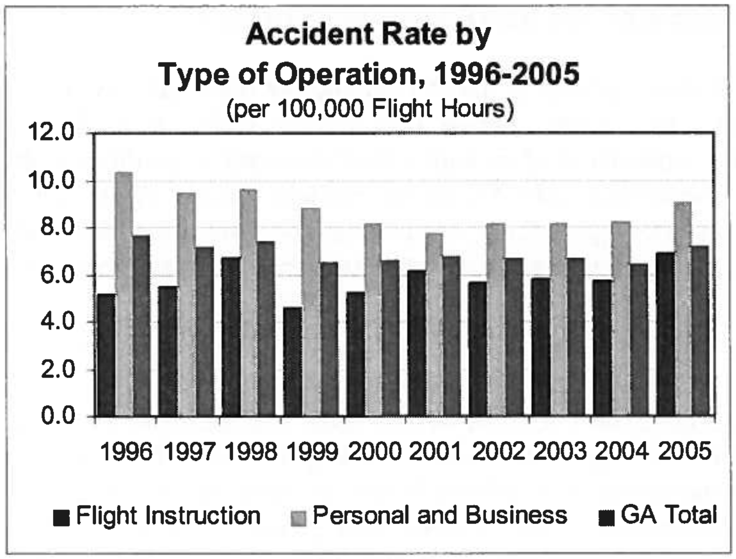
The accident data reported by the NTSB and the flight activity data reported by the FAA presented throughout this review define instructional flying to include all flight operations conducted under the supervision of an authorized instructor, regardless of the certification of the student, and any supervised solo flying by student pilots. Flight operations for personal recreation, aircraft positioning or ferry, or demonstration are not considered instructional flights for the purposes of this review, even if an authorized instructor is on board the aircraft.

Flight Activity

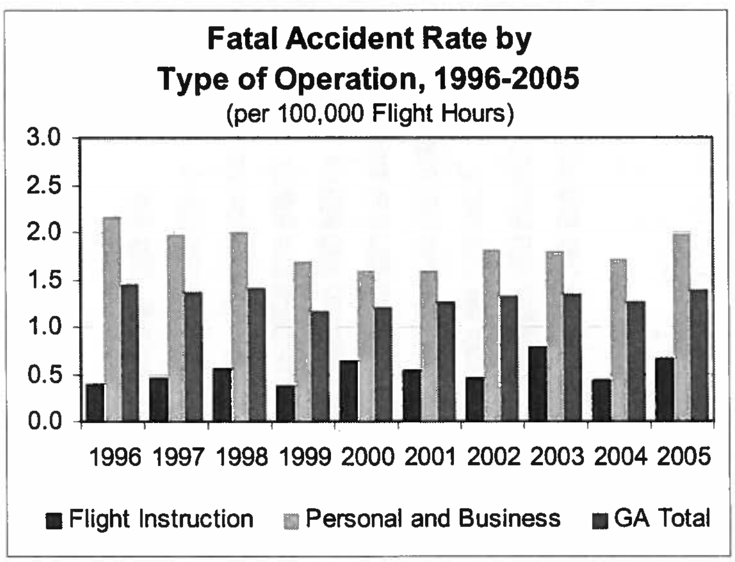
Activity data from the *GAATAA Survey* show that between 1996 and 2005, instructional flight hours, like the rest of general aviation, peaked in 1999 and decreased gradually after that. During 2005, approximately 3.6 million hours or 16% of all general aviation flight hours comprised flight instruction operations. Like most general aviation activity, instructional flights are typically conducted in single-engine piston airplanes. In 2005, approximately 2.9 million instructional flight hours (80% of the total) were flown in single-engine piston airplanes, approximately 340,000 hours (9%) in piston helicopters, and approximately 250,000 hours (7%) in multi-engine piston airplanes.



Based on the distribution of all general aviation flight hours and accidents, instructional flights have historically been safer than some other types of general aviation activities. For example, the most common type of general aviation flying—personal and business—accounted for approximately 53% of general aviation flight hours between 1996 and 2005 and 68% of the accidents while instructional flight accounted for 17% of flight hours and 14% of accidents.



In addition to having a lower total accident rate than personal/business flying and general aviation overall, instructional flights have historically been associated with a noticeably lower rate of fatal accidents. Between 1996 and 2005, instructional flights were associated with an average of 0.52 fatal accidents per 100,000 flight hours, compared to 1.83 fatal accidents per 100,000 hours for personal/business flights and 1.32 for all general aviation operations.

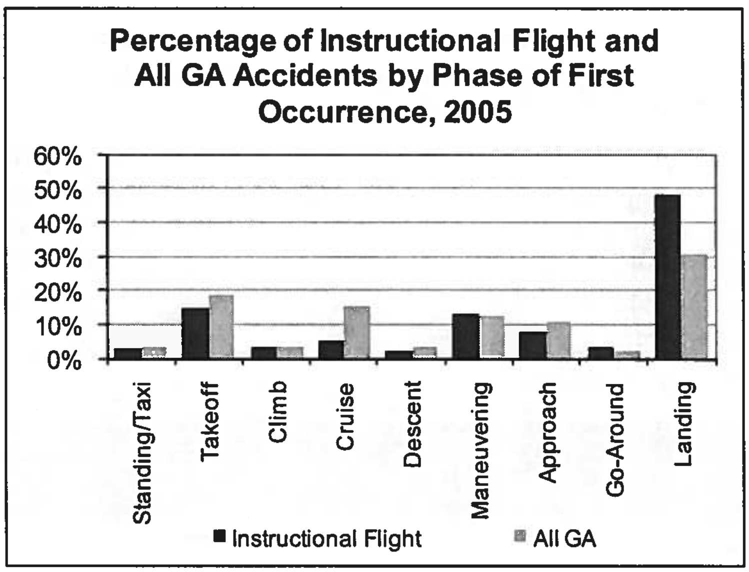


Although it may be safer than many other general aviation operations, instructional flying has unique risks associated with both the personnel and activities typically involved. For example, student pilots are in many cases acquiring new skills and may lack overall experience as pilots and/or experience with a particular type of aircraft or operation. The number and rate of instructional accidents, as well as the circumstances of those events, also reflect the operational differences associated with teaching and practicing piloting skills. Aviation is fundamentally a means of transportation, and the largest percentage of most flights is spent in the cruise phase of flight traveling from one place to another. In contrast, instructional flying typically involves a lot of time spent practicing takeoffs, landings, and maneuvers, and the differences can be observed in the distribution of accidents by phase of flight associated with the occurrence.

Finally, accident risk for instructional flights differs by aircraft category. Of the 248 instructional flight accidents during 2005, 194 (78%) involved fixed-wing airplanes and 48 (19%) involved rotorcraft. In comparison, *GAATAA Survey* data indicate that 88% of instructional hours flown during 2005 were in fixed-wing airplanes and 10% were in rotorcraft. Further, the accident rate for instructional rotorcraft flights was more than double that of airplanes: 6.08 accidents per 100,000 flight hours for airplanes and 12.69 accidents per 100,000 hours for rotorcraft.

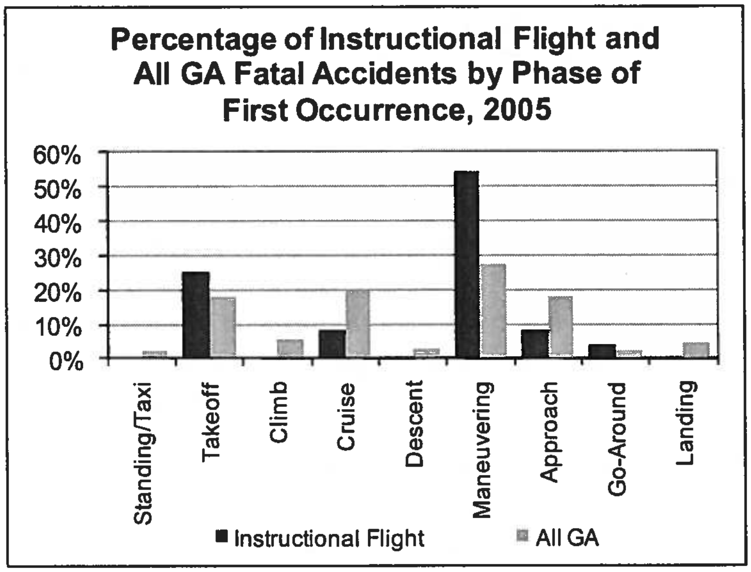
Phase of Flight

This section compares the distribution of accidents by flight phase for instructional flights and all general aviation operations. The largest percentage of instructional accidents (48%) occurred during landing, illustrating both the difficulties associated with becoming proficient at landing an aircraft and the amount of time spent practicing landings. Although prevalent, landing accidents are typically less severe than accidents that occur during other phases of flight because of the relatively slow speeds and low impact forces associated with these events. This is particularly true of instructional flying because of the slow approach speeds characteristic of the aircraft typically used for training.



The distribution of fatal accidents by phase of flight further illustrates the relationship between flight activity and resulting accidents. In 2005, the maneuvering phase accounted for more than 54% of all fatal instructional flight accidents. The maneuvering phase involves common instructional flight activities such as the practice of stalls, steep turns, and ground reference maneuvers to build pilots' proficiency with aircraft control and the management of multiple tasks. Accidents may occur during the maneuvering phase of an instructional flight if a maneuver is not executed properly or if a simulated training event results in an actual emergency.

Therefore, the types of accidents that are likely to occur during the maneuvering phase (for example, loss of aircraft control or a stall/spin) are also more likely to have severe outcomes. In contrast, typical landing accident scenarios associated with instructional flights include hard or bounced landings and maintaining directional control or correcting for wind conditions. Such events may result in dragged wingtips or damaged landing gear, but are typically not severe enough to cause fatal injury. In 2005, none of the instructional flight accidents that occurred during landing was fatal.



Accident First Occurrence

The distribution of the most common accident first occurrences further illustrates the difference between instructional flight accidents and general aviation accidents overall. As indicated by the following tables, loss of control on the ground, loss of control in flight, and hard landings accounted for 58% of instructional flight accidents during 2005, compared to only 36% of all general aviation accidents. Again, the higher percentages of loss of control on the ground and hard landings reflect the combined characteristics of the pilots and activities typically associated with instructional flights.

Five Most Frequently Cited Accident First Occurrences, 2005	Percentage of Flight Instruction Accidents	Percentage of All GA Accidents
LOSS OF CONTROL - ON GROUND/WATER	21%	13%
LOSS OF CONTROL - IN FLIGHT	19%	16%
HARD LANDING	18%	7%
AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION	5%	5%
IN FLIGHT COLLISION WITH TERRAIN/WATER	5%	5%

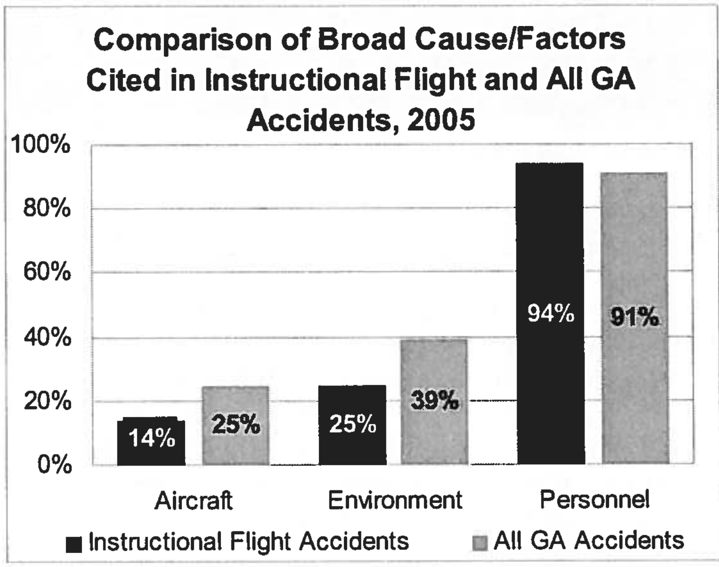
Similarly, loss of control in flight was the most commonly cited first occurrence in fatal accidents during 2005, for both instructional flying and general aviation operations overall. Instructional flying also appears to be similar to the rest of general aviation with regard to the percentage of fatal accidents associated with in-flight collisions with terrain or objects.

Five Most Frequently Cited Fatal Accident First Occurrences, 2005	Percentage of Fatal Flight Instruction Accidents	Percentage of Fatal GA Accidents
LOSS OF CONTROL - IN FLIGHT	46%	32%
IN FLIGHT COLLISION WITH TERRAIN/WATER	17%	12%
MIDAIR COLLISION	13%	3%
AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION	8%	2%
IN FLIGHT COLLISION WITH OBJECT	8%	12%

A notable difference is the high percentage of fatal instructional accidents involving midair collisions. Of the midair collisions that occurred in U.S. civil aviation between 1996 and 2005, 29% involved general aviation instructional flights, even though instructional flights accounted for less than 10% of the total civil aviation (general aviation and commercial aviation combined) flight hours during that period. Instructional flights are more likely to be involved in midair collisions in part because so many of these flights occur near airports, and because pilots and flight instructors must divide their attention between training and avoiding collisions. Pilots who are focusing on a maneuver, or instructors who are observing students, can be easily distracted from monitoring other aircraft traffic.

Accident Causes

Although some occurrences are common to all fatal general aviation accidents, the causes and factors contributing to those accidents are often different for instructional flying than for general aviation as a whole. For example, weather is often a contributing factor in fatal general aviation accidents. Loss of control and/or collision with terrain are typical outcomes when a pilot becomes disoriented during flight in IMC or inadvertently encounters clouds or reduced visibility. However, with the exception of training for an instrument rating, instructional flights are less likely than other general aviation operations to encounter weather-related hazards. Since most instructional flying is done near an airport, the risk of unexpectedly encountering hazardous weather is low. Further, several flight maneuvers commonly practiced during instructional flights, such as stalls and steep turns, are subject to minimum altitude and visibility requirements that often make it impractical to conduct some instructional flights in marginal weather conditions. This difference is illustrated in a comparison of the broad causes and factors cited in accidents during 2005. Environmental conditions were cited in only 25% percent of instructional accidents, compared to 39% of all general aviation accidents.



Dual Instruction and Supervised Solo

Instructional flying includes training both by pilots seeking additional certification or rating and certificated pilots receiving instruction to maintain currency and proficiency requirements. Flight hour requirements for initial flight instruction vary by the type of certificate or rating being pursued and whether the training is conducted by a certificated pilot school. For example, 14 CFR part 61, subpart E, prescribes the minimum aeronautical experience requirements for a private pilot certificate with single-engine airplane privileges, which include 40 hours of flight time of which a minimum of 20 hours of flight training are with an authorized flight instructor and 10 hours are supervised solo flight. The aeronautical experience requirements for certificate eligibility are similar for the recreational pilot and sport pilot certificates, with solo flight comprising approximately 10 to 25% of the required minimum.

Pilots are also required to receive additional dual flight instruction to maintain currency and to qualify for additional certificates and/or ratings. For example, to act as pilot-in-command of an aircraft, 14 CFR 61.56 requires a pilot to complete a flight review by an authorized instructor, or equivalent proficiency training or review, during the preceding 24 months. The FAA general aviation activity data do not distinguish between dual flight instruction and supervised solo, but the distribution of regulatory requirements for supervised solo by unrated pilots in comparison to the dual flight instruction requirements for all pilots suggests that supervised solo comprises a relatively small percentage of all instructional flight activity.

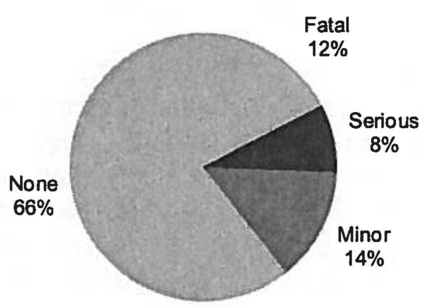
Of the 247 instructional accidents that occurred during 2005, 157 involved dual flight instruction and 90 involved supervised solo flights.

- Of those accidents involving dual flight instruction, 35 involved pilots who held a student pilot certificate and were pursuing a new or additional certificate in the category of aircraft involved in the accident.

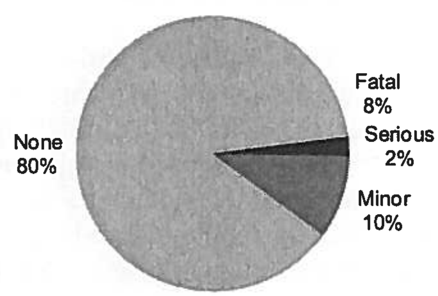
- In the accidents involving supervised solo flight, 79 of the accident pilots held only a student pilot certificate with no other certification. The remaining 11 pilots held a student pilot certificate for the category of aircraft involved in the accident, but held a private certificate or higher in at least one other aircraft category.

A comparison of the flight time requirements for certification and the high proportion of accidents involving supervised solo flights by student pilots—36% of instructional accidents—suggest that solo flights exhibit a greater risk of accident than dual instruction flights. This finding is not particularly surprising since student pilots are still acquiring the skills necessary for certification and lack total flight experience and/or experience with the aircraft they are operating. However, accidents resulting from supervised solo flights had less severe outcomes than those involving dual flights. In 2005, the percentages of accidents resulting in all levels of injury—fatal, serious, and minor—were lower for solo flights than for dual flights, which suggest differences in the circumstances of the two groups of accidents.

Distribution of Accidents by Highest Injury, Dual Instructional Flights, 2005



Distribution of Accidents by Highest Injury, Solo Instructional Flights, 2005



A further analysis of accident first occurrences, comparing dual and solo flights, illustrates that solo flights were more than twice as likely to experience the problems with loss of control on the ground and hard landings as previously discussed, while dual flights were more likely to experience in-flight loss of control or collision with terrain.

Five Most Commonly Cited Accident First Occurrences, 2005	Dual Instruction Flights		Supervised Solo Flights	
	Accidents	%	Accidents	%
LOSS OF CONTROL - IN FLIGHT	33	21%	14	15%
LOSS OF CONTROL - ON GROUND/WATER	23	14%	28	31%
HARD LANDING	19	12%	26	29%
LOSS OF ENGINE POWER	12	8%	1	1%
IN FLIGHT COLLISION WITH TERRAIN/WATER	11	7%	2	2%

Simulated Emergencies

Another difference between dual and solo instructional flights is that flight instructors must often simulate hazardous conditions to train pilots to handle in-flight emergencies. What is not readily apparent from the summary statistics is the number of instructional flight accidents that result not from external hazards but from simulated flight training scenarios going awry. For example, a simulated emergency descent due to engine failure may continue below a safe altitude, or an instructor may fail to intervene in a timely manner when a student is having difficulty maintaining aircraft control. The following narratives from 2005 illustrate training situations that resulted in accidents.

> The flight instructor was demonstrating a simulated emergency landing in a local training area with known transmission power lines. The flight instructor initiated a climb to recover from the simulated emergency landing and the airplane collided with the transmission wire. The flight instructor stated, "I simply failed to maintain a visual look out resulting in the collision with the wires."

> The certificated airline transport pilot was receiving instruction for a seaplane rating. He made three water landings in a float-equipped seaplane, and after the third landing, the flight instructor told him to climb to and maintain 100 feet. The pilot climbed the airplane to the assigned altitude, and made a left turn to a downwind leg at 80-85 knots. Once on the downwind leg, the instructor simulated an engine failure by pulling the power lever back to idle, and the pilot receiving instruction began a left turn to land into the wind. The instructor then told him to turn to the right, and subsequently joined him on the controls for the right turn. Neither pilot added power, nor the airplane "landed hard," in a descending right turn, at an estimated 45-90 degrees from the wind line. Upon landing, the left float separated from the airplane, and the airplane subsequently sank. No mechanical anomalies were noted.

A similar example of the need to balance training realism with accident risk can be observed in the history of spin training. Prior to 1949, pilot applicants were required to demonstrate spin entry and recovery for certification. However, the requirement was changed to focus on spin recognition and avoidance after a large number of fatal accidents were associated with the required spin training. A special study published by the NTSB in 1972 examined the effect of this change and found a noticeable decrease in spin accidents after the 1949 change.

Increasingly, simulators are being used for light aircraft instruction, giving general aviation pilots the training opportunities that have long been available for larger aircraft. Simulators allow pilots to safely practice scenarios that would be impractical or unsafe in a real aircraft. However, since simulator training will not replace training in the aircraft any time soon, the responsibility will continue to be on flight instructors to ensure that their training techniques do not subject their students and themselves to additional accident risk.

Conclusion

The 2005 accident record is similar to the recent history of general aviation accidents, which indicates that instructional flying is less likely than many other types of general aviation flying to result in accidents. The relative safety of instructional flight is notable considering that it involves pilots who, in many cases, are learning new skills and may lack experience in the aircraft they are flying, or in aviation in general. However, the opportunity for improvement still exists, considering that instructional flights typically have less exposure to risks like hazardous weather that often result in serious accidents for other general aviation operations. In many cases, the biggest hazards associated with instructional flying result from training techniques and procedures used by instructors. Most fatal instructional flight accidents in 2005 resulted from a loss of control or a collision with terrain while students practiced flight maneuvers or emergency procedures. Flight instructors can minimize the risks associated with training by ensuring that they do not simulate conditions that actually increase the risk of an accident and do not allow training scenarios to progress to the point that options for safe recovery are limited.

Appendix A: The National Transportation Safety Board Aviation Accident/Incident Database

The National Transportation Safety Board is responsible for maintaining the government's database on civil aviation accidents. The NTSB's Accident/Incident Database is the official repository of aviation accident data and causal factors. The database was established in 1962 and about 2,000 new event records are added each year.

The Accident/Incident Database is primarily composed of aircraft accidents. An "accident" is defined in 49 CFR 830.2 as, "an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage." The database also contains a select number of aviation "incidents," defined in 49 CFR 830.2 as, "occurrences other than accidents that are associated with the operation of an aircraft and that affect or could affect the safety of operations."

Accident investigators use the NTSB's Accident Data Management System (ADMS) software to enter data into the Accident/Incident Database. Shortly after the event, a preliminary report containing a few data elements such as date, location, aircraft operator, type of aircraft, etc. becomes available. A factual report with additional information concerning the occurrence is available within a few months. A final report, which includes a statement of the probable cause and other contributing factors, may not be completed for months until the investigation is closed.

An accident-based relational database is currently available to the public at http://www.ntsb.gov/ntsb/query.asp#query_start. It contains records of about 40,000 accidents and incidents that occurred between 1982 and the present. Each record may contain more than 650 fields of data concerning the aircraft, event, engines, injuries, sequence of accident events, and other topics. Individual data files are also available for download at http://www.ntsb.gov/avdata, including one complete data set for each year beginning with 1982. The data files are in Microsoft Access (.mdb) format and are updated monthly. This download site also provides weekly "change" updates and complete documentation.

Appendix B: Definitions

Definitions of NTSB Severity Classifications

The severity of a general aviation accident or incident is classified as the combination of the highest level of injury sustained by the personnel involved (that is, fatal, serious, minor, or none) and level of damage to the aircraft involved (that is, destroyed, substantial, minor, or none). Accidents include those events in which any person suffers fatal or serious injury, or in which the aircraft receives substantial damage or is destroyed. An event that results in minor or no injuries *and* minor or no damage is not classified as an accident.

Definitions for Highest Level of Injury

Fatal—Any injury that results in death within 30 days of the accident.

Serious—Any injury that (1) requires the individual to be hospitalized for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5% of the body surface.

Minor—Any injury that is neither fatal nor serious.

None—No injury.

Definitions for Level of Aircraft Damage

Destroyed—Damage due to impact, fire, or in-flight failures to the extent that the aircraft cannot be repaired economically.[1]

Substantial Damage—Damage or failure that adversely affects the structural strength, performance, or flight characteristics of the aircraft, and that would normally require major repair or replacement of the affected component. Engine failure or damage limited to an engine if only one engine fails or is damaged, bent fairings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered "substantial damage."[2]

Minor Damage—Any damage that neither destroys the aircraft nor causes substantial damage (see definition of substantial damage for details).

None—No damage.

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[1] Title 49 CFR 830.2 does not define "destroyed." This term is difficult to define because aircraft are sometimes rebuilt even when it is not economical to do so.

[2] See 49 CFR 830.2.

Appendix C: The National Transportation Safety Board Investigative Process

The National Transportation Safety Board investigates every accident that occurs in the United States involving civil aviation and public aircraft flights that do not involve military or intelligence agencies. It also provides investigators to serve as U.S. Accredited Representatives as specified in international treaties for aviation accidents overseas involving U.S.-registered aircraft or involving aircraft or major components of U.S. manufacture.[1] Investigations are conducted from NTSB Headquarters in Washington, D.C. or from one of the regional offices.[2]

In determining probable cause(s) of a domestic accident, investigators consider the facts, conditions, and circumstances of the event. The objective is to ascertain those cause and effect relationships in the accident sequence about which something can be done to prevent recurrence of the type of accident under consideration.

Note the distinction between the population of accidents investigated by the NTSB and those that are included in the *Annual Review of Aircraft Accident Data, U.S. General Aviation.* Although the NTSB is mandated by Congress to investigate all civil aviation accidents that occur on U.S. soil (including those involving both domestic and foreign operators), the *Annual Review* describes accidents that occurred among U.S.-registered aircraft in all parts of the world.

BY THE NATIONAL TRANSPORTATION SAFETY BOARD

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Acting Chairman

KATHRYN O'LEARY HIGGINS
Member

DEBORAH A. P. HERSMAN
Member

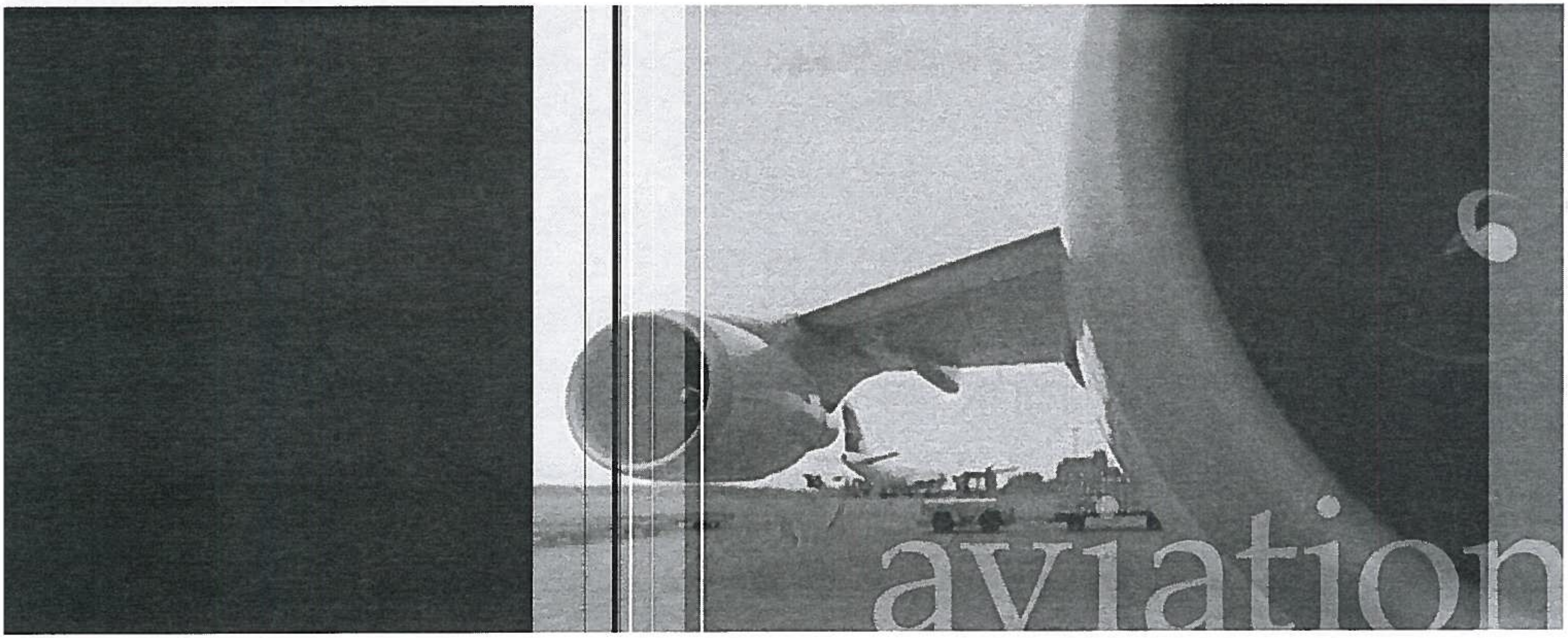
ROBERT L. SUMWALT
Member

Adopted: May 26, 2009

[1] For more detailed information about the NTSB's investigation of aviation accidents or incidents, see 49 CFR 831.2.

[2] For locations of NTSB offices, see <http://www.ntsb.gov/Abt_NTSB/regions/aviation.htm>.

Annual Review of Aircraft Accident Data
U.S. General Aviation, Calendar Year 2004



ANNUAL REVIEW OF AIRCRAFT ACCIDENT DATA

NTSB/ARG-08/01
PB2009-101761

National Transportation Safety Board

Annual Review of Aircraft Accident Data

U.S. General Aviation, Calendar Year 2004

NTSB/ARG-08/01
PB2009-101761
Notation 7534F
Adopted May 28, 2008

National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2008. *U.S. General Aviation, Calendar Year 2004.* Annual Review of Aircraft Accident Data NTSB/ARG-08/01. Washington, D.C.

Abstract: The National Transportation Safety Board's *2004 Annual Review of Aircraft Accident Data for U.S. General Aviation* is a statistical compilation and review of general aviation accidents that occurred in 2004 involving U.S.-registered aircraft. As a summary of all U.S. general aviation accidents for 2004, the review is designed to inform general aviation pilots and their passengers and to provide detailed information to support future government, industry, and private research efforts and safety improvement initiatives.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

Recent publications are available in their entirety on the Web at <http://www.ntsb.gov>. Other information about available publications also may be obtained from the Web site or by contacting:

National Transportation Safety Board
Records Management Division, CIO-40
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594
(800) 877-6799 or (202) 314-6551

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Contents

2004 General Aviation Accident Summary

A total of 1,619 general aviation accidents occurred during calendar year 2004, involving 1,635 aircraft.[1] The total number of general aviation accidents in 2004 was slightly lower than in 2003, with a 7% decrease of 121 accidents. Of the total number of accidents, 314 were fatal, resulting in a total of 559 fatalities. The number of fatal general aviation accidents in 2004 decreased 11% from calendar year 2003, and the total number of fatalities decreased by 12%. The circumstances of these accidents and details related to the aircraft, pilots, and locations are presented throughout this review.

2004 General Aviation Accident Statistics

General Aviation Accidents	
Total accidents	1,619
Fatal accidents	314
Accident aircraft	1,635
General Aviation Accident Injuries	
Fatal	559
Serious	266
Minor	425
Persons involved in accidents with no injuries	1,972
General Aviation Accident Rate	
General aviation hours flown[a]	24,888,000
All accidents[b]	6.49/100,000 hours
Fatal accidents[b]	1.26/100,000 hours
Accidents per active pilots	2.62/1,000 active pilots
Fatal accidents per active pilots	0.51/1,000 active pilots

[a] Federal Aviation Administration, *General Aviation and Air Taxi Survey, 2004.*
[b] Excludes events involving suicide, sabotage, and stolen/unauthorized use

[1] In this review, a collision between two aircraft is counted as a single accident. The 11 midair collisions that occurred in 2004 involved 22 general aviation aircraft. In addition, 5 ground collisions involved 10 general aviation aircraft.

INTRODUCTION

Purpose of the Review

The National Transportation Safety Board's *2004 Annual Review of Aircraft Accident Data for U.S. General Aviation* is a statistical compilation and review of general aviation accidents that occurred in 2004 involving U.S.-registered aircraft. As a summary of all U.S. general aviation accidents for 2004, the review is designed to inform general aviation pilots and their passengers about trends in general aviation safety and to provide detailed information to support future government, industry, and private research efforts and safety improvement initiatives.

For this review, the Safety Board extracted accident data from the Board's Aviation Accident/Incident Database.[2] Activity data were extracted from the *General Aviation and Air Taxi Activity and Avionics Survey* (*GAATAA Survey*)[3] and from *U.S. Civil Airmen Statistics*,[4] which are published by the Federal Aviation Administration (FAA), Statistics and Forecast Branch, Planning and Analysis Division, Office of Aviation Policy and Plans. Additional information was extracted from the *General Aviation Statistical Databook*, published by the General Aviation Manufacturers Association (GAMA).

What Is General Aviation?

General aviation can be described as any civil aircraft operation that is *not* covered under 14 *Code of Federal Regulations* (CFR) Parts 121, 129, and 135, commonly referred to as commercial air carrier operations.[5]

Which Operations Are Included in this Review?

This review includes accidents involving U.S.-registered aircraft operating under 14 CFR Part 91, as well as public aircraft[6] flights that do not involve military or intelligence agencies. Aircraft operating under Part 91 include aircraft that are flown for recreation and personal transportation and certain aircraft operations that are flown with the intention of generating revenue,[7] including business flights, flight instruction, corporate/executive flights, positioning or ferry flights, aerial application, pipeline/powerline patrols, and news and traffic reporting.

[2] See appendix A for more details.

[3] FAA: <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004/>. Although they are included in the *GAATAA Survey*, data associated with air taxi and air tour operations are not included in this review.

[4] FAA: <http://www.faa.gov/data_statistics/aviation_data_statistics/civil_airmen_statistics/>

[5] For a review of accident statistics related to air carrier operations, see National Transportation Safety Board, *Annual Review of Aircraft Accident Data, U.S. Air Carrier Operations, Calendar Year 2004* (Washington, DC: 2007), available at <http://www.ntsb.gov>.

[6] Although the precise statutory definition has changed over the years, public aircraft operations for Safety Board purposes are qualified government missions that may include law enforcement, low-level observation, aerial application, firefighting, search and rescue, biological or geological resource management, and aeronautical research.

[7] See 14 CFR 119.1.

Which Aircraft Are Included in this Review?

General aviation operations employ a wide range of aircraft, including airplanes, rotorcraft, gliders, balloons and blimps, and registered experimental or amateur-built aircraft. The diverse set of operations and aircraft types included within the scope of general aviation must be considered when interpreting the data in this review. The type of aircraft being flown is usually closely related to the type of flight operation being conducted. Jet and turboprop aircraft are commonly used for corporate/executive transportation, smaller single-engine piston aircraft are commonly used for instructional flights, and a variety of aircraft types are used for personal and business flights.

Not included in this review are any accident data associated with aircraft operating under 14 CFR Parts 121, 129, or 135 inside and outside the United States. Also not included are data for military or intelligence agencies, non-U.S.-registered aircraft, unregistered ultralights, and commercial space launches, unless the accident also involved aircraft conducting general aviation operations. Crashes involving illegal operations, stolen aircraft, suicide, or sabotage are included in the accident total, but not in accident rates.[8]

Organization of the Review

The *2004 Annual Review* is organized into four parts:

1. A summary of general aviation accident statistics for 2004, industry markers related to general aviation activity in 2004, and contextual statistics from previous years.
2. An investigation of trends over the past 10 years, providing the context for such accident information as operation types, levels of aircraft damage, and injuries.
3. A discussion of specific accident circumstances, a description of accident occurrences, and a summary of the Safety Board's findings of probable cause and contributing factors.
4. In-depth coverage of a special topic important to general aviation safety. The *2004 Annual Review* focuses on sport pilot and light sport aircraft.

Graphics are used to present much of the information in this review. For readers who wish to view tabular data or to manipulate the data used in this review, the data set is available online at < http://www.ntsb.gov/aviation/Stats.htm>.

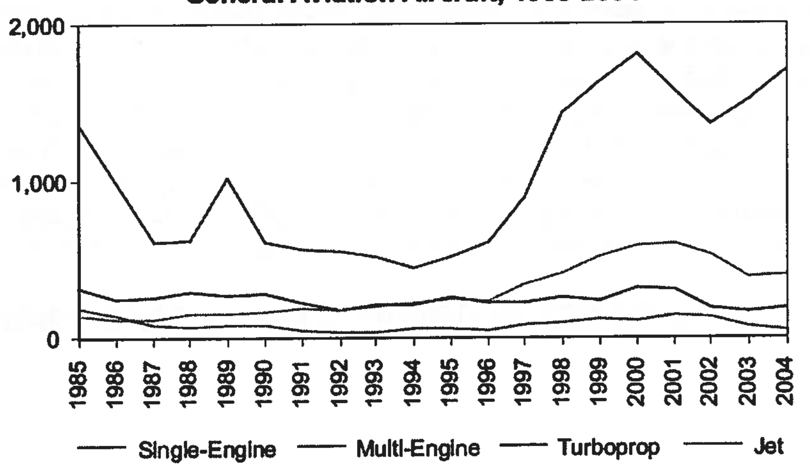
[8] In 2004, three crashes involved stolen/unauthorized use of aircraft.

The General Aviation Environment in 2004

General Aviation Industry Indicators

A theme repeated throughout the annual reviews is that general aviation accident numbers should be interpreted in light of related information, such as aircraft type, type of operation, and operating environment. Because personal and business operations account for the largest percentage of general aviation flying, prevailing economic conditions and/or trends may noticeably affect both the general aviation industry and flight operations. In 2004, the general aviation climate was influenced by generally favorable economic conditions and an increase in general aviation aircraft production.

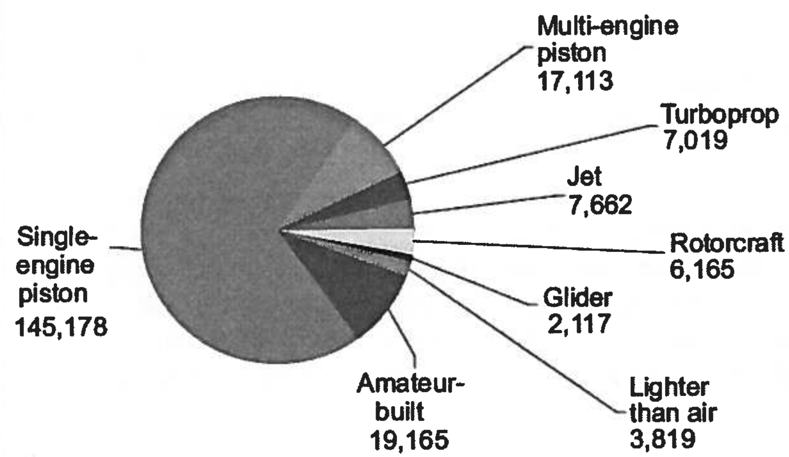
Annual Shipments of U.S.-Manufactured General Aviation Aircraft, 1985-2004



Fleet Makeup

Although sales of new general aviation aircraft increased noticeably after the mid-1990s, FAA registry data indicate that general aviation aircraft in use during 2004 were on average more than 31 years old. U.S. manufacturers delivered 2,355 new general aviation aircraft in 2004, compared to an estimated 211,821 in service. Single-engine piston aircraft currently have the highest average age of all general aviation aircraft types and account for the largest percentage of the general aviation fleet. As a consequence, any structural or design improvements incorporated into newly manufactured aircraft may not be reflected in the accident record for several years. The safety benefits of improved equipment, such as avionics, are also difficult to track because most new equipment is also available for installation in older aircraft.

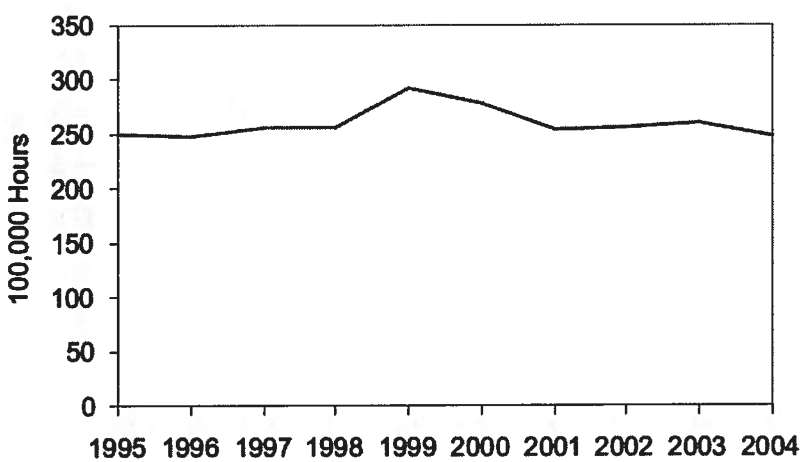
Number of Active Aircraft in General Aviation, 2004



General Aviation Activity

Because general aviation includes such a diverse group of aircraft types and operations, some measure of exposure must be considered to make meaningful comparisons of accident numbers. Flight activity is typically used to normalize accident numbers across different groups, with the level of activity corresponding to the level of exposure to potential accident risk. Total flight hours, departures, and miles flown are common indicators used to measure activity. As the following figure shows, annual general aviation flight hour estimates from 1995 through 2004 peaked in 1999, but were lower after that. In 2004, the estimated number of general aviation flight hours was 24.8 million, slightly lower from 2003.

Number of General Aviation Hours Flown Annually, 1995-2004



Activity data for general aviation are far less reliable than data available for commercial air carriers. Unlike Part 121 and scheduled Part 135 air carriers, which are required to report total flight hours, departures, and miles flown to the Department of Transportation (DOT),[9] operators of general aviation aircraft are not required to report actual flight activity data. As a result, activity for this group of aircraft must be estimated using data from the *GAATAA Survey*,[10] which was established in 1978 to gather information about aircraft use, flight hours, and avionics equipment installations from owners of general aviation and on-demand Part 135 aircraft. General aviation activity data are considered less reliable because a sample of aircraft is selected from the registry of aircraft owners for use in the *GAATAA Survey*, and reporting is not required.

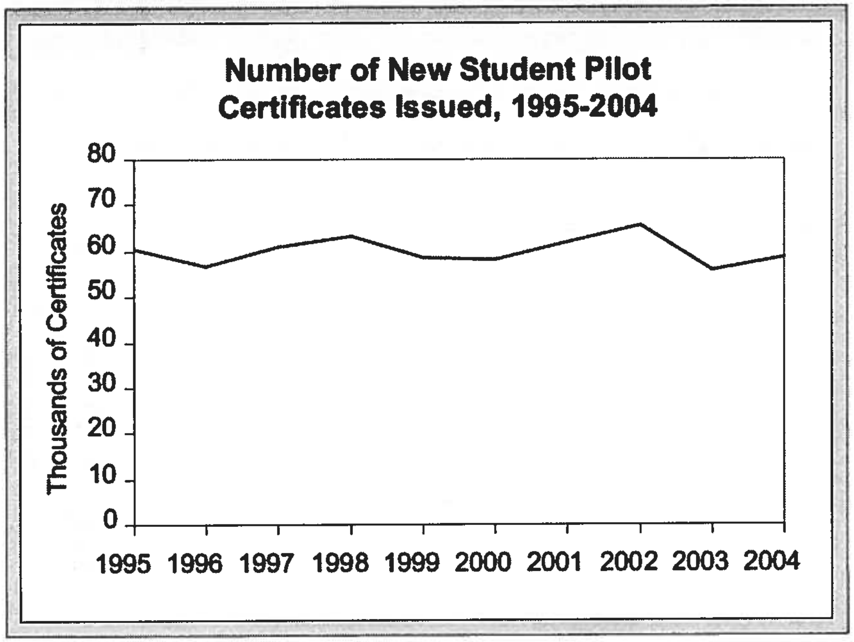
In addition to flight-hour estimates, the number of pilots can be used to establish the level of exposure to risk for the various types of general aviation operations. Available measures of the pilot population include both the number of certificates issued to new pilots, which represents positive growth in the pilot population, and the number of medical certificates issued, which represents an informal census of all active pilots.

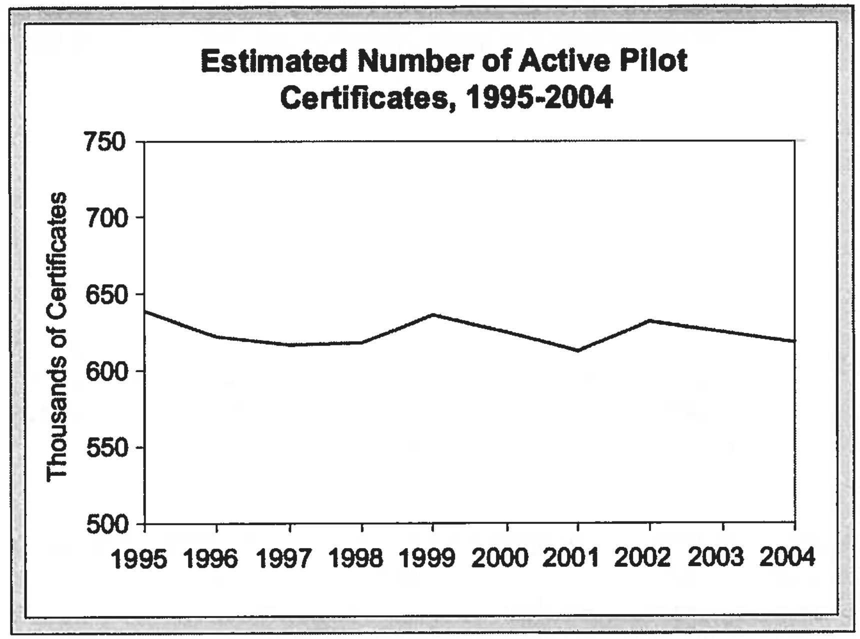
The number of new student pilot certificates fluctuated annually between 1995 and 2004.[11] The total number of new student certificates issued in 2004 came to 58,362, an increase from the 55,446 issued in 2003.

[9] Part 121 operators report activity monthly, and scheduled Part 135 operators report quarterly.

[10] Available at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004/>.

[11] Available at <http://www.faa.gov/data_statistics/aviation_data_statistics/civil_airmen_statistics/>.





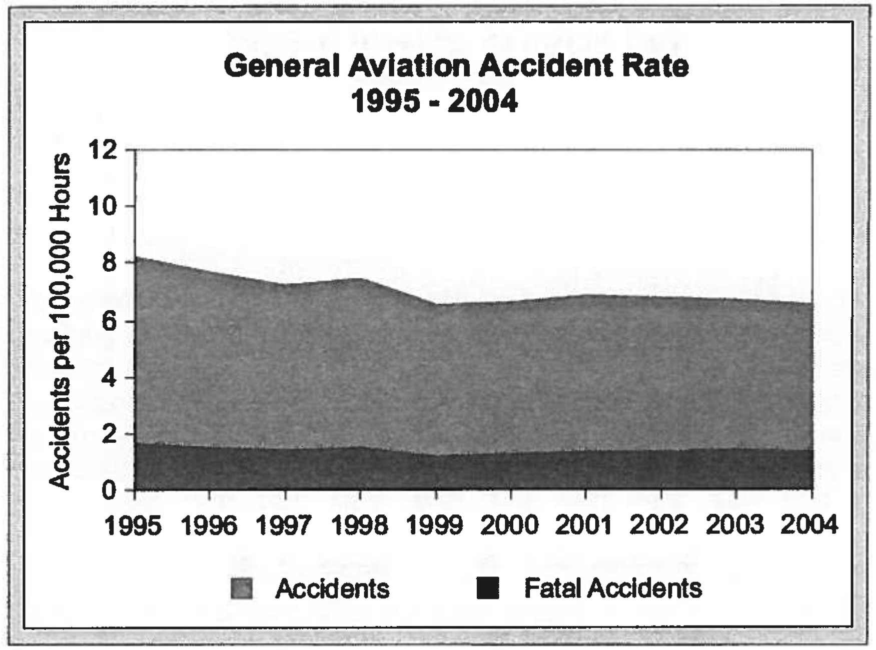
As shown by the number of medical certificates issued, the total number of active pilots in the U.S., including general aviation pilots, decreased steadily throughout the early and mid-1990s, from 692,095 in 1990 to 622,261 in 1996. Between 1996 and 2004, the number of active pilots fluctuated, with an estimated total of 618,633 active U.S. pilots in 2004.

In summary, general aviation indicators—flight hours and the total number of active and newly issued pilot certificates—have fluctuated annually, with little overall change, between 1995 and 2004.

Historical Trends In Accident Data

Accident Rates

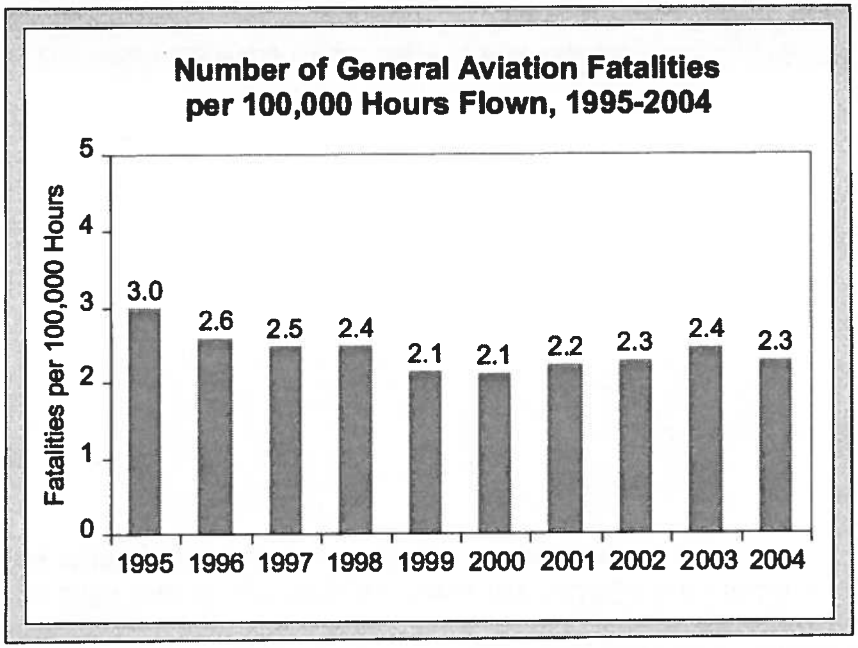
In the last decade, the calculated general aviation accident rate declined overall as annual estimates of general aviation activity increased noticeably[12] without a corresponding increase in the number of accidents. The rate of 6.49 accidents per 100,000 hours flown in 2004 was substantially lower than the 8.21 accidents per 100,000 hours recorded in 1995. In fact, the 2004 rate was only slightly higher than that of 1999, which had the lowest rate since the Safety Board began reporting general aviation-only annual accident rates in 1975.[13] The relative percentage of fatal accidents remained fairly constant from 1995 through 2004, at 18 to 21% of the total rate. The 2004 rate of 1.26 fatal accidents per 100,000 flight hours was only slightly lower than the 2003 fatal accident rate of 1.34.

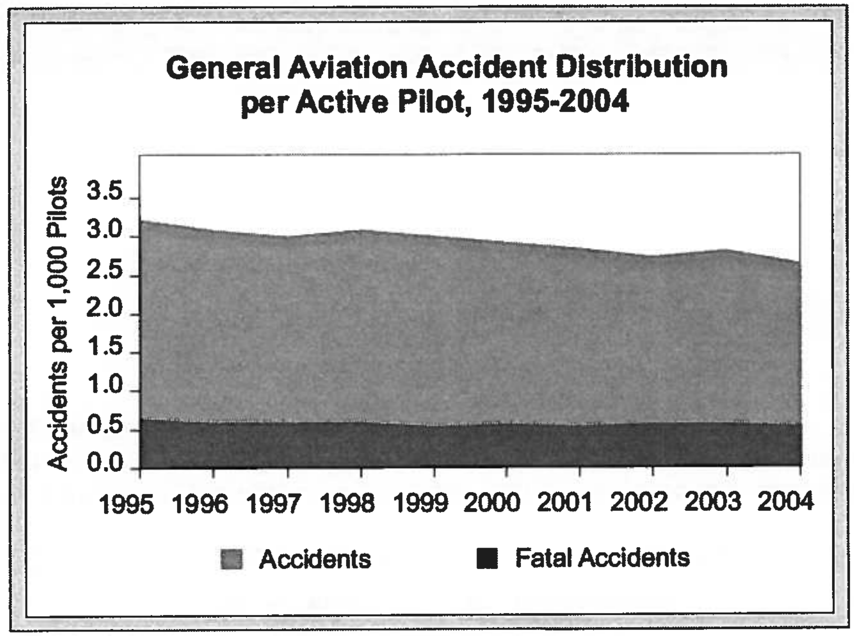


In 2004, accident-related deaths per flight hour were 2.3 fatalities per 100,000 hours flown. The highest annual fatality-per-hour rate occurred in 1995 with 3.0 deaths per 100,000 hours flown.

[12] FAA estimates of annual general aviation activity increased noticeably after 1998 due to a change of *GAATAA Survey* methodology that increased the estimated general aviation aircraft population by about 10%. See appendix A of the *GAATAA Survey, Calendar Year 2004,* for an explanation of the changes in survey methodology.

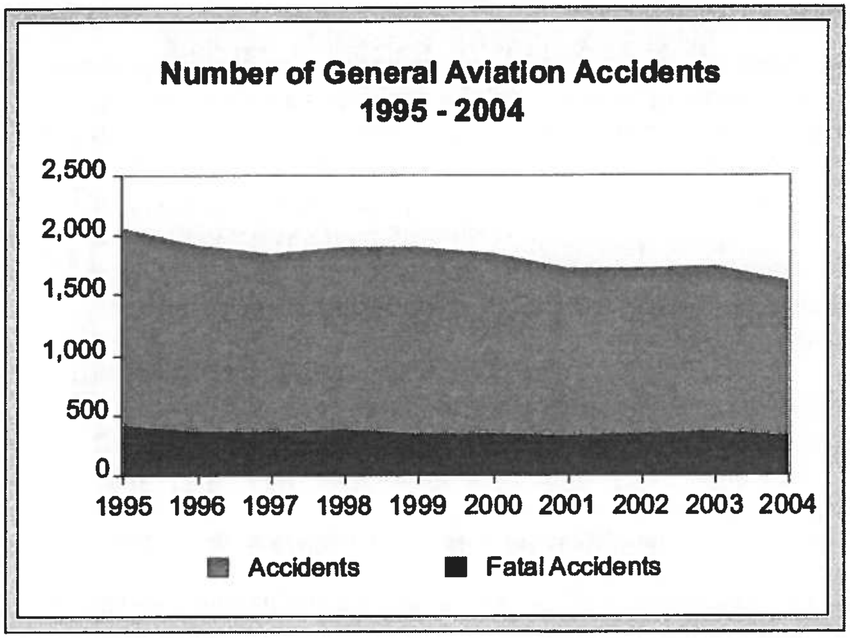
[13] Prior to 1975, scheduled 14 CFR 135 commuter and non-scheduled 14 CFR 135 air taxi aircraft operations were included in the Safety Board's annual general aviation accident total and rate.





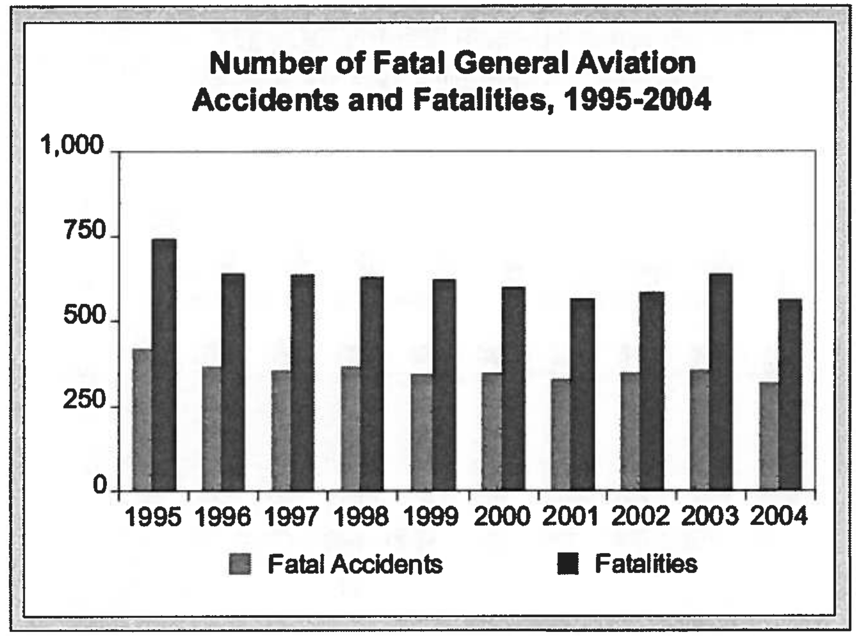
Another measure of accident distribution is the number of accidents per active pilot. Although this measure was considerably more stable from 1995 through 2004 than the per-hour accident rate, it did decrease slightly overall. The per-pilot rate in 2004 was only slightly lower than the 2003 rate.

Accident rate calculations based on flight hours require the use of *GAATAA* activity data extrapolated from a relatively small sample of aircraft owners. As a result, the calculated values are accurate only to the extent that the sample represents the larger population of general aviation operators. For this reason, accident rate data presented in this review typically also include raw frequency data for comparison.



Number of Accidents and Fatalities

Although the number of general aviation accidents fluctuated slightly from year to year, the number of accidents that occurred annually between 1995 and 2004 declined overall from 2,056 in 1995 to 1,619 in 2004, and the number of fatal accidents decreased overall, from 413 to 314.



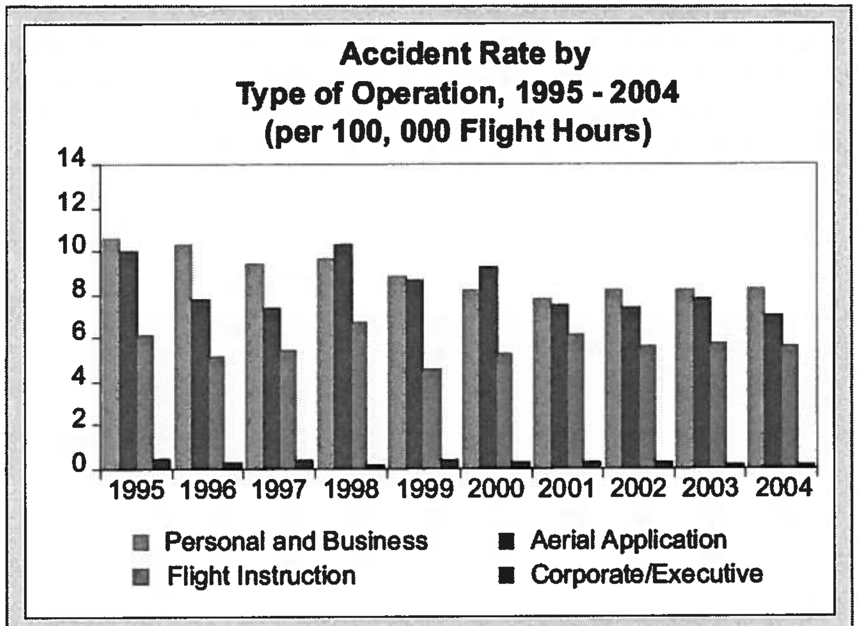
The number of general aviation fatalities also exhibited a generally downward trend from the high of 735 in 1995 to 559 in 2004. It should be noted that 2004 continues a generally downward trend in total fatalities for the 10-year period. It should also be noted that the trend reflects a decrease in general aviation flight hours annually following the events of September 11, 2001.

Accident Rate by Type of Operation

General aviation includes a wide range of operations, each with unique aircraft types, flight profiles, and operating procedures. This diversity is evident in the accident record. However, the *GAATAA* flight data allow for only a coarse representation of the many types of general aviation operations. For some types of operations, such as public aircraft flights,[14] no activity data are available. The data presented here include four operational categories selected because they are representative of general aviation and have activity information available. The categories selected as typical of general aviation activity include personal/business flights,[15] corporate flights, aerial application, and instructional flights.

- Personal flights make up the largest portion of general aviation activity and include all flying for pleasure and/or personal transportation. Although similar to personal flights, business flights include the use of an aircraft for business transportation without a paid, professional crew. Personal and business flights are typically conducted in single- and multi-engine piston airplanes, but may include a range of aircraft including gliders, rotorcraft, and balloons.
- Corporate flights include any business transportation with a professional crew and usually involve larger, multi-engine piston, turboprop, and jet airplanes.
- Aerial application includes the use of specially equipped aircraft for seeding and for spraying pesticides, herbicides, and fertilizer. Aerial application is unique because it requires pilots to fly close to the ground.
- Instructional flights include any flight under the supervision of a certificated flight instructor.[16] Instructional flights typically include both dual training flights and student solo flights. Aircraft used for instruction are often similar to those used for personal flying. However, instructional operations are unique because they often involve the repeated practice of takeoffs and landings, flight maneuvers, and emergency procedures.

In 8 of the last 10 years, personal and business flights have had the highest average accident rate, followed by aerial application. The lowest accident rate was for corporate/executive transportation, which for the 10-year period ranked lowest overall each year.

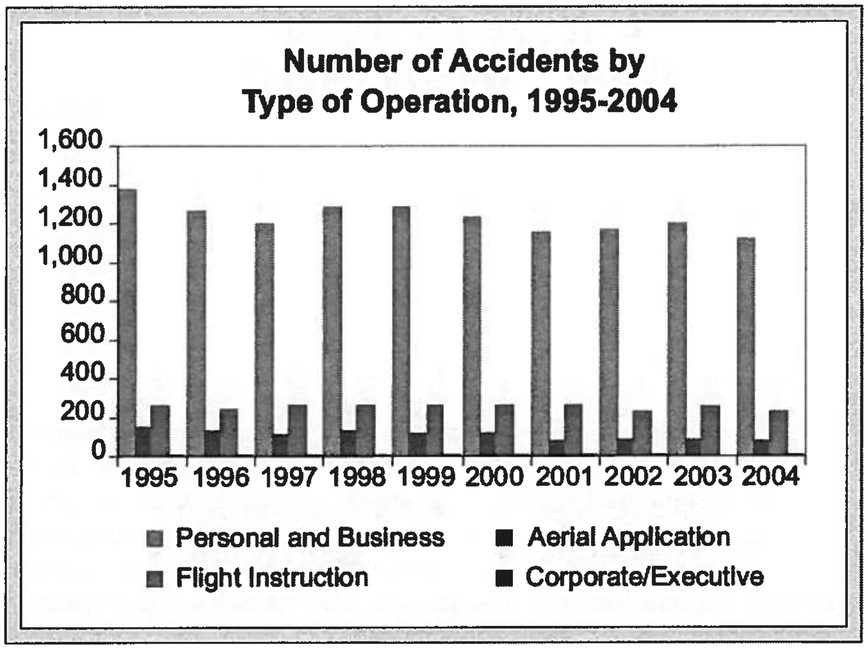


[14] *Annual Review 2004* data include 17 public aircraft accidents, 6 of which resulted in 1 or more fatalities.

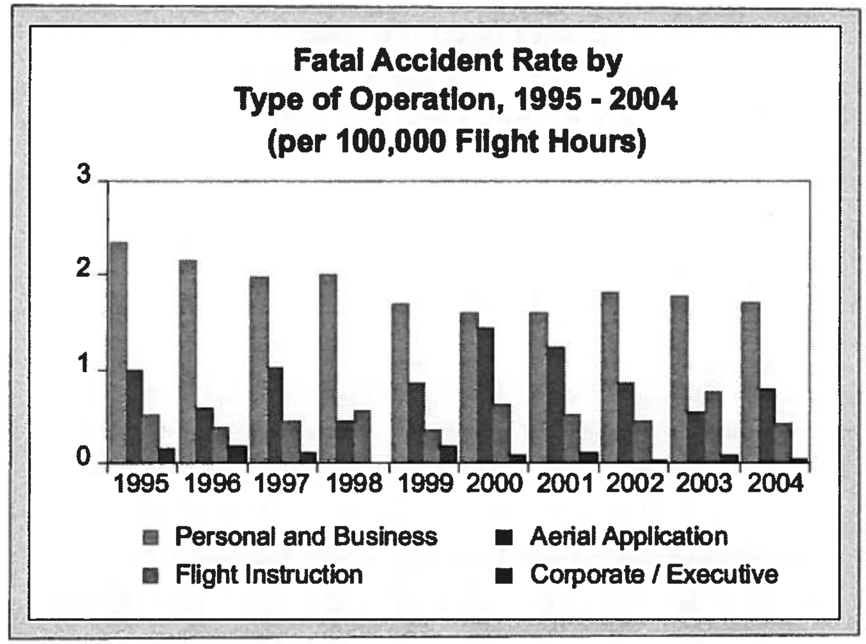
[15] Because of the difficulty of accurately distinguishing between personal and business flying for both the activity survey and the accident record, the rate presented in this review is calculated using combined exposure data (hours flown).

[16] See 14 CFR Part 61, Subpart H, for flight instructor certificate and rating requirements.

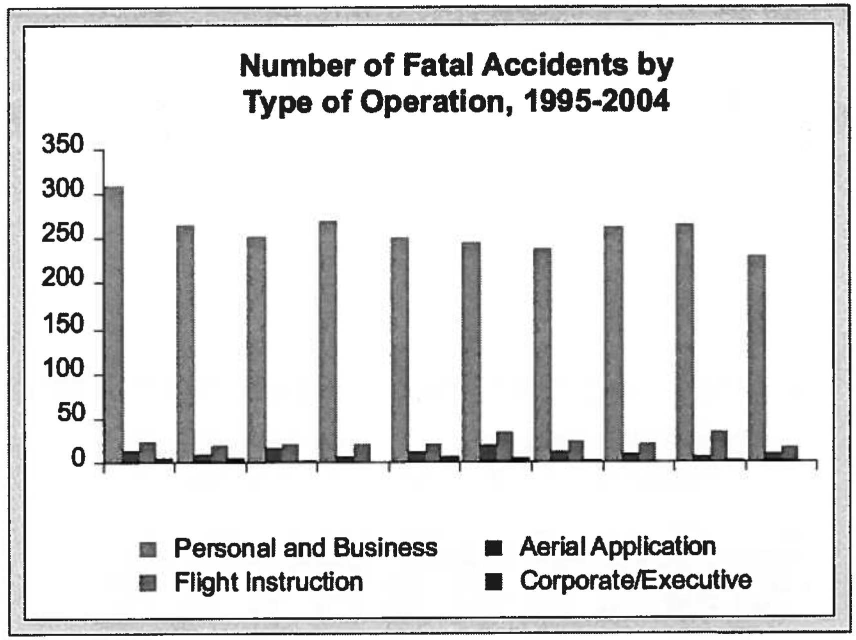
In 2004, the highest proportion of flying time was associated with personal and business operations, which accounted for the largest proportion of accidents, 69% (n = 1,118), a percentage consistent with the 10-year average. Less than 1% of the accidents (n = 6) were corporate/executive operations, 5% were aerial application (n = 80), and 14%, instructional flying (n = 229). Totals for corporate/executive accidents are barely visible when graphed in comparison to accidents involving other types of operations. For both corporate/executive operations and instructional flights, the proportion of flight hours was higher than the proportion of accidents, reflecting the relative safety of these missions.



Throughout the 10-year period, the combined category of personal/business flights also had the highest fatal accident rate. Except for 2000 and 2001, the rate was typically more than double the rate for any other type of flying.



Between 1995 and 2004, an average 259 fatal accidents per year were personal/business flights, compared to an average 23 fatal accidents for instructional flights, 12 for aerial application, and 3 for corporate/executive flights. Differences in the number and rate of fatalities and injuries among types of operation are likely related to the type of aircraft and equipment, the level of pilot training, and the operating environments unique to each type of operation. The number of fatal accidents per year among each type of flight operation exhibits a distribution similar to the number of accidents; personal and business flying accounted for an average 74% of all fatal general aviation accidents and 74% of all fatal injuries for 1995 through 2004.



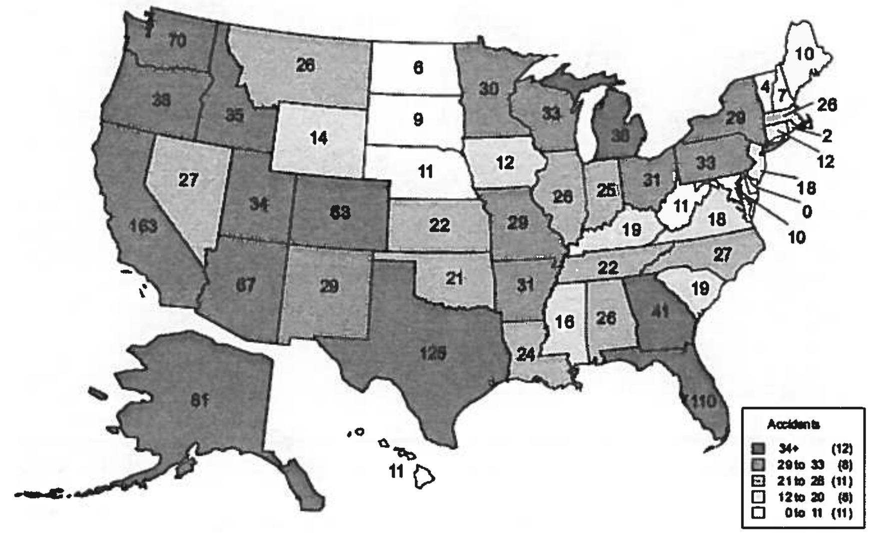
2004 in Depth

Location of General Aviation Accidents in 2004

United States Aircraft Accidents

Geographic location can contribute to general aviation accident totals because of increased activity associated with population density, increased risk due to hazardous terrain, a propensity for hazardous weather, or a concentration of particularly hazardous flight operations. The following map shows state by state the number of all general aviation accidents that occurred within the United States in 2004. Although the specific hourly activity data needed to calculate general aviation accident rates for each state are not available, some assumptions can be made about general aviation activity levels based on the size and population of each state. For example, California, Texas, and Florida had the greatest number of accidents in 2004. U.S. Census Bureau data[17] indicate that California had the highest state population in 2004, followed by Texas (second), and Florida (fourth). In addition, all three states have warm climates that favor year-round flying, and all three are popular travel destinations that attract general aviation traffic from other states. These states also had the largest numbers of active pilots[18] and active aircraft.[19] These data suggest that the high number of accidents in California, Texas, and Florida are related primarily to a high level of activity.

General Aviation Accidents by U.S. State, 2004



Regional differences that affect general aviation accident numbers may also include hazards unique to the local terrain and weather. For example, the operating environment, infrastructure, and travel requirements in Alaska present unique challenges[20] to aviation that are reflected in the general aviation accident record. After California, Texas, and Florida, Alaska had the most general aviation accidents in 2004.

[17] U.S. Census Bureau; data are available at <http://factfinder.census.gov/>.

[18] Available at <http://www.faa.gov/data_statistics/aviation_data_statistics/civil_airmen_statistics/>.

[19] Available at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004/>.

The top 10 states by number of general aviation accidents in 2004 are presented here along with the 10-year average. Note that many of the state accident totals for 2004 were below historical averages, but the distribution of accidents among states remained similar during the period.

Foreign Aircraft Accidents

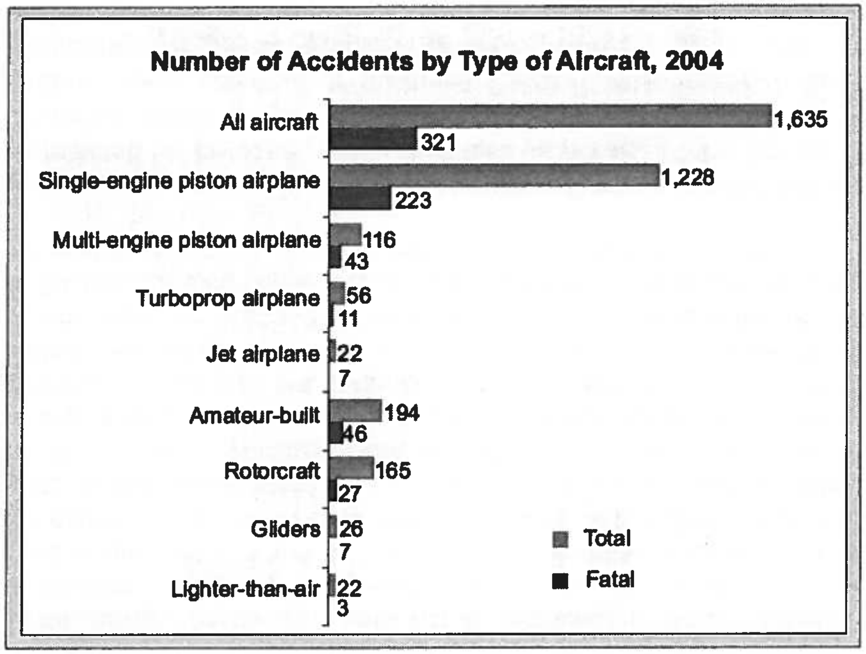
In 2004, U.S.-registered aircraft were involved in 30 accidents outside the 50 United States. Those accidents occurred in 16 different countries and territories, and in the Atlantic and Pacific Oceans. Of those accidents, 10 were fatal, resulting in 18 deaths. Most of these accidents occurred in the Bahamas, with four accidents. As expected, general aviation accidents involving U.S.-registered aircraft outside the United States usually occur in neighboring countries like Canada and Mexico, and the Caribbean island nations, but in 2004, accidents occurred as far away as France, Malaysia, and Romania.

Accidents Involving U.S.-Registered General Aviation Aircraft Outside the 50 United States, 2004

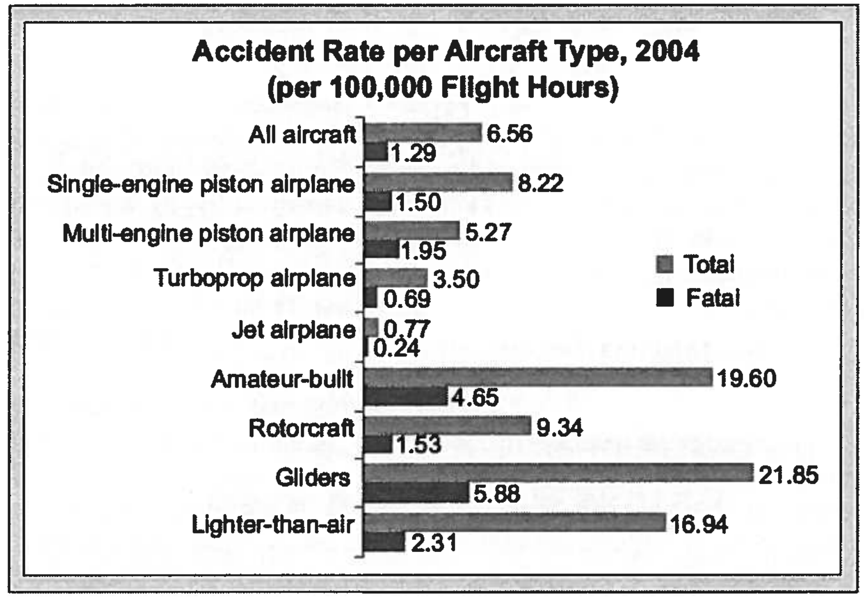
	Number of Accidents	Number of Fatal Accidents	Number of Fatalities
Pacific Ocean			
From Fishing Vessel	1	0	0
Subtotal	1	0	0
Atlantic Ocean			
Left Naples, Italy	1	0	0
Subtotal	1	0	0
Other Locations			
Bahamas	4	1	3
Canada	3	1	1
Chile	1	0	0
Corsica	1	1	2
Dominican Republic	1	0	0
France	2	2	7
Greenland	1	1	1
Honduras	1	1	1
Mexico	3	0	0
Malaysia	1	0	0
Netherlands Antilles	1	0	0
Puerto Rico	3	0	0
Romania	1	0	0
St. Kitts and Nevis	1	0	0
United Kingdom	1	1	1
Virgin Islands	3	2	2
Subtotal	28	10	18
Total	30	10	18

Aircraft Type

The following figure summarizes the total number of general aviation accidents and fatal accidents occurring in 2004 by aircraft type. Most notable is the large number of accidents involving single-engine piston airplanes, which accounted for 75% of all accident aircraft and 69% of all fatal accident aircraft.



In 2004, the per-aircraft accident rate for all aircraft types was 6.56 accidents and 1.29 fatal accidents per 100,000 hours flown.[21] Among fixed-wing powered aircraft, the rate for single-engine piston airplanes was 8.22 accidents and 1.50 fatal accidents per 100,000 hours flown. Amateur-built aircraft[22] had the highest accident rate among all general aviation aircraft, with 19.60 accidents and 4.65 fatal accidents per 100,000 flight hours. Rotorcraft had the second-highest rate among powered aircraft, with 9.34 accidents and 1.53 fatal accidents per 100,000 hours flown. However, glider operations had the second-highest accident rate overall, with 21.85 accidents and 5.88 fatal accidents per 100,000 hours flown.



[21] Note that the reported rates are per aircraft and differ from per-accident rates because each aircraft is counted separately for collisions. Included in the accident totals, but excluded from the associated rates, are three single-engine piston aircraft crashes with a probable cause attributed to stolen/unauthorized use of aircraft.

[22] Title 14 CFR 21.191(g) provides for the issuance of a Special Airworthiness Certificate in the experimental category to permit the operation of amateur-built aircraft. Amateur-built aircraft may be fabricated from plans or assembled from a kit, so long as the *major* portion of construction is completed by the amateur builder(s).

Purpose of Flight

The type of operation or purpose of flight can be defined as the reason a flight is initiated. Activity data by purpose of flight are derived from the *GAATAA Survey*, which includes 14 purpose/use categories. Two of these categories, air taxis and air tours, are covered under 14 CFR Part 135 and are therefore not included in this review. The remaining 12 include the previously mentioned categories of personal, business, instructional, corporate, and aerial application, which together accounted for 90% of all general aviation operations during 2004. The remaining 10% are included in more specific categories, such as external load and medical use. A limitation of the *GAATAA* activity data is that those categories provide only a coarse representation of the range of possible flight operations. For example, personal flying includes but does not distinguish between travel, recreation, or proficiency flying. At the same time, the differences between similar categories like personal and business flying are not easily identified. Accordingly, the purpose-of-flight information presented in this review is limited to the combined categories of personal and business flying, as well as corporate, instructional, and aerial application flights.

According to the *GAATAA Survey*, most general aviation operations are conducted for personal and/or business purposes. Of the estimated 25 million general aviation hours flown in 2004, more than half—13.5 million—were personal or business flights.[23] Accordingly, a large percentage of general aviation accidents involve personal/business flights. However, personal/business flying is still over-represented in the accident record: although this segment represented about 54% of the general aviation hours in 2004, it accounted for 69% of all general aviation accidents (n = 1,118) and 73% of all fatal accidents in 2004 (n = 230).

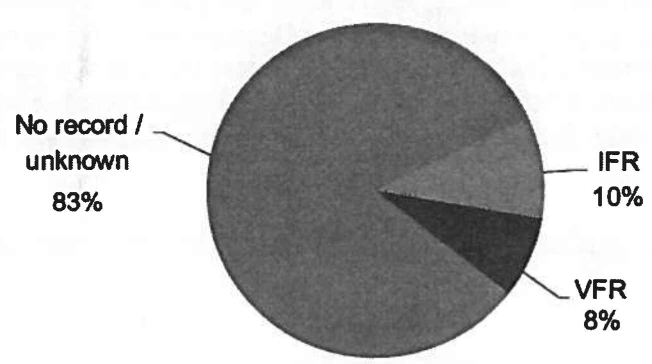
The accident rate for instructional flights was about half that of personal/business flights overall. This relatively low rate is surprising because student pilots could be expected to make more mistakes than experienced pilots. Flight instruction accidents were also less likely to be fatal. Only 7% of the flight instruction accidents that occurred in 2004 resulted in fatalities, compared to 21% of personal/business accidents. When compared with the number of hours flown, the fatal accident rate for instructional flights was 0.42 fatal accidents per 100,000 hours flown. The fatal accident rate for personal/business flights remained the highest in general aviation with 1.71 fatal accidents per 100,000 hours flown.

Flight Plan

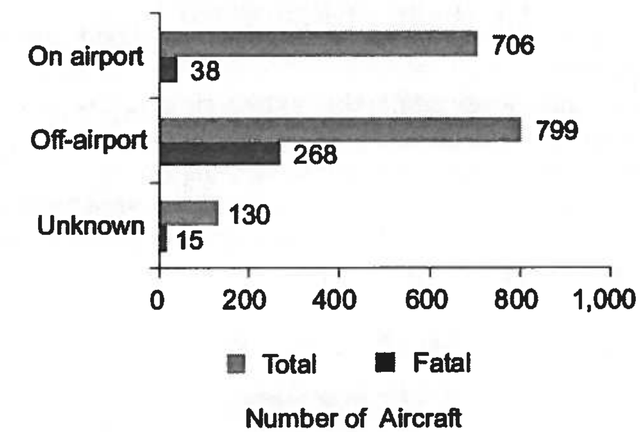
In 2004, 1,635 pilots were involved in general aviation accidents, and for those pilots, 1,349 (83%) showed no record of filing a flight plan. In most cases, a flight plan is required only for flight under instrument flight rules (IFR). However, pilots operating under visual flight rules (VFR) on point-to-point flights have the option of filing a flight plan, which aids search and rescue efforts for pilots who fail to arrive at their intended destinations.

[23] *GAATAA Survey 2004*: <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004/>.

Flight Plan Filed by Accident Pilot, 2004



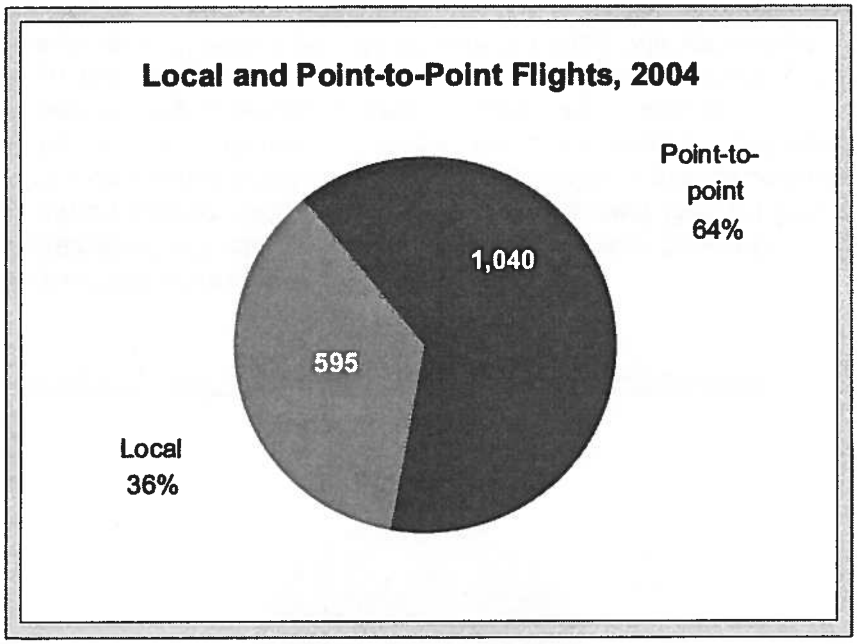
Location of Accident Aircraft, 2004



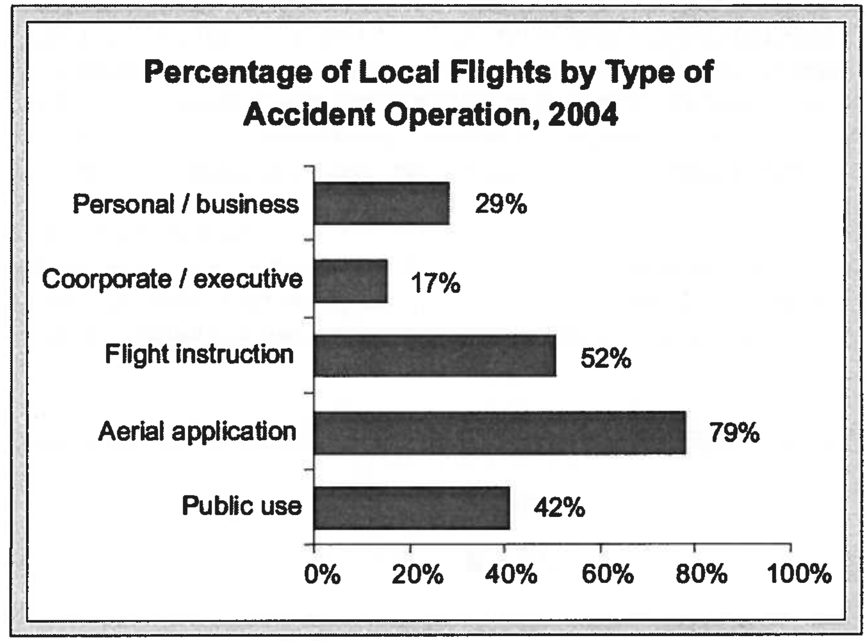
Airport Involvement

Aircraft accident locations were closely split between those occurring on airport property (43%) and those occurring away from an airport (49%). Comparing accident risk based on location is difficult because of the exposure differences between types of operations and types of aircraft. For example, a single-engine piston aircraft used for instructional flights will spend a large percentage of its operating time near an airport while a jet aircraft used for corporate transportation will not. However, a relationship can be observed between the location and severity of accidents. Accidents on or near an airport or airstrip typically involve aircraft operating at relatively low altitudes and airspeeds while taking off, landing, or maneuvering to land. In contrast, accidents that occur away from an airport typically involve the climb, cruise, maneuvering, and descent phases of flight, which typically occur at higher altitudes and higher airspeeds. As a result, these accidents are more likely to result in higher levels of injury and aircraft damage than accidents that occur on an airstrip or near an airport. Most fatal accidents in 2004 (85%) were located away from an airport or airstrip.

Another distinction that can be drawn between flight profiles is between local and point-to-point operations. A local flight is one that departs and lands at the same airport, and a point-to-point flight is one that lands at an airport other than the one from which it departed. Typical local flight operations include sightseeing, flight instruction, proficiency flights, pleasure flights, and most aerial observation and aerial application flights. Conversely, point-to-point flights include any operation conducted with the goal of moving people, cargo, or equipment from one place to another. Typical point-to-point operations include corporate/executive transportation, personal and business travel, and aircraft repositioning flights. A comparison of the numbers of accident aircraft on local flights with those on point-to-point flights illustrates that the percentages of aircraft on point-to-point flights accounted for more accident aircraft.



The activity data necessary to compare accident rates for local and point-to-point flights are not available. However, a comparison of the percentage of local and point-to-point accident flights conducted for different purposes provides an indirect measure of the types of flying represented in both flight profiles. The following figure shows that most personal/business flights were point-to-point, while more than half of instructional flights were local. Corporate/executive transportation and aerial application operations were also inversely proportional, with 83% of corporate flights being point-to-point and 79% of aerial application flights being local.



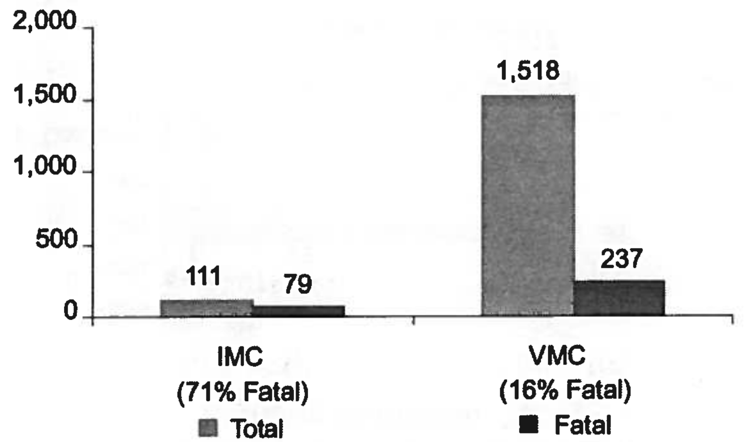
Environmental Conditions

Many hazards are unique to the type of flight operation, type of aircraft, and flight profile, but environmental conditions may be hazardous to all flight operations and all types of aircraft to some degree. Aircraft control, for example, is highly dependant on visual cues related to speed, distance, orientation, and altitude. When visual information is degraded or obliterated because of clouds, fog, haze, or precipitation, pilots must rely on aircraft instruments. Because of the difficulties associated with flying an aircraft solely by reference to instruments, the FAA has established specific pilot, aircraft, and procedural requirements[24] for flight in instrument meteorological conditions

[24] Title 14 CFR 61.579(c), 91.167-193, 91.205(d).

(IMC). According to the FAA *Pilot/Controller Glossary,*[25] instrument meteorological conditions are defined as "meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minima[26] specified for Visual Meteorological Conditions (VMC)." Weather minima differ based on altitude, airspace, and lighting conditions, but 3 statute miles visibility and a cloud clearance of 1,000 feet above, 500 feet below, and 2,000 feet horizontal distance are typical. The following figure illustrates the percentage of accidents and fatal accidents that occurred in VMC and IMC. A comparison of the percentages of accidents in each weather condition that resulted in a fatality illustrates the hazards associated with flight in IMC. In 2004, only 16% of the accidents that occurred in visual conditions resulted in a fatality, but 71% of accidents in instrument conditions were fatal.

Total Accidents and Fatal Accidents by Weather Condition, 2004



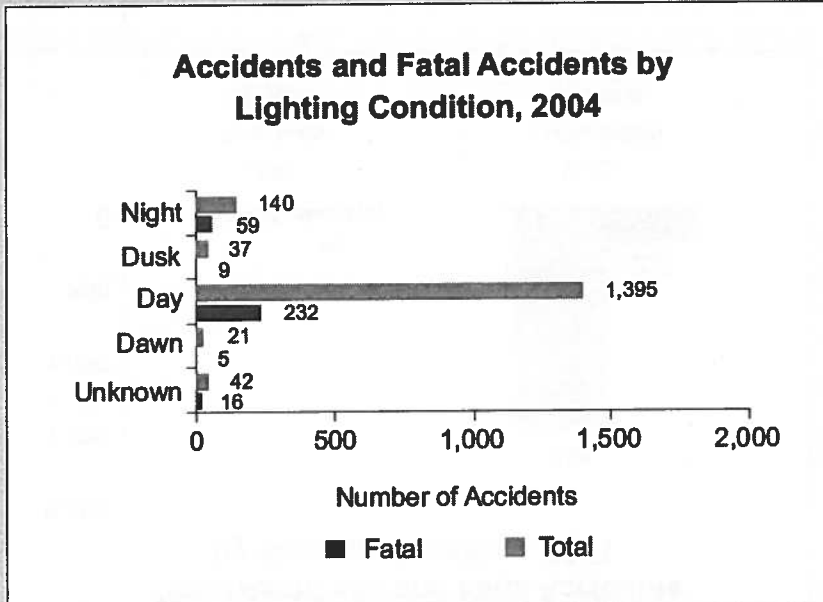
Although instrument conditions were present for only 7% of all accidents, 25% of fatal general aviation accidents in 2004 occurred in IMC. One reason for the disproportionate number of fatal accidents in IMC is that such accidents are more likely to involve pilot disorientation, loss of control, and collision with terrain or objects—accident profiles that typically result in high levels of damage and injury. Instrument conditions may also contribute to accident severity by further complicating situations that might be more easily handled in visual conditions. For example, a forced landing due to an engine malfunction or failure, which might result in minor damage if it occurred in visual conditions, might pose an even greater threat to a pilot flying in instrument conditions because reduced visibility would hinder selection of a suitable landing site.

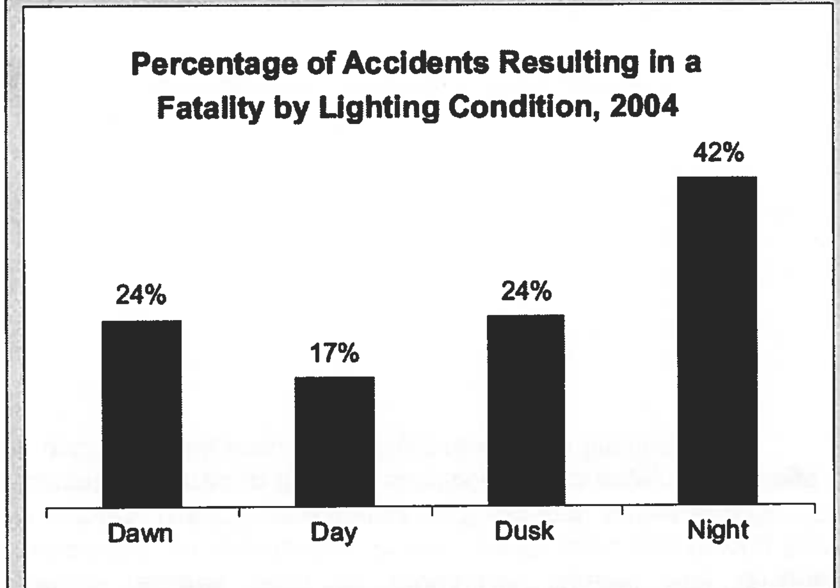
Lighting Conditions

Lighting conditions can present a similar hazard to pilots because of physiological factors related to night vision, difficulties in seeing potential hazards such as mountains, terrain, and unlighted obstructions, and perceptual illusions associated with having fewer visual cues. The following figures illustrate that, similar to IMC, most accidents occurred in daylight conditions but a larger percentage of the accidents that occurred at night resulted in fatalities.

[25] FAA, *Pilot/Controller Glossary*, Washington, D.C., available at <http://faa.gov/atpubs/PCG/INDEX.HTM>

[26] Minima for visual meteorological conditions are specified in 14 CFR 91.155.





In fact, accidents that occurred at night were more than twice as likely as daylight accidents to be fatal. Like weather-related accidents, accidents at night are more likely to involve disorientation, loss of control, and/or collision with objects or terrain, resulting in higher levels of injury. The reduction in visual cues at night also hinders pilots from identifying deteriorating weather conditions and further complicates their ability to deal with any aircraft equipment malfunctions.

Injuries and Damage for 2004

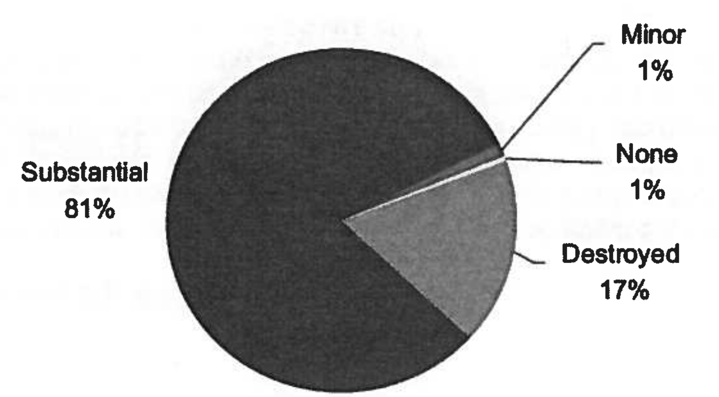
Aircraft Damage

Safety Board investigators record aircraft damage as either "destroyed," "substantial," or "minor." Title 49 CFR 830.2 defines "substantial damage" as "damage or failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component." Although not specifically defined in 49 CFR 830.2, "destroyed" can be operationally defined as any damage in which repair costs exceed the value of the aircraft,[27] and "minor" damage as any damage that is not classified as either "destroyed" or "substantial."

27 Missing or unrecoverable aircraft are also considered "destroyed."

Nearly 8 of every 10 aircraft involved in accidents during 2004 sustained substantial damage, and about 1 in 5 accident aircraft were destroyed. "Minor" and "no damage" classifications together comprised about 1% of accident aircraft.

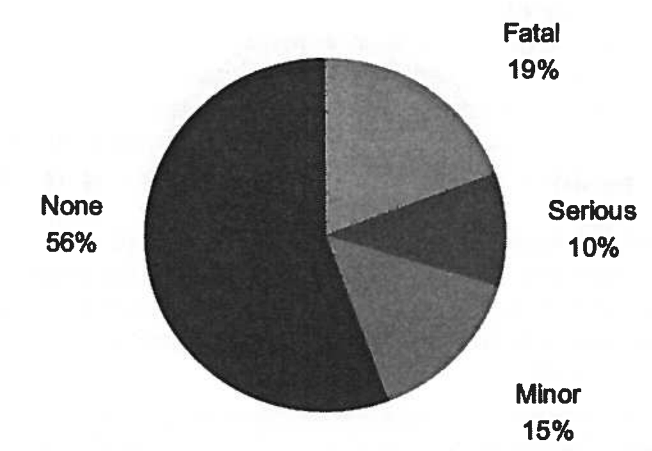
Damage to Accident Aircraft, 2004



Accident Injuries

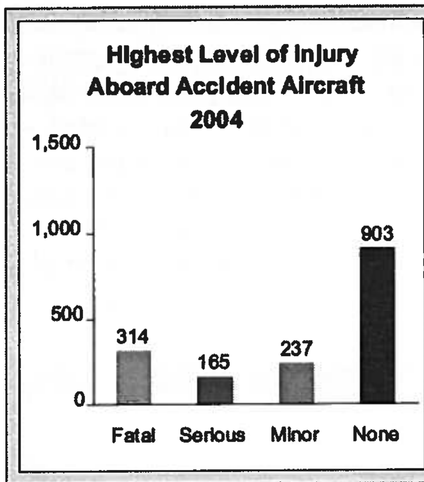
In accordance with 49 CFR 830.2, Safety Board investigators categorize general aviation injuries as "fatal," "serious," or "minor." A fatal injury is defined as "any injury which results in death within 30 days of the accident." Title 49 CFR 830.2 also outlines several attributes[28] of serious injury that include, but are not limited to, hospitalization for more than 48 hours, bone fracture, internal organ damage, or second- or third-degree burns. The following figure depicts the percentage of general aviation accidents resulting in each level of injury during 2004. Most notable is the fact that more than half the accidents did not result in injury.

Highest Level of Accident Injury, 2004



The following figures illustrate both the number of accident aircraft in each injury category and the corresponding number of persons aboard those aircraft who sustained injuries in each category. Categorization of injury level in an accident is based on the highest level of injury sustained by an occupant of an accident aircraft. Again, most persons who were aboard general aviation aircraft that were involved in accidents sustained no injuries.

[28] See appendix B for the complete definition of injury categories.



General Aviation Accident Injuries, 2004

Personal Injuries	Fatal	Serious	Minor	None	Total
Pilot	295	158	228	954	1,635
Copilot	20	3	10	40	73
Flight instructor	10	8	13	72	103
Dual student	4	1	4	11	20
Check pilot	2	0	1	6	9
Other crew	10	1	4	29	44
Passenger	218	92	157	860	1,327
Total aboard	559	263	417	1,972	3,211
On ground	0	3	8	0	11
Other aircraft	0	0	0	0	0
Total	559	266	425	1,972	3,222

Injuries by Role for 2004

The table to the right presents detailed information about the types of injuries incurred by all persons involved in general aviation accidents during 2004. The distribution of general aviation accident injuries varies with the type of operation and the size of aircraft; the number of injuries experienced by any group of persons varies with their level of activity (that is, their exposure to risk). For example, all aircraft have a pilot, but not all have passengers on board.

In 2004, 467 passengers suffered some level of injury in general aviation accidents, compared to the 714 pilots and copilots who were injured. Pilots sustained the highest percentage of injuries, suffering 53% of all fatalities, 60% of all serious injuries, and 55% of all minor injuries.

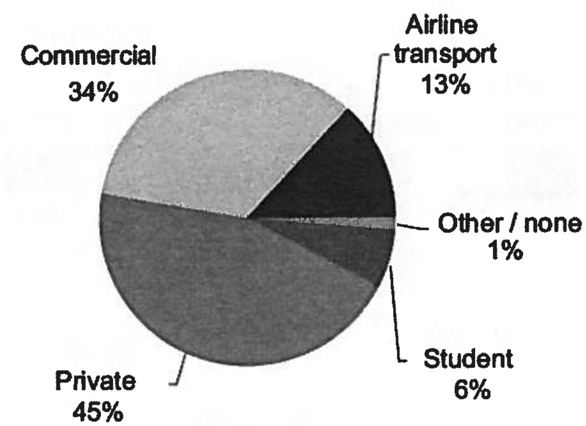
In addition to injuries sustained by persons on board the accident aircraft, 11 persons on the ground sustained injuries as a result of general aviation accidents. For example, one person in an automobile was seriously injured when an aircraft collided with vehicles during a forced landing on the freeway, a passenger was seriously injured after being struck by an aircraft propeller, and three people sustained minor injuries when the aircraft impacted a residence following an uncontrolled descent.

Accident Pilots

Rating

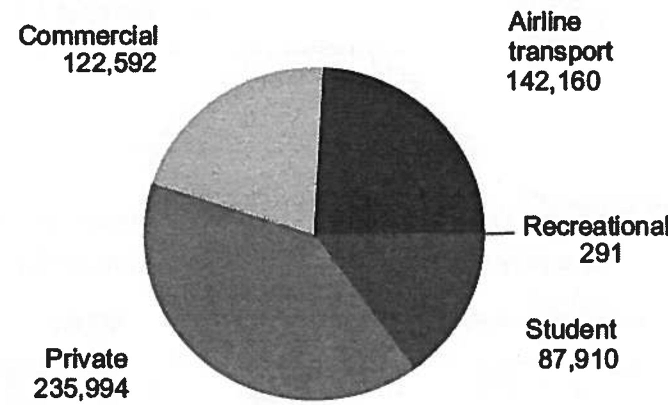
Of the 1,635 pilots involved in general aviation accidents in 2004, the largest percentage held a private pilot certificate.[29] The second-largest percentage held a commercial pilot certificate, which is required for any person to act as pilot-in-command of an aircraft for compensation or hire.[30]

Highest Certificate Held by Accident Pilot, 2004



When compared to the number of active pilots in 2004 holding each type of pilot certificate, commercial pilot certificate holders were over-represented among general aviation accidents. Although commercial pilot certificate holders accounted for only 20% of all active general aviation pilots, they were involved in 34% of all general aviation accidents in 2004.

Number of Active Pilots by Highest Certificate, 2004



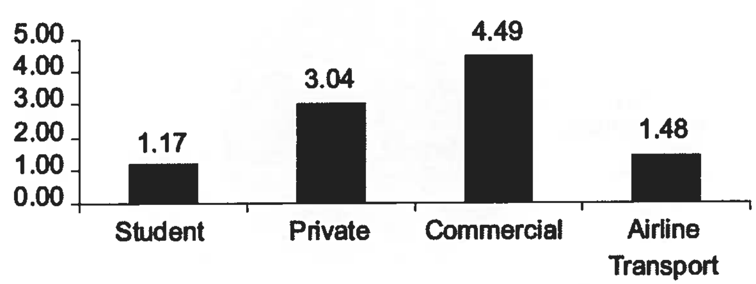
Similarly, the accident rate was highest for commercial pilot certificate holders during 2004, with 4.49 accidents per 1,000 active pilots. One possible explanation for the higher numbers of accidents is that commercial certificate holders may be employed as pilots and would therefore be likely to fly more hours annually than student or private

[29] Available at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004/>.

[30] See 14 CFR 61.133 for the privileges granted by a commercial pilot certificate.

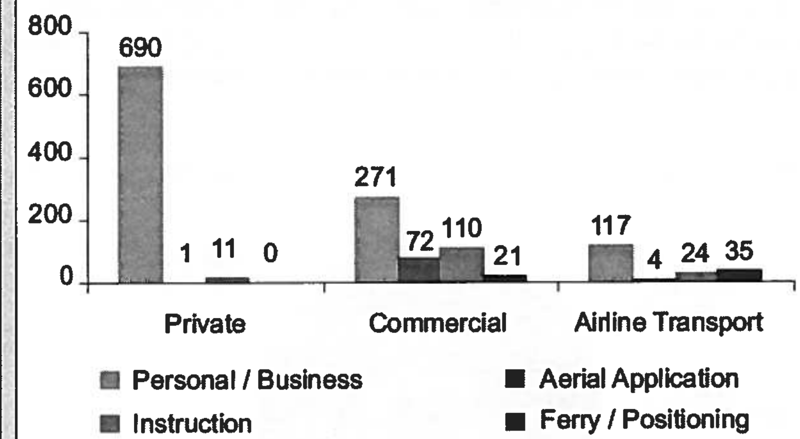
pilots. However, more than one-third of commercial pilots involved in accidents during 2004 (34%) were conducting personal flights and were not involved in commercial operations at the time of the accidents.

Accident Rate per 1,000 Active Pilots by Certificate, 2004



(1,603 of accident pilot records with data available, 2004)

Type of Operation Conducted by Accident Pilot Certificate, 2004



Because annual flight-hour data are not compiled separately for pilots holding each type of certificate, it is not possible to compare activity-based accident rates. The *U.S. Civil Airmen Statistics*[31] also do not include information about the type of operation that certificate holders engage in. Examples of other commercial operations not presented in the figure above include corporate/executive transportation, sightseeing flights, banner towing, and aerial observation.

[31] Available at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004/>.

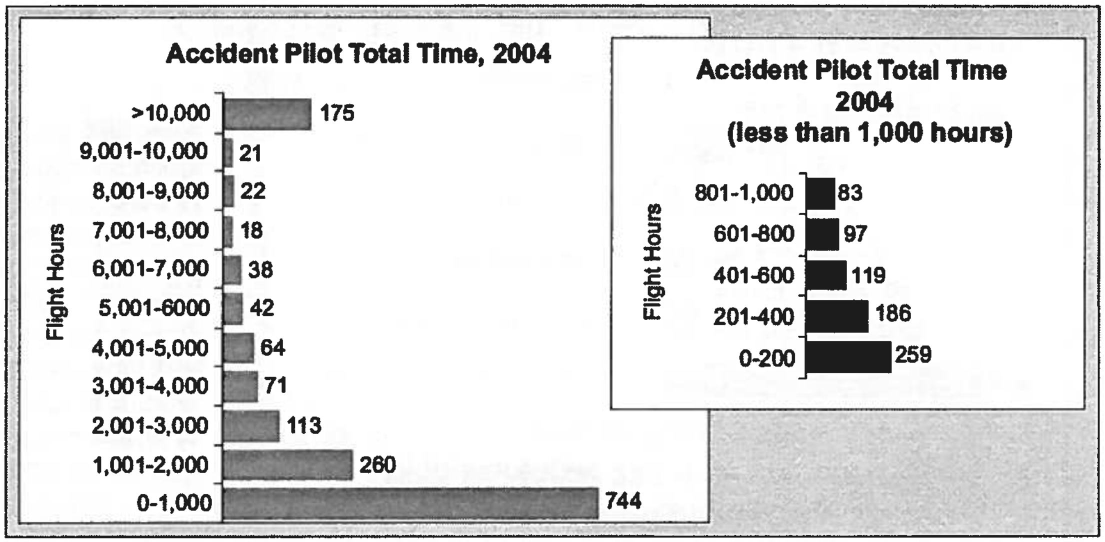
Total Time

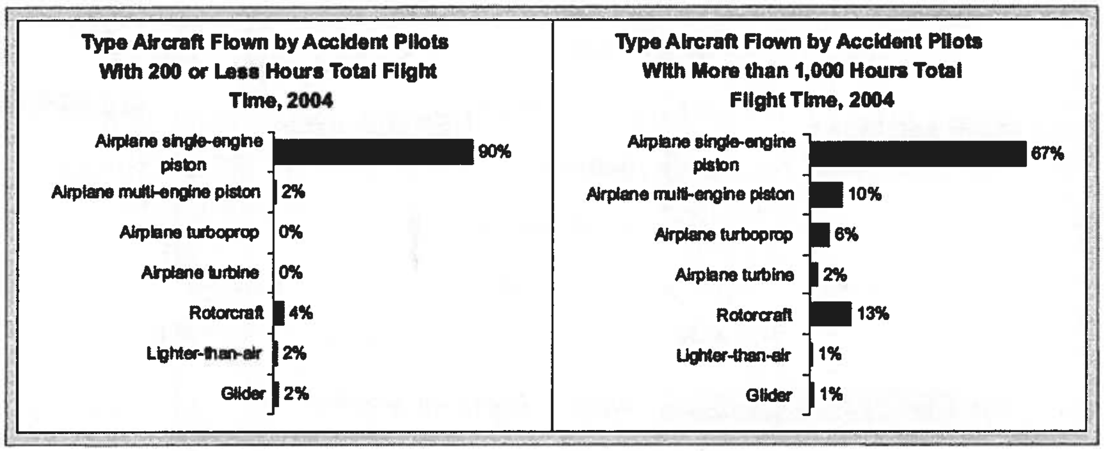
For the 1,568 accident pilots for whom total flight experience data are available (as shown in the figure on this page, upper right), 47% were pilots with a total flight time of 1,000 hours or less. The following figure depicts the distribution of experience among accident pilots. The inset focuses on those pilots with less than 1,000 hours. The largest percentage of accident pilots in this group had 200 hours or less of total flight time. When compared to all accident pilots with available data, about 16% of accident pilots had 200 hours of flight experience or less.

It is not surprising that 9 of 10 accident pilots with 200 hours total flight time or less were flying single-engine piston airplanes. Most accident pilots with more than 1,000 hours were also flying single-engine piston airplanes, but this group also operated a more diverse selection of aircraft—multi-engine piston, turboprop, and turbine-powered airplanes—and more than twice as many rotorcraft.

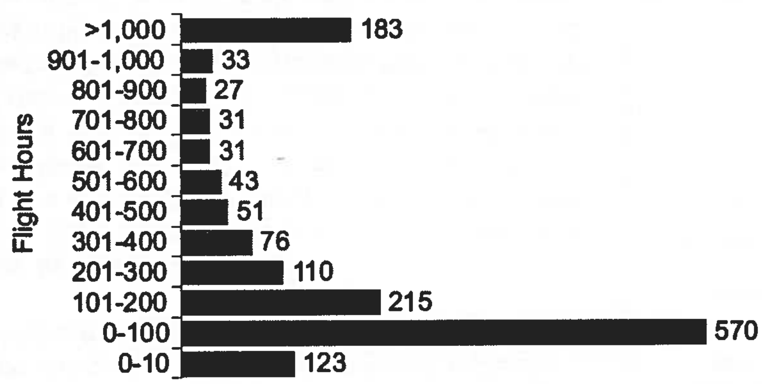
Time in Type of Aircraft

Of the 1,370 accidents in 2004 for which pertinent data are available (as shown in the figure on this page, lower right), 42% involved pilots with 100 hours or less of time in the accident aircraft make and model. Of those, 123 pilots (9% of all accident pilots for whom data are available) had less than 10 hours in type. Most accident pilots with less than 10 hours of flight time in make and model were flying single-engine piston aircraft.



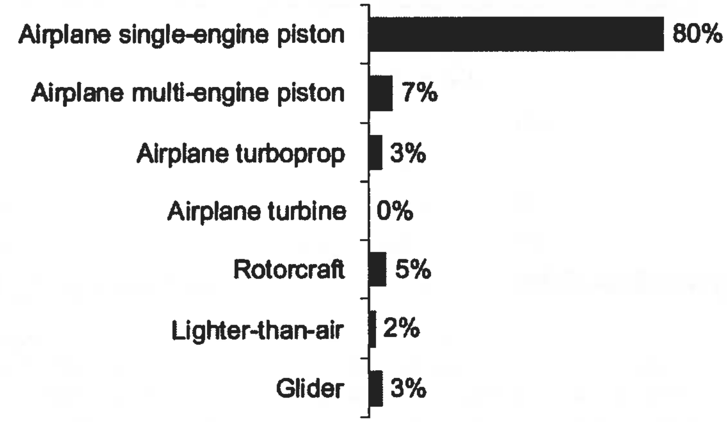


Accident Pilot Total Time in Aircraft Type, 2004

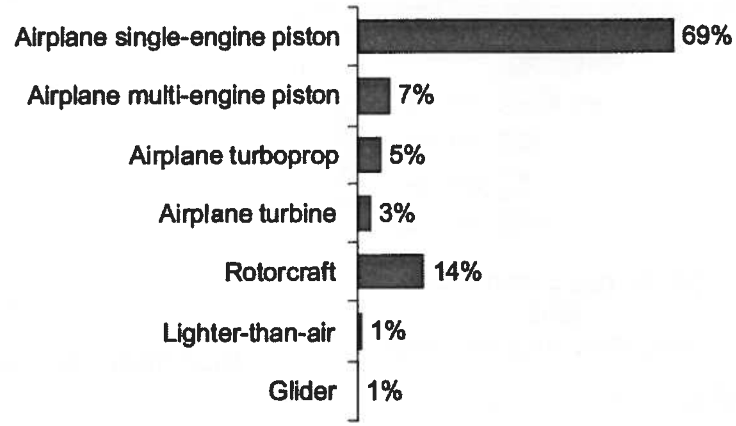


Pilots may have low time in type because they are new pilots with low total time or they are experienced pilots who are transitioning to a new aircraft. Two groups of pilots that might be expected to have accumulated significant time in make and model are those who own their own airplanes and fly them often and professional pilots who fly the same aircraft often. A large number of general aviation pilots who own aircraft have single-engine piston airplanes. Helicopters and multi-engine piston, jet, and turboprop airplanes are more likely to be operated by professional pilots. Although not specifically detailed in the figure above, it is worth noting that 34 of the 123 accident pilots in 2004 who had less than 10 hours in the accident aircraft type were operating amateur-built aircraft.

Type Aircraft Flown by Accident Pilots With 10 or Less Hours in Accident Aircraft Type, 2004



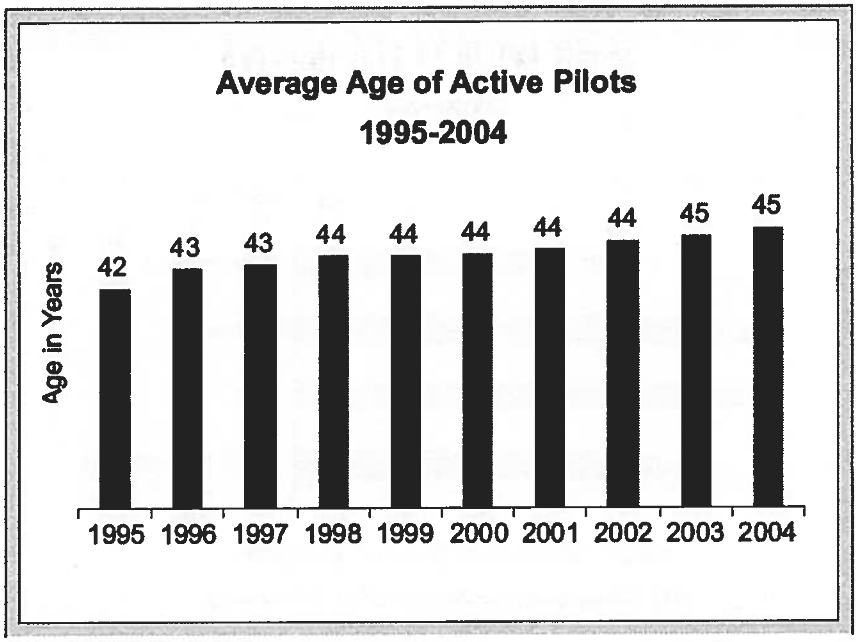
Type Aircraft Flown by Accident Pilots With More than 200 Hours in Accident Aircraft Type, 2004



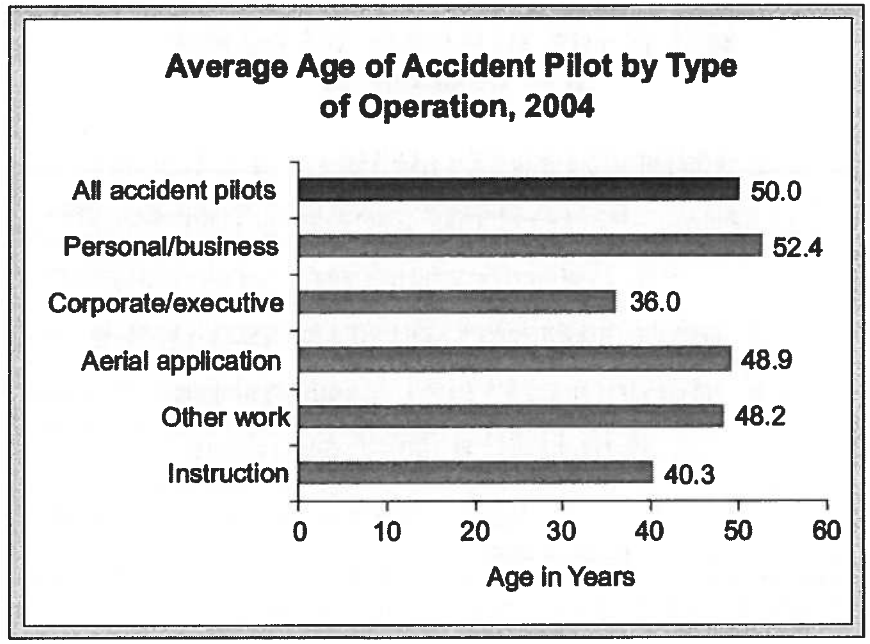
Comparison of the two figures in the right column, page 26, shows that accident pilots with more than 200 hours in make and model were more likely than pilots with fewer hours in type to be flying rotorcraft or multi-engine piston, jet, or turboprop airplanes.

Age

The average age of all active pilots in the U.S. increased steadily from 1995 through 2004 and by 2004 was 45[32] years. In contrast, the average age of general aviation accident pilots was 50. Despite the difference in average age, no meaningful conclusions can be made regarding specific age-related accident risk because FAA flight-hour activity numbers are not available for each age group. Age differences could be the result of activity if opportunities for recreational flying were to increase with age.

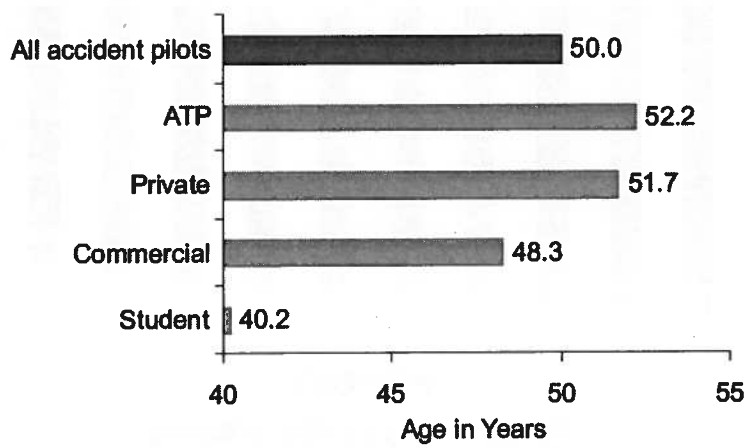


The two figures that follow on this page and the next show the relationship of the accident pilot's age by type of operation and by highest pilot certificate.



[32] Available at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2004/>.

Average Age of Accident Pilot by Highest Pilot Certificate, 2004



Accident Occurrences for 2004

Safety Board accident reports document the circumstances of an accident as "accident occurrences" and "sequence of events." Occurrence data can be defined as *what* happened during the accident. A total of 54 occurrence codes are available to describe the events for any given accident.[33] Because aviation accidents are rarely limited to a single occurrence, each occurrence is coded as part of a sequence (that is, occurrence 1, occurrence 2, etc.), with as many as six different occurrence codes in one accident. For accidents that involve more than one aircraft, the list of occurrences may be different for each aircraft. Of the 1,601 accident aircraft in 2004 for which data are available, 1,285 cited 2 or more occurrences, 725 cited 3 or more, 178 cited 4 or more, 12 cited 5 or more, and 2 cited a total of 6.

The excerpt from a brief report shown here, which is for a 2004 accident with four occurrences, illustrates how an accident with multiple occurrences is coded. In this accident, an airplane entered an inverted spin during a skydiving operation when a parachute deployed while the parachutist exited the airplane. The parachute became entangled around the landing gear and the parachutist could not be freed. The pilot, who was wearing a parachute, and the remaining parachutists jumped from the airplane. The airplane then impacted a flat field, inverted, and the entangled parachutist was killed. Each of these occurrences was coded in order, as shown.

Example of Occurrence Findings Cited in an NTSB Accident Brief, 2004

Occurrence #1: MISCELLANEOUS/OTHER
Phase of Operation: CRUISE

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: CRUISE

Occurrence #3: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: DESCENT – UNCONTROLLED

Occurrence #4: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT – UNCONTROLLED

[33] Two of the codes, missing aircraft and undetermined, do not represent operational events.

Occurrence data do not include specific information about why an accident may have happened; the first occurrence can instead be considered the first observable link in the accident chain of events. The following table displays first occurrences for all year-2004 general aviation accident aircraft with sequence of events data available. To simplify the presentation of accident occurrence data, similar occurrences can be grouped into eight major categories.

Among the eight major categories of first occurrences, the largest percentage of accidents (26%) related to aircraft power. Among the individual occurrences, the most common involved a loss of control in flight (13%), followed closely by loss of control on the ground (13%). Although occurrences involving loss of aircraft control on the ground resulted in only 4 fatal accidents in 2004, loss-of-control occurrences in flight resulted in a total of 77 fatal accidents—more than one-quarter of all fatal accidents and more than twice that of any other single occurrence.

General Aviation Accident First Occurrences, 2004

First Occurrences	Total	Fatal
Collision – In-flight	217	73
In-flight Collision with Object	115	35
In-flight Collision with Terrain/Water	63	22
Midair Collision	22	14
Undershoot	17	2
Near Collision Between Aircraft	0	0
Noncollision – In-flight	414	162
Loss Of Control - In-flight	215	77
Airframe/Component/System Failure/Malfunction	96	19
In-flight Encounter with Weather	92	62
Abrupt Maneuver	4	3
Vortex Turbulence Encountered	2	1
Altitude Deviation, Uncontrolled	1	0
Forced Landing	4	0
Decompression	0	0
Collision – On-ground or Water	93	1
On Ground/Water Collision with Object	37	0
On Ground/Water Encounter with Terrain/Water	40	0
Collision Between Aircraft (Other Than Midair)	10	0
Dragged Wing, Rotor, Pod, Float or Tail/Skid	6	1
Noncollision – On-ground or Water	399	7
Loss of Control - On Ground/Water	213	4
Hard Landing	114	1
Overrun	46	0
Nose Over	11	1
Roll Over	8	1
Propeller/Rotor Contact to Person	1	0
Propeller Blast or Jet Exhaust/Suction	1	0
Nose Down	0	0
Ditching	0	0
On Ground/Water Encounter with Weather	5	0

First Occurrences (Cont.)	Total	Fatal
Power Related	420	55
Loss of Engine Power	161	25
Loss of Engine Power(Total) - Nonmechanical	117	11
Loss of Engine Power(Total) - Mech Failure/Malf	57	8
Loss of Engine Power(Partial) - Nonmechanical	38	7
Loss of Engine Power(Partial) - Mech Failure/Malf	43	3
Propeller Failure/Malfunction	1	0
Rotor Failure/Malfunction	3	1
Engine Tear-away	0	0
Landing Gear	25	0
Gear Collapsed	6	0
Wheels-up Landing	11	0
Main Gear Collapsed	2	0
Gear Retraction on Ground	2	0
Nose Gear Collapsed	3	0
Complete Gear Collapsed	0	0
Wheels-down Landing in Water	1	0
Tail Gear Collapsed	0	0
Other Gear Collapsed	0	0
Gear Not Extended	0	0
Gear Not Retracted	0	0
Miscellaneous	31	3
Miscellaneous/Other	18	2
Fire	9	1
Cargo Shift	0	0
Fire/Explosion	2	0
Hazardous Materials Leak/Spill	0	0
Explosion	2	0
Undetermined	2	2
Missing Aircraft	1	1
Undetermined	1	1

Phase of Flight

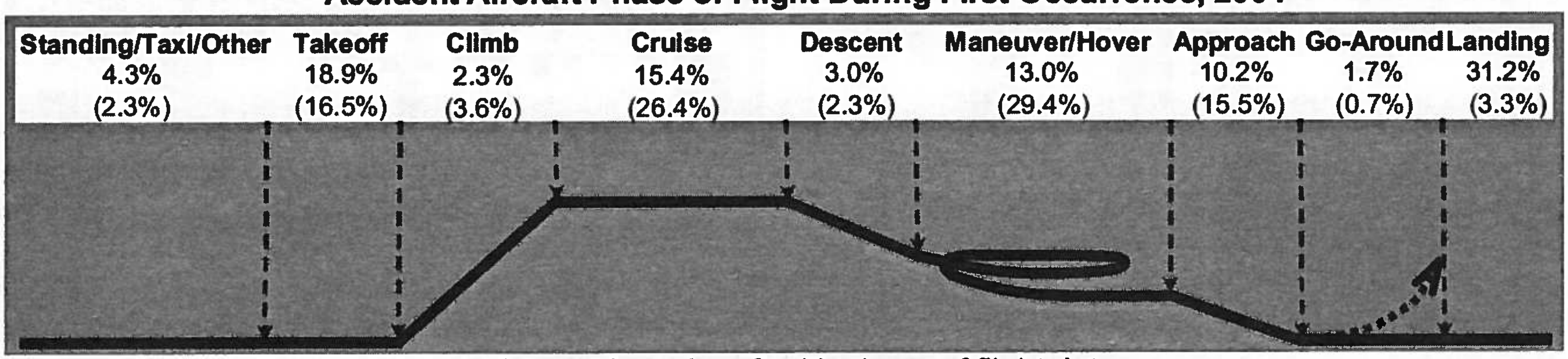
The figure below displays the percentage of accident aircraft in each phase of flight at the time of the first occurrence. The phase of flight defines when, during the operation of the aircraft, the first occurrence took place. Fifty distinct phases of flight are used to describe the operational chronology of occurrences. To simplify this information, the detailed phases are grouped into the nine broad categories shown. For example, the category "approach" includes any segment of an instrument approach, or position in the airport traffic pattern, and continues until the aircraft lands on the runway. The upper set of numbers shows the percentage of accidents associated with each phase for first occurrences, and the numbers in parentheses show the percentage of fatal accidents in each phase associated with first occurrences.

As shown here, half of all general aviation accidents (50%) occurred during either takeoff or landing, despite the relatively short duration of these phases compared to the entire profile of a normal flight. This high number of accidents reflects the increased workload during takeoff and landing when the flight crew must control the aircraft, change altitude and speed, communicate with air traffic control (ATC) and/or other aircraft, and maintain separation from obstacles and other aircraft. Aircraft systems are also stressed during takeoff and landing with changes to engine power settings, the possible operation of retractable landing gear, flaps, slats, and spoilers, and changes in cabin pressurization. In addition, while the aircraft is at low altitude, it is also most susceptible to hazards caused by wind and weather conditions.

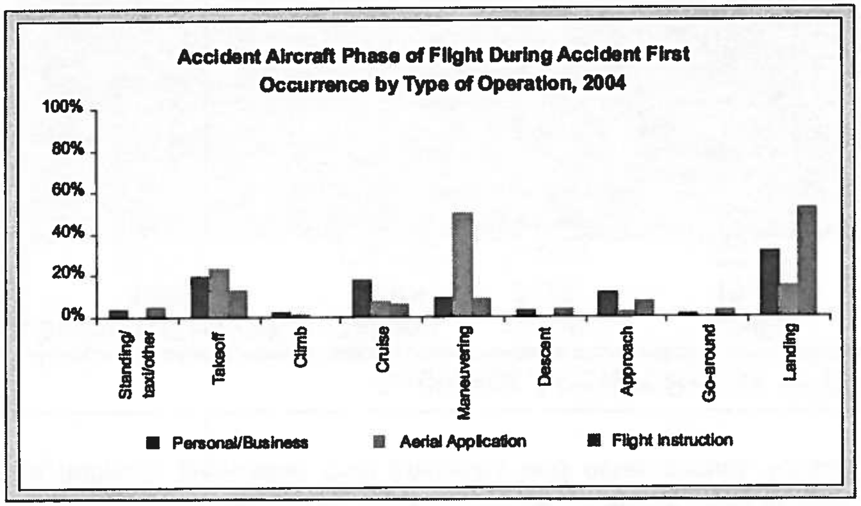
Notably, landing accounted for the largest percentage of total accident first occurrences (31%) of any single phase but only 3% of fatal accident first occurrences. The combination of cruise and maneuvering phases accounted for over half (56%) of fatal accident first occurrences, but less than one-third (28%) of all accidents. These differences reflect the relative severity of accidents that are likely to occur during each phase. Accidents during cruise and maneuvering are more likely to result in higher levels of injury and aircraft damage due to higher speeds and altitudes.

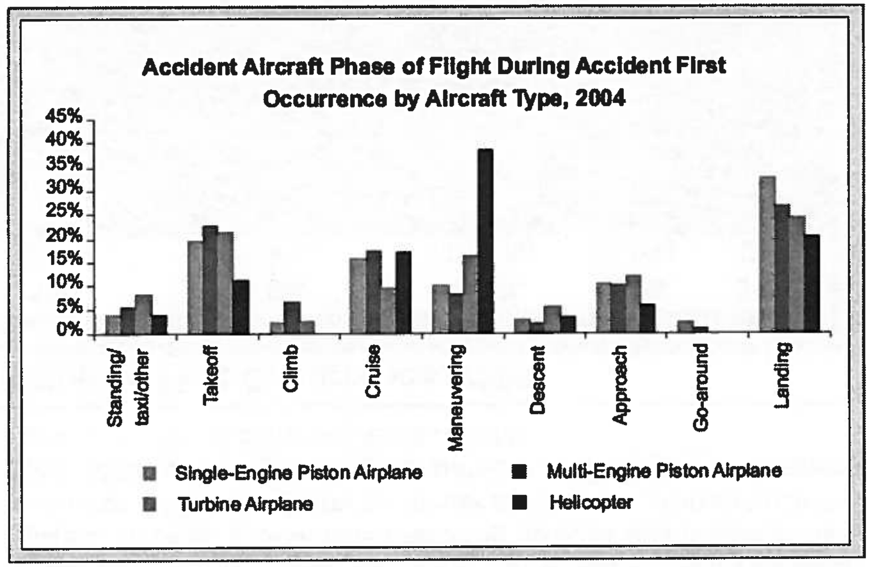
The likelihood of an aircraft accident first occurrence during each phase of flight varies by aircraft type and type of operation due to the unique hazards associated with each. For example, flight instruction typically involves a lot of time practicing takeoffs and landings. As a result, about 52% of all first occurrences for 2004 involving instructional flights occurred during landing compared to 31% of personal/business flights and 15% of aerial application flights.

Accident Aircraft Phase of Flight During First Occurrence, 2004



1,601 accident aircraft with phase of flight data





Accident phase-of-flight differences among aircraft types are the result of the amount of time spent in each phase, aircraft-specific hazards associated with that phase, and the type of operations typically conducted with that aircraft. For example, the largest percentage of first occurrences for accidents involving helicopter flights, about 39%, occurred while maneuvering. The percentage of accidents during this phase reflects the hazards unique to helicopters while hovering and during operations that are unique to helicopters, such as carrying external loads. In contrast, the largest percentage of accidents involving single-engine piston aircraft occurred during landing. Takeoff accounted for 20-25% of accidents involving airplanes, but only 11% of accidents involving helicopters.

Chain of Occurrences

An accident's first occurrence and phase of flight during first occurrence indicate how and when an accident begins. However, the entire accident can also be viewed as a chain of all the accident occurrences cited in the order in which they happen. As previously discussed, accident events often include a combination of multiple occurrences, with many possible combinations. For example, of the 1,601 accidents that occurred during 2004 for which occurrence data are available, 405 unique combinations of accident occurrences were cited. The following tables, which list the top ten combinations of occurrences for all accidents and fatal accidents, illustrate the most common events.

Rank	Chain Of Occurrences - All GA Accidents, 2004	Number of Accidents
1	1) LOSS OF CONTROL - IN FLIGHT - 2) IN FLIGHT COLLISION WITH TERRAIN/WATER	133
2	1) IN FLIGHT COLLISION WITH OBJECT	59
3	1) LOSS OF CONTROL - ON GROUND/WATER - 2) ON GROUND/WATER ENCOUNTER WITH TERRAIN/WATER	57
4	1) HARD LANDING	54
5	1) IN FLIGHT COLLISION WITH TERRAIN/WATER	52
6	1) LOSS OF CONTROL - ON GROUND/WATER - 2) ON GROUND/WATER COLLISION WITH OBJECT	38
7	1) IN FLIGHT COLLISION WITH OBJECT - 2) IN FLIGHT COLLISION WITH TERRAIN/WATER	31
8	1) ON GROUND/WATER COLLISION WITH OBJECT	30
9	1) IN FLIGHT ENCOUNTER WITH WEATHER - 2) LOSS OF CONTROL - IN FLIGHT - 3) IN FLIGHT COLLISION WITH TERRAIN/WATER	29
10	1) LOSS OF CONTROL - IN FLIGHT - 2) IN FLIGHT COLLISION WITH OBJECT	26

The top ten occurrence chains cited in fatal accidents are similar to those cited for all accidents. Loss of control followed by in-flight collision with terrain or water tops both lists, with almost half those accidents being fatal. It is important to note that, although this was the most frequent chain of occurrences in 2004, it accounted for only 8% of all accidents for the year.

Rank	Chain Of Occurrences - Fatal GA Accidents, 2004	Number of Accidents
1	1) LOSS OF CONTROL - IN FLIGHT - 2) IN FLIGHT COLLISION WITH TERRAIN/WATER	60
2	1) IN FLIGHT COLLISION WITH TERRAIN/WATER	20
3	1) IN FLIGHT ENCOUNTER WITH WEATHER - 2) LOSS OF CONTROL - IN FLIGHT - 3) IN FLIGHT COLLISION WITH TERRAIN/WATER	20
4	1) IN FLIGHT COLLISION WITH OBJECT	16
5	1) IN FLIGHT COLLISION WITH OBJECT - 2) IN FLIGHT COLLISION WITH TERRAIN/WATER	14
6	1) IN FLIGHT ENCOUNTER WITH WEATHER - 2) IN FLIGHT COLLISION WITH TERRAIN/WATER	13
7	1) AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION - 2) LOSS OF CONTROL - IN FLIGHT - 3) IN FLIGHT COLLISION WITH TERRAIN/WATER	11
8	1) LOSS OF CONTROL - IN FLIGHT - 2) IN FLIGHT COLLISION WITH OBJECT	11
9	1) LOSS OF ENGINE POWER - 2) FORCED LANDING - 3) LOSS OF CONTROL - IN FLIGHT - 4) IN FLIGHT COLLISION WITH TERRAIN/WATER	9
10	1) MIDAIR COLLISION	9

A diverse range of events can, in combination, result in an accident. Fatal accidents, however, are more likely to result from an in-flight collision, often preceded by loss of control and/or weather encounters or equipment malfunctions. For example, all of the top ten chains of fatal accident occurrences included an in-flight collision with terrain or object, events that are more likely to result in the high impact forces likely to cause serious injury. In contrast to the severity of these cases, most accidents in 2004 did not involve catastrophic events, and a large number of accidents involved aircraft on the ground that resulted in minor or no injuries.

Most Prevalent Causes/ Factors for 2004

Probable Causes, Factors, Findings, and the Broad Cause/ Factor Classification

Besides coding accident occurrences, the Safety Board makes a determination of probable cause with the objective of defining the cause and effect relationships in the accident sequence. The probable cause could be described as *why* the accident happened. In determining probable cause, the Board considers the facts, conditions, and circumstances of the event. Within each accident occurrence, any information that helps explain why that event happened is identified as a "finding" and may be further designated as either a "cause" or "factor." The term "factor" is used to describe situations or circumstances that contributed to the accident cause. The details of probable cause are coded as the combination of all causes, factors, and findings associated with the accident. Just as accidents often include a series of events, the reason why those events led to an accident reflects a combination of multiple causes and factors. For this reason, a single accident report can include multiple cause and factor codes, as shown in the following brief.

Example of NTSB Accident Brief, 2004

Occurrence #1: IN FLIGHT ENCOUNTER WITH WEATHER
Phase of Operation: CRUISE

Findings
1. (F) PREFLIGHT BRIEFING SERVICE - NOT FOLLOWED - PILOT IN COMMAND
2. (C) PLANNING/DECISION - INADEQUATE - PILOT IN COMMAND
3. (C) VFR FLIGHT INTO IMC - INADVERTENT - PILOT IN COMMAND
4. (F) WEATHER CONDITION - FOG
5. (F) WEATHER CONDITION - DRIZZLE/MIST
6. (F) WEATHER CONDITION - OBSCURATION

Occurrence #2: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

Findings
7. (C) CLEARANCE - NOT MAINTAINED - PILOT IN COMMAND
8. TERRAIN CONDITION - GROUND

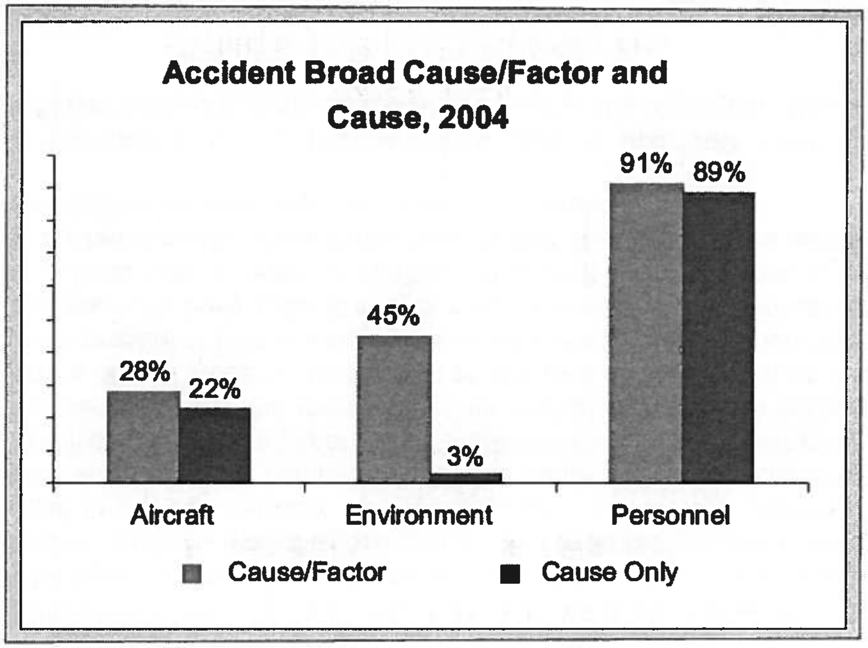
Findings Legend: (C) = Cause, (F) = Factor

The National Transportation Safety Board determines the probable cause(s) of this accident as follows: the pilot's inadequate planning/decision which resulted in VFR flight into IMC, and his failure to maintain terrain clearance. Contributing factors were the pilot's failure to follow the briefing recommendation, fog, mist, and observation.

During a cross-country flight, the pilot encountered instrument meteorological conditions (IMC), and the airplane was destroyed after impacting the terrain in a nose-low attitude. Radar data depicted the airplane traveling in a west-northwesterly direction. Then, approximately 4 minutes before the accident, the airplane executed a series of 360-degree turns. The investigation revealed that before the flight, the pilot had obtained a weather briefing and the briefer informed the pilot that a VFR flight was not recommended. Witnesses at the departure airport stated that before the flight, the pilot and passenger seemed tired and anxious to get home. A witness located near the accident site reported misty and foggy weather conditions and visibility of about 200 feet. In this accident, the pilot's decision-making about the flight, inadvertent flight into IMC, and inability to maintain clearance from terrain were cited as causes. The preflight briefing and weather were all cited as factors, and the terrain was cited as the only finding.

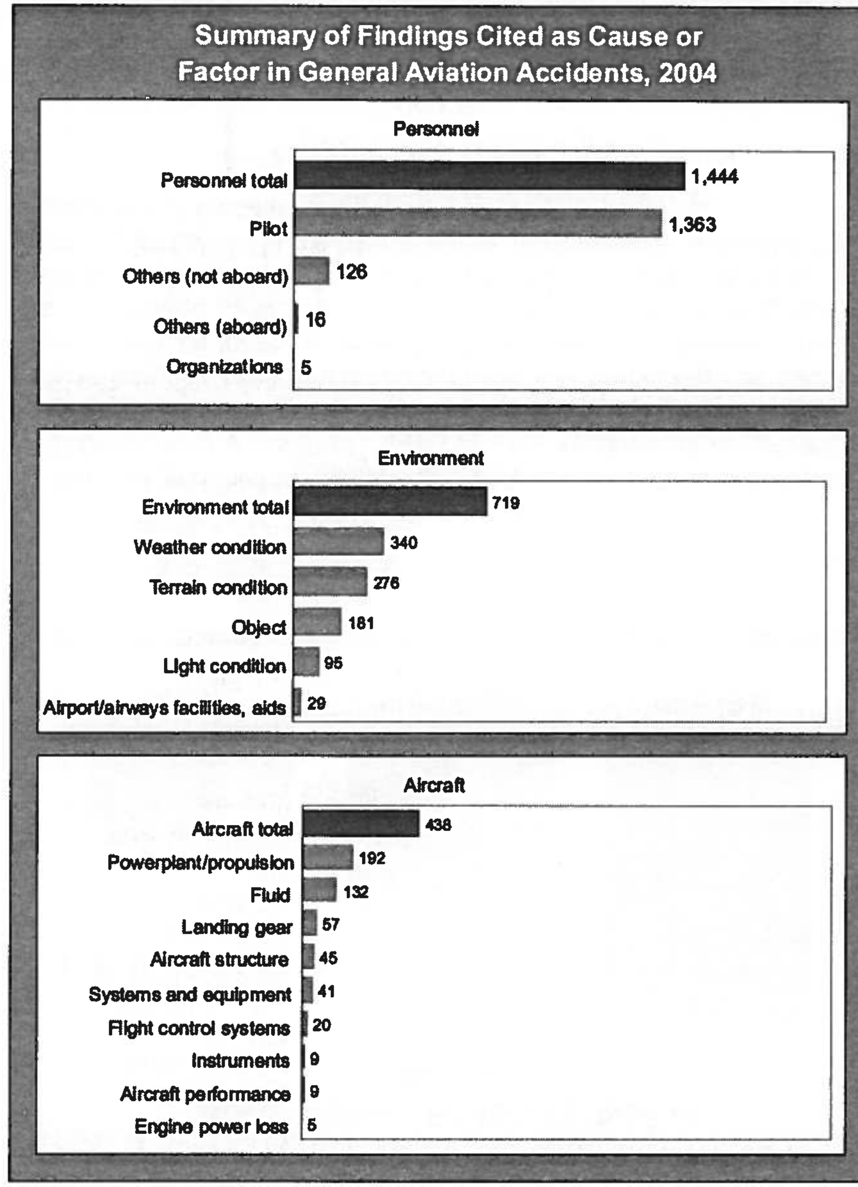
To simplify the presentation of probable cause information in this review, the hundreds of unique codes used by investigators to code probable cause can be grouped into three broad cause/factor categories: aircraft, environment, and personnel. The following figure shows the percentage of general aviation accidents that fall into each category. Personnel-related causes or factors were cited in 91% of the 1,585 general aviation accident reports for 2004 for which cause/factor data were available (see the following figure). Environmental causes/factors were cited in 45% of these accident reports, and aircraft-related causes/factors were cited in 28%.[34]

[34] Because the Safety Board frequently cites multiple causes and factors for an aircraft accident, the number of causes and factors will result in a sum greater than the total number of accidents.



Environmental conditions are rarely cited as an accident cause but are more likely to be cited as a contributing factor. In 2004, only 47 of 719 environmental citations (3% of all causes/factors cited) were listed as a cause, with the remainder listed as contributing factors. For example, rough terrain might be cited as a contributing factor, but not a cause, to explain why an aircraft was damaged during a forced landing due to engine failure. In that case, the origin(s) of the engine failure would be cited as cause, but the terrain would be cited as a factor because it contributed to the accident outcome.

As mentioned previously, several hundred unique codes are available to document causes/factors, as summarized in the group of tables to the right (1,585 accidents with findings).

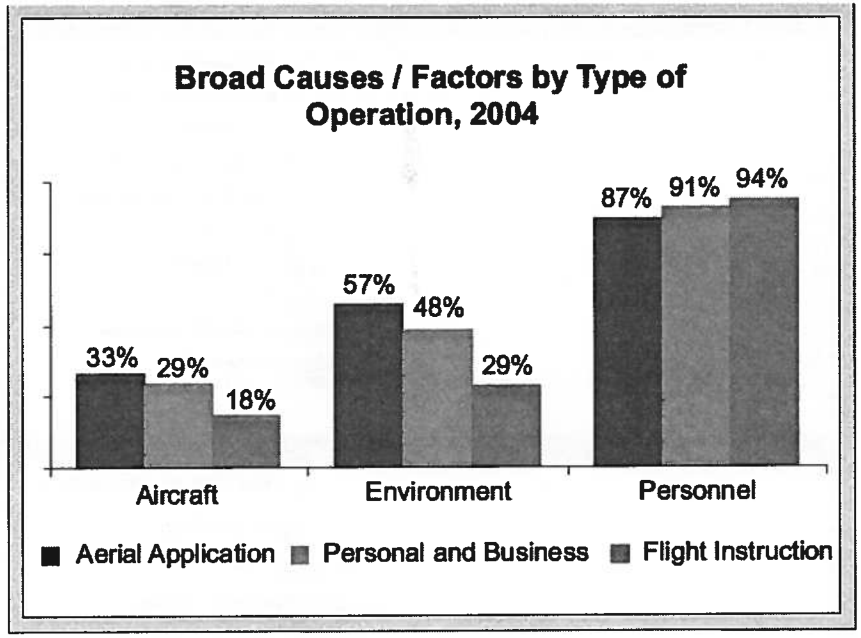


As the figure on this page shows, most causes and factors attributed to general aviation accidents in 2004 were related to personnel. Much like the pilot and passenger injury differences discussed previously, part of the reason why personnel are cited so often may have to do with exposure to risk. Personnel, and pilots in particular, are associated with every flight. However, potential aircraft and environmental accident causes and factors depend on a range of variables, including the type of flight, type of aircraft, time of day, time of year, and location.

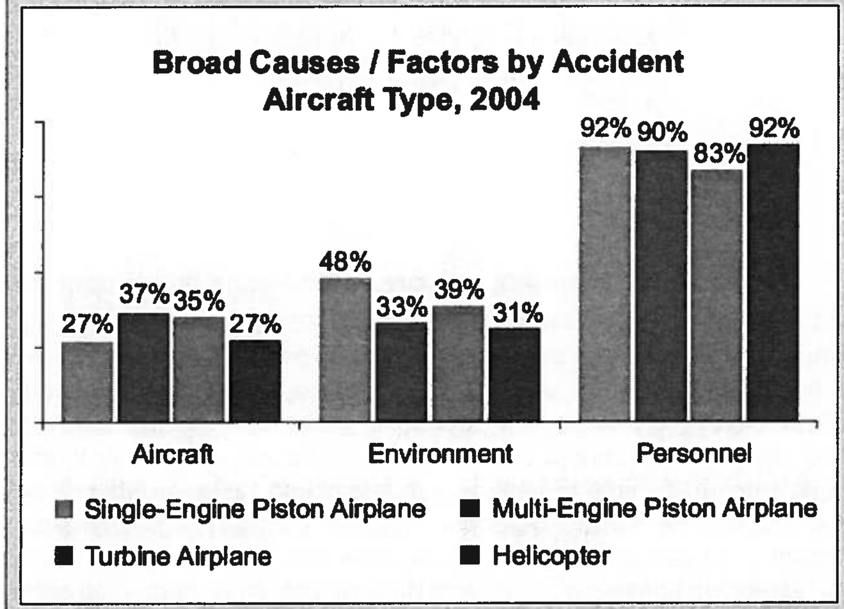
Although the pilot was the most frequently cited individual in the personnel category in 2004, other persons not aboard the aircraft were also cited as a cause or factor in 126 accidents. Such personnel included flight instructors, maintenance technicians, and airport personnel. In the broad category of environmental factors, weather conditions were cited in 340 (21%) of the accidents. Powerplant-related[35] causes/factors, cited in 192 (12%) of all general aviation accidents, were the most commonly cited aircraft factors.

The figure on this page shows how specific accident causes and factors varied by type of flight operation. For example, personnel were cited in 94% of instructional flight accidents and 91% of personal/business accidents, compared to 87% of aerial application accidents. The high percentage of personnel causes/factors for flight instruction accidents is likely the result of aircraft control and decision-making errors due to students' lower level of skill and ability, as well as the large amount of time practicing maneuvers like takeoffs and landings that are more likely to result in accidents. In contrast, aerial application accidents cited a higher percentage of aircraft causes/factors, most likely because the low altitude flown during spray operations allows few options for recovery in the event of a mechanical failure.

A comparison of the causes/factors cited in accidents involving different types of aircraft reveals similar results. The higher percentage of multi-engine piston accidents that cited aircraft causes/factors in 2004 is likely a result of more complex systems as compared to single-engine piston airplanes. Conversely, the high reliability of turbine engines likely contributes to the low percentage of aircraft-related findings for those aircraft. There is also a noticeable drop in the percentage of environmental cause/factor citations progressing from single- to multi-engine piston, and to turbine airplane accidents, mirroring increases in the typical range, performance, and equipment capabilities of those aircraft.



35 Powerplant/propulsion causes and factors include any partial loss or disruption of engine power, as well as the malfunction or failure of any part(s), equipment, or system associated with engine propulsion. Engine power loss refers only to the total loss of engine power.



Human Performance

The information recorded in the personnel category refers primarily to *whose* actions were a cause or factor in an accident. However, details about the actions or behavior that may have led to an accident, causal data related to human performance issues, and any underlying explanatory factors are also recorded. The information in these categories can be thought of as *how* and *why* human performance contributed to the accident. For example, if a pilot becomes disoriented and loses control of an aircraft after continuing visual flight into instrument flight conditions, the pilot's inability to maintain control would be cited as a "cause" in the personnel category, and planning/decision-making would likely also be cited in the human performance issues category.

Of the 1,349 accidents for which the cause or factor was attributed to human performance in 2004, the most frequently cited cause/factor was aircraft handling and control (71%), followed by planning and decision-making (39%) and use of aircraft equipment (11%). Issues related to personnel qualification were cited in about 28% of the 139 accidents with underlying explanatory factors related to human performance. Examples of qualification issues that were cited in the 2004 accident record included lack of total experience, lack of recent experience, and lack of certification.

Human Performance and Explanatory Causes / Factors, 2004

	All Accidents	Fatal Accidents
Human Performance Issues	1,349	270
Aircraft handling/control	960	222
Planning/decision	532	122
Use of aircraft equipment	146	16
Maintenance	87	19
Communications/Information/ATC	56	11
Meteorological service	8	7
Airport	2	0
Dispatch	0	0
Underlying Explanatory Factors	139	57
Physiological condition	49	36
Qualification	39	15
Psychological condition	35	6
Procedure inadequate	9	3
Aircraft/equipment inadequate	5	0
Institutional factors	5	3
Information	3	2
Material inadequate	2	0
Facility inadequate	0	0

Weather as a Cause/Factor

Because general aviation aircraft are usually smaller, slower, and more limited in maximum altitude and range than transport-category aircraft, they can be more vulnerable to hazards posed by weather. Smaller aircraft are affected to a greater degree by adverse wind conditions, and precipitation, icing, and convective weather have a greater effect on aircraft that lack the speed, altitude, and/or range capabilities to avoid those conditions. Weather conditions cited most often as a cause or factor in general aviation accidents are related to winds, including gusts, crosswind, and tailwind.

The top three environmental causes/factors cited in general aviation accidents in 2004 were all related to wind. Because aircraft are most susceptible to the effects of wind during takeoffs and landings, the effect of adverse wind was reflected in a high percentage of general aviation accidents that occurred during those phases of flight.

As previously discussed, most landing accidents do not result in fatal injuries. Because of the strong association of wind with landing accidents, it is not surprising that most wind-related accidents in 2004 were not fatal. The wind-related weather factors gusts, crosswind, and tailwind were cited as a cause/factor in 182 accidents, but only 4 of those accidents were fatal. Among fatal general aviation accidents, the three most frequently cited weather factors were related to conditions that resulted in reduced visibility, including clouds, low ceiling, and fog. Accidents under conditions of low visibility typically involve either loss of aircraft control and/or collision with obstacles or terrain, both of which are likely to result in severe injuries and aircraft damage. The high number of fatal general aviation accidents occurring in low visibility weather led the Safety Board to conduct a safety study of these accidents.[36] Several of the weather-related accidents that occurred during 2004 were included in that study.

Weather Condition	All Accidents	Fatal Accidents
	340	85
Gusts	69	3
Crosswind	64	0
Tailwind	49	1
Low ceiling	31	27
Clouds	30	28
High density altitude	20	4
High wind	20	4
Carburetor icing conditions	18	0
Fog	18	14
Downdraft	15	3
Icing conditions	11	6
Thunderstorm	10	7
Windshear	9	0
Turbulence	7	3
Rain	7	4
Sudden windshift	6	0
Snow	5	5
Unfavorable wind	5	0
Drizzle/mist	5	5
Variable wind	4	1
Turbulence, terrain induced	3	1
Obscuration	3	2
Dust devil/whirlwind	3	0
Below approach/landing minimums	2	1
Haze/smoke	2	1
Other	2	1
Turbulence, clear air (CAT)	1	0
Temperature, high	1	0
Temperature, low	1	1
Thermal lift	1	0
Whiteout	1	0
Turbulence (thunderstorms)	1	1
Turbulence, convection induced	1	1
Ice fog	1	1

Note: due to the possibility of multiple findings, the sum of causes/factors is greater than the total number of accidents.

[36] National Transportation Safety Board, *Risk Factors Associated with Weather-Related General Aviation Accidents*, NTSB/SS-05/01 (Washington, DC: 2005).

Focus on General Aviation Safety: Regulatory Changes Associated with the Sport Pilot Certificate and Light Sport Aircraft

This section includes statistical data and a discussion of significant regulatory changes related to the sport pilot certificate and light sport aircraft that went into effect in 2004. This section is not meant to be an exhaustive discussion of all aspects of the regulatory changes, but rather a discussion of the details of an issue important to general aviation.

The approach used in this section of the 2004 *Annual Review* differs from the rest of this review and from most other annual reviews by including data from accidents that occurred after the review year. An accident investigation—particularly when fatalities are involved—may take a year or more to complete. The Safety Board typically produces an annual review of accidents after more than 95% of the investigations during that year are complete, resulting in a difference between the publication year of an annual review and the date of accidents analyzed. The new light sport aircraft and sport pilot certificate rules were selected as the special topic for the 2004 review because the rule was enacted in 2004, and it represents a significant regulatory change affecting general aviation.

New Regulation

In July 2004, the FAA issued the final rule for certification of aircraft and airmen for the operation of light sport aircraft, and the rule went into effect in September that year. The associated changes to 14 CFR Parts 1, 21, 43, 45, 61, 65, and 91 established new maintenance, certification, and operational regulations for a new designation of aircraft—light sport—as well as requirements for sport pilots.

Light Sport Aircraft

The regulatory changes enacted in 2004 grew out of an industry desire to recognize a group of aircraft new to U.S. general aviation.[37] These aircraft are heavier and more capable than traditional ultralights, but far less sophisticated than larger aircraft, and are used primarily for recreation. As defined by 14 CFR 1.1, light sport aircraft are "... aircraft, other than helicopter or powered-lift," that meet the specifications below:

Maximum weight
- 1,320 pounds for operation not intended to take place over water
- 1,430 pounds for operations intended to take place on water

Maximum airspeed in level flight with maximum continuous power
- Not more than 120 knots

Maximum stall speed: 45 knots

Configuration
- Single reciprocating engine
- Fixed or ground-adjustable propeller
- Non-pressurized cabin
- Fixed landing gear

Maximum seating capacity: 2, including pilot

Six Classes
- Airplanes
- Gliders
- Balloons
- Weight shift (new class)
- Powered parachute (new class)
- Gyroplane (experimental light sport only)

[37] Although light sport aircraft (LSA) represent a new concept for domestic aviation, similar "microlight" aircraft have been common in European general aviation for many years, and many of the first LSA models available in the U.S. were imported.

The two types of light sport aircraft airworthiness certificates are special light sport (S-LSA) and experimental light sport (E-LSA). S-LSAs are factory-built aircraft manufactured in accordance with American Society for Testing and Materials (ASTM) consensus standards for light sport aircraft. Applicants for special airworthiness certificates for S-LSAs are required to provide the FAA with a manufacturer's statement of compliance (FAA Form 8130-15) and satisfactory evidence that the aircraft was manufactured to the applicable consensus standards.[38] Since S-LSAs are not built under a type certificate, an FAA inspector or designated airworthiness representative (DAR) must complete a records inspection, documentation review, and airworthiness inspection of each aircraft built. For the same reason, there is no mechanism for issuing supplemental type certificates (STCs) or airworthiness directives (ADs) for S-LSAs. Therefore, the manufacturer must approve all modifications and is responsible for issuing service alerts and bulletins when necessary.

E-LSAs can include a wide range of experimental aircraft, including kit- or amateur-built aircraft that meet the operational definition of an LSA, existing two-seat ultralight trainers brought onto the registry,[39] or manufactured LSAs whose owners wish to modify or otherwise operate in a manner requiring the aircraft to be recertified as an E-LSA rather than an S-LSA.

A significant change associated with light sport aircraft was the introduction of an industry consensus standard in lieu of the traditional FAA aircraft certification requirements.[40] In response to comments on the light sport/sport pilot notice of proposed rulemaking (NPRM),[41] the FAA stated why it made this change: "the consensus standard process will minimize costs while meeting the level of safety appropriate for these aircraft." The FAA accepted the first industry consensus standards for manufactured light sport aircraft in February 2005, a few months after the law passed.

Sport Pilots

The sport pilot airman certificate differs from the private pilot certificate in that it requires a minimum of 20 hours total flight time compared to the 40 hours required by the private pilot certificate, with some additional operating limitations. Sport pilots may only operate light sport aircraft or aircraft that meet the light sport definition.[42] Sport pilots may not carry more than one passenger and may not operate an aircraft at night, above 10,000 feet mean sea level, when flight visibility is less than 3 statute miles, or in class A airspace. Additional training and a logbook endorsement are required for a sport pilot to operate an aircraft in B, C, or D airspace, or to operate from a control-towered airport.

In addition to new training requirements and operating limitations,

[38] See 14 CFR 21.190 and FAA Order 8130.2F, "Airworthiness Certification of Aircraft and Related Products."

[39] Two-place ultralight trainers formerly operated under an exemption in 14 CFR Part 103.

[40] The National Technology Transfer and Advancement Act of 1995 mandated that federal agencies "use technical standards that are developed or adopted by voluntary consensus standards bodies." The guidance for using consensus standards stated, "federal agencies and departments shall consult with voluntary, private sector consensus bodies and shall, when such participation is in the public interest and is compatible with agency and departmental missions, authorities, priorities, and budget resources, participate with such bodies in the development of technical standards." The Office of Management and Budget provided related guidance that, "when properly conducted, standards development can increase productivity and efficiency in Government and industry, expand opportunities for international trade, conserve resources, improve health and safety, and protect the environment."

[41] *Federal Register*, Vol. 69, No. 143 (Tuesday, July 27, 2004), p. 44788.

[42] Examples of previously type-certificated aircraft that meet the light-sport operational definition include models of Piper Cub, Taylorcraft, Aeronca, Luscombe, and Ercoupe.

the sport pilot certificate includes a self-certification medical requirement. Pilots holding a sport pilot certificate or operating under its provisions[43] are not required to hold a medical certificate to act as pilot-in-command, but may instead use a valid, current driver's license and determine for themselves whether they are medically fit to fly.

Accidents

Between September 1, 2004, and October 31, 2007, 19 general aviation accidents involved pilots holding a sport pilot certificate, and 41 general aviation accidents involved S-LSA airplanes piloted by airmen holding certificates of all levels. These accidents are summarized below.

Sport Pilot Accidents

Of the 19 accidents for which the accident pilot held a sport pilot certificate, two resulted in fatalities (a total of three fatalities), five resulted in serious injuries (a total of five serious injuries), two resulted in a minor injury, and the remaining ten accidents resulted in no injuries.

Only two of the accident pilots who held a sport pilot certificate were flying S-LSAs. Another two pilots were flying normally certificated aircraft that met the operational definition of LSA. The remaining pilots were flying amateur-built aircraft that met the operational definition of LSA or existing ultralights registered or re-registered in the experimental light sport category—including one power-parachute and one gyroplane.

As the following table indicates, the average number of flight hours for accident pilots holding sport pilot certificates was noticeably lower than for those holding private certificates. The average pilot-in-command and total flight times of sport pilots were slightly higher than student pilots and noticeably lower than private pilots. The low number of total hours among sport pilots might have been due in part to the recent introduction of the sport pilot certificate.

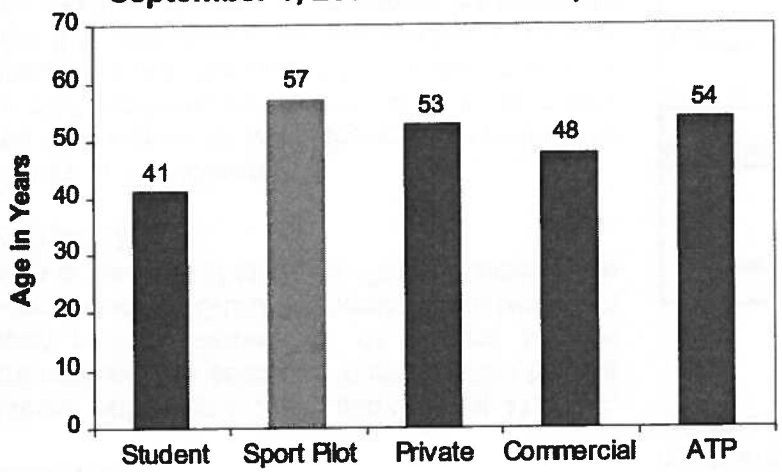
Average Flight Time of General Aviation Accident Pilots by Highest Certificate Held
September 1, 2004-October 31, 2007

		Student	Sport Pilot	Private	Commercial	ATP
Last 90 Days	All Aircraft	26	29	26	95	99
	Same make/model	24	31	21	60	48
Pilot in Command	All Aircraft	49	213	857	3,716	9,071
	Same make/model	20	92	293	987	818
Total	All Aircraft	91	255	1,070	4,357	12,092
	Same make/model	54	100	865	1,195	903

[43] Airmen holding a private, commercial, or airline transport pilot certificate may act as pilot-in-command of an aircraft meeting the definition of light sport using the driver's license medical provision, while adhering to the operational limitations of the sport pilot certificate.

As shown below, accident pilots holding sport pilot certificates were older on average than holders of all other types of pilot certificate. The driver's license medical provision may contribute to the popularity of the sport pilot certificate and may encourage persons to apply who are concerned about their ability to meet the medical requirements for another pilot certificate.

Average General Aviation Accident Pilot Age by Highest Certificate Held September 1, 2004 - October 31, 2007



Despite the apparent simplicity of using a driver's license in lieu of a medical certificate, sport pilots must also meet the requirements of 14 CFR 61.23(c)(2), which state that the person must:

(i) Comply with each restriction and limitation imposed by that person's U.S. driver's license and any judicial or administrative order applying to the operation of a motor vehicle;

(ii) Have been found eligible for the issuance of at least a third-class airman medical certificate at the time of his or her most recent application (if the person has applied for a medical certificate);

(iii) Not have had his or her most recently issued medical certificate (if the person has held a medical certificate) suspended or revoked or most recent Authorization for a Special Issuance of a Medical Certificate withdrawn; and

(iv) Not know or have reason to know of any medical condition that would make that person unable to operate a light-sport aircraft in a safe manner.

The bottom line is that, even if pilots use driver's licenses in lieu of medical certificates, they are still responsible as pilot-in-command for ensuring that they are fit to conduct a flight safely and that they do not fly if they know of any condition that could affect their ability to fly.

Light Sport Aircraft Accidents

Due to the potentially large variations in aircraft types that may be certificated as E-LSA, the aircraft-specific data presented in this section are limited to S-LSA airplanes. Of the 41 accidents between September 1, 2004, and October 31, 2007, involving S-LSA airplanes, 7 were fatal[44] (11 fatalities); 6 resulted in serious injuries (8 serious injuries); 7 resulted in minor injuries (11 minor injuries); and the remaining 21 resulted in no injuries. The total number of accidents as of October 31, 2007, was small enough that percentages associated with accident subgroups may not yet indicate a trend; however, the ratio of fatal S-LSA accidents to total S-LSA accidents is similar to that of general aviation overall at approximately 17%.

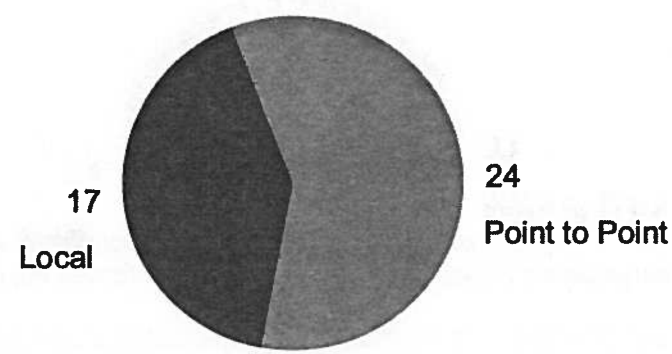
[44] One accident involved an aircraft that, at the time of writing, was missing and presumed to involve fatal injury.

Although the privileges of the sport pilot certificate include some restrictions on where and how flight operations can be conducted, there are no similar restrictions on the operation of light sport aircraft. Rather than being a lower class of aircraft, many light sport aircraft are equipped with advanced avionics, glass cockpit displays, and autopilots. A properly equipped light sport aircraft can be certified for instrument flight and can be flown in any condition or for any purpose allowed by the certification of the pilot-in-command. Of the S-LSA accidents included in this review, all but one occurred during daylight hours and all 41 occurred in VMC. In addition to personal recreation, light sport aircraft can be used to conduct flight training and can be offered for rental.[45] Twelve of the S-LSA accident aircraft were being used for instructional flights at the time of the accident and the remaining 29, for personal/business flights. Seventeen of the S-LSA accident aircraft were being used for local flights.

The sport pilot rule establishes a new type of pilot certificate; however, any holder of a higher level pilot certificate may also use the driver's license medical provision to act as pilot-in-command of an E-LSA, S-LSA, or normally certificated aircraft that meets the operational definition of an LSA, as long as he or she adheres to the operational limitations of the sport pilot certificate. Only two of the accident pilots flying S-LSA aircraft held a sport pilot certificate as their highest level of certification. Three of the accident pilots held student pilot certificates and the remaining pilots held private certificates or greater.

The figure on the next page compares data concerning the average number of flight hours for pilots flying S-LSA and normally certificated single-engine piston aircraft involved in accidents occurring between September 1, 2004, and October 31, 2007. Note that the average number of flight hours for accident pilots flying S-LSA airplanes is relatively high overall and very similar to the single-engine pilots on average. The exception is the time in make/model, which is understandably low because the aircraft type is new. Accordingly, these averages may change in the future but they do indicate that most persons piloting S-LSA airplanes hold a private pilot or greater certificate and had previous flying experience.

Accidents Involving S-LSA Aircraft on Local and Point-to-Point Flights September 1, 2004 - October 31, 2007

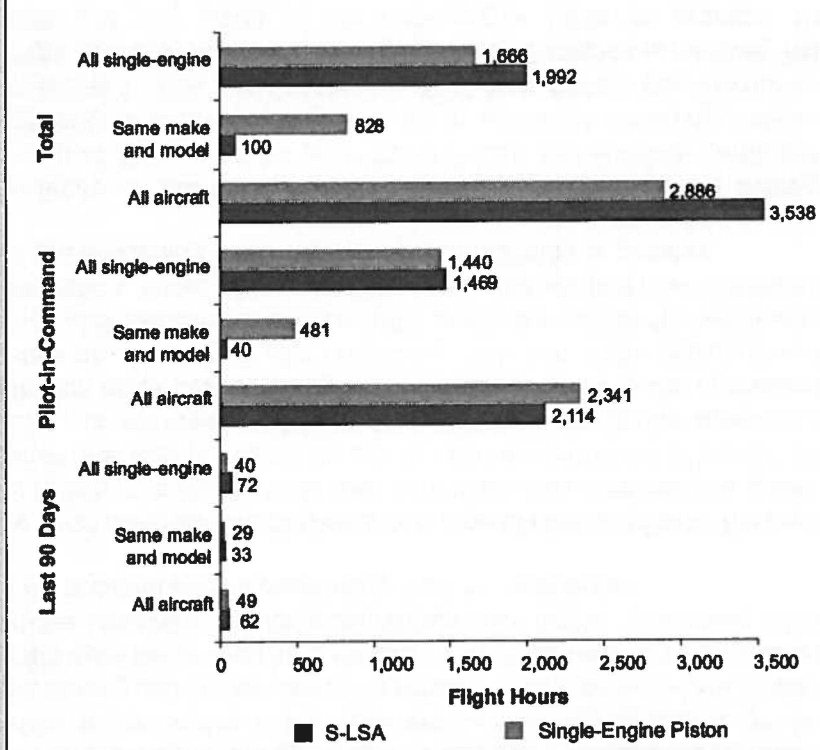


As mentioned previously, sport pilots using driver's licenses in lieu of medical certificates may do so because they are concerned that they may be unable to pass the medical examination required to continue or resume flying. When compared to accident pilots flying single-engine piston aircraft during the same period, pilots and student pilots flying S-LSA airplanes were noticeably older than those flying single-engine piston aircraft.

At least 10 of the 41 accident pilots held either no medical certificate or an expired certificate and were using the driver's license provision. As previously mentioned, 14 CFR 61.23(c)(2) states that when using the driver's license provision, pilots-in-command cannot fly if they are taking medication or experiencing a condition that would make them ineligible for a medical certificate.

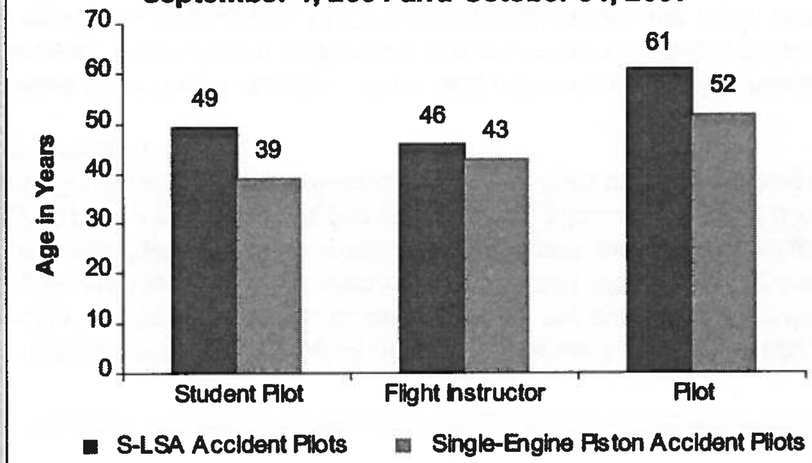
[45] Experimental light sport aircraft may be used for flight instruction, but may not be rented.

Comparison of Average Flight Time of Accident Pilots Flying S-LSAs and Single-Engine Piston Airplanes September 1, 2004, and October 31, 2007



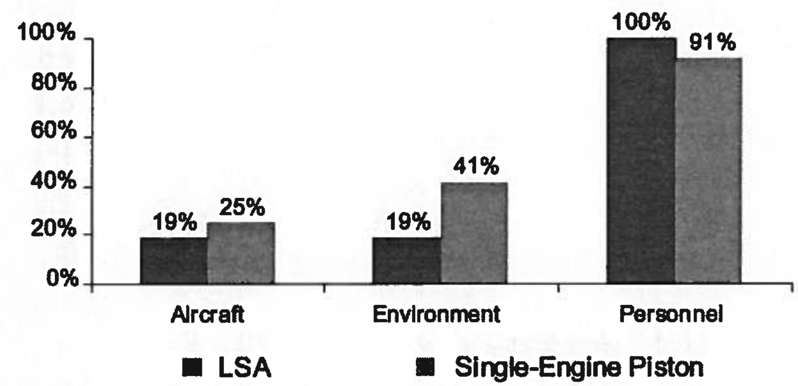
As of publication, probable cause was available for 32 of the 41 accidents involving S-LSA airplanes. The breakdown of broad cause/factor categories cited in S-LSA investigations indicates that personnel were cited in all of the accidents with probable cause released and that light sport aircraft were involved in more loss-of-control and hard landings than type-certificated single-engine piston-powered airplanes. The percentages of cases citing aircraft or environment as cause or factor were lower than for accidents involving other single-engine piston

Average Pilot Age for Accidents Involving S-LSA and Standard Single-Engine Piston Aircraft September 1, 2004 and October 31, 2007



aircraft, but the validity of this finding may be limited by the small number of S-LSA investigations that have been completed.

Comparison of Broad Cause / Factors of Completed Investigations of Accidents Involving S-LSA and Single - Engine Piston Aircraft September 1, 2004, and October 31, 2007



Summary

The recent addition of the light sport aircraft and sport pilot certificate regulations is a significant change for U.S. general aviation. It appears that the largest effect to date may have been to encourage inactive pilots to resume flying, or to transition pilots to light sport aircraft to take advantage of the driver's license medical provisions of the certificate. This change may affect general aviation for years to come as pilots—and the population in general—continue to age. As more data are collected on sport pilot and light sport aircraft operations, it will be important to follow the use of the medical provision, as well as pilot and aircraft-related data, to identify any effect of the new rule on general aviation safety.

Appendix A: The National Transportation Safety Board Aviation Accident/Incident Database

The National Transportation Safety Board is responsible for maintaining the government's database on civil aviation accidents. The Safety Board's Accident/Incident Database is the official repository of aviation accident data and causal factors. The database was established in 1962 and about 2,000 new event records are added each year.

The Accident/Incident Database is primarily composed of aircraft accidents. An "accident" is defined in 49 CFR 830.2 as "an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage." The database also contains a select number of aviation "incidents," defined in 49 CFR 830.2 as "occurrences other than accidents that are associated with the operation of an aircraft and that affect or could affect the safety of operations."

Accident investigators use the Safety Board's Accident Data Management System (ADMS) software to enter data into the Accident/Incident Database. Shortly after the event, a preliminary report containing a few data elements such as date, location, aircraft operator, type of aircraft, etc. becomes available. A factual report with additional information concerning the occurrence is available within a few months. A final report, which includes a statement of the probable cause and other contributing factors, may not be completed for months until the investigation is closed.

An accident-based relational database is currently available to the public at http://www.ntsb.gov/ntsb/query.asp#query_start. It contains records of about 40,000 accidents and incidents that occurred between 1982 and the present. Each record may contain more than 650 fields of data concerning the aircraft, event, engines, injuries, sequence of accident events, and other topics. Individual data files are also available for download at ftp://www.ntsb.gov/avdata, including one complete data set for each year beginning with 1982. The data files are in Microsoft Access (.mdb) format and are updated monthly. This download site also provides weekly "change" updates and complete documentation.

Appendix B: Definitions

Definitions of Safety Board Severity Classifications

The severity of a general aviation accident or incident is classified as the combination of the highest level of injury sustained by the personnel involved (that is, fatal, serious, minor, or none) and level of damage to the aircraft involved (that is, destroyed, substantial, minor, or none). Accidents include those events in which any person suffers fatal or serious injury, or in which the aircraft receives substantial damage or is destroyed. An event that results in minor or no injuries *and* minor or no damage is not classified as an accident.

Definitions for Highest Level of Injury

Fatal—Any injury that results in death within 30 days of the accident.

Serious—Any injury that (1) requires the individual to be hospitalized for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5% of the body surface.

Minor—Any injury that is neither fatal nor serious.

None—No injury.

Definitions for Level of Aircraft Damage

Destroyed—Damage due to impact, fire, or in-flight failures to the extent that the aircraft cannot be repaired economically.[1]

Substantial Damage—Damage or failure that adversely affects the structural strength, performance, or flight characteristics of the aircraft, and that would normally require major repair or replacement of the affected component. Engine failure or damage limited to an engine if only one engine fails or is damaged, bent fairings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered "substantial damage."[2]

Minor Damage—Any damage that neither destroys the aircraft nor causes substantial damage (see definition of substantial damage for details).

None—No damage.

[1] Title 49 CFR 830.2 does not define "destroyed." This term is difficult to define because aircraft are sometimes rebuilt even when it is not economical to do so.

[2] See 49 CFR 830.2.

Appendix C: The National Transportation Safety Board Investigative Process

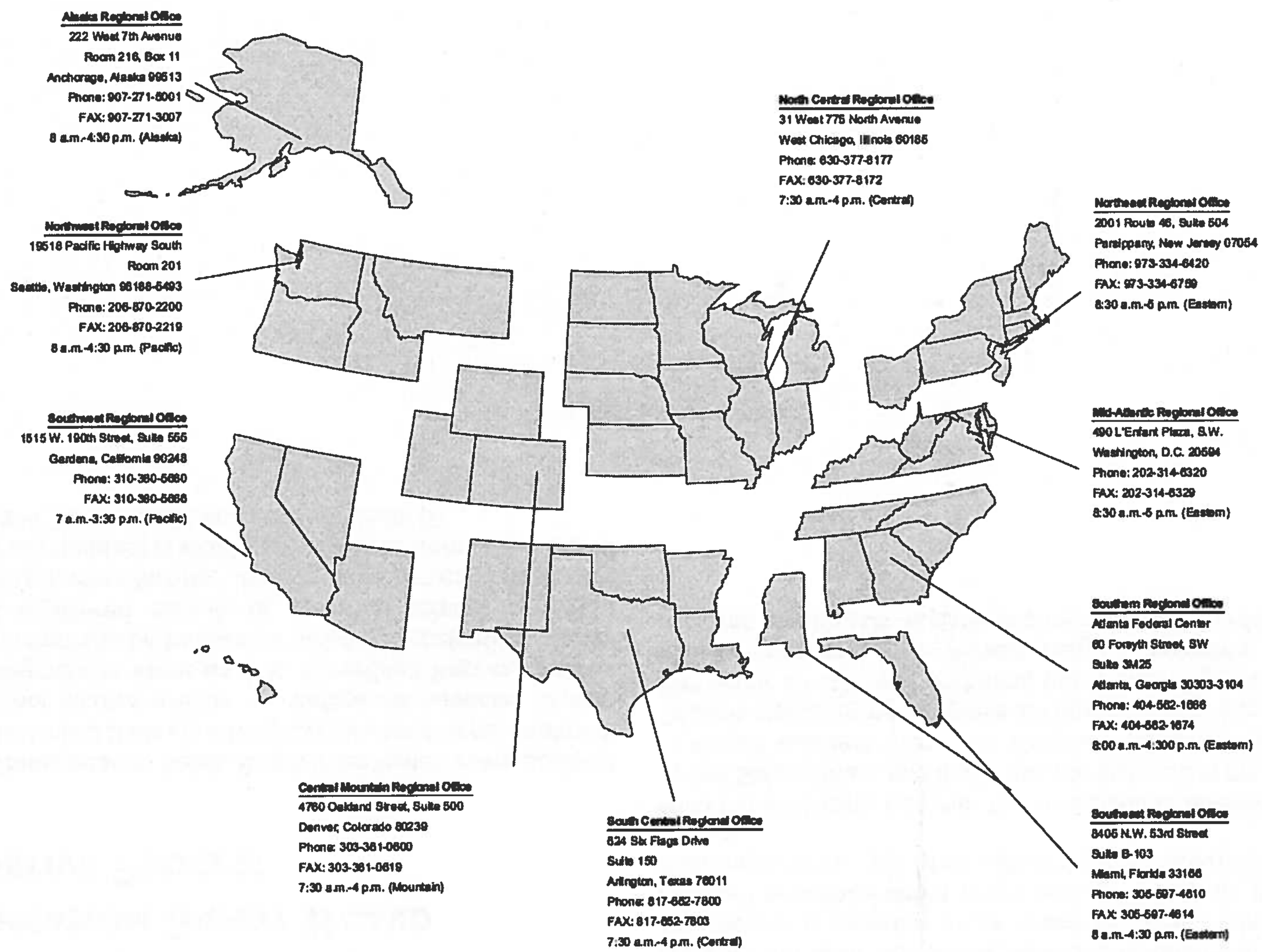
The National Transportation Safety Board investigates every accident that occurs in the United States involving civil aviation and public aircraft flights that do not involve military or intelligence agencies. It also provides investigators to serve as U.S. Accredited Representatives as specified in international treaties for aviation accidents overseas involving U.S.-registered aircraft or involving aircraft or major components of U.S. manufacture.[1] Investigations are conducted from Safety Board Headquarters in Washington, D.C. or from one of the 10 regional offices in the United States (see appendix D).

In determining probable cause(s) of a domestic accident, investigators consider the facts, conditions, and circumstances of the event. The objective is to ascertain those cause and effect relationships in the accident sequence about which something can be done to prevent recurrence of the type of accident under consideration.

Note the distinction between the population of accidents investigated by the Safety Board and those that are included in the *Annual Review of Aircraft Accident Data, U.S. General Aviation*. Although the Safety Board is mandated by Congress to investigate all civil aviation accidents that occur on U.S. soil (including those involving both domestic and foreign operators), the *Annual Review* describes accidents that occurred among U.S.-registered aircraft in all parts of the world.

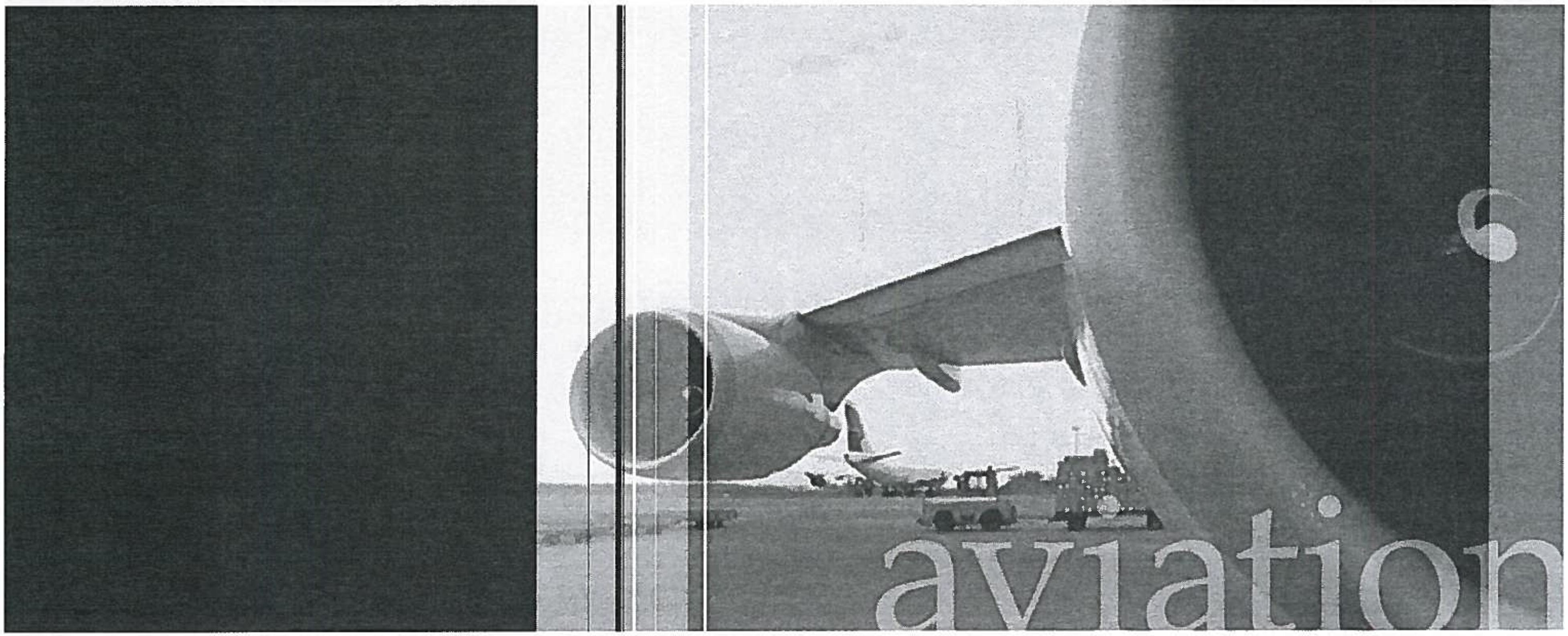
[1] For more detailed information about the Safety Board's investigation of aviation accidents or incidents, see 49 CFR 831.2.

APPENDIX D: NATIONAL TRANSPORTATION SAFETY BOARD REGIONAL OFFICES[1]



[1] As of fiscal year 2004.

Annual Review of Aircraft Accident Data
U.S. General Aviation, Calendar Year 2003



ACCIDENT REPORT

NTSB/ARG-07/01
PB2007-105388

National Transportation Safety Board

Annual Review of Aircraft Accident Data

U.S. General Aviation, Calendar Year 2003

NTSB/ARG-07/01
PB2007-105388
Notation 7534E
Adopted November 29, 2006

National Transportation Safety Board
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594

National Transportation Safety Board. 2007. *U.S. General Aviation, Calendar Year 2003.* Annual Review of Aircraft Accident Data NTSB/ARG-07/01. Washington, D.C.

Abstract: The National Transportation Safety Board's *2003 Annual Review of Aircraft Accident Data for U.S. General Aviation* is a statistical compilation and review of general aviation accidents that occurred in 2003 involving U.S.-registered aircraft. As a summary of all U.S. general aviation accidents for 2003, the review is designed to inform general aviation pilots and their passengers and to provide detailed information to support future government, industry, and private research efforts and safety improvement initiatives.

The National Transportation Safety Board is an independent Federal agency dedicated to promoting aviation, railroad, highway, marine, pipeline, and hazardous materials safety. Established in 1967, the agency is mandated by Congress through the Independent Safety Board Act of 1974 to investigate transportation accidents, determine the probable causes of the accidents, issue safety recommendations, study transportation safety issues, and evaluate the safety effectiveness of government agencies involved in transportation. The Safety Board makes public its actions and decisions through accident reports, safety studies, special investigation reports, safety recommendations, and statistical reviews.

Recent publications are available in their entirety on the Web at <http://www.ntsb.gov>. Other information about available publications also may be obtained from the Web site or by contacting:

National Transportation Safety Board
Records Management Division, CIO-40
490 L'Enfant Plaza, S.W.
Washington, D.C. 20594
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Contents

2003 General Aviation Accident Summary

A total of 1,739 general aviation accidents occurred during calendar year 2003, involving 1,758 aircraft.[1] The number of general aviation accidents in 2003 was slightly higher than in 2002, with a 1% increase of 24 accidents. Of the total number of accidents, 352 were fatal, resulting in 632 fatalities. The number of fatal general aviation accidents in 2003 increased 2% from calendar year 2002, and the number of fatalities increased by 9%. The circumstances of these accidents and details related to the aircraft, pilots, and locations are presented throughout this review.

2003 General Aviation Accident Statistics

General Aviation Accidents	
Total Accidents	1,739
Fatal Accidents	352
Accident Aircraft	1,758
General Aviation Accident Injuries	
Fatal	632
Serious	324
Minor	523
Persons involved in accidents with no injuries	1,697
General Aviation Accident Rate	
General Aviation Hours Flown[a]	25,998,000
All Accidents[b]	6.67/100,000 hours
Fatal Accidents[b]	1.34/100,000 hours
Accidents per Active Pilots	2.78/1,000 active pilots
Fatal Accidents per Active Pilots	0.56/1,000 active pilots

[a] Federal Aviation Administration, *General Aviation and Air Taxi Survey, 2003.*
[b] Excludes events involving suicide, sabotage, and stolen/unauthorized use

[1] In this review, a collision between two aircraft is counted as a single accident. The 11 midair collision accidents that occurred in 2003 involved 22 general aviation aircraft. In addition, 9 ground collision accidents involved 17 general aviation aircraft.

INTRODUCTION

Purpose of the Review

The National Transportation Safety Board's *2003 Annual Review of Aircraft Accident Data for U.S. General Aviation* is a statistical compilation and review of general aviation accidents that occurred in 2003 involving U.S.-registered aircraft. As a summary of all U.S. general aviation accidents for 2003, the review is designed to inform general aviation pilots and their passengers and to provide detailed information to support future government, industry, and private research efforts and safety improvement initiatives.

The Safety Board drew on several resources in compiling data for this review. Accident data, for example, were extracted from the Safety Board's Aviation Accident/Incident Database.[2] Activity data were extracted from the *General Aviation and Air Taxi Activity Survey* (*GAATA Survey*)[3] and from *U.S. Civil Airmen Statistics*,[4] both of which are published by the Federal Aviation Administration (FAA), Statistics and Forecast Branch, Planning and Analysis Division, Office of Aviation Policy and Plans. Additional information was extracted from the *General Aviation Statistical Databook*, published by the General Aviation Manufacturers Association (GAMA).

What Is General Aviation?

General aviation can be described as any civil aircraft operation that is *not* covered under 14 *Code of Federal Regulations* (CFR) Parts 121, 129, and 135, commonly referred to as commercial air carrier operations.[5]

Which Operations Are Included in This Review?

This review includes accidents involving U.S.-registered aircraft operating under 14 CFR Part 91, as well as public aircraft[6] flights that do not involve military or intelligence agencies. Aircraft operating under Part 91 include aircraft that are flown for recreation and personal transportation and certain aircraft operations that are flown with the intention of generating revenue,[7] including business flying, flight instruction, corporate/executive flights, positioning or ferry flights, aerial application, pipeline/powerline patrols, and news and traffic reporting.

Which Aircraft Are Included in This Review?

General aviation operations are conducted using a wide range of aircraft, including airplanes, rotorcraft, gliders, balloons and blimps, and registered experimental or amateur-built aircraft. The diverse set

[2] See appendix A for more details.

[3] Although included in the *GAATA Survey*, data associated with air taxi and air tour operations are not included in this review.

[4] FAA, *U.S. Civil Airmen Statistics*, 2003, available online at <http://www.faa.gov/data_statistics/aviation_data_statistics/civil_airmen_statistics/>.

[5] For a review of accident statistics related to air carrier operations, see National Transportation Safety Board, *Annual Review of Aircraft Accident Data, U.S. Air Carrier Operations, Calendar Year 2003* (Washington, DC: 2006), available at <http://www.ntsb.gov>.

[6] Although the precise statutory definition has changed over the years, public aircraft operations for Safety Board purposes are qualified government missions that may include law enforcement, low-level observation, aerial application, firefighting, search and rescue, biological or geological resource management, and aeronautical research.

[7] See 14 CFR 119.1.

of operations and aircraft types included within the scope of general aviation must be considered when interpreting the data in this review. The type of aircraft being flown is usually closely related to the type of flight operation being conducted. Jet and turboprop aircraft are commonly used for corporate/executive transportation, smaller single-engine piston aircraft are commonly used for instructional flights, and a variety of aircraft types are used for personal and business flights.

Not included in this review are any accident data associated with aircraft operating under 14 CFR Parts 121, 129, or 135. Also not included are data for military or intelligence agencies, non-U.S.-registered aircraft, unregistered ultralights, and commercial space launches, unless the accident also involved aircraft conducting general aviation operations. Crashes involving illegal operations, stolen aircraft, suicide, or sabotage are included in the accident total, but not in accident rates.[8]

Organization of the Review

The *2003 Annual Review* is organized into four parts.

1. The first part summarizes general aviation accident statistics for 2003, industry markers related to general aviation activity in 2003, and contextual statistics from previous years.
2. The second part investigates trends over the past 10 years and provides context for such accident information as operation types, levels of aircraft damage, and injuries.
3. The third part focuses on specific circumstances of accidents that occurred during 2003. This section describes accident occurrences and summarizes the Safety Board's findings of probable cause and contributing factors.
4. The fourth section presents in-depth coverage of a special topic important to general aviation safety. The *2003 Annual Review* focuses on night flying, which has historically accounted for a disproportionate number of fatal accidents.

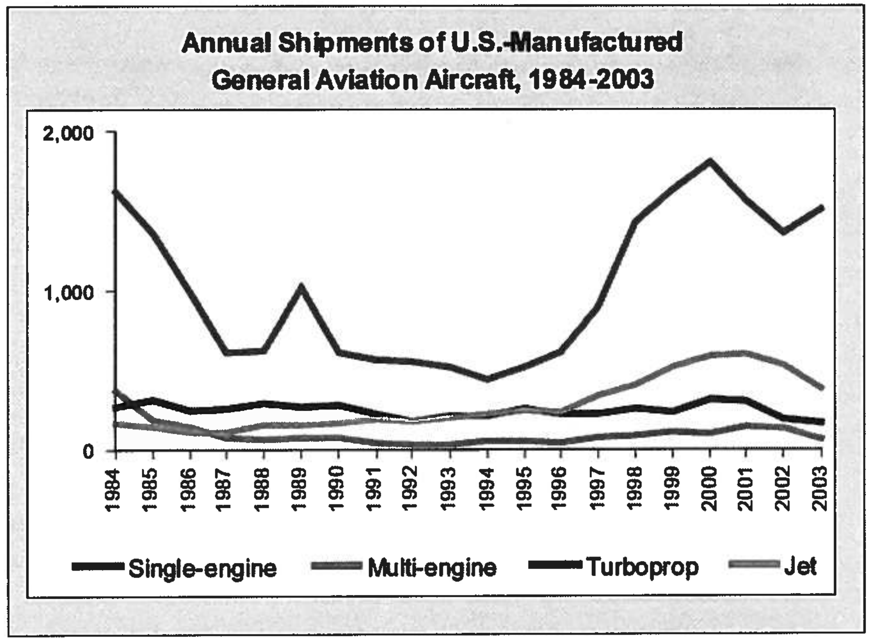
Graphics are used to present much of the information in this review. For readers who wish to view tabular data or to manipulate the data used in this review, the data set is available online at < http://www.ntsb.gov/aviation/Stats.htm>.

[8] In 2003, three crashes were attributed to pilot suicide and one accident to sabotage.

The General Aviation Environment in 2003

General Aviation Industry Indicators

A theme repeated throughout this review is that general aviation accident numbers should be interpreted in light of related information, such as aircraft type, type of operation, and operating environment. Because personal and business flying account for the largest percentage of general aviation flying, prevailing economic conditions and/or trends may noticeably affect both the general aviation industry and flight operations. In 2003, the general aviation climate was influenced by generally favorable economic conditions and an increase in general aviation aircraft production.

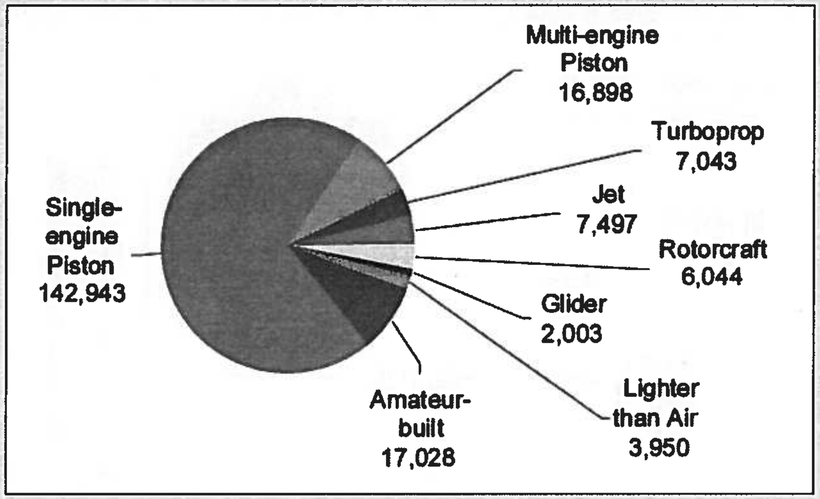


Fleet Makeup

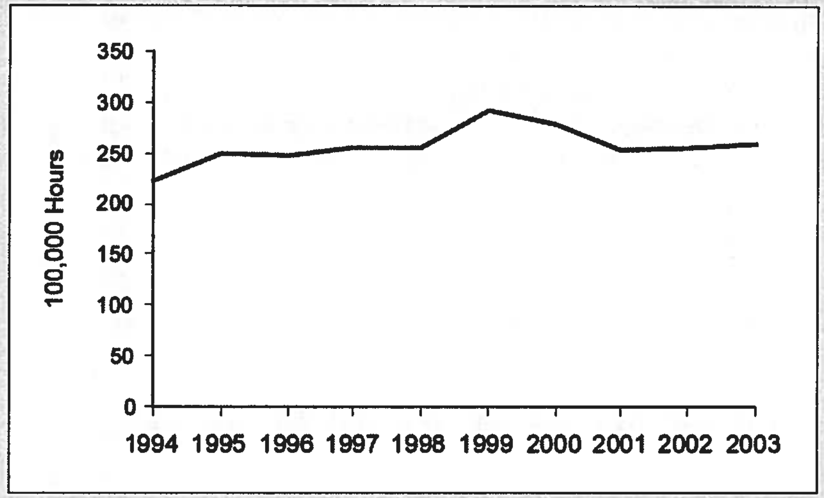
Although sales of new general aviation aircraft increased noticeably after the mid-1990s, most general aviation aircraft in use in 2003 were more than 25 years old.[9] U.S. manufacturers delivered 2,137 new general aviation aircraft in 2003, compared to an estimated total of 206,917 in service. Single-engine piston aircraft currently have the highest average age of all general aviation aircraft types and account for the largest percentage of the general aviation fleet. As a consequence, any structural or design improvements incorporated into newly manufactured aircraft may not be reflected in the accident record for several years. The safety benefits of improved equipment, such as avionics, are also difficult to track because most new equipment is also available for installation in older aircraft.

[9] In 2002, the FAA estimated the average age of all single-engine and multi-engine aircraft to be 31 years. No revised estimate is associated with 2003.

Number of Active Aircraft in General Aviation, 2003



Number of General Aviation Hours Flown Annually, 1994-2003



General Aviation Activity

Because general aviation includes such a diverse group of aircraft types and operations, some measure of exposure must be considered to make meaningful comparisons of accident numbers. Flight activity is typically used to normalize accident numbers across different groups, with the level of activity corresponding to the level of exposure to potential accident risk. Total flight hours, departures, and miles flown are common indicators used to measure activity. As the graph shows, annual general aviation flight hour estimates from 1994 through 2003 peaked in 1999, but were lower after that. In 2003, the estimated number of general aviation flight hours was 25.9 million, up slightly from 2002.

Activity data for general aviation are far less reliable than data available for commercial air carriers. Unlike Part 121 and scheduled Part 135 air carriers, which are required to report total flight hours, departures, and miles flown to the Department of Transportation,[10] operators of general aviation aircraft are not required to report actual flight activity data. As a result, activity for this group of aircraft must be estimated using data from the *GAATA Survey*,[11] which was established in 1978 to gather information about aircraft use, flight hours, and avionics equipment installations from owners of general aviation and on-demand Part 135 aircraft. General aviation activity data are considered less reliable because a sample of aircraft is selected from the registry of aircraft owners for use in the *GAATA Survey*, and reporting is not required.

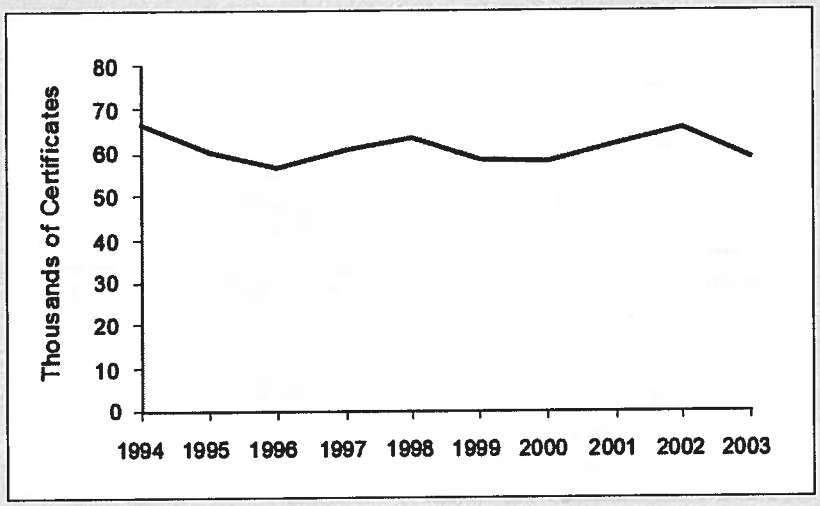
[10] Part 121 operators report activity monthly, and scheduled Part 135 operators report quarterly.

[11] The *GAATA Survey* is available at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2003/>.

In addition to flight-hour estimates, the number of pilots can be used to establish the level of exposure to risk for the various types of general aviation operations. Available measures of the pilot population include both the number of certificates issued to new pilots, which represents positive growth in the pilot population, and the number of medical certificates issued, which represents an informal census of all active pilots.

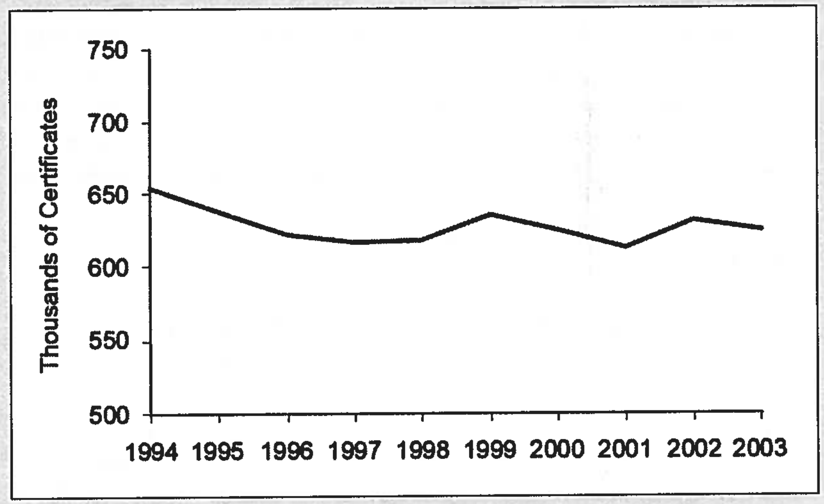
The number of new student pilot certificates annually fluctuated between 1994 and 2003.[12] The total number of new student certificates issued in 2003 came to 58,842, a decrease from the total of 65,421 issued in 2002.

Number of New Student Pilot Certificates Issued, 1994-2003



As shown by the number of medical certificates issued, the total number of active pilots in U.S. general aviation decreased steadily throughout the early and mid-1990s, from 702,659 in 1990 to 622,261 in 1996. Between 1997 and 2003, the number of active pilots fluctuated, with an estimated total of 625,011 active U.S. pilots in 2003.

Estimated Number of Active Pilot Certificates, 1994-2003



In summary, general aviation indicators—flight hours and the total number of active and newly issued pilot certificates—decreased annually between 1990 and 1996. From 1996 through 2003, the number of active and new student pilots fluctuated annually, with little overall change, during a period with a noticeable increase in estimated flight activity. This increase in activity had a noticeable effect on the accident rate and should be considered when attempting to interpret the general aviation accident record for 2003 in the context of previous years.

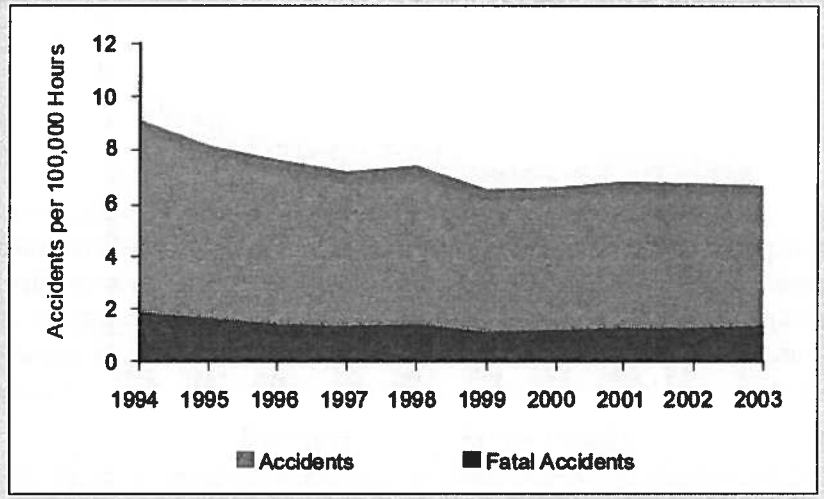
[12] FAA, *U.S. Civil Airmen Statistics*, 2003, is available at <http://www.faa.gov/data_statistics/aviation_data_statistics/civil_airmen_statistics/>.

Historical Trends in Accident Data

Accident Rates

In the last decade, the calculated general aviation accident rate declined overall as annual estimates of general aviation activity increased noticeably[13] without a corresponding increase in the number of accidents. The rate of 6.67 accidents per 100,000 hours flown in 2003 was substantially lower than the 9.08 accidents per 100,000 hours recorded in 1994. In fact, the 2003 rate was only slightly higher than that of 1999, which had the lowest rate since the Safety Board began reporting general aviation-only annual accident rates in 1975.[14] The relative percentage of fatal accidents remained fairly constant from 1994 through 2003, at 18 to 21% of the total rate. The 2003 rate of 1.34 fatal accidents per 100,000 flight hours was only slightly higher than the 2002 fatal accident rate of 1.33.

General Aviation Accident Rate
1994-2003

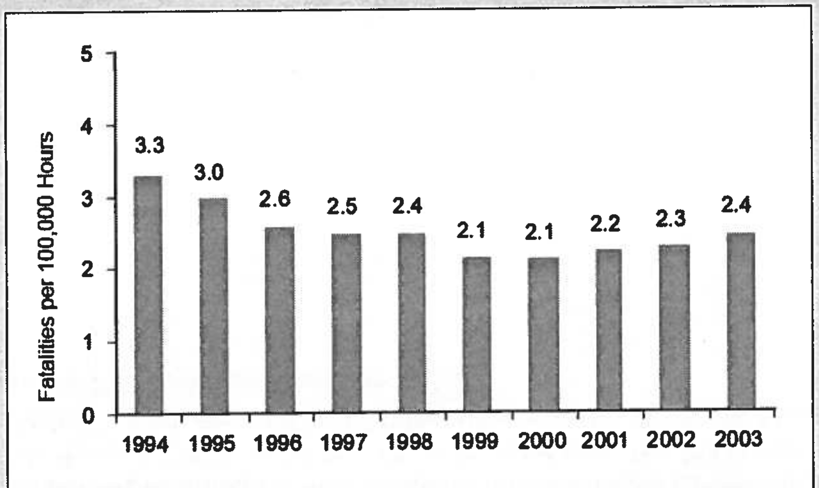


In 2003, accident-related deaths per flight hour were 2.43 fatalities per 100,000 hours flown. The highest annual fatality-per-hour rate occurred in 1994 with 3.28 deaths per 100,000 hours flown.

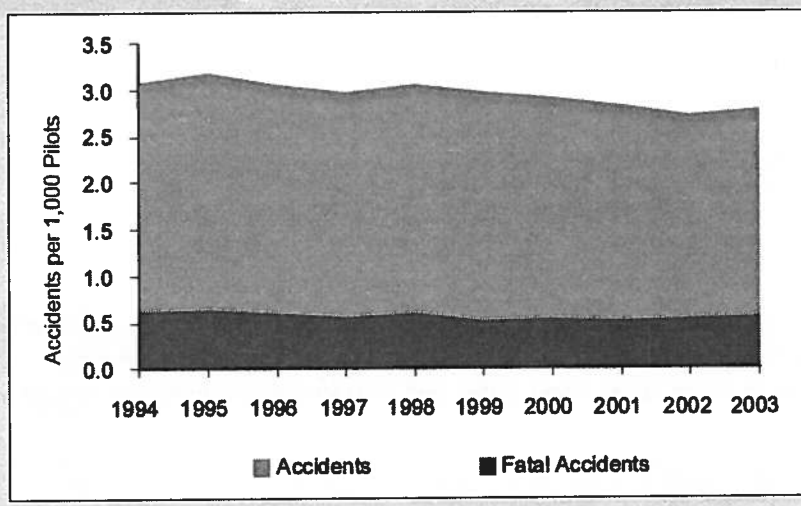
[13] FAA estimates of annual general aviation activity increased noticeably after 1998 due to a change of *GAATA Survey* methodology that increased the estimated general aviation aircraft population by about 10 %. See appendix A of the *GAATA Survey, Calendar Year 2003*, for an explanation of the changes in survey methodology.

[14] Prior to 1975, scheduled 14 CFR 135 "commuter" and non-scheduled 14 CFR 135 air taxi aircraft operations were included in the Safety Board's annual general aviation accident total and rate.

Number of General Aviation Fatalities per 100,000 Hours Flown, 1994-2003



General Aviation Accident Distribution per Active Pilot, 1994-2003



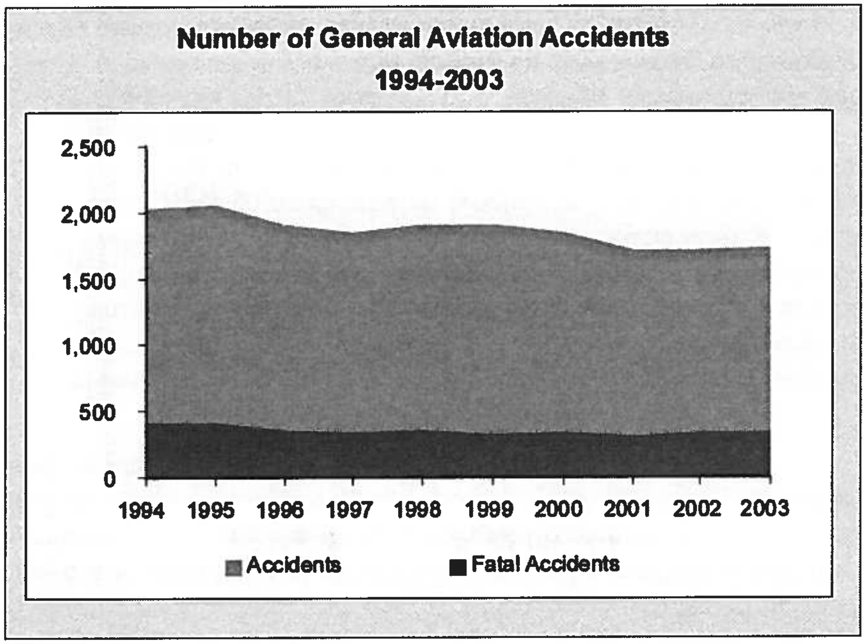
Another measure of accident distribution is the number of accidents per active pilot. Although this measure was considerably more stable from 1994 through 2003 than the per-hour accident rate, it did decrease slightly overall. The per-pilot rate in 2003 was only slightly higher than the low for the period, which occurred in 2002.

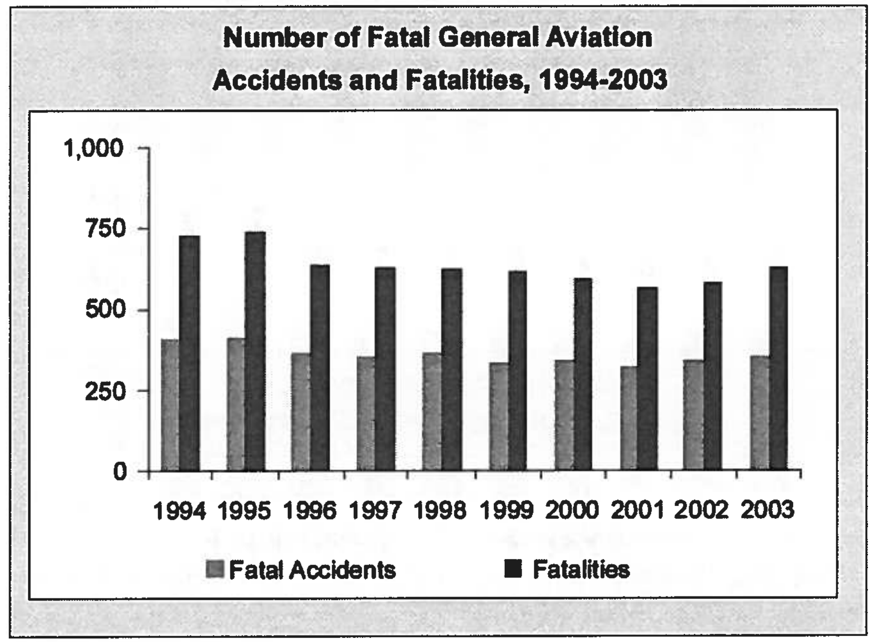
Accident rate calculations based on flight hours require the use of *GAATA Survey* activity data extrapolated from a relatively small sample of aircraft owners. As a result, the calculated values are accurate only to the extent that the sample represents the larger population of general aviation operators. For this reason, accident rate data presented in this review typically also include raw frequency data for comparison.

Number of Accidents and Fatalities

Although the number of general aviation accidents fluctuated slightly from year to year, the number of accidents that occurred annually between 1994 and 2003 declined overall from 2,021 in 1994 to 1,739 in 2003, and the number of fatal accidents decreased overall, from 404 to 352.

The number of fatalities from general aviation accidents also exhibited a generally downward trend from the high of 730 in 1994 to 632 in 2003. It should be noted that 2003 continued a generally downward trend in total fatalities for the overall 10-year period. It should also be noted that the trend reflects a decrease in general aviation flight hours flown annually following the events of September 11, 2001.





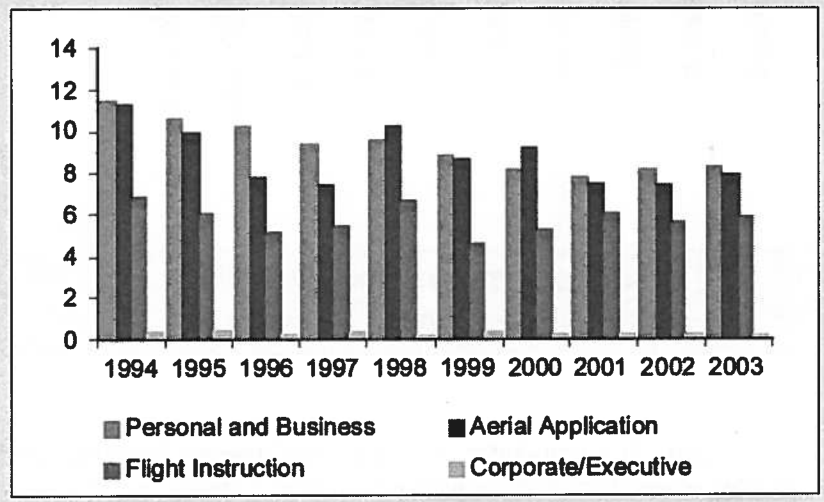
Accident Rate by Type of Operation

General aviation includes a wide range of operations, each with unique aircraft types, flight profiles, and operating procedures. This diversity is evident in the accident record. However, the flight data collected in the *GAATA Survey* allow for only a coarse representation of the many types of general aviation operations. For some types of operations, such as public aircraft flights,[15] no activity data are available. The data presented here include four operational categories selected because they are representative of general aviation and have activity information available. The categories selected as typical of general aviation activity include personal/business flying,[16] corporate flying, aerial application, and instructional flights.

- Personal flying makes up the largest portion of general aviation activity and includes all flying for pleasure and/or personal transportation. Although similar to personal flying, business flying includes the use of an aircraft for business transportation without a paid, professional crew. Personal and business flights are typically conducted in single- and multi-engine piston airplanes, but may include a range of aircraft including gliders, rotorcraft, and balloons.
- Corporate flying includes any business transportation with a professional crew and usually involves larger, multi-engine piston, turboprop, and jet airplanes.
- Aerial application includes the use of specially equipped aircraft for seeding and for spraying pesticides, herbicides, and fertilizer. Aerial application is unique because it requires pilots to fly close to the ground.
- Instructional flying includes any flight under the supervision of a certificated flight instructor.[17] Instructional flying typically includes both dual training flights and student solo flights. Aircraft used for instruction are often similar to those used for personal flying. However, instructional operations are unique because they often involve the repeated practice of takeoffs and landings, flight maneuvers, and emergency procedures.

In 8 out of the 10 years, personal and business flying had the highest average accident rate, followed by aerial application. The lowest accident rate was for corporate/executive transportation, which for the 10-year period ranked lowest overall each year.

Accident Rate by Type of Operation, 1994-2003
(per 100,000 Flight Hours)



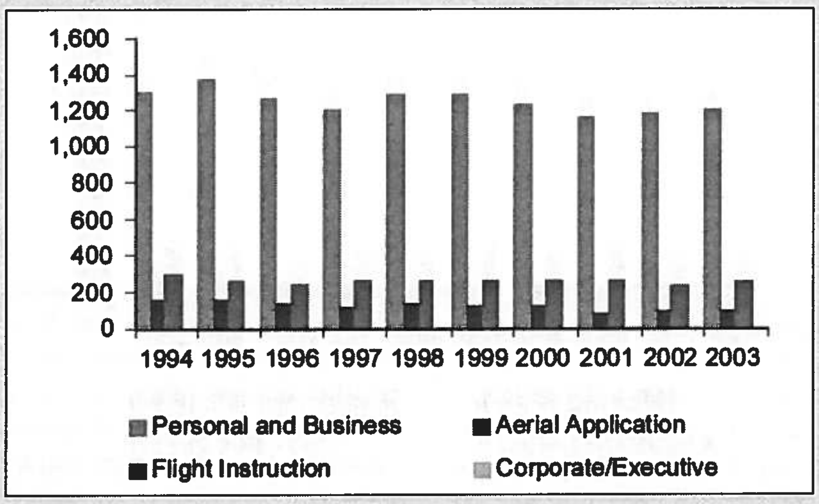
[15] The *2003 Annual Review* data include 20 public aircraft accidents, 3 of which resulted in 1 or more fatalities.

[16] Because of the difficulty of accurately distinguishing between personal and business flying for both the activity survey and the accident record, the rate presented in this review is calculated using combined exposure data (hours flown).

[17] See 14 CFR Part 61, Subpart H, for flight instructor certificate and rating requirements.

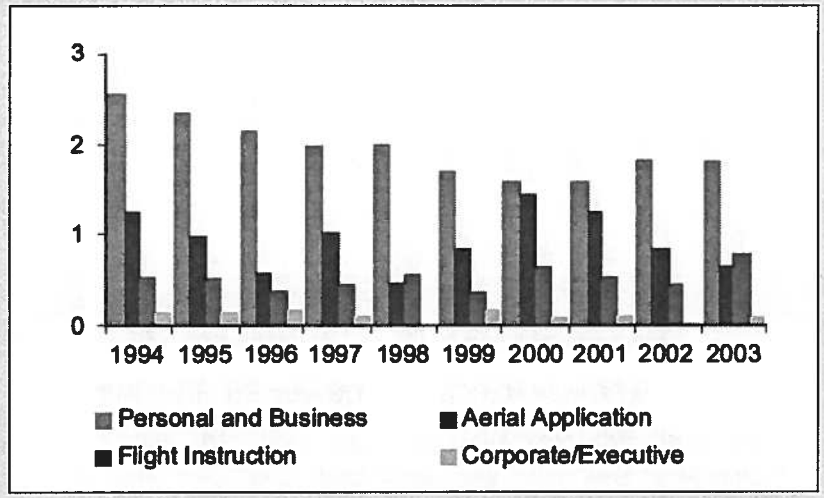
In 2003, the highest proportion of flying time was associated with personal and business operations, which accounted for the largest proportion of accidents, 69% (n = 1197), a percentage consistent with the 10-year average. Less than 1% of the accidents (n = 5) were corporate/executive operations, 5% were aerial application (n = 86), and 14.7%, instructional flying (n = 255). Totals for corporate/executive accidents are barely visible when graphed in comparison to accidents involving other types of operations. For both corporate/executive operations and instructional flights, the proportion of flight hours was higher than the proportion of accidents, reflecting the relative safety of these missions.

Number of Accidents by Type of Operation, 1994-2003

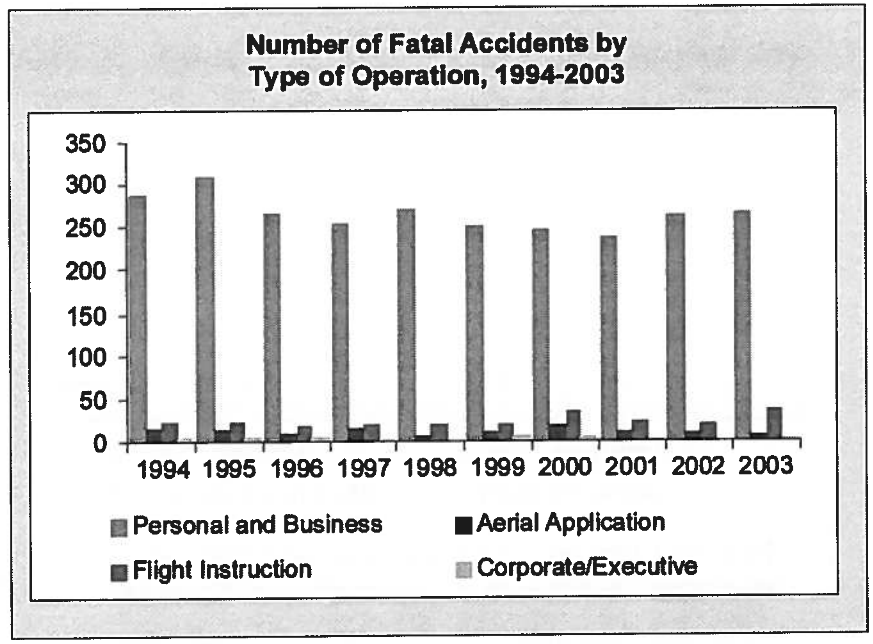


Throughout the 10-year period, the combined category of personal/business flying also had the highest fatal accident rate. Except for 2000 and 2001, the rate was typically more than double the rate for any other type of flying.

Fatal Accident Rate by Type of Operation, 1994-2003 (per 100,000 Flight Hours)



Between 1994 and 2003, an average 265 fatal accidents per year were personal/business flights, compared to an average 24 fatal accidents per year related to instructional flying, 12 for aerial application, and 3 for corporate/executive flights. Differences in the number and rate of fatalities and injuries among types of operation are likely related to the type of aircraft and equipment, the level of pilot training, and the operating environments unique to each type of operation. The number of fatal accidents per year among each type of flight operation exhibits a distribution similar to the number of accidents; personal and business flying accounted for an average 74% of all fatal general aviation accidents and 74% of all fatal injuries for 1994 through 2003.



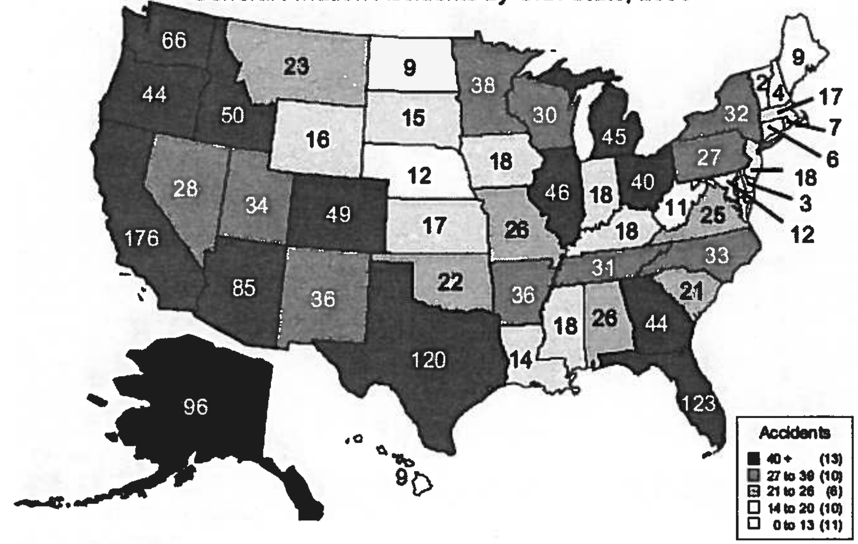
2003 IN DEPTH

Location of General Aviation Accidents in 2003

United States Aircraft Accidents

Geographic location can contribute to general aviation accident totals because of increased activity associated with population density, or increased risk due to hazardous terrain, a propensity for hazardous weather, or a concentration of particularly hazardous flight operations. The following map shows state by state the number of all general aviation accidents that occurred within the United States in 2003. Although the specific hourly activity data needed to calculate general aviation accident rates for each state are not available, some assumptions can be made about general aviation activity levels based on the size and population of each state. For example, California, Florida, and Texas had the greatest number of accidents in 2003. U.S. Census Bureau data[18] indicate that California had the highest state population in 2003, followed by Texas (second) and Florida (fourth). In addition, all three states have warm climates that favor year-round flying, and all three are popular travel destinations that attract general aviation traffic from other states. These states also had the largest numbers of active pilots[19] and active aircraft.[20] These data suggest that the high number of accidents in California, Florida, and Texas are related primarily to a high level of activity.

General Aviation Accidents by U.S. State, 2003



Regional differences that affect general aviation accident numbers may also include hazards unique to the local terrain and weather. For example, the operating environment, infrastructure, and travel requirements in Alaska present unique challenges[21] to aviation that are reflected in the general aviation accident record. After California, Florida, and Texas, Alaska had the most general aviation accidents in 2003.

[18] U.S. Census Bureau; data are available at <http://factfinder.census.gov/>.

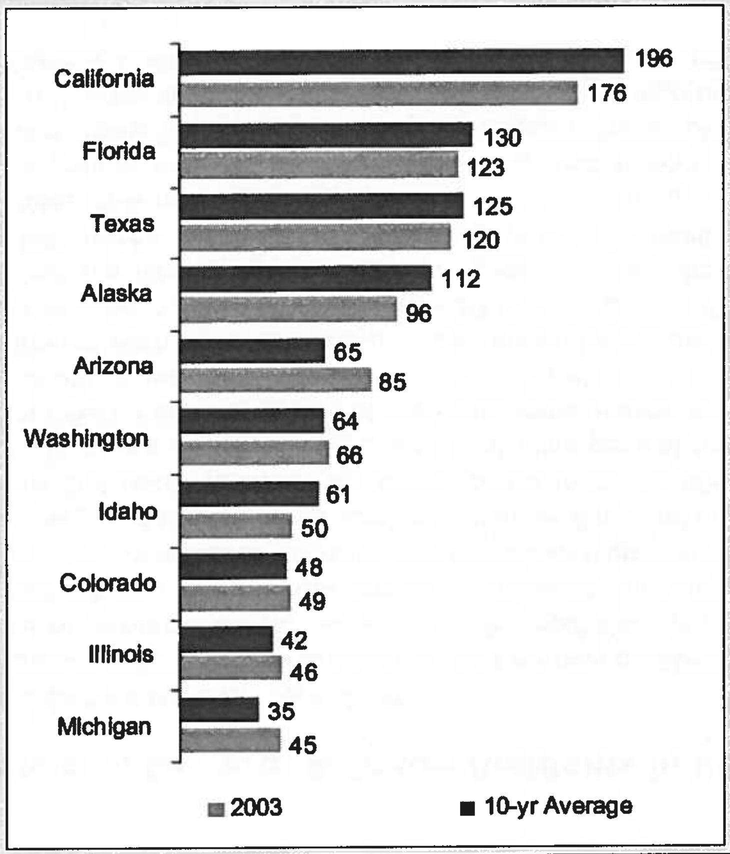
[19] FAA, *U.S. Civil Airmen Statistics, 2003*, available at <http://www.faa.gov/data_statistics/aviation_data_statistics/civil_airmen_statistics/>.

[20] FAA, *GAATA Survey 2003*, available at <http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2003/.>.

[21] For an analysis of aviation safety in Alaska, see National Transportation Safety Board, *Aviation Safety in Alaska*, Safety Study, NTSB/SS-95/03 (Washington, DC: 1995). The Safety Board is also supporting an ongoing effort to identify and mitigate risk factors specific to aviation operations in Alaska; for details, see <http://www.ntsb.gov/aviation/AK/alaska_stat.htm>.

The top 10 states by number of general aviation accidents in 2003 are presented here along with the 10-year average. Note that many of the state accident totals for 2003 were below historical averages, but the distribution of accidents among states remained similar during the period.

Top 10 General Aviation Accident States 2003



Foreign Aircraft Accidents

In 2003, U.S.-registered aircraft were involved in 34 accidents outside the 50 United States. Those accidents occurred in 17 different countries and territories, in the Atlantic and Pacific Oceans, and in the Gulf of Mexico. Of those accidents, 15 were fatal, resulting in 31 deaths. Most of these accidents occurred in Mexico, with 5 accidents, followed by Canada with 4. As expected, general aviation accidents involving U.S.-registered aircraft outside the United States usually occur in neighboring countries like Canada, Mexico, and the Caribbean island nations, but in 2003, accidents occurred as far away as Germany, Bolivia, Malaysia, and Antarctica.

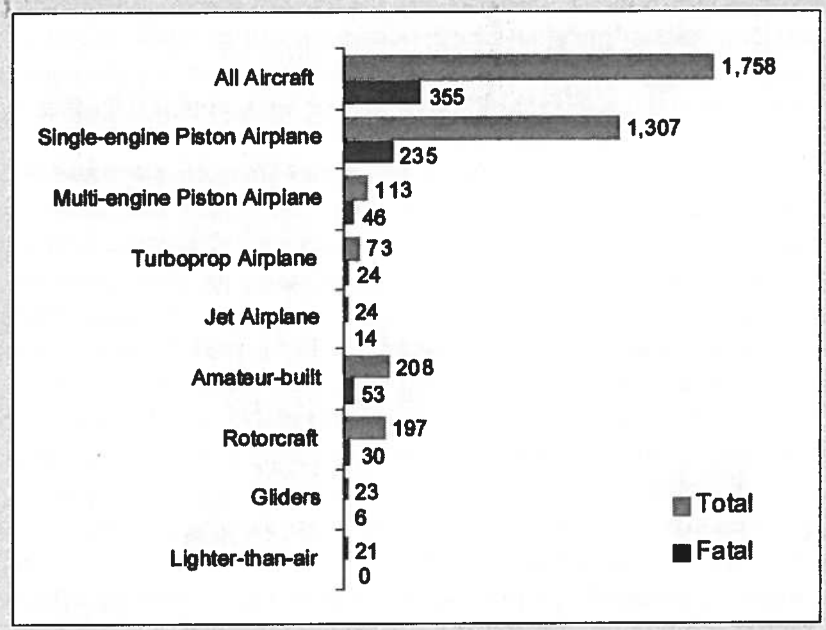
Accidents Involving U.S.-Registered General Aviation Aircraft Outside the 50 United States, 2003

	Number of Accidents	Number of Fatal Accidents	Number of Fatalities
Pacific Ocean			
En route Hawaii	1	0	1
Subtotal	1	0	1
Atlantic Ocean			
Off Florida	1	1	1
Subtotal	1	1	1
Gulf of Mexico			
Off Oil Platform	1	0	0
Subtotal	1	0	0
Other Locations			
Antarctica	1	0	0
Bahamas	3	2	2
Bolivia	1	1	2
Canada	4	2	3
Colombia	1	1	1
Costa Rica	3	1	3
Dominican Republic	1	0	0
France	1	0	0
Germany	1	0	0
Martinique	1	0	0
Mexico	5	4	7
Malaysia	1	0	0
Netherlands	1	0	0
Netherlands Antilles	1	0	0
Puerto Rico	3	0	0
Spain	1	1	3
United Kingdom	2	2	4
Subtotal	31	14	29
Total	34	15	31

Aircraft Type

The following graphs summarize the total number of general aviation accidents and fatal accidents occurring in 2003 by aircraft type. Most notable is the large number of accidents involving single-engine piston airplanes, which accounted for 74% of all accident aircraft and 66% of all fatal accident aircraft.

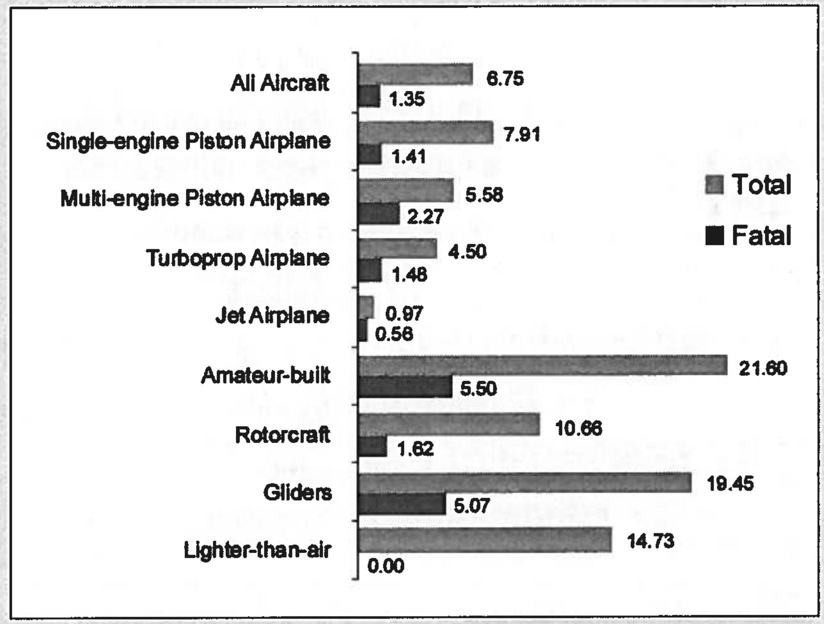
Number of Accidents by Type of Aircraft, 2003



In 2003, the per-aircraft accident rate for all aircraft types was 6.75 accidents and 1.35 fatal accidents per 100,000 hours flown.[22]

Among fixed-wing powered aircraft, the rate for single-engine piston airplanes was 7.91 accidents and 1.41 fatal accidents per 100,000 hours flown. Amateur-built aircraft[23] had the highest accident rate with 21.60 accidents and 5.50 fatal accidents per 100,000 flight hours. Rotorcraft had the second-highest rate among powered aircraft, with 10.60 accidents and 1.62 fatal accidents per 100,000 hours flown. However, glider operations had the second-highest accident rate overall, with 19.45 accidents and 5.07 fatal accidents per 100,000 hours flown.

Accident Rate per Aircraft Type, 2003 (per 100,000 Flight Hours)



22 Note that the reported rates are per aircraft and differ from per-accident rates because each aircraft is counted separately in the event of a collision. Included in the accident totals, but excluded from the associated rates, are four single-engine piston aircraft crashes with a probable cause attributed to suicide, sabotage, or stolen/unauthorized use.

23 Title 14 CFR Part 21 (21.191(g)) provides for the issuance of a Special Airworthiness Certificate in the experimental category to permit the operation of amateur-built aircraft. Amateur-built aircraft may be fabricated from plans or assembled from a kit, so long as the *major* portion of construction is completed by the amateur builder(s).

Purpose of Flight

The type of operation or purpose of flight can be defined as the reason a flight is initiated. Activity data by purpose of flight are derived from the *GAATA Survey*, which includes 14 purpose/use categories. Two of these categories, air taxis and air tours, are covered under 14 CFR Part 135 and are therefore not included in this review. The remaining 12 include the previously mentioned categories of "personal," "business," "instructional," "corporate," and "aerial application," which together accounted for 90% of all general aviation operations during 2003. The remaining 10% are included in more specific categories, such as "external load" and "medical use." A limitation of the *GAATA* activity data is that those categories provide only a coarse representation of the range of possible flight operations. For example, "personal flying" includes but does not distinguish between travel, recreation, or proficiency flying. At the same time, the differences between similar categories like "personal" and "business flying" are not easily identified. Accordingly, the purpose-of-flight information presented in this review is limited to the combined categories of personal and business flying, as well as corporate, instructional, and aerial application flights.

According to the *GAATA Survey*, most general aviation operations are conducted for personal and/or business purposes. Of the estimated 26 million general aviation hours flown in 2003, more than half—14.6 million—were conducted for personal or business reasons.[24] Accordingly, a large percentage of general aviation accidents involve personal/business flying. However, personal/business flying is still over-represented in the accident record: although this segment represented about 56% of the general aviation hours in 2003, it accounted for 68% of all general aviation accidents (n=1,197) and 76% of all fatal accidents in 2003 (n=264).

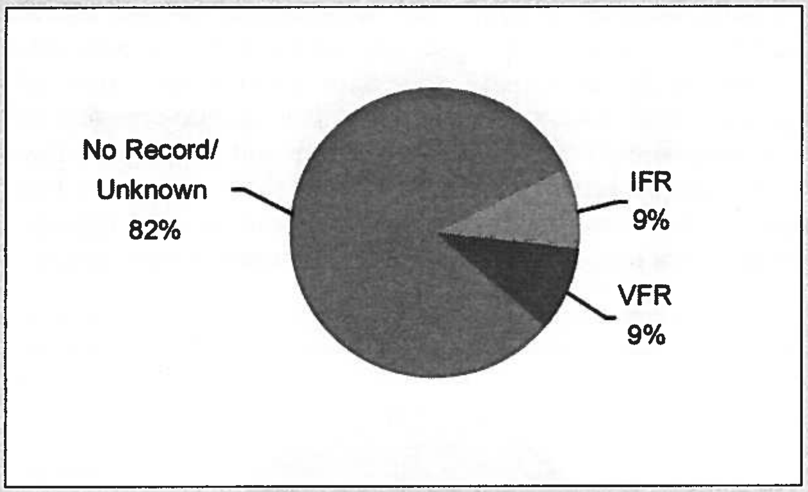
The accident rate for instructional flights is about half that of personal/business flights. This relatively low rate is surprising because student pilots could be expected to make more mistakes than experienced pilots while they are learning to fly. Flight instruction accidents were also less likely to be fatal. Only 13% of the flight instruction accidents that occurred in 2003 resulted in fatalities, compared to 22% of personal/business accidents. When compared with the number of hours flown, the fatal accident rate for instructional flights was 0.77 fatal accidents per 100,000 hours flown. The fatal accident rate for personal/business flying remained the highest in general aviation with 1.78 fatal accidents per 100,000 hours flown.

Flight Plan

There were 1,758 pilots involved in general aviation accidents in 2003, and for 1,434 (82%) of those pilots, there was no record of filing a flight plan. In most cases, a flight plan is required only for flight under instrument flight rules (IFR). However, pilots operating under visual flight rules (VFR) on point-to-point flights have the option of filing a flight plan, which aids search and rescue efforts for pilots who fail to arrive at their intended destinations.

[24] FAA, *GAATA Survey 2003*, available at http://www.faa.gov/data_statistics/aviation_data_statistics/general_aviation/CY2003/.

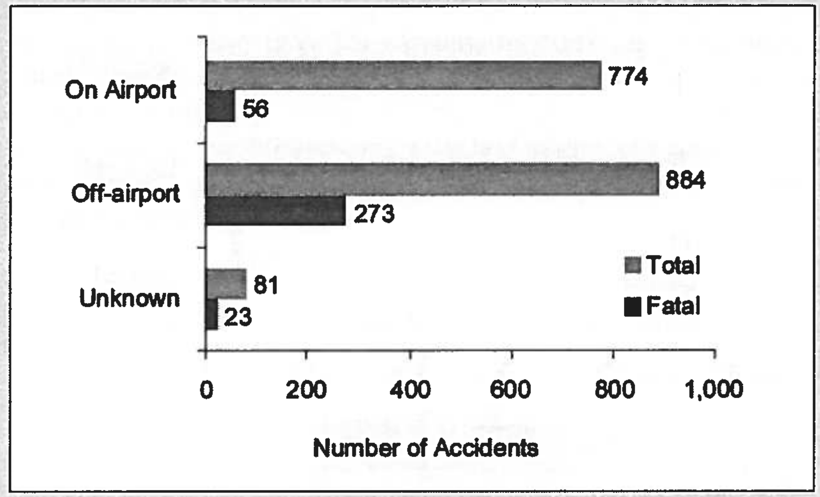
Flight Plan Filed by Accident Pilot 2003



Airport Involvement

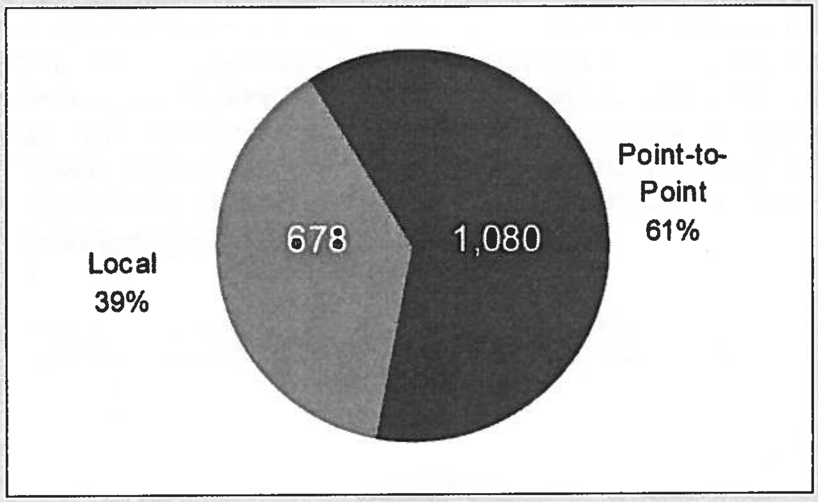
Aircraft accident locations were closely split between those occurring on airport property (45%) and those occurring away from an airport (51%). Comparing accident risk based on location is difficult because of the exposure differences among different operations and aircraft types. For example, a single-engine piston aircraft used for instructional flights will spend a large percentage of its operating time near an airport while a jet aircraft used for corporate transportation will not. However, a relationship can be observed between the location and severity of accidents. Accidents on or near an airport or airstrip typically involve aircraft operating at relatively low altitudes and airspeeds while taking off, landing, or maneuvering to land. In contrast, accidents that occur away from an airport typically involve the climb, cruise, maneuvering, and descent phases of flight, which typically occur at higher altitudes and higher airspeeds. As a result, these accidents are more likely to result in higher levels of injury and aircraft damage than accidents that occur on an airstrip or near an airport. Most fatal accidents in 2003 (78%) were located away from an airport or airstrip.

Accident Location, 2003



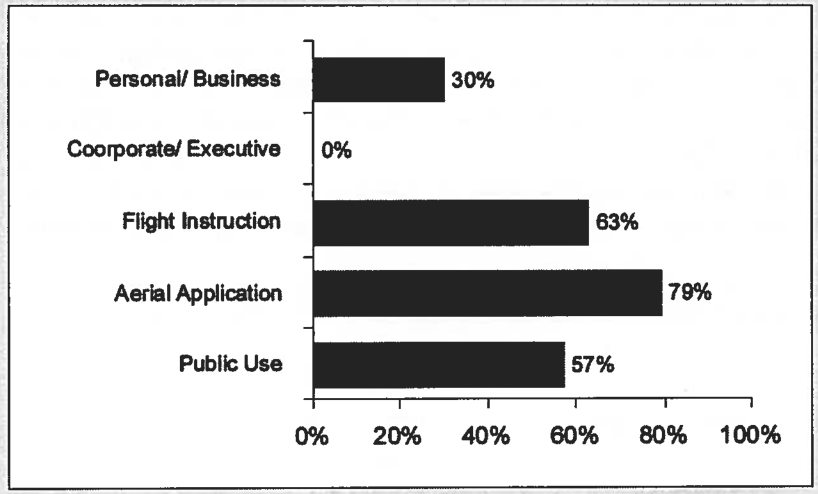
Another distinction that can be drawn between flight profiles is between local and point-to-point operations. A local flight is one that departs and lands at the same airport, and a point-to-point flight is one that lands at an airport other than the one from which it departed. Typical local flight operations include sightseeing, flight instruction, proficiency flights, pleasure flights, and most aerial observation and aerial application flights. Conversely, point-to-point flights include any operation conducted with the goal of moving people, cargo, or equipment from one place to another. Typical point-to-point operations include corporate/executive transportation, personal and business travel, and aircraft repositioning flights. A comparison of the numbers of accident aircraft on local flights with those on point-to-point flights illustrates that the percentages of aircraft on point-to-point flights accounted for more accident aircraft.

Local and Point-to-Point Flights, 2003



The activity data necessary to compare accident rates for local and point-to-point flights are not available. However, a comparison of the percentage of local and point-to-point accident flights conducted for different purposes provides an indirect measure of the types of flying represented in both flight profiles. The following graph shows that most personal/business flights were point-to-point, while most instructional flights were local. Corporate/executive transportation and aerial application operations were also inversely proportionate, with 100% of corporate flights being point-to-point and 79% of aerial application flights being local.

Percentage of Local Flights by Type of Accident Operation, 2003



Environmental Conditions

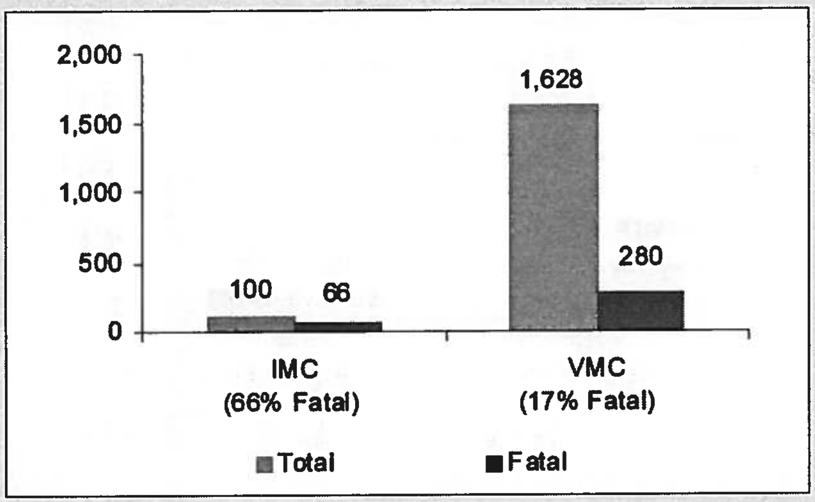
Many hazards are unique to the type of flight operation, type of aircraft, and flight profile, but environmental conditions may be hazardous to all flight operations and all types of aircraft to some degree. Aircraft control, for example, is highly dependent on visual cues related to speed, distance, orientation, and altitude. When visual information is degraded or obliterated because of clouds, fog, haze, or precipitation, pilots must rely on aircraft instruments. Because of the difficulties associated with flying an aircraft solely by reference to instruments, the FAA has established specific pilot, aircraft, and procedural requirements[25] for flight in instrument meteorological conditions (IMC). According to the FAA *Pilot/Controller Glossary*,[26] "instrument meteorological conditions" are defined as "meteorological

[25] Title 14 CFR 61.579(c), 91.167-193, 91.205(d).

[26] FAA, *Pilot/Controller Glossary*, Washington, D.C., available at <http://faa.gov/atpubs/PCG/INDEX.HTM>.

conditions expressed in terms of visibility, distance from cloud, and ceiling less than the minima[27] specified for Visual Meteorological Conditions (VMC)." Weather minima differ based on altitude, airspace, and lighting conditions, but 3 statute miles visibility and a cloud clearance of 1,000 feet above, 500 feet below, and 2,000 feet horizontal distance is typical. The following chart illustrates the percentage of accidents and fatal accidents that occurred in VMC and IMC. A comparison of the percentages of accidents in each weather condition that resulted in a fatality illustrates the hazards associated with flight in IMC. In 2003, only 17% of the accidents that occurred in visual conditions resulted in a fatality, but 66% of accidents in instrument conditions were fatal.

Total Accidents and Fatal Accidents by Weather Condition, 2003



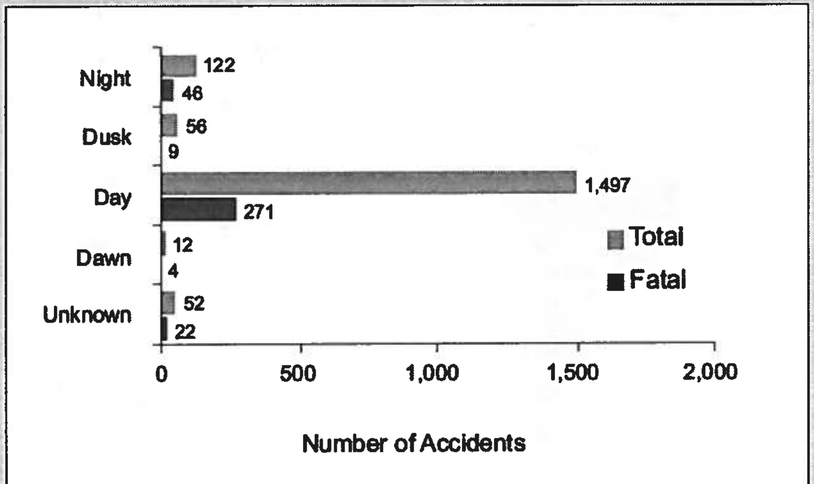
Although instrument conditions were present for only 6% of all accidents, 19% of fatal general aviation accidents in 2003 occurred in IMC. One reason for the disproportionate number of fatal accidents in IMC is that such accidents are more likely to involve pilot disorientation, loss of control, and collision with terrain or objects—accident profiles that typically result in high levels of damage and injury. Instrument conditions may also contribute to accident severity by further complicating situations that might be more easily handled in visual conditions. For example, a forced landing due to an engine malfunction or failure, which might result in minor damage if it were to occur in visual conditions, might pose an even greater threat to a pilot flying in instrument conditions because reduced visibility would make the selection of a suitable landing site more difficult.

Lighting Conditions

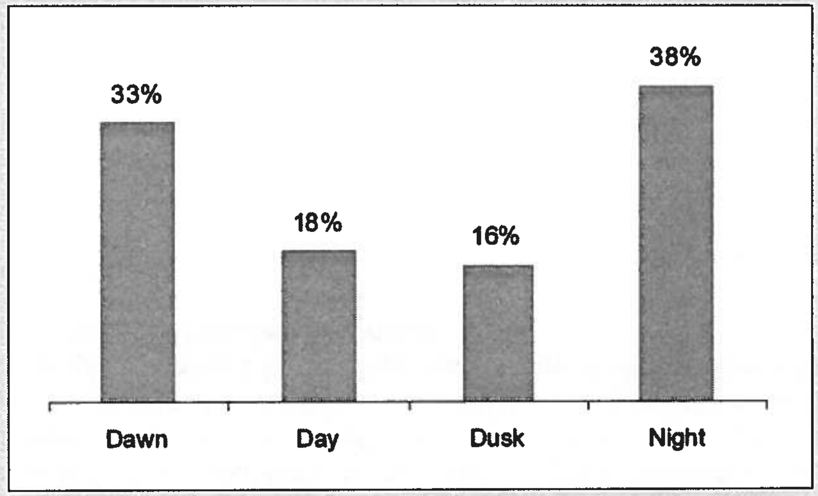
Lighting conditions can present a similar hazard to pilots because of physiological factors related to night vision, difficulties in seeing potential hazards such as mountains, terrain, and unlighted obstructions, and perceptual illusions associated with having fewer visual cues. The following graphs illustrate that, similar to IMC, most accidents occurred in daylight conditions but a larger percentage of the accidents that occurred at night resulted in fatalities.

27 Minima for visual meteorological conditions are specified in 14 CFR 91.155.

Accidents and Fatal Accidents by Lighting Condition, 2003



Percentage of Accidents Resulting in a Fatality by Lighting Condition, 2003



In fact, accidents that occurred at night were more than twice as likely as daylight accidents to be fatal. Like weather-related accidents, accidents at night are more likely to involve disorientation, loss of control, and/or collision with objects or terrain that result in higher levels of injury. The reduction in visual cues at night also hinders pilots from identifying deteriorating weather conditions and further complicates their ability to deal with any aircraft equipment malfunctions. For additional information about the safety issues associated with night flying, refer to the special topic section of this report for a more detailed discussion of night accidents.

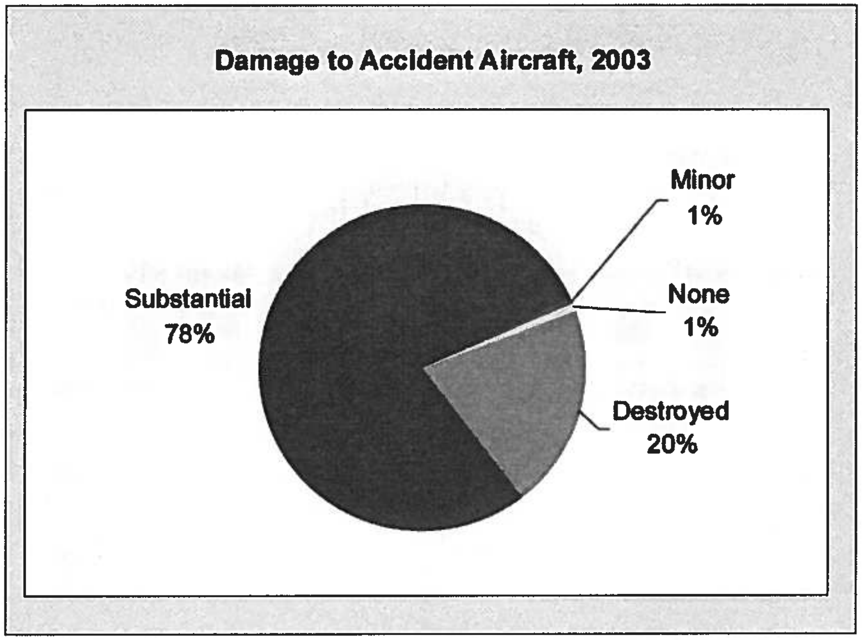
Injuries and Damage for 2003

Aircraft Damage

Safety Board investigators record aircraft damage as either "destroyed," "substantial," or "minor." Title 49 CFR 830.2 defines "substantial damage" as "damage or failure which adversely affects the structural strength, performance, or flight characteristics of the aircraft, and which would normally require major repair or replacement of the affected component." Although not specifically defined in 49 CFR 830.2, "destroyed" can be operationally defined as any damage in which repair costs exceed the value of the aircraft,[28] and "minor" damage as any damage that is not classified as either "destroyed" or "substantial."

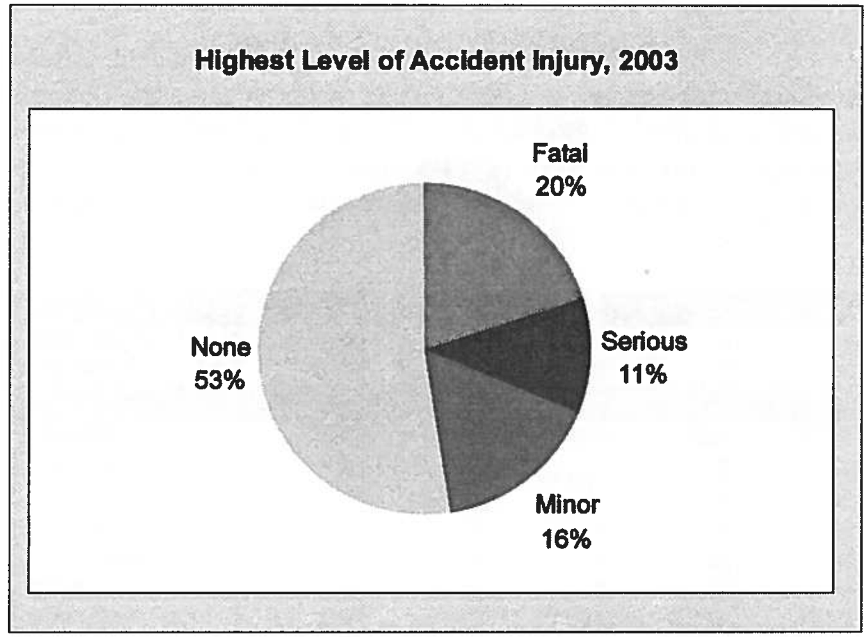
[28] Missing or unrecoverable aircraft are also considered "destroyed."

Nearly 8 of every 10 aircraft involved in accidents during 2003 sustained substantial damage, and about 1 in 5 accident aircraft was destroyed. "Minor" and "no damage" classifications together comprised about 1% of accident aircraft.



Accident Injuries

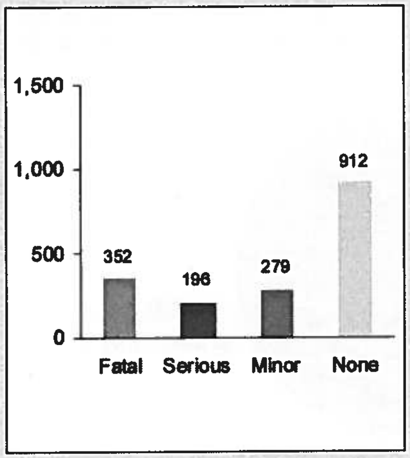
In accordance with 49 CFR 830.2, Safety Board investigators categorize general aviation injuries as "fatal," "serious," or "minor." A fatal injury is defined as "any injury which results in death within 30 days of the accident." Title 49 CFR 830.2 also outlines several qualifications[29] of serious injury that include, but are not limited to, hospitalization for more than 48 hours, bone fracture, internal organ damage, or second- or third-degree burns. The following graph depicts the percentage of general aviation accidents resulting in each level of injury during 2003. Most notable is the fact that more than half the accidents did not result in injury.



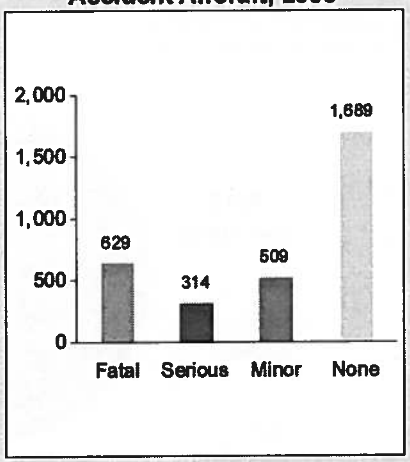
[29] See appendix B for the complete definition of injury categories.

The following graphs illustrate both the number of accident aircraft in each injury category and the corresponding number of persons aboard those aircraft who sustained injuries in each category. Categorization of injury level in an accident is based on the highest level of injury sustained by an occupant of an accident aircraft. Again, most persons who were aboard general aviation aircraft that were involved in accidents sustained no injuries.

Highest Level of Injury Aboard Accident Aircraft, 2003



Total Injuries Sustained by Persons Aboard Accident Aircraft, 2003



Injuries by Role for 2003

The following table presents detailed information about the types of injuries incurred by all persons involved in general aviation accidents during 2003. The distribution of injuries varies with the type of operation and the size of aircraft, and the number of injuries experienced by any group of persons varies with their level of activity (that is, their exposure to risk). For example, all aircraft have a pilot, but not all have passengers on board.

General Aviation Accident Injuries, 2003

Personal Injuries	Fatal	Serious	Minor	None	Total
Pilot	338	166	284	970	1,758
Copilot	19	14	9	37	79
Flight instructor	14	4	6	24	48
Dual student	11	8	15	62	96
Check pilot	1	2	1	6	10
Other crew	6	4	7	15	32
Passenger	240	116	187	575	1,118
Total aboard	629	314	509	1,689	3,141
On ground	3	10	13	0	26
Other Aircraft	0	0	1	8	9
Total	632	324	523	1,697	3,176

In 2003, 543 passengers suffered some level of injury in general aviation accidents, compared to the 830 pilots and copilots who were injured. Pilots sustained the highest percentage of injuries in general aviation accidents in 2003, suffering 53% of all fatalities, 51% of all serious injuries, and 54% of all minor injuries.

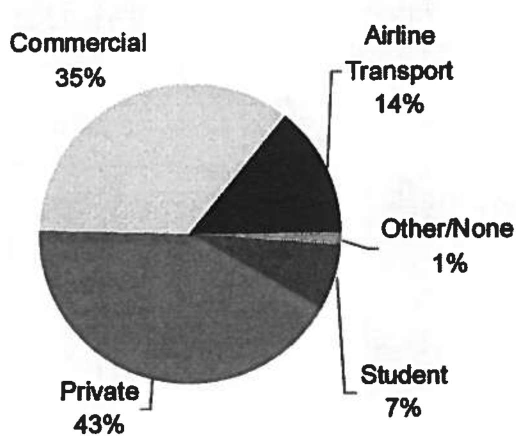
In addition to injuries sustained by persons on board the accident aircraft, 26 persons on the ground sustained injuries as a result of general aviation accidents. For example, one person was killed and eight were seriously injured when an aircraft hit an apartment building after losing control in IMC, a person operating a jet ski was seriously injured after being struck by the float of a landing seaplane, and six people sustained minor injuries when the wreckage of two single-engine aircraft fell on a residential neighborhood after a midair collision.

Accident Pilots

Rating

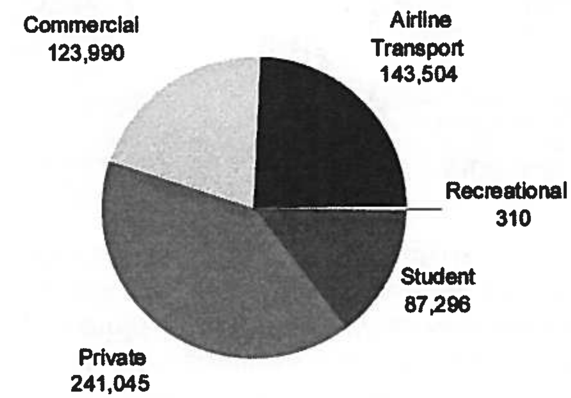
Of the 1,758 pilots involved in general aviation accidents in 2003, the largest percentage held a private pilot certificate.[30] The second-largest percentage held a commercial pilot certificate, which is required for any person to act as pilot-in-command of an aircraft for compensation or hire.[31]

Highest Certificate Held by Accident Pilot, 2003



When compared to the number of active pilots in 2003 holding each type of pilot certificate, commercial pilot certificate holders were over-represented among general aviation accidents. Although commercial pilot certificate holders accounted for only 20% of all active general aviation pilots, they were involved in 35% of all general aviation accidents in 2003.

Number of Active Pilots by Highest Certificate, 2003

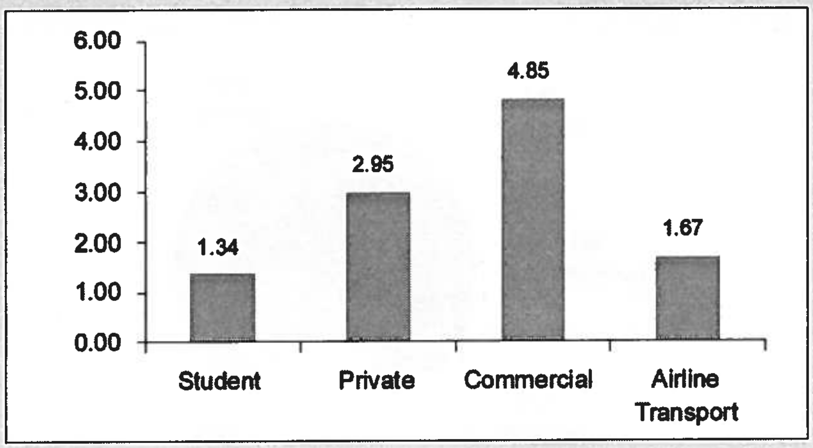


Similarly, the per-pilot accident rate was highest for commercial pilot certificate holders during 2003, with 4.85 accidents per 1,000 active pilots. One possible explanation for the higher numbers of accidents is that commercial certificate holders may be employed as pilots and would therefore be likely to fly more hours annually than student or private pilots. However, more than one-third of commercial pilots involved in accidents during 2003 (35%) were conducting personal flights and were not involved in commercial operations at the time of the accidents.

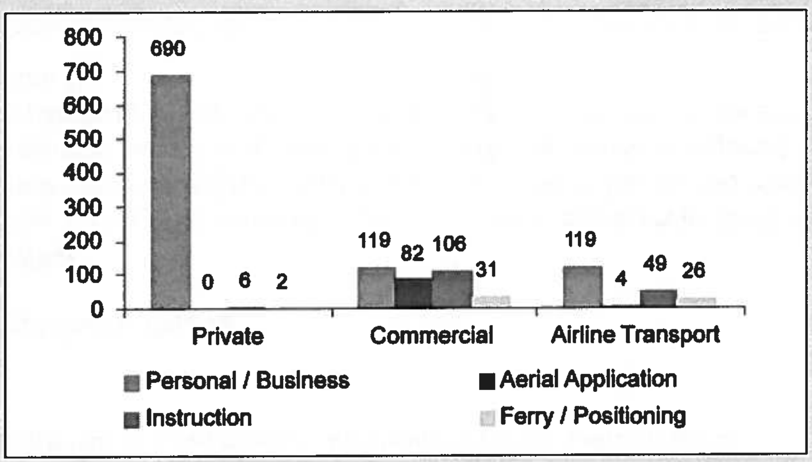
[30] FAA, *U.S. Civil Airmen Statistics*, 2003.

[31] See 14 CFR 61.133 for the privileges granted by a commercial pilot certificate.

Accident Rate per 1,000 Active Pilots by Certificate, 2003



Type of Operation Conducted by Accident Pilot Certificate, 2003

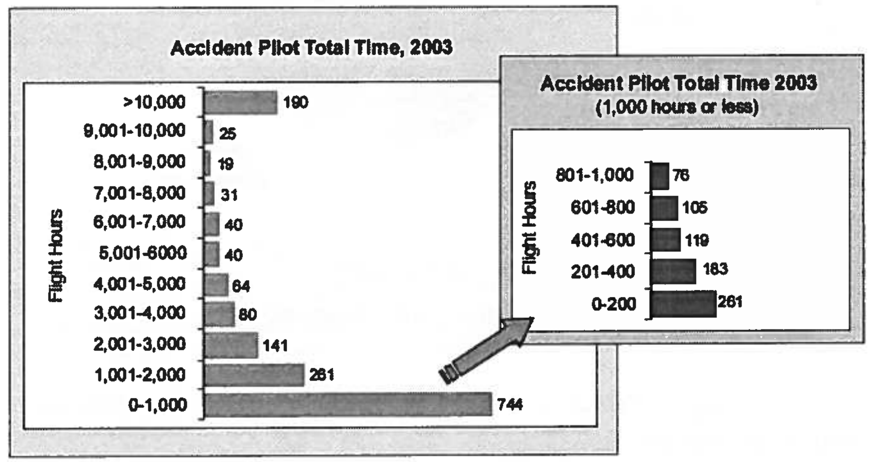


(1,693 of accident pilot records with data available, 2003)

Because annual flight-hour data are not compiled separately for pilots holding each type of certificate, it is not possible to compare activity-based accident rates. The *U.S. Civil Airmen Statistics*[32] also do not include information about the type of operation that certificate holders engage in. Examples of other commercial operations not presented in the chart include corporate/executive transportation, sightseeing flights, banner towing, and aerial observation.

Total Time

For the 1,635 accident pilots for which total flight experience data are available, 46% involved pilots with a total flight time of 1,000 hours or less. The following chart depicts the distribution of experience among accident pilots. The inset focuses on those pilots with less than 1,000 total hours. The largest percentage of accident pilots in this group had 200 hours or less of total flight time. When compared to all accident pilots with available data, about 16% of accident pilots had 200 hours of flight experience or less.

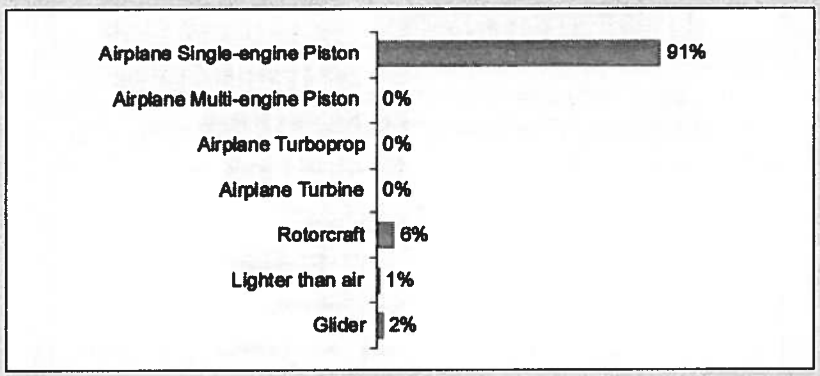


(1,635 accident pilot records with total flight time information)

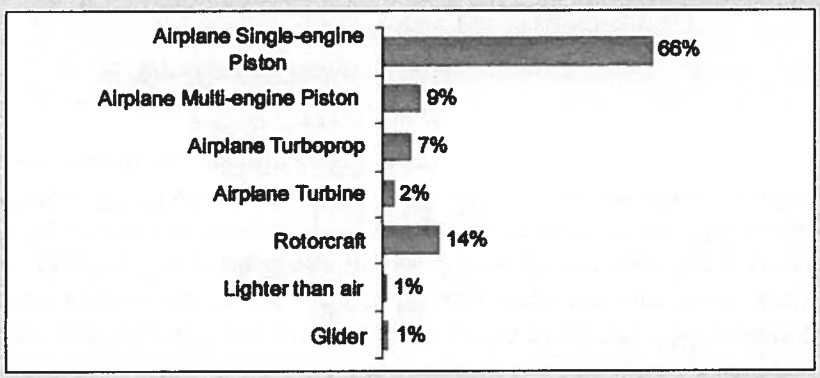
[32] FAA, *U.S. Civil Airmen Statistics*, 2003.

It is not surprising that 9 of 10 accident pilots with 200 hours total flight time or less were flying single-engine piston airplanes. Most accident pilots with more than 1,000 hours were also flying single-engine piston airplanes, but the list includes a more diverse selection of aircraft, multi-engine piston, turboprop, and turbine-powered airplanes, and more than twice as many who were flying rotorcraft.

Type Aircraft Flown by Accident Pilots With 200 or Less Hours Total Flight Time, 2003



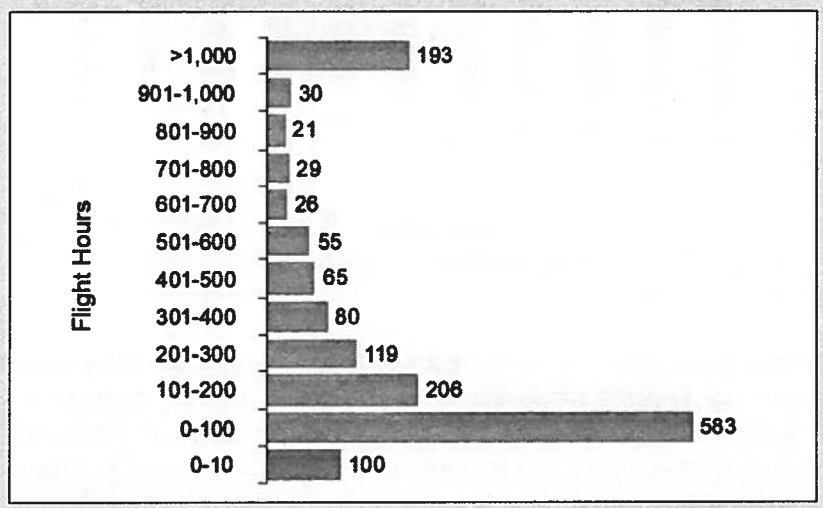
Type Aircraft Flown by Accident Pilots with More than 1,000 Hours Total Flight Time, 2003



Time in Type of Aircraft

Of the 1,407 accidents in 2003 for which pertinent data are available, 41% involved pilots with 100 hours or less of time in the accident aircraft make and model. Of those, 100 pilots (7% of all accident pilots for whom data are available) had less than 10 hours in type. Most accident pilots with less than 10 hours of flight time in make and model were flying single-engine piston aircraft.

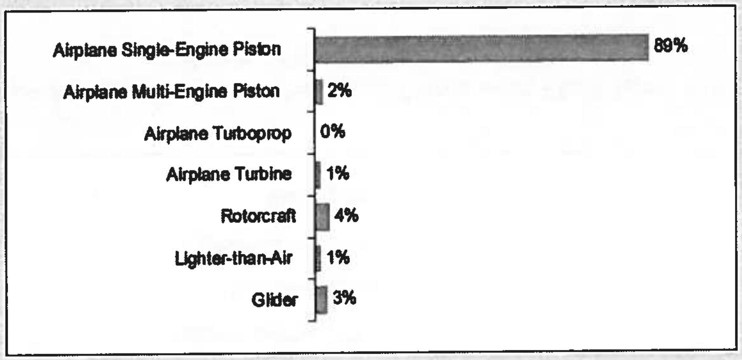
Accident Pilot Total Time in Aircraft Type, 2003



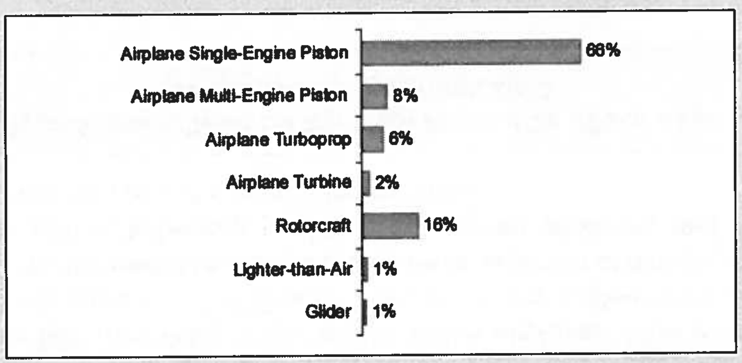
(1,407 accident pilot records with time in aircraft type information)

Pilots may have low time in type because they are new pilots with low total time or they are experienced pilots who are transitioning to a new aircraft. Two groups of pilots who might be expected to have accumulated significant time in make and model are those who own their own airplanes and fly them often and professional pilots who fly the same aircraft often. A large number of general aviation pilots who own aircraft have single-engine piston airplanes. Helicopters and multi-engine piston, jet, and turboprop airplanes are more likely to be operated by professional pilots. Although not specifically detailed in the chart, it is particularly worth noting that 38 of the 100 accident pilots in 2003 who had less than 10 hours in the accident aircraft type were operating amateur-built aircraft.

Type Aircraft Flown by Accident Pilots With 10 or Less Hours in Accident Aircraft Type, 2003



Type Aircraft Flown by Accident Pilots With More than 200 Hours in Accident Aircraft Type, 2003

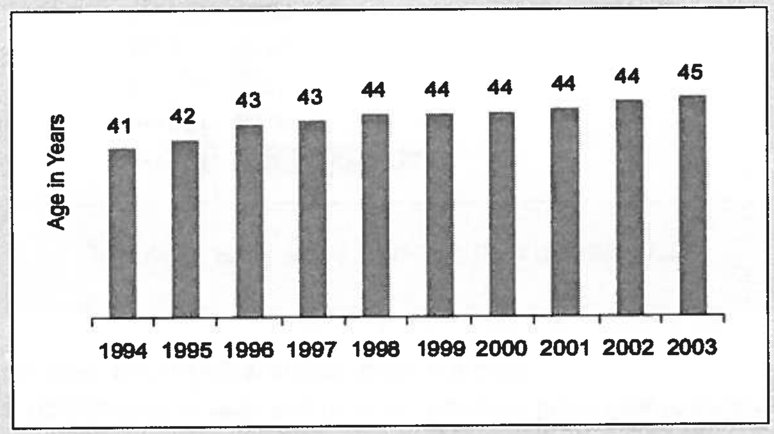


Comparison of these two graphs shows that accident pilots with more than 200 hours in make and model were more likely than pilots with fewer hours in type to be flying rotorcraft or multi-engine piston, jet, or turboprop airplanes.

Age

The average age of all active pilots in the U.S. increased steadily from 1994 through 2003 and by 2003 was 45 years.[33] In contrast, the average age of general aviation accident pilots was 51. Despite the difference in average age, no meaningful conclusions can be made regarding specific age-related accident risk because FAA flight-hour activity numbers are not available for each age group. Age differences could be the result of activity if opportunities for recreational flying were to increase with age.

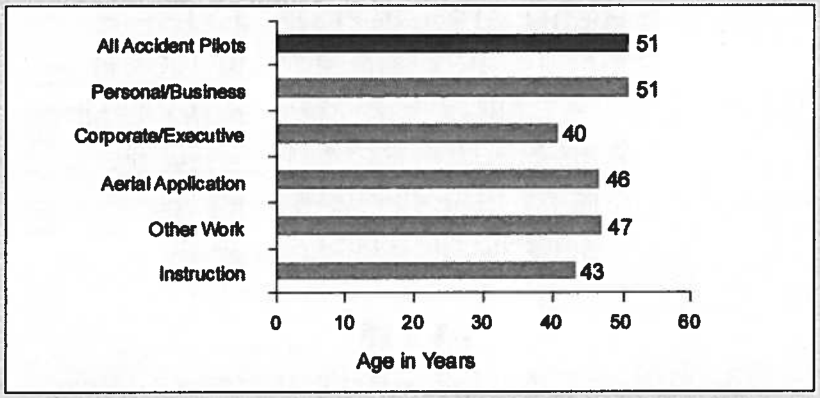
Average Age of Active Pilots 1994-2003



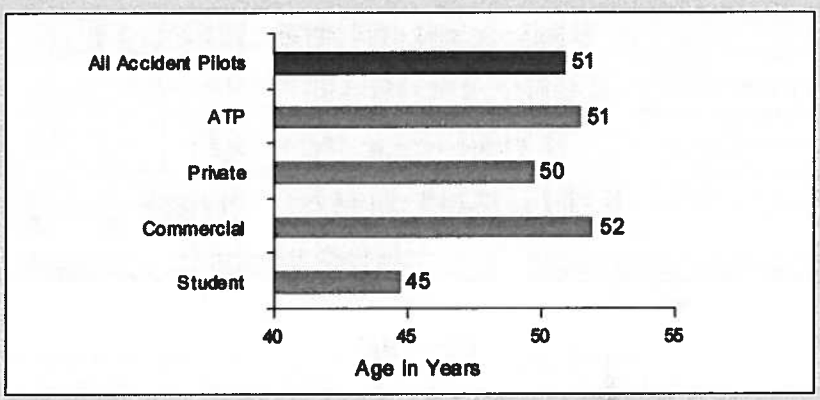
33 FAA, *U.S. Civil Airmen Statistics*, 2003.

The two charts that follow show the relationship of the accident pilot's age by type of operation and by highest pilot certificate.

Average Age of Accident Pilot By Type of Operation, 2003



Average Age of Accident Pilot By Highest Pilot Certificate, 2003



Accident Occurrences for 2003

Safety Board accident reports document the circumstances of an accident as "accident occurrences" and the "sequence of events."

Occurrence data can be defined as *what* happened during the accident. A total of 54 occurrence codes are available to describe the events for any given accident.[34] Because aviation accidents are rarely limited to a single occurrence, each occurrence is coded as part of a sequence (that is, occurrence 1, occurrence 2, etc.), with as many as six different occurrence codes in one accident. For accidents that involve more than one aircraft, the list of occurrences may be different for each aircraft. Of the 1,695 accident aircraft in 2003 for which data are available, 1,345 cited 2 or more occurrences, 707 cited 3 or more, 117 cited 4 or more, 11 cited 5 or more, and 1 cited a total of 6.

The excerpt from a brief report shown here, which is for a 2003 accident with three occurrences, illustrates how an accident with multiple occurrences is coded. In this accident, the pilot was flying to a remote mountain airstrip when a witness saw the aircraft make a wrong turn into a dead-end canyon. The aircraft impacted trees while the pilot was attempting to reverse course. The pilot subsequently lost control of the airplane, and it impacted terrain. Each of these occurrences was coded in order, as shown.

Example of Occurrence Findings Cited in an NTSB Accident Brief, 2003

Occurrence #1: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: MANEUVERING

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: DESCENT - UNCONTROLLED

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: DESCENT - UNCONTROLLED

[34] Two of the codes, "missing aircraft" and "undetermined," do not represent operational events.

Occurrence data do not include specific information about why an accident may have happened; the first occurrence can instead be considered the first observable link in the accident chain of events. The following table displays first occurrences for all year-2003 general aviation accident aircraft with sequence of events data available. To simplify the presentation of accident occurrence data, similar occurrences are grouped into eight major categories.

General Aviation Accident First Occurrences, 2003

First Occurrences	Total	Fatal
Collision – In-flight	254	82
In-flight Collision with Object	141	40
In-flight Collision with Terrain/Water	76	30
Midair Collision	20	12
Undershoot	17	0
Near Collision Between Aircraft	0	0
Noncollision – In-flight	443	166
Loss Of Control - In-flight	247	95
Airframe/Component/System Failure/Malfunction	94	16
In-flight Encounter with Weather	87	51
Abrupt Maneuver	11	3
Vortex Turbulence Encountered	3	1
Altitude Deviation, Uncontrolled	1	0
Forced Landing	0	0
Decompression	0	0
Collision – On-ground or Water	89	5
On Ground/Water Collision with Object	35	1
On Ground/Water Encounter with Terrain/Water	31	1
Collision Between Aircraft (Other Than Midair)	16	2
Dragged Wing, Rotor, Pod, Float or Tail/Skid	7	1
Noncollision – On-ground or Water	405	7
Loss of Control - On Ground/Water	229	2
Hard Landing	98	1
Overrun	50	2
Nose Over	11	0
Roll Over	5	0
Propeller/Rotor Contact to Person	5	2
Propeller Blast or Jet Exhaust/Suction	4	0
Nose Down	2	0
Ditching	1	0
On Ground/Water Encounter with Weather	0	0
First Occurrences (Cont.)	**Total**	**Fatal**
Power Related	446	52
Loss of Engine Power	182	22
Loss of Engine Power(Total) - Nonmechanical	131	18
Loss of Engine Power(Total) - Mech Failure/Malf	64	5
Loss of Engine Power(Partial) - Nonmechanical	37	6
Loss of Engine Power(Partial) - Mech Failure/Malf	19	1
Propeller Failure/Malfunction	8	0
Rotor Failure/Malfunction	5	0
Engine Tear-away	0	0
Landing Gear	29	0
Gear Collapsed	11	0
Wheels-up Landing	8	0
Main Gear Collapsed	4	0
Gear Retraction on Ground	3	0
Nose Gear Collapsed	2	0
Complete Gear Collapsed	1	0
Wheels-down Landing in Water	0	0
Tail Gear Collapsed	0	0
Other Gear Collapsed	0	0
Gear Not Extended	0	0
Gear Not Retracted	0	0
Miscellaneous	25	5
Miscellaneous/Other	19	5
Fire	3	0
Cargo Shift	2	0
Fire/Explosion	1	0
Hazardous Materials Leak/Spill	0	0
Explosion	0	0
Undetermined	4	4
Missing Aircraft	4	4
Undetermined	0	0

Among the eight major categories of first occurrences, the largest percentage of accidents (26%) included occurrences related to aircraft power. Among the individual occurrences, the most common involved a loss of control in flight (15%), followed closely by loss of control on the ground (14%). Although occurrences involving loss of aircraft control on the ground resulted in only 2 fatal accidents in 2003, loss-of-control occurrences in flight resulted in a total of 95 fatal accidents—more than one-quarter of all fatal accidents and more than twice that of any other single occurrence.

Phase of Flight

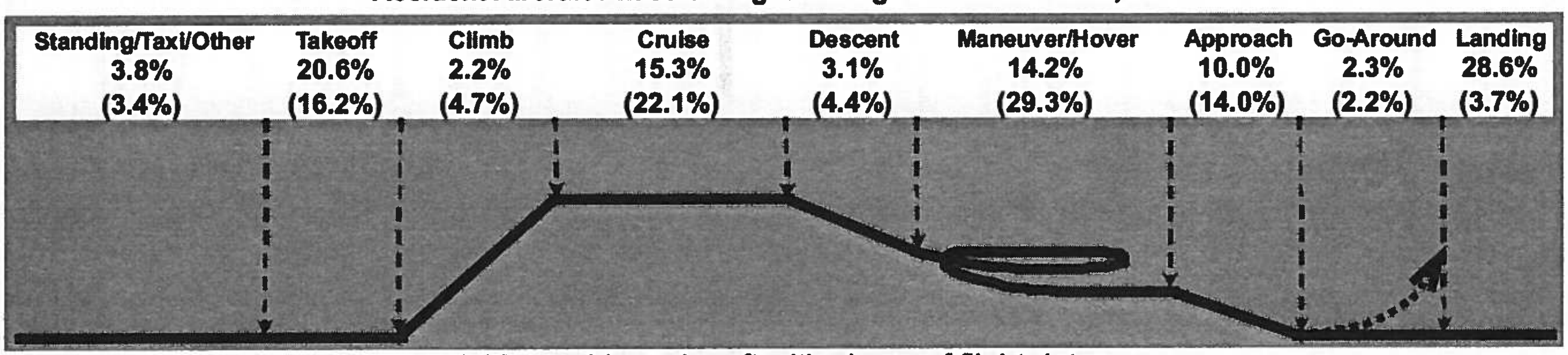
The following illustration displays the percentage of accident aircraft in each phase of flight at the time of the first occurrence. The phase of flight can be defined as when, during the operation of the aircraft, the first occurrence took place. Fifty distinct phases of flight are used to describe the operational chronology of occurrences. To simplify the presentation of this information, the detailed phases are grouped into the nine broad categories shown in this illustration. For example, the category "approach" includes any segment of an instrument approach or position in the airport traffic pattern and continues until the aircraft is landing on the runway. The upper set of numbers shows the distribution of accidents by each phase associated with each first occurrence, and the numbers in parentheses show the distribution of fatal accidents by each phase associated with each first occurrence.

As shown in the illustration, almost half of all general aviation accidents (49%) occurred during either takeoff or landing, despite the relatively short duration of these phases compared to the entire profile of a normal flight. The high number of accidents that occurred during takeoff and landing reflects the increased workload placed on both the flight crew and the aircraft during these phases. During both takeoff and landing, the flight crew must control the aircraft, change altitude and speed, communicate with air traffic control (ATC) and/or other aircraft, and maintain separation from obstacles and other aircraft. Aircraft systems are also stressed during takeoff and landing with changes to engine power settings, the possible operation of retractable landing gear, flaps, slats, and spoilers, and changes in cabin pressurization. While the aircraft is at low altitude during takeoff and landing, it is also most susceptible to hazards caused by wind and weather conditions.

Notably, landing accounted for the largest percentage of total accident first occurrences (29%) of any single phase but only 4% of fatal accident first occurrences. The combination of the cruise and maneuvering phases accounted for about half (51%) of fatal accident first occurrences, but less than one-third (29%) of all accidents. These differences reflect the relative severity of accidents that are likely to occur during each phase. Accidents during cruise and maneuvering are more likely to result in higher levels of injury and aircraft damage due to higher speeds and altitudes.

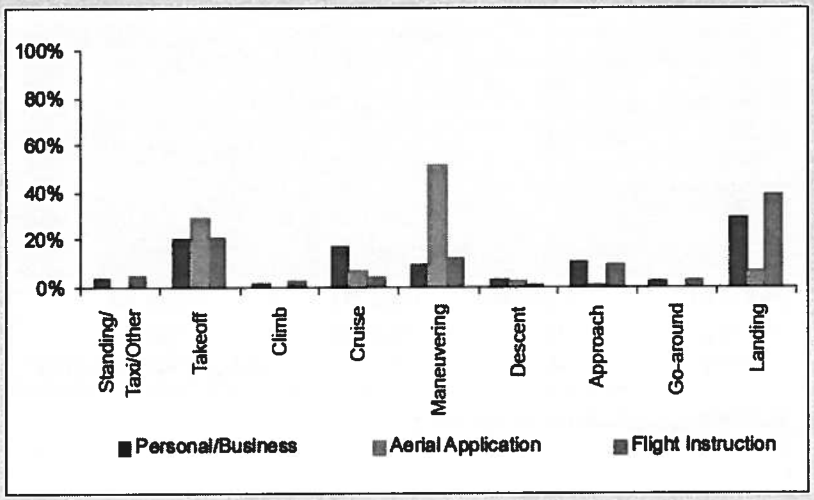
The likelihood of an aircraft accident first occurrence during each phase of flight varies by aircraft type and type of operation due to the unique hazards associated with each. For example, flight instruction typically involves a lot of time spent practicing takeoffs and landings. As a result, about 39% of all first occurrences for 2003 accidents involving instructional flights occurred during landing compared to 29% of personal/business flights and 7% of aerial application flights.

Accident Aircraft Phase of Flight During First Occurrence, 2003



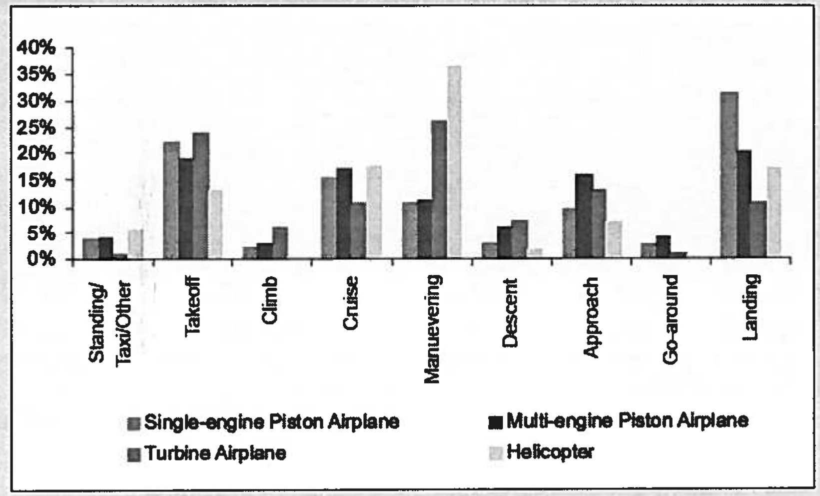
1,695 accident aircraft with phase of flight data

Accident Aircraft Phase of Flight During Accident First Occurrence by Type of Operation, 2003



Accident phase-of-flight differences among aircraft types are the result of the amount of time spent in each phase, aircraft-specific hazards associated with that phase, and the type of operations typically conducted with that aircraft. For example, the largest percentage of first occurrences for accidents involving helicopter flights, about 37%, occurred while maneuvering. The percentage of accidents during this phase reflects the hazards unique to helicopters while hovering and during operations that are unique to helicopters, such as carrying external loads. In contrast, the largest percentage of accidents involving single-engine piston aircraft occurred during landing. Takeoff accounted for 20-25% of accidents involving airplanes, but only 13% of accidents involving helicopters.

Accident Aircraft Phase of Flight During Accident First Occurrence by Aircraft Type, 2003



Chain of Occurrences

An accident's first occurrence and phase of flight during first occurrence indicate how and when an accident begins. However, the entire accident can also be viewed as a chain of all the accident occurrences cited in the order in which they happen. As previously discussed, accident events often include a combination of multiple occurrences, with many possible combinations. For example, of the 1,695 accidents that occurred during 2003 for which occurrence data are available, 405 unique combinations of accident occurrences were cited. The following tables, which list the top ten combinations of occurrences for all accidents and fatal accidents, illustrate the most common events.

Chain Of Occurrences - All General Aviation Accidents, 2003

Rank		Number of Accidents
1	1) Loss Of Control - In Flight 2) In Flight Collision With Terrain/water	157
2	1) In Flight Collision With Object	74
3	1) In Flight Collision With Terrain/water	67
4	1) Loss Of Control - On Ground/water 2) On Ground/water Encounter With Terrain/water	65
5	1) In Flight Collision With Object 2) In Flight Collision With Terrain/water	43
6	1) Hard Landing	42
7	1) Loss Of Control - In Flight 2) In Flight Collision With Object	39
8	1) Loss Of Engine Power 2) Forced Landing 3) In Flight Collision With Object	37
9	1) Loss Of Control - On Ground/water 2) On Ground/water Collision With Object	34
10	1) Loss Of Engine Power 2) Forced Landing 3) In Flight Collision With Terrain/water	32

The top ten occurrence chains cited in fatal accidents are similar to those cited for all accidents. Loss of control followed by in-flight collision with terrain or water tops both lists, with almost half those accidents being fatal. It is important to note that, although this was the most frequent chain of occurrences in 2003, it accounted for only 9% of all accidents for the year.

Chain Of Occurrences - Fatal General Aviation Accidents, 2003

Rank		Number of Accidents
1	1) Loss Of Control - In Flight 2) In Flight Collision With Terrain/water	71
2	1) In Flight Collision With Terrain/water	30
3	1) In Flight Collision With Object	17
4	1) In Flight Collision With Object 2) In Flight Collision With Terrain/water	17
5	1) In Flight Encounter With Weather 2) In Flight Collision With Terrain/water	17
6	1) In Flight Encounter With Weather 2) Loss Of Control - In Flight 3) In Flight Collision With Terrain/water	14
7	1) Loss Of Control - In Flight 2) In Flight Collision With Object	14
8	1) Loss Of Engine Power 2) Forced Landing 3) Loss Of Control - In Flight 4) In Flight Collision With Terrain/water	9
9	1) Airframe/component/system Failure/malfunction 2) Loss Of Control - In Flight 3) In Flight Collision With Terrain/water	8
10	1) Loss Of Control - In Flight 2) In Flight Collision With Object 3) In Flight Collision With Terrain/water	7

A diverse range of events can, in combination, result in an accident. Fatal accidents, however, are more likely to result from an in-flight collision, often preceded by loss of control and/or weather encounters or equipment malfunctions. For example, all of the top ten chains of fatal accident occurrences included an in-flight collision with terrain or object, events that are more likely to result in the high impact forces likely to cause serious injury. In contrast to the severity of these cases, most accidents in 2003 did not involve catastrophic events, and a large number of accidents involved aircraft on the ground that resulted in minor or no injuries.

Most Prevalent Causes/Factors for 2003

Probable Causes, Factors, Findings, and the Broad Cause/Factor Classification

In addition to coding accident occurrences, the Safety Board makes a determination of probable cause. The objective of the probable cause statement is to define the cause and effect relationships in the accident sequence. The probable cause could be described as *why* the accident happened. In determining probable cause, the Board considers the facts, conditions, and circumstances of the event. Within each accident occurrence, any information that helps explain why that event happened is identified as a "finding" and may be further designated as either a "cause" or "factor." The term "factor" is used to describe situations or circumstances that contributed to the accident cause. The details of probable cause are coded as the combination of all causes, factors, and findings associated with the accident. Just as accidents often include a series of events, the reason why those events led to an accident reflects a combination of multiple causes and factors. For this reason, a single accident report can include multiple cause and factor codes, as shown in the following brief.

Example of NTSB Accident Brief, 2003

Occurrence #1: MISCELLANEOUS/OTHER
Phase of Operation: MANEUVERING
Findings
1. (C) DOOR - NOT SECURED
2. (C) ALTITUDE/CLEARANCE - NOT MAINTAINED - PILOT IN COMMAND
3. DOOR - OPEN
4. (C) PREFLIGHT PLANNING/PREPARATION - INADEQUATE - PILOT IN COMMAND

Occurrence #2: LOSS OF CONTROL - IN FLIGHT
Phase of Operation: EMERGENCY LANDING AFTER TAKEOFF
Findings
5. AIRCRAFT CONTROL - NOT MAINTAINED - PILOT IN COMMAND
6. DIVERTED ATTENTION - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation: MANEUVERING
Findings
7. TERRAIN CONDITION - GROUND

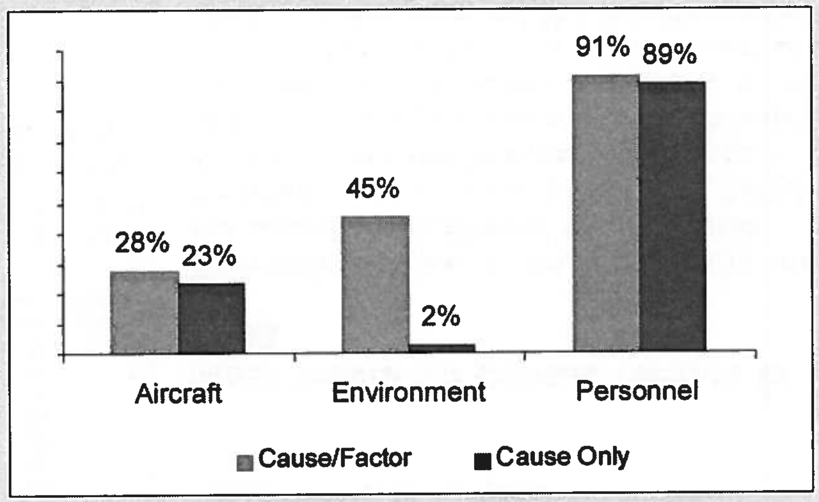
Findings Legend: (C) = Cause, (F) = Factor

The National Transportation Safety Board determines the probable cause(s) of this accident as follows. The pilot's inadequate preflight preparation in which he failed to secure the cabin door which diverted his attention and resulted in the failure to maintain directional control.

This accident happened just after takeoff, when the aircraft door opened in flight. The pilot attempted to return to the runway and make an emergency landing. While maneuvering to land, the pilot lost control of the airplane and began descending. The aircraft struck trees, power lines, and then impacted the ground. The investigation revealed that the airplane door had not been properly latched and locked prior to departure. In this accident, the unsecured door, the pilot's failure to maintain altitude in flight, and inadequate preflight preparation were cited as causes. The open door, the pilot's diverted attention, and the subsequent loss of aircraft control were all cited as findings but not assigned as a cause or factor.

To simplify the presentation of probable cause information in this review, the hundreds of unique codes used by investigators to code probable cause are grouped into broad cause/factor categories. This broad cause/factor classification provides an overview of fundamental accident origins by dividing all accident causes and factors into three groups: aircraft, environment, and personnel. The following graph shows the percentage of general aviation accidents that fall into each broad cause/factor classification. Personnel-related causes or factors were cited in 91% of the 1,677 general aviation accident reports for 2003 for which cause/factor data were available. Environmental causes/factors were cited in 45% of these accident reports, and aircraft-related causes/factors were cited in 28%.[35]

Accident Broad Cause/Factor and Cause, 2003

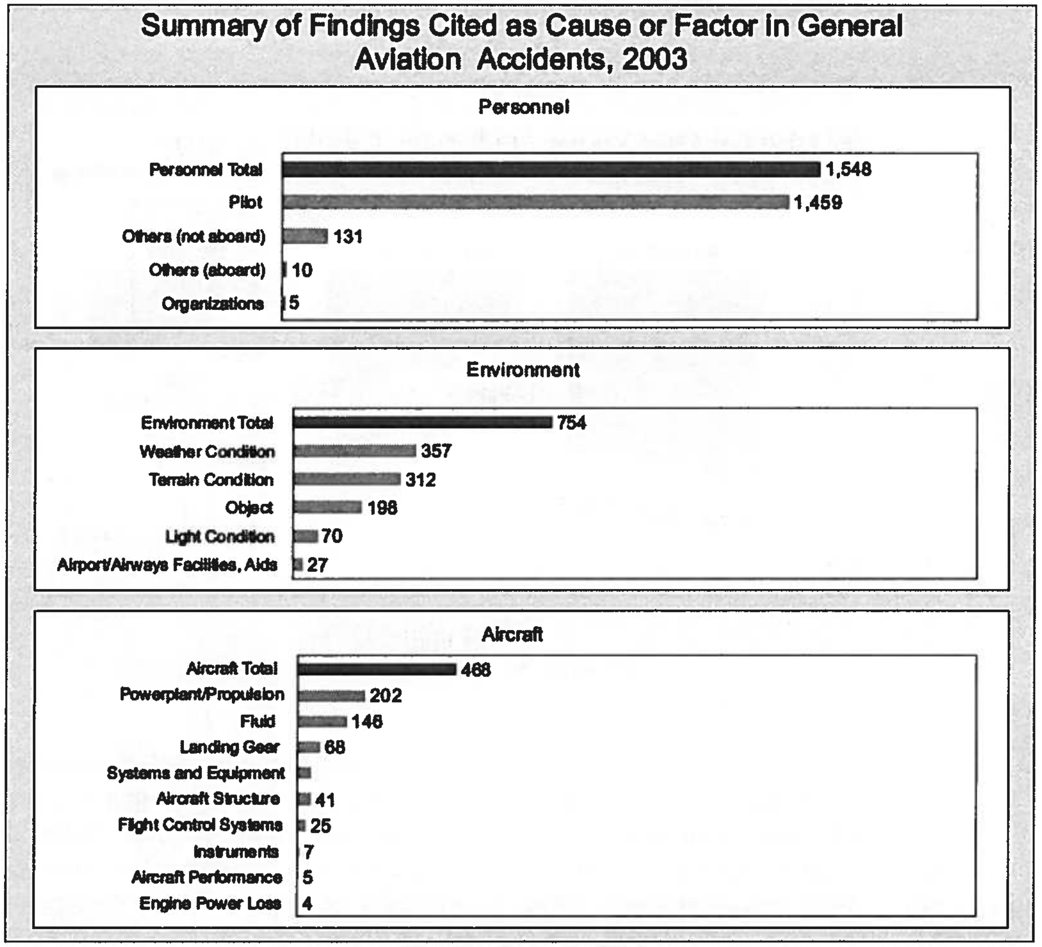


(1,677 accidents with findings)

Environmental conditions are rarely cited as an accident cause but are more likely to be cited as a contributing factor. In 2003, only 39 of 754 environmental citations (2% of all causes/factors cited) were listed as

35 Because the Safety Board frequently cites multiple causes and factors for an aircraft accident, the number of causes and factors will result in a sum greater than the total number of accidents.

a cause, with the remainder listed as contributing factors. For example, rough terrain might be cited as a contributing factor, but not a cause, to explain why an aircraft was damaged during a forced landing due to engine failure. In that case, the origin(s) of the engine failure would be cited as cause, but the terrain would be cited as a factor because it contributed to the accident outcome.



(1,677 accidents with findings in 2003)

As mentioned previously, several hundred unique codes are available to document causes/factors, as summarized in the graph on this page.

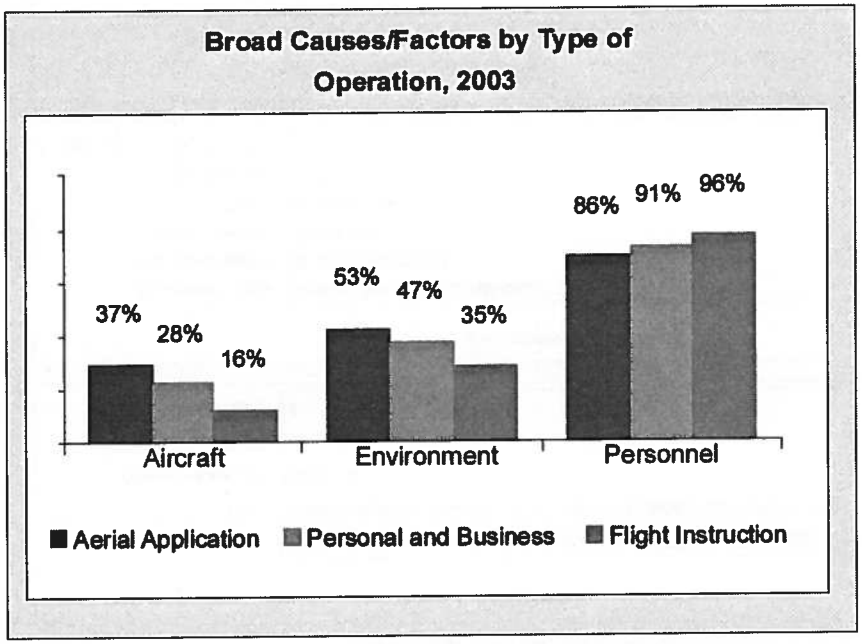
As this graph shows, most causes and factors attributed to general aviation accidents in 2003 were related to personnel. Much like the pilot and passenger injury differences discussed previously, part of the reason why personnel are cited so often may have to do with exposure to risk. Personnel, and pilots in particular, are associated with every flight. However, potential aircraft and environmental accident causes and factors depend on a range of variables, including the type of flight, type of aircraft, time of day, time of year, and location.

Although the pilot was the most frequently cited individual in the personnel category in 2003, other persons not aboard the aircraft were also cited as a cause or factor in 131 accidents. Such personnel included flight instructors, maintenance technicians, and airport personnel. In the broad category of environmental factors, weather conditions were cited in 357 (21%) of the accidents. Powerplant-related[36] causes/factors, cited in 202 (12%) of all general aviation accidents, were the most commonly cited aircraft factors.

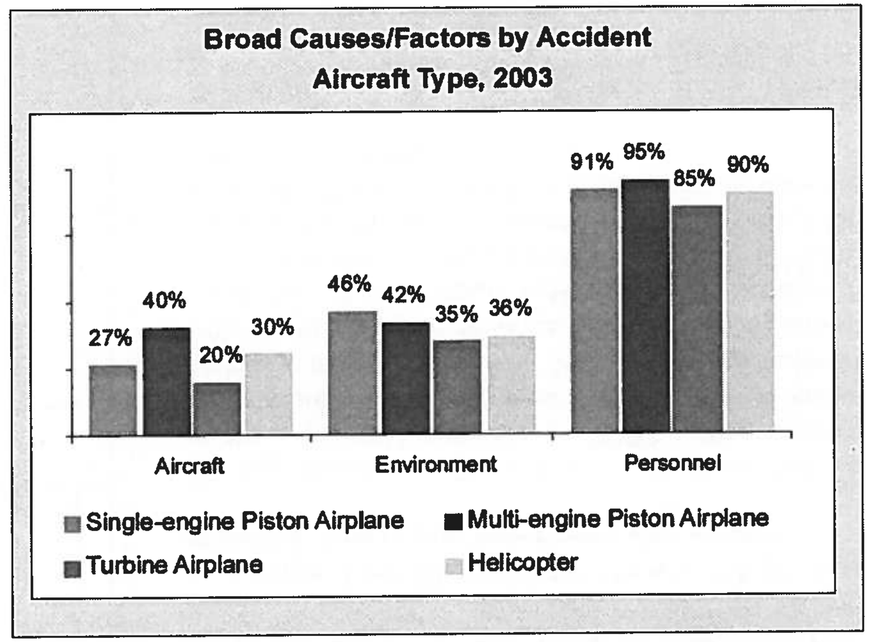
The following graph shows how specific accident causes and factors varied by type of flight operation. For example, personnel were cited in 96% of instructional flight accidents and 91% of personal/business accidents, compared to 86% for aerial application accidents. The high percentage of personnel causes/ factors for flight instruction accidents is likely the

36 "Powerplant/propulsion" causes and factors include any partial loss or disruption of engine power, as well as the malfunction or failure of any part(s), equipment, or system associated with engine propulsion. "Engine power loss" refers only to the total loss of engine power.

result of aircraft control and decision-making errors due to students' lower level of skill and ability, as well as the large amount of time practicing maneuvers like takeoffs and landings, which are more likely to result in accidents. In contrast, aerial application accidents cited a higher percentage of aircraft causes/factors, most likely because the low altitude flown during spray operations allows few options for recovery in the event of a mechanical failure.



A comparison of the causes/factors cited in accidents involving different types of aircraft reveals similar results. The higher percentage of multi-engine piston accidents that cited aircraft causes/factors in 2003 is likely a result of more complex systems as compared to single-engine piston airplanes. Conversely, the high reliability of turbine engines likely contributes to the low percentage of aircraft-related findings for those aircraft. There is also a noticeable drop in the percentage of environmental causes/factor citations progressing from single- to multi-engine piston, and turbine airplane accidents, mirroring increases in the typical range, performance, and equipment capabilities of those aircraft.



Human Performance

The information recorded in the personnel category refers primarily to *whose* actions were a cause or factor in an accident. However, details about the actions or behavior that may have led to an accident, causal data related to human performance issues, and any underlying explanatory factors are also recorded. The information in these categories can be thought of as *how* and *why* human performance contributed to the accident. For example, if a pilot becomes disoriented and loses control of an aircraft after continuing visual flight into instrument flight conditions, the pilot's inability to maintain control would be cited as a "cause" in the personnel category, and planning/ decision-making would likely also be cited in the human performance issues category.

Human Performance and Explanatory Causes/Factors 2003

	All Accidents	Fatal Accidents
Human Performance Issues	1,431	285
Aircraft Handling/Control	1,012	227
Planning/Decision	530	125
Use of Aircraft Equipment	162	22
Maintenance	90	10
Communications/Information/ATC	62	12
Meteorological Service	8	8
Airport	2	1
Dispatch	0	0
Underlying Explanatory Factors	157	75
Qualification	51	19
Physiological Condition	46	42
Psychological Condition	40	15
Aircraft/Equipment Inadequate	11	2
Procedure Inadequate	8	1
Institutional Factors	5	2
Facility Inadequate	4	1
Information	2	2
Material Inadequate	2	1

Of the 1,431 accidents for which the cause or factor was attributed to human performance in 2003, the most frequently cited cause/factor was aircraft handling and control (71%), followed by planning and decision-making (37%) and use of aircraft equipment (11%). Issues related to personnel qualification were cited in about 32% of the 157 accidents with underlying explanatory factors related to human performance. Examples of qualification issues that were cited in the 2003 accident record included lack of total experience, lack of recent experience, and lack of certification.

Weather as a Cause/Factor

Because general aviation aircraft are usually smaller, slower, and more limited in maximum altitude and range than transport-category aircraft, they can be more vulnerable to hazards posed by weather. Smaller aircraft are affected to a greater degree by adverse wind conditions; and precipitation, icing, and convective weather have a greater effect on aircraft that lack the speed, altitude, and/or range capabilities to avoid those conditions. Weather conditions cited most often as a cause or factor in general aviation accidents are related to winds, including "gusts," "crosswind," and "tailwind."

The top three environmental causes/factors cited in general aviation accidents in 2003 were all related to wind. Because aircraft are most susceptible to the effects of wind during takeoffs and landings, the effect of adverse wind was reflected in a high percentage of general aviation accidents that occurred during those phases of flight.

Accidents by Weather Cause/Factor

	All Accidents	Fatal Accidents
Weather Condition	357	91
Crosswind	94	4
Gusts	85	7
Tailwind	43	1
Low ceiling	38	33
High density altitude	30	4
Fog	22	17
High wind	22	10
Carburetor icing conditions	19	1
Clouds	19	17
Downdraft	14	3
Icing conditions	13	8
Unfavorable wind	9	0
Sudden windshift	8	0
Rain	8	7
Turbulence	7	3
Snow	4	1
Thunderstorm	4	1
Windshear	4	1
Variable wind	4	0
Turbulence (thunderstorms)	4	2
Temperature, low	3	0
Turbulence in clouds	3	1
Hail	3	1
No thermal lift	3	0
Mountain wave	2	2
Dust devil/whirlwind	2	0
Haze/smoke	2	1
Other	2	0
Turbulence, terrain induced	1	0
Whiteout	1	0
Updraft	1	0
Obscuration	1	1
Below approach/landing minimums	1	1
Drizzle/mist	1	1
Lightning	1	0

Note: due to the possibility of multiple findings, the sum of causes/factors is greater than the total number of accidents.

As previously discussed, most landing accidents do not result in fatal injuries. Because of the strong association of wind with landing accidents, it is not surprising that most wind-related accidents in 2003 were not fatal. The wind-related weather factors "crosswind," "gusts," and "tailwind" were cited as a cause/factor in 222 accidents, but only 12 of those accidents were fatal. Among fatal general aviation accidents, the three most frequently cited weather factors were related to conditions that resulted in reduced visibility, including "low ceiling," "fog," and "clouds." Accidents under conditions of low visibility typically involve either loss of aircraft control and/or collision with obstacles or terrain, both of which are likely to result in severe injuries and aircraft damage. The high number of fatal general aviation accidents occurring in low visibility weather led the Safety Board to conduct a safety study of these accidents.[37] Several of the weather-related accidents that occurred during 2003 were included in that study.

[37] National Transportation Safety Board, *Risk Factors Associated with Weather-Related General Aviation Accidents*, NTSB/SS-05/01 (Washington, DC: 2005)

Focus on General Aviation Safety: Night Flying

Recent general aviation accident data demonstrate that accidents that occur at night are more likely to be fatal than those that occur during the day. This section attempts to explain the risks associated with flying at night. To that end, this section includes statistical data and discusses safety issues related to general aviation operations at night. This section is not meant to be an exhaustive discussion of all the related safety concerns, but rather a discussion of the details of an issue important to the safety of general aviation pilots.

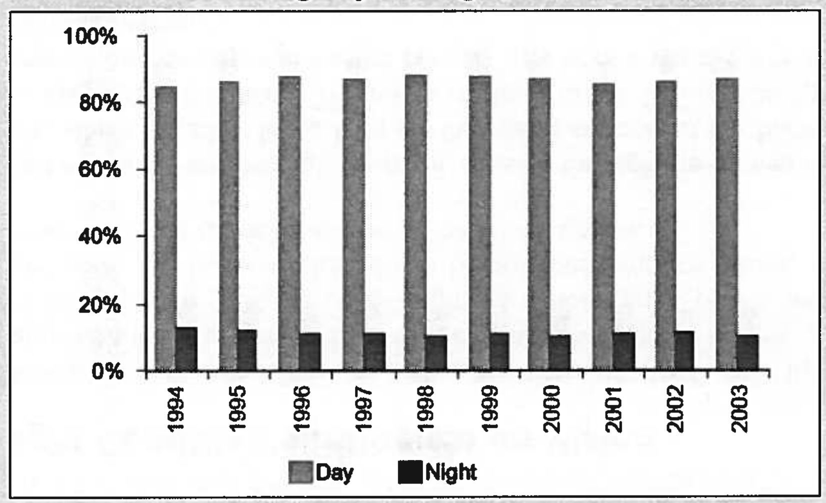
Historical Record of Night Accidents

Each year between 1994 and 2003, an average 11% of general aviation accidents occurred at night. Estimates of the distribution of general aviation flight hours based on the FAA general aviation activity survey[38] suggest that accidents are proportionate to activity, with an estimated 12% of general aviation hours flown at night. However, each year, an average 33% of night accidents were fatal, making them almost twice as likely to be fatal as accidents that occurred during the day. Reasons for the increased risk include the effects of darkness on the pilot's ability to see and avoid obstacles and the increased difficulty of safely responding to emergency situations.

General Aviation Night Accident Statistics, 2003

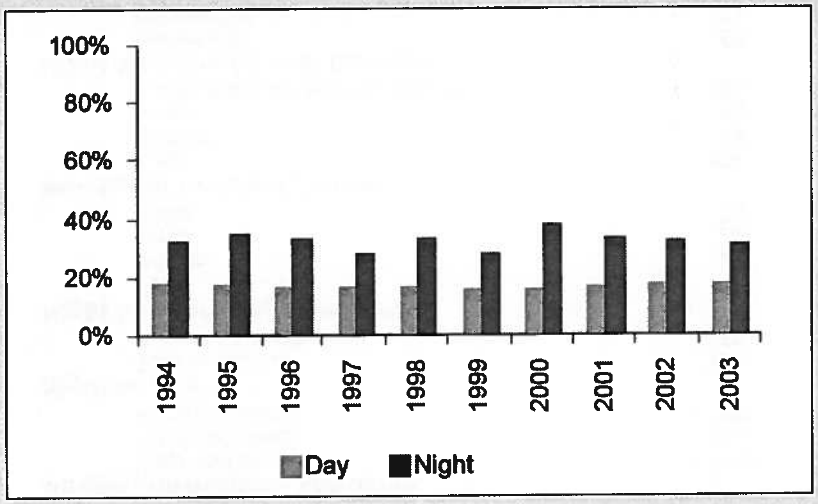
All General Aviation Accidents	
Total Accidents	1,739
Fatal Accidents	352
Accident Aircraft	1,758
Night Accidents	
Total Accidents	178
Accident Aircraft	179
Night Accidents by Injury Level	
Fatal	55
Serious	24
Minor	29
None	70
Number of Accident Injuries	
Fatal	104
Serious	45
Minor	66
Persons aboard with no Injuries	168
Night Accident Aircraft Damage	
Destroyed	52
Substantial	121
Minor	2
None	4

Percentage of General Aviation Accidents Occurring Day and Night, 1994-2003



[38] Data were provided by the FAA, Office of Accident Investigation, using results from the newly revised, 2004 *General Aviation and Air Taxi Activity and Avionics Survey*. Estimates of the day/night distribution of activity were calculated from survey responses, excluding those from aircraft owners who reported having flown any time in 14 CFR Part 135 operations.

Percentage of General Aviation Accidents Resulting in a Fatality by Day and Night, 1994-2003



What Is Night?

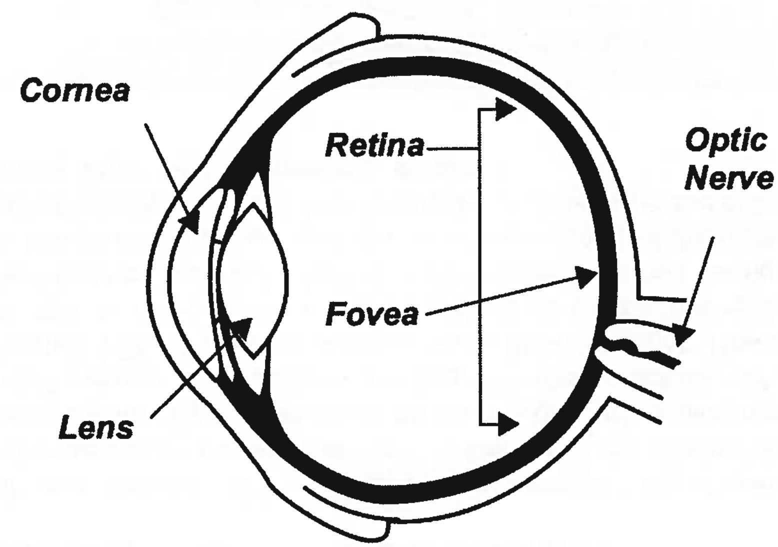
In 14 CFR Part 1, the FAA defines night as "the time between the end of evening civil twilight and the beginning of morning civil twilight, as published in the American Air Almanac, converted to local time." Civil twilight is defined as the time at which the sun is 6 degrees below the horizon, roughly 30 minutes before sunrise and 30 minutes after sunset. This definition applies to most night-related regulatory requirements, such as required minimum aircraft equipment, VFR weather minimums, logging of flight time, and required fuel reserves.

Rather than using a simple day/night distinction, Safety Board investigations record lighting conditions at the time of an accident as one of the following: dawn, day, dusk, and night, with the additional classifications of dark night and bright night. For purposes of clarity, the data presented in this section will be limited to the day/night classification.[39]

Light Condition's Influence on Vision

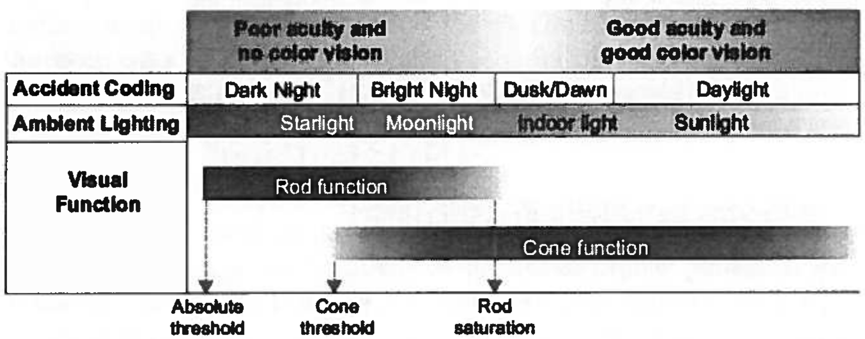
Many of the human performance difficulties associated with night flying begin with the structure and function of the human visual system, and the corresponding effects of low-light conditions on a pilot's visual perception. To better explain those human performance issues, this section includes a brief overview of the visual system.

Light enters the eye through the pupil, passing through the cornea and lens, which together focus light on the inside surface of the back of the eye, called the retina. The retina contains about 125 million light-sensitive photoreceptor cells that convert light from a visual scene into neural impulses.



[39] For the purposes of this section, "day" includes the Safety Board reporting categories of "dawn" and "day," and "night" includes Board reporting categories "dusk," "night," "bright night," and "dark night," unless otherwise specified.

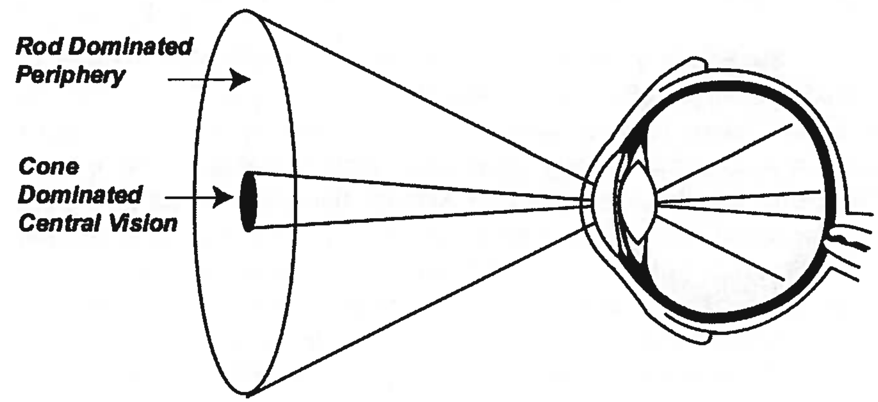
The human visual system is able to function over an extreme range of light conditions from sunlit day to starlit night. This range is possible because the retina includes two distinct types of photoreceptors—cones and rods—that interact dynamically based on ambient light levels. Because cones and rods differ in size, shape, and response, and in the way they interact, cones mediate visual function in bright light conditions, and rods mediate visual function in low light conditions. At intermediate light levels, both systems operate together and the resulting visual function shares qualities of both systems.



Pilots should be aware that their ability to read text, identify objects and terrain features, and perceive color are all impaired in low light conditions.

Cones are mostly concentrated in the part of the retina associated with the central field of vision, called the fovea. Cone cells include three additional subtypes that are sensitive to different wavelengths of light—what we perceive as red, green, and blue—which allow for color vision. Rods are more abundant than cones and are distributed throughout the remaining area of the retina. Unlike cones, rods provide no color information.

Cones are smaller in both diameter and length than rods, allowing room for more cone cells in a smaller area, which results in higher visual acuity. Rods tend to be larger and accumulate light over a longer period of time than cones, making them more sensitive in low-light conditions because they are more likely to absorb enough light to stimulate a response.



Pilots should modify their scanning technique in dark conditions to compensate for changes in visual acuity, and try to look to the side of small targets rather than trying to fixate on them.

In addition to the size and shape of individual photoreceptors, rods and cones differ in how they interact with each other. Although the retina is made of about 125 million photoreceptor cells, the optic nerve that carries the signals from the retina to the brain is made up of only about 1 million cells; as a result, many photoreceptors feed a single optic nerve cell. However, the ratio of receptors to nerve cells is not uniform across the retina. Cone cells in the fovea can have a receptor-to-nerve cell ratio as low as one to one while rod cells in the periphery can have a ratio of several hundred to one. Combining the inputs of multiple cells over a larger area further increases the sensitivity of rod cells at the expense of visual acuity; as a result, large objects remain visible under low light levels but fine detail features are harder to detect and text is harder to read. Further, the cones provide little information in low light conditions to help us perceive the color of unlighted objects at night and a functional blind spot is created in the fovea.

Pilots should allow sufficient time for their eyes to adapt before departing on a night flight, and should thereafter avoid exposure to bright light for more than a second or two to avoid a loss of dark adaptation.

When a rod or cone is stimulated by light, pigments in the cell convert the light into a neural impulse. The cell must regenerate these pigments after each impulse before it is ready to fire again. Pigment regeneration takes about 5 minutes in the cone cells and up to 30 minutes in rod cells. These differences in cell recovery time result in a two-stage increase in sensitivity when transitioning from bright to low light. When a person moves from bright to low light, sensitivity improves for the first 3-4 minutes and levels off briefly as the cones adjust. Sensitivity then continues to increase as the rods adapt, reaching maximum sensitivity after about 30 minutes.

Dim red light is used for cockpit illumination because rods are least sensitive to long wavelength (red) light, and it has little negative effect on dark adaptation. However, the *Aeronautical Information Manual* recommends the brief use of dim white light as necessary in the cockpit at night because red light illumination can make it difficult to read aeronautical charts or focus on objects in the cockpit. If pilots must use white light in the cockpit, they should close one eye to retain some dark adaptation.

Pilots can take steps to improve their night vision.

Smoking, vitamin A deficiency, high cabin altitude, exposure to carbon monoxide from engine exhaust, and fatigue can all negatively affect a pilot's night vision. In addition to not smoking and maintaining a healthy diet, pilots can improve their night vision by maintaining a lower cabin altitude and/or using oxygen at night.

Pilots should use all available flight instruments, navigation aids, and approach guidance to counter potential illusory perceptions resulting from changes in visual function in the dark.

Even healthy pilots with good night vision are susceptible to perceptual problems in low light conditions. In addition to acuity changes and dark adaptation, visual performance is negatively affected by reduced contrast at night. As ambient lighting decreases, contrast—the difference between the brightest and darkest visual features—also decreases. In daylight conditions, we are able to detect obstacles, rising terrain, and ground features because of the high-contrast edges outlining an obstacle, or the line where terrain or water meets sky. As ambient lighting decreases, the contrast of objects and terrain features decreases and it becomes harder to distinguish those features from the surrounding environment.

Perceptions of speed and direction of movement are based on visual details like the apparent flow of the surroundings when moving through the environment, the relative size and height of familiar objects, texture gradients, and linear perspective. When flying, these details also provide information about altitude and climb/descent rate. Reduced lighting limits the amount of visual detail available and increases the likelihood of experiencing illusory perceptions of speed, distance, altitude, or climb/descent rate. As a result, pilots may simply be unable to see rising terrain, trees, or unlit obstacles. In other cases, they may become disoriented and have difficulty maintaining level flight in cruise or flying a proper descent angle while on approach to landing.

Some examples of nighttime perceptual illusions include the following:

- False Horizon Illusion – At night, pilots may become disoriented because they are unable to distinguish ground lights from stars. Cloud formations or patterns of ground lights can also create the illusion of sloping terrain or the perception that the plane is banking. Such illusions can disorient pilots and cause them to lose control of their aircraft if they rely on their perceptions, which can be false, rather than aircraft flight instruments.

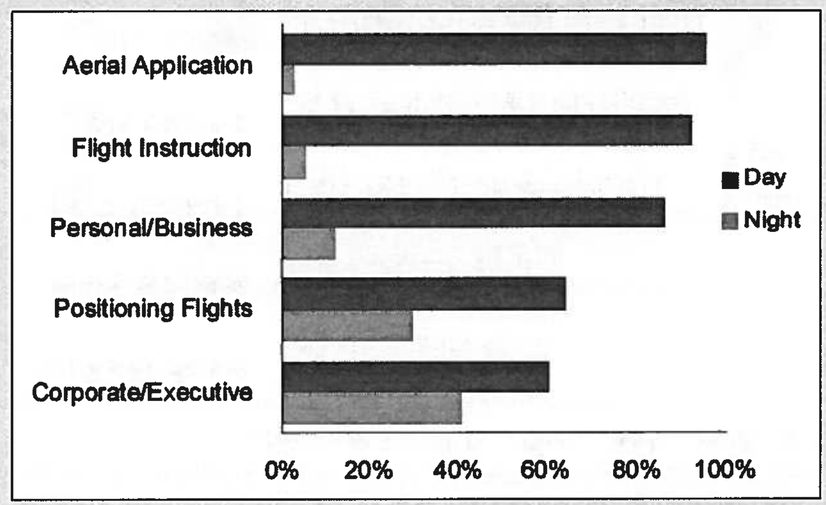
- Distance Illusions – Bright approach or runway lights can be seen from long distances at night. This can create the illusion that the aircraft is much closer to the runway than it is, leading to a lower than appropriate approach path.
- Featureless Terrain or "Black Hole" Illusion – In dark conditions, with few ground lights, pilots may be unable to perceive enough orientation clues to judge altitude or descent rate, causing them to perceive the aircraft to be higher than it actually is. If this occurs while on approach, pilots may have the sensation that the aircraft is stationary while the runway is sloping away. This illusion can cause pilots to unknowingly descend into terrain or water, or cause them to fly a low approach or undershoot the runway while landing.

In general, pilots are susceptible to illusions at night that are similar to those encountered during flight in instrument conditions. The best way to overcome these and similar illusions is to use aircraft flight instruments and other resources. For example, pilots should use glideslope, visual approach path indicator lighting, and/or global positioning system (GPS) vertical navigation information, if available, during approach and landing at night to counter possible false perceptions of altitude or decent rate. Long straight-in approaches should also be avoided in favor of an appropriate traffic pattern whenever possible.

Purpose of Flight

Accident likelihood is based on the level of risk associated with an activity and the frequency of that activity. The Safety Board has found that the distribution of accidents that occur during the day and at night is proportionate to the number of hours flown; however, the unique risks that night conditions pose to specific operations is reflected in the distribution of accidents by purpose of flight. For example, only 2% of aerial application accidents occur at night, most likely because aerial application is almost exclusively a daytime activity.

Day and Night Distribution of Accidents by Purpose of Flight, 2003

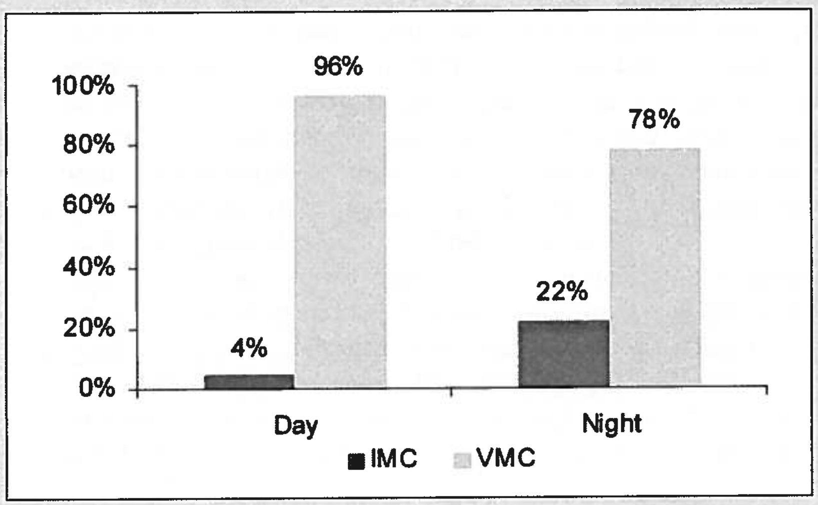


For other types of flight operations, the differences may be more complex. Positioning flights are a unique type of general aviation operation because they usually involve aircraft and pilots that do much of their flying under either 14 CFR Part 121, or more likely, Part 135. If an on-demand Part 135 operator flies an empty airplane to pick up passengers for a subsequent flight, the empty leg is a positioning flight subject to Part 91, and therefore a general aviation operation. As the previous graph illustrates, one-third of general aviation accidents in 2003 that involved positioning flights occurred at night. These flights may pose an additional risk if the pilot is experiencing the effects of fatigue due to the time of day and/or from having already completed a long day of flying.

Weather

Another source of increased risk for fatal accidents at night is the hazard posed by weather. Conditions like fog and low clouds that reduce visibility can either form or worsen as the temperature decreases at night and water vapor in the air condenses. Clouds, fog, and precipitation are an even greater threat to VFR flights at night than during the day because the conditions are harder to see and avoid, particularly because the illumination that is available from ground lights or moonlight is limited. The minimum visibility and cloud clearance requirements for visual flight outlined in 14 CFR 91.155 address this increased risk by requiring greater clearance for night VFR in class G (uncontrolled) airspace. However, 2003 data on accident weather conditions indicate that night accidents occurred more than five times more often in IMC than in VMC. These data demonstrate that preflight planning and obtaining weather information are critical at night—even for local flights—because clouds and precipitation are harder to see.

Percentage of Accidents in VMC/IMC by Day and Night, 2003

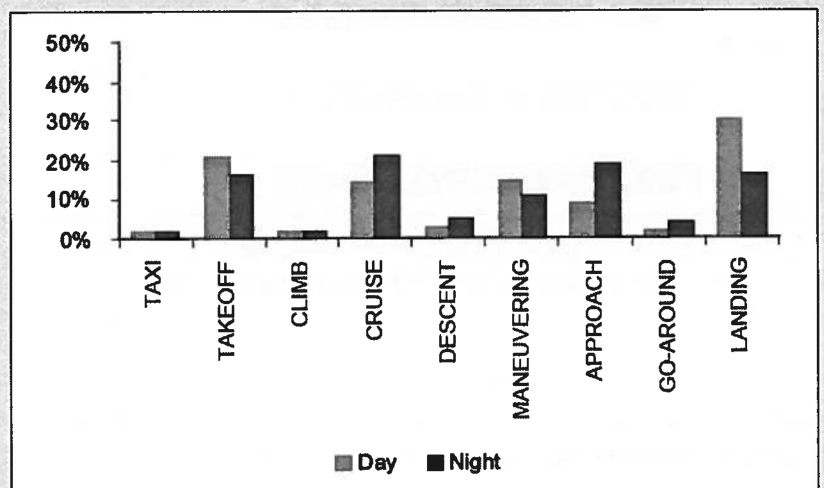


Phase of Flight

As previously noted, the percentage of general aviation accidents that occur at night is roughly equivalent to the percentage of general aviation flying estimated to occur at night. However, accidents that occur at night are about twice as likely to result in a fatal injury, which can be explained partly by differences in typical day and night accident profiles.

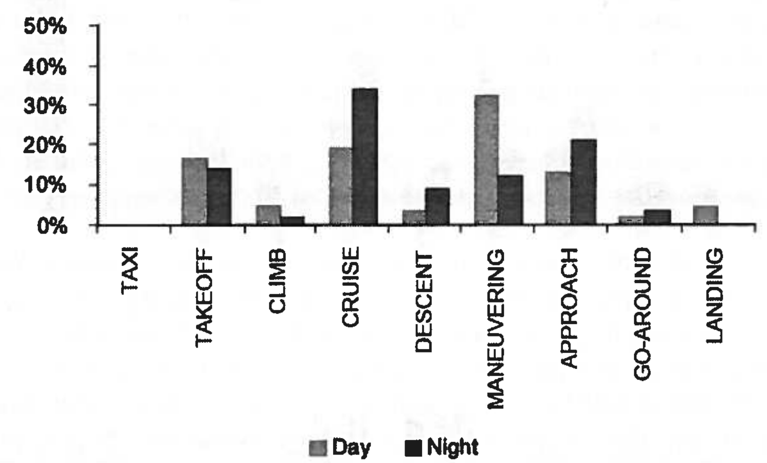
As noted earlier, most general aviation accidents occur during takeoff and landing. In 2003, the combined phases of takeoff and landing accounted for 51% of daytime accidents; night accidents do not, however, exhibit a similar distribution. As the following chart shows, the largest percentage of night-accident initiating events occurred during cruise, followed by approach. Night accidents also involved slightly higher percentages during descent and go-around.

First Occurence Phase of Flight for Day/Night Accident Aircraft, 2003



The distribution of fatal accidents by phase of flight shows that injury severity is closely related to the impact forces generated by the speed and altitude typical of each phase. In 2003, cruise and approach phases together accounted for 54% of all fatal night accidents. In contrast, none of the accidents that occurred during landing, which involve relatively slow speeds and low impact forces, were fatal.

First Occurence Phase of Flight for Fatal Day/Night Accident Aircraft, 2003



Accident First Occurrence

General aviation accidents at night differ from those that occur during the day with regard to how the accident events typically unfold. As the following tables show, loss of control in flight, loss of engine power, and aircraft system and equipment malfunctions are frequently cited as first occurrences in both day and night accidents. However, the percentage of accidents citing collision with objects, collisions with terrain, and in-flight encounters with weather were noticeably higher for accidents that occurred at night.

Ten Most Frequently Cited Occurrences in Day Accidents, 2003

	Accident Aircraft	% of Day Accident Aircraft
Loss of control - on ground/water	220	15%
Loss of control - in flight	219	14%
Loss of engine power	163	11%
In flight collision with object	116	8%
Loss of engine power (total) - nonmechanical	112	7%
Hard landing	91	6%
Airframe/component/system failure/malfunction	83	5%
In flight encounter with weather	66	4%
In flight collision with terrain/water	64	4%
Loss of engine power (total) - mechanical failure/malfunction	59	4%

Ten Most Frequently Cited Occurrences in Night Accidents, 2003

	Accident Aircraft	% of night Accident Aircraft
Loss of control - in flight	29	16%
In flight collision with object	25	14%
In flight encounter with weather	22	12%
Loss of engine power	18	10%
Loss of engine power (total) - nonmechanical	18	10%
In flight collision with terrain/water	13	7%
Airframe/component/system failure/malfunction	10	6%
Loss of control - on ground/water	8	4%
Hard landing	6	3%
On ground/water collision with object	5	3%

The earlier discussion of the human visual system and how it functions in low light helps explain why higher percentages of night flying accidents occur during cruise, approach, and descent, and why accidents at night are more likely to involve collision with objects or terrain.

Regulatory Requirements

The FAA has established specific requirements for pilot training and currency to address the unique risks associated with night flight. For example, 14 CFR 61.109 requires applicants for a private pilot license to have logged at least 3 hours of night-flight training, including at least one night-cross-country flight greater than 100 nautical miles, and at least 10 takeoffs and landings to a full stop at night. Private pilot applicants must also have logged at least 3 hours of instruction flying solely by reference to aircraft instruments, which is relevant to night flying because of the similarities between operating at night and in IMC conditions. Once certificated, pilots must also maintain a minimum level of activity to be eligible to carry passengers at night. The currency requirements of 14 CFR 61.57(b) state that pilots may not carry passengers at night unless they have, within the last 90 days, performed at least three takeoffs and landings to a full stop during the period from 1 hour after sunset until 1 hour before sunrise.

Unlike the United States, many countries require a separate rating to fly at night. For example, Canada, the United Kingdom, Australia, and the European Joint Aviation Authority all require pilots to receive additional training to fly at night. To fly VFR at night, Australian Civil Aviation Orders require[40] pilots to have at least 10 hours of flight time at night including, among other things, 3 hours of dual instruction on a cross-country flight greater than 100 nautical miles in length and landing at a remote airfield without sufficient lighting to create a discernible horizon. Once they have completed this training, pilots must demonstrate their knowledge and proficiency by passing a flight test to receive a night visual flight rules (NVFR) rating. Canadian requirements[41] for a night rating state that applicants must have logged a minimum of 20 hours in the same category of aircraft, including at least 10 hours of night flying and 10 hours of instrument instruction. The 10 hours at night must consist of 5 hours of dual instruction, including a cross-country, and 5 hours of solo flight, including at least 10 takeoffs and landings.

Pilot Experience

Much like flight by reference to instruments, flying at night requires practice and can be more difficult for pilots with little experience. However, the data that are available for 2003[42] suggest that many of the pilots involved in night accidents were not inexperienced, and the median total flight experience of pilots involved in night flying accidents was only slightly less than that of all general aviation accident pilots.

A comparison of night flying experience indicates, however, that the median number of flight hours logged at night was higher for pilots involved in nighttime accidents. This difference may be another example of increased exposure to risk: pilots who spend more time flying at night are naturally more likely to be involved in an accident at night than pilots who do most of their flying during the day.

Median Flight Experience

	Total	Night
All Accident Pilots	1,194 hrs	65 hrs
Night Accident Pilots	1,078 hrs	100 hrs

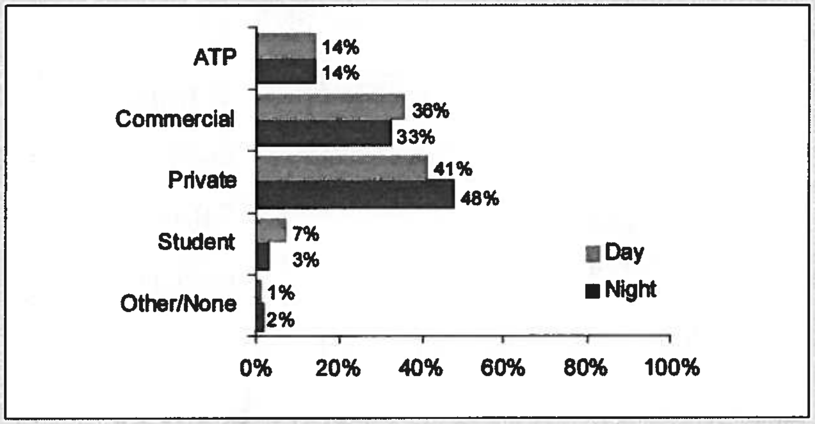
[40] Australian Civil Aviation Orders, 40.2.2.

[41] Canadian Aviation Regulations, 421.42.

[42] Total flight hour data were available for 1,639 accident pilots and night flight hour data were available for 1,049 pilots.

Similarly, differences in the distribution of accident pilots with regard to their highest level of certification do not appear to be large.

Percentage of Accident Pilots by Highest Certificate Day and Night, 2003



Conclusion

The 2003 accident record and recent general aviation accident data indicate that accidents at night are more likely to be fatal than those that occur during daylight. Over the past decade, one-third of all general aviation accidents at night resulted in a fatality. The severity of night accidents is the result of an increased likelihood of accidents involving collision with objects or terrain and in-flight encounters with weather, which are in turn the byproduct of low light conditions and their effect on human performance.

Although the human visual system is capable of functioning over a wide range of light conditions, it is limited in low light, making pilots susceptible to illusory perceptions of speed, altitude, and distance that can lead to severe accidents. Much like flight in IMC, safe night flying requires training and practice. Pilots can minimize their risks at night by maintaining proficiency with aircraft instruments, using all available approach guidance while landing, and taking the necessary steps to maintain or improve their night vision.

APPENDIX A

The National Transportation Safety Board Aviation Accident/Incident Database

The National Transportation Safety Board is responsible for maintaining the government's database on civil aviation accidents. The Safety Board's Accident/Incident Database is the official repository of aviation accident data and causal factors. The database was established in 1962 and about 2,000 new event records are added each year.

The Accident/Incident Database is primarily composed of aircraft accidents. An "accident" is defined in 49 CFR 830.2 as, "an occurrence associated with the operation of an aircraft which takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage." The database also contains a select number of aviation "incidents," defined in 49 CFR 830.2 as, "occurrences other than accidents that are associated with the operation of an aircraft and that affect or could affect the safety of operations."

Accident investigators use the Safety Board's Accident Data Management System (ADMS) software to enter data into the Accident/Incident Database. Shortly after the event, a preliminary report containing a few data elements such as date, location, aircraft operator, and type of aircraft, etc. becomes available. A factual report with additional information concerning the occurrence is available within a few months. A final report, which includes a statement of the probable cause and other contributing factors, may not be completed for months until the investigation is closed.

An accident-based relational database is currently available to the public at http://www.ntsb.gov/ntsb/query.asp#query_start. It contains records of about 40,000 accidents and incidents that occurred between 1982 and the present. Each record may contain more than 650 fields of data concerning the aircraft, event, engines, injuries, sequence of accident events, and other topics. Individual data files are also available for download at ftp://www.ntsb.gov/avdata, including one complete data set for each year beginning with 1982. The data files are in Microsoft Access (.mdb) format and are updated monthly. This download site also provides weekly updates and complete documentation.

Appendix B

Definitions

Definitions of Safety Board Severity Classifications

The severity of a general aviation accident or incident is classified as the combination of the highest level of injury sustained by the personnel involved (that is, fatal, serious, minor, or none) and level of damage to the aircraft involved (that is, destroyed, substantial, minor, or none). Accidents include those events in which any person suffers fatal or serious injury, or in which the aircraft receives substantial damage or is destroyed. An event that results in minor or no injuries and minor or no damage is not classified as an accident.

Definitions for Highest Level of Injury

Fatal—Any injury that results in death within 30 days of the accident.

Serious—Any injury that (1) requires the individual to be hospitalized for more than 48 hours, commencing within 7 days from the date the injury was received; (2) results in a fracture of any bone (except simple fractures of fingers, toes, or nose); (3) causes severe hemorrhages, nerve, muscle, or tendon damage; (4) involves any internal organ; or (5) involves second- or third-degree burns, or any burns affecting more than 5% of the body surface.

Minor—Any injury that is neither fatal nor serious.

None—No injury.

Definitions for Level of Aircraft Damage

Destroyed—Damage due to impact, fire, or in-flight failures to the extent that the aircraft cannot be repaired economically.[1]

Substantial Damage—Damage or failure that adversely affects the structural strength, performance, or flight characteristics of the aircraft, and that would normally require major repair or replacement of the affected component. Engine failure or damage limited to an engine if only one engine fails or is damaged, bent fairings or cowling, dented skin, small puncture holes in the skin or fabric, ground damage to rotor or propeller blades, and damage to landing gear, wheels, tires, flaps, engine accessories, brakes, or wingtips are not considered "substantial damage."[2]

Minor Damage—Any damage that neither destroys the aircraft nor causes substantial damage (see definition of substantial damage for details).

None—No damage.

[1] Title 49 CFR 830.2 does not define "destroyed." This term is difficult to define because aircraft are sometimes rebuilt even when it is not economical to do so.

[2] See 49 CFR 830.2.

APPENDIX C

The National Transportation Safety Board Investigative Process

The National Transportation Safety Board investigates every accident that occurs in the United States involving civil aviation and public aircraft flights that do not involve military or intelligence agencies. It also provides investigators to serve as U.S. Accredited Representatives as specified in international treaties for aviation accidents overseas involving U.S.-registered aircraft or involving aircraft or major components of U.S. manufacture.[1] Investigations are conducted from Safety Board Headquarters in Washington, D.C. or from one of the 10 regional offices in the United States (see appendix D).

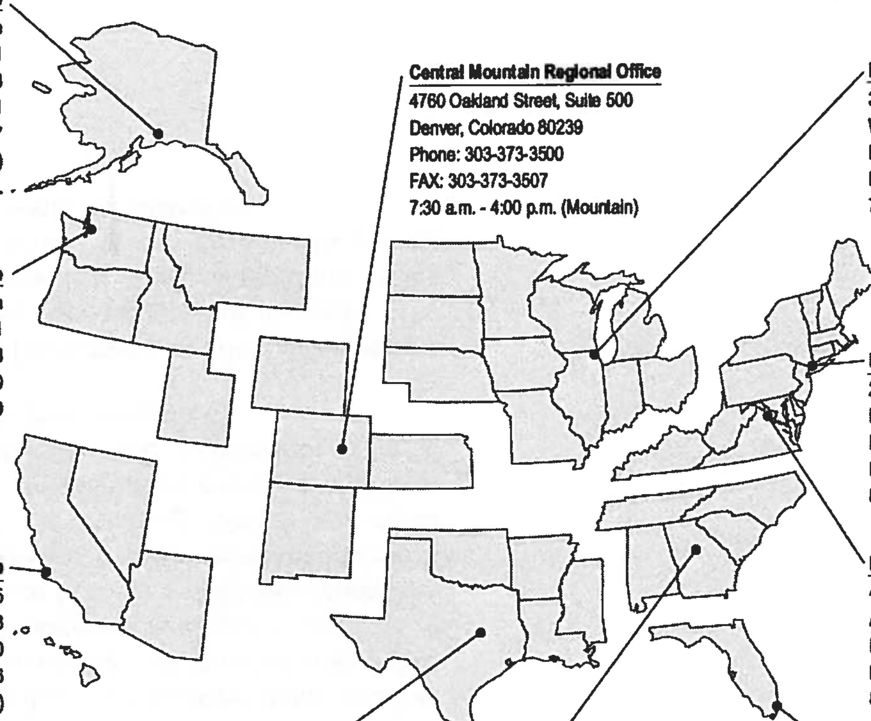
In determining probable cause(s) of a domestic accident, investigators consider the facts, conditions, and circumstances of the event. The objective is to ascertain those cause and effect relationships in the accident sequence about which something can be done to prevent recurrence of the type of accident under consideration.

Note the distinction between the population of accidents investigated by the Safety Board and those that are included in the Annual Review of Aircraft Accident Data, U.S. General Aviation. Although the Safety Board is mandated by Congress to investigate all civil aviation accidents that occur on U.S. soil (including those involving both domestic and foreign operators), the Annual Review describes accidents that occurred among U.S.-registered aircraft in all parts of the world.

[1] For more detailed information about the Safety Board's investigation of aviation accidents or incidents, see 49 CFR 831.2

APPENDIX D

National Transportation Safety Board Regional Offices[1]



[1] As of FY 2003

Illinois Department of Transportation
Division of Traffic Safety

County Summary Crash Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number Of Crashes							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
WEATHER CONDITION											
Rain	484	1	123	360	855	2	169	50	74	45	1,063
Clear	2,606	10	670	1,926	4,683	10	898	242	381	275	5,473
Snow	201	0	38	163	320	0	46	5	25	16	440
Sleet/hail	12	0	1	11	19	0	3	2	1	0	24
Other	16	0	2	14	23	0	2	0	2	0	21
Severe cross wind	12	0	3	9	14	0	3	0	3	0	14
Fog/smoke/haze	12	0	4	8	21	0	7	2	3	2	17
Unknown	52	0	6	46	93	0	6	0	2	4	57
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**
TYPE OF CRASH											
Angle	498	1	132	365	1,021	1	214	76	83	55	1,283
Animal	204	0	6	198	206	0	6	0	5	1	300
Fixed object	520	2	139	379	532	2	164	35	97	32	598
Head on	21	1	13	7	42	2	23	6	15	2	36
Other non collision	32	0	11	21	35	0	17	6	10	1	36
Other object	26	0	6	20	29	0	6	1	3	2	37
Overturned	94	0	57	37	95	0	72	20	42	10	60
Parked motor vehicle	332	0	22	310	682	0	26	13	8	5	401
Pedalcyclist	70	1	68	1	70	1	68	14	37	17	93
Pedestrian	45	3	42	0	46	3	45	8	23	14	61
Rear end	800	2	199	599	1,741	2	279	70	73	136	2,183
Sideswipe opp. direction	25	0	7	18	51	0	10	1	7	2	68
Sideswipe same direction	193	0	24	169	393	0	30	8	8	14	564
Turning	535	1	121	413	1,085	1	174	43	80	51	1,389
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**

Report No : SDM-ERC113

Sorted by : County

Illinois Department of Transportation
Division of Traffic Safety

Report Produced : 7/23/2010 2:25 PM

By: CENTRAL\KENDALLMB

County Summary Crash Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Crashes							Injury Severity			
	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
ROAD SURFACE CONDITION											
Dry	2,254	10	588	1,656	4,068	10	786	211	339	236	4,745
Ice	169	0	36	133	259	0	45	8	25	12	311
Other	10	0	4	6	11	0	6	2	2	2	11
Sand or mud or dirt	1	0	0	1	1	0	0	0	0	0	1
Snow or slush	234	0	35	199	394	0	41	6	22	13	528
Unknown	66	0	9	57	117	0	13	0	8	5	94
Wet	661	1	175	485	1,178	2	243	74	95	74	1,419
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Crash Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number of Crashes							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
CLASS OF TRAFFICWAY											
City Streets Urban	1,589	1	349	1,239	2,997	1	443	112	179	152	3,421
Controlled Rural	238	1	47	190	314	1	62	25	30	7	452
Controlled Urban	173	2	51	120	261	2	81	23	41	17	332
County & Local Roads Rural	391	2	130	259	564	2	170	50	85	35	571
State Numbered Rural	204	2	62	140	303	2	92	27	43	22	342
State Numbered Urban	585	2	159	424	1,151	3	205	42	79	84	1,442
Unmarked Highway Rural	49	1	13	35	81	1	19	4	11	4	89
Unmarked Highway Urban	166	0	36	130	357	0	62	18	23	21	460
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**
DAY OF WEEK											
Sunday	385	1	92	292	638	1	122	31	59	32	828
Monday	475	2	118	355	849	3	155	46	69	40	981
Tuesday	514	0	141	373	916	0	188	50	76	62	1,045
Wednesday	516	1	126	389	939	1	164	46	63	55	1,075
Thursday	505	3	118	384	909	3	148	39	59	50	1,043
Friday	544	1	142	401	996	1	201	45	93	63	1,184
Saturday	456	3	110	343	781	3	156	44	72	40	953
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Crash Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Crashes: Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity: A	B	C	O
TIME OF DAY											
Midnight	69	0	17	52	105	0	21	3	11	7	117
01 AM	56	2	8	46	84	2	10	1	6	3	83
02 AM	66	1	17	48	98	1	20	6	12	2	117
03 AM	39	0	7	32	56	0	7	3	3	1	55
04 AM	33	0	4	29	42	0	5	3	2	0	45
05 AM	45	0	5	40	57	0	6	2	3	1	68
06 AM	65	1	17	47	103	2	20	4	6	10	102
07 AM	168	0	53	115	295	0	67	18	25	24	298
08 AM	184	0	46	138	339	0	58	14	25	19	362
09 AM	127	1	37	89	216	1	45	11	13	21	238
10 AM	155	0	49	106	286	0	57	16	22	19	332
11 AM	168	0	44	124	307	0	58	10	28	20	352
Noon	247	1	59	187	476	1	84	23	39	22	602
1 PM	193	0	56	137	363	0	81	22	31	28	405
2 PM	219	0	62	157	415	0	93	29	32	32	506
3 PM	266	2	52	212	510	2	78	15	39	24	648
4 PM	252	0	59	193	466	0	81	27	32	22	596
5 PM	290	0	68	222	548	0	84	18	35	31	689
6 PM	177	0	39	138	313	0	60	16	22	22	402
7 PM	128	0	31	97	209	0	39	10	22	7	267
8 PM	125	0	44	81	214	0	57	18	26	13	244
9 PM	110	2	26	82	179	2	41	11	23	7	214
10 PM	126	0	27	99	204	0	33	10	18	5	220
11 PM	87	1	20	66	143	1	29	11	16	2	147
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Crash Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number Of Crashes							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
LIGHT CONDITION											
Darkness	611	4	131	476	879	4	165	57	80	28	1,053
Darkness/Lighted road	430	2	110	318	796	2	142	28	82	32	944
Dawn	45	1	8	36	58	2	9	3	2	4	72
Daylight	2,191	3	585	1,603	4,085	3	798	207	317	274	4,824
Dusk	67	1	11	55	120	1	18	6	10	2	163
Unknown	51	0	2	49	90	0	2	0	0	2	53
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**
ROAD DEFECTS											
Construction zone	34	0	13	21	60	0	16	5	7	4	68
Debris on roadway	6	0	1	5	8	0	1	0	1	0	7
Maintenance zone	2	0	0	2	6	0	0	0	0	0	8
No defects	3,196	11	812	2,373	5,693	12	1,094	290	475	329	6,710
Other	14	0	3	11	19	0	3	0	2	1	21
Rut, holes	7	0	2	5	11	0	2	2	0	0	13
Unknown	127	0	12	115	216	0	13	1	4	8	271
Utility work zone	1	0	0	1	2	0	0	0	0	0	3
Work zone – unk.	4	0	2	2	8	0	3	2	1	0	5
Worn surface	4	0	2	2	5	0	2	1	1	0	3
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Crash Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number Of Crashes							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
TRAFFIC CONTROL											
Lane use marking	644	6	160	478	907	6	223	62	110	51	1,179
No controls	1,533	3	355	1,175	2,737	4	453	111	200	142	2,935
No passing	1	0	0	1	2	0	0	0	0	0	1
Other	20	0	6	14	33	0	8	3	4	1	46
Other reg. sign	7	0	2	5	11	0	3	3	0	0	16
Other warning sign	24	0	8	16	29	0	10	4	5	1	32
Police/flagman	4	0	3	1	7	0	4	1	2	1	10
RR crossing gate	1	0	0	1	3	0	0	0	0	0	7
School zone	2	0	1	1	3	0	1	0	1	0	2
Stop sign/flasher	498	1	135	362	959	1	194	53	83	58	1,188
Traffic signal	641	1	171	469	1,304	1	231	62	83	86	1,656
unknown	12	0	4	8	19	0	4	0	2	2	19
Yield	8	0	2	6	14	0	3	2	1	0	18
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**
ROADWAY FEATURE											
Bridge	11	0	2	9	18	0	3	2	1	0	26
Intersctn of 2 Mrked Rts OR Mrked Rt and 8# OR 2 8#'s	112	0	33	79	226	0	45	16	9	20	269
Intersection of Mrked Rts & Pub Rd(Major Arterial)	127	0	28	99	267	0	42	10	27	5	331
Intersection of Mrked Rts & Pub Rd(Major Collector)	101	0	29	72	199	0	41	11	12	18	242
Intersection of Mrked Rts & Pub Rd(Minor Collector)	2	0	1	1	4	0	3	0	3	0	4
Intersection of Ramp and Other Roadway	77	0	15	62	143	0	19	6	6	7	178
Not Applicable	2,953	11	735	2,207	5,150	12	975	254	431	290	6,032
Railroad Crossing	3	0	2	1	9	0	2	0	0	2	9
Underpass	9	0	2	7	12	0	4	2	2	0	18
TOTALS	**3,395**	**11**	**847**	**2,537**	**6,028**	**12**	**1,134**	**301**	**491**	**342**	**7,109**

Report No : SDM-ERC115
Sorted by : County

Illinois Department of Transportation
Division of Traffic Safety

Report Produced : 7/23/2010 2:33 PM
By: CENTRAL\KENDALLMB

County Summary Vehicle Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number Of Vehicles							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
VEHICLE DEFECTS											
Brakes	30	0	6	24	30	0	4	0	2	2	44
Cargo	2	0	0	2	2	0	0	0	0	0	4
Engine/motor	2	0	0	2	2	0	0	0	0	0	1
Fuel system	1	0	0	1	1	0	0	0	0	0	0
Lights	1	0	0	1	1	0	0	0	0	0	1
None	5,035	13	1,286	3,736	5,035	6	916	256	373	287	6,095
Other	6	0	0	6	6	0	0	0	0	0	1
Signals	5	0	0	5	5	0	0	0	0	0	6
Steering	4	0	1	3	4	0	0	0	0	0	4
Suspension	1	0	0	1	1	0	0	0	0	0	1
Tires	7	0	3	4	7	0	9	1	6	2	15
Trailer coupling	1	0	0	1	1	0	0	0	0	0	4
Unknown	929	3	146	780	929	2	89	18	51	20	926
Wheels	1	0	0	1	1	0	0	0	0	0	1
Windows	3	0	1	2	3	0	0	0	0	0	3
TOTALS	**6,028**	**16**	**1,443**	**4,569**	**6,028**	**8**	**1,018**	**275**	**432**	**311**	**7,106**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Vehicle Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number Of Vehicles							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
VEHICLE TYPE											
All-terrain vehicle (ATV)	1	0	1	0	1	0	1	0	1	0	0
Bus over 15 pass.	39	0	10	29	39	0	5	1	2	2	85
Bus up to 15 pass	7	0	2	5	7	0	0	0	0	0	15
Farm equipment	5	0	1	4	5	0	0	0	0	0	4
Motor driven cycle	12	0	11	1	12	0	11	5	4	2	1
Motorcycle (over 150cc)	34	0	31	3	34	0	34	17	16	1	3
Other	35	0	6	29	35	0	1	0	1	0	33
Other vehicle with trailer	1	0	0	1	1	0	0	0	0	0	1
Passenger	3,728	11	905	2,812	3,728	7	682	177	288	217	4,288
Pickup	709	1	169	539	709	0	94	28	44	22	796
Sport utility vehicle (SUV)	645	3	167	475	645	1	93	27	40	26	851
Tractor w/ semi-trailer	109	1	13	95	109	0	5	1	1	3	112
Tractor w/o semi-trailer	3	0	1	2	3	0	0	0	0	0	3
Truck -- single unit	58	0	13	45	58	0	7	1	2	4	61
Unknown/NA	191	0	16	175	191	0	3	0	0	3	181
Van/mini van	451	0	97	354	451	0	82	18	33	31	672
TOTALS	**6,028**	**16**	**1,443**	**4,569**	**6,028**	**8**	**1,018**	**275**	**432**	**311**	**7,106**

Report No : SDM-ERC114

Sorted by : County

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number Of Persons							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
DRIVER CONDITION											
Asleep/fainted	32	1	13	18	32	1	13	4	6	3	18
Fatigued	8	0	5	3	8	0	3	1	2	0	5
Had been drinking	30	0	10	20	30	0	8	2	5	1	22
Illness	19	0	11	8	19	0	11	3	4	4	8
Impaired – alcohol	134	2	58	74	134	1	46	14	28	4	87
Impaired – drugs	8	3	3	2	8	2	3	3	0	0	3
Medicated	4	0	2	2	4	0	2	0	1	1	2
Normal	4,992	10	1,249	3,733	4,992	1	615	159	253	203	4,376
Other/unknown	440	0	62	378	440	0	21	7	12	2	419
TOTALS	**5,667**	**16**	**1,413**	**4,238**	**5,667**	**5**	**722**	**193**	**311**	**218**	**4,940**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

		Number Of Persons							Injury Severity			
Champaign		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
DRIVER AGE/GENDER												
10-14												
	Female	1	0	0	1	1	0	0	0	0	0	1
15												
	Female	2	0	1	1	2	0	0	0	0	0	2
	Male	5	0	2	3	5	0	1	0	1	0	4
16												
	Female	66	0	17	49	66	0	11	2	8	1	55
	Male	49	0	10	39	49	0	5	1	4	0	44
17												
	Female	62	0	17	45	62	0	6	2	3	1	56
	Male	80	0	23	57	80	0	7	0	5	2	73
18												
	Female	90	0	23	67	90	0	15	4	7	4	75
	Male	119	1	26	92	119	1	14	3	8	3	104
19												
	Female	90	0	18	72	90	0	14	4	6	4	76
	Male	118	0	29	89	118	0	16	6	5	5	102
20												
	Female	108	0	21	86	108	0	13	5	5	3	95
	Male	119	0	20	99	119	0	9	1	6	2	110
21												
	Female	136	0	31	105	136	0	16	3	9	4	120
	Male	123	0	33	89	123	0	13	6	5	2	110
22-24												
	Female	278	0	60	218	278	0	27	5	12	10	251
	Male	298	1	76	220	298	1	39	6	18	15	258
25-29												
	Female	270	0	62	208	270	0	36	7	17	12	234
	Male	364	1	103	259	364	1	48	8	30	10	315

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons						Injury Severity			
	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
DRIVER AGE/GENDER											
30-34											
Female	206	0	55	150	206	0	32	9	15	8	174
Male	241	0	56	185	241	0	33	12	13	8	208
35-39											
Female	178	0	47	131	178	0	28	7	10	11	150
Male	237	1	55	181	237	1	20	6	9	5	216
40-44											
Female	178	0	63	115	178	0	29	4	12	13	149
Male	217	1	68	148	217	1	35	15	11	9	181
45-49											
Female	188	0	58	130	188	0	29	9	7	13	159
Male	198	0	57	138	198	0	34	7	19	8	164
50-54											
Female	158	0	50	108	158	0	33	11	6	16	125
Male	219	0	53	166	219	0	20	4	5	11	199
55-59											
Female	160	0	40	119	160	0	23	9	10	4	137
Male	159	0	39	120	159	0	19	3	6	10	140
60-64											
Female	102	0	31	71	102	0	19	6	5	8	83
Male	123	0	21	102	123	0	13	4	4	5	110
65-69											
Female	72	0	20	52	72	0	15	6	5	4	57
Male	82	0	23	59	82	0	12	6	5	1	70
70-74											
Female	44	0	14	29	44	0	6	3	3	0	38
Male	54	0	13	41	54	0	4	1	1	2	50
75-79											
Female	25	0	10	15	25	0	6	3	3	0	19

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons							Injury Severity			
		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
DRIVER AGE/GENDER												
	Male	41	0	17	24	41	0	11	4	4	3	30
80-84												
	Female	20	0	7	13	20	0	2	0	1	1	18
	Male	42	0	12	29	42	0	3	0	3	0	39
85-89												
	Female	13	0	4	9	13	0	4	0	4	0	9
	Male	12	0	2	10	12	0	1	1	0	0	11
90-94												
	Female	3	0	0	3	3	0	0	0	0	0	3
	Male	6	0	3	3	6	0	1	0	1	0	5
95-98												
	Male	1	0	1	0	1	0	0	0	0	0	1
Unknown												
	Female	7	0	1	6	7	0	0	0	0	0	7
	Male	21	0	3	18	21	0	0	0	0	0	21
	Not Stated	282	0	18	264	282	0	0	0	0	0	282
TOTALS		**5,667**	**16**	**1,413**	**4,238**	**5,667**	**5**	**722**	**193**	**311**	**218**	**4,940**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity A	B	C	O
PASSENGER AGE/GENDER												
00												
	Female	26	1	9	16	26	0	4	0	2	2	22
	Male	22	0	5	17	22	0	0	0	0	0	22
01												
	Female	27	0	6	21	27	0	2	1	1	0	25
	Male	27	0	7	20	27	0	2	0	2	0	25
	Not Stated	1	0	0	1	1	0	0	0	0	0	1
02												
	Female	25	0	2	23	25	0	1	0	1	0	24
	Male	29	0	5	24	29	0	2	0	1	1	27
03												
	Female	26	0	9	17	26	0	4	0	2	2	22
	Male	26	0	8	18	26	0	1	0	1	0	25
04												
	Female	23	0	8	15	23	0	2	1	0	1	21
	Male	14	0	4	10	14	0	1	1	0	0	13
05												
	Female	28	0	7	21	28	0	1	0	0	1	27
	Male	20	0	5	15	20	0	2	1	0	1	18
06												
	Female	25	0	9	16	25	0	7	5	0	2	18
	Male	22	0	4	18	22	0	1	1	0	0	21
07												
	Female	20	0	6	14	20	0	2	0	1	1	18
	Male	27	0	5	22	27	0	2	0	2	0	25
08												
	Female	22	0	2	20	22	0	1	1	0	0	21
	Male	15	0	2	13	15	0	0	0	0	0	15

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

		Number Of Persons							Injury Severity			
Champaign		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PASSENGER AGE/GENDER												
09												
	Female	21	0	9	12	21	0	4	3	1	0	17
	Male	21	0	12	9	21	0	3	1	2	0	18
10-14												
	Female	105	0	42	63	105	0	22	2	10	10	83
	Male	92	0	29	63	92	0	8	2	5	1	84
15												
	Female	33	0	5	28	33	0	3	0	1	2	30
	Male	39	0	13	26	39	0	5	2	3	0	34
16												
	Female	42	0	12	30	42	0	6	2	2	2	36
	Male	40	0	8	32	40	0	3	1	1	1	37
	Not Stated	1	0	1	0	1	0	0	0	0	0	1
17												
	Female	52	0	13	39	52	0	11	3	6	2	41
	Male	38	0	13	25	38	0	8	2	5	1	30
18												
	Female	51	1	14	36	51	0	4	0	4	0	47
	Male	45	0	13	32	45	0	3	0	3	0	42
19												
	Female	59	0	11	48	59	0	7	1	3	3	52
	Male	70	1	19	50	70	1	7	1	3	3	62
20												
	Female	59	0	16	43	59	0	6	1	4	1	53
	Male	50	0	8	42	50	0	2	0	2	0	48
	Not Stated	1	0	0	1	1	0	0	0	0	0	1
21												
	Female	44	0	9	35	44	0	1	0	0	1	43
	Male	57	0	16	41	57	0	6	4	2	0	51

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons							Injury Severity			
		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PASSENGER AGE/GENDER												
22-24												
	Female	79	1	23	55	79	0	10	2	4	4	69
	Male	115	0	25	90	115	0	8	4	3	1	107
25-29												
	Female	88	2	28	58	88	1	17	4	9	4	70
	Male	88	2	31	55	88	0	14	4	5	5	74
	Not Stated	1	0	0	1	1	0	0	0	0	0	1
30-34												
	Female	67	0	20	47	67	0	11	2	5	4	56
	Male	42	0	9	33	42	0	3	0	2	1	39
35-39												
	Female	43	0	18	25	43	0	8	1	2	5	35
	Male	35	0	16	19	35	0	8	2	2	4	27
40-44												
	Female	37	0	13	24	37	0	8	0	5	3	29
	Male	34	0	14	20	34	0	4	3	0	1	30
45-49												
	Female	50	0	19	31	50	0	11	5	3	3	39
	Male	27	0	12	15	27	0	4	1	0	3	23
	Not Stated	1	0	0	1	1	0	0	0	0	0	1
50-54												
	Female	50	0	14	36	50	0	8	2	3	3	42
	Male	30	0	14	16	30	0	9	5	2	2	21
55-59												
	Female	34	0	6	28	34	0	3	2	1	0	31
	Male	19	0	4	15	19	0	0	0	0	0	19
60-64												
	Female	28	0	7	21	28	0	4	0	0	4	24
	Male	17	0	5	12	17	0	0	0	0	0	17

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity A	B	C	O
PASSENGER AGE/GENDER												
65-69												
	Female	33	0	8	25	33	0	4	3	0	1	29
	Male	5	0	1	4	5	0	0	0	0	0	5
70-74												
	Female	13	0	7	6	13	0	5	0	3	2	8
	Male	5	0	1	4	5	0	0	0	0	0	5
75-79												
	Female	18	0	8	10	18	0	3	1	1	1	15
	Male	7	0	3	4	7	0	1	1	0	0	6
80-84												
	Female	20	0	5	15	20	0	3	1	1	1	17
	Male	7	1	2	4	7	0	2	0	0	2	5
85-89												
	Female	4	0	1	3	4	0	0	0	0	0	4
	Male	1	0	1	0	1	0	1	1	0	0	0
95-98												
	Female	1	1	0	0	1	1	0	0	0	0	0
Unknown												
	Female	9	0	1	8	9	0	0	0	0	0	9
	Male	31	0	8	23	31	0	3	2	0	1	28
	Not Stated	81	0	12	69	81	0	0	0	0	0	81
TOTALS		**2,465**	**10**	**702**	**1,753**	**2,465**	**3**	**296**	**82**	**121**	**93**	**2,166**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons							Injury Severity			
		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDESTRIAN AGE/GENDER												
06												
	Female	1	0	1	0	1	0	1	1	0	0	0
08												
	Male	1	0	1	0	1	0	1	0	0	1	0
10-14												
	Female	3	0	3	0	3	0	3	0	2	1	0
	Male	1	0	1	0	1	0	1	0	1	0	0
15												
	Female	2	0	2	0	2	0	2	0	0	2	0
16												
	Female	1	0	1	0	1	0	1	0	1	0	0
17												
	Male	1	0	1	0	1	0	1	0	1	0	0
18												
	Female	2	0	2	0	2	0	2	1	0	1	0
19												
	Female	1	0	1	0	1	0	1	0	1	0	0
	Male	2	0	2	0	2	0	2	1	1	0	0
20												
	Female	1	0	0	1	1	0	0	0	0	0	1
21												
	Male	2	0	2	0	2	0	2	1	1	0	0
22-24												
	Female	2	0	2	0	2	0	2	0	0	2	0
	Male	2	0	2	0	2	0	2	1	1	0	0
25-29												
	Female	5	0	5	0	5	0	5	1	3	1	0
	Male	2	1	1	0	2	1	1	0	1	0	0

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity A	B	C	O
PEDESTRIAN AGE/GENDER												
30-34												
	Female	1	0	1	0	1	0	1	0	0	1	0
	Male	1	0	1	0	1	0	1	0	1	0	0
35-39												
	Female	3	0	3	0	3	0	3	1	1	1	0
	Male	4	0	3	1	4	0	3	0	2	1	1
40-44												
	Female	1	0	1	0	1	0	1	0	0	1	0
45-49												
	Female	3	0	3	0	3	0	3	2	1	0	0
	Male	1	0	1	0	1	0	1	0	1	0	0
50-54												
	Female	1	0	1	0	1	0	1	0	1	0	0
	Male	2	0	2	0	2	0	2	1	0	1	0
55-59												
	Female	1	0	1	0	1	0	1	0	1	0	0
65-69												
	Female	2	1	1	0	2	1	1	0	0	1	0
70-74												
	Male	1	0	1	0	1	0	1	1	0	0	0
80-84												
	Female	1	0	1	0	1	0	1	1	0	0	0
	Male	2	1	1	0	2	1	1	0	1	0	0
TOTALS		**53**	**3**	**48**	**2**	**53**	**3**	**48**	**12**	**22**	**14**	**2**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

	Number Of Persons							Injury Severity			
Champaign	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDALCYCLIST AGE/GENDER											
03											
Male	1	0	1	0	1	0	1	0	1	0	0
06											
Male	2	0	2	0	2	0	2	0	1	1	0
07											
Female	1	0	1	0	1	0	1	0	0	1	0
Male	1	0	1	0	1	0	1	0	1	0	0
09											
Male	2	0	2	0	2	0	2	0	2	0	0
10-14											
Female	4	0	4	0	4	0	4	0	4	0	0
Male	8	0	8	0	8	0	8	0	6	2	0
15											
Female	1	0	1	0	1	0	1	0	0	1	0
Male	2	0	2	0	2	0	2	0	2	0	0
16											
Male	1	0	1	0	1	0	1	0	1	0	0
17											
Male	1	0	1	0	1	0	1	0	1	0	0
18											
Female	2	0	2	0	2	0	2	2	0	0	0
19											
Female	1	0	1	0	1	0	1	1	0	0	0
Male	4	0	4	0	4	0	4	2	1	1	0
20											
Female	1	0	1	0	1	0	1	0	1	0	0
Male	3	0	3	0	3	0	3	0	2	1	0
21											
Female	2	0	2	0	2	0	2	0	2	0	0

Illinois Department of Transportation
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County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons							Injury Severity			
		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDALCYCLIST AGE/GENDER												
	Male	2	0	2	0	2	0	2	1	1	0	0
22-24												
	Female	4	0	4	0	4	0	4	0	3	1	0
	Male	1	0	1	0	1	0	1	0	0	1	0
25-29												
	Female	5	0	5	0	5	0	5	3	2	0	0
	Male	6	1	5	0	6	1	5	0	1	4	0
30-34												
	Male	4	0	4	0	4	0	4	0	2	2	0
35-39												
	Male	2	0	1	1	2	0	1	0	1	0	1
40-44												
	Male	1	0	1	0	1	0	1	1	0	0	0
45-49												
	Male	1	0	1	0	1	0	1	0	1	0	0
55-59												
	Male	4	0	4	0	4	0	4	3	0	1	0
60-64												
	Female	1	0	1	0	1	0	1	0	1	0	0
70-74												
	Male	1	0	1	0	1	0	1	0	0	1	0
75-79												
	Male	1	0	1	0	1	0	1	1	0	0	0
TOTALS		**70**	**1**	**68**	**1**	**70**	**1**	**68**	**14**	**37**	**17**	**1**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Persons							Injury Severity			
	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDESTRIAN PRIOR ACTION AGE/GENDER											
Crossing – against signal											
25-29											
Female	1	0	1	0	1	0	1	0	1	0	0
45-49											
Female	1	0	1	0	1	0	1	1	0	0	0
Crossing – with signal											
08											
Male	1	0	1	0	1	0	1	0	0	1	0
16											
Female	1	0	1	0	1	0	1	0	1	0	0
19											
Female	1	0	1	0	1	0	1	0	1	0	0
Male	1	0	1	0	1	0	1	0	1	0	0
21											
Male	1	0	1	0	1	0	1	0	1	0	0
22-24											
Female	2	0	2	0	2	0	2	0	0	2	0
25-29											
Female	2	0	2	0	2	0	2	0	2	0	0
35-39											
Female	1	0	1	0	1	0	1	0	0	1	0
45-49											
Female	1	0	1	0	1	0	1	1	0	0	0
Male	1	0	1	0	1	0	1	0	1	0	0
65-69											
Female	1	0	1	0	1	0	1	0	0	1	0
80-84											
Male	2	1	1	0	2	1	1	0	1	0	0

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Persons: Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity: A	B	C	O
PEDESTRIAN PRIOR ACTION AGE/GENDER											
Crossing not at intersection											
10-14											
Female	2	0	2	0	2	0	2	0	1	1	0
Male	1	0	1	0	1	0	1	0	1	0	0
15											
Female	1	0	1	0	1	0	1	0	0	1	0
35-39											
Female	1	0	1	0	1	0	1	0	1	0	0
40-44											
Female	1	0	1	0	1	0	1	0	0	1	0
45-49											
Female	1	0	1	0	1	0	1	0	1	0	0
Intoxicated ped/pedal											
25-29											
Male	2	1	1	0	2	1	1	0	1	0	0
30-34											
Male	1	0	1	0	1	0	1	0	1	0	0
No action											
21											
Male	1	0	1	0	1	0	1	1	0	0	0
35-39											
Male	1	0	1	0	1	0	1	0	0	1	0
Other action											
06											
Female	1	0	1	0	1	0	1	1	0	0	0
20											
Female	1	0	0	1	1	0	0	0	0	0	1
25-29											
Female	1	0	1	0	1	0	1	1	0	0	0

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Persons Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity A	B	C	O
PEDESTRIAN PRIOR ACTION AGE/GENDER											
35-39											
Male	2	0	1	1	2	0	1	0	1	0	1
50-54											
Male	1	0	1	0	1	0	1	1	0	0	0
55-59											
Female	1	0	1	0	1	0	1	0	1	0	0
70-74											
Male	1	0	1	0	1	0	1	1	0	0	0
80-84											
Female	1	0	1	0	1	0	1	1	0	0	0
Playing in roadway											
22-24											
Male	1	0	1	0	1	0	1	0	1	0	0
Standing in roadway											
18											
Female	1	0	1	0	1	0	1	0	0	1	0
19											
Male	1	0	1	0	1	0	1	1	0	0	0
22-24											
Male	1	0	1	0	1	0	1	1	0	0	0
50-54											
Female	1	0	1	0	1	0	1	0	1	0	0
Unknown/NA											
15											
Female	1	0	1	0	1	0	1	0	0	1	0
25-29											
Female	1	0	1	0	1	0	1	0	0	1	0
35-39											
Male	1	0	1	0	1	0	1	0	1	0	0

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Persons							Injury Severity			
	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDESTRIAN PRIOR ACTION AGE/GENDER											
50-54											
Male	1	0	1	0	1	0	1	0	0	1	0
Walking/riding against traffic											
10-14											
Female	1	0	1	0	1	0	1	0	1	0	0
Walking/riding to/from disabled vehicle											
65-69											
Female	1	1	0	0	1	1	0	0	0	0	0
Walking/riding with traffic											
17											
Male	1	0	1	0	1	0	1	0	1	0	0
35-39											
Female	1	0	1	0	1	0	1	1	0	0	0
Working in roadway											
18											
Female	1	0	1	0	1	0	1	1	0	0	0
30-34											
Female	1	0	1	0	1	0	1	0	0	1	0
TOTALS	**53**	**3**	**48**	**2**	**53**	**3**	**48**	**12**	**22**	**14**	**2**

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Persons Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity A	B	C	O
PEDALCYCLIST PRIOR ACTION AGE/GENDER											
Crossing – against signal											
10-14											
Male	2	0	2	0	2	0	2	0	2	0	0
30-34											
Male	1	0	1	0	1	0	1	0	1	0	0
Crossing – with signal											
15											
Male	1	0	1	0	1	0	1	0	1	0	0
19											
Female	1	0	1	0	1	0	1	1	0	0	0
Male	1	0	1	0	1	0	1	1	0	0	0
20											
Female	1	0	1	0	1	0	1	0	1	0	0
22-24											
Female	1	0	1	0	1	0	1	0	1	0	0
Male	1	0	1	0	1	0	1	0	0	1	0
25-29											
Male	1	0	1	0	1	0	1	0	1	0	0
45-49											
Male	1	0	1	0	1	0	1	0	1	0	0
Crossing not at intersection											
19											
Male	1	0	1	0	1	0	1	0	1	0	0
25-29											
Male	1	0	1	0	1	0	1	0	0	1	0
Enter from drive/alley											
03											
Male	1	0	1	0	1	0	1	0	1	0	0

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons							Injury Severity			
		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDALCYCLIST PRIOR ACTION AGE/GENDER												
06												
	Male	1	0	1	0	1	0	1	0	1	0	0
07												
	Male	1	0	1	0	1	0	1	0	1	0	0
09												
	Male	1	0	1	0	1	0	1	0	1	0	0
10-14												
	Male	3	0	3	0	3	0	3	0	1	2	0
18												
	Female	1	0	1	0	1	0	1	1	0	0	0
25-29												
	Female	1	0	1	0	1	0	1	1	0	0	0
No action												
10-14												
	Female	1	0	1	0	1	0	1	0	1	0	0
19												
	Male	1	0	1	0	1	0	1	0	0	1	0
21												
	Male	2	0	2	0	2	0	2	1	1	0	0
25-29												
	Male	1	1	0	0	1	1	0	0	0	0	0
35-39												
	Male	1	0	1	0	1	0	1	0	1	0	0
55-59												
	Male	1	0	1	0	1	0	1	0	0	1	0
Other action												
09												
	Male	1	0	1	0	1	0	1	0	1	0	0

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign	Number Of Persons: Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	Injury Severity: A	B	C	O
PEDALCYCLIST PRIOR ACTION AGE/GENDER											
10-14											
Male	1	0	1	0	1	0	1	0	1	0	0
20											
Male	1	0	1	0	1	0	1	0	1	0	0
22-24											
Female	2	0	2	0	2	0	2	0	1	1	0
25-29											
Female	1	0	1	0	1	0	1	1	0	0	0
Male	1	0	1	0	1	0	1	0	0	1	0
30-34											
Male	1	0	1	0	1	0	1	0	0	1	0
75-79											
Male	1	0	1	0	1	0	1	1	0	0	0
Turning left											
21											
Female	1	0	1	0	1	0	1	0	1	0	0
35-39											
Male	1	0	0	1	1	0	0	0	0	0	1
55-59											
Male	1	0	1	0	1	0	1	1	0	0	0
Unknown/NA											
06											
Male	1	0	1	0	1	0	1	0	0	1	0
07											
Female	1	0	1	0	1	0	1	0	0	1	0
10-14											
Female	2	0	2	0	2	0	2	0	2	0	0
15											
Female	1	0	1	0	1	0	1	0	0	1	0

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Champaign		Number Of Persons						Injury Severity			
	Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDALCYCLIST PRIOR ACTION AGE/GENDER											
Male	1	0	1	0	1	0	1	0	1	0	0
16											
Male	1	0	1	0	1	0	1	0	1	0	0
20											
Male	1	0	1	0	1	0	1	0	1	0	0
25-29											
Male	1	0	1	0	1	0	1	0	0	1	0
30-34											
Male	1	0	1	0	1	0	1	0	0	1	0
Walking/riding against traffic											
10-14											
Female	1	0	1	0	1	0	1	0	1	0	0
Male	2	0	2	0	2	0	2	0	2	0	0
22-24											
Female	1	0	1	0	1	0	1	0	1	0	0
25-29											
Female	2	0	2	0	2	0	2	1	1	0	0
40-44											
Male	1	0	1	0	1	0	1	1	0	0	0
55-59											
Male	1	0	1	0	1	0	1	1	0	0	0
70-74											
Male	1	0	1	0	1	0	1	0	0	1	0
Walking/riding with traffic											
17											
Male	1	0	1	0	1	0	1	0	1	0	0
18											
Female	1	0	1	0	1	0	1	1	0	0	0

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

		Number Of Persons							Injury Severity			
Champaign		Total	Fatal	Injury	Property Damage	Total Vehicles	Total Killed	Total Injured	A	B	C	O
PEDALCYCLIST PRIOR ACTION AGE/GENDER												
19												
	Male	1	0	1	0	1	0	1	1	0	0	0
20												
	Male	1	0	1	0	1	0	1	0	0	1	0
21												
	Female	1	0	1	0	1	0	1	0	1	0	0
25-29												
	Female	1	0	1	0	1	0	1	0	1	0	0
	Male	1	0	1	0	1	0	1	0	0	1	0
30-34												
	Male	1	0	1	0	1	0	1	0	1	0	0
55-59												
	Male	1	0	1	0	1	0	1	1	0	0	0
60-64												
	Female	1	0	1	0	1	0	1	0	1	0	0
TOTALS		**70**	**1**	**68**	**1**	**70**	**1**	**68**	**14**	**37**	**17**	**1**

Illinois Department of Transportation
Division of Traffic Safety

County Summary Person Report

1/1/2009 to 12/31/2009

County : Champaign | *See Notes at End of Report.

Notes

Current year and previous year data are not yet complete and are subject to change as more information becomes available. Calendar date selections include data based on the date of the crash. Year selections include data based on the statistical year in which the crash was processed.

U.S. Department of Transportation
Federal Aviation Administration

Advisory Circular

Subject: NOISE LEVELS FOR AIRCRAFT USED FOR COMMERCIAL OPERATIONS IN GRAND CANYON NATIONAL PARK SPECIAL FLIGHT RULES AREA

Date: 6/13/2006
Initiated by: AEE-100

AC No: AC-93-2
Change:

1. **Purpose.** This circular contains the measured or estimated noise levels for aircraft currently used for commercial sightseeing operations in the Grand Canyon National Park (GCNP) special flight rules area, ranked in alphabetical order for the conditions and assumptions described below. This information is provided both for aircraft that have been noise type certificated under 14 CFR part 36, and for aircraft for which no such requirements existed at the time of type certification. The noise level data presented in the appendices are provided for determining the GCNP quiet aircraft technology designation status for each aircraft subject to 14 CFR part 93.

2. **Cancellation.**

3. **Background.** On March 29, 2005, the Federal Aviation Administration (FAA) published a Final Rule entitled "Noise Limitations for Aircraft Operations in the Vicinity of Grand Canyon National Park". This amendment of 14 CFR part 93 is necessary to establish reasonably achievable requirements for aircraft operating in the GCNP to be considered as employing quiet aircraft technology. The standards for the GCNP quiet aircraft technology proposed in the rule will be used to assist the National Park Service (NPS) achieve its statutory mandate to provide for the substantial restoration of natural quiet and to enhance visitor' experience in the GCNP.

4. **Aircraft Noise Limits for GCNP Quiet Aircraft Technology.** Noise levels of propeller-driven small airplanes and helicopters that operate at GCNP at the time of preparation of this circular are presented in Appendices 1 and 2. The data were obtained by the methodology described in Section 5 of this circular. The sources of the data as they relate to Section 5 of this circular are designated in the "NOTES" column. The GCNP quiet aircraft technology status of each aircraft is provided in the "QUIET TECHNOLOGY" column.

   Appendix 1 provides noise levels of propeller driven small airplanes that are subject to Appendix F or G of 14 CFR part 36. Appendix 1 includes maximum takeoff weights, landing weights, engine type, horsepower, propeller type and diameter.

Appendix 2 contains noise levels of helicopters that are subject to Appendix H or J of 14 CFR part 36. This appendix includes maximum takeoff weights, landing weights, engine type, rotor type and diameter.

Aircraft are listed in alphabetical order by make and model in Appendices 1 and 2. The noise levels in the appendices were obtained during the noise certification process as prescribed under 14 CFR part 36. Where no certificated noise level is available, the Administrator may approve an alternative measurement or estimation procedure.

Part 93 classifies aircraft used in commercial sightseeing flight operations over GCNP by the noise they produce. Part 93 establishes the GCNP quiet aircraft technology designation status for propeller-driven small airplanes and helicopters. The status of each aircraft was determined according to its noise nuisance at a common noise sensitive reference point in GCNP. The aircraft noise limits, based on aircraft certification noise levels are shown in Figure 1 through 4 for GCNP quiet aircraft technology.

The noise limits are expressed for propeller-driven small airplanes and helicopters as follows:

(a) For helicopters with a flyover noise level obtained in accordance with the measurement procedures prescribed in Appendix H of part 36, the limit is 80 dB for helicopters having 2 or fewer passenger seats, increasing at 3 decibels per doubling of the number of passenger seats for helicopters having 3 or more passenger seats. The limit for helicopters having 3 or more seats can be calculated using the formula:

EPNL(H) = 80 +10log(# PAX seats/2) dB

(b) For helicopters with a flyover noise level obtained in accordance with the measurement procedures prescribed in Appendix J of part 36, the limit is 77 dB for helicopters having 2 or fewer passenger seats, increasing at 3 decibels per doubling of the number of passenger seats for helicopters having 3 or more passenger seats. The limit for helicopters having 3 or more seats can be calculated using the formula:

SEL(J) = 77 +10log(# PAX seats/2) dB

(c) For propeller-driven airplanes with a measured flyover noise level obtained in accordance with the measurement procedures prescribed in Appendix F of part 36 without the performance correction defined in Sec. F35.201(c), the limit is 69 dB for airplanes having 2 or fewer passenger seats, increasing at 3 decibels per doubling of the number of passenger seats for airplanes having 3 or more passenger seats. The noise limit for propeller-driven airplanes having 3 or more seats can be calculated using the formula:

LAmax(F) = 69 +10log(# PAX seats/2) dB

(d) In the event that a flyover noise level is not available in accordance with Appendix F of 14 CFR part 36, the noise limit for propeller-driven airplanes with a takeoff noise level obtained in accordance with the measurement procedures prescribed in Appendix G is 74 dB or 77 dB depending on 14 CFR part 36 amendment level, for airplanes having two or fewer passenger seats, increasing at 3 dB per doubling of the number of passenger seats for airplanes having three or more passenger seats. The noise limit for propeller driven airplanes having 3 or more seats can be calculated using the formula:

LAmax(G) = 74 +10log(# PAX seats/2) dB
for aircraft certificated to 14 CFR part 36 Amendment 21 or earlier;

LAmax(G) = 77+10log(# PAX seats/2) dB
for aircraft certificated to 14 CFR part 36 Amendment 22 or later.

5. **Methodology to Categorize Noise Efficiency.** The GCNP noise incentive plan is based on certificated noise levels determined under 14 CFR part 36. These levels may be found in FAA AC 36-1H or in the aircraft flight manual. Some aircraft, depending on the date of type certification, were not subject to the noise certification provisions of 14 CFR part 36, and do not have noise certification levels. For those aircraft, either measured noise levels from tests that are not approved by the FAA as certification quality (e.g., research test data) or estimates by approved methods were used. All estimated noise certification levels provided in this circular are for the sole and specific purpose of determining compliance with GCNP noise efficiency criteria and may not be used to establish compliance under any regulation.

The following hierarchy of noise level data sources was used in establishing noise levels for aircraft listed in Appendices 1 and 2. The same hierarchy will be used for future additions to the appendices.

1. U.S. type certifications using 14 CFR part 36 with noise certification levels obtained from FAA-approved flight manuals or FAA AC 36-1.
   a) For propeller driven small airplanes the hierarchy of regulations is:
      1) 14 CFR part 36 Appendix F
      2) 14 CFR part 36 Appendix G
   b) For helicopters the hierarchy of regulations is:
      3) 14 CFR part 36 Appendix J
      4) 14 CFR part 36 Appendix H
2. Foreign type certifications using ICAO Annex 16, Volume I with noise certification levels obtained from approved flight manuals, data approved by the foreign civil aviation authority, or FAA AC 36-1.
   a) For propeller driven small airplanes the applicable hierarchy of regulations is:
      1) ICAO Annex 16, Volume I Chapter 6
      2) ICAO Annex 16, Volume I Chapter 10
   b) For helicopters the hierarchy of regulations is:
      3) ICAO Annex 16, Volume I Chapter 11
      4) ICAO Annex 16, Volume I Chapter 8
3. Research or other measurement test data obtained under controlled conditions, documented and corrected to the certification conditions of part 36 Appendix F for small propeller driven airplanes and part 36 Appendix J for helicopters. Preference would be placed on those data obtained under certification-like conditions or those data collected under an FAA-sponsored noise research test.
4. FAA approved noise estimation methods that seek to estimate part 36 Appendix F noise levels for small propeller driven airplanes or part 36 Appendix J noise levels for helicopters. Currently the following methods may be suitable for use, but are subject to FAA approval on a case-by-case basis.

a) For propeller driven small airplanes: Method in Section 2.2 of DOT/FAA/AEE-82-1[1]
b) For helicopters: SAE/AIR 1989[2]

5. FAA approved noise level estimation method using FAA's Integrated Noise Model (INM) or an FAA-approved equivalent.

As one moves down in the hierarchy, the expected level of substantiation (as the representative noise certification level-estimated) by the operator or owner increases, and the level of FAA scrutiny will increase.

The resulting noise levels will vary depending upon the availability of FAA-approved data and its rank in the hierarchy. In the case of helicopters, the noise levels must be the flyover noise certification level and expressed in the noise metric of Effective Perceived Noise Level (14 CFR part 36, Appendix H) or Sound Exposure Level (14 CFR part 36, Appendix J). In the case of small propeller-driven airplanes the noise levels must be the flyover (14 CFR part 36, Appendix F) or takeoff (14 CFR part 36, Appendix G) noise certification level and expressed in the noise metric of maximum A-weighted sound level.

6. Distribution.

7. Revisions.

Carl E. Burleson
Director of Environment and Energy

[1] DOT/FAA/AEE-82-1: "A Description of Methodologies Used in Estimation of A-Weighted Sound Levels for FAA Advisory Circular AC-36-3B", published by AEE in January 1982

[2] SAE/AIR 1989: "Helicopter External Noise Estimation ", published by Society of Automotive Engineering in December 1992.

LIST OF FIGURES

Figure 1
GCNP Aircaft Noise Limits for Quiet Technology Helicopters Measured Under Appendix H

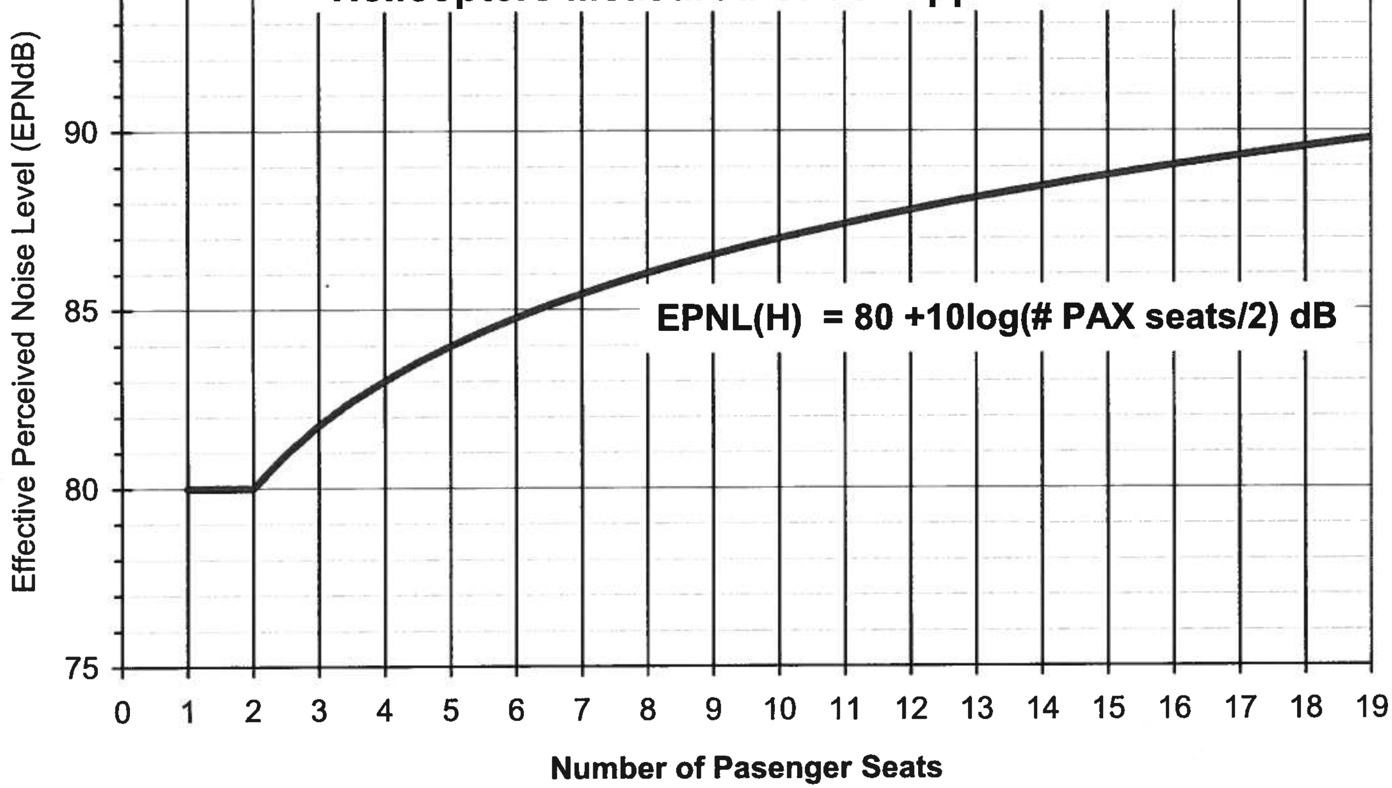


Figure 2
GCNP Aircaft Noise Limits for Quiet Technology Helicopters Measured Under Appendix J

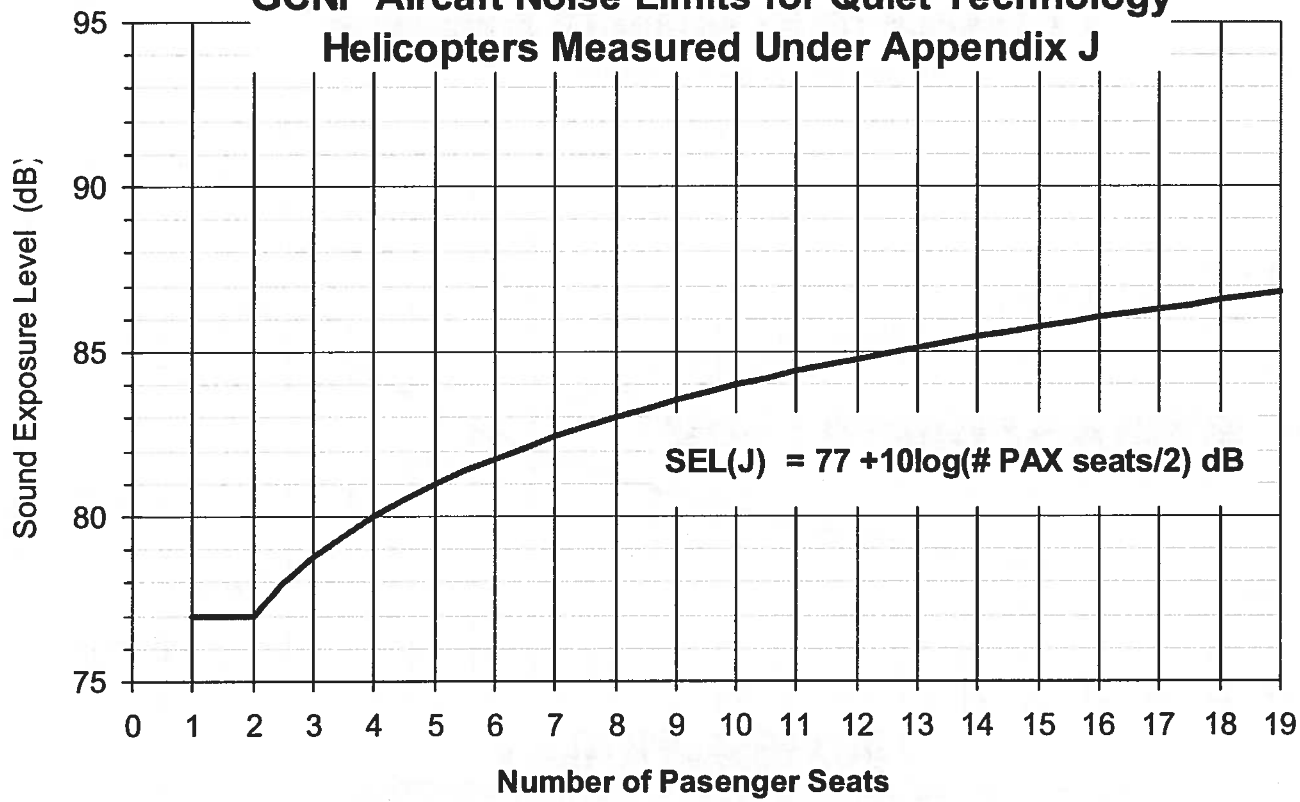


Figure 3
GCNP Aircaft Noise Limits for Quiet Technology Propeller-Driven Small Airplanes Measured Under Appendix F

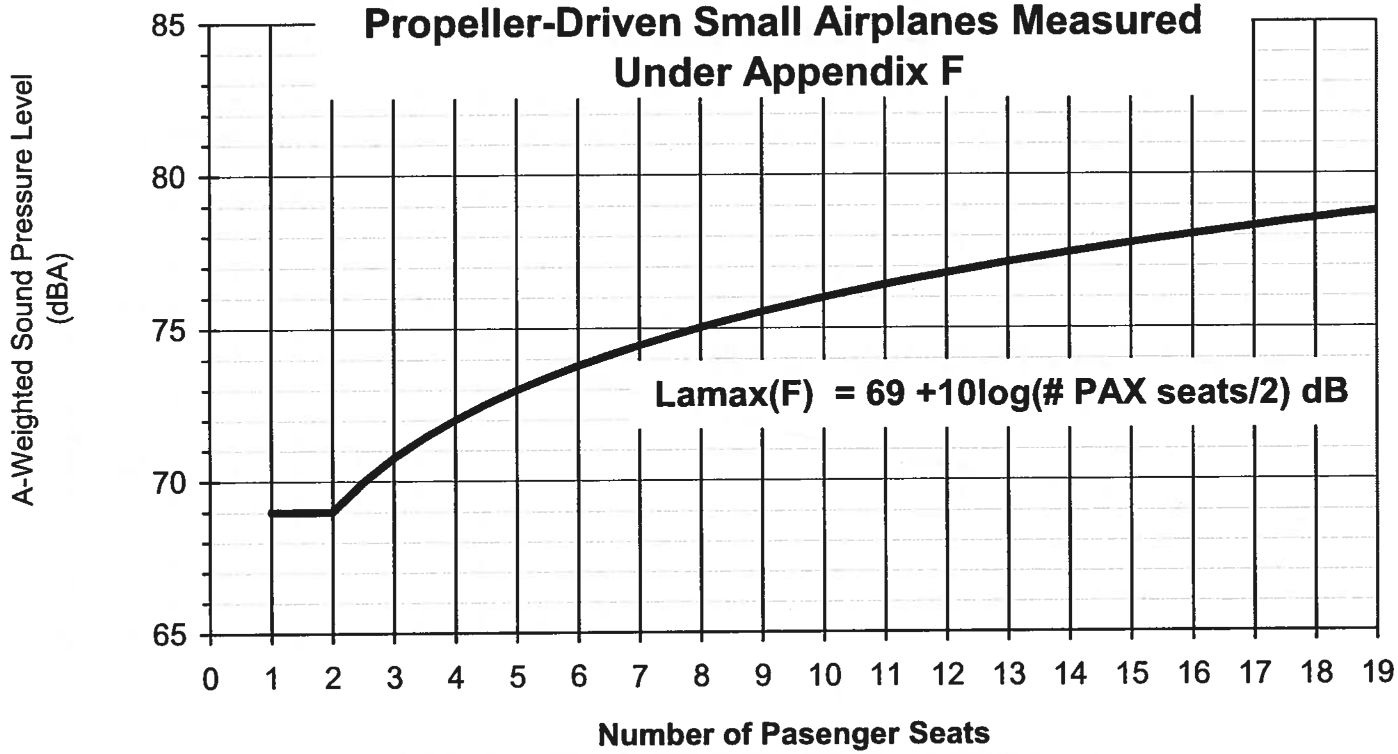
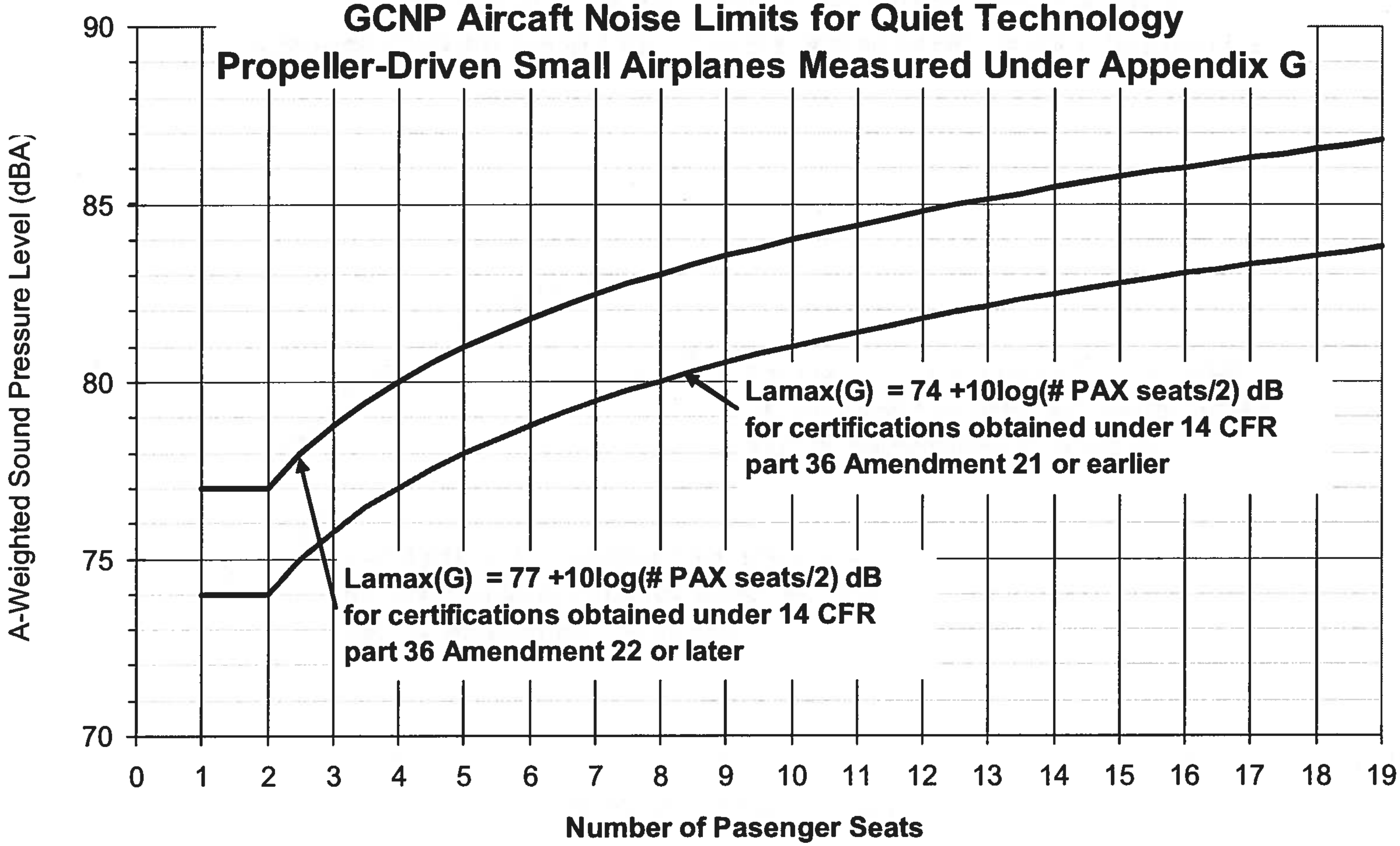


Figure 4
GCNP Aircaft Noise Limits for Quiet Technology Propeller-Driven Small Airplanes Measured Under Appendix G



APPENDICES

Updated 12/22/2008

APPENDIX I
GCNP INCENTIVE PLAN NOISE LEVELS
PROPELLER-DRIVEN SMALL AIRPLANES

MAKE MODEL	MTOW MLW	# OF ENGINES MAKE MODEL	ENG. PWR RPM	EXHAUST	# OF PROP BLADES MAKE MODEL	PROP DIA RPM PITCH	NOISE LEVEL APP. F (dBA)	NOISE LEVEL APP. G (dBA)	# OF PAX	NOTES	QUIET TECHNOLOGY
BEECH 36, A36	3.6 3.6	1 TCM I0-520-B(A)	285 2700	5	3 MCCAULEY 3A32C76	80 2700 V	78.8		5	F	NO
BEECH 36, A36	3.6 3.6	1 TCM I0-520-BB	275 2550	5	2 MCCAULEY 2A36C23	84 2550 V	78.0		5	F	NO
BEECH 36, A36	3.65 3.7	1 TCM IO-550-B	300 2700	5	3 MCCAULEY 3A32C406	80 2700 V	78.2		5	F	NO
BEECH 65A90	9.3 8.8	2 P&W PT6A-20	500 2200	9	3 HARTZELL HC-B3TN-2B/M	93 2200 V	78.7		8	F	NO
BEECH 76	3.9 3.9	2 LYC O-360-A1G6D	165 2700	2	2 HARTZELL HC-M2YR-2CEUF	76 2700 V	80.2		5	F	NO
BEECH 76	3.98 3.98	2 LYC O-360-A1G6D	165 2700	5	2 HARTZELL HC-M2YR-2CLUF	76 2700 V	79.5		5	F	NO
BEECH C99	11.3 11.3	2 P&W PT6A-36	715 2200	9	3 HARTZELL HC-B3TN-3B/M	93 2200 V	79.3		15	F	NO
BEECH V35	3.4 3.4	1 TCM I0-520-BA	285 2700	5	3 MCCAULEY 3A32C406	78 2700 V	78.1		4	F	NO
CESSNA 172M	2.3 2.3	1 LYC 0-320-E2D	150 2700	6	2 MCCAULEY 1C160/CTM/DTM	75 2700 F	74.3		3	F	NO
CESSNA 172P	2.4 2.4	1 LYC 0-320-D2J	150 2700	6	2 MCCAULEY 1C160/DTM	75 2700 F	74.3		3	F	NO

Updated 12/22/2008

APPENDIX I
GCNP INCENTIVE PLAN NOISE LEVELS
PROPELLER-DRIVEN SMALL AIRPLANES

MAKE MODEL	MTOW MLW	# OF ENGINES MAKE MODEL	ENG. PWR RPM	EXHAUST	# OF PROP BLADES MAKE MODEL	PROP DIA RPM PITCH	NOISE LEVEL APP. F (dBA)	NOISE LEVEL APP. G (dBA)	# OF PAX	NOTES	QUIET TECHNOLOGY
CESSNA 182*	2.55 2.55	1 TCM 0-470-L	230 2600	5	2 HARTZELL HC-82XF-1	82 2600 V	72.0		3	F	NO
CESSNA 182H*	2.8 2.8	1 TCM 0-470-R	230 2600	5	2 MCCAULEY 2A34C66	82 2600 V	72.0		3	F	NO
CESSNA 182P	2.95 2.95	1 LYC 0-470-R/S	230 2600	5	2 MCCAULEY 2A34C-201/66	82 2600 V	72.0		3	F	NO
CESSNA 182R	3.1	1 TCM 0-470-V	230 2600	5	2 MCCAULEY C2A34C204	82 2400 V	72.0		3	F	NO
CESSNA 182Q	2.95 2.95	1 LYC 0-470-U	230 2400	5	2 MCCAULEY C2A34C204	82 2400 V	72.0		3	F	NO
CESSNA 206*	3.3 3.3	1 TCM IO-520-A	285 2700	5	2 MCCAULEY D2A34C58	82 2700 V	78.5		5	F	NO
CESSNA 207*	3.8 3.8	1 TCM IO-520-F	285 2700	5	3 MCCAULEY D3A32C90	80 2700 V	77.8		6	F	NO
CESSNA 207A*	3.8 3.8	1 TCM IO-520-F	285 2700	5	3 MCCAULEY D3A34C404	80 2700 V	79.0		6	F	NO
CESSNA 208 (AMPHIB)*	7.6 7.3	1 P&W PT6A-114	600	9	3 HARTZELL HC-B3MN-3	100 1900 V	72.8		9	F	YES
CESSNA 208 (LAND)*	8 7.8	1 P&W PT6A-114	600	9	3 HARTZELL HC-B3MN-3	100 1900 V	72.8		9	F	YES

APPENDIX I
GCNP INCENTIVE PLAN NOISE LEVELS
PROPELLER-DRIVEN SMALL AIRPLANES

MAKE MODEL	MTOW MLW	# OF ENGINES MAKE MODEL	ENG. PWR RPM	EXHAUST	# OF PROP BLADES MAKE MODEL	PROP DIA RPM PITCH	NOISE LEVEL APP. F (dBA)	NOISE LEVEL APP. G (dBA)	# OF PAX	NOTES	QUIET TECHNOLOGY
CESSNA 208B*	8.75 8.5	1 PRATT+WHITNEY PT6A-114	600	8	3 HARTZELLL HC-B3MN-3	100 1900 V	72.8		13	F	YES
CESSNA 402 / 402B*	6.3 6.2	2 TCM TSIO-520-E/B	300 2700	4	3 MCCAULEY 3AF32C504	76.5 2700 V	81.6		8	F	NO
CESSNA 402A*	6.3 6.2	2 TCM TSIO-520E	300 2700	4	3 MCCAULEY 3AF32C87NR	76.5 2700 V	81.6		8	F	NO
CESSNA 402C*	6.85 6.9	2 TCM TSIO-520-UB	325 2700	4	3 MCCAULEY 3AF32C92N	76 2700 V	80.8		9	F	NO
CESSNA 402C*	6.85 6.9	2 TCM TSIO-520-VB	310 2600	4	3 MCCAULEY 3AF32C93	77 2600 V	77.2		9	F	NO
CESSNA 421C	7.2 7.45	2 TCM GTSIO-520-L/N	375 2235	4	3 MCCAULEY 3FF32C501	90 2235 V	80.3		9	F	NO
CESSNA 425	8.2 8.0	2 P&W PT6A-112	500	9	3 HARTZELL HC-B3TN-3D	102 2110 V	75.7		19	F	YES
CESSNA CE-182R*	3.10	1 TCM O-470-V	230 2400	8	2 MCCAULEY D2A34C203	82 2400 V	72.0		3	F	NO
CESSNA CE-182-R182*	3.10 3.10	1 TCM O-540-J3C5D	235 2400	8	2 MCCAULEY B3D34C214	82 2400 V	72.7		3	F	NO
CESSNA CE-402-B*	6.85 6.85	2 TCM TSIO-520-E	150 2700	3	3 MCCAULEY 3AF32C87M	76 2700 V	81.6		9	F	NO

APPENDIX I
GCNP INCENTIVE PLAN NOISE LEVELS
PROPELLER-DRIVEN SMALL AIRPLANES

MAKE MODEL	MTOW MLW	# OF ENGINES MAKE MODEL	ENG. PWR RPM	EXHAUST	# OF PROP BLADES MAKE MODEL	PROP DIA RPM PITCH	NOISE LEVEL		# OF PAX	NOTES	QUIET TECHNOLOGY
							APP. F (dBA)	APP. G (dBA)			
CESSNA T207*	3.8 3.8	1 TCM TSIO-520-G	285 2600	4	3 MCCAULEY D3A32C90	80 2600 V	77.9		6	F	NO
CESSNA T207A*	3.8 3.8	1 TCM TSIO-520-G-1A	285 2600	4	3 MCCAULEY 3A32C401	80 2600 V	77.9		6	F	NO
CESSNA T210L	3.8 3.8	1 TCM IO-520-L	285 2700	5	3 MCCAULEY D3A34C402-C	80 2700 V	80.2		5	F	NO
CESSNA T210M*	3.8 3.8	1 TCM IO-520-L	285 2700	5	3 MCCAULEY D3A32C88	80 2700 V	77.4		5	F	NO
CESSNA T210N	3.8 3.8	1 TCM IO-520-L	285 2700	5	3 MCCAULEY D3A34C404	80 2700 V	77.4		5	F	NO
CESSNA TR182	3.1 3.1	1 LYC O-540-L3C5D	235 2400	5	2 MCCAULEY B2D34C217	82 2400 V	73.8		3	F	NO
CESSNA TR182	3.1 3.1	1 LYC O-540-L3C5D	235 2400	5	3 MCCAULEY B3D32C407	79 2400 V	70.6		3	F	YES
CESSNA TU206C / TU206F*	3.6 3.6	1 TCM TSIO-520-C	285 2700	4	3 MCCAULEY D2A34C78	82 2700 V	78.5		5	F	NO
CESSNA TU206G*	3.6 3.6	1 TCM TSIO-520-M	285 2600	4	3 MCCAULEY D3A34C402	80 2600 V	78.5		5	F	NO
CESSNA TU206G (AMPHIB)*	3.6 3.6	1 TCM TSIO-520-M	285 2600	4	3 MCCAULEY D3A34C402	80 2600 V	78.0		5	F	NO

Updated 12/22/2008

APPENDIX I
GCNP INCENTIVE PLAN NOISE LEVELS
PROPELLER-DRIVEN SMALL AIRPLANES

MAKE MODEL	MTOW MLW	# OF ENGINES MAKE MODEL	ENG. PWR RPM	EXHAUST	# OF PROP BLADES MAKE MODEL	PROP DIA RPM PITCH	NOISE LEVEL APP. F (dBA)	NOISE LEVEL APP. G (dBA)	# OF PAX	NOTES	QUIET TECHNOLOGY
CESSNA U206B/D/F*	3.6 3.6	1 TCM IO-520-F	285 2700	5	3 MCCAULEY D2A34C58	82 2700 V	77.9		5	F	NO
CESSNA U206B/D/F/G*	3.6 3.6	1 TCM IO-520-F	285 2700	5	3 HARTZELL HC-C3YF-IRF	78 2700 V	77.9		5	F	NO
DE HAVILLAND DHC-6-300*	12.5 12.3	2 P&W PT6A-27	680	9	3 HARTZELL HC-B3TN-3D	102 2110 V	77.2		19	6	YES
DORNIER DO-228-202*	13.15	2 ALLIED SIGNAL TPE-331-5-252D	455 3810	1	4 HARTZELL HC-B4TN-5ML	107 V	78.3		4	6	NO
DORNIER DO-228-202*	13.15	2 ALLIED SIGNAL TPE-331-5-252D	455 3810	1	4 HARTZELL HC-B4TN-5ML	107 V	78.3		19	6	YES
FOKKER F27	45.0 42.0	2 ROLLS ROYCE DART 532-7R	2307	8	2? DOWTY ROTOL R193-4-30-4	138 V	85.0		42	I	YES
PARTENAVIA 68CTC	4.38 4.38	2 LYC TIO/T0-360-C1A6D	210 2575	4	2 HARTZELL HC-C2YK-2CUF	76 2575 V	75.4		6	F	NO
PIPER PA-18-150	17.5 17.5	1 LYC O-320-A2B	150 2700	7	2 SENSENICH M74DM6-0-56	74 2700 F	69.0		3	F	YES
PIPER 28-R200	2.65 2.65	2 TCM TSI0-360-E/EB	200 2700	5	2 HARTZELL HC-C2YK-1( )/F	74 2700 V	75.5		3	F	NO
PIPER 32-300	3.4 3.4	1 LYC I0-540-K1A/G5	300 2700	5	2 HARTZELL HC-C2YK-1( )/F	80 2700 V	80.5		6	F	NO

APPENDIX I
GCNP INCENTIVE PLAN NOISE LEVELS
PROPELLER-DRIVEN SMALL AIRPLANES

MAKE MODEL	MTOW MLW	# OF ENGINES MAKE MODEL	ENG. PWR RPM	EXHAUST	# OF PROP BLADES MAKE MODEL	PROP DIA RPM PITCH	NOISE LEVEL APP. F (dBA)	NOISE LEVEL APP. G (dBA)	# OF PAX	NOTES	QUIET TECHNOLOGY
PIPER 32RT-300T	3.6 3.6	1 LYC TI0-540-S1AD	270 2575	4	2 HARTZELL HCE2YR-1( )/F	80 2575 V	75.7		6	F	NO
PIPER PA-31-350	7.01 7	2 LYC TIO-540-J2BD	315 2400	4	3 HARTZELL HC-E3YR-2ATF	80 2400 V	78.0		9	F	NO
PIPER PA-31-T3	9.0	2 PWC PT6A-11	455 3810	1	3 HARTZELL HC-B3TN-3B/T	93 V	76.6		3	F	NO
PIPER PA-34-200T	4.57 4.34	2 TCM TSI0-360-E/EB	200 2575	4	2 HARTZELL BHC-C2YF-2( )F/UF	76 2575 V	75.7		5	F	NO
PIPER PA-34-200T	4.57 4.34	1 LYC I0-360-C1C/6	200 2575	5	3 MCCAULEY 3AF34C502/3	76 2575 V	78.6		5	F	NO
PIPER PA-42-720	11.2 10.23	2 PRATT+WHITNEY PT6A-41	720	8	3 HARTZELLL HC-B3TN-3B/T10173AB-6Q	95 2000 V	80.3		8	F	NO

* currently flying at GCNP
EXHAUST CONFIG STUB PIPES
1 = SMALL COLLECTOR, SHORT EXHAUST PIPE
2 = BAFFLES IN COLLECTOR AND/OR CONES IN EXHAUST PIPE
3 = TURBOCHARGER
4 = HEAT MUFF
5 = COLLECTOR WRAPAROUND MANIFOLD STRAIGHT PIPE
6 = MANIFOLD MUFFLER
7 = RESONATOR MUFFLER
8 = TURBINE

APPENDIX I
GCNP INCENTIVE PLAN NOISE LEVELS
PROPELLER-DRIVEN SMALL AIRPLANES

MAKE MODEL	MTOW MLW	# OF ENGINES MAKE MODEL	ENG. PWR RPM	EXHAUST	# OF PROP BLADES MAKE MODEL	PROP DIA RPM PITCH	NOISE LEVEL		# OF PAX	NOTES	QUIET TECHNOLOGY
							APP. F (dBA)	APP. G (dBA)			

NOTES COLUMN INDICATE THE HIERARCHY USED IN OBTAINING THE NOISE LEVEL
FOR THE EXPLANATION OF THE HIERARCHY SEE SECTION 6.

F = 14 CFR part 36 Appendix F measured noise levels
G = 14 CFR part 36 Appendix G certificated noise level
6 = ICAO Annex 16, Volume I Chapter 6 measured noise levels
10 = ICAO Annex 16, Volume I Chapter 10 certificated noise level
R = Research or other measurement test data
E = FAA approved noise estimation method defined by fourth hierarcy in Section 5
I = FAA approved noise estimation using the Integrated Noise Model

FOR DEFINITION OF CATEGORIES SEE SECTION 4 AND FIGURE 1.

NOMENCLATURE

#	Number
APP. F (dBA)	Measured/Estimated APP. F level in dBA by the method described in column labeled NOTES
APP. G (dBA)	Measured/Estimated APP. G level in dBA by the method described in column labeled NOTES
ENG, POWER, RPM	Engine power in HP, operational RPM
MAKE, MODEL	Manufacturer and model designation
MTOW, MLW	Maximum Takeoff Weight, Maximum Landing Weight
PAX	Passenger seats
PROP DIAM, RPM, PITCH	Propeller diameter in inches, operational RPM AND PITCH (V: Variable, F: Fix)

Updated 12/22/2008

APPENDIX II
GCNP INCENTIVE PLAN NOISE LEVELS
HELICOPTERS

HELICOPTER MAKE MODEL	MGW MLW	# OF ENGINES MAKE MODEL	MAIN ROTOR #OF BLADES MAKE MODEL	MAIN ROTOR DIA.	TAIL ROTOR #OF BLADES MAKE MODEL	TAIL ROTOR DIA	NOISE LEVEL APP. H (EPNdB)	NOISE LEVEL APP. J (SEL)	# OF PAX	NOTES	QUIET TECHNOLOGY
AEROSPATIALE AS-350-B ASTAR	4.63	1 Turbomeca Arriel 1B	3 AEROSPATIALE/ EUROCOPTER	35'	2 AERO/EURO	6'10"	86.8		6	H	NO
AEROSPATIALE AS-350-BA*	4.63	1 Turbomeca Arriel 1B	3 AEROSPATIALE/ EUROCOPTER	35'	2 AERO/EURO	6'10"	86.8		6	H	NO
AEROSPATIALE AS-350-B2 Ecureuil *	4.96	1 Turbomeca Arriel 1D1	3 AEROSPATIALE/ EUROCOPTER	35'	2 AERO/EURO	6'10"	87.1		6	H	NO
AEROSPATIALE AS-350-B2 Ecureuil *	4.96	1 Honeywell LTS101-700D-2	3 AEROSPATIALE/ EUROCOPTER	35'	2 AERO/EURO	6'10"		85.4	6		NO
AEROSPATIALE AS-350-B3 Ecureuil	4.96	1 Turbomeca Arriel 2B	3 AEROSPATIALE/ EUROCOPTER	35'	2 AERO/EURO	6'10"	87.3		6	H/8	NO
AEROSPATIALE AS-350-B3 Ecureuil	5.071	1 Turbomeca Arriel 2B	3 AEROSPATIALE/ EUROCOPTER	35'	2 AERO/EURO	6'10"		84.7	6	J/11	NO
BELL Jet Ranger BHT-206-B/BII*	3.2	1 Allison 250-C20	2 BHT-206	33' 4"	2 BHT-206	5' 5"	84.6		4	8	NO
BELL - Long Ranger BHT-206-L/ L1*	4.05	1 Allison 250-C28B	2 BHT-206	37'	2 BHT-206	5' 6"	85.8		6	8	NO
BELL - Long Ranger III BHT-206-L3*	4.15	1 Allison 250-C30P	2 BHT-206	37'	2 BHT-206	5' 6"	87.8		6	8	NO
BELL - Long Ranger IV BHT-206-L4*	4.45	1 Allison 250-C30P	2 BHT-206	37'	2 BHT-206	5' 6"	85.2		6	H	NO
BELL - Long Ranger BHT-206-L4*	4.55	1 Allison 250-C20R	2 BHT-206	37'	2 BHT-206	5' 6"		85.2	6	J	NO
BELL BHT-407*	5	1 Allison 250-C47	4 BHT-407	35'	2 BHT-407	5' 5"		85.1	6	J	NO
BELL BHT-407 with Quiet Cruise Kit*	5	1 Allison 250-C47	4 BHT-407	35'	2 BHT-407	5' 5"		81.3	6	J	YES

APPENDIX II
GCNP INCENTIVE PLAN NOISE LEVELS
HELICOPTERS

EUROCOPTER EC-130-B4*	5.291	1 Turbomeca Arriel 2 B 1	3 EUROCOPTER	35'	10 EUROCOPTER	3'3"	84		7	H/8	YES
EUROCOPTER EC-130-B4*	5.351	1 Turbomeca Arriel 2 B 1	3 EUROCOPTER	35'	10 EUROCOPTER	3'3"	84		7	H/8	YES
MDHI MD-900 Explorer*	6.25	1 PW206A 1C	5 MDHI	33.83'	NOTAR System	-	83		8	H	YES
MDHI MD-900 Explorer*	6.25	1 PW207E	5 MDHI	33.83'	NOTAR System	-	83		8	H	YES
Whisper Jet S-55QT (Sikorsky S-55 modified)*	7.7	1 Allied Signal TSE 331-10-591 SW	5 S-55	53'	2 S-55	8' 9"	80		9	H	YES

* Currently flying at GCNP
FOR THE EXPLANATION OF THE HIERARCHY SEE SECTION 6.

H = 14 CFR part 36 Appendix H
J = 14 CFR part 36 Appendix J
8 = ICAO Annex 16, Volume I Chapter 8
11 = ICAO Annex 16, Volume I Chapter 11
R = Research or other measurement test data
E = FAA approved noise estimation method as defined in the fourth hieraracy in Section 5
I = FAA approved noise estimation using the Integrated Noise Model

FOR DEFINITION OF CATEGORIES SEE SECTION 4 AND FIGURE 1-4.

NOMENCLATURE

#	Number
APP. H NOISE LEVEL	Measured/Estimated App. H level in EPNdB by method described in column labeled NOTES
APP. J NOISE LEVEL	Measured/Estimated App. J level in SEL by method described in column labeled NOTES
DIA	Diameter in feet
MAKE, MODEL	Manufacturer and model designation
MTOW, MLW (1000 LBS)	Maximum Takeoff Weight, Maximum Landing Weight
PAX	Passenger seats

U.S. Department
of Transportation
Federal Aviation
Administration

Advisory Circular

SUBJECT: Estimated Airplane Noise Levels in A-Weighted Decibels

Date: 05/25/2012

Initiated by: AEE-100

AC No: 36-3H
Change 1

1. Purpose.

a. This Advisory Circular (AC) publishes needed changes to the existing AC material as a result of additions of certificated aircraft noise levels submitted since the AC was published.

b. This change revises Appendix l(TO), Estimated Maximum A-Weighted Sound Levels Measured in Accordance with Part 36 Appendix-C Procedures (Takeoff), Appendix l(APP), Estimated Maximum AWeighted Sound Levels Measured in Accordance with Part 36 Appendix-C Procedures (Approach), Appendix 2, Estimated Maximum A-Weighted Sound Levels Measured in Accordance with Part 36 Appendix-C Procedures, and Reference Notes.

c. The change number and the date ofthe changed material are shown at the top of each page in Appendix l(TO), Appendix 1 (APP), and Appendix 2.

2. Principal Changes. Appendix l(TO), Appendix 1 (APP), Appendix 2, and Reference Notes.

3. Website Availability. To access this AC electronically, go to http://www.faa.gov/regulations_policies/advisory_circulars/

PAGE CONTROL CHART

Remove Pages	Dated	Insert Pages	Dated
Appendix 1 1T thru 33T	04/25/2002	Appendix 1 1T thru 37T	04/05/2012
Appendix 1 1A and 43A	04/25/2002	Appendix 1 1A thru 48A	04/05/2012
Appendix 2 1 thru 45	04/25/2002	Appendix 2 1 thru 53	04/05/2012
Reference Notes 2	04/25/2002	Reference 2	04/05/2012

Lourdes Q. Maurice
Director, Office of Environment and Energy

U.S. Department
of Transportation

Federal Aviation
Administration

Advisory Circular

Subject: **Date:** 4/25/02 **AC No:** 36-3H
Initiated by: AEE-100 **Change:**

ESTIMATED AIRPLANE NOISE LEVELS IN A-WEIGHTED DECIBELS

1. **Purpose.** This circular provides listings of estimated airplane noise levels in units of A-weighted sound level in decibels (dBA), ranked in descending order for the conditions and assumptions described below. This information is provided both for aircraft that have been noise type certificated under 14 CFR part 36, and for aircraft for which no such requirement currently exists.

2. **Cancellation.** Advisory Circular 36-3G, Estimated Airplane Noise Levels in A-Weighted Decibels, dated April 2, 1996, is canceled.

3. **Background.** 14 CFR part 36 requires the reporting of turbojet and large transport category aircraft certificated noise levels in units of Effective Perceived Noise Level in decibels (EPNdB). Many airport and other community noise analyses utilize a noise rating scale that is based upon A-weighted decibels. For this reason, A-weighted noise levels for aircraft under 14 CFR part 36 conditions have been estimated to provide a reference source for aircraft noise levels that is consistent with the many noise rating scales having A-weighted noise level as the basic measure.

4. **Noise Levels.**

(a) A-weighted noise levels were estimated for each airplane as they might occur during type certification tests conducted under Appendices A, B, and C of 14 CFR part 36. However, it should be specifically noted that the reported levels are estimates and do not represent actual certificated values. This is because certification data are reported to the Federal Aviation Administration (FAA) in EPNdB for large transport category airplanes and turbojet powered aircraft. Where possible, the levels in dBA were estimated from certification data. Further, since 14 CFR part 91, Section 126(c) requires turbojet powered aircraft to use minimum certificated landing flap settings, noise levels for approaches at less than maximum flaps are listed for many turbojet aircraft.

(b) Propeller-driven small airplanes and commuter category airplanes are certificated in A-weighted noise level, however the certification flight procedure differs from that used for 14 CFR part 36, Appendix C noise certification. In addition, 14 CFR part 36 does not require approach noise tests for noise certification of propeller-driven small airplanes and commuter category airplanes. Therefore, the propeller-driven small airplane and commuter category airplane noise levels contained in this circular were also estimated.

(c) The listings of the various certificated and uncertificated airplanes include tabulations of their noise levels at maximum takeoff and landing gross weights. Noise level estimates are provided at 14 CFR part 36, Appendix C positions (6,500 meters from start of takeoff roll, and 2,000 meters from the runway threshold for approach).

(d) Since the noise levels are estimated as they might occur during type certification tests conducted under Appendix C of 14 CFR part 36, these values are intended to provide a consistent basis for comparison of noise levels of major aircraft models rather than establishing absolute levels of individual aircraft. The noise levels of individual aircraft may also differ due to variations in weight and operating procedures from those used during certification. For instance, takeoff noise levels are reduced substantially as aircraft takeoff weight is reduced. Takeoff weights during normal in-service operations are often less than the maximum certificated weight. In general, for equal application of noise control technology, the lower the maximum weight of an airplane the lower the noise level. Conversely, those aircraft normally associated with high weight, long range operation and, therefore, greater productivity, have higher noise levels and will appear predominantly at the top of the list. This aspect of increasing noise levels with increasing weight is embodied in the noise type certification requirements of 14 CFR part 36. The takeoff noise level is also dependent on which operating procedures are applied. The takeoff noise level estimates in the table(s) in this Advisory circular represent full thrust conditions for some aircraft and a reduced thrust condition, as permitted by 14 CFR part 36, for other aircraft. Neither of these conditions may be representative of the in-service operation of a particular aircraft at a particular airport. Similarly, approach noise levels are given for maximum landing weight. However, as Federal Aviation Regulations require turbojet powered aircraft to use the minimum certificated landing flap setting for normal approaches rather than the maximum certificated flap setting (the configuration that is most critical from a noise standpoint), estimates of approach noise levels with reduced flap settings have been included for many of these aircraft. An asterisk (*) next to the flap setting indicates less than maximum flaps. Variations in the absolute value of the noise estimates presented in this circular, for individual flights at actual airports, will occur when operating conditions do not conform with those corresponding to noise certification. However, the FAA believes that the ranking of aircraft noise levels that occur under uniform certification conditions provides the best information currently available on the relative noisiness of airplanes over a wide variety of conditions.

(e) In addition to the Appendix 1 listing of noise levels in order of descending magnitude, this Advisory Circular also provides the same data listed by aircraft manufacturer. This list, contained in Appendix 2, is presented as a convenience in locating data on specific airplanes.

(f) While these listings provide data on a wide variety of airplane types and models within types, other specific model designations (often peculiar to just one carrier) may not be shown. Thus, for example a Boeing 727-232 is not listed, but the equivalent data for a Boeing 727-200 with the proper engine should be used. Similarly, data for a McDonnell-Douglas DC-10-30 should be used for other models of the DC-10-30 series of aircraft.

(g) The FAA's Integrated Noise Model (INM) computer program may be useful in providing more detailed noise predictions for aircraft as they are actually flown. Further, the INM can provide predictions of noise levels at other locations which may be of greater interest to a particular community.

5. Noise Level Estimation Procedure.

Noise level estimation procedures utilized in this revision are outlined below:

(a) The results of FAA noise measurement and assessment programs have been used to establish noise levels for certain aircraft. Reference note 10 identifies these aircraft.

(b) Noise levels for certain light propeller driven aircraft have been computed using primary reference data (either from Pilot Operating Handbooks or direct from the manufacturer) as input to the noise level estimation procedure outlined in Report FAA-EE-82-1. This procedure considers both propeller and engine noise components for reciprocating engine aircraft takeoff and approach operations. Noise levels estimated using this procedure are identified in this document by Reference note 11.

(c) In the case of certain general aviation jet aircraft, the appropriate maximum noise level one-third-octave frequency spectrum has been obtained from 14 CFR part 36 certification reports. The A-weighted sound level has been computed for each spectrum. Noise level estimates established using this procedure are identified by Reference note 12.

(d) The noise levels of certain other general aviation jet aircraft included in this report have been converted to A-weighted sound level from EPNL certification data using conversion factors derived for specific engine types. The details of the procedure are outlined in Report FAA-EE-82-1. Data appearing in this Advisory Circular derived using the above conversion technique are identified by Reference note 13.

(e) The noise levels of certain large jet aircraft included in this Advisory Circular have been derived from 14 CFR part 36 certification EPNL values using the FAA INM. Data appearing in this document derived using the INM procedure are identified by Reference note 14.

(f) The noise levels of certain large jet aircraft have been derived from data provided to the FAA directly by aircraft manufacturers. Data appearing in this document derived from such sources are identified by Reference note 15.

The FAA welcomes substantive discussion on any estimate in this document. Readers are encouraged to present data and alternative assumptions which they feel provide or lead to more accurate estimates of noise levels. Any person wishing to provide input to subsequent revisions of this AC are encouraged to write the Manager, Noise Division (AEE-100), Office of Environment and Energy, Federal Aviation Administration, 800 Independence Ave., SW, Washington, DC 20591.

6. **Distribution.**

Requests for additional copies of this Advisory Circular should be sent to:

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Requests to be placed on the mailing list to receive future revisions of this Advisory Circular should be sent to:

U.S. Department of Transportation
Distribution Requirements Section
SVC-121.21
Washington, DC 20590.

7. **Revisions.** The airplane noise level listings in this Advisory Circular will be revised and updated periodically.

Carl E. Burleson
Director of Environment and Energy

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
CONCORDE	CONCORDE	O-593/M-602	400.00	112.9	-	4,8
BOEING	B-747-100	JT9D-7F	750.00	100.5	10	4,6
BOEING	B-747-100	JT9D-7FWET	750.00	100.5	10	4,6
BOEING	B-747-200	JT9D-3A	767.00	100.5	10	4,6
BOEING	B-747-100	JT9D-7WET	750.00	100.2	10	4,6
BOEING	B-747-200	JT9D-7FWET	805.00	99.9	10	4,6
BOEING	B-747-200	JT9D-3AWET	773.00	99.6	10	4,6
BOEING	B-747-200	JT9D-7	770.00	99.4	10	4,6
BOEING	B-747-200	JT9D-7WET	785.00	99.3	10	4,6
BOEING	B-747-100	JT9D-7	710.00	99.1	10	4,6
BOEING	B-747-200	JT9D-7F	775.00	99.1	10	4,6
BOEING	B-747-200/300	RB211-524C2	833.00	99.1	10	15
MCDONNELL DOUG.	DC-10-30	CF6-50C1	590.00	96.4	6	15
BOEING	B-747-SP	JT9D-7FWET	695.00	96.2	10	4,6
BOEING	B-747-SP	JT9D-7A	690.00	96.1	10	4,6
BOEING	B-747-200	RB211-524B	800.00	96.0	10	4
BOEING	B-747-200/300	RB211-524C2	775.00	95.7	10	15
MCDONNELL DOUG.	DC-10-30	CF6-50A	565.00	95.7	8	15
BOEING	B-747-SP	JT9D-7A	660.00	94.9	10	4,6
BOEING	B-747-SP	JT9D-7F	660.00	94.9	10	4,6
MCDONNELL DOUG.	DC-10-30	CF6-50C1	572.00	94.6	10	15
BOEING	B-747-200	JT9D-70A	820.00	94.1	10	4
MCDONNELL DOUG.	DC-10-30	CF6-50C	565.00	94.1	10	15
BOEING	B-707-300B/C (COMTRAN QN)	JT3D-3B	322.30	94.0	14	8
BOEING	B-747-200/300	RB211-524D4	833.00	93.9	10	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C1	562.00	93.9	10	15
BOEING	B-747-SR	JT9D-7A	610.00	92.9	10	4,6

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-727-200	JT8D-17RQN	208.00	92.6	5	2,8,15
BOEING	B-727-200	JT8D-17QN	203.10	92.2	5	2,8,14,15
BOEING	B-747-200/300	CF6-50E	833.00	92.2	10	8,15
BOEING	B-747-200/300	CF6-50E2	833.00	92.2	10	8,15
BOEING	B-747-100	CF6-45A2	767.00	92.0	10	8,15
BOEING	B-747-100	CF6-50E2	750.00	92.0	10	8,15
MCDONNELL DOUG.	DC-10-40	JT9D-59A	572.00	91.8	10	15
MCDONNELL DOUG.	DC-08-63 (ADC QN)	JT3D-3B	355.00	91.7	12	8,15
MCDONNELL DOUG.	DC-10-40	JT9D-20	530.00	91.7	10	15
MCDONNELL DOUG.	DC-10-30	CF6-50A	519.60	91.4	8	15
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-3B	348.00	91.1	12	8,15,16
MCDONNELL DOUG.	DC-08-63F (ADC QN)	JT3D-7	355.00	91.0	12	8,15
BOEING	B-747-400	RB211-524G	875.00	90.8	10	8,15
MCDONNELL DOUG.	DC-10-40	JT9D-59A	555.00	90.6	10	15
AIRBUS UK	1-11-400	SPEY-MK511	89.50	90.5	8	8,15
AIRBUS UK	1-11-500	SPEY-MK512	104.50	90.5	8	4
MCDONNELL DOUG.	DC-08-63 (TNC QN)	JT3D-3B	350.00	90.5	12	8,15
BOEING	B-727-200	JT8D-9QN	184.80	90.4	5	2,8,14,15
BOEING	B-747-400F	RB211-524G	875.00	90.4	10	8,15
MCDONNELL DOUG.	DC-08-50 (QNC QN)	JT3D-3B	309.80	90.3	-	8,12
MCDONNELL DOUG.	DC-08-61 (QNC QN)	JT3D-3B	309.80	90.3	-	8,12
BOEING	B-747-200/300	RB211-524D4	775.00	90.2	10	8,15
BOEING	B-747-SR	JT9D-7A	570.00	90.0	10	4,6
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-3B	335.00	90.0	12	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-3B	350.00	90.0	12	8,15,16
AIRBUS UK	1-11-500	SPEY-MK512	99.70	89.9	8	4
BOEING	B-727-200	JT8D-17RQN	197.00	89.9	5	2,8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-747-400	PW4056 PKG A (FB2T)	875.00	89.8	10	8,15
IAI	1121 COMMODORE	CJ610-5	18.50	89.7	-	4
IAI	1123 WESTWIND	CJ610-9	20.70	89.7	-	4
MESSERSCHMITT	HFB-320 HANSA	CJ610-9	20.30	89.7	-	13
BOEING	B-747-200/300	CF6-50E2	775.00	89.6	10	8,15
MCDONNELL DOUG.	DC-08-63 (TNC QN)	JT3D-7	355.00	89.6	12	8,15
BOEING	B-747-200/300	CF6-50E	775.00	89.4	10	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	875.00	89.4	10	8,15
MCDONNELL DOUG.	DC-08-63 (BAC/BACII)	JT3D-7	353.00	89.2	12	8,15,16
MCDONNELL DOUG.	DC-08-63 (BAC/R1)	JT3D-7	355.00	89.2	12	8,15,16
BOEING	B-727-200 (Fed Ex)	JT8D-9	189.20	89.1		8,15,25,28
BOEING	B-727-200	JT8D-15QN	190.50	89.0	5	2,8,14,15
BOEING	B-747-400	RB211-524H	875.00	89.0	10	8,15
BOEING	B-747-400F	RB211-524H	875.00	89.0	10	8,15
MCDONNELL DOUG.	DC-08-61 (BAC/BAC II)	JT3D-3B	325.00	88.8	15	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-7	350.00	88.8	12	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-3B	335.00	88.8	12	8,15,16
MCDONNELL DOUG.	DC-10-30	CF6-6K	455.00	88.8	-	15
LOCKHEED	1329 JETSTAR	JT12A-8	42.00	88.7	-	8,13
BOEING	B-727-200	JT8D-17QN	190.50	88.5	5	2,8,14,15
BOEING	B-727-200 (Fed Ex)	JT8D-17	199.50	88.5		8,15,25,28
MCDONNELL DOUG.	DC-10-10	CF6-6D	440.00	88.5	5	15
MCDONNELL DOUG.	DC-09-50	JT8D-15	121.00	88.4	-	1,8,15
MCDONNELL DOUG.	DC-10-40	JT9D-20	484.00	88.4	10	15
MCDONNELL DOUG.	DC-09-30	JT8D-17	121.00	88.2	-	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-17	121.00	88.2	-	1,8,15
BOEING	B-727-200	JT8D-7QN	172.50	88.0	5	2,8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-727-200 (Fed Ex)	JT8D-7	178.00	88.0		8,15,24,29
BOEING	B-737-200	JT8D-15QN	117.00	88.0	1	2,8,15
BOEING	B-737-200	JT8D-9QN	117.00	88.0	1	2,8,14,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	875.00	88.0	10	8,15
BOEING	B-747-400F	RB211-524G	830.00	88.0	10	8,15
BOEING	B-747-400	CF6-80C2B1F	875.00	87.9	10	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	875.00	87.9	10	8,15
BOEING	B-747-400	RB211-524G	820.00	87.9	10	8,15
SABRELINER CORP.	SABRE 70	JT12A-8	21.00	87.9	-	8,12
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-7	335.00	87.8	12	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-7	335.00	87.8	12	8,15,16
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	875.00	87.6	10	8,15
AIRBUS UK	1-11-400	MK511-W/HUSHKIT	89.50	87.5	8	15
BOEING	B-727-200	JT8D-15QN	184.20	87.5	5	2,8,14,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	875.00	87.5	10	8,15
BOEING	B-747-400F	CF6-80C2B1F	875.00	87.5	10	8,15
MCDONNELL DOUG.	DC-09-40	JT8D-11	114.00	87.5	-	1,8,15
BOEING	B-737-200	JT8D-17QN	122.50	87.3	1	2,8,14,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	875.00	87.3	10	8,15
BOEING	B-727-200 (Fed Ex)	JT8D-17	190.50	87.2		8,15,25,28
MCDONNELL DOUG.	DC-10-30	CF6-50C2	590.00	87.2	15	8,15
LOCKHEED	L-1011-1	RB211-22C	430.00	87.1	10	
MCDONNELL DOUG.	DC-09-30	JT8D-7	108.00	87.1	-	8,15
BOEING	B-727-200 (Fed Ex)	JT8D-15	190.50	87.0		8,15,25
BOEING	B-737-200	JT8D-9QN	114.50	87.0	1	2,8,14,15
BOEING	B-747-200/300	CF6-80C2B1F	833.00	86.9	10	8,15
LOCKHEED	L-1011-1	RB211-22C	422.00	86.9	10	

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-727-100 (Fed Ex)	JT8D-7	174.50	86.8		8,15,16,28
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	833.00	86.8	10	8,15
BOEING	B-727-200	JT8D-9QN	172.50	86.7	5	2,8,14,15
BOEING	B-747-400	PW4056 PKG A (FB2T)	820.00	86.7	10	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	830.00	86.7	10	8,15
BOEING	B-747-400F	RB211-524H	830.00	86.7	10	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2B	590.00	86.7	-	8,15
BOEING	B-727-200 (Fed Ex)	JT8D-7	172.60	86.6		8,15,24,29
MCDONNELL DOUG.	DC-09-30	JT8D-9	108.00	86.5	-	8,15
BOEING	B-747-400	RB211-524H	820.00	86.3	10	8,15
BOEING	B-747-400D	CF6-80C2B1F	833.00	86.3	10	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	875.00	86.3	10	8,15
MCDONNELL DOUG.	DC-09-30	JT8D-9	110.00	86.3	-	1,8,15
BOEING	B-727-100	JT8D-7FCD	169.50	86.1	5	3,8,14,15
BOEING	B-747-200/300	CF6-80C2B1F	820.00	86.1	10	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	875.00	86.1	10	8,15,23
BOEING	B-727-200 (Fed Ex)	JT8D-9	173.88	86.0		8,15,24,28
GENERAL DYNAMICS	CV-440	R-2800	48.00	86.0	-	5
MCDONNELL DOUG.	DC-09-50	JT8D-17	115.00	85.9	-	1,8,15
AIRBUS UK	1-11-200	SPEY-MK506	80.00	85.8	8	15
BOEING	B-737-200	JT8D-7QN	109.00	85.8	1	2,8,14
MCDONNELL DOUG.	DC-09-30	JT8D-15	114.00	85.8	-	1,8,15
MCDONNELL DOUG.	DC-09-40	JT8D-15	114.00	85.8	-	1,8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	830.00	85.6	10	8,15
MCDONNELL DOUG.	DC-08-72	CFM56-2-C1	362.50	85.6	12	
BOEING	B-727-200 (Fed Ex)	JT8D-9	165.60	85.5		8,15,24,28
MCDONNELL DOUG.	DC-09-30	JT8D-7	108.00	85.5	-	1,8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
MCDONNELL DOUG.	DC-09-30	JT8D-9	108.00	85.4	-	1,8,15
LOCKHEED	L-1011-1	RB211-22C	416.00	85.3	10	8
MCDONNELL DOUG.	DC-10-10	CF6-6D1	440.00	85.3	8	15
RAYTHEON	HAWKER 125- 400A	VIPER-522	23.60	85.3		8,15
BOEING	B-727-100 (Fed Ex)	JT8D-7	160.50	85.2		8,15,16,28
BOEING	B-727-200 (Fed Ex)	JT8D-9	175.00	85.2		8,15,24,29
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-15	209.42	85.2	5	8,15,37,47
BOEING	B-737-200	JT8D-15QN	115.50	85.2	1	2,8,15
BOEING	B-747-400	CF6-80C2B1F	820.00	85.2	10	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	820.00	85.2	10	8,15
BOEING	B-747-400F	CF6-80C2B1F	830.00	85.2	10	8,15
LOCKHEED	L-1011-1	RB211-22C	396.00	85.2	10	4,8
MCDONNELL DOUG.	DC-10-10	CF6-6D	410.00	85.2	14	15
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17	209.50	85.1	5	8,15,37,48
LOCKHEED	L-1011	RB211-22B	430.00	85.1	14	4,5
BOEING	B-727-100	JT8D-9FCD	169.50	85.0	5	3,8,15
BOEING	B-777-300	RR TRENT 884	660.00	85.0	5	8,15
DOUGLAS	DC-3	R-1830-90C	25.20	85.0	-	5
MCDONNELL DOUG.	DC-10-40	JT9D-20	430.00	85.0	10	15
BOEING	B-737-200	JT8D-9QN	109.00	84.8	1	2,8,14,15
MCDONNELL DOUG.	DC-09-40	JT8D-11	107.00	84.8	-	1,8,15
RAYTHEON	HAWKER 125- 3A/R	VIPER-522	22.70	84.8	-	8,15
RAYTHEON	HAWKER 125- 3A/RA	VIPER-522	22.70	84.8		8,15
LEARJET	LEARJET 23	CJ610-1	12.50	84.7	-	4,8
SABRELINER CORP.	SABRE 60	JT12A-8	20.10	84.7	-	8,12
BOEING	B-737-200	JT8D-17QN	115.50	84.5	1	2,8,14,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	820.00	84.5	10	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
MCDONNELL DOUG.	DC-10-30	CF6-50C2	555.00	84.4	10	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	820.00	84.3	10	8,15
MCDONNELL DOUG.	DC-09-50	JT8D-15	110.00	84.3	-	1,8,15
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	65.50	84.2	10	8,15,16
AIRBUS UK	1-11-200	MK506-W/HUSHKIT	80.00	84.1	8	15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	820.00	84.1	10	8,15
MCDONNELL DOUG.	DC-08-71	CFM56-2-C1	337.00	84.1	15	
SABRELINER CORP.	SABRE 60A	JT12A-8	22.70	83.8	-	8,12
BOEING	B-727-100	JT8D-7FCD	160.50	83.7	5	3,8,14,15
BOEING	B-747-400F	PW4056 FB2B/2C	830.00	83.7	10	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	160.00	83.7	2	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2B	555.00	83.6	5	8,15
SABRELINER CORP.	SABRE 40A	JT12A-8	19.60	83.4	-	8,12
BOEING	B-777-300	PW4090	660.00	83.3	5	8,15,59
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	820.00	83.2	10	8,15,23
MCDONNELL DOUG.	MD-80	JT8D-209	149.50	83.2	0	8,15
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-9	198.50	83.1	5	8,15,37,46
MCDONNELL DOUG.	MD-80	JT8D-217C	160.00	83.1	2	8,15
RAYTHEON	HAWKER 125- 1A	VIPER-522	21.20	83.1	-	8,15
BOEING	B-777-300	RR TRENT 892	660.00	82.9	5	8,15
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17A	203.10	82.8	5	8,15,37
GULFSTREAM	GULFSTREAM IIB/GIII	SPEY MK511-8	69.70	82.8	10	8,15,16
LEARJET	LEARJET 25B/C	CJ610-6	15.00	82.8	20	4,8,18
BOEING	B-767-300/300ER	RB211-524G	407.00	82.6	5	8,15
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	62.00	82.6	-	8,15
MCDONNELL DOUG.	DC-10-30	CF6-6K	410.00	82.6	-	8,15
BOEING	B-777-200	RR TRENT 884	632.50	82.5	5	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-727-100	JT8D-9FCD	160.50	82.4	5	3,8,15
BOEING	B-737-200	JT8D-7QN	100.50	82.4	1	2,8,14
BOEING	B-767-200	JT9D-7R4E	360.00	82.3	1	8,15
LEARJET	LEARJET 25 B/C/D/F XR	CJ610-6/8A	16.30	82.3	10	8,13
LOCKHEED	1329-25 JETSTAR	TFE731-3-1E	43.80	82.3	20	4
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	198.70	82.2	5	8,15,37,46
BOEING	B-777-200	RR TRENT 892	656.00	82.1	5	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	160.00	82.1	2	8,15
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-15	198.70	82.0	5	8,15,37,50,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-15	197.00	82.0	5	8,15,37,50,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-17	198.70	82.0	5	8,15,37
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	198.70	81.9	5	8,15,37,49,51
BOEING	B-737-200 (AVAERO)	JT8D-15	123.50	81.9	1	8,15,32
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	121.50	81.9	1	8,15,31
RAYTHEON	HAWKER 125- 600A	VIPER 601-22	25.50	81.9	-	8,15,16
BOEING	B-737-200 (AVAERO)	JT8D-9	120.50	81.8	1	8,15,31
BOEING	B-737-200 (AVAERO)	JT8D-15	124.50	81.7	1	8,15,31
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	123.50	81.7	1	8,15,32
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	124.50	81.6	1	8,15,31
BOEING	B-767-300	JT9D-7R4D(B)	351.00	81.6	5	8,15
BOEING	B-727-100 (Dee Hwd)	TAY651-54	169.50	81.5		8,15
BOEING	B-737-200 (AVAERO)	JT8D-9	117.50	81.5	1	8,15,30
BOEING	B-767-300/300ER	RB211-524H	407.00	81.5	5	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	149.50	81.4	0	8,15
BOEING	B-727-100 (Fed Ex)	JT8D-9	160.50	81.3		8,15,16,29
BOEING	B-737-100 (AVAERO)	JT8D-7	114.50	81.3	1	8,15,30
BOEING	B-737-200 (AVAERO)	JT8D-7	114.50	81.3	1	8,15,30

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	117.50	81.3	1	8,15,30
BOEING	B-777-200	PW4090	656.00	81.3	5	8,15,59
LOCKHEED	L-188	501-D13	116.00	81.3	-	4,8
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-9	111.70	81.3	0	8,15,16
MCDONNELL DOUG.	DC-09-40 (ABS STC165CH)	JT8D-9	111.70	81.3	0	8,15,16
BOEING	B-737-200 ADV (AVAERO)	JT8D-7	114.50	81.2	1	8,15,30
BOEING	B-767-300/300ER	PW4056	407.00	81.2	5	8,15
BOEING	B-777-200	RR TRENT 895	656.00	81.2	5	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	149.50	81.2	1	8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-7	108.50	81.1	0	8,15,16
BOEING	B-777-300	PW4098	660.00	81.0	5	8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-7	105.00	81.0	0	8,15,16
NIHON	YS-11A-200	DART MK 542	54.00	81.0	-	5
MCDONNELL DOUG.	DC-10-10	CF6-6D1	386.50	80.9	15	15
MORANE-SAULNIER	MS 760B (PARIS II)	MARBORE VI C2	8.65	80.9	10	19
BOEING	B-767-300	JT9D-7R4E	351.00	80.8	5	8,15
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	115.50	80.6	1	8,15,30
BOEING	B-767-300	CF6-80A	351.00	80.6	5	8,15
LEARJET	LEARJET 24D	CJ610-6	13.50	80.6	-	8
MCDONNELL DOUG.	MD-87	JT8D-217C	149.50	80.6	1	8,15
SABRELINER CORP.	SABRE 80A	CF700-2D-2	25.50	80.5	-	12
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17	190.50	80.4	5	8,15,37,48
BOEING	B-737-400	CFM56-3-B1	142.50	80.4		8,15
BOEING	B-737-400	CFM56-3-B1	142.50	80.4	5	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	412.00	80.3	5	8,15
MCDONNELL DOUG.	MD-80	JT8D-209	140.00	80.3	0	8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-7	103.00	80.2	0	8,15,16

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
TAKEOFF

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	62.00	80.1	-	8,15,16
MCDONNELL DOUG.	DC-09-40 (ABS STC165CH)	JT8D-11	111.00	80.1	0	8,15,16
BOEING	B-737-200 (AVAERO)	JT8D-15	118.50	80.0	1	8,15,30
BOEING	B-747-100	CF6-45A2	570.00	80.0	10	8,15
BOEING	B-767-300/300ER	PW4060	408.00	80.0	5	8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-9	105.00	80.0	0	8,15,16
AIRBUS	A-310-322	JT9D-7R4E1	337.30	79.9		8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-11	111.00	79.9	0	8,15,16
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	190.50	79.8	5	8,15,37,46
BOEING	B-767-300/300ER	CF6-80C2B4	407.00	79.8	5	8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-7	105.00	79.8	0	8,15,16
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	118.50	79.7	1	8,15,30
BOEING	B-767-300	CF6-80A2	351.00	79.7	5	8,15
BOEING	B-777-200	RR TRENT 895	632.50	79.7	5	8,15
LEARJET	LEARJET 25D	CJ610-6	15.00	79.7	8	8,13
LEARJET	LEARJET 25F	CJ610-6	15.00	79.7	8	4,8
MCDONNELL DOUG.	DC-09-10	JT8D-7	90.70	79.7	10	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	149.50	79.7	1	8,15
SABRELINER CORP.	SABRE 80	CF700-2D-2	23.30	79.6	15	12
AIRBUS	A-300B4-2C	CF6-50C	346.50	79.4	-	4,8,9
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-9	103.00	79.3	0	8,15,16
FOKKER	F-28 MK1000	SPEY MK555-15	65.00	79.2	6	4
AIRBUS	A-300B	CF6-50A	302.00	79.1	-	4,8
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-9	184.00	79.1	5	8,15,37,46
BOEING	B-767-300/300ER	CF6-80C2B6	412.00	79.1	5	8,15
AIRBUS	A-310-322	JT9D-7R4E1	330.69	79.0		8,15
BOEING	B-777-200	RR TRENT 875	545.00	79.0	5	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-777-200	RR TRENT 877	555.00	79.0	5	8,15
AIRBUS	A-310-304	CF6-80C2A2	346.12	78.9		8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	187.70	78.9	1	8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-9	105.00	78.8	0	8,15,16
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-15	184.00	78.7	5	8,15,37,47
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	408.00	78.7	5	8,15
BOEING	B-777-200	GE90-85B	632.50	78.7	5	8,15,57
BOEING	B-777-200	GE90-90B	656.00	78.7	5	8,15,57
MCDONNELL DOUG.	MD-80	JT8D-217	140.00	78.7	0	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	140.00	78.7	0	8,15
BOEING	B727-100RE(Rohr)	JT8D-217C/JT8D-9	174.50	78.6	5	8,15,37
MCDONNELL DOUG.	DC-09-10	JT8D-7	90.70	78.6	10	1,8,15
AIRBUS	A-300B4-2C	CF6-50C	336.60	78.5	-	4,8,9
BOEING	B-767-300/300ER	CF6-80C2B6F	408.00	78.5	5	8,15
BOEING	B-737-400	CFM56-3B-2	150.00	78.4	5	8,15
BOEING	B-737-500	CFM56-3-B1(R)	132.80	78.4		8,15
AEROSPATIALE	NORD-262C	BASTAN-VIIA	22.90	78.3	-	4,8
AIRBUS	A-300B2-1A	CF6-50A	312.40	78.3	-	4,8,9
BAE SYSTEMS (BAe)	BAe-748 SERIES 2B	RR-DART-MK535	46.50	78.3	15	8,15
MCDONNELL DOUG.	DC-09-20 (ABS STC1613GL)	JT8D-9	100.00	78.3	0	8,15,16
MCDONNELL DOUG.	MD-80	JT8D-217C	140.00	78.3	0	8,15
AIRBUS	A-310-324	PW4152	346.12	78.2		8,15
BOEING	B-737-300	CFM56-3-B1	139.50	78.2	1	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	412.00	78.2	5	8,15
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-7B	174.50	78.1	5	8,15,37
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	187.70	78.1	1	8,15,56
BOEING	B-777-200	GE90-90B(BLK IV)	656.00	78.1	5	8,15,58

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
VICKERS ARMSTRONGS	VISCOUNT 745	RR DART6 MK510	72.50	78.1	-	11
BAE SYSTEMS (BAe)	BAE-748 SERIES 2A	RR DART MK532-2L	44.50	78.0	15	8,15
BAE SYSTEMS (BAe)	BAe-748 SERIES 2B	RR-DART MK535-W/HUSHKIT	46.50	78.0	15	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	187.70	78.0	1	8,15
BOEING	B-767-300/300ER	PW4060 PHASE 3 (FB2C)	412.00	78.0	-	8,15,23
BOEING	B-777-200	GE90-85B(BLK IV)	632.50	78.0	5	8,15,58
FOKKER	F-27-200	MK532-7	43.50	78.0	-	5
FOKKER	F-27-500/600	MK532-7R	43.50	78.0	-	5
AIRBUS	A-300B4-2C	CF6-50C	330.00	77.9	-	4,8,9
BOEING	B-737-500	CFM56-3-B1	139.00	77.9		8,15
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-9	174.50	77.8	5	8,15,37
BOEING	B-767-300/300ER	CF6-80C2B7F	407.00	77.8	5	8,15
LEARJET	LEARJET 24B/D W/RAISBECK	CJ610-6	13.50	77.8	10	8,13
BOEING	B-737-400	CFM56-3-B1	138.50	77.7	5	8,15
BOEING	B-737-400	CFM56-3-B1	138.50	77.7		8,15
BOEING	B-767-200/200ER	CF6-80C2B4	387.00	77.7	1	8,15
SABRELINER CORP.	SABRE 75A	CF700-2D-2	23.00	77.7	-	4
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	187.70	77.6	1	8,15
BOEING	B727-100RE(Rohr)	JT8D-217C/JT8D-9	169.50	77.5	5	8,15,37
BOEING	B-777-200	PW4074	535.00	77.5	5	8,15
BOEING	B-777-200	PW4077	545.00	77.5	5	8,15
BOEING	B-777-200	PW4090 at PW4074 rating	535.00	77.5	5	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	545.00	77.5	5	8,15,59
MCDONNELL DOUG.	MD-80	JT8D-219	140.00	77.5	0	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	140.00	77.4	0	8,15
AIRBUS	A-310-221	JT9D-7R4D1	313.05	77.3		8,15
AIRBUS	A-310-308	CF6-80C2A8	361.55	77.3		8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
AIRBUS	A320-232	V2527-A5	182.98	77.3		8,15
BOEING	B-767-200/200ER	PW4056 PHASE 3 (FB2C)	395.00	77.3	-	8,15,23
FAIRCHILD	F-27-F	RR DART MK529	38.50	77.3	-	11
AIRBUS	A-310-203	CF6-80A3	313.05	77.2		8,15
AIRBUS	A-310-203C	CF6-80A3	313.05	77.2		8,15
BOEING	B-737-400	CFM56-3C-1	150.00	77.2	5	8,15
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	187.70	77.2	1	8,15,56
BOEING	B-757-300	RB211-535E4	275.00	77.2	5	8,15,35
AIRBUS	A-300B2-1C	CF6-50C	312.40	77.1	-	4,8,9
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	166.44	77.1		8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	166.44	77.1		8,15
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	205.02	77.1		8,15
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-7B	169.50	77.1	5	8,15,37
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	171.00	77.1	1	8,15,55
BOEING	B-737-900	CFM56-7B24	174.20	77.1	1	8,15
BOEING	B-737-900W	CFM56-7B24	174.20	77.1	1	8,15,56
BOEING	B-767-200	JT9D-7R4D	315.00	77.1	1	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	380.00	77.1	5	8,15
BOEING	B-777-200	GE90-94B(BLK IV)	656.00	77.0	5	8,15,58
DASSAULT	FALCON 20	CF700-2D-2	28.60	77.0	10	8,15
DASSAULT	FALCON 20-Basic/D/E	CF700-2D-2	28.66	77.0	15	8,15
AIRBUS	A-310-222	JT9D-7R4E1	313.05	76.9		8,15
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-9	169.50	76.9	5	8,15,37
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	171.00	76.9	1	8,15,54,55
BOEING	B-737-800SFP	CFM56-7B24	174.20	76.9	1	8,15,60
AIRBUS	A-300B1	CF6-50A	302.00	76.8	-	4,8,9
AIRBUS	A-300B2-1A	CF6-50A	301.40	76.8	-	4,8,9

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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TAKEOFF

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-800	CFM56-7B24	174.20	76.8	1	8,15
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	187.70	76.8	1	8,15,56
BAE SYSTEMS (BAe)	BAe-146-200A	ALF-502R-5	93.00	76.7	18	8,15,22
BAE SYSTEMS (BAe)	BAe-146-200A	ALF-502R-3A/-5	89.50	76.5	18	8,15,22
BOEING	B-737-800	CFM56-7B24/2 DAC	174.20	76.5	1	8,15,54
BOEING	B-777-300	RR TRENT 884	550.00	76.5	5	8,15
BOEING	B-767-300/300ER	RB211-524G	340.00	76.4	5	8,15
AIRBUS	A-310-203C	CF6-80A3	305.55	76.3		8,15
MCDONNELL DOUG.	DC-09-10 (ABS STC1563GL)	JT8D-7	90.70	76.3	10	8,15,16
AIRBUS	A-310-324	PW4152	330.69	76.2		8,15
AIRBUS	A321-231	V2533-A5	205.02	76.2		8,15
BOEING	B-767-200/200ER	PW4052	351.00	76.2	1	8,15
BOEING	B-777-200	RR TRENT 884	545.00	76.1	5	8,15
RAYTHEON	HAWKER 125- 700A	TFE731-3R-1H	25.50	76.1	-	8,15,20,26
AEROSPATIALE	MOHAWK 298	PT6A-45A	23.40	76.0	-	4
AIRBUS	A-300B2-1C	CF6-50C	302.00	76.0	-	4,8,9
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	171.00	76.0	1	8,15,55,56
BOEING	B-737-800W	CFM56-7B24	174.20	76.0	1	8,15,56
FOKKER	F-27 MK500/600	MK552-7R	45.90	76.0	0	15,16
FOKKER	F-27-100	RR DART6 MK514	39.00	76.0	-	11
GULFSTREAM	500S	IO-540-E1B5	6.80	76.0	-	10
AIRBUS	A-300B2-K-3C	CF6-50C	312.40	75.9	-	4,8,9
AIRBUS	A-310-222	JT9D-7R4E1	305.55	75.9		8,15
BOEING	B-737-800SFP W	CFM56-7B24	174.20	75.9	1	8,15,56,60
BOEING	B-757-200	PW2037	255.50	75.9	5	8,15
BOEING	B-757-200	PW2037(BG-3)	255.50	75.9	5	8,15,39
BOEING	B-757-200	RB211-535C	240.00	75.9	5	8,15

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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-767-300/300ER	CF6-80C2B2F	351.00	75.9	5	8,15
FOUND AIRCRAFT CANADA	FBA-2C1	IO-540-D4A5	3.20	75.9	-	11,21
BAE SYSTEMS (BAe)	BAe-146-300A	LF507	101.50	75.8		8,15,22
BOEING	B-767-200/200ER	CF6-80C2B2	351.00	75.8	1	8,15
RAYTHEON	HAWKER 125- 600A	TFE731-3-1H	25.50	75.8		8,15
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	25.50	75.8	-	8,15,26
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	101.50	75.7	18	8,15,22
BOEING	B727-100RE(Rohr)	JT8D-217C/JT8D-9	160.50	75.7	5	8,15,37
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	171.00	75.7	1	8,15,54,55,56
BOEING	B-737-800W	CFM56-7B24/2 DAC	174.20	75.7	1	8,15,54,56
BOEING	B-767-300	JT9D-7R4D(B)	300.00	75.7	5	8,15
AIRBUS	A-310-308	CF6-80C2A8	346.12	75.6		8,15
BOEING	B-737-300	CFM56-3B-2	139.50	75.6	1	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	600.00	75.6	10	8,15
BOEING	B-767-300/300ER	RB211-524H	340.00	75.5	5	8,15
FOKKER	F-28 MK4000	SPEY MK555-15H	73.00	75.5	15	
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	171.00	75.4	1	8,15,55
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	24.20	75.4		8,15,26
BOEING	B-737-400	CFM56-3B-2	138.50	75.3	5	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	174.20	75.3	1	8,15
BOEING	B-747-400D	CF6-80C2B1F	600.00	75.3	10	8,15
FOKKER	F-27 MK500/600	MK552-7R	45.00	75.3	0	15,16
BOEING	B-737-900	CFM56-7B26	174.20	75.2	1	8,15
BOEING	B-737-900W	CFM56-7B26	174.20	75.2	1	8,15,56
BOEING	B-777-200	GE90-77B(BLK IV)	545.00	75.2	5	8,15,58
BOEING	B-737-700	CFM56-7B20	154.50	75.1	1	8,15
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	171.00	75.1	1	8,15,54,55

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B20	154.50	75.1	1	8,15,55
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	174.20	75.1	1	8,15,60
BOEING	B-757-300	RB211-535E4B	275.00	75.1	5	8,15,35
BOEING	B-757-300	RB211-535E4C	275.00	75.1	5	8,15,35
BOEING	B-777-200	GE90-76B	545.00	75.1	5	8,15,57
BOEING	B-777-200	GE90-76B(BLK IV)	545.00	75.1	5	8,15,58
BEECH	C35	E-185-11	2.70	75.0	-	11
BEECH	E35	E-225-8	2.70	75.0	-	11
BOEING	B-737-800	CFM56-7B26/2 DAC	174.20	75.0	1	8,15,54
BOEING	B-777-300	RR TRENT 892	550.00	75.0	5	8,15
LOCKHEED	1329-25 JETSTAR w/STAR 3	TFE731-3	44.50	75.0	20	8,15,34
BOEING	B-737-700	CFM56-7B20/2 DAC	154.50	74.9	1	8,15,54
BOEING	B-737-700C/-700ER	CFM56-7B20/2 DAC	154.50	74.9	1	8,15,54,55
BOEING	B-777-200	GE90-77B	545.00	74.9	5	8,15,57
BOEING	B-777-200	PW4090	545.00	74.9	5	8,15,59
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	171.00	74.8	1	8,15,55,56
BOEING	B-737-900	CFM56-7B24	164.00	74.8	1	8,15
BOEING	B-737-900W	CFM56-7B24	164.00	74.8	1	8,15,56
BOEING	B-767-300	JT9D-7R4E	300.00	74.8	5	8,15
LOCKHEED	1329-23 JETSTAR w/STAR 3	TFE731-3	44.25	74.7	20	8,15,33
MCDONNELL DOUG.	MD-87	JT8D-217A	125.00	74.7	0	8,15
AIRBUS	A-310-204	CF6-80C2A2	313.05	74.6		8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	171.95	74.6		8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	171.95	74.6		8,15
BOEING	B-777-200	RR TRENT 892	545.00	74.6	5	8,15
BOMBARDIER	BD-700-1A10 (Global Express)	BR700-710-A2-20	96.00	74.6	16	8,15
LEARJET	LEARJET 24F	CJ610-6	12.90	74.6	20	4,8

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	171.00	74.5	1	8,15,54,55,56
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	174.20	74.5	1	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	174.20	74.5	1	8,15,60
BOEING	B-737-900	CFM56-7B27	174.20	74.5	1	8,15
BOEING	B-737-900W	CFM56-7B27	174.20	74.5	1	8,15,56
BOEING	B-767-300	CF6-80A	300.00	74.5	5	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	125.00	74.5	0	8,15
AIRBUS	A319-132	V2524-A5	166.44	74.4		8,15
BOEING	B-777-300	PW4098	550.00	74.4	5	8,15
MOONEY	M20F w/MODWORK STC# SA02204AT	IO-360-E5	2.74	74.4	-	11,21
BOEING	B-737-400	CFM56-3C-1	138.50	74.3	5	8,15
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B20	154.50	74.3	1	8,15,55,56
BOEING	B-737-700W	CFM56-7B20	154.50	74.3	1	8,15,56
BOEING	B-767-200/200ER	PW4052	335.00	74.3	1	8,15
CESSNA	207	IO-520-F	3.80	74.3	-	11
GENERAL DYNAMICS	CV-580	501-D13	54.60	74.3	-	10
BOEING	B-737-600	CFM56-7B18	145.50	74.2	1	8,15
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	171.00	74.2	1	8,15,55
BOEING	B-737-800	CFM56-7B27/2 DAC	174.20	74.2	1	8,15,54
BOEING	B-737-900	CFM56-7B27/B1	174.20	74.2	1	8,15
BOEING	B-737-900W	CFM56-7B27/B1	174.20	74.2	1	8,15,56
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	174.20	74.1	1	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	174.20	74.1	1	8,15,60
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	174.20	74.1	1	8,15,56
AIRBUS	A319-114	CFM56-5A5	163.14	74.0	10	8,15
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	145.50	74.0	1	8,15,54
BOEING	B-737-700C/-700ER W	CFM56-7B20/2 DAC	154.50	74.0	1	8,15,54,55,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700W	CFM56-7B20/2 DAC	154.50	74.0	1	8,15,54,56
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	174.20	74.0	1	8,15,56,60
GULFSTREAM	G200	PW306A	34.85	74.0	25	8,15,44
GULFSTREAM	G200	PW306A	34.85	74.0	25	8,15,45
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	171.00	73.9	1	8,15,54,55
BOEING	B-737-800	CFM56-7B27/2B1 DAC	174.20	73.9	1	8,15,54
BOEING	B-737-800W	CFM56-7B26/2 DAC	174.20	73.8	1	8,15,54,56
BOEING	B-767-200/200ER	CF6-80C2B4	351.00	73.8	1	8,15
AIRBUS	A-320-211	CFM56-5A1	162.00	73.7	-	8,15
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	97.00	73.7	18	8,15,22
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	164.00	73.7	1	8,15
BOEING	B-757-200	PW2040	255.50	73.7	5	8,15
BOEING	B-757-200	RB211-535E4	255.50	73.7	5	8,15,35
BOEING	B-757-200	RB211-535E4	255.50	73.7	5	8,15,36
BOEING	B-767-300	CF6-80A2	300.00	73.7	5	8,15
BOEING	B-737-300	CFM56-3-B1	124.50	73.6	1	8,15
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	171.00	73.6	1	8,15,55
BOMBARDIER	BD-700-1A10 (Global Express)	BR700-710-A2-20	93.50	73.6	16	8,15
CIRRUS DESIGN CORP.	SR 22	IO-550-N	3.40	73.6	-	11,21
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	90.00	73.4	18	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	LF507	95.00	73.4		8,15,22
BOEING	B-737-700	CFM56-7B22	154.50	73.4	1	8,15
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	154.50	73.4	1	8,15,55
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	174.20	73.4	1	8,15,56,60
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	174.20	73.4	1	8,15,56
AIRBUS	A319-112/P	CFM56-5B6/P	166.44	73.3	10	8,15
AIRBUS	A320-214/P	CFM56-5B4/P	171.95	73.3	10	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
TAKEOFF

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	95.00	73.3	18	8,15,22
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	171.00	73.3	1	8,15,54,55
BOEING	B-767-200/200ER	PW4056	340.00	73.3	1	8,15
AEROSPATIALE	ATR72-200	PW124/HS 14SF11	48.50	73.2	15	15
AIRBUS	A319-131	V2522A5	158.73	73.2	10	8,15
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	174.20	73.2	1	8,15,56
GULFSTREAM	GIIB/GIII (HAT STC ST01567LA)	SPEY MK 511-8	69.70	73.2	10	8,15,16
BOEING	B-737-600	CFM56-7B20	145.50	73.1	1	8,15
BOEING	B-737-700	CFM56-7B22/2 DAC	154.50	73.1	1	8,15,54
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	154.50	73.1	1	8,15,54,55
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	171.00	73.1	1	8,15,55,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	174.20	73.1	1	8,15,54,56
LEARJET	LEARJET 24E	CJ610-6	12.90	73.1	20	4,8
BEECH	B55	IO-470-L	5.10	73.0	-	11
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	174.20	73.0	1	8,15,56,60
BOEING	B-737-900	CFM56-7B26	164.00	73.0	1	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	164.00	73.0	1	8,15
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	164.00	73.0	1	8,15,56
BOEING	B-737-900W	CFM56-7B26	164.00	73.0	1	8,15,56
CESSNA	T210L	TSI0-520-R	3.80	73.0	-	11
GULFSTREAM	GIIB/GIII (QTA STC ST03621AT)	SPEY MK 511-8	69.70	73.0	0	8,15,16
MCDONNELL DOUG.	MD-90-30	V2525-D5	166.00	73.0	5	8,15
AIRBUS	A-320-231	V2500.A1	162.00	72.9		8,15
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	95.00	72.9	18	8,15,22,43
BOEING	B-737-600	CFM56-7B20/2 DAC	145.50	72.9	1	8,15,54
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	174.20	72.9	1	8,15,54,56
BOEING	B-767-200	JT9D-7R4D	282.00	72.9	1	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-777-200	GE90-85B	545.00	72.9	5	8,15,57
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	171.00	72.8	1	8,15,54,55,56
BOEING	B-737-800SFP	CFM56-7B24	155.50	72.8	1	8,15,60
BOEING	B-757-200	RB211-535C	220.00	72.8	5	8,15
BOEING	B-737-800	CFM56-7B24	155.50	72.7	1	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	164.00	72.7	1	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	345.00	72.7	5	8,15
AIRBUS	A-310-221	JT9D-7R4D1	275.57	72.6		8,15
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	171.00	72.6	1	8,15,55,56
BOEING	B-777-200	GE90-76B	506.00	72.6	5	8,15,57
BOEING	B-777-200	GE90-76B(BLK IV)	506.00	72.6	5	8,15,58
BOEING	B-777-200	GE90-77B(BLK IV)	506.00	72.6	5	8,15,58
DASSAULT	FALCON 50 (M1230)	TFE731-3-1C	40.78	72.6	20	8,15
BAE SYSTEMS (JETSTREAM)	JETSTREAM 4100	TPE331-14-801H/802H/805H	24.00	72.5		12,15
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	154.50	72.5	1	8,15,55,56
BOEING	B-737-700W	CFM56-7B22	154.50	72.5	1	8,15,56
BOEING	B-777-200	GE90-77B	506.00	72.5	5	8,15,57
BOEING	B-777-200	GE90-85B(BLK IV)	545.00	72.5	5	8,15,58
ESTUMKEDA LTD d.b.a MICCO AIRCRAFT CO.	MAC-145B	IO-540-T4B5	2.85	72.5	-	11,21
GULFSTREAM	GIIB/GIII (HAT STC ST01567LA)	SPEY MK 511-8	68.20	72.5	10	8,15,16
AIRBUS	A-310-203	CF6-80A3	275.57	72.4		8,15
AIRBUS	A-310-204	CF6-80C2A2	295.41	72.4		8,15
AIRBUS	A-310-304	CF6-80C2A2	295.41	72.4		8,15
BAE SYSTEMS (BAe)	BAe-146-100A	ALF-502R-3A/-5	84.00	72.4	18	8,15,22
BOEING	B-737-800	CFM56-7B24/2 DAC	155.50	72.4	1	8,15,54
BOEING	B-737-900	CFM56-7B27	164.00	72.4	1	8,15
BOEING	B-737-900W	CFM56-7B27	164.00	72.4	1	8,15,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-757-200	PW2040 (nCBQFC)	255.50	72.4	5	8,15,41
BOEING	B-757-200	RB211-535E4B	255.50	72.4	5	8,15,36
GULFSTREAM	GIIB/GIII (QTA STC ST03621AT)	SPEY MK 511-8	68.20	72.4	0	8,15,16
RAYTHEON	HAWKER 125- 3A/RA	TFE731-3-1H	23.60	72.4	-	8,15
RAYTHEON	HAWKER 125- 400A	TFE731-3-1H	23.60	72.4	-	8,15
AEROSPATIALE	ATR72-210	PW127/HS 14SF11	48.50	72.3	15	15
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	171.00	72.3	1	8,15,54,55,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	164.00	72.3	1	8,15,56
BOEING	B-757-200	RB211-535E4B	255.50	72.3	5	8,15,35
CIRRUS DESIGN CORP.	SR 20 (2 Bladed Prop)	IO-360-ES	2.90	72.3	-	11,21
BOEING	B-737-500	CFM56-3-B1(R)	115.50	72.2		8,15
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	154.50	72.2	1	8,15,54,55,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	154.50	72.2	1	8,15,54,56
DASSAULT	FALCON 900 (M1196)	TFE731-5AR-1C	46.50	72.2	20	8,15
BOEING	B-717-200	BR700-715A1-30 (MP)	121.00	72.1	5	8,15,53
BOEING	B-737-900	CFM56-7B27/B1	164.00	72.1	1	8,15
BOEING	B-737-900W	CFM56-7B27/B1	164.00	72.1	1	8,15,56
BOEING	B-777-200	RR TRENT 875	458.00	72.1	5	8,15
CIRRUS DESIGN CORP.	SR 20 (3 Bladed Prop)	IO-360-ES	2.90	72.1	-	11,21
DASSAULT	FALCON 20-C5/D5/E5 (M3547)	TFE731-5BR-2C	30.50	72.1	15	8,15
IAI	1125 ASTRA	TFE731-3A-200G	24.65	72.1	12	8,15
BOEING	B-717-200	BR700-715A1-30	121.00	72.0	5	8,15,52
BOEING	B-737-700	CFM56-7B24	154.50	72.0	1	8,15
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	154.50	72.0	1	8,15,55
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	164.00	72.0	1	8,15,56
BOEING	B-777-200	GE90-94B(BLK IV)	580.00	72.0	5	8,15,58
DASSAULT	FALCON 20-C5/D5/E5 (M3500)	TFE731-5AR-2C	29.10	72.0	15	8,15

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MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
FOKKER	F100	RR TAY MK620-15	95.00	72.0	-	8,15
PIPER	PA-28-235	O-540-B4B5	3.00	72.0	-	11
BOEING	B-737-800W	CFM56-7B24	155.50	71.9	1	8,15,56
GULFSTREAM	GII TT (QTA STC ST03621AT)	SPEY MK 511-8	65.50	71.9	0	8,15,16
MITSUBISHI	MU300 DIAMOND I	JT15D-4	14.10	71.9	-	12
AEROSPATIALE	ATR72-210	PW127/HS 14SF11	47.40	71.8	15	15
BEECH	BEECHJET 400	JT15D-5	15.80	71.8	-	15
BOEING	B-737-700	CFM56-7B24/2 DAC	154.50	71.8	1	8,15,54
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	154.50	71.8	1	8,15,54,55
BOEING	B-737-800SFP W	CFM56-7B24	155.50	71.8	1	8,15,56,60
BOEING	B-777-200	GE90-90B	545.00	71.8	5	8,15,57
GULFSTREAM	GIISP (HAT STC ST01567LA)	SPEY MK 511-8	64.80	71.8	20	8,15,16
MITSUBISHI	MU300-10 DIAMOND II	JT15D-5	15.80	71.8	-	15
RAYTHEON	HAWKER 125-1000A	PW305	31.00	71.8		8,15
BOEING	B-737-800W	CFM56-7B24/2 DAC	155.50	71.7	1	8,15,54,56
DASSAULT	FALCON 20-G (M2500)	ATF3-6-2C	32.00	71.7	10	8,15
DASSAULT	FALCON 200	ATF3-6A-4C	32.00	71.7	5	8,15
IAI	1124IW WESTWIND IW	TFE731-3-1G	23.50	71.7	12	15
BAE SYSTEMS (JETSTREAM)	JETSTREAM 4100	TPE331-14-801H/802H	23.00	71.6		12,15
BOEING	B-737-600	CFM56-7B22	145.50	71.6	1	8,15
GULFSTREAM	GII (QTA STC ST03621AT)	SPEY MK 511-8	64.80	71.6	0	8,15,16
LEARJET	LEARJET 35A	TFE731-2	18.00	71.6	8	15
LEARJET	LEARJET 36A	TFE731-2	18.00	71.6	8	15
SHORTS	SKYVAN	TPE-331-201	12.50	71.6	15	
BOEING	B-737-300	CFM56-3B-2	124.50	71.5	1	8,15
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	154.50	71.4	1	8,15,55,56
BOEING	B-737-700W	CFM56-7B24	154.50	71.4	1	8,15,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
CESSNA	210	IO-520-L	3.80	71.4	-	10,11
DASSAULT	FALCON 20-Basic/D/E/F (M2851)	CF700-2D-2Q	28.66	71.4	0	8,15
DASSAULT	FALCON 20-F5 (M3547)	TFE731-5BR-2C	30.50	71.4	10	8,15
BOEING	B-737-600	CFM56-7B22/2 DAC	145.50	71.3	1	8,15,54
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	155.50	71.3	1	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	155.50	71.3	1	8,15,60
BOEING	B-767-200/200ER	CF6-80A	279.90	71.3	1	8,15
BOEING	B-777-200	PW4074	440.90	71.3	5	8,15
BOEING	B-777-200	PW4090 at PW4074 rating	447.40	71.3	5	8,15,59
BOEING	B-777-200	RR TRENT 877	458.00	71.3	5	8,15
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	84.00	71.2	18	8,15,22
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	154.50	71.2	1	8,15,54,55,56
BOEING	B-737-700W	CFM56-7B24/2 DAC	154.50	71.2	1	8,15,54,56
DASSAULT	FALCON 900	TFE731-5AR-1C	45.50	71.2	20	8,15
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	21.70	71.2		8,15
RAYTHEON	HAWKER 125- 3A	TFE731-3-1H	21.70	71.2		8,15
SHORTS	3-30	PT6A-45A	22.40	71.2	-	8,15
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	89.50	71.1	18	8,15,22
BEECH	C99 AIRLINER	PT6A-34	11.30	71.1	-	5,11
BOEING	B-737-800	CFM56-7B26/2 DAC	155.50	71.1	1	8,15,54
MCDONNELL DOUG.	MD-90-30	V2525-D5	156.00	71.1	5	8,15
AIRBUS	A-320-111	CFM56-5A1	149.90	71.0		8,15
BEECH	35-B33	I0-470-K	3.00	71.0	-	10,11
BEECH	A36	IO-520-BA	3.60	71.0	-	11
BEECH	B36TC BONANZA	TSIO-520U	3.85	71.0	-	11
BEECH	B55(3BLD)	IO-470-L	5.10	71.0	-	11
BOEING	B-737-500	CFM56-3-B1	115.50	71.0		8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-757-300	RB211-535E4	236.00	71.0	5	8,15,35
CESSNA	T210M	TSI0-520-R	3.80	71.0	-	11
CESSNA	TU206G	TSI0-520-M	3.60	71.0	-	11
EMBRAER	EMB 110-P2	PT6A-34	12.50	71.0	-	4
FAIRCHILD DORNIER	SA226-AT	TPE-331-3U-303G	12.50	71.0	-	4
FAIRCHILD DORNIER	SA226-T	TPE-331-3U-303G	12.50	71.0	-	4
FAIRCHILD DORNIER	SA226-TC METRO II	TPE-331-3UW-303G	12.50	71.0	-	4
GULFSTREAM	GULFSTREAM I	RR DART MK529	35.10	71.0	-	15
MCDONNELL DOUG.	MD-90-30	V2528-D5	166.00	71.0	5	8,15
PIPER	PA-31-350	TI0-540-J2BD	7.00	71.0	-	11
PIPER	PA-32-300	IO-540-K1G5D	3.40	71.0	-	
PIPER	PA-32R-300	IO-540-K1G5D	3.60	71.0	-	11
PIPER	PA-32RT-300	IO-540-K1A5D	3.60	71.0	-	11
BOEING	B-737-700	CFM56-7B26	154.50	70.9	1	8,15
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	154.50	70.9	1	8,15,55
DASSAULT	FALCON 50	TFE731-3-1C	38.80	70.9	20	8,15
DASSAULT	FALCON 50	TFE731-3-1C	38.80	70.9	20	8,15
BOEING	B-767-300/300ER	CF6-80C2B2F	300.00	70.8	5	8,15
BOEING	B-777-200	PW4077	445.00	70.8	5	8,15
SABRELINER CORP.	SABRE 65	TFE731-3R-1D	24.00	70.8	-	8,12
AEROSPATIALE	ATR72-200	PW124/HS 14SF11	44.07	70.7	15	15
AIRBUS	A-320-211	CFM56-5A1	149.90	70.7	-	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	155.50	70.7	1	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	155.50	70.7	1	8,15,60
BOEING	B-777-200	PW4090 at PW4077 rating	447.50	70.7	5	8,15,59
BOEING	B-737-700	CFM56-7B26/2 DAC	154.50	70.6	1	8,15,54
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	154.50	70.6	1	8,15,54,55

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-777-200	GE90-90B(BLK IV)	545.00	70.6	5	8,15,58
DASSAULT	FALCON 20-F5	TFE731-5AR-2C	29.10	70.6	10	8,15
DASSAULT	FALCON 20-F5 (M3500)	TFE731-5AR-2C	29.10	70.6	10	8,15
DASSAULT	FALCON 50 (M1810)	TFE731-40-1	40.79	70.6	20	8,15
DASSAULT	FALCON 50 (M2193)	TFE731-40-1	40.79	70.6	20	8,15
GULFSTREAM	GIISP (HAT STC ST01567LA)	SPEY MK 511-8	62.00	70.6	20	8,15,16
LEARJET	LEARJET 36	TFE731-2	17.00	70.6	8	4
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	154.50	70.5	1	8,15,55
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	155.50	70.5	1	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	155.50	70.5	1	8,15,60
DASSAULT	FALCON 7X (SFI)	PW307A	69.00	70.5	9	
BOEING	B-737-800	CFM56-7B27/2 DAC	155.50	70.4	1	8,15,54
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	155.50	70.4	1	8,15,56
LEARJET	LEARJET 35	TFE731-2	17.00	70.4	8	4
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	21.20	70.4	-	8,15
AIRBUS	A-320-231	V2500.A1	149.90	70.3		8,15
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	154.50	70.3	1	8,15,54,55
BOEING	B-737-800	CFM56-7B27/2B1 DAC	155.50	70.3	1	8,15,54
BOEING	B-767-200/200ER	CF6-80C2B2	300.00	70.3	1	8,15
BOEING	B-767-300/300ER	PW4060	315.00	70.3	5	8,15
IAI	1124A WESTWIND II	TFE731-3-1G	23.50	70.3	12	15
IAI	1125 ASTRA	TFE731-3A-200G	23.50	70.3	12	8,15
PIPER	PA-42 CHEYENNE	PT6A-41	10.50	70.3	-	10,11
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	155.50	70.2	1	8,15,56,60
BOEING	B-737-800W	CFM56-7B26/2 DAC	155.50	70.2	1	8,15,54,56
CESSNA	206	IO-520-A	3.30	70.2	-	11
GULFSTREAM	GII (QTA STC ST03621AT)	SPEY MK 511-8	62.00	70.2	0	8,15,16

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
TAKEOFF

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
CASA AIRCRAFT	CN-235-200	CT7-9C	34.83	70.1	10	15
BEECH	35-C33A	I0-520-B	3.30	70.0	-	11
BEECH	F33A	I0-520-B	3.40	70.0	-	11
BEECH	K35/M35	IO-470-C	3.00	70.0	-	11
BOEING	B-737-700	CFM56-7B20	133.00	70.0	1	8,15
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	154.50	70.0	1	8,15,55,56
BOEING	B-737-700W	CFM56-7B26	154.50	70.0	1	8,15,56
CESSNA	182P	O-470-S	3.00	70.0	-	10,11
CESSNA	320C	TSI0-470-D	5.20	70.0	-	11
CESSNA	337H	IO-360-G	4.60	70.0	-	11
PIPER	601P	IO-540-S1A5	6.00	70.0	-	11
PIPER	PA-31-325	TIO-540-F2BD	6.50	70.0	-	11
PIPER	PA-32R-301	IO-540-K1G5D	3.60	70.0	-	11
PIPER	PA-46-31P MALIBU	TSIO-520-BE	4.10	70.0	-	11
CASA AIRCRAFT	C-295	PW 127 GM	46.30	69.9	10	15
DASSAULT	FALCON 900B (M1200)	TFE731-5BR-1C	46.50	69.9	20	8,15
FOKKER	F100	RR TAY MK650-15	98.00	69.9	-	8,15
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	165.34	69.8		8,15
BOEING	B-737-700	CFM56-7B20/2 DAC	133.00	69.8	1	8,15,54
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	155.50	69.8	1	8,15,56
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	154.50	69.7	1	8,15,54,55,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	154.50	69.7	1	8,15,54,56
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	155.50	69.7	1	8,15,56,60
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	27.40	69.7		8,15,20
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	27.40	69.7		8,15
BEECH	H18	R-985AN-14B	9.90	69.6	-	11
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	154.50	69.6	1	8,15,55,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-800W	CFM56-7B27/2 DAC	155.50	69.6	1	8,15,54,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	155.50	69.6	1	8,15,56
BOEING	B-757-200	PW2037	220.00	69.6	5	8,15
BOEING	B-757-200	PW-2037(BG-3)	220.00	69.6	5	8,15,39
BOEING	B-717-200	BR700-715C1-30 (MP)	121.00	69.5	5	8,15,53
FAIRCHILD DORNIER	SA227-AT MERLIN III C	TPE-331-10U	13.20	69.5	-	5,11
BOEING	B-717-200	BR700-715C1-30	121.00	69.4	5	8,15,52
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	154.50	69.4	1	8,15,54,55,56
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	155.50	69.4	1	8,15,56,60
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	155.50	69.4	1	8,15,54,56
CESSNA	CITATION V (560)	JT15D-5A	16.30	69.4	7	8,15
DASSAULT	FALCON 10	TFE731-2	19.30	69.4	15	8,15
DASSAULT	FALCON 10	TFE731-2-1C	19.30	69.4	15	8,15
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	84.00	69.3	18	8,15,22,43
CESSNA	206H	IO-580-A1A	3.60	69.3	-	11,21
CESSNA	CITATION III (650)	TFE731-3B-100S	22.00	69.3	7	7,8,15
CESSNA	CITATION VI (650)	TFE731-3C-100S	22.00	69.3	7	8,15
BOEING	B-737-600	CFM56-7B18	124.00	69.2	1	8,15
BOEING	B-737-700W	CFM56-7B20	133.00	69.2	1	8,15,56
BOEING	B-777-300	PW4090	450.00	69.2	5	8,15,59
DASSAULT	FALCON 20-C5/D5/E5 (M3530)	TFE-731-5BR-2C	29.10	69.2	15	8,15
DASSAULT	FALCON 900	TFE731-5AR-1C	45.50	69.2	7	8,15
FAIRCHILD DORNIER	SA226-AC METRO III	TPE-331-11U	14.50	69.2	-	10,11
FAIRCHILD DORNIER	SA227-AT MERLIN IV C	TPE-331-11U	14.50	69.2	-	10,11
FOKKER	F70	RR TAY MK620-15	92.00	69.2		8,15
BAE SYSTEMS (BAe)	BAe-146-100A	ALF-502R-3A/-5	76.00	69.1	18	8,15,22
BOEING	B-737-700W	CFM56-7B20/2 DAC	133.00	69.1	1	8,15,54,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES ***TAKEOFF***

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOMBARDIER	CL-600-2C10 (CRJ700)	CF34-8C1	75.00	69.1	8	8,15
CASA AIRCRAFT	CN-235-300	CT7-9C3	34.83	69.1	10	15
BEECH	V35B (3BLD)	I0-520-B	3.40	69.0	-	11
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	124.00	69.0	1	8,15,54
BOEING	B-757-300	RB211-535E4B	235.87	69.0	5	8,15,35
BOEING	B-757-300	RB211-535E4C	235.87	69.0	5	8,15,35
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	295.00	69.0	5	8,15
BOMBARDIER	DHC-7	PT6A-50	45.50	69.0		15
CESSNA	180	O-470-J	2.80	69.0	-	11
CESSNA	182Q	0-470-U	3.00	69.0	-	10,11
MCDONNELL DOUG.	MD-90-30	V2528-D5	156.00	69.0	5	8,15
PIPER	PA-31-310	TI0-540-A2C	6.50	69.0	-	11
PIPER	PA-32R-301T	TIO-540-S1AD	3.60	69.0	-	11
BOEING	B-767-300/300ER	PW4056	295.00	68.9	5	8,15
FAIRCHILD DORNIER	SA226-T(B) MERLIN IIIB	TPE-331-10U	12.50	68.9		5,11
LEARJET	LEARJET 31	TFE731-2-3B	17.00	68.9		13,15
BEECH	SUPER KINGAIR 200	PT6A-41	12.50	68.8	-	11
BEECH	SUPER KINGAIR B200	PT6A-41	12.50	68.8	-	10,11
BEECH	SUPER KINGAIR B200T/CT	PT6A-42	12.50	68.8	-	5,11
CASA AIRCRAFT	CN-235-100	CT7-9C	33.29	68.8	10	15
CESSNA	CITATION III (650)	TFE731-3B-100S	21.50	68.8	7	8,15
BOEING	B-737-700	CFM56-7B22	133.00	68.7	1	8,15
CESSNA	560	JT15D-5A	15.90	68.7	7	8,15
AEROSPATIALE	ATR42-300	PW120/HS 14SF5	37.26	68.4	15	15
BOEING	B-737-700	CFM56-7B22/2 DAC	133.00	68.4	1	8,15,54
LEARJET	LEARJET 55B	TFE731-3A-2B	21.50	68.4	-	
DASSAULT	FALCON 2000EX (M1842)	PW308C	42.20	68.3		

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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TAKEOFF

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
SHORTS	SD3-60-300	PT6A-67R	27.10	68.3	15	13
BOMBARDIER	CL-600-2C10 (CRJ700)	CF34-8C1	72.50	68.2	8	8,15
DASSAULT	FALCON 900EX (M3000)	TFE731-60-1	49.00	68.2	20	8,15
RAYTHEON	HAWKER 125- 800XP	TFE731-5BR-1H	28.00	68.2	0	8,15
AIRBUS	A321-231	V2533-A5	165.34	68.1		8,15
BOEING	B-737-600	CFM56-7B20	124.00	68.1	1	8,15
BOEING	B-757-200	RB211-535E4	220.00	68.1	5	8,15,36
DASSAULT	FALCON 20-F5 (M3530)	TFE-731-5BR-2C	29.10	68.1	10	8,15
BEECH	C90	PT6A-21	9.70	68.0	-	10
BOEING	B-737-600	CFM56-7B20/2 DAC	124.00	68.0	1	8,15,54
BOEING	B-757-200	PW2037 (CBQFC)	220.00	68.0	5	8,15,40
BRITTEN-NORMAN	ISLANDER BN-2B	O-540-E4C5	6.20	68.0	-	11
CASA AIRCRAFT	C-212-DE	PT6A-5B	16.98	68.0	10	15
CESSNA	170B	C-145-2H	2.20	68.0	-	11
CESSNA	310Q	IO-470-V0	5.20	68.0	-	10,11
CESSNA	402C	TSIO-520-VB	6.90	68.0	-	11
EMBRAER	EMB-145LR	AE3007A1/1	48.50	68.0	9	8,15
GULFSTREAM	G-V	BR700-710A1-10	90.50	68.0	10	8,15
PIPER	PA-23-250	IO-540-C4B5	5.20	68.0	-	11
PIPER	PA-28-236	O-540-J3A5D	3.00	68.0	-	11
BOEING	B-757-200	PW2040	220.00	67.9	5	8,15
EXTRA FLUGZEUGBAU	EA 400	TSIOL-550-A	4.41	67.9	-	11,21
SHORTS	3-60	PT6A-65R	26.40	67.9	5	8,15
BEECH	A36 BONANZA	IO-550-B	3.65	67.8	-	11
BOEING	B-737-700W	CFM56-7B22	133.00	67.8	1	8,15,56
BOEING	B-757-200	RB211-535E4	220.00	67.8	5	8,15,35
AEROSPATIALE	ATR42-320	PW121/HS 14SF5	37.26	67.7	15	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
TAKEOFF

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700	CFM56-7B24	133.00	67.7	1	8,15
BOEING	B-737-700W	CFM56-7B22/2 DAC	133.00	67.7	1	8,15,54,56
BOEING	B-767-300/300ER	CF6-80C2B6	288.70	67.6	5	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	288.70	67.6	5	8,15
BOEING	B-737-700	CFM56-7B24/2 DAC	133.00	67.5	1	8,15,54
CANADAIR	CHALLENGER CL-600	ALF-502L	41.25	67.5	20	15
CESSNA	CITATION II (550)	JT15D-4	14.60	67.4		8,15
IAI	1124 WESTWIND	TFE731-3-1G	22.90	67.4	20	8,15
CESSNA	CITATION I	JT15D-1A	11.90	67.3	15	8,15
DASSAULT	FALCON 2000EX (M1826)	PW308C	41.30	67.3		
CANADAIR	RJ (CL-600-2B19)	CF34-3A1	53.00	67.2	20	15
BOEING	B-757-200	RB211-535E4B	220.00	67.1	5	8,15,36
BOMBARDIER	DHC-8 314	PW123	43.00	67.1		8,15
CESSNA	CITATION ULTRA (560)	JT15D-5D	16.30	67.1	7	8,15
AEROSPATIALE	ATR72-210	PW127/HS 247F	48.50	67.0	15	8,15
BEECH	58 (2BLD)	IO-520-C	5.40	67.0	-	11
BEECH	58TC	TSIO-520-WB	6.20	67.0	-	10,11
BEECH	E55 (2 BLD)	IO-520-C	5.30	67.0	-	11
BOMBARDIER	DHC-6	PT6A-27	12.50	67.0	-	4
BOMBARDIER	DHC-6	PT6A-27	12.50	67.0		4
CANADAIR	CHALLENGER CL-601	CF34-1A	45.10	67.0	20	15
CESSNA	401	TSIO-520-E	6.30	67.0	-	11
CESSNA	414A	TSIO-520-N	6.80	67.0	-	11
CESSNA	500	JT15D-1	10.90	67.0	15	15
FAIRCHILD DORNIER	328-100 Mod 20	PW 119C	30.84	67.0	12	15,38
GULFSTREAM	G100	TFE731-40R-200G	24.65	67.0	25	8,15
LEARJET	LEARJET 55	TFE731-3B	20.50	67.0	-	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
PIPER	PA-28RT-201(2BLD)	I0-360-C1C6	2.80	67.0	-	11
PIPER	PA-28RT-201T(3BLD)	TSIO-360-FB	2.90	67.0	-	11
BOEING	B-737-600	CFM56-7B22	124.00	66.9	1	8,15
BOEING	B-737-700W	CFM56-7B24	133.00	66.9	1	8,15,56
CANADAIR	CHALLENGER CL-600	ALF-502L	40.40	66.9	20	12
BOEING	B-737-700W	CFM56-7B24/2 DAC	133.00	66.8	1	8,15,54,56
AEROSPATIALE	ATR42-320	PW121/HS 14SF5	35.60	66.7	15	15
BOEING	B-717-200	BR700-715A1-30 (MP)	104.50	66.7	5	8,15,53
BOEING	B-737-600	CFM56-7B22/2 DAC	124.00	66.7	1	8,15,54
BOEING	B-757-200	RB211-535E4B	220.00	66.7	5	8,15,35
BOMBARDIER	DHC-8 102	PW120	34.50	66.7		15
BOEING	B-757-200	PW2040 (CBQFC)	220.00	66.6	5	8,15,40
FAIRCHILD DORNIER	328-100 Mod 10	PW 119B	30.84	66.6	12	15,38
AEROSPATIALE	ATR42-300	PW120/HS 14SF5	34.72	66.5	15	15
BEECH	1900/1900C	PT6A-65B	16.60	66.5	-	10
BOEING	B-737-700	CFM56-7B26	133.00	66.5	1	8,15
CANADAIR	CHALLENGER CL-601	CF34-3A/A1/A2	45.10	66.5	20	15
DASSAULT	FALCON 900LX (M5281)	TFE731-60(-1C)	49.00	66.5		
AEROSPATIALE	ATR72-210	PW127/HS 247F	47.40	66.4	15	8,15
BOMBARDIER	DHC-8 106	PW121	36.30	66.4		15
BOMBARDIER	DHC-8 201/202	PW123	36.30	66.4		15
CANADAIR	CHALLENGER CL-601	CF34-1A	43.10	66.4	-	15
DASSAULT	FALCON 900DX (M4000, M3755, M3758)	TFE731-60(-1C)	46.70	66.4		
BOEING	B-717-200	BR700-715A1-30	104.50	66.3	5	8,15,52
BOEING	B-737-700	CFM56-7B26/2 DAC	133.00	66.3	1	8,15,54
FAIRCHILD DORNIER	DORNIER 228	TPE-331-5-252D	13.10	66.3	-	
AIRBUS	A320-232	V2527-A5	132.27	66.1		8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BEECH	B200/T/CT/C;C-12F(4 BLD)	PT6A-42	12.50	66.1	-	
BEECH	58P	TSIO-520WB	6.20	66.0	-	10,11
BEECH	99A	PT6A-27	10.40	66.0	-	4
BEECH	B80	IGS0-540-A1D	8.80	66.0	-	11
CESSNA	185F	I0-520-D	3.40	66.0	-	11
CESSNA	340A	TSIO-520-MB	6.00	66.0	-	11
GULFSTREAM	690B	TPE-331-5-251K	10.30	66.0	-	10
MITSUBISHI	MU-2B-36A	TPE-331-5-252M	11.00	66.0	-	4
PIPER	PA-602P	IO-540-AA1A5	6.00	66.0	-	11
PIPER	PA-60-600	IO-540-K1J5	5.50	66.0	-	11
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	123.45	65.9		8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	123.45	65.9		8,15
BEECH	65 QUEENAIR	IGSO-480-A1B6	7.70	65.9	-	11
EMBRAER	EMB-145ER	AE3007A	45.41	65.9	9	8,15
BOEING	B-737-700W	CFM56-7B26	133.00	65.8	1	8,15,56
AIRBUS	A319-131	V2522A5	123.45	65.7	10	8,15
BOMBARDIER	DHC-8 103	PW121	34.50	65.7		15
CASA AIRCRAFT	C-212-CC	TPE 331-10/10R-501C/511C	16.98	65.7	10	15
CASA AIRCRAFT	C-212-CF	TPE 331-10R-501C/511C	16.98	65.7	10	15
CESSNA	CITATION VII (650)	TFE731-4C-3S	23.00	65.7	7	8,15
BOEING	B-737-700W	CFM56-7B26/2 DAC	133.00	65.6	1	8,15,54,56
CESSNA	T206H	TIO-540-AJ1A	3.60	65.6	-	11,21
LEARJET	LEARJET 35 W/CENTURY III	TFE731-2	17.00	65.6	-	8,15
LEARJET	LEARJET 36 W/CENTURY III	TFE731-2	17.00	65.6	-	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	127.86	65.5		8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	127.86	65.5		8,15
BOMBARDIER	DHC-8 311	PW123	43.00	65.4		8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
CESSNA	CITATION VII (650)	TFE731-4R-3S	22.45	65.4		8,15
FOKKER	F70	RR TAY MK620-15	81.00	65.4		8,15
SAAB FAIRCHILD	SF340	GE CT7-5A2	27.30	65.3	15	12
AIRBUS	A320-214/P	CFM56-5B4/P	132.27	65.2	10	8,15
BOEING	B-717-200	BR700-715C1-30 (MP)	104.50	65.2	5	8,15,53
BEECH	58/58A BARON (3 BLD)	IO-550-C	5.50	65.1	-	11
LEARJET	LEARJET 35A/36A	TFE731-2	18.30	65.1	8	8,15
BEECH	A24R	I0-360-A1B6	2.80	65.0	-	11
BELLANCA	17-30A	I0-540-T4B5D	3.30	65.0	-	4
CESSNA	177RG	I0-360-A1B6	2.80	65.0	-	11
CESSNA	310R	TSIO-520-BB	5.50	65.0	-	11
MOONEY	M20C	0-360-A1D	2.60	65.0	-	11
PIPER	PA-24-260	IO-540-B1A5	3.20	65.0	-	11
AIRBUS	A319-112/P	CFM56-5B6/P	123.45	64.9	10	8,15
CESSNA	CARAVAN I	PT6A-114	7.30	64.9	10	
GULFSTREAM	GULFSTREAM IV - SP	RR TAY 611-8	74.60	64.9	20	8,15
CESSNA	S550 (SII)	JT15D-4B	15.10	64.8	7	8,15
MOONEY	M20M	TIO-540-AF1A	3.37	64.8		11,21
BEECH	300/300C KING AIR	PT6A-60A	14.00	64.7	-	
BOEING	B-717-200	BR700-715C1-30	104.50	64.7	5	8,15,52
CASA AIRCRAFT	C-212-CD	TPE 331-10R-512C/502C	16.98	64.7	10	15
CASA AIRCRAFT	C-212-CE	TPE 331-10R-512C/502C	16.98	64.7	10	15
CASA AIRCRAFT	C-212-DF	TPE 331-10R-502C/512C/513C	16.98	64.7	10	15
AIRBUS	A319-114	CFM56-5A5	123.45	64.6	10	8,15
AIRBUS	A319-132	V2524-A5	123.45	64.3		8,15
GULFSTREAM	GULFSTREAM IV	RR TAY 611-8	73.20	64.2	10	8,15
SAAB	SF340B (HS14RF-19 props)	GE CT7-9B	29.00	64.2	15	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
SAAB	SF340B (Dowty props)	GE CT7-9B	29.00	64.1	15	8,15
DASSAULT	FALCON 2000	CFE738-1-1B	36.50	64.0	20	8,15
GULFSTREAM	680FL	IGSO-540-B1A	8.50	64.0	-	11
MITSUBISHI	MU-2B-26A	TPE-331-5-252M	10.00	64.0	-	4
PIPER	PA-34-200T	TSI0-360-E	4.80	64.0	-	11
PIPER	PA-34-220T	TSIO-360-KB	4.75	64.0	-	11
MOONEY	M20M	TIO-540-AF1A	3.20	63.9		11,21
AEROSPATIALE	SN601 CORVETTE	JT15D-4	13.90	63.8	15	4
BAE SYSTEMS (JETSTREAM)	JETSTREAM 31	TPE331-10U-501H	15.20	63.7	-	15
SAAB	2000	AE2100A	49.60	63.5	15	8,15
SAAB	SF340B (HS14RF-19 props)	GE CT7-9B	28.50	63.5	15	8,15
SAAB	SF340B (Dowty props)	GE CT7-9B	28.50	63.4	15	8,15
EMBRAER	EMB-120 BRASILIA	PW115	21.20	63.2	15	12
MAULE	MX7-235	0540-J1A5D	2.50	63.2	-	11
BEECH	58 (3BLD)	IO-520-C	5.40	63.0	-	11
BEECH	B60	TI0-541-E1C4	6.80	63.0	-	10,11
BEECH	C24R	IO-360-A1B6	2.80	63.0	-	11
BEECH	E55 (3BLD)	IO-520-C	5.30	63.0	-	11
CESSNA	172N	0-320-H2AD	2.30	63.0	-	10
CESSNA	CONQUEST I	PT6A-112	8.20	63.0	-	10,11
CESSNA	CONQUEST II	TPE-331-8	9.80	63.0	-	5,11
GULFSTREAM	112	IO-360-C1D6	2.70	63.0	-	11
GULFSTREAM	GA-7	O-320-D1D	3.80	63.0	-	4
PIPER	PA-28-200	I0-360-C1C	2.70	63.0	-	
SAAB	SF340A (Dowty props)	GE CT7-5A2	28.00	62.9	15	8,15
CANADAIR	RJ (CL-600-2B19)	CF34-3A1	47.50	62.7	20	15
CESSNA	CITATION JET II (525A)	FJ44-2C	12.38	62.7	15	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
FAIRCHILD DORNIER	328-300 Mod 10	PW306B	34.52	62.7	12	8,15
SAAB	SF340A (Dowty props)	GE CT7-5A2	27.27	62.7	15	8,15
CESSNA	CITATION II (550)	JT15D-4	13.30	62.6	15	8,15
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	65.20	62.5	5	8,15
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	65.20	62.5	5	8,15,42
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	65.20	62.5	5	8,15,42
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	65.20	62.5	5	8,15
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	65.20	62.5	5	8,15,42
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	65.20	62.5	5	8,15
FAIRCHILD DORNIER	328-300	PW306B	33.51	62.2	12	8,15
BEECH	76	I0-360-A1G6D	3.90	62.0	-	11
BEECH	A100	PT6A-28	11.50	62.0	-	4
BEECH	F90 KINGAIR	PT6A-135	10.90	62.0	-	5,11
GULFSTREAM	695	TPE-331-10	10.30	62.0	-	5,15
GULFSTREAM	695 COMMANDER 980	TPE-331-10	10.30	62.0	-	5,11
PIPER	PA-31T	PT6A-28	9.00	62.0	-	4
PIPER	PA-44-180	O-360-E1A6D	3.80	62.0	-	11
PIPER	PA-44-180T(2BLD)	TO-360-E1A6D	3.90	62.0	-	11
GULFSTREAM	690D COMMANDER 900	TPE-331-5	10.70	61.7	-	10
GULFSTREAM	695A COMMANDER 1000	TPE-331-10	11.20	61.6	-	5,11
BEECH	B100 KINGAIR	TPE-331-6	11.80	61.5	-	11
CESSNA	CITATION BRAVO (550)	PW530A	14.80	61.3	15	8,15
GULFSTREAM	690C COMMANDER 840	TPE-331-5	10.30	61.3	-	5,11
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	61.70	61.0	5	8,15
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	61.70	61.0	5	8,15,42
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	61.70	61.0	5	8,15
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	61.70	61.0	5	8,15,42

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	61.70	61.0	5	8,15,42
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	61.70	61.0	5	8,15
CESSNA	172	O-320-E2D	2.30	61.0	-	11
CESSNA	404	GTSIO-520-M	8.40	61.0	-	11
CESSNA	421C	GTSIO-520-L	7.50	61.0	-	11
OSTMECKLENBURGISCHE FLUGZEUGBAU	OMF-100-160	O-320-D2A	1.96	61.0	-	11,21
LEARJET	LEARJET 60	PW305A	23.50	60.9	8	8,15
LEARJET	LEARJET 60	PW305A	23.10	60.9		8,15
LEARJET	LEARJET 45	TFE731-20R-1B	20.50	60.7	8	8,15
CESSNA	CITATION EXCEL (560XL)	PW545	20.00	60.6	7	8,15
CESSNA	CITATION JET (525)	FJ44-1A	10.40	60.3	15	8,15
GULFSTREAM	AA-5A	O-320-E2G	2.20	60.0	-	11
PIPER	PA-28-140	O-320-E3D	2.20	60.0	-	11
PIPER	PA-28-151	O-320-E3D	2.20	60.0	-	11
PIPER	PA-28-181	O-360-A4M	2.55	60.0	-	11
PIPER	PA-44-180T(3BLD)	TO-360-E1A6D	3.90	60.0	-	11
BEECH	C23	0-360-A4K	2.50	59.0	-	11
GULFSTREAM	560E	GO-480-C1B6	6.50	59.0	-	11
PIPER	PA-28-161	O-320-D3G	2.40	59.0	-	11
CESSNA	CITATION ENCORE (560)	PW535A	16.63	58.3	7	8,15
BEECH	A-23	IO-360-A	2.40	58.0	-	11
BEECH	D95A TRAVELAIR	IO-320-B1B	4.20	58.0	-	11
BELLANCA	8GCBC	0-360-C2E	2.20	58.0	-	11
MOONEY	M20J	I0-360-A1B6D	2.70	58.0	-	4
CLASSIC AIRCRAFT	WACO CLASSIC F-5	R-755-B2	2.70	57.8	-	11
GULFSTREAM	AA-5B TIGER	O-360-A4K	2.20	57.4	-	10,11
GULFSTREAM	AA-1B	O-235	1.60	57.1	-	11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****TAKEOFF*****

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	EST dBA	FLAPS	NOTES
PIPER	CHEYENNE 400LS	TPE-331-14	12.05	57.0	-	11
BEECH	77	O-235-L2C	1.70	56.0	-	11
CESSNA	150	0-200-A	1.60	56.0	-	11
PIPER	PA-30 TWIN COMANCHE	IO-320-B	3.60	56.0	-	11
PIPER	PA-38-112	O-235-L2C	1.70	56.0	-	11
CESSNA	150M	O-200-A	1.60	55.0	-	11
CESSNA	152	0-235-L2C	1.70	55.0	-	11
PIPER	PA-18-150	0-320-A2B	1.80	53.0	-	11
BELLANCA	7GCAA	0-320-A2B	1.70	51.0	-	4

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
CONCORDE	CONCORDE	O-593/M-602		109.5	-	4,8
LOCKHEED	1329 JETSTAR	JT12A-8	35.00	101.0	50	8,13
IAI	1121 COMMODORE	CJ610-5	18.50	100.0	-	4
IAI	1123 WESTWIND	CJ610-9	19.00	99.0	-	4
MESSERSCHMITT	HFB-320 HANSA	CJ610-9	19.40	99.0	-	13
RAYTHEON	HAWKER 125- 3A/R	VIPER-522	20.00	98.7	50	8,15
RAYTHEON	HAWKER 125- 3A/RA	VIPER-522	20.00	98.7	45	8,15
RAYTHEON	HAWKER 125- 400A	VIPER-522	20.00	98.7	45	8,15
AIRBUS UK	1-11-500	SPEY-MK512	87.00	98.6	45	4
RAYTHEON	HAWKER 125- 1A	VIPER-522	19.60	98.5	50	8,15
BOEING	B-707-300B/C (COMTRAN QN)	JT3D-3B	247.00	98.4	25	8
BOEING	B-747-100	JT9D-7F	585.00	97.8	30	4,6
BOEING	B-747-100	JT9D-7FWET	585.00	97.8	30	4,6
BOEING	B-747-100	JT9D-7WET	585.00	97.3	30	4,6
MCDONNELL DOUG.	DC-10-30	CF6-50C1	411.00	97.3	50	15
BOEING	B-747-100	JT9D-7	564.00	97.2	30	4,6
BOEING	B-747-200	JT9D-7FWET	630.00	97.2	30	4,6
BOEING	B-747-200	RB211-524B	630.00	97.2	30	4
MCDONNELL DOUG.	DC-10-30	CF6-50C1	403.00	97.1	50	15
MCDONNELL DOUG.	DC-10-40	JT9D-59A	403.00	97.1	50	15
BOEING	B-747-200/300	RB211-524C2	585.00	96.8	30	15
BOEING	B-747-200	JT9D-7WET	630.00	96.7	30	4,6
BOEING	B-747-200	JT9D-7F	564.00	96.6	30	4,6
BOEING	B-747-200/300	RB211-524C2	564.00	96.5	30	15
MCDONNELL DOUG.	DC-10-30	CF6-50CA	424.00	96.3	50	15
AIRBUS UK	1-11-400	SPEY-MK511	78.00	96.2	45	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C	411.00	96.2	50	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-747-200	JT9D-3AWET	585.00	96.1	30	4,6
BOEING	B-747-200	JT9D-7	564.00	96.1	30	4,6
BOEING	B-747-SR	JT9D-7A	564.00	96.1	30	4,6
BOEING	B-727-100	JT8D-9FCD	137.50	96.0	40	3,8,15
MCDONNELL DOUG.	DC-08-63 (ADC QN)	JT3D-3B	245.00	96.0	50	8,15
MCDONNELL DOUG.	DC-09-30	JT8D-7	99.00	96.0	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50A	403.00	96.0	50	15
RAYTHEON	HAWKER 125- 600A	VIPER 601-22	22.00	96.0	45	8,15,16
BOEING	B-747-200	JT9D-3A	564.00	95.9	30	4,6
BOEING	B-747-200/300	RB211-524C2	666.00	95.9	25	15
MCDONNELL DOUG.	DC-08-63F (ADC QN)	JT3D-7	245.00	95.9	50	8,15
MCDONNELL DOUG.	DC-09-10	JT8D-7	81.70	95.7	50	8,15
MCDONNELL DOUG.	DC-10-10	CF6-6D	363.50	95.7	50	15
MCDONNELL DOUG.	DC-10-10	CF6-6D1	363.50	95.7	50	15
BOEING	B-747-SR	JT9D-7A	564.00	95.6	30	4,6
MCDONNELL DOUG.	DC-08-63 (TNC QN)	JT3D-3B	250.00	95.4	50	8,15
SABRELINER CORP.	SABRE 60A	JT12A-8	20.60	95.4	-	8,12
BOEING	B-747-200/300	RB211-524C2	564.00	95.3	25*	15
BOEING	B-747-200	JT9D-70A	630.00	95.2	30	4
MCDONNELL DOUG.	DC-08-63 (TNC QN)	JT3D-7	275.00	95.2	35	8,15
MCDONNELL DOUG.	DC-10-10	CF6-6D	363.50	95.1	50	15
MCDONNELL DOUG.	DC-10-30	CF6-50C2	411.00	95.1	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2B	411.00	95.1	50	8,15
BOEING	B-747-200/300	CF6-80C2B1F	666.00	95.0	30	8,15
MCDONNELL DOUG.	DC-10-40	JT9D-20	403.00	94.9	50	15
MCDONNELL DOUG.	DC-10-40	JT9D-59A	403.00	94.9	35*	15
BOEING	B-747-200/300	CF6-50E	630.00	94.8	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
FOKKER	F-28 MK1000	SPEY MK555-15	59.00	94.7	42	4
LEARJET	LEARJET 24D	CJ610-6	11.90	94.7	40	4,8,17
MCDONNELL DOUG.	DC-10-10	CF6-6D1	363.50	94.7	50	15
BOEING	B-727-100	JT8D-7FCD	137.50	94.5	40	3,8,14,15
MCDONNELL DOUG.	DC-08-50 (QNC QN)	JT3D-3B	240.00	94.5	-	8,12
MCDONNELL DOUG.	DC-08-61 (QNC QN)	JT3D-3B	240.00	94.5	-	8,12
MCDONNELL DOUG.	DC-10-40	JT9D-20	403.00	94.5	50	15
BOEING	B-747-200/300	CF6-50E	564.00	94.4	30	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	666.00	94.4	30	8,15
AIRBUS UK	1-11-200	SPEY-MK506	71.00	94.3	45	15
BOEING	B-747-400	PW4056 PKG A (FB2T)	652.00	94.3	30	8,15
BOEING	B-747-400F	CF6-80C2B1F	666.00	94.3	30	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	666.00	94.3	30	8,15
BOEING	B-747-200/300	CF6-50E2	630.00	94.2	30	8,15
BOEING	B-747-400	CF6-80C2B1F	652.00	94.2	30	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	652.00	94.2	30	8,15
BOEING	B-747-400D	CF6-80C2B1F	630.00	94.2	30	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	630.00	94.2	30	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2	403.00	94.2	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2B	424.00	94.2	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-6K	403.00	94.2	50	15
BOEING	B-747-200/300	RB211-524D4	666.00	94.1	30	8,15
BOEING	B-747-400	PW4056 PKG A (FB2T)	564.00	94.1	25*	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	630.00	94.1	25*	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	630.00	94.1	30	8,15
FOKKER	F-28 MK1000	SPEY MK555-15	59.00	94.1	42	4
BOEING	B-747-400	PW4056 PKG A (FB2T)	652.00	94.0	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-747-400F	PW4056 PKG A (FB2T)	666.00	94.0	25*	8,15
BOEING	B-747-100	CF6-45A2	605.00	93.9	30	8,15
BOEING	B-747-100	CF6-50E2	605.00	93.9	30	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	652.00	93.9	30	8,15
BOEING	B-747-400	PW4056 PKG A (FB2T)	564.00	93.9	30	8,15
BOEING	B-747-400D	CF6-80C2B1F	564.00	93.9	30	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	564.00	93.9	30	8,15
BOEING	B-747-400F	CF6-80C2B1F	630.00	93.9	30	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	630.00	93.9	30	8,15
BOEING	B-747-200/300	CF6-50E	666.00	93.8	25	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	652.00	93.8	30	8,15
LEARJET	LEARJET 25B/C	CJ610-6	13.30	93.8	40	4,8,18
MCDONNELL DOUG.	DC-09-30	JT8D-9	99.00	93.8	50	8,15
SABRELINER CORP.	SABRE 70	JT12A-8	18.50	93.8	-	8,12
BOEING	B-747-200/300	CF6-80C2B1F	564.00	93.7	30	8,15
BOEING	B-747-200/300	RB211-524D4	666.00	93.5	25*	8,15
BOEING	B-747-200/300	RB211-524D4	564.00	93.5	30	8,15
BOEING	B-747-200/300	RB211-524D4	564.00	93.5	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	652.00	93.5	30	8,15
BOEING	B-747-SP	JT9D-7FWET	475.00	93.5	30	4,6
MCDONNELL DOUG.	DC-08-63 (BAC/BACII)	JT3D-7	275.00	93.5	35	8,15,16
MCDONNELL DOUG.	DC-08-63 (BAC/R1)	JT3D-7	275.00	93.5	35	8,15,16
MCDONNELL DOUG.	DC-10-30	CF6-50C1	421.00	93.5	35*	15
BOEING	B-747-100	CF6-45A2	564.00	93.4	30	8,15
BOEING	B-747-100	CF6-50E2	564.00	93.4	30	8,15
BOEING	B-747-200/300	CF6-50E2	564.00	93.4	30	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	564.00	93.4	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
MCDONNELL DOUG.	DC-10-30	CF6-50A	403.00	93.4	35*	15
BOEING	B-747-200/300	CF6-80C2B1F	666.00	93.3	25*	8,15
BOEING	B-747-400	CF6-80C2B1F	564.00	93.3	30	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	564.00	93.3	30	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	564.00	93.3	30	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	652.00	93.2	25*	8,15
MCDONNELL DOUG.	DC-08-63 (BAC/BACII)	JT3D-7	258.00	93.2	35	8,15,16
BOEING	B-747-400	PW4056 PHASE 1/PKG B	564.00	93.1	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	652.00	93.1	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	564.00	93.1	30	8,15
BOEING	B-747-400F	RB211-524G	666.00	93.1	30	8,15
BOEING	B-747-400F	RB211-524H	666.00	93.1	30	8,15
BOEING	B-747-SP	JT9D-7A	450.00	93.1	30	4,6
BOEING	B-747-SP	JT9D-7F	475.00	93.1	30	4,6
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-7	250.00	93.1	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-7	250.00	93.1	35	8,15,16
BOEING	B-747-200/300	CF6-50E2	666.00	93.0	25	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	564.00	93.0	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	652.00	93.0	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	564.00	93.0	25*	8,15
BOEING	B-747-400	RB211-524G	652.00	93.0	30	8,15
BOEING	B-747-400	RB211-524H	652.00	93.0	30	8,15
BOEING	B-747-400D	CF6-80C2B1F	630.00	93.0	25*	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	630.00	93.0	25*	8,15
BOEING	B-747-400F	CF6-80C2B1F	666.00	93.0	25*	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	666.00	93.0	25*	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	666.00	93.0	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-7	240.00	93.0	35	8,15,16
MCDONNELL DOUG.	DC-10-30	CF6-50A	403.00	93.0	35*	15
BOEING	B-747-200/300	CF6-50E	564.00	92.9	25*	8,15
BOEING	B-747-400	CF6-80C2B1F	652.00	92.9	25*	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	652.00	92.9	25*	8,15
BOEING	B-747-400	RB211-524G	585.00	92.8	25	8,15
BOEING	B-747-400	RB211-524H	585.00	92.8	25	8,15
BOEING	B-747-400F	CF6-80C2B1F	630.00	92.8	25*	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	630.00	92.8	25*	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	630.00	92.8	30	8,15
BOEING	B-747-400F	RB211-524G	630.00	92.8	30	8,15
BOEING	B-747-400F	RB211-524H	630.00	92.8	30	8,15
BOEING	B-747-SP	JT9D-7A	450.00	92.8	30	4,6
BOEING	B-747-200/300	CF6-80C2B1F	564.00	92.7	25*	8,15
LOCKHEED	L-1011-1	RB211-22C	358.00	92.7	42	
BOEING	B-747-100	CF6-45A2	605.00	92.6	25*	8,15
BOEING	B-747-100	CF6-50E2	605.00	92.6	25*	8,15
BOEING	B-747-400D	CF6-80C2B1F	564.00	92.6	25*	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	564.00	92.6	25*	8,15
BOEING	B-747-400F	RB211-524G	630.00	92.6	25*	8,15
BOEING	B-747-400F	RB211-524H	630.00	92.6	25*	8,15
AIRBUS UK	1-11-400	MK511-W/HUSHKIT	78.00	92.5	45	15
BOEING	B-747-400	CF6-80C2B1F	564.00	92.5	25*	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	564.00	92.5	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	652.00	92.5	30	8,15,23
BOEING	B-747-400	RB211-524G	652.00	92.5	25*	8,15
BOEING	B-747-400	RB211-524H	652.00	92.5	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-747-400F	RB211-524G	666.00	92.5	25*	8,15
BOEING	B-747-400F	RB211-524H	666.00	92.5	25*	8,15
BOEING	B-747-400	RB211-524G	564.00	92.4	30	8,15
BOEING	B-747-400	RB211-524H	564.00	92.4	30	8,15
BOEING	B-747-100	CF6-45A2	564.00	92.3	25*	8,15
BOEING	B-747-100	CF6-50E2	564.00	92.3	25*	8,15
BOEING	B-747-200/300	CF6-50E2	564.00	92.3	25*	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	666.00	92.3	25*	8,15
BOEING	B-767-300	JT9D-7R4D(B)	320.00	92.3	30	8,15
BOEING	B-767-300	JT9D-7R4E	320.00	92.3	30	8,15
MCDONNELL DOUG.	DC-09-50	JT8D-17	110.00	92.3	50	1,8,15
BOEING	B-727-100	JT8D-9FCD	137.50	92.2	30*	3,8,15
BOEING	B-747-400F	PW4056 FB2B/2C	630.00	92.2	25*	8,15
MCDONNELL DOUG.	DC-09-30	JT8D-17	101.00	92.2	50	1,8,15
BOEING	B-737-200	JT8D-15QN	101.00	92.1	40	2,8,15
LOCKHEED	L-1011	RB211-22B	358.00	92.1	42	4,5
BOEING	B-737-200	JT8D-9QN	101.70	92.0	40	2,8,14,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	564.00	92.0	30	8,15,23
LEARJET	LEARJET 24B/D W/RAISBECK	CJ610-6	11.90	92.0	40	8,13
LEARJET	LEARJET 25 B/C/D/F XR	CJ610-6/8A	13.30	92.0	40	8,13
MCDONNELL DOUG.	DC-09-50	JT8D-15	110.00	92.0	50	1,8,15
SABRELINER CORP.	SABRE 40A	JT12A-8	17.50	92.0	-	8,12
SABRELINER CORP.	SABRE 60	JT12A-8	17.50	92.0	24	8,12
BOEING	B-737-200	JT8D-15QN	101.00	91.9	40	2,8,15
BOEING	B-737-200	JT8D-9QN	103.00	91.9	40	2,8,14,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	652.00	91.9	25*	8,15,23
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	564.00	91.8	25*	8,15,23

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
AIRBUS	A-310-324	PW4152	271.16	91.6	40	8,15
BOEING	B-737-200	JT8D-17QN	101.00	91.6	40	2,8,14,15
AIRBUS	A-300B4-2C	CF6-50C	293.30	91.5	25	4,8,9
MORANE-SAULNIER	MS 760B (PARIS II)	MARBORE VI C2	6.96	91.5	55	19
AIRBUS	A-300B1	CF6-50A	269.00	91.4	25	4,8,9
AIRBUS	A-300B2-1A	CF6-50A	281.10	91.4	15*	4,8,9
LOCKHEED	L-1011-1	RB211-22C	358.00	91.4	33*	
AIRBUS	A-300B2-K-3C	CF6-50C	286.70	91.3	25	4,8,9
BOEING	B-767-200	JT9D-7R4E	300.00	91.3	30	8,15
LOCKHEED	L-1011	RB211-22B	358.00	91.3	33*	4,5
BOEING	B-767-300	JT9D-7R4D(B)	280.00	91.2	30	8,15
BOEING	B-767-300	JT9D-7R4E	280.00	91.2	30	8,15
MCDONNELL DOUG.	DC-08-61 (BAC/BAC II)	JT3D-3B	240.00	91.2	35	8,15,16
MCDONNELL DOUG.	DC-10-10	CF6-6D	363.50	91.1	35*	15
BOEING	B-737-200	JT8D-17QN	103.50	91.0	40	2,8,14,15
BOEING	B-777-300	PW4098	524.00	91.0	30	8,15
SABRELINER CORP.	SABRE 80A	CF700-2D-2	22.00	91.0	-	12
AIRBUS	A-300B	CF6-50A	269.00	90.9	25	4,8
AIRBUS	A-300B2-1A	CF6-50A	286.70	90.9	25	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	286.70	90.9	25	4,8,9
MCDONNELL DOUG.	DC-09-30	JT8D-15	101.00	90.9	50	1,8,15
MCDONNELL DOUG.	DC-09-40	JT8D-11	102.00	90.9	50	1,8,15
MCDONNELL DOUG.	DC-09-40	JT8D-15	102.00	90.9	50	1,8,15
BOEING	B-737-200	JT8D-9QN	95.00	90.8	40	2,8,14,15
BOEING	B-767-300	JT9D-7R4D(B)	320.00	90.8	25*	8,15
BOEING	B-767-300	JT9D-7R4E	320.00	90.8	25*	8,15
LOCKHEED	L-1011-1	RB211-22C	358.00	90.8	33*	8

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
MCDONNELL DOUG.	DC-09-30	JT8D-9	99.00	90.8	50	1,8,15
AIRBUS	A-300B1	CF6-50A	269.00	90.7	15*	4,8,9
AIRBUS	A-300B2-1A	CF6-50A	281.10	90.7	25	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	281.10	90.7	25	4,8,9
AIRBUS	A-300B2-K-3C	CF6-50C	286.70	90.7	15*	4,8,9
BOEING	B-737-400	CFM56-3B-2	124.00	90.7	40	8,15
BOEING	B-737-400	CFM56-3C-1	124.00	90.7	40	8,15
BOEING	B-777-300	RR TRENT 884	524.00	90.7	30	8,15
BOEING	B-777-300	RR TRENT 892	524.00	90.7	30	8,15
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	58.50	90.7	39	8,15,16
BOEING	B-727-200	JT8D-7QN	142.50	90.6	40	2,8,15
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17A	164.00	90.6	30	8,15,37
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	58.50	90.6	39	8,15
MCDONNELL DOUG.	DC-09-30	JT8D-9	99.00	90.6	50	1,8,15
BOEING	B-767-300/300ER	PW4056	320.00	90.5	30	8,15
BOEING	B-767-300/300ER	PW4060	320.00	90.5	30	8,15
AIRBUS	A-300B2-1A	CF6-50A	286.70	90.4	15*	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	281.10	90.4	15*	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	286.70	90.4	15*	4,8,9
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-15	164.00	90.4	30	8,15,37,47
BOEING	B-737-300	CFM56-3-B1	121.00	90.4	40	8,15
BOEING	B-737-300	CFM56-3B-2	121.00	90.4	40	8,15
BOEING	B-737-400	CFM56-3-B1	121.00	90.4	40	8,15
BOEING	B-737-400	CFM56-3B-2	121.00	90.4	40	8,15
BOEING	B-737-400	CFM56-3C-1	121.00	90.4	40	8,15
BOEING	B-767-200	JT9D-7R4D	257.00	90.4	30	8,15
AIRBUS UK	1-11-200	MK506-W/HUSHKIT	71.00	90.3	45	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-727-100 (Fed Ex)	JT8D-7	142.50	90.3	30	8,15,16,28
BOEING	B-727-200 (Fed Ex)	JT8D-7	150.00	90.3	30	8,15,24,29
BOEING	B-767-300/300ER	CF6-80C2B7F	340.00	90.3	30	8,15
DASSAULT	FALCON 20-Basic/D/E	CF700-2D-2	27.32	90.3	40	8,15
MCDONNELL DOUG.	DC-10-10	CF6-6D	363.50	90.3	35*	15
SABRELINER CORP.	SABRE 75A	CF700-2D-2	22.00	90.3	25	4
SABRELINER CORP.	SABRE 80	CF700-2D-2	22.00	90.3	25	12
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17	162.00	90.2	30	8,15,37,48
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-9	162.00	90.2	30	8,15,37,46
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-15	162.00	90.2	30	8,15,37,50 ,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	162.00	90.2	30	8,15,37,49 ,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	162.00	90.2	30	8,15,37,46
BOEING	B-767-300/300ER	PW4056	280.00	90.2	30	8,15
BOEING	B-767-300/300ER	PW4056	320.00	90.2	25*	8,15
BOEING	B-767-300/300ER	PW4060	280.00	90.2	30	8,15
BOEING	B-767-300/300ER	PW4060	320.00	90.2	25*	8,15
BOEING	B-777-300	PW4090	524.00	90.2	30	8,15,59
MCDONNELL DOUG.	DC-10-40	JT9D-20	403.00	90.2	35*	15
AIRBUS	A-310-322	JT9D-7R4E1	271.16	90.1	40	8,15
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17	159.00	90.1	30	8,15,37,48
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-15	159.00	90.1	30	8,15,37,50 ,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-17	162.00	90.1	30	8,15,37
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	88.00	90.1	40	8,15,30
BOEING	B-777-300	PW4098	524.00	90.1	25*	8,15
DASSAULT	FALCON 20	CF700-2D-2	27.30	90.1	25*	8,15
AIRBUS	A-300B4-2C	CF6-50C	293.30	90.0	15*	4,8,9
BOEING	B-727-100 (Fed Ex)	JT8D-7	137.50	90.0	30	8,15,16,28

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-15	156.00	90.0	30	8,15,37,47
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-9	156.00	90.0	30	8,15,37,46
BOEING	B-757-200	RB211-535C	198.00	90.0	30	8,15
BOEING	B-767-200/200ER	PW4052	285.00	90.0	30	8,15
BOEING	B-767-200/200ER	PW4052	270.00	90.0	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B2F	340.00	90.0	30	8,15
BOEING	B-777-200	RR TRENT 875	470.00	90.0	30	8,15
BOEING	B-777-200	RR TRENT 877	470.00	90.0	30	8,15
BOEING	B-777-200	RR TRENT 884	470.00	90.0	30	8,15
BOEING	B-777-200	RR TRENT 892	470.00	90.0	30	8,15
BOEING	B-777-200	RR TRENT 895	470.00	90.0	30	8,15
LOCKHEED	L-1011-1	RB211-22C	358.00	90.0	33*	4,8
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-3B	250.00	90.0	35	8,15,16
MCDONNELL DOUG.	DC-09-40	JT8D-11	102.00	90.0	50	1,8,15
NIHON	YS-11A-200	DART MK 542	52.90	90.0	-	5
BOEING	B-727-200 (Fed Ex)	JT8D-17	166.00	89.9	30	8,15,25,28
BOEING	B-727-200 (Fed Ex)	JT8D-9	150.00	89.9	30	8,15,24,29
BOEING	B-767-300/300ER	PW4056	280.00	89.9	25*	8,15
BOEING	B-767-300/300ER	PW4060	280.00	89.9	25*	8,15
MCDONNELL DOUG.	DC-09-30	JT8D-7	99.00	89.9	50	1,8,15
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	152.50	89.8	30	8,15,37,46
BOEING	B-737-500	CFM56-3-B1	114.00	89.8	40	8,15
BOEING	B-737-500	CFM56-3-B1(R)	114.00	89.8	40	8,15
BOEING	B-777-300	RR TRENT 884	524.00	89.8	25*	8,15
BOEING	B-777-300	RR TRENT 892	524.00	89.8	25*	8,15
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-3B	240.00	89.8	35	8,15,16
MCDONNELL DOUG.	DC-10-10	CF6-6D1	363.50	89.8	35*	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-767-300	JT9D-7R4D(B)	280.00	89.7	25*	8,15
BOEING	B-767-300	JT9D-7R4E	280.00	89.7	25*	8,15
BOEING	B-777-300	PW4098	445.00	89.7	30	8,15
GULFSTREAM	GULFSTREAM IIB/GIII	SPEY MK511-8	58.50	89.7	39	8,15,16
LEARJET	LEARJET 23	CJ610-1	11.90	89.7	-	4,8
BOEING	B-727-100 (Dee Hwd)	TAY651-54	137.50	89.6	40	8,15
BOEING	B-727-100 (Fed Ex)	JT8D-9	142.50	89.6	30	8,15,16,29
BOEING	B-727-200 (Fed Ex)	JT8D-15	161.00	89.6	30	8,15,25
BOEING	B-727-200 (Fed Ex)	JT8D-17	161.00	89.6	30	8,15,25,28
BOEING	B-727-200 (Fed Ex)	JT8D-9	154.50	89.6	30	8,15,24,28
BOEING	B-777-200	RR TRENT 875	445.00	89.6	30	8,15
BOEING	B-777-200	RR TRENT 877	445.00	89.6	30	8,15
BOEING	B-777-200	RR TRENT 884	445.00	89.6	30	8,15
BOEING	B-777-200	RR TRENT 892	445.00	89.6	30	8,15
BOEING	B-777-200	RR TRENT 895	445.00	89.6	30	8,15
BOEING	B-777-300	PW4090	524.00	89.6	25*	8,15,59
BOEING	B-737-300	CFM56-3-B1	110.00	89.5	40	8,15
BOEING	B-737-300	CFM56-3B-2	110.00	89.5	40	8,15
BOEING	B-767-200	JT9D-7R4E	300.00	89.5	25*	8,15
BOEING	B-777-200	PW4074	440.90	89.5	30	8,15
BOEING	B-777-200	PW4074	445.00	89.5	30	8,15
BOEING	B-777-200	PW4077	440.90	89.5	30	8,15
BOEING	B-777-200	PW4077	445.00	89.5	30	8,15
BOEING	B-777-200	PW4090	470.00	89.5	30	8,15,59
BOEING	B-777-200	PW4090 at PW4074 rating	470.00	89.5	30	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	470.00	89.5	30	8,15,59
BOEING	B-777-300	RR TRENT 884	445.00	89.5	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-777-300	RR TRENT 892	445.00	89.5	30	8,15
LOCKHEED	L-188	501-D13	95.70	89.5	-	4,8
MCDONNELL DOUG.	DC-09-50	JT8D-15	110.00	89.5	-	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-17	104.00	89.5	-	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-17	110.00	89.5	40*	1,8,15
GULFSTREAM	GIIB/GIII (QTA STC ST03621AT)	SPEY MK 511-8	58.50	89.5	39	8,15,16
GULFSTREAM	GIIB/GIII (QTA STC ST03621AT)	SPEY MK 511-8	58.50	89.5	39	8,15,16
BOEING	B-727-200 (Fed Ex)	JT8D-9	150.00	89.4	30	8,15,24,28
BOEING	B-767-300	CF6-80A	320.00	89.4	30	8,15
BOEING	B-767-300	CF6-80A2	320.00	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	320.00	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	320.00	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	320.00	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	320.00	89.4	30	8,15
LEARJET	LEARJET 24D	CJ610-6	11.90	89.4	40	8
MCDONNELL DOUG.	DC-10-40	JT9D-20	403.00	89.4	35*	15
GULFSTREAM	GII TT (QTA STC ST03621AT)	SPEY MK 511-8	58.50	89.4	39	8,15,16
GULFSTREAM	GII (QTA STC ST03621AT)	SPEY MK 511-8	58.50	89.4	39	8,15,16
GULFSTREAM	GII (QTA STC ST03621AT)	SPEY MK 511-8	58.50	89.4	39	8,15,16
BOEING	B-767-300/300ER	CF6-80C2B4	320.00	89.3	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	320.00	89.3	30	8,15
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-3B	250.00	89.3	35	8,15,16
AIRBUS	A-310-221	JT9D-7R4D1	267.85	89.2	40	8,15
AIRBUS	A-310-222	JT9D-7R4E1	267.85	89.2	40	8,15
AIRBUS	A-310-222	JT9D-7R4E1	268.96	89.2	40	8,15
BOEING	B-757-200	RB211-535C	210.00	89.2	25*	8,15
BOEING	B-757-200	RB211-535C	210.00	89.2	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-767-200	JT9D-7R4D	270.00	89.2	25*	8,15
BOEING	B-767-300	CF6-80A	280.00	89.2	30	8,15
BOEING	B-767-300	CF6-80A	320.00	89.2	25*	8,15
BOEING	B-767-300	CF6-80A2	280.00	89.2	30	8,15
BOEING	B-767-300	CF6-80A2	320.00	89.2	25*	8,15
BOEING	B-767-300/300ER	RB211-524G	320.00	89.2	30	8,15
BOEING	B-767-300/300ER	RB211-524H	320.00	89.2	30	8,15
AIRBUS	A-310-304	CF6-80C2A2	273.37	89.1	40	8,15
BOEING	B-727-100	JT8D-7FCD	137.50	89.1	30*	3,8,14,15
BOEING	B-737-500	CFM56-3-B1	105.00	89.1	40	8,15
BOEING	B-737-500	CFM56-3-B1(R)	105.00	89.1	40	8,15
BOEING	B-767-200/200ER	CF6-80A	257.00	89.1	30	8,15
BOEING	B-767-200/200ER	PW4056	270.00	89.1	30	8,15
BOEING	B-767-300	CF6-80A	280.00	89.1	25*	8,15
BOEING	B-767-300	CF6-80A2	280.00	89.1	25*	8,15
BOEING	B-777-200	PW4090	445.00	89.1	30	8,15,59
BOEING	B-777-200	PW4090 at PW4074 rating	445.00	89.1	30	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	445.00	89.1	30	8,15,59
BOEING	B-777-200	RR TRENT 875	470.00	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 877	470.00	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 884	470.00	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 892	470.00	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 895	470.00	89.1	25*	8,15
MCDONNELL DOUG.	DC-09-10	JT8D-7	81.70	89.1	50	1,8,15
AIRBUS	A-310-204	CF6-80C2A2	268.96	89.0	40	8,15
AIRBUS	A-310-221	JT9D-7R4D1	261.24	89.0	40	8,15
BOEING	B-777-200	PW4090	470.00	89.0	25*	8,15,59

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-777-200	PW4090 at PW4074 rating	470.00	89.0	25*	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	470.00	89.0	25*	8,15,59
BOEING	B-777-300	PW4090	445.00	89.0	30	8,15,59
AEROSPATIALE	NORD-262C	BASTAN-VIIA	22.70	88.9	-	4,8
AIRBUS	A-310-308	CF6-80C2A8	273.37	88.9	40	8,15
BOEING	B-727-200	JT8D-15QN	142.50	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-17QN	142.50	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-17QN	158.00	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-17RQN	142.50	88.9	40	2,8,15
BOEING	B-727-200	JT8D-9QN	142.50	88.9	40	2,8,14,15
BOEING	B-757-200	RB211-535C	198.00	88.9	25*	8,15
DASSAULT	FALCON 20-Basic/D/E/F (M2851)	CF700-2D-2Q	27.32	88.9	40	8,15
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-3B	240.00	88.9	35	8,15,16
BAE SYSTEMS (BAe)	BAE-748 SERIES 2A	RR DART MK532-2L	41.50	88.8	27	8,15
BAE SYSTEMS (BAe)	BAe-748 SERIES 2B	RR-DART-MK535	43.00	88.8	27	8,15
BOEING	B-737-100 (AVAERO)	JT8D-7	107.00	88.8	30	8,15,30
BOEING	B-737-200	JT8D-7QN	95.00	88.8	40	2,8,14
BOEING	B-737-200	JT8D-7QN	98.00	88.8	40	2,8,14
BOEING	B-737-200 (AVAERO)	JT8D-15	107.00	88.8	30	8,15,30
BOEING	B-737-200 (AVAERO)	JT8D-15	107.00	88.8	30	8,15,31
BOEING	B-737-200 (AVAERO)	JT8D-15	107.00	88.8	30	8,15,32
BOEING	B-737-200 (AVAERO)	JT8D-7	107.00	88.8	30	8,15,30
BOEING	B-737-200 (AVAERO)	JT8D-9	107.00	88.8	30	8,15,31
BOEING	B-737-200 (AVAERO)	JT8D-9	107.00	88.8	30	8,15,30
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	107.00	88.8	30	8,15,31
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	107.00	88.8	30	8,15,30
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	107.00	88.8	30	8,15,32

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-200 ADV (AVAERO)	JT8D-7	107.00	88.8	30	8,15,30
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	107.00	88.8	30	8,15,31
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	107.00	88.8	30	8,15,30
BOEING	B-737-800	CFM56-7B24/2 DAC	146.30	88.8	40	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	146.30	88.8	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	146.30	88.8	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	146.30	88.8	40	8,15,54
BOEING	B-777-200	GE90-76B(BLK IV)	470.00	88.8	30	8,15,58
BOEING	B-777-200	GE90-77B(BLK IV)	470.00	88.8	30	8,15,58
BOEING	B-777-200	GE90-85B(BLK IV)	470.00	88.8	30	8,15,58
BOEING	B-777-200	GE90-90B(BLK IV)	470.00	88.8	30	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	470.00	88.8	30	8,15,58
BOEING	B-777-300	PW4098	445.00	88.8	25*	8,15
MCDONNELL DOUG.	DC-08-71	CFM56-2-C1	245.00	88.8	46	
BOEING	B-737-800	CFM56-7B24/2 DAC	144.00	88.7	40	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	144.00	88.7	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	144.00	88.7	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	144.00	88.7	40	8,15,54
BOEING	B-737-800W	CFM56-7B24/2 DAC	146.30	88.7	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	146.30	88.7	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	146.30	88.7	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	146.30	88.7	40	8,15,54,56
BOEING	B-767-300/300ER	CF6-80C2B2F	340.00	88.7	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	340.00	88.7	25*	8,15
BOEING	B-767-300/300ER	PW4060 PHASE 3 (FB2C)	320.00	88.7	30	8,15,23
BOEING	B-767-300/300ER	RB211-524G	280.00	88.7	25*	8,15
BOEING	B-767-300/300ER	RB211-524G	320.00	88.7	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-767-300/300ER	RB211-524G	280.00	88.7	30	8,15
BOEING	B-767-300/300ER	RB211-524H	280.00	88.7	30	8,15
BOEING	B-767-300/300ER	RB211-524H	280.00	88.7	25*	8,15
BOEING	B-767-300/300ER	RB211-524H	320.00	88.7	25*	8,15
BOEING	B-777-200	GE90-76B	460.00	88.7	30	8,15,57
BOEING	B-777-200	GE90-77B	460.00	88.7	30	8,15,57
BOEING	B-777-200	GE90-85B	460.00	88.7	30	8,15,57
BOEING	B-777-200	GE90-90B	460.00	88.7	30	8,15,57
BOEING	B-777-200	PW4074	440.90	88.7	25*	8,15
BOEING	B-777-200	PW4074	445.00	88.7	25*	8,15
BOEING	B-777-200	PW4077	445.00	88.7	25*	8,15
BOEING	B-777-200	PW4077	440.90	88.7	25*	8,15
MCDONNELL DOUG.	DC-10-30	CF6-6K	403.00	88.7	35*	8,15
BOEING	B-737-800W	CFM56-7B24/2 DAC	144.00	88.6	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	144.00	88.6	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	144.00	88.6	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	144.00	88.6	40	8,15,54,56
BOEING	B-767-300/300ER	CF6-80C2B2F	280.00	88.6	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	280.00	88.6	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	280.00	88.6	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	280.00	88.6	30	8,15
BOEING	B-777-200	RR TRENT 875	445.00	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 877	445.00	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 884	445.00	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 892	445.00	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 895	445.00	88.6	25*	8,15
MCDONNELL DOUG.	DC-08-72	CFM56-2-C1	245.00	88.6	46	

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
MCDONNELL DOUG.	DC-08-73	CFM56-2-C1	245.00	88.6	46	
BOEING	B-737-400	CFM56-3B-2	124.00	88.5	30*	8,15
BOEING	B-737-400	CFM56-3C-1	124.00	88.5	30*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	320.00	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	280.00	88.5	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	320.00	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	280.00	88.5	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	320.00	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	320.00	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	320.00	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	320.00	88.5	25*	8,15
BOEING	B-777-200	GE90-76B	445.00	88.5	30	8,15,57
BOEING	B-777-200	GE90-76B(BLK IV)	445.00	88.5	30	8,15,58
BOEING	B-777-200	GE90-77B	445.00	88.5	30	8,15,57
BOEING	B-777-200	GE90-77B(BLK IV)	445.00	88.5	30	8,15,58
BOEING	B-777-200	GE90-85B	445.00	88.5	30	8,15,57
BOEING	B-777-200	GE90-85B(BLK IV)	445.00	88.5	30	8,15,58
BOEING	B-777-200	GE90-90B	445.00	88.5	30	8,15,57
BOEING	B-777-200	GE90-90B(BLK IV)	445.00	88.5	30	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	445.00	88.5	30	8,15,58
BOEING	B-777-200	PW4090	445.00	88.5	25*	8,15,59
BOEING	B-777-200	PW4090 at PW4074 rating	445.00	88.5	25*	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	445.00	88.5	25*	8,15,59
BOEING	B-767-200/200ER	CF6-80C2B2	300.00	88.4	30	8,15
BOEING	B-767-200/200ER	CF6-80C2B2	270.00	88.4	30	8,15
BOEING	B-767-200/200ER	CF6-80C2B4	270.00	88.4	30	8,15
BOEING	B-767-200/200ER	CF6-80C2B4	300.00	88.4	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-767-200/200ER	PW4056 PHASE 3 (FB2C)	300.00	88.4	30	8,15,23
BOEING	B-767-300/300ER	CF6-80C2B2F	280.00	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	280.00	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	280.00	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	280.00	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	280.00	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	280.00	88.4	25*	8,15
BOEING	B-777-300	RR TRENT 884	445.00	88.4	25*	8,15
BOEING	B-777-300	RR TRENT 892	445.00	88.4	25*	8,15
BOEING	B-737-200	JT8D-15QN	101.00	88.3	30*	2,8,15
BOEING	B-737-200	JT8D-17QN	103.50	88.3	30*	2,8,14,15
BOEING	B-737-400	CFM56-3-B1	121.00	88.3	30*	8,15
BOEING	B-737-400	CFM56-3B-2	121.00	88.3	30*	8,15
BOEING	B-737-400	CFM56-3C-1	121.00	88.3	30*	8,15
BOEING	B-737-700C/-700ER	CFM56-7B20/2 DAC	134.00	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	134.00	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	134.00	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	134.00	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	134.00	88.3	40	8,15,54,55
LEARJET	LEARJET 24E	CJ610-6	11.90	88.3	40	4,8
LEARJET	LEARJET 24F	CJ610-6	11.90	88.3	40	4,8
LOCKHEED	1329-23 JETSTAR w/STAR 3	TFE731-3	36.00	88.3	59	8,15,33
LOCKHEED	1329-25 JETSTAR	TFE731-3-1E	36.00	88.3	50	4
LOCKHEED	1329-25 JETSTAR w/STAR 3	TFE731-3	36.00	88.3	59	8,15,34
BOEING	B-737-300	CFM56-3-B1	121.00	88.2	30*	8,15
BOEING	B-737-300	CFM56-3B-2	121.00	88.2	30*	8,15
BOEING	B-737-700C/-700ER W	CFM56-7B20/2 DAC	134.00	88.2	40	8,15,54,55 ,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	134.00	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	134.00	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	134.00	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	134.00	88.2	40	8,15,54,55,56
BOEING	B-777-300	PW4090	445.00	88.2	25*	8,15,59
LEARJET	LEARJET 25D	CJ610-6	13.30	88.2	40	8,13
LEARJET	LEARJET 25F	CJ610-6	13.30	88.2	40	4,8
BOEING	B-737-700	CFM56-7B20/2 DAC	129.20	88.1	40	8,15,54
BOEING	B-737-700	CFM56-7B22/2 DAC	129.20	88.1	40	8,15,54
BOEING	B-737-700	CFM56-7B24/2 DAC	129.20	88.1	40	8,15,54
BOEING	B-737-700	CFM56-7B26/2 DAC	129.20	88.1	40	8,15,54
FOKKER	F-27-200	MK532-7	41.00	88.1	-	5
BOEING	B-737-500	CFM56-3-B1	114.00	88.0	30*	8,15
BOEING	B-737-500	CFM56-3-B1(R)	114.00	88.0	30*	8,15
BOEING	B-737-700	CFM56-7B20/2 DAC	128.00	88.0	40	8,15,54
BOEING	B-737-700	CFM56-7B22/2 DAC	128.00	88.0	40	8,15,54
BOEING	B-737-700	CFM56-7B24/2 DAC	128.00	88.0	40	8,15,54
BOEING	B-737-700	CFM56-7B26/2 DAC	128.00	88.0	40	8,15,54
BOEING	B-737-700W	CFM56-7B20/2 DAC	129.20	88.0	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	129.20	88.0	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B24/2 DAC	129.20	88.0	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	129.20	88.0	40	8,15,54,56
BOEING	B-737-200	JT8D-9QN	95.00	87.9	30*	2,8,14,15
BOEING	B-737-200	JT8D-9QN	101.70	87.9	30*	2,8,14,15
BOEING	B-737-200	JT8D-9QN	103.00	87.9	30*	2,8,14,15
BOEING	B-737-700W	CFM56-7B20/2 DAC	128.00	87.9	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	128.00	87.9	40	8,15,54,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700W	CFM56-7B24/2 DAC	128.00	87.9	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	128.00	87.9	40	8,15,54,56
BOEING	B-757-200	PW2037	210.00	87.9	30	8,15
BOEING	B-757-200	PW2037(BG-3)	210.00	87.9	30	8,15,39
BOEING	B-757-200	PW2040	210.00	87.9	30	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	157.30	87.8	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	157.30	87.8	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	157.30	87.8	40	8,15
BOEING	B-777-200	GE90-76B(BLK IV)	470.00	87.8	25*	8,15,58
BOEING	B-777-200	GE90-77B(BLK IV)	470.00	87.8	25*	8,15,58
BOEING	B-777-200	GE90-85B(BLK IV)	470.00	87.8	25*	8,15,58
BOEING	B-777-200	GE90-90B(BLK IV)	470.00	87.8	25*	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	470.00	87.8	25*	8,15,58
BOEING	B-737-300	CFM56-3-B1	110.00	87.7	30*	8,15
BOEING	B-737-300	CFM56-3B-2	110.00	87.7	30*	8,15
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	120.50	87.7	40	8,15,54
BOEING	B-737-600	CFM56-7B20/2 DAC	120.50	87.7	40	8,15,54
BOEING	B-737-600	CFM56-7B22/2 DAC	120.50	87.7	40	8,15,54
BOEING	B-777-200	GE90-76B	460.00	87.7	25*	8,15,57
BOEING	B-777-200	GE90-77B	460.00	87.7	25*	8,15,57
BOEING	B-777-200	GE90-85B	460.00	87.7	25*	8,15,57
BOEING	B-777-200	GE90-90B	460.00	87.7	25*	8,15,57
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	88.50	87.6	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	LF507	88.50	87.6	33	8,15,22
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	157.30	87.6	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	157.30	87.6	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	157.30	87.6	40	8,15,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-777-200	GE90-76B	445.00	87.6	25*	8,15,57
BOEING	B-777-200	GE90-76B(BLK IV)	445.00	87.6	25*	8,15,58
BOEING	B-777-200	GE90-77B	445.00	87.6	25*	8,15,57
BOEING	B-777-200	GE90-77B(BLK IV)	445.00	87.6	25*	8,15,58
BOEING	B-777-200	GE90-85B	445.00	87.6	25*	8,15,57
BOEING	B-777-200	GE90-85B(BLK IV)	445.00	87.6	25*	8,15,58
BOEING	B-777-200	GE90-90B	445.00	87.6	25*	8,15,57
BOEING	B-777-200	GE90-90B(BLK IV)	445.00	87.6	25*	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	445.00	87.6	25*	8,15,58
DASSAULT	FALCON 50	TFE731-3-1C	35.72	87.6	48	8,15
AIRBUS	A-310-203	CF6-80A3	267.85	87.5	40	8,15
AIRBUS	A-310-203C	CF6-80A3	267.85	87.5	40	8,15
BOEING	B-737-500	CFM56-3-B1	105.00	87.5	30*	8,15
BOEING	B-737-500	CFM56-3-B1(R)	105.00	87.5	30*	8,15
BOEING	B-737-800	CFM56-7B24	146.30	87.5	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	146.30	87.5	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	146.30	87.5	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	146.30	87.5	40	8,15
BOEING	B-737-900	CFM56-7B24	147.30	87.5	40	8,15
BOEING	B-737-900	CFM56-7B26	147.30	87.5	40	8,15
BOEING	B-737-900	CFM56-7B27	147.30	87.5	40	8,15
BOEING	B-737-900	CFM56-7B27/B1	147.30	87.5	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	149.30	87.5	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	149.30	87.5	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	149.30	87.5	40	8,15
BOEING	B-737-900W	CFM56-7B24	147.30	87.5	40	8,15,56
BOEING	B-737-900W	CFM56-7B26	147.30	87.5	40	8,15,56

**ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH**

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-900W	CFM56-7B27	147.30	87.5	40	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	147.30	87.5	40	8,15,56
AIRBUS	A-310-203	CF6-80A3	261.24	87.4	40	8,15
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	83.50	87.4	33	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	83.50	87.4	33	8,15,22,43
BOEING	B-727-200	JT8D-7QN	142.50	87.4	30*	2,8,15
BOEING	B-737-800	CFM56-7B24	144.00	87.4	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	144.00	87.4	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	144.00	87.4	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	144.00	87.4	40	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	146.30	87.4	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	146.30	87.4	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	146.30	87.4	40	8,15,60
BOEING	B-737-800SFP	CFM56-7B24	146.30	87.4	40	8,15,60
BOEING	B-737-800W	CFM56-7B24	146.30	87.4	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	146.30	87.4	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	146.30	87.4	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	146.30	87.4	40	8,15,56
BOEING	B-737-900	CFM56-7B24	146.30	87.4	40	8,15
BOEING	B-737-900	CFM56-7B26	146.30	87.4	40	8,15
BOEING	B-737-900	CFM56-7B27	146.30	87.4	40	8,15
BOEING	B-737-900	CFM56-7B27/B1	146.30	87.4	40	8,15
BOEING	B-737-900W	CFM56-7B24	146.30	87.4	40	8,15,56
BOEING	B-737-900W	CFM56-7B26	146.30	87.4	40	8,15,56
BOEING	B-737-900W	CFM56-7B27	146.30	87.4	40	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	146.30	87.4	40	8,15,56
MCDONNELL DOUG.	DC-09-40 (ABS STC165CH)	JT8D-9	101.00	87.4	40	8,15,16

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	85.00	87.3	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	ALF-502R-5	83.00	87.3	33	8,15,22
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	144.00	87.3	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	144.00	87.3	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	144.00	87.3	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	146.30	87.3	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	146.30	87.3	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	146.30	87.3	40	8,15,56,60
BOEING	B-737-800SFP	CFM56-7B24	144.00	87.3	40	8,15,60
BOEING	B-737-800SFP W	CFM56-7B24	146.30	87.3	40	8,15,56,60
BOEING	B-737-800W	CFM56-7B24	144.00	87.3	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	144.00	87.3	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	144.00	87.3	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	144.00	87.3	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	149.30	87.3	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	149.30	87.3	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	149.30	87.3	40	8,15,56
DASSAULT	FALCON 50 (M1230)	TFE731-3-1C	35.71	87.3	48	8,15
MCDONNELL DOUG.	DC-09-40 (ABS STC165CH)	JT8D-11	99.00	87.3	40	8,15,16
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	83.00	87.2	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-200A	ALF-502R-5	81.00	87.2	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	LF507	83.00	87.2	33	8,15,22
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	144.00	87.2	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	144.00	87.2	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	144.00	87.2	40	8,15,56,60
BOEING	B-737-800SFP W	CFM56-7B24	144.00	87.2	40	8,15,56,60
BOEING	B-757-200	PW2037	198.00	87.2	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-757-200	PW-2037(BG-3)	198.00	87.2	30	8,15,39
BOEING	B-757-200	PW2040	198.00	87.2	30	8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-11	101.00	87.2	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-9	102.00	87.2	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-7	101.00	87.1	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-9	101.00	87.1	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-7	101.00	87.1	40	8,15,16
BAE SYSTEMS (BAe)	BAe-146-100A	ALF-502R-3A/-5	77.50	87.0	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-200A	ALF-502R-3A/-5	77.50	87.0	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	ALF-502R-5	84.50	87.0	33	8,15,22
BOEING	B727-100RE(Rohr)	JT8D-217C/JT8D-9	142.50	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-7B	142.50	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-9	142.50	87.0	30	8,15,37
FAIRCHILD	F-27-F	RR DART MK529	36.70	87.0	-	11
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-7	99.00	87.0	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-9	99.00	87.0	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-9	99.00	87.0	40	8,15,16
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B20	134.00	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	134.00	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	134.00	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	134.00	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	134.00	86.9	40	8,15,55
BOEING	B-737-800	CFM56-7B24/2 DAC	146.30	86.9	30*	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	146.30	86.9	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	146.30	86.9	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	146.30	86.9	30*	8,15,54
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B20	134.00	86.8	40	8,15,55,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	134.00	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	134.00	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	134.00	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	134.00	86.8	40	8,15,55,56
BOEING	B-737-800	CFM56-7B24/2 DAC	144.00	86.8	30*	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	144.00	86.8	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	144.00	86.8	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	144.00	86.8	30*	8,15,54
FOKKER	F-27-500/600	MK532-7R	42.00	86.8	-	5
MCDONNELL DOUG.	DC-09-20 (ABS STC1613GL)	JT8D-9	93.40	86.8	40	8,15,16
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	166.44	86.7	25	8,15
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	77.50	86.7	33	8,15,22
BOEING	B-737-700	CFM56-7B20	129.20	86.7	40	8,15
BOEING	B-737-700	CFM56-7B22	129.20	86.7	40	8,15
BOEING	B-737-700	CFM56-7B24	129.20	86.7	40	8,15
BOEING	B-737-700	CFM56-7B26	129.20	86.7	40	8,15
BOEING	B-737-800W	CFM56-7B24/2 DAC	144.00	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B24/2 DAC	146.30	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	146.30	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	144.00	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	144.00	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	146.30	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	144.00	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	146.30	86.7	30*	8,15,54,56
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	157.30	86.7	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	157.30	86.7	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	157.30	86.7	30*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-757-200	PW2037	210.00	86.7	25*	8,15
BOEING	B-757-200	PW2037(BG-3)	210.00	86.7	25*	8,15,39
BOEING	B-757-200	PW2040	210.00	86.7	25*	8,15
MCDONNELL DOUG.	DC-09-10 (ABS STC1563GL)	JT8D-7	81.70	86.7	40	8,15,16
BOEING	B-737-700	CFM56-7B20	128.00	86.6	40	8,15
BOEING	B-737-700	CFM56-7B22	128.00	86.6	40	8,15
BOEING	B-737-700	CFM56-7B24	128.00	86.6	40	8,15
BOEING	B-737-700	CFM56-7B26	128.00	86.6	40	8,15
BAE SYSTEMS (BAe)	BAe-146-100A	ALF-502R-3A/-5	72.40	86.5	33	8,15,22
BOEING	B-737-700W	CFM56-7B20	128.00	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B22	128.00	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B24	128.00	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B26	128.00	86.5	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	157.30	86.5	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	157.30	86.5	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	157.30	86.5	30*	8,15,56
BOEING	B-757-200	PW2037 (CBQFC)	210.00	86.5	30	8,15,40
BOEING	B-757-200	PW2037 (nCBQFC)	210.00	86.5	30	8,15,41
BOEING	B-757-200	PW2040 (CBQFC)	210.00	86.5	30	8,15,40
BOEING	B-757-200	PW2040 (nCBQFC)	210.00	86.5	30	8,15,41
BOEING	B-727-100 (Dee Hwd)	TAY651-54	142.50	86.4	30	8,15
BOEING	B-737-700C/-700ER	CFM56-7B20/2 DAC	134.00	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	134.00	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	134.00	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	134.00	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	134.00	86.4	30*	8,15,54,55
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	149.30	86.4	30*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	149.30	86.4	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	149.30	86.4	30*	8,15
BOEING	B-737-700C/-700ER W	CFM56-7B20/2 DAC	134.00	86.3	30*	8,15,54,55 ,56
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	134.00	86.3	30*	8,15,54,55 ,56
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	134.00	86.3	30*	8,15,54,55 ,56
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	134.00	86.3	30*	8,15,54,55 ,56
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	134.00	86.3	30*	8,15,54,55 ,56
FOKKER	F-28 MK4000	SPEY MK555-15H	64.00	86.3	-	
GULFSTREAM	GIIB/GIII (HAT STC ST01567LA)	SPEY MK 511-8	58.50	86.3	39	8,15,16
GULFSTREAM	GIIB/GIII (HAT STC ST01567LA)	SPEY MK 511-8	58.50	86.3	39	8,15,16
BOEING	B-737-600	CFM56-7B18	120.50	86.2	40	8,15
BOEING	B-737-600	CFM56-7B20	120.50	86.2	40	8,15
BOEING	B-737-600	CFM56-7B22	120.50	86.2	40	8,15
BOEING	B-737-700	CFM56-7B20/2 DAC	128.00	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B20/2 DAC	129.20	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B24/2 DAC	129.20	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B24/2 DAC	128.00	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B26/2 DAC	129.20	86.2	30*	8,15,54
BOEING	B-757-200	PW2037	198.00	86.2	25*	8,15
BOEING	B-757-200	PW-2037(BG-3)	198.00	86.2	25*	8,15,39
BOEING	B-757-200	PW2040	198.00	86.2	25*	8,15
BOEING	B-757-300	RB211-535E4	224.00	86.2	30	8,15,35
BOEING	B-757-300	RB211-535E4B	224.00	86.2	30	8,15,35
BOEING	B-757-300	RB211-535E4C	224.00	86.2	30	8,15,35
BOEING	B-727-200	JT8D-15QN	142.50	86.1	30*	2,8,14,15
BOEING	B-727-200	JT8D-17QN	142.50	86.1	30*	2,8,14,15
BOEING	B-727-200	JT8D-17QN	158.00	86.1	30*	2,8,14,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-727-200	JT8D-17RQN	142.50	86.1	30*	2,8,15
BOEING	B-727-200	JT8D-9QN	142.50	86.1	30*	2,8,14,15
BOEING	B-737-700W	CFM56-7B20/2 DAC	128.00	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	128.00	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B24/2 DAC	128.00	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	128.00	86.1	30*	8,15,54,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	149.30	86.1	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	149.30	86.1	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	149.30	86.1	30*	8,15,56
GULFSTREAM	GIISP (HAT STC ST01567LA)	SPEY MK 511-8	58.50	86.1	39	8,15,16
GULFSTREAM	GIISP (HAT STC ST01567LA)	SPEY MK 511-8	58.50	86.1	39	8,15,16
RAYTHEON	HAWKER 125- 600A	TFE731-3-1H	22.00	86.1	45	8,15
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	22.00	86.1	45	8,15,26
AEROSPATIALE	MOHAWK 298	PT6A-45A	23.00	86.0	-	4
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	143.29	86.0	25	8,15
BOEING	B-757-200	PW2037 (CBQFC)	198.00	86.0	30	8,15,40
BOEING	B-757-200	PW2037 (nCBQFC)	198.00	86.0	30	8,15,41
BOEING	B-757-200	PW2040 (CBQFC)	198.00	86.0	30	8,15,40
BOEING	B-757-200	PW2040 (nCBQFC)	198.00	86.0	30	8,15,41
RAYTHEON	HAWKER 125- 3A	TFE731-3-1H	20.00	86.0	45	8,15
RAYTHEON	HAWKER 125- 700A	TFE731-3R-1H	22.00	86.0	45	8,15,20,26
AIRBUS	A-320-111	CFM56-5A1	139.90	85.9	35	8,15
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	120.50	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B20/2 DAC	120.50	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B22/2 DAC	120.50	85.9	30*	8,15,54
GULFSTREAM	GULFSTREAM I	RR DART MK529	33.60	85.9	-	15
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	88.50	85.8	24*	8,15,22

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-200	JT8D-7QN	95.00	85.8	30*	2,8,14
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	19.55	85.8	45	8,15
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	83.50	85.7	24*	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	83.50	85.7	24*	8,15,22,43
BOEING	B-737-900	CFM56-7B24	147.30	85.7	30*	8,15
BOEING	B-737-900	CFM56-7B26	147.30	85.7	30*	8,15
BOEING	B-737-900	CFM56-7B27	147.30	85.7	30*	8,15
BOEING	B-737-900	CFM56-7B27/B1	147.30	85.7	30*	8,15
BOEING	B-737-900W	CFM56-7B24	147.30	85.7	30*	8,15,56
BOEING	B-737-900W	CFM56-7B26	147.30	85.7	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27	147.30	85.7	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	147.30	85.7	30*	8,15,56
BOEING	B-757-300	RB211-535E4	210.00	85.7	30	8,15,35
BOEING	B-757-300	RB211-535E4B	210.00	85.7	30	8,15,35
BOEING	B-757-300	RB211-535E4C	210.00	85.7	30	8,15,35
GENERAL DYNAMICS	CV-580	501-D13	52.00	85.7	-	10
AIRBUS	A-320-211	CFM56-5A1	142.20	85.6	35	8,15
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	166.44	85.6	21*	8,15
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	85.00	85.6	24*	8,15,22
BOEING	B-737-900	CFM56-7B26	146.30	85.6	30*	8,15
BOEING	B-737-900	CFM56-7B27	146.30	85.6	30*	8,15
BOEING	B-737-900	CFM56-7B27/B1	146.30	85.6	30*	8,15
BOEING	B-737-900W	CFM56-7B24	146.30	85.6	30*	8,15,56
BOEING	B-737-900W	CFM56-7B26	146.30	85.6	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27	146.30	85.6	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	146.30	85.6	30*	8,15,56
BOEING	B-757-200	PW2037 (nCBQFC)	210.00	85.6	25*	8,15,41

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-757-200	PW2040 (nCBQFC)	210.00	85.6	25*	8,15,41
BOEING	B-757-300	RB211-535E4	224.00	85.6	25	8,15,35
BOEING	B-757-300	RB211-535E4B	224.00	85.6	25	8,15,35
BOEING	B-757-300	RB211-535E4C	224.00	85.6	25	8,15,35
AIRBUS	A320-214/P	CFM56-5B4/P	149.91	85.5	35	8,15
AIRBUS	A321-231	V2533-A5	166.44	85.5	25	8,15
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	83.00	85.5	24*	8,15,22
BOEING	B-737-800	CFM56-7B24	146.30	85.5	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	146.30	85.5	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	146.30	85.5	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	146.30	85.5	30*	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	146.30	85.5	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	146.30	85.5	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	146.30	85.5	30*	8,15,60
BOEING	B-737-800SFP	CFM56-7B24	146.30	85.5	30*	8,15,60
BOEING	B-757-200	PW2037 (CBQFC)	210.00	85.5	25*	8,15,40
BOEING	B-757-200	PW2040 (CBQFC)	210.00	85.5	25*	8,15,40
RAYTHEON	HAWKER 125- 3A/RA	TFE731-3-1H	20.00	85.5	45	8,15
RAYTHEON	HAWKER 125- 400A	TFE731-3-1H	20.00	85.5	45	8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	149.91	85.4	40	8,15
AIRBUS	A319-112/P	CFM56-5B6/P	149.91	85.4	40	8,15
BOEING	B-737-800	CFM56-7B24	144.00	85.4	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	144.00	85.4	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	144.00	85.4	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	144.00	85.4	30*	8,15
BOEING	B-737-800/BBJ 2 SFP '	CFM56-7B26; -7B26/B1	144.00	85.4	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	144.00	85.4	30*	8,15,60

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	144.00	85.4	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	146.30	85.4	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	146.30	85.4	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	146.30	85.4	30*	8,15,56,60
BOEING	B-737-800SFP	CFM56-7B24	144.00	85.4	30*	8,15,60
BOEING	B-737-800SFP W	CFM56-7B24	146.30	85.4	30*	8,15,56,60
BOEING	B-737-800W	CFM56-7B24	146.30	85.4	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	146.30	85.4	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	146.30	85.4	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	146.30	85.4	30*	8,15,56
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	144.00	85.3	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	144.00	85.3	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	144.00	85.3	30*	8,15,56,60
BOEING	B-737-800SFP W	CFM56-7B24	144.00	85.3	30*	8,15,56,60
BOEING	B-757-200	RB211-535E4	210.00	85.3	30	8,15,35
BOEING	B-757-200	RB211-535E4	210.00	85.3	30	8,15,36
BOEING	B-757-200	RB211-535E4B	210.00	85.3	30	8,15,36
BOEING	B-757-200	RB211-535E4B	210.00	85.3	30	8,15,35
DASSAULT	FALCON 10	TFE731-2-1C	17.64	85.3	52	8,15
AIRBUS	A-320-111	CFM56-5A1	139.90	85.2	20*	8,15
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	143.29	85.2	21*	8,15
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	77.50	85.2	24*	8,15,22
BOEING	B-737-800W	CFM56-7B24	144.00	85.2	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	144.00	85.2	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	144.00	85.2	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	144.00	85.2	30*	8,15,56
AIRBUS	A320-214/P	CFM56-5B4/P	127.86	85.1	35	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-757-200	PW2037 (nCBQFC)	198.00	85.1	25*	8,15,41
BOEING	B-757-200	PW2040 (nCBQFC)	198.00	85.1	25*	8,15,41
BOEING	B-757-300	RB211-535E4	210.00	85.1	25	8,15,35
BOEING	B-757-300	RB211-535E4B	210.00	85.1	25	8,15,35
BOEING	B-757-300	RB211-535E4C	210.00	85.1	25	8,15,35
BOEING	B-757-200	PW2037 (CBQFC)	198.00	85.0	25*	8,15,40
BOEING	B-757-200	PW2040 (CBQFC)	198.00	85.0	25*	8,15,40
CESSNA	CITATION EXCEL (560XL)	PW545	18.70	85.0	35	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	150.00	85.0	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	150.00	85.0	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	150.00	85.0	40	8,15
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	23.35	85.0	45	8,15
AEROSPATIALE	ATR42-300	PW120/HS 14SF5	34.17	84.9	30	15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	121.25	84.9	40	8,15
AIRBUS	A319-112/P	CFM56-5B6/P	121.25	84.9	40	8,15
AIRBUS	A319-114	CFM56-5A5	149.91	84.9	40	8,15
AIRBUS	A321-231	V2533-A5	143.29	84.9	25	8,15
AIRBUS	A321-231	V2533-A5	166.44	84.9	21*	8,15
BOEING	B-757-200	RB211-535E4	198.00	84.9	30	8,15,35
BOEING	B-757-200	RB211-535E4	198.00	84.9	30	8,15,36
BOEING	B-757-200	RB211-535E4	210.00	84.9	25*	8,15,36
BOEING	B-757-200	RB211-535E4	210.00	84.9	25*	8,15,35
BOEING	B-757-200	RB211-535E4B	210.00	84.9	25*	8,15,35
BOEING	B-757-200	RB211-535E4B	198.00	84.9	30	8,15,36
BOEING	B-757-200	RB211-535E4B	210.00	84.9	25*	8,15,36
BOEING	B-757-200	RB211-535E4B	198.00	84.9	30	8,15,35
AEROSPATIALE	ATR42-320	PW121/HS 14SF5	35.27	84.8	30	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B20	134.00	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	134.00	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	134.00	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	134.00	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	134.00	84.8	30*	8,15,55
CESSNA	CITATION III (650)	TFE731-3B-100S	20.00	84.8	37	7,8,15
CESSNA	CITATION VI (650)	TFE731-3C-100S	20.00	84.8	40	8,15
AEROSPATIALE	ATR42-300	PW120/HS 14SF5	36.16	84.7	30	15
AEROSPATIALE	ATR42-320	PW121/HS 14SF5	36.16	84.7	30	15
AIRBUS	A-320-231	V2500.A1	142.20	84.7	40	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	142.20	84.7	40	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	142.20	84.7	40	8,15
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B20	134.00	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	134.00	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	134.00	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	134.00	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	134.00	84.7	30*	8,15,55,56
VICKERS ARMSTRONGS	VISCOUNT 745	RR DART6 MK510	64.00	84.6	-	11
AIRBUS	A319-114	CFM56-5A5	121.25	84.5	40	8,15
BOEING	B-737-700	CFM56-7B20	129.20	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B20	128.00	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B22	129.20	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B22	128.00	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B24	129.20	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B24	128.00	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B26	128.00	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B26	129.20	84.5	30*	8,15

**ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
APPROACH**

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOEING	B-757-200	RB211-535E4	198.00	84.5	25*	8,15,35
BOEING	B-757-200	RB211-535E4	198.00	84.5	25*	8,15,36
BOEING	B-757-200	RB211-535E4B	198.00	84.5	25*	8,15,35
BOEING	B-757-200	RB211-535E4B	198.00	84.5	25*	8,15,36
DASSAULT	FALCON 50 (M1810)	TFE731-40-1	35.72	84.5	48	8,15
DASSAULT	FALCON 50 (M2193)	TFE731-40-1	35.72	84.5	48	8,15
AIRBUS	A-320-211	CFM56-5A1	142.20	84.4	20*	8,15
BOEING	B-737-700W	CFM56-7B20	128.00	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B22	128.00	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B24	128.00	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B26	128.00	84.4	30*	8,15,56
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	149.91	84.3	20*	8,15
AIRBUS	A319-112/P	CFM56-5B6/P	149.91	84.3	20*	8,15
AIRBUS	A321-231	V2533-A5	143.29	84.3	21*	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	130.00	84.3	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	130.00	84.3	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	130.00	84.3	40	8,15
AIRBUS	A320-214/P	CFM56-5B4/P	127.86	84.2	20*	8,15
IAI	1124A WESTWIND II	TFE731-3-1G	19.00	84.2	40	15
MCDONNELL DOUG.	MD-87	JT8D-219	128.00	84.2	40	8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	121.25	84.1	20*	8,15
AIRBUS	A319-112/P	CFM56-5B6/P	121.25	84.1	20*	8,15
AIRBUS	A320-214/P	CFM56-5B4/P	149.91	84.1	20*	8,15
BOEING	B-737-600	CFM56-7B18	120.50	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B20	120.50	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B22	120.50	84.1	30*	8,15
DASSAULT	FALCON 20-G (M2500)	ATF3-6-2C	27.56	84.1	40	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
DASSAULT	FALCON 200	ATF3-6A-4C	27.60	84.1	40	8,15
BOMBARDIER	DHC-7	PT6A-50	42.00	84.0	25	15
DASSAULT	FALCON 7X (SFI)	PW307A	62.40	84.0	40	
DOUGLAS	DC-3	R-1830-90C	24.40	84.0	-	5
GENERAL DYNAMICS	CV-440	R-2800	47.20	84.0	-	5
IAI	1124 WESTWIND	TFE731-3-1G	19.00	84.0	40	8,15
IAI	1124IW WESTWIND IW	TFE731-3-1G	19.00	84.0	40	15
SHORTS	SD3-60-300	PT6A-67R	26.50	84.0	30	13
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	58.50	83.9	20*	8,15
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	58.50	83.9	20*	8,15,16
MCDONNELL DOUG.	MD-80	JT8D-209	130.00	83.9	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	130.00	83.9	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	150.00	83.9	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	150.00	83.9	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	150.00	83.9	28*	8,15
DASSAULT	FALCON 2000	CFE738-1-1B	33.00	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-209	128.00	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	128.00	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	128.00	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	128.00	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	128.00	83.8	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	120.00	83.7	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	120.00	83.7	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	130.00	83.6	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	130.00	83.6	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	130.00	83.6	28*	8,15
RAYTHEON	HAWKER 125-600A	TFE731-3-1H	22.00	83.6	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST. dBA	FLAPS	NOTES
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	22.00	83.6	25*	8,15,26
AIRBUS	A319-131	V2522A5	149.91	83.5	40	8,15
AIRBUS	A319-132	V2524-A5	149.91	83.5	40	8,15
AIRBUS	A320-232	V2527-A5	123.45	83.5	40	8,15
AIRBUS	A320-232	V2527-A5	149.91	83.5	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-209	128.00	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-209	130.00	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	130.00	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	128.00	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	128.00	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	128.00	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	128.00	83.5	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	128.00	83.5	28*	8,15
RAYTHEON	HAWKER 125- 3A	TFE731-3-1H	20.00	83.5	25*	8,15
RAYTHEON	HAWKER 125- 700A	TFE731-3R-1H	22.00	83.5	25*	8,15,20,26
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	60.50	83.4	15	8,15
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	60.50	83.4	15	8,15
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	60.50	83.4	15	8,15
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	62.00	83.3	15	8,15
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	62.00	83.3	15	8,15
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	62.00	83.3	15	8,15
FOKKER	F100	RR TAY MK620-15	88.00	83.3	42	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	120.00	83.3	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	120.00	83.3	28*	8,15
MCDONNELL DOUG.	MD-90-30	V2525-D5	142.00	83.3	40	8,15
MCDONNELL DOUG.	MD-90-30	V2528-D5	142.00	83.3	40	8,15
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	19.55	83.3	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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APPROACH

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BOMBARDIER	BD-700-1A10 (Global Express)	BR700-710-A2-20	78.50	83.2	30	8,15
BOMBARDIER	BD-700-1A10 (Global Express)	BR700-710-A2-20	78.50	83.2	30	8,15
AIRBUS	A-320-231	V2500.A1	142.20	83.1	20*	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	142.20	83.1	20*	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	142.20	83.1	20*	8,15
GULFSTREAM	G200	PW306A	28.00	83.1	40	8,15,44
LEARJET	LEARJET 35	TFE731-2	14.30	83.1	40	4
LEARJET	LEARJET 36	TFE731-2	14.30	83.1	40	4
BEECH	BEECHJET 400	JT15D-5	14.20	83.0	-	15
CESSNA	CITATION ENCORE (560)	PW535A	15.20	83.0	35	8,15
FAIRCHILD DORNIER	328-100 Mod 10	PW 119B	29.17	83.0	12	15,38
FAIRCHILD DORNIER	328-100 Mod 20	PW 119C	29.17	83.0	12	15,38
MITSUBISHI	MU300-10 DIAMOND II	JT15D-5	14.20	83.0	-	15
RAYTHEON	HAWKER 125- 3A/RA	TFE731-3-1H	20.00	83.0	25*	8,15
RAYTHEON	HAWKER 125- 400A	TFE731-3-1H	20.00	83.0	25*	8,15
AIRBUS	A319-131	V2522A5	121.25	82.9	40	8,15
AIRBUS	A319-132	V2524-A5	121.25	82.9	40	8,15
BOEING	B-717-200	BR700-715A1-30 (MP)	110.00	82.9	40	8,15,53
DASSAULT	FALCON 900EX (M3000)	TFE731-60-1	44.50	82.9	40	8,15
EMBRAER	EMB-145ER	AE3007A	41.22	82.9	45	8,15
LEARJET	LEARJET 31	TFE731-2-3B	15.30	82.9	40	13,15
RAYTHEON	HAWKER 125-1000A	PW305	25.00	82.9	45	8,15
FOKKER	F100	RR TAY MK650-15	88.00	82.8	42	8,15
AEROSPATIALE	ATR72-200	PW124/HS 14SF11	43.87	82.7	30	15
DASSAULT	FALCON 900	TFE731-5AR-1C	42.00	82.6	40	8,15
DASSAULT	FALCON 900 (M1196)	TFE731-5AR-1C	42.00	82.6	40	8,15
DASSAULT	FALCON 900B (M1200)	TFE731-5BR-1C	42.00	82.6	40	8,15

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*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
FOKKER	F-27-100	RR DART6 MK514	37.50	82.6	-	11
RAYTHEON	HAWKER 125- 800XP	TFE731-5BR-1H	23.35	82.6	45	8,15
BOMBARDIER	CL-600-2C10 (CRJ700)	CF34-8C1	66.90	82.5	45	8,15
DASSAULT	FALCON 900DX (M4000, M3755, M3758)	TFE731-60(-1C)	42.20	82.5	40	
DASSAULT	FALCON 900LX (M5281)	TFE731-60(-1C)	44.50	82.5	40	
EMBRAER	EMB-145LR	AE3007A1/1	42.54	82.5	45	8,15
GULFSTREAM	GULFSTREAM IIB/GIII	SPEY MK511-8	58.50	82.5	20*	8,15,16
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	23.35	82.5	25*	8,15
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	23.35	82.5	25*	8,15,20
AEROSPATIALE	ATR72-200	PW124/HS 14SF11	47.07	82.4	30	15
BOEING	B-717-200	BR700-715A1-30	110.00	82.4	40	8,15,52
BOEING	B-717-200	BR700-715C1-30	110.00	82.4	40	8,15,52
CESSNA	CITATION BRAVO (550)	PW530A	13.50	82.3	40	8,15
AEROSPATIALE	ATR72-210	PW127/HS 14SF11	47.07	82.2	33	15
DASSAULT	FALCON 20-C5/D5/E5 (M3547)	TFE731-5BR-2C	28.88	82.2	40	8,15
RAYTHEON	HAWKER 125-1000A	PW305	25.00	82.2	25*	8,15
FOKKER	F100	RR TAY MK650-15	88.00	82.1	25*	8,15
DASSAULT	FALCON 50	TFE731-3-1C	35.70	82.0	20*	8,15
DASSAULT	FALCON 50 (M1230)	TFE731-3-1C	35.71	82.0	20*	8,15
GULFSTREAM	G-V	BR700-710A1-10	75.30	82.0	39	8,15
SAAB	SF340A (Dowty props)	GE CT7-5A2	27.20	82.0	20	8,15
SAAB	SF340B (Dowty props)	GE CT7-9B	28.50	82.0	20	8,15
LEARJET	LEARJET 55B	TFE731-3A-2B	18.00	81.9	40	
BOEING	B-717-200	BR700-715A1-30	98.00	81.8	40	8,15,52
DASSAULT	FALCON 10	TFE731-2	17.64	81.8	30*	8,15
DASSAULT	FALCON 20-C5/D5/E5 (M3500)	TFE731-5AR-2C	27.73	81.8	40	8,15
DASSAULT	FALCON 20-C5/D5/E5 (M3530)	TFE-731-5BR-2C	27.73	81.8	40	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
EMBRAER	EMB-120 BRASILIA	PW115	21.20	81.8	45	12
SHORTS	3-30	PT6A-45A	22.10	81.8	-	8,15
BOEING	B-717-200	BR700-715A1-30 (MP)	98.00	81.7	40	8,15,53
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	62.00	81.7	35	8,15,42
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	62.00	81.7	35	8,15,42
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	62.00	81.7	35	8,15,42
CANADAIR	CHALLENGER CL-600	ALF-502L	36.00	81.7	45	12
CANADAIR	CHALLENGER CL-600	ALF-502L	36.00	81.7	45	15
CESSNA	CITATION JET (525)	FJ44-1A	9.70	81.7	35	8,15
LEARJET	LEARJET 35A	TFE731-2	15.30	81.7	40	15
LEARJET	LEARJET 35A/36A	TFE731-2	15.30	81.7	40	8,15
LEARJET	LEARJET 36A	TFE731-2	15.30	81.7	40	15
SABRELINER CORP.	SABRE 65	TFE731-3R-1D	21.80	81.7	-	8,12
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	60.50	81.6	35	8,15,42
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	60.50	81.6	35	8,15,42
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	60.50	81.6	35	8,15,42
CASA AIRCRAFT	C-295	PW 127 GM	45.63	81.6	15	15
CESSNA	CITATION VII (650)	TFE731-4C-3S	20.00	81.6	40	8,15
CESSNA	CITATION VII (650)	TFE731-4R-3S	20.00	81.6	40	8,15
DASSAULT	FALCON 2000EX (M1826)	PW308C	39.30	81.6	40	
DASSAULT	FALCON 2000EX (M1842)	PW308C	39.30	81.6	40	
LEARJET	LEARJET 35 W/CENTURY III	TFE731-2	14.30	81.6	40	8,15
LEARJET	LEARJET 36 W/CENTURY III	TFE731-2	14.30	81.6	40	8,15
LEARJET	LEARJET 45	TFE731-20R-1B	19.20	81.5	40	8,15
LEARJET	LEARJET 55	TFE731-3B	17.00	81.5	40	15
CANADAIR	RJ (CL-600-2B19)	CF34-3A1	44.70	81.4	45	15
CANADAIR	RJ (CL-600-2B19)	CF34-3A1	47.00	81.4	45	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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*****APPROACH*****

MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
CESSNA	CITATION III (650)	TFE731-3B-100S	20.00	81.4	20*	7,8,15
GULFSTREAM	G200	PW306A	28.00	81.4	40	8,15,45
DASSAULT	FALCON 20-F5 (M3547)	TFE731-5BR-2C	28.88	81.3	40	8,15
GULFSTREAM	GULFSTREAM IV - SP	RR TAY 611-8	66.00	81.3	39	8,15
BOMBARDIER	DHC-8 102	PW120	33.90	81.2	35	15
BOMBARDIER	DHC-8 103	PW121	33.90	81.2	35	15
BOMBARDIER	DHC-8 106	PW121	33.90	81.2	35	15
BOMBARDIER	DHC-8 201/202	PW123	33.90	81.2	35	15
GULFSTREAM	G100	TFE731-40R-200G	20.70	81.2	40	8,15
CESSNA	CITATION III (650)	TFE731-3B-100S	19.00	81.1	20*	8,15
AEROSPATIALE	ATR72-210	PW127/HS 247F	47.07	81.0	33	8,15
DASSAULT	FALCON 20-F5 (M3500)	TFE731-5AR-2C	27.73	81.0	40	8,15
DASSAULT	FALCON 20-F5 (M3530)	TFE-731-5BR-2C	27.73	81.0	40	8,15
DASSAULT	FALCON 900	TFE731-5AR-1C	42.00	81.0	20*	8,15
CASA AIRCRAFT	CN-235-100	CT7-9C	32.85	80.8	23	15
BOMBARDIER	DHC-8 311	PW123	42.00	80.7	35	8,15
GULFSTREAM	GULFSTREAM IV	RR TAY 611-8	58.50	80.7	39	8,15
BOMBARDIER	DHC-8 314	PW123	42.00	80.6	35	8,15
CASA AIRCRAFT	C-212-CD	TPE 331-10R-512C/502C	16.42	80.5	40	15
CASA AIRCRAFT	C-212-CE	TPE 331-10R-512C/502C	16.42	80.5	40	15
CASA AIRCRAFT	C-212-DF	TPE 331-10R-502C/512C/513C	16.42	80.5	40	15
CESSNA	560	JT15D-5A	15.20	80.5	35	8,15
CESSNA	CITATION V (560)	JT15D-5A	15.20	80.5	35	8,15
CANADAIR	CHALLENGER CL-601	CF34-1A	36.00	80.4	45	15
CANADAIR	CHALLENGER CL-601	CF34-1A	36.00	80.4	-	15
CANADAIR	CHALLENGER CL-601	CF34-3A/A1/A2	36.00	80.4	45	15
IAI	1125 ASTRA	TFE731-3A-200G	20.70	80.4	40	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
CESSNA	CITATION JET II (525A)	FJ44-2C	11.50	80.3	35	8,15
FAIRCHILD DORNIER	328-300 Mod 10	PW306B	31.72	80.3	32	8,15
CASA AIRCRAFT	CN-235-300	CT7-9C3	34.39	80.2	15	15
SHORTS	3-60	PT6A-65R	26.10	80.1	30	8,15
BAE SYSTEMS (BAe)	BAe-748 SERIES 2B	RR-DART MK535-W/HUSHKIT	43.00	80.0	27	8,15
BEECH	B60	TI0-541-E1C4	6.80	80.0	-	10,11
SAAB FAIRCHILD	SF340	GE CT7-5A2	26.50	80.0	35	12
CASA AIRCRAFT	CN-235-200	CT7-9C	34.39	79.9	40	15
CESSNA	CITATION II (550)	JT15D-4	13.50	79.8	40	8,15
CASA AIRCRAFT	C-212-CC	TPE 331-10/10R-501C/511C	16.42	79.7	40	15
CASA AIRCRAFT	C-212-CF	TPE 331-10R-501C/511C	16.42	79.7	40	15
CESSNA	S550 (SII)	JT15D-4B	14.40	79.6	35	8,15
FAIRCHILD DORNIER	328-300	PW306B	31.06	79.5	32	8,15
DASSAULT	FALCON 20-F5	TFE731-5AR-2C	27.76	79.4	25*	8,15
FOKKER	F-27 MK500/600	MK552-7R	43.50	79.4	40	15,16
CESSNA	CITATION II (550)	JT15D-4	12.70	79.3	40	8,15
AEROSPATIALE	SN601 CORVETTE	JT15D-4	12.40	79.1	35	4
FOKKER	F-27 MK500/600	MK552-7R	41.00	79.1	40	15,16
FOKKER	F70	RR TAY MK620-15	81.00	79.0	42	8,15
SAAB	2000	AE2100A	47.40	78.9	20	8,15
SAAB	SF340B (HS14RF-19 props)	GE CT7-9B	28.50	78.8	20	8,15
SAAB	SF340B (HS14RF-19 props)	GE CT7-9B	28.00	78.8	20	8,15
FOKKER	F70	RR TAY MK620-15	75.00	78.6	42	8,15
FAIRCHILD DORNIER	SA226-AC METRO III	TPE-331-11U	14.00	78.5	-	10,11
FAIRCHILD DORNIER	SA226-T(B) MERLIN IIIB	TPE-331-10U	12.50	78.5	-	5,11
FAIRCHILD DORNIER	SA227-AT MERLIN III C	TPE-331-10U	13.20	78.5	-	5,11
FAIRCHILD DORNIER	SA227-AT MERLIN IV C	TPE-331-11U	14.00	78.5	-	10,11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
PIPER	CHEYENNE 400LS	TPE-331-14	11.10	78.5	-	11
BOMBARDIER	DHC-6	PT6A-27	12.50	78.0		4
CESSNA	CITATION ULTRA (560)	JT15D-5D	15.20	78.0	35	8,15
CESSNA	CITATION VII (650)	TFE731-4C-3S	20.00	78.0	20*	8,15
GULFSTREAM	695A COMMANDER 1000	TPE-331-10	10.60	77.9	-	5,11
BEECH	SUPER KINGAIR 200	PT6A-41	12.50	77.8	-	11
BEECH	SUPER KINGAIR B200	PT6A-41	12.50	77.8	-	10,11
BEECH	SUPER KINGAIR B200T/CT	PT6A-42	12.50	77.8	-	5,11
CESSNA	500	JT15D-1	10.90	77.7	40	15
CESSNA	CITATION I	JT15D-1A	11.40	77.7	40	8,15
GULFSTREAM	690C COMMANDER 840	TPE-331-5	9.70	77.4	-	5,11
GULFSTREAM	690D COMMANDER 900	TPE-331-5	10.60	77.4	-	10
GULFSTREAM	695	TPE-331-10	9.70	77.4	-	5,15
GULFSTREAM	695 COMMANDER 980	TPE-331-10	9.70	77.4	-	5,11
LEARJET	LEARJET 60	PW305A	19.50	77.4	40	8,15
BEECH	F90 KINGAIR	PT6A-135	10.90	77.3	-	5,11
SHORTS	SKYVAN	TPE-331-201	12.50	77.3	46	
MITSUBISHI	MU300 DIAMOND I	JT15D-4	13.20	77.2	30	12
BEECH	B100 KINGAIR	TPE-331-6	11.20	77.1	-	11
BEECH	C99 AIRLINER	PT6A-34	11.30	77.1	-	5,11
PIPER	PA-42 CHEYENNE	PT6A-41	9.40	77.1	-	10,11
BEECH	1900/1900C	PT6A-65B	16.10	77.0	-	10
BEECH	58P	TSIO-520WB	6.20	77.0	-	10,11
BEECH	58TC	TSIO-520-WB	6.20	77.0	-	10,11
GULFSTREAM	500S	IO-540-E1B5	6.80	77.0	-	10
CASA AIRCRAFT	C-212-DE	PT6A-5B	16.42	76.9	40	15
BEECH	B200/T/CT/C;C-12F(4 BLD)	PT6A-42	12.50	76.6	-	

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
CESSNA	CONQUEST II	TPE-331-8	9.80	76.5	-	5,11
BAE SYSTEMS (JETSTREAM)	JETSTREAM 4100	TPE331-14-801H/802H	22.30	76.4	15	12,15
BAE SYSTEMS (JETSTREAM)	JETSTREAM 4100	TPE331-14-801H/802H/805H	23.30	76.3	15	12,15
EMBRAER	EMB 110-P2	PT6A-34	12.50	76.0	-	4
FAIRCHILD DORNIER	SA226-AT	TPE-331-3U-303G	12.50	76.0	-	4
FAIRCHILD DORNIER	SA226-T	TPE-331-3U-303G	12.50	76.0	-	4
FAIRCHILD DORNIER	SA226-TC METRO II	TPE-331-3UW-303G	12.50	76.0	-	4
GULFSTREAM	690B	TPE-331-5-251K	9.70	76.0	-	10
MITSUBISHI	MU-2B-26A	TPE-331-5-252M	10.00	76.0	-	4
MITSUBISHI	MU-2B-36A	TPE-331-5-252M	10.20	76.0	-	4
BEECH	300/300C KING AIR	PT6A-60A	14.00	75.9	-	
SAAB	SF340A (Dowty props)	GE CT7-5A2	26.50	75.8	20	8,15
BEECH	C90	PT6A-21	9.70	75.0	-	10
BEECH	H18	R-985AN-14B	9.50	75.0	-	11
CESSNA	CONQUEST I	PT6A-112	8.20	75.0	-	10,11
BAE SYSTEMS (JETSTREAM)	JETSTREAM 31	TPE331-10U-501H	14.60	74.7	-	15
FAIRCHILD DORNIER	DORNIER 228	TPE-331-5-252D	12.60	74.7	-	
BEECH	99A	PT6A-27	10.40	74.0	-	4
BEECH	A100	PT6A-28	11.20	74.0	-	4
BEECH	B80	IGS0-540-A1D	8.80	74.0	-	11
BEECH	E55 (2 BLD)	I0-520-C	5.30	74.0	-	11
BEECH	E55 (3BLD)	IO-520-C	5.30	74.0	-	11
CESSNA	402C	TSIO-520-VB	6.90	74.0	-	11
CESSNA	404	GTSIO-520-M	8.40	74.0	-	11
CESSNA	421C	GTSIO-520-L	7.50	74.0	-	11
GULFSTREAM	680FL	IGSO-540-B1A	8.00	74.0	-	11
PIPER	PA-31-325	TIO-540-F2BD	6.50	74.0	-	11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
PIPER	PA-31-350	TI0-540-J2BD	7.00	74.0	-	11
PIPER	PA-31T	PT6A-28	9.00	74.0	-	4
BEECH	65 QUEENAIR	IGSO-480-A1B6	7.40	73.8	-	11
CESSNA	310Q	I0-470-V0	5.20	73.7	-	10,11
BEECH	58/58A BARON (3 BLD)	IO-550-C	5.40	73.3	-	11
BEECH	58 (2BLD)	I0-520-C	5.40	73.0	-	11
BEECH	58 (3BLD)	IO-520-C	5.40	73.0	-	11
BEECH	B55	IO-470-L	5.10	73.0	-	11
BEECH	B55(3BLD)	IO-470-L	5.10	73.0	-	11
BRITTEN-NORMAN	ISLANDER BN-2B	O-540-E4C5	6.20	73.0	-	11
CESSNA	310R	TSIO-520-BB	5.50	73.0	-	11
CESSNA	320C	TSI0-470-D	5.20	73.0	-	11
CESSNA	340A	TSIO-520-MB	6.00	73.0	-	11
CESSNA	401	TSIO-520-E	6.30	73.0	-	11
CESSNA	414A	TSIO-520-N	6.80	73.0	-	11
CESSNA	CARAVAN I	PT6A-114	7.30	73.0	-	
GULFSTREAM	560E	GO-480-C1B6	6.50	73.0	-	11
PIPER	601P	IO-540-S1A5	6.00	73.0	-	11
PIPER	PA-23-250	IO-540-C4B5	4.94	73.0	-	11
PIPER	PA-31-310	TI0-540-A2C	6.50	73.0	-	11
PIPER	PA-602P	IO-540-AA1A5	6.00	73.0	-	11
PIPER	PA-60-600	IO-540-K1J5	5.50	73.0	-	11
CESSNA	337H	IO-360-G	4.60	72.0	-	11
GULFSTREAM	GA-7	O-320-D1D	3.80	72.0	-	4
PIPER	PA-34-200T	TSI0-360-E	4.50	72.0	-	11
PIPER	PA-34-220T	TSIO-360-KB	4.50	72.0	-	11
BEECH	D95A TRAVELAIR	IO-320-B1B	4.20	71.1	-	11

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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
BEECH	76	I0-360-A1G6D	3.90	71.0	-	11
PIPER	PA-44-180	O-360-E1A6D	3.80	71.0	-	11
PIPER	PA-44-180T(2BLD)	TO-360-E1A6D	3.90	71.0	-	11
PIPER	PA-44-180T(3BLD)	TO-360-E1A6D	3.90	71.0	-	11
PIPER	PA-30 TWIN COMANCHE	IO-320-B	3.60	70.6	-	11
BEECH	35-B33	I0-470-K	3.00	68.0	-	10,11
CESSNA	210	IO-520-L	3.80	67.1	-	10,11
BEECH	35-C33A	I0-520-B	3.30	64.0	-	11
BEECH	A36	IO-520-BA	3.60	64.0	-	11
BEECH	A36 BONANZA	IO-550-B	3.65	64.0	-	11
BEECH	B36TC BONANZA	TSIO-520U	3.85	64.0	-	11
BEECH	F33A	I0-520-B	3.40	64.0	-	11
BEECH	V35B (3BLD)	I0-520-B	3.40	64.0	-	11
BELLANCA	17-30A	I0-540-T4B5D	3.30	64.0	-	4
CESSNA	185F	I0-520-D	3.40	64.0	-	11
CESSNA	T210L	TSI0-520-R	3.80	64.0	-	11
CESSNA	T210M	TSI0-520-R	3.80	64.0	-	11
CESSNA	TU206G	TSI0-520-M	3.60	64.0	-	11
EXTRA FLUGZEUGBAU	EA 400	TSIOL-550-A	4.41	64.0	-	11,21
PIPER	PA-32-300	IO-540-K1G5D	3.40	64.0	-	
PIPER	PA-32R-300	IO-540-K1G5D	3.60	64.0	-	11
PIPER	PA-32R-301	IO-540-K1G5D	3.60	64.0	-	11
PIPER	PA-32R-301T	TIO-540-S1AD	3.60	64.0	-	11
PIPER	PA-32RT-300	IO-540-K1A5D	3.60	64.0	-	11
PIPER	PA-46-31P MALIBU	TSIO-520-BE	4.10	63.9	-	11
CESSNA	207	IO-520-F	3.80	63.8	-	11
CESSNA	T206H	TIO-540-AJ1A	3.60	63.8	-	11,21

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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
CIRRUS DESIGN CORP.	SR 22	IO-550-N	3.40	63.8	-	11,21
CESSNA	206H	IO-580-AIA	3.60	63.7	-	11,21
CESSNA	206	IO-520-A	3.30	63.5	-	11
CLASSIC AIRCRAFT	WACO CLASSIC F-5	R-755-B2	2.70	63.4	-	11
MOONEY	M20M	TIO-540-AF1A	3.37	63.3	-	11,21
MOONEY	M20M	TIO-540-AF1A	3.20	63.3	-	11,21
ESTUMKEDA LTD d.b.a MICCO AIRCRAFT CO.	MAC-145B	IO-540-T4B5	2.74	63.1	-	11,21
FOUND AIRCRAFT CANADA	FBA-2C1	IO-540-D4A5	3.20	63.1	-	11,21
BEECH	E35	E-225-8	2.70	63.0	-	11
BEECH	K35/M35	IO-470-C	3.00	63.0	-	11
CESSNA	180	O-470-J	2.80	63.0	-	11
PIPER	PA-24-260	IO-540-B1A5	3.20	63.0	-	11
PIPER	PA-28-235	O-540-B4B5	3.00	63.0	-	11
PIPER	PA-28-236	O-540-J3A5D	3.00	63.0	-	11
MAULE	MX7-235	0540-J1A5D	2.50	62.7	-	11
BEECH	A24R	I0-360-A1B6	2.80	62.0	-	11
BEECH	C23	0-360-A4K	2.50	62.0	-	11
BEECH	C24R	IO-360-A1B6	2.80	62.0	-	11
BEECH	C35	E-185-11	2.70	62.0	-	11
BELLANCA	8GCBC	0-360-C2E	2.20	62.0	-	11
CESSNA	172N	0-320-H2AD	2.30	62.0	-	10
CESSNA	177RG	I0-360-A1B6	2.80	62.0	-	11
GULFSTREAM	112	IO-360-C1D6	2.70	62.0	-	11
MOONEY	M20C	0-360-A1D	2.60	62.0	-	11
MOONEY	M20F w/MODWORK STC# SA02204AT	IO-360-E5	2.74	62.0	-	11,21
MOONEY	M20J	I0-360-A1B6D	2.70	62.0	-	4
PIPER	PA-28-181	O-360-A4M	2.50	62.0	-	11

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MANUFACTURER	AIRPLANE	ENGINE	MLW 1000 LBS	EST dBA	FLAPS	NOTES
PIPER	PA-28RT-201(2BLD)	I0-360-C1C6	2.80	62.0	-	11
PIPER	PA-28RT-201T(3BLD)	TSIO-360-FB	2.90	62.0	-	11
CIRRUS DESIGN CORP.	SR 20 (2 Bladed Prop)	IO-360-ES	2.90	61.9	-	11,21
CIRRUS DESIGN CORP.	SR 20 (3 Bladed Prop)	IO-360-ES	2.90	61.9	-	11,21
BEECH	A-23	IO-360-A	2.40	61.0	-	11
CESSNA	170B	C-145-2H	2.20	61.0	-	11
CESSNA	172	O-320-E2D	2.30	61.0	-	11
GULFSTREAM	AA-5A	O-320-E2G	2.20	61.0	-	11
OSTMECKLENBURGISCHE FLUGZEUGBAU	OMF-100-160	O-320-D2A	1.96	61.0	-	11,21
PIPER	PA-18-150	0-320-A2B	1.80	61.0	-	11
PIPER	PA-28-140	O-320-E3D	2.20	61.0	-	11
PIPER	PA-28-151	O-320-E3D	2.20	61.0	-	11
PIPER	PA-28-161	O-320-D3G	2.40	61.0	-	11
PIPER	PA-28-200	I0-360-C1C	2.70	61.0	-	
BEECH	77	O-235-L2C	1.70	60.0	-	11
BELLANCA	7GCAA	0-320-A2B	1.70	60.0	-	4
PIPER	PA-38-112	O-235-L2C	1.70	60.0	-	11
CESSNA	150	0-200-A	1.60	59.0	-	11
CESSNA	150M	O-200-A	1.60	59.0	-	11
CESSNA	152	0-235-L2C	1.70	59.0	-	11
GULFSTREAM	AA-1B	O-235	1.60	59.0	-	11
CESSNA	182P	O-470-S	3.00	56.0	-	10,11
CESSNA	182Q	0-470-U	3.00	56.0	-	10,11
GULFSTREAM	AA-5B TIGER	O-360-A4K	2.20	52.0	-	10,11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
AEROSPATIALE	ATR42-300	PW120/HS 14SF5	34.72	34.17	66.5	84.9	30	15
AEROSPATIALE	ATR42-300	PW120/HS 14SF5	37.26	36.16	68.4	84.7	30	15
AEROSPATIALE	ATR42-320	PW121/HS 14SF5	35.60	35.27	66.7	84.8	30	15
AEROSPATIALE	ATR42-320	PW121/HS 14SF5	37.26	36.16	67.7	84.7	30	15
AEROSPATIALE	ATR72-200	PW124/HS 14SF11	44.07	43.87	70.7	82.7	30	15
AEROSPATIALE	ATR72-200	PW124/HS 14SF11	48.50	47.07	73.2	82.4	30	15
AEROSPATIALE	ATR72-210	PW127/HS 14SF11	47.40	47.07	71.8	82.2	33	15
AEROSPATIALE	ATR72-210	PW127/HS 14SF11	48.50	47.07	72.3	82.2	33	15
AEROSPATIALE	ATR72-210	PW127/HS 247F	47.40	47.07	66.4	81.0	33	8,15
AEROSPATIALE	ATR72-210	PW127/HS 247F	48.50	47.07	67.0	81.0	33	8,15
AEROSPATIALE	MOHAWK 298	PT6A-45A	23.40	23.00	76.0	86.0	-	4
AEROSPATIALE	NORD-262C	BASTAN-VIIA	22.90	22.70	78.3	88.9	-	4,8
AEROSPATIALE	SN601 CORVETTE	JT15D-4	13.90	12.40	63.8	79.1	35	4
AIRBUS	A-300B	CF6-50A	302.00	269.00	79.1	90.9	25	4,8
AIRBUS	A-300B1	CF6-50A	302.00	269.00	76.8	90.7	15*	4,8,9
AIRBUS	A-300B1	CF6-50A	302.00	269.00	76.8	91.4	25	4,8,9
AIRBUS	A-300B2-1A	CF6-50A	301.40	281.10	76.8	90.7	25	4,8,9
AIRBUS	A-300B2-1A	CF6-50A	301.40	281.10	76.8	91.4	15*	4,8,9
AIRBUS	A-300B2-1A	CF6-50A	312.40	286.70	78.3	90.4	15*	4,8,9
AIRBUS	A-300B2-1A	CF6-50A	312.40	286.70	78.3	90.9	25	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	302.00	281.10	76.0	90.4	15*	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	302.00	281.10	76.0	90.7	25	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	312.40	286.70	77.1	90.4	15*	4,8,9
AIRBUS	A-300B2-1C	CF6-50C	312.40	286.70	77.1	90.9	25	4,8,9
AIRBUS	A-300B2-K-3C	CF6-50C	312.40	286.70	75.9	90.7	15*	4,8,9
AIRBUS	A-300B2-K-3C	CF6-50C	312.40	286.70	75.9	91.3	25	4,8,9

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
AIRBUS	A-300B4-2C	CF6-50C	330.00	293.30	77.9	90.0	15*	4,8,9
AIRBUS	A-300B4-2C	CF6-50C	330.00	293.30	77.9	91.5	25	4,8,9
AIRBUS	A-300B4-2C	CF6-50C	336.60	293.30	78.5	90.0	15*	4,8,9
AIRBUS	A-300B4-2C	CF6-50C	346.50	293.30	79.4	90.0	15*	4,8,9
AIRBUS	A-310-203	CF6-80A3	275.57	261.24	72.4	87.4	40	8,15
AIRBUS	A-310-203	CF6-80A3	313.05	267.85	77.2	87.5	40	8,15
AIRBUS	A-310-203C	CF6-80A3	305.55	267.85	76.3	87.5	40	8,15
AIRBUS	A-310-203C	CF6-80A3	313.05	267.85	77.2	87.5	40	8,15
AIRBUS	A-310-204	CF6-80C2A2	295.41	268.96	72.4	89.0	40	8,15
AIRBUS	A-310-204	CF6-80C2A2	313.05	268.96	74.6	89.0	40	8,15
AIRBUS	A-310-221	JT9D-7R4D1	275.57	261.24	72.6	89.0	40	8,15
AIRBUS	A-310-221	JT9D-7R4D1	313.05	267.85	77.3	89.2	40	8,15
AIRBUS	A-310-222	JT9D-7R4E1	305.55	267.85	75.9	89.2	40	8,15
AIRBUS	A-310-222	JT9D-7R4E1	313.05	268.96	76.9	89.2	40	8,15
AIRBUS	A-310-304	CF6-80C2A2	295.41	273.37	72.4	89.1	40	8,15
AIRBUS	A-310-304	CF6-80C2A2	346.12	273.37	78.9	89.1	40	8,15
AIRBUS	A-310-308	CF6-80C2A8	346.12	273.37	75.6	88.9	40	8,15
AIRBUS	A-310-308	CF6-80C2A8	361.55	273.37	77.3	88.9	40	8,15
AIRBUS	A-310-322	JT9D-7R4E1	330.69	271.16	79.0	90.1	40	8,15
AIRBUS	A-310-322	JT9D-7R4E1	337.30	273.37	79.9	90.1	40	8,15
AIRBUS	A-310-324	PW4152	330.69	271.16	76.2	91.6	40	8,15
AIRBUS	A-310-324	PW4152	346.12	273.37	78.2	91.6	40	8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	123.45	121.25	65.9	84.1	20*	8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	123.45	121.25	65.9	84.9	40	8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	166.44	149.91	77.1	84.3	20*	8,15
AIRBUS	A319-111	CFM56-5B5/P; Mod No. 27772	166.44	149.91	77.1	85.4	40	8,15
AIRBUS	A319-112/P	CFM56-5B6/P	123.45	121.25	64.9	84.1	20*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
AIRBUS	A319-112/P	CFM56-5B6/P	123.45	121.25	64.9	84.9	40	8,15
AIRBUS	A319-112/P	CFM56-5B6/P	166.44	149.91	73.3	84.3	20*	8,15
AIRBUS	A319-112/P	CFM56-5B6/P	166.44	149.91	73.3	85.4	40	8,15
AIRBUS	A319-114	CFM56-5A5	123.45	121.25	64.6	84.5	40	8,15
AIRBUS	A319-114	CFM56-5A5	163.14	149.91	74.0	84.9	40	8,15
AIRBUS	A319-131	V2522A5	123.45	121.25	65.7	82.9	40	8,15
AIRBUS	A319-131	V2522A5	158.73	149.91	73.2	83.5	40	8,15
AIRBUS	A319-132	V2524-A5	123.45	121.25	64.3	82.9	40	8,15
AIRBUS	A319-132	V2524-A5	166.44	149.91	74.4	83.5	40	8,15
AIRBUS	A-320-111	CFM56-5A1	149.90	139.90	71.0	85.2	20*	8,15
AIRBUS	A-320-111	CFM56-5A1	149.90	139.90	71.0	85.9	35	8,15
AIRBUS	A-320-211	CFM56-5A1	149.90	142.20	70.7	84.4	20*	8,15
AIRBUS	A-320-211	CFM56-5A1	162.00	142.20	73.7	85.6	35	8,15
AIRBUS	A320-214/P	CFM56-5B4/P	132.27	127.86	65.2	84.2	20*	8,15
AIRBUS	A320-214/P	CFM56-5B4/P	132.27	127.86	65.2	85.1	35	8,15
AIRBUS	A320-214/P	CFM56-5B4/P	171.95	149.91	73.3	84.1	20*	8,15
AIRBUS	A320-214/P	CFM56-5B4/P	171.95	149.91	73.3	85.5	35	8,15
AIRBUS	A-320-231	V2500.A1	149.90	142.20	70.3	83.1	20*	8,15
AIRBUS	A-320-231	V2500.A1	162.00	142.20	72.9	84.7	40	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	127.86	142.20	65.5	83.1	20*	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	127.86	142.20	65.5	84.7	40	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	171.95	142.20	74.6	83.1	20*	8,15
AIRBUS	A320-231	V2500-A1; Mod No. 23408	171.95	142.20	74.6	84.7	40	8,15
AIRBUS	A320-232	V2527-A5	132.27	123.45	66.1	83.5	40	8,15
AIRBUS	A320-232	V2527-A5	182.98	149.91	77.3	83.5	40	8,15
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	165.34	143.29	69.8	85.2	21*	8,15
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	165.34	143.29	69.8	86.0	25	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	205.02	166.44	77.1	85.6	21*	8,15
AIRBUS	A321-211	CFM56-5B3/P; Mod No. 27772	205.02	166.44	77.1	86.7	25	8,15
AIRBUS	A321-231	V2533-A5	165.34	143.29	68.1	84.3	21*	8,15
AIRBUS	A321-231	V2533-A5	165.34	143.29	68.1	84.9	25	8,15
AIRBUS	A321-231	V2533-A5	205.02	166.44	76.2	84.9	21*	8,15
AIRBUS	A321-231	V2533-A5	205.02	166.44	76.2	85.5	25	8,15
AIRBUS UK	1-11-200	MK506-W/HUSHKIT	80.00	71.00	84.1	90.3	45	15
AIRBUS UK	1-11-200	SPEY-MK506	80.00	71.00	85.8	94.3	45	15
AIRBUS UK	1-11-400	MK511-W/HUSHKIT	89.50	78.00	87.5	92.5	45	15
AIRBUS UK	1-11-400	SPEY-MK511	89.50	78.00	90.5	96.2	45	8,15
AIRBUS UK	1-11-500	SPEY-MK512	99.70	87.00	89.9	98.6	45	4
AIRBUS UK	1-11-500	SPEY-MK512	104.50	87.00	90.5	98.6	45	4
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	84.00	83.50	69.3	85.7	24*	8,15,22,43
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	84.00	83.50	71.2	85.7	24*	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	84.00	83.50	71.2	87.4	33	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	84.00	83.50	69.3	87.4	33	8,15,22,43
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	90.00	83.50	73.4	85.7	24*	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	90.00	83.50	73.4	87.4	33	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	95.00	83.50	72.9	85.7	24*	8,15,22,43
BAE SYSTEMS (AVRO)	146-RJ 70	LF507-1F	95.00	83.50	72.9	87.4	33	8,15,22,43
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	89.50	77.50	71.1	85.2	24*	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	89.50	77.50	71.1	86.7	33	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	97.00	85.00	73.7	85.6	24*	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 85	LF507-1F	97.00	85.00	73.7	87.3	33	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	95.00	83.00	73.3	85.5	24*	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	95.00	83.00	73.3	87.2	33	8,15,22
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	101.50	88.50	75.7	85.8	24*	8,15,22

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BAE SYSTEMS (AVRO)	146-RJ 100	LF507-1F	101.50	88.50	75.7	87.6	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-100A	ALF-502R-3A/-5	76.00	72.40	69.1	86.5	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-100A	ALF-502R-3A/-5	84.00	77.50	72.4	87.0	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-200A	ALF-502R-3A/-5	89.50	77.50	76.5	87.0	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-200A	ALF-502R-5	93.00	81.00	76.7	87.2	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	ALF-502R-5	95.00	83.00	77.6	87.3	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	ALF-502R-5	97.50	84.50	78.3	87.0	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	LF507	95.00	83.00	73.4	87.2	33	8,15,22
BAE SYSTEMS (BAe)	BAe-146-300A	LF507	101.50	88.50	75.8	87.6	33	8,15,22
BAE SYSTEMS (BAe)	BAE-748 SERIES 2A	RR DART MK532-2L	44.50	41.50	78.0	88.8	27	8,15
BAE SYSTEMS (BAe)	BAe-748 SERIES 2B	RR-DART MK535-W/HUSHKIT	46.50	43.00	78.0	80.0	27	8,15
BAE SYSTEMS (BAe)	BAe-748 SERIES 2B	RR-DART-MK535	46.50	43.00	78.3	88.8	27	8,15
BAE SYSTEMS (JETSTREAM)	JETSTREAM 31	TPE331-10U-501H	15.20	14.60	63.7	74.7	-	15
BAE SYSTEMS (JETSTREAM)	JETSTREAM 4100	TPE331-14-801H/802H	23.00	22.30	71.6	76.4	15	12,15
BAE SYSTEMS (JETSTREAM)	JETSTREAM 4100	TPE331-14-801H/802H/805H	24.00	23.30	72.5	76.3	15	12,15
BEECH	1900/1900C	PT6A-65B	16.60	16.10	66.5	77.0	-	10
BEECH	300/300C KING AIR	PT6A-60A	14.00	14.00	64.7	75.9	-	
BEECH	35-B33	I0-470-K	3.00	3.00	71.0	68.0	-	10,11
BEECH	35-C33A	I0-520-B	3.30	3.30	70.0	64.0	-	11
BEECH	58 (2BLD)	I0-520-C	5.40	5.40	67.0	73.0	-	11
BEECH	58 (3BLD)	IO-520-C	5.40	5.40	63.0	73.0	-	11
BEECH	58/58A BARON (3 BLD)	IO-550-C	5.50	5.40	65.1	73.3	-	11
BEECH	58P	TSIO-520WB	6.20	6.20	66.0	77.0	-	10,11
BEECH	58TC	TSIO-520-WB	6.20	6.20	67.0	77.0	-	10,11
BEECH	65 QUEENAIR	IGSO-480-A1B6	7.70	7.40	65.9	73.8	-	11
BEECH	76	I0-360-A1G6D	3.90	3.90	62.0	71.0	-	11
BEECH	77	O-235-L2C	1.70	1.70	56.0	60.0	-	11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BEECH	99A	PT6A-27	10.40	10.40	66.0	74.0	-	4
BEECH	A100	PT6A-28	11.50	11.20	62.0	74.0	-	4
BEECH	A-23	IO-360-A	2.40	2.40	58.0	61.0	-	11
BEECH	A24R	I0-360-A1B6	2.80	2.80	65.0	62.0	-	11
BEECH	A36	IO-520-BA	3.60	3.60	71.0	64.0	-	11
BEECH	A36 BONANZA	IO-550-B	3.65	3.65	67.8	64.0	-	11
BEECH	B100 KINGAIR	TPE-331-6	11.80	11.20	61.5	77.1	-	11
BEECH	B200/T/CT/C;C-12F(4 BLD)	PT6A-42	12.50	12.50	66.1	76.6	-	
BEECH	B36TC BONANZA	TSIO-520U	3.85	3.85	71.0	64.0	-	11
BEECH	B55	IO-470-L	5.10	5.10	73.0	73.0	-	11
BEECH	B55(3BLD)	IO-470-L	5.10	5.10	71.0	73.0	-	11
BEECH	B60	TI0-541-E1C4	6.80	6.80	63.0	80.0	-	10,11
BEECH	B80	IGS0-540-A1D	8.80	8.80	66.0	74.0	-	11
BEECH	BEECHJET 400	JT15D-5	15.80	14.20	71.8	83.0	-	15
BEECH	C23	0-360-A4K	2.50	2.50	59.0	62.0	-	11
BEECH	C24R	IO-360-A1B6	2.80	2.80	63.0	62.0	-	11
BEECH	C35	E-185-11	2.70	2.70	75.0	62.0	-	11
BEECH	C90	PT6A-21	9.70	9.70	68.0	75.0	-	10
BEECH	C99 AIRLINER	PT6A-34	11.30	11.30	71.1	77.1	-	5,11
BEECH	D95A TRAVELAIR	IO-320-B1B	4.20	4.20	58.0	71.1	-	11
BEECH	E35	E-225-8	2.70	2.70	75.0	63.0	-	11
BEECH	E55 (2 BLD)	I0-520-C	5.30	5.30	67.0	74.0	-	11
BEECH	E55 (3BLD)	IO-520-C	5.30	5.30	63.0	74.0	-	11
BEECH	F33A	I0-520-B	3.40	3.40	70.0	64.0	-	11
BEECH	F90 KINGAIR	PT6A-135	10.90	10.90	62.0	77.3	-	5,11
BEECH	H18	R-985AN-14B	9.90	9.50	69.6	75.0	-	11
BEECH	K35/M35	IO-470-C	3.00	3.00	70.0	63.0	-	11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BEECH	SUPER KINGAIR 200	PT6A-41	12.50	12.50	68.8	77.8	-	11
BEECH	SUPER KINGAIR B200	PT6A-41	12.50	12.50	68.8	77.8	-	10,11
BEECH	SUPER KINGAIR B200T/CT	PT6A-42	12.50	12.50	68.8	77.8	-	5,11
BEECH	V35B (3BLD)	I0-520-B	3.40	3.40	69.0	64.0	-	11
BELLANCA	17-30A	I0-540-T4B5D	3.30	3.30	65.0	64.0	-	4
BELLANCA	7GCAA	0-320-A2B	1.70	1.70	51.0	60.0	-	4
BELLANCA	8GCBC	0-360-C2E	2.20	2.20	58.0	62.0	-	11
BOEING	B-707-300B/C (COMTRAN QN)	JT3D-3B	322.30	247.00	94.0	98.4	25	8
BOEING	B-717-200	BR700-715A1-30	104.50	98.00	66.3	81.8	40	8,15,52
BOEING	B-717-200	BR700-715A1-30	121.00	110.00	72.0	82.4	40	8,15,52
BOEING	B-717-200	BR700-715A1-30 (MP)	104.50	98.00	66.7	81.7	40	8,15,53
BOEING	B-717-200	BR700-715A1-30 (MP)	121.00	110.00	72.1	82.9	40	8,15,53
BOEING	B-717-200	BR700-715C1-30	104.50	98.00	64.7	81.8	40	8,15,52
BOEING	B-717-200	BR700-715C1-30	121.00	110.00	69.4	82.4	40	8,15,52
BOEING	B-717-200	BR700-715C1-30 (MP)	104.50	98.00	65.2	81.7	40	8,15,53
BOEING	B-717-200	BR700-715C1-30 (MP)	121.00	110.00	69.5	82.9	40	8,15,53
BOEING	B-727-100	JT8D-7FCD	160.50	137.50	83.7	89.1	30*	3,8,14,15
BOEING	B-727-100	JT8D-7FCD	160.50	137.50	83.7	94.5	40	3,8,14,15
BOEING	B-727-100	JT8D-7FCD	169.50	137.50	86.1	89.1	30*	3,8,14,15
BOEING	B-727-100	JT8D-9FCD	160.50	137.50	82.4	96.0	40	3,8,15
BOEING	B-727-100	JT8D-9FCD	169.50	137.50	85.0	92.2	30*	3,8,15
BOEING	B-727-100	JT8D-9FCD	169.50	137.50	85.0	96.0	40	3,8,15
BOEING	B-727-100 (Dee Hwd)	TAY651-54	169.50	142.50	81.5	86.4	30	8,15
BOEING	B-727-100 (Dee Hwd)	TAY651-54	169.50	137.50	81.5	89.6	40	8,15
BOEING	B-727-100 (Fed Ex)	JT8D-7	160.50	137.50	85.2	90.0	30	8,15,16,28
BOEING	B-727-100 (Fed Ex)	JT8D-7	174.50	142.50	86.8	90.3	30	8,15,16,28
BOEING	B-727-100 (Fed Ex)	JT8D-9	160.50	142.50	81.3	89.6	30	8,15,16,29

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B727-100RE(Rohr)	JT8D-217C/JT8D-9	160.50	142.50	75.7	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-217C/JT8D-9	169.50	142.50	77.5	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-217C/JT8D-9	174.50	142.50	78.6	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-7B	169.50	142.50	77.1	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-7B	174.50	142.50	78.1	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-9	169.50	142.50	76.9	87.0	30	8,15,37
BOEING	B727-100RE(Rohr)	JT8D-219/JT8D-9	174.50	142.50	77.8	87.0	30	8,15,37
BOEING	B-727-200	JT8D-15QN	184.20	142.50	87.5	86.1	30*	2,8,14,15
BOEING	B-727-200	JT8D-15QN	184.20	142.50	87.5	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-15QN	190.50	142.50	89.0	86.1	30*	2,8,14,15
BOEING	B-727-200	JT8D-15QN	190.50	142.50	89.0	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-17QN	190.50	142.50	88.5	86.1	30*	2,8,14,15
BOEING	B-727-200	JT8D-17QN	190.50	142.50	88.5	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-17QN	203.10	158.00	92.2	86.1	30*	2,8,14,15
BOEING	B-727-200	JT8D-17QN	203.10	158.00	92.2	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-17RQN	197.00	142.50	89.9	86.1	30*	2,8,15
BOEING	B-727-200	JT8D-17RQN	197.00	142.50	89.9	88.9	40	2,8,15
BOEING	B-727-200	JT8D-17RQN	208.00	142.50	92.6	86.1	30*	2,8,15
BOEING	B-727-200	JT8D-17RQN	208.00	142.50	92.6	88.9	40	2,8,15
BOEING	B-727-200	JT8D-7QN	172.50	142.50	88.0	87.4	30*	2,8,15
BOEING	B-727-200	JT8D-7QN	172.50	142.50	88.0	90.6	40	2,8,15
BOEING	B-727-200	JT8D-9QN	172.50	142.50	86.7	88.9	40	2,8,14,15
BOEING	B-727-200	JT8D-9QN	184.80	142.50	90.4	86.1	30*	2,8,14,15
BOEING	B-727-200	JT8D-9QN	184.80	142.50	90.4	88.9	40	2,8,14,15
BOEING	B-727-200 (Fed Ex)	JT8D-15	190.50	161.00	87.0	89.6	30	8,15,25
BOEING	B-727-200 (Fed Ex)	JT8D-17	190.50	161.00	87.2	89.6	30	8,15,25,28
BOEING	B-727-200 (Fed Ex)	JT8D-17	199.50	166.00	88.5	89.9	30	8,15,25,28

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-727-200 (Fed Ex)	JT8D-7	172.60	150.00	86.6	90.3	30	8,15,24,29
BOEING	B-727-200 (Fed Ex)	JT8D-7	178.00	150.00	88.0	90.3	30	8,15,24,29
BOEING	B-727-200 (Fed Ex)	JT8D-9	165.60	154.50	85.5	89.6	30	8,15,24,28
BOEING	B-727-200 (Fed Ex)	JT8D-9	173.88	150.00	86.0	89.4	30	8,15,24,28
BOEING	B-727-200 (Fed Ex)	JT8D-9	175.00	150.00	85.2	89.9	30	8,15,24,29
BOEING	B-727-200 (Fed Ex)	JT8D-9	189.20	160.00	89.1	89.6	30	8,15,25,28
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-15	184.00	156.00	78.7	90.0	30	8,15,37,47
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-15	209.42	164.00	85.2	90.4	30	8,15,37,47
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17	190.50	159.00	80.4	90.1	30	8,15,37,48
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17	209.50	162.00	85.1	90.2	30	8,15,37,48
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-17A	203.10	164.00	82.8	90.6	30	8,15,37
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-9	184.00	156.00	79.1	90.0	30	8,15,37,46
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-217C/JT8D-9	198.50	162.00	83.1	90.2	30	8,15,37,46
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-15	197.00	159.00	82.0	90.1	30	8,15,37,50,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-15	198.70	162.00	82.0	90.2	30	8,15,37,50,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-17	198.70	162.00	82.0	90.1	30	8,15,37
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	190.50	152.50	79.8	89.8	30	8,15,37,46
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	198.70	162.00	81.9	90.2	30	8,15,37,49,51
BOEING	B-727-200 RE (ROHR STC SA4363NM)	JT8D-219/JT8D-9	198.70	162.00	82.2	90.2	30	8,15,37,46
BOEING	B-737-100 (AVAERO)	JT8D-7	114.50	107.00	81.3	88.8	30	8,15,30
BOEING	B-737-200	JT8D-15QN	115.50	101.00	85.2	88.3	30*	2,8,15
BOEING	B-737-200	JT8D-15QN	115.50	101.00	85.2	92.1	40	2,8,15
BOEING	B-737-200	JT8D-15QN	117.00	101.00	88.0	88.3	30*	2,8,15
BOEING	B-737-200	JT8D-15QN	117.00	101.00	88.0	91.9	40	2,8,15
BOEING	B-737-200	JT8D-17QN	115.50	101.00	84.5	91.6	40	2,8,14,15
BOEING	B-737-200	JT8D-17QN	122.50	103.50	87.3	88.3	30*	2,8,14,15
BOEING	B-737-200	JT8D-17QN	122.50	103.50	87.3	91.0	40	2,8,14,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-200	JT8D-7QN	100.50	95.00	82.4	85.8	30*	2,8,14
BOEING	B-737-200	JT8D-7QN	100.50	95.00	82.4	88.8	40	2,8,14
BOEING	B-737-200	JT8D-7QN	109.00	98.00	85.8	88.8	40	2,8,14
BOEING	B-737-200	JT8D-9QN	109.00	95.00	84.8	87.9	30*	2,8,14,15
BOEING	B-737-200	JT8D-9QN	109.00	95.00	84.8	90.8	40	2,8,14,15
BOEING	B-737-200	JT8D-9QN	114.50	103.00	87.0	87.9	30*	2,8,14,15
BOEING	B-737-200	JT8D-9QN	114.50	103.00	87.0	91.9	40	2,8,14,15
BOEING	B-737-200	JT8D-9QN	117.00	101.70	88.0	87.9	30*	2,8,14,15
BOEING	B-737-200	JT8D-9QN	117.00	101.70	88.0	92.0	40	2,8,14,15
BOEING	B-737-200 (AVAERO)	JT8D-15	118.50	107.00	80.0	88.8	30	8,15,30
BOEING	B-737-200 (AVAERO)	JT8D-15	123.50	107.00	81.9	88.8	30	8,15,32
BOEING	B-737-200 (AVAERO)	JT8D-15	124.50	107.00	81.7	88.8	30	8,15,31
BOEING	B-737-200 (AVAERO)	JT8D-7	114.50	107.00	81.3	88.8	30	8,15,30
BOEING	B-737-200 (AVAERO)	JT8D-9	117.50	107.00	81.5	88.8	30	8,15,30
BOEING	B-737-200 (AVAERO)	JT8D-9	120.50	107.00	81.8	88.8	30	8,15,31
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	118.50	107.00	79.7	88.8	30	8,15,30
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	123.50	107.00	81.7	88.8	30	8,15,32
BOEING	B-737-200 ADV (AVAERO)	JT8D-15	124.50	107.00	81.6	88.8	30	8,15,31
BOEING	B-737-200 ADV (AVAERO)	JT8D-7	114.50	107.00	81.2	88.8	30	8,15,30
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	115.50	88.00	80.6	90.1	40	8,15,30
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	117.50	107.00	81.3	88.8	30	8,15,30
BOEING	B-737-200 ADV (AVAERO)	JT8D-9	121.50	107.00	81.9	88.8	30	8,15,31
BOEING	B-737-300	CFM56-3-B1	124.50	110.00	73.6	87.7	30*	8,15
BOEING	B-737-300	CFM56-3-B1	124.50	110.00	73.6	89.5	40	8,15
BOEING	B-737-300	CFM56-3-B1	139.50	121.00	78.2	88.2	30*	8,15
BOEING	B-737-300	CFM56-3-B1	139.50	121.00	78.2	90.4	40	8,15
BOEING	B-737-300	CFM56-3B-2	124.50	110.00	71.5	87.7	30*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-300	CFM56-3B-2	124.50	110.00	71.5	89.5	40	8,15
BOEING	B-737-300	CFM56-3B-2	139.50	121.00	75.6	88.2	30*	8,15
BOEING	B-737-300	CFM56-3B-2	139.50	121.00	75.6	90.4	40	8,15
BOEING	B-737-400	CFM56-3-B1	138.50	121.00	77.7	88.3	30*	8,15
BOEING	B-737-400	CFM56-3-B1	138.50	121.00	77.7	90.4	40	8,15
BOEING	B-737-400	CFM56-3-B1	142.50	121.00	80.4	88.3	30*	8,15
BOEING	B-737-400	CFM56-3-B1	142.50	121.00	80.4	90.4	40	8,15
BOEING	B-737-400	CFM56-3B-2	138.50	121.00	75.3	88.3	30*	8,15
BOEING	B-737-400	CFM56-3B-2	138.50	121.00	75.3	90.4	40	8,15
BOEING	B-737-400	CFM56-3B-2	150.00	124.00	78.4	88.5	30*	8,15
BOEING	B-737-400	CFM56-3B-2	150.00	124.00	78.4	90.7	40	8,15
BOEING	B-737-400	CFM56-3C-1	138.50	121.00	74.3	88.3	30*	8,15
BOEING	B-737-400	CFM56-3C-1	138.50	121.00	74.3	90.4	40	8,15
BOEING	B-737-400	CFM56-3C-1	150.00	124.00	77.2	88.5	30*	8,15
BOEING	B-737-400	CFM56-3C-1	150.00	124.00	77.2	90.7	40	8,15
BOEING	B-737-500	CFM56-3-B1	115.50	105.00	71.0	87.5	30*	8,15
BOEING	B-737-500	CFM56-3-B1	115.50	105.00	71.0	89.1	40	8,15
BOEING	B-737-500	CFM56-3-B1	139.00	114.00	77.9	88.0	30*	8,15
BOEING	B-737-500	CFM56-3-B1	139.00	114.00	77.9	89.8	40	8,15
BOEING	B-737-500	CFM56-3-B1(R)	115.50	105.00	72.2	87.5	30*	8,15
BOEING	B-737-500	CFM56-3-B1(R)	115.50	105.00	72.2	89.1	40	8,15
BOEING	B-737-500	CFM56-3-B1(R)	132.80	114.00	78.4	88.0	30*	8,15
BOEING	B-737-500	CFM56-3-B1(R)	132.80	114.00	78.4	89.8	40	8,15
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	124.00	120.50	69.0	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	124.00	120.50	69.0	87.7	40	8,15,54
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	145.50	120.50	74.0	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B/2 DAC (B18 derate)	145.50	120.50	74.0	87.7	40	8,15,54

**ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES**

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-600	CFM56-7B18	124.00	120.50	69.2	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B18	124.00	120.50	69.2	86.2	40	8,15
BOEING	B-737-600	CFM56-7B18	145.50	120.50	74.2	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B18	145.50	120.50	74.2	86.2	40	8,15
BOEING	B-737-600	CFM56-7B20	124.00	120.50	68.1	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B20	124.00	120.50	68.1	86.2	40	8,15
BOEING	B-737-600	CFM56-7B20	145.50	120.50	73.1	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B20	145.50	120.50	73.1	86.2	40	8,15
BOEING	B-737-600	CFM56-7B20/2 DAC	124.00	120.50	68.0	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B20/2 DAC	124.00	120.50	68.0	87.7	40	8,15,54
BOEING	B-737-600	CFM56-7B20/2 DAC	145.50	120.50	72.9	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B20/2 DAC	145.50	120.50	72.9	87.7	40	8,15,54
BOEING	B-737-600	CFM56-7B22	124.00	120.50	66.9	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B22	124.00	120.50	66.9	86.2	40	8,15
BOEING	B-737-600	CFM56-7B22	145.50	120.50	71.6	84.1	30*	8,15
BOEING	B-737-600	CFM56-7B22	145.50	120.50	71.6	86.2	40	8,15
BOEING	B-737-600	CFM56-7B22/2 DAC	124.00	120.50	66.7	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B22/2 DAC	124.00	120.50	66.7	87.7	40	8,15,54
BOEING	B-737-600	CFM56-7B22/2 DAC	145.50	120.50	71.3	85.9	30*	8,15,54
BOEING	B-737-600	CFM56-7B22/2 DAC	145.50	120.50	71.3	87.7	40	8,15,54
BOEING	B-737-700	CFM56-7B20	133.00	128.00	70.0	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B20	133.00	128.00	70.0	86.6	40	8,15
BOEING	B-737-700	CFM56-7B20	154.50	129.20	75.1	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B20	154.50	129.20	75.1	86.7	40	8,15
BOEING	B-737-700	CFM56-7B20/2 DAC	133.00	128.00	69.8	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B20/2 DAC	133.00	128.00	69.8	88.0	40	8,15,54
BOEING	B-737-700	CFM56-7B20/2 DAC	154.50	129.20	74.9	86.2	30*	8,15,54

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-700	CFM56-7B20/2 DAC	154.50	129.20	74.9	88.1	40	8,15,54
BOEING	B-737-700	CFM56-7B22	133.00	128.00	68.7	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B22	133.00	128.00	68.7	86.6	40	8,15
BOEING	B-737-700	CFM56-7B22	154.50	129.20	73.4	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B22	154.50	129.20	73.4	86.7	40	8,15
BOEING	B-737-700	CFM56-7B22/2 DAC	133.00	128.00	68.4	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B22/2 DAC	133.00	128.00	68.4	88.0	40	8,15,54
BOEING	B-737-700	CFM56-7B22/2 DAC	154.50	129.20	73.1	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B22/2 DAC	154.50	129.20	73.1	88.1	40	8,15,54
BOEING	B-737-700	CFM56-7B24	133.00	128.00	67.7	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B24	133.00	128.00	67.7	86.6	40	8,15
BOEING	B-737-700	CFM56-7B24	154.50	129.20	72.0	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B24	154.50	129.20	72.0	86.7	40	8,15
BOEING	B-737-700	CFM56-7B24/2 DAC	133.00	128.00	67.5	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B24/2 DAC	133.00	128.00	67.5	88.0	40	8,15,54
BOEING	B-737-700	CFM56-7B24/2 DAC	154.50	129.20	71.8	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B24/2 DAC	154.50	129.20	71.8	88.1	40	8,15,54
BOEING	B-737-700	CFM56-7B26	133.00	128.00	66.5	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B26	133.00	128.00	66.5	86.6	40	8,15
BOEING	B-737-700	CFM56-7B26	154.50	129.20	70.9	84.5	30*	8,15
BOEING	B-737-700	CFM56-7B26	154.50	129.20	70.9	86.7	40	8,15
BOEING	B-737-700	CFM56-7B26/2 DAC	133.00	128.00	66.3	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B26/2 DAC	133.00	128.00	66.3	88.0	40	8,15,54
BOEING	B-737-700	CFM56-7B26/2 DAC	154.50	129.20	70.6	86.2	30*	8,15,54
BOEING	B-737-700	CFM56-7B26/2 DAC	154.50	129.20	70.6	88.1	40	8,15,54
BOEING	B-737-700C/-700ER	CFM56-7B20/2 DAC	154.50	134.00	74.9	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B20/2 DAC	154.50	134.00	74.9	88.3	40	8,15,54,55

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	154.50	134.00	73.1	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	154.50	134.00	73.1	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	171.00	134.00	76.9	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B22/2 DAC	171.00	134.00	76.9	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	154.50	134.00	71.8	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	154.50	134.00	71.8	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	171.00	134.00	75.1	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B24/2 DAC	171.00	134.00	75.1	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	154.50	134.00	70.6	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	154.50	134.00	70.6	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	171.00	134.00	73.9	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B26/2 DAC	171.00	134.00	73.9	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	154.50	134.00	70.3	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	154.50	134.00	70.3	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	171.00	134.00	73.3	86.4	30*	8,15,54,55
BOEING	B-737-700C/-700ER	CFM56-7B27/2 DAC	171.00	134.00	73.3	88.3	40	8,15,54,55
BOEING	B-737-700C/-700ER W	CFM56-7B20/2 DAC	154.50	134.00	74.0	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B20/2 DAC	154.50	134.00	74.0	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	154.50	134.00	72.2	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	154.50	134.00	72.2	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	171.00	134.00	75.7	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B22/2 DAC	171.00	134.00	75.7	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	154.50	134.00	71.2	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	154.50	134.00	71.2	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	171.00	134.00	74.5	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B24/2 DAC	171.00	134.00	74.5	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	154.50	134.00	69.7	86.3	30*	8,15,54,55,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	154.50	134.00	69.7	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	171.00	134.00	72.8	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B26/2 DAC	171.00	134.00	72.8	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	154.50	134.00	69.4	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	154.50	134.00	69.4	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	171.00	134.00	72.3	86.3	30*	8,15,54,55,56
BOEING	B-737-700C/-700ER W	CFM56-7B27/2 DAC	171.00	134.00	72.3	88.2	40	8,15,54,55,56
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B20	154.50	134.00	75.1	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B20	154.50	134.00	75.1	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	154.50	134.00	73.4	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	154.50	134.00	73.4	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	171.00	134.00	77.1	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B22	171.00	134.00	77.1	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	154.50	134.00	72.0	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	154.50	134.00	72.0	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	171.00	134.00	75.4	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B24	171.00	134.00	75.4	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	154.50	134.00	70.9	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	154.50	134.00	70.9	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	171.00	134.00	74.2	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B26; -7B26/B1	171.00	134.00	74.2	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	154.50	134.00	70.5	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	154.50	134.00	70.5	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	171.00	134.00	73.6	84.8	30*	8,15,55
BOEING	B-737-700C/-700ER/BBJ	CFM56-7B27; -7B27/B3	171.00	134.00	73.6	86.9	40	8,15,55
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B20	154.50	134.00	74.3	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B20	154.50	134.00	74.3	86.8	40	8,15,55,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	154.50	134.00	72.5	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	154.50	134.00	72.5	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	171.00	134.00	76.0	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B22	171.00	134.00	76.0	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	154.50	134.00	71.4	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	154.50	134.00	71.4	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	171.00	134.00	74.8	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B24	171.00	134.00	74.8	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	154.50	134.00	70.0	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	154.50	134.00	70.0	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	171.00	134.00	73.1	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B26; -7B26/B1	171.00	134.00	73.1	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	154.50	134.00	69.6	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	154.50	134.00	69.6	86.8	40	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	171.00	134.00	72.6	84.7	30*	8,15,55,56
BOEING	B-737-700C/-700ER/BBJ W	CFM56-7B27; -7B27/B3	171.00	134.00	72.6	86.8	40	8,15,55,56
BOEING	B-737-700W	CFM56-7B20	133.00	128.00	69.2	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B20	133.00	128.00	69.2	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B20	154.50	129.20	74.3	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B20	154.50	129.20	74.3	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B20/2 DAC	133.00	128.00	69.1	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B20/2 DAC	133.00	128.00	69.1	87.9	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B20/2 DAC	154.50	129.20	74.0	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B20/2 DAC	154.50	129.20	74.0	88.0	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B22	133.00	128.00	67.8	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B22	133.00	128.00	67.8	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B22	154.50	129.20	72.5	84.4	30*	8,15,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-700W	CFM56-7B22	154.50	129.20	72.5	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	133.00	128.00	67.7	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	133.00	128.00	67.7	87.9	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	154.50	129.20	72.2	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B22/2 DAC	154.50	129.20	72.2	88.0	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B24	133.00	128.00	66.9	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B24	133.00	128.00	66.9	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B24	154.50	129.20	71.4	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B24	154.50	129.20	71.4	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B24/2 DAC	133.00	128.00	66.8	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B24/2 DAC	133.00	128.00	66.8	87.9	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B24/2 DAC	154.50	129.20	71.2	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B24/2 DAC	154.50	129.20	71.2	88.0	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B26	133.00	128.00	65.8	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B26	133.00	128.00	65.8	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B26	154.50	129.20	70.0	84.4	30*	8,15,56
BOEING	B-737-700W	CFM56-7B26	154.50	129.20	70.0	86.5	40	8,15,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	133.00	128.00	65.6	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	133.00	128.00	65.6	87.9	40	8,15,54,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	154.50	129.20	69.7	86.1	30*	8,15,54,56
BOEING	B-737-700W	CFM56-7B26/2 DAC	154.50	129.20	69.7	88.0	40	8,15,54,56
BOEING	B-737-800	CFM56-7B24	155.50	144.00	72.7	85.4	30*	8,15
BOEING	B-737-800	CFM56-7B24	155.50	144.00	72.7	87.4	40	8,15
BOEING	B-737-800	CFM56-7B24	174.20	146.30	76.8	85.5	30*	8,15
BOEING	B-737-800	CFM56-7B24	174.20	146.30	76.8	87.5	40	8,15
BOEING	B-737-800	CFM56-7B24/2 DAC	155.50	144.00	72.4	86.8	30*	8,15,54
BOEING	B-737-800	CFM56-7B24/2 DAC	155.50	144.00	72.4	88.7	40	8,15,54

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-800	CFM56-7B24/2 DAC	174.20	146.30	76.5	86.9	30*	8,15,54
BOEING	B-737-800	CFM56-7B24/2 DAC	174.20	146.30	76.5	88.8	40	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	155.50	144.00	71.1	86.8	30*	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	155.50	144.00	71.1	88.7	40	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	174.20	146.30	75.0	86.9	30*	8,15,54
BOEING	B-737-800	CFM56-7B26/2 DAC	174.20	146.30	75.0	88.8	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	155.50	144.00	70.4	86.8	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	155.50	144.00	70.4	88.7	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	174.20	146.30	74.2	86.9	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2 DAC	174.20	146.30	74.2	88.8	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	155.50	144.00	70.3	86.8	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	155.50	144.00	70.3	88.7	40	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	174.20	146.30	73.9	86.9	30*	8,15,54
BOEING	B-737-800	CFM56-7B27/2B1 DAC	174.20	146.30	73.9	88.8	40	8,15,54
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	155.50	144.00	71.3	85.4	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	155.50	144.00	71.3	87.4	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	174.20	146.30	75.3	85.5	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B26; -7B26/B1	174.20	146.30	75.3	87.5	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	155.50	144.00	70.5	85.4	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	155.50	144.00	70.5	87.4	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	174.20	146.30	74.1	85.5	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27/B1; -7B27/B2	174.20	146.30	74.1	87.5	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	155.50	144.00	70.7	85.4	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	155.50	144.00	70.7	87.4	40	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	174.20	146.30	74.5	85.5	30*	8,15
BOEING	B-737-800/BBJ 2	CFM56-7B27; -7B27/B3	174.20	146.30	74.5	87.5	40	8,15
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	155.50	144.00	71.3	85.4	30*	8,15,60

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	155.50	144.00	71.3	87.3	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	174.20	146.30	75.1	85.5	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B26; -7B26/B1	174.20	146.30	75.1	87.4	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	155.50	144.00	70.5	85.4	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	155.50	144.00	70.5	87.3	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	174.20	146.30	74.1	85.5	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27/B1; -7B27/B2	174.20	146.30	74.1	87.4	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	155.50	144.00	70.7	85.4	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	155.50	144.00	70.7	87.3	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	174.20	146.30	74.5	85.5	30*	8,15,60
BOEING	B-737-800/BBJ 2 SFP	CFM56-7B27; -7B27/B3	174.20	146.30	74.5	87.4	40	8,15,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	155.50	144.00	70.2	85.3	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	155.50	144.00	70.2	87.2	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	174.20	146.30	74.0	85.4	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B26; -7B26/B1	174.20	146.30	74.0	87.3	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	155.50	144.00	69.4	85.3	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	155.50	144.00	69.4	87.2	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	174.20	146.30	73.0	85.4	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27/B1; -7B27/B2	174.20	146.30	73.0	87.3	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	155.50	144.00	69.7	85.3	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	155.50	144.00	69.7	87.2	40	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	174.20	146.30	73.4	85.4	30*	8,15,56,60
BOEING	B-737-800/BBJ 2 SFP W	CFM56-7B27; -7B27/B3	174.20	146.30	73.4	87.3	40	8,15,56,60
BOEING	B-737-800SFP	CFM56-7B24	155.50	144.00	72.8	85.4	30*	8,15,60
BOEING	B-737-800SFP	CFM56-7B24	155.50	144.00	72.8	87.3	40	8,15,60
BOEING	B-737-800SFP	CFM56-7B24	174.20	146.30	76.9	85.5	30*	8,15,60
BOEING	B-737-800SFP	CFM56-7B24	174.20	146.30	76.9	87.4	40	8,15,60

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-800SFP W	CFM56-7B24	155.50	144.00	71.8	85.3	30*	8,15,56,60
BOEING	B-737-800SFP W	CFM56-7B24	155.50	144.00	71.8	87.2	40	8,15,56,60
BOEING	B-737-800SFP W	CFM56-7B24	174.20	146.30	75.9	85.4	30*	8,15,56,60
BOEING	B-737-800SFP W	CFM56-7B24	174.20	146.30	75.9	87.3	40	8,15,56,60
BOEING	B-737-800W	CFM56-7B24	155.50	144.00	71.9	85.2	30*	8,15,56
BOEING	B-737-800W	CFM56-7B24	155.50	144.00	71.9	87.3	40	8,15,56
BOEING	B-737-800W	CFM56-7B24	174.20	146.30	76.0	85.4	30*	8,15,56
BOEING	B-737-800W	CFM56-7B24	174.20	146.30	76.0	87.4	40	8,15,56
BOEING	B-737-800W	CFM56-7B24/2 DAC	155.50	144.00	71.7	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B24/2 DAC	155.50	144.00	71.7	88.6	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B24/2 DAC	174.20	146.30	75.7	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B24/2 DAC	174.20	146.30	75.7	88.7	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	155.50	144.00	70.2	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	155.50	144.00	70.2	88.6	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	174.20	146.30	73.8	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B26/2 DAC	174.20	146.30	73.8	88.7	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	155.50	144.00	69.6	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	155.50	144.00	69.6	88.6	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	174.20	146.30	73.1	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2 DAC	174.20	146.30	73.1	88.7	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	155.50	144.00	69.4	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	155.50	144.00	69.4	88.6	40	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	174.20	146.30	72.9	86.7	30*	8,15,54,56
BOEING	B-737-800W	CFM56-7B27/2B1 DAC	174.20	146.30	72.9	88.7	40	8,15,54,56
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	155.50	144.00	70.4	85.2	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	155.50	144.00	70.4	87.3	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	174.20	146.30	74.1	85.4	30*	8,15,56

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-800W/BBJ 2	CFM56-7B26; -7B26/B1	174.20	146.30	74.1	87.4	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	155.50	144.00	69.6	85.2	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	155.50	144.00	69.6	87.3	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	174.20	146.30	73.2	85.4	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27/B1; -7B27/B2	174.20	146.30	73.2	87.4	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	155.50	144.00	69.8	85.2	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	155.50	144.00	69.8	87.3	40	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	174.20	146.30	73.4	85.4	30*	8,15,56
BOEING	B-737-800W/BBJ 2	CFM56-7B27; -7B27/B3	174.20	146.30	73.4	87.4	40	8,15,56
BOEING	B-737-900	CFM56-7B24	164.00	146.30	74.8	85.6	30*	8,15
BOEING	B-737-900	CFM56-7B24	164.00	146.30	74.8	87.4	40	8,15
BOEING	B-737-900	CFM56-7B24	174.20	147.30	77.1	85.7	30*	8,15
BOEING	B-737-900	CFM56-7B24	174.20	147.30	77.1	87.5	40	8,15
BOEING	B-737-900	CFM56-7B26	164.00	146.30	73.0	85.6	30*	8,15
BOEING	B-737-900	CFM56-7B26	164.00	146.30	73.0	87.4	40	8,15
BOEING	B-737-900	CFM56-7B26	174.20	147.30	75.2	85.7	30*	8,15
BOEING	B-737-900	CFM56-7B26	174.20	147.30	75.2	87.5	40	8,15
BOEING	B-737-900	CFM56-7B27	164.00	146.30	72.4	85.6	30*	8,15
BOEING	B-737-900	CFM56-7B27	164.00	146.30	72.4	87.4	40	8,15
BOEING	B-737-900	CFM56-7B27	174.20	147.30	74.5	85.7	30*	8,15
BOEING	B-737-900	CFM56-7B27	174.20	147.30	74.5	87.5	40	8,15
BOEING	B-737-900	CFM56-7B27/B1	164.00	146.30	72.1	85.6	30*	8,15
BOEING	B-737-900	CFM56-7B27/B1	164.00	146.30	72.1	87.4	40	8,15
BOEING	B-737-900	CFM56-7B27/B1	174.20	147.30	74.2	85.7	30*	8,15
BOEING	B-737-900	CFM56-7B27/B1	174.20	147.30	74.2	87.5	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	164.00	149.30	73.7	86.4	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	164.00	149.30	73.7	87.5	40	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	187.70	157.30	78.9	86.7	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B26	187.70	157.30	78.9	87.8	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	164.00	149.30	73.0	86.4	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	164.00	149.30	73.0	87.5	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	187.70	157.30	78.0	86.7	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27	187.70	157.30	78.0	87.8	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	164.00	149.30	72.7	86.4	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	164.00	149.30	72.7	87.5	40	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	187.70	157.30	77.6	86.7	30*	8,15
BOEING	B-737-900ER/BBJ 3	CFM56-7B27/B1	187.70	157.30	77.6	87.8	40	8,15
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	164.00	149.30	73.0	86.1	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	164.00	149.30	73.0	87.3	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	187.70	157.30	78.1	86.5	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B26	187.70	157.30	78.1	87.6	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	164.00	149.30	72.3	86.1	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	164.00	149.30	72.3	87.3	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	187.70	157.30	77.2	86.5	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27	187.70	157.30	77.2	87.6	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	164.00	149.30	72.0	86.1	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	164.00	149.30	72.0	87.3	40	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	187.70	157.30	76.8	86.5	30*	8,15,56
BOEING	B-737-900ER/BBJ 3 W	CFM56-7B27/B1	187.70	157.30	76.8	87.6	40	8,15,56
BOEING	B-737-900W	CFM56-7B24	164.00	146.30	74.8	85.6	30*	8,15,56
BOEING	B-737-900W	CFM56-7B24	164.00	146.30	74.8	87.4	40	8,15,56
BOEING	B-737-900W	CFM56-7B24	174.20	147.30	77.1	85.7	30*	8,15,56
BOEING	B-737-900W	CFM56-7B24	174.20	147.30	77.1	87.5	40	8,15,56
BOEING	B-737-900W	CFM56-7B26	164.00	146.30	73.0	85.6	30*	8,15,56

**ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES**

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-737-900W	CFM56-7B26	164.00	146.30	73.0	87.4	40	8,15,56
BOEING	B-737-900W	CFM56-7B26	174.20	147.30	75.2	85.7	30*	8,15,56
BOEING	B-737-900W	CFM56-7B26	174.20	147.30	75.2	87.5	40	8,15,56
BOEING	B-737-900W	CFM56-7B27	164.00	146.30	72.4	85.6	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27	164.00	146.30	72.4	87.4	40	8,15,56
BOEING	B-737-900W	CFM56-7B27	174.20	147.30	74.5	85.7	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27	174.20	147.30	74.5	87.5	40	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	164.00	146.30	72.1	85.6	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	164.00	146.30	72.1	87.4	40	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	174.20	147.30	74.2	85.7	30*	8,15,56
BOEING	B-737-900W	CFM56-7B27/B1	174.20	147.30	74.2	87.5	40	8,15,56
BOEING	B-747-100	CF6-45A2	570.00	564.00	80.0	92.3	25*	8,15
BOEING	B-747-100	CF6-45A2	570.00	564.00	80.0	93.4	30	8,15
BOEING	B-747-100	CF6-45A2	767.00	605.00	92.0	92.6	25*	8,15
BOEING	B-747-100	CF6-45A2	767.00	605.00	92.0	93.9	30	8,15
BOEING	B-747-100	CF6-50E2	750.00	564.00	92.0	92.3	25*	8,15
BOEING	B-747-100	CF6-50E2	750.00	605.00	92.0	92.6	25*	8,15
BOEING	B-747-100	CF6-50E2	750.00	564.00	92.0	93.4	30	8,15
BOEING	B-747-100	CF6-50E2	750.00	605.00	92.0	93.9	30	8,15
BOEING	B-747-100	JT9D-7	710.00	564.00	99.1	97.2	30	4,6
BOEING	B-747-100	JT9D-7F	750.00	585.00	100.5	97.8	30	4,6
BOEING	B-747-100	JT9D-7FWET	750.00	585.00	100.5	97.8	30	4,6
BOEING	B-747-100	JT9D-7WET	750.00	585.00	100.2	97.3	30	4,6
BOEING	B-747-200	JT9D-3A	767.00	564.00	100.5	95.9	30	4,6
BOEING	B-747-200	JT9D-3AWET	773.00	585.00	99.6	96.1	30	4,6
BOEING	B-747-200	JT9D-7	770.00	564.00	99.4	96.1	30	4,6
BOEING	B-747-200	JT9D-70A	820.00	630.00	94.1	95.2	30	4

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ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-747-200	JT9D-7F	775.00	564.00	99.1	96.6	30	4,6
BOEING	B-747-200	JT9D-7FWET	805.00	630.00	99.9	97.2	30	4,6
BOEING	B-747-200	JT9D-7WET	785.00	630.00	99.3	96.7	30	4,6
BOEING	B-747-200	RB211-524B	800.00	630.00	96.0	97.2	30	4
BOEING	B-747-200/300	CF6-50E	775.00	564.00	89.4	92.9	25*	8,15
BOEING	B-747-200/300	CF6-50E	775.00	564.00	89.4	94.4	30	8,15
BOEING	B-747-200/300	CF6-50E	833.00	666.00	92.2	93.8	25	8,15
BOEING	B-747-200/300	CF6-50E	833.00	630.00	92.2	94.8	30	8,15
BOEING	B-747-200/300	CF6-50E2	775.00	564.00	89.6	92.3	25*	8,15
BOEING	B-747-200/300	CF6-50E2	775.00	564.00	89.6	93.4	30	8,15
BOEING	B-747-200/300	CF6-50E2	833.00	666.00	92.2	93.0	25	8,15
BOEING	B-747-200/300	CF6-50E2	833.00	630.00	92.2	94.2	30	8,15
BOEING	B-747-200/300	CF6-80C2B1F	820.00	564.00	86.1	92.7	25*	8,15
BOEING	B-747-200/300	CF6-80C2B1F	820.00	564.00	86.1	93.7	30	8,15
BOEING	B-747-200/300	CF6-80C2B1F	833.00	666.00	86.9	93.3	25*	8,15
BOEING	B-747-200/300	CF6-80C2B1F	833.00	666.00	86.9	95.0	30	8,15
BOEING	B-747-200/300	RB211-524C2	775.00	564.00	95.7	95.3	25*	15
BOEING	B-747-200/300	RB211-524C2	775.00	564.00	95.7	96.5	30	15
BOEING	B-747-200/300	RB211-524C2	833.00	666.00	99.1	95.9	25	15
BOEING	B-747-200/300	RB211-524C2	833.00	585.00	99.1	96.8	30	15
BOEING	B-747-200/300	RB211-524D4	775.00	564.00	90.2	93.5	30	8,15
BOEING	B-747-200/300	RB211-524D4	775.00	564.00	90.2	93.5	25*	8,15
BOEING	B-747-200/300	RB211-524D4	833.00	666.00	93.9	93.5	25*	8,15
BOEING	B-747-200/300	RB211-524D4	833.00	666.00	93.9	94.1	30	8,15
BOEING	B-747-400	CF6-80C2B1F	820.00	564.00	85.2	92.5	25*	8,15
BOEING	B-747-400	CF6-80C2B1F	820.00	564.00	85.2	93.3	30	8,15
BOEING	B-747-400	CF6-80C2B1F	875.00	652.00	87.9	92.9	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-747-400	CF6-80C2B1F	875.00	652.00	87.9	94.2	30	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	820.00	564.00	85.2	92.5	25*	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	820.00	564.00	85.2	93.3	30	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	875.00	652.00	87.9	92.9	25*	8,15
BOEING	B-747-400	CF6-80C2B1F W/N1 MOD	875.00	652.00	87.9	94.2	30	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	820.00	564.00	84.3	93.1	25*	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	820.00	564.00	84.3	93.4	30	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	875.00	652.00	87.5	93.2	25*	8,15
BOEING	B-747-400	PW4056 PHASE 1/PKG B	875.00	652.00	87.5	93.9	30	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	820.00	564.00	84.5	93.0	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	820.00	564.00	84.5	93.3	30	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	875.00	652.00	87.6	93.1	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2B)	875.00	652.00	87.6	93.8	30	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	820.00	564.00	83.2	91.8	25*	8,15,23
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	820.00	564.00	83.2	92.0	30	8,15,23
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	820.00	564.00	84.1	93.0	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	820.00	564.00	84.1	93.1	30	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	875.00	652.00	86.1	91.9	25*	8,15,23
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	875.00	652.00	86.1	92.5	30	8,15,23
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	875.00	652.00	87.3	93.0	25*	8,15
BOEING	B-747-400	PW4056 PHASE 3 (FB2C)	875.00	652.00	87.3	93.5	30	8,15
BOEING	B-747-400	PW4056 PKG A (FB2T)	820.00	564.00	86.7	93.9	30	8,15
BOEING	B-747-400	PW4056 PKG A (FB2T)	820.00	564.00	86.7	94.1	25*	8,15
BOEING	B-747-400	PW4056 PKG A (FB2T)	875.00	652.00	89.8	94.0	25*	8,15
BOEING	B-747-400	PW4056 PKG A (FB2T)	875.00	652.00	89.8	94.3	30	8,15
BOEING	B-747-400	RB211-524G	820.00	564.00	87.9	92.4	30	8,15
BOEING	B-747-400	RB211-524G	820.00	585.00	87.9	92.8	25	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-747-400	RB211-524G	875.00	652.00	90.8	92.5	25*	8,15
BOEING	B-747-400	RB211-524G	875.00	652.00	90.8	93.0	30	8,15
BOEING	B-747-400	RB211-524H	820.00	564.00	86.3	92.4	30	8,15
BOEING	B-747-400	RB211-524H	820.00	585.00	86.3	92.8	25	8,15
BOEING	B-747-400	RB211-524H	875.00	652.00	89.0	92.5	25*	8,15
BOEING	B-747-400	RB211-524H	875.00	652.00	89.0	93.0	30	8,15
BOEING	B-747-400D	CF6-80C2B1F	600.00	564.00	75.3	92.6	25*	8,15
BOEING	B-747-400D	CF6-80C2B1F	600.00	564.00	75.3	93.9	30	8,15
BOEING	B-747-400D	CF6-80C2B1F	833.00	630.00	86.3	93.0	25*	8,15
BOEING	B-747-400D	CF6-80C2B1F	833.00	630.00	86.3	94.2	30	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	600.00	564.00	75.6	92.6	25*	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	600.00	564.00	75.6	93.9	30	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	833.00	630.00	86.8	93.0	25*	8,15
BOEING	B-747-400D	CF6-80C2B1F W/N1 MOD	833.00	630.00	86.8	94.2	30	8,15
BOEING	B-747-400F	CF6-80C2B1F	830.00	630.00	85.2	92.8	25*	8,15
BOEING	B-747-400F	CF6-80C2B1F	830.00	630.00	85.2	93.9	30	8,15
BOEING	B-747-400F	CF6-80C2B1F	875.00	666.00	87.5	93.0	25*	8,15
BOEING	B-747-400F	CF6-80C2B1F	875.00	666.00	87.5	94.3	30	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	830.00	630.00	85.6	92.8	25*	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	830.00	630.00	85.6	93.9	30	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	875.00	666.00	88.0	93.0	25*	8,15
BOEING	B-747-400F	CF6-80C2B1F W/N1 MOD	875.00	666.00	88.0	94.3	30	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	830.00	630.00	83.7	92.2	25*	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	830.00	630.00	83.7	92.8	30	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	875.00	666.00	86.3	92.3	25*	8,15
BOEING	B-747-400F	PW4056 FB2B/2C	875.00	666.00	86.3	93.0	30	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	830.00	630.00	86.7	94.1	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-747-400F	PW4056 PKG A (FB2T)	830.00	630.00	86.7	94.1	25*	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	875.00	666.00	89.4	94.0	25*	8,15
BOEING	B-747-400F	PW4056 PKG A (FB2T)	875.00	666.00	89.4	94.4	30	8,15
BOEING	B-747-400F	RB211-524G	830.00	630.00	88.0	92.6	25*	8,15
BOEING	B-747-400F	RB211-524G	830.00	630.00	88.0	92.8	30	8,15
BOEING	B-747-400F	RB211-524G	875.00	666.00	90.4	92.5	25*	8,15
BOEING	B-747-400F	RB211-524G	875.00	666.00	90.4	93.1	30	8,15
BOEING	B-747-400F	RB211-524H	830.00	630.00	86.7	92.6	25*	8,15
BOEING	B-747-400F	RB211-524H	830.00	630.00	86.7	92.8	30	8,15
BOEING	B-747-400F	RB211-524H	875.00	666.00	89.0	92.5	25*	8,15
BOEING	B-747-400F	RB211-524H	875.00	666.00	89.0	93.1	30	8,15
BOEING	B-747-SP	JT9D-7A	660.00	450.00	94.9	92.8	30	4,6
BOEING	B-747-SP	JT9D-7A	690.00	450.00	96.1	93.1	30	4,6
BOEING	B-747-SP	JT9D-7F	660.00	475.00	94.9	93.1	30	4,6
BOEING	B-747-SP	JT9D-7FWET	695.00	475.00	96.2	93.5	30	4,6
BOEING	B-747-SR	JT9D-7A	570.00	564.00	90.0	95.6	30	4,6
BOEING	B-747-SR	JT9D-7A	610.00	564.00	92.9	96.1	30	4,6
BOEING	B-757-200	PW2037	220.00	198.00	69.6	86.2	25*	8,15
BOEING	B-757-200	PW2037	220.00	198.00	69.6	87.2	30	8,15
BOEING	B-757-200	PW2037	255.50	210.00	75.9	86.7	25*	8,15
BOEING	B-757-200	PW2037	255.50	210.00	75.9	87.9	30	8,15
BOEING	B-757-200	PW2037 (CBQFC)	220.00	198.00	68.0	85.0	25*	8,15,40
BOEING	B-757-200	PW2037 (CBQFC)	220.00	198.00	68.0	86.0	30	8,15,40
BOEING	B-757-200	PW2037 (CBQFC)	255.50	210.00	74.3	85.5	25*	8,15,40
BOEING	B-757-200	PW2037 (CBQFC)	255.50	210.00	74.3	86.5	30	8,15,40
BOEING	B-757-200	PW2037 (nCBQFC)	220.00	198.00	68.1	85.1	25*	8,15,41
BOEING	B-757-200	PW2037 (nCBQFC)	220.00	198.00	68.1	86.0	30	8,15,41

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-757-200	PW2037 (nCBQFC)	255.50	210.00	74.5	85.6	25*	8,15,41
BOEING	B-757-200	PW2037 (nCBQFC)	255.50	210.00	74.5	86.5	30	8,15,41
BOEING	B-757-200	PW-2037(BG-3)	220.00	198.00	69.6	86.2	25*	8,15,39
BOEING	B-757-200	PW-2037(BG-3)	220.00	198.00	69.6	87.2	30	8,15,39
BOEING	B-757-200	PW2037(BG-3)	255.50	210.00	75.9	86.7	25*	8,15,39
BOEING	B-757-200	PW2037(BG-3)	255.50	210.00	75.9	87.9	30	8,15,39
BOEING	B-757-200	PW2040	220.00	198.00	67.9	86.2	25*	8,15
BOEING	B-757-200	PW2040	220.00	198.00	67.9	87.2	30	8,15
BOEING	B-757-200	PW2040	255.50	210.00	73.7	86.7	25*	8,15
BOEING	B-757-200	PW2040	255.50	210.00	73.7	87.9	30	8,15
BOEING	B-757-200	PW2040 (CBQFC)	220.00	198.00	66.6	85.0	25*	8,15,40
BOEING	B-757-200	PW2040 (CBQFC)	220.00	198.00	66.6	86.0	30	8,15,40
BOEING	B-757-200	PW2040 (CBQFC)	255.50	210.00	72.2	85.5	25*	8,15,40
BOEING	B-757-200	PW2040 (CBQFC)	255.50	210.00	72.2	86.5	30	8,15,40
BOEING	B-757-200	PW2040 (nCBQFC)	220.00	198.00	66.7	85.1	25*	8,15,41
BOEING	B-757-200	PW2040 (nCBQFC)	220.00	198.00	66.7	86.0	30	8,15,41
BOEING	B-757-200	PW2040 (nCBQFC)	255.50	210.00	72.4	85.6	25*	8,15,41
BOEING	B-757-200	PW2040 (nCBQFC)	255.50	210.00	72.4	86.5	30	8,15,41
BOEING	B-757-200	RB211-535C	220.00	198.00	72.8	88.9	25*	8,15
BOEING	B-757-200	RB211-535C	220.00	198.00	72.8	90.0	30	8,15
BOEING	B-757-200	RB211-535C	240.00	210.00	75.9	89.2	25*	8,15
BOEING	B-757-200	RB211-535C	240.00	210.00	75.9	89.2	30	8,15
BOEING	B-757-200	RB211-535E4	220.00	198.00	67.8	84.5	25*	8,15,35
BOEING	B-757-200	RB211-535E4	220.00	198.00	68.1	84.5	25*	8,15,36
BOEING	B-757-200	RB211-535E4	220.00	198.00	67.8	84.9	30	8,15,35
BOEING	B-757-200	RB211-535E4	220.00	198.00	68.1	84.9	30	8,15,36
BOEING	B-757-200	RB211-535E4	255.50	210.00	73.7	84.9	25*	8,15,35

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-757-200	RB211-535E4	255.50	210.00	73.7	84.9	25*	8,15,36
BOEING	B-757-200	RB211-535E4	255.50	210.00	73.7	85.3	30	8,15,36
BOEING	B-757-200	RB211-535E4	255.50	210.00	73.7	85.3	30	8,15,35
BOEING	B-757-200	RB211-535E4B	220.00	198.00	67.1	84.5	25*	8,15,36
BOEING	B-757-200	RB211-535E4B	220.00	198.00	66.7	84.5	25*	8,15,35
BOEING	B-757-200	RB211-535E4B	220.00	198.00	66.7	84.9	30	8,15,35
BOEING	B-757-200	RB211-535E4B	220.00	198.00	67.1	84.9	30	8,15,36
BOEING	B-757-200	RB211-535E4B	255.50	210.00	72.3	84.9	25*	8,15,35
BOEING	B-757-200	RB211-535E4B	255.50	210.00	72.4	84.9	25*	8,15,36
BOEING	B-757-200	RB211-535E4B	255.50	210.00	72.4	85.3	30	8,15,36
BOEING	B-757-200	RB211-535E4B	255.50	210.00	72.3	85.3	30	8,15,35
BOEING	B-757-300	RB211-535E4	236.00	210.00	71.0	85.1	25	8,15,35
BOEING	B-757-300	RB211-535E4	236.00	210.00	71.0	85.7	30	8,15,35
BOEING	B-757-300	RB211-535E4	275.00	224.00	77.2	85.6	25	8,15,35
BOEING	B-757-300	RB211-535E4	275.00	224.00	77.2	86.2	30	8,15,35
BOEING	B-757-300	RB211-535E4B	235.87	210.00	69.0	85.1	25	8,15,35
BOEING	B-757-300	RB211-535E4B	235.87	210.00	69.0	85.7	30	8,15,35
BOEING	B-757-300	RB211-535E4B	275.00	224.00	75.1	85.6	25	8,15,35
BOEING	B-757-300	RB211-535E4B	275.00	224.00	75.1	86.2	30	8,15,35
BOEING	B-757-300	RB211-535E4C	235.87	210.00	69.0	85.1	25	8,15,35
BOEING	B-757-300	RB211-535E4C	235.87	210.00	69.0	85.7	30	8,15,35
BOEING	B-757-300	RB211-535E4C	275.00	224.00	75.1	85.6	25	8,15,35
BOEING	B-757-300	RB211-535E4C	275.00	224.00	75.1	86.2	30	8,15,35
BOEING	B-767-200	JT9D-7R4D	282.00	257.00	72.9	90.4	30	8,15
BOEING	B-767-200	JT9D-7R4D	315.00	270.00	77.1	89.2	25*	8,15
BOEING	B-767-200	JT9D-7R4E	360.00	300.00	82.3	89.5	25*	8,15
BOEING	B-767-200	JT9D-7R4E	360.00	300.00	82.3	91.3	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-767-200/200ER	CF6-80A	279.90	257.00	71.3	89.1	30	8,15
BOEING	B-767-200/200ER	CF6-80C2B2	300.00	270.00	70.3	88.4	30	8,15
BOEING	B-767-200/200ER	CF6-80C2B2	351.00	300.00	75.8	88.4	30	8,15
BOEING	B-767-200/200ER	CF6-80C2B4	351.00	270.00	73.8	88.4	30	8,15
BOEING	B-767-200/200ER	CF6-80C2B4	387.00	300.00	77.7	88.4	30	8,15
BOEING	B-767-200/200ER	PW4052	335.00	270.00	74.3	90.0	30	8,15
BOEING	B-767-200/200ER	PW4052	351.00	285.00	76.2	90.0	30	8,15
BOEING	B-767-200/200ER	PW4056	340.00	270.00	73.3	89.1	30	8,15
BOEING	B-767-200/200ER	PW4056 PHASE 3 (FB2C)	395.00	300.00	77.3	88.4	30	8,15,23
BOEING	B-767-300	CF6-80A	300.00	280.00	74.5	89.1	25*	8,15
BOEING	B-767-300	CF6-80A	300.00	280.00	74.5	89.2	30	8,15
BOEING	B-767-300	CF6-80A	351.00	320.00	80.6	89.2	25*	8,15
BOEING	B-767-300	CF6-80A	351.00	320.00	80.6	89.4	30	8,15
BOEING	B-767-300	CF6-80A2	300.00	280.00	73.7	89.1	25*	8,15
BOEING	B-767-300	CF6-80A2	300.00	280.00	73.7	89.2	30	8,15
BOEING	B-767-300	CF6-80A2	351.00	320.00	79.7	89.2	25*	8,15
BOEING	B-767-300	CF6-80A2	351.00	320.00	79.7	89.4	30	8,15
BOEING	B-767-300	JT9D-7R4D(B)	300.00	280.00	75.7	89.7	25*	8,15
BOEING	B-767-300	JT9D-7R4D(B)	300.00	280.00	75.7	91.2	30	8,15
BOEING	B-767-300	JT9D-7R4D(B)	351.00	320.00	81.6	90.8	25*	8,15
BOEING	B-767-300	JT9D-7R4D(B)	351.00	320.00	81.6	92.3	30	8,15
BOEING	B-767-300	JT9D-7R4E	300.00	280.00	74.8	89.7	25*	8,15
BOEING	B-767-300	JT9D-7R4E	300.00	280.00	74.8	91.2	30	8,15
BOEING	B-767-300	JT9D-7R4E	351.00	320.00	80.8	90.8	25*	8,15
BOEING	B-767-300	JT9D-7R4E	351.00	320.00	80.8	92.3	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B2F	300.00	280.00	70.8	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B2F	300.00	280.00	70.8	88.6	30	8,15

**ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES**

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-767-300/300ER	CF6-80C2B2F	351.00	340.00	75.9	88.7	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B2F	351.00	340.00	75.9	90.0	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	380.00	280.00	77.1	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	380.00	280.00	77.1	88.5	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	407.00	320.00	79.8	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4	407.00	320.00	79.8	89.3	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	295.00	280.00	69.0	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	295.00	280.00	69.0	88.6	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	412.00	320.00	80.3	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B4F W/N1 MOD	412.00	320.00	80.3	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	288.70	280.00	67.6	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	288.70	280.00	67.6	88.5	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	412.00	320.00	79.1	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6	412.00	320.00	79.1	89.3	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	345.00	280.00	72.7	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	345.00	280.00	72.7	88.6	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	408.00	320.00	78.5	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F	408.00	320.00	78.5	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	288.70	280.00	67.6	88.4	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	288.70	280.00	67.6	88.6	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	408.00	320.00	78.7	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B6F W/N1 MOD	408.00	320.00	78.7	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	407.00	320.00	77.8	88.5	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	407.00	320.00	77.8	89.4	30	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	412.00	340.00	78.2	88.7	25*	8,15
BOEING	B-767-300/300ER	CF6-80C2B7F	412.00	340.00	78.2	90.3	30	8,15
BOEING	B-767-300/300ER	PW4056	295.00	280.00	68.9	89.9	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-767-300/300ER	PW4056	295.00	280.00	68.9	90.2	30	8,15
BOEING	B-767-300/300ER	PW4056	407.00	320.00	81.2	90.2	25*	8,15
BOEING	B-767-300/300ER	PW4056	407.00	320.00	81.2	90.5	30	8,15
BOEING	B-767-300/300ER	PW4060	315.00	280.00	70.3	89.9	25*	8,15
BOEING	B-767-300/300ER	PW4060	315.00	280.00	70.3	90.2	30	8,15
BOEING	B-767-300/300ER	PW4060	408.00	320.00	80.0	90.2	25*	8,15
BOEING	B-767-300/300ER	PW4060	408.00	320.00	80.0	90.5	30	8,15
BOEING	B-767-300/300ER	PW4060 PHASE 3 (FB2C)	412.00	320.00	78.0	88.7	30	8,15,23
BOEING	B-767-300/300ER	RB211-524G	340.00	280.00	76.4	88.7	30	8,15
BOEING	B-767-300/300ER	RB211-524G	340.00	280.00	76.4	88.7	25*	8,15
BOEING	B-767-300/300ER	RB211-524G	407.00	320.00	82.6	88.7	25*	8,15
BOEING	B-767-300/300ER	RB211-524G	407.00	320.00	82.6	89.2	30	8,15
BOEING	B-767-300/300ER	RB211-524H	340.00	280.00	75.5	88.7	25*	8,15
BOEING	B-767-300/300ER	RB211-524H	340.00	280.00	75.5	88.7	30	8,15
BOEING	B-767-300/300ER	RB211-524H	407.00	320.00	81.5	88.7	25*	8,15
BOEING	B-767-300/300ER	RB211-524H	407.00	320.00	81.5	89.2	30	8,15
BOEING	B-777-200	GE90-76B	506.00	445.00	72.6	87.6	25*	8,15,57
BOEING	B-777-200	GE90-76B	506.00	445.00	72.6	88.5	30	8,15,57
BOEING	B-777-200	GE90-76B	545.00	460.00	75.1	87.7	25*	8,15,57
BOEING	B-777-200	GE90-76B	545.00	460.00	75.1	88.7	30	8,15,57
BOEING	B-777-200	GE90-76B(BLK IV)	506.00	445.00	72.6	87.6	25*	8,15,58
BOEING	B-777-200	GE90-76B(BLK IV)	506.00	445.00	72.6	88.5	30	8,15,58
BOEING	B-777-200	GE90-76B(BLK IV)	545.00	470.00	75.1	87.8	25*	8,15,58
BOEING	B-777-200	GE90-76B(BLK IV)	545.00	470.00	75.1	88.8	30	8,15,58
BOEING	B-777-200	GE90-77B	506.00	445.00	72.5	87.6	25*	8,15,57
BOEING	B-777-200	GE90-77B	506.00	445.00	72.5	88.5	30	8,15,57
BOEING	B-777-200	GE90-77B	545.00	460.00	74.9	87.7	25*	8,15,57

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-777-200	GE90-77B	545.00	460.00	74.9	88.7	30	8,15,57
BOEING	B-777-200	GE90-77B(BLK IV)	506.00	445.00	72.6	87.6	25*	8,15,58
BOEING	B-777-200	GE90-77B(BLK IV)	506.00	445.00	72.6	88.5	30	8,15,58
BOEING	B-777-200	GE90-77B(BLK IV)	545.00	470.00	75.2	87.8	25*	8,15,58
BOEING	B-777-200	GE90-77B(BLK IV)	545.00	470.00	75.2	88.8	30	8,15,58
BOEING	B-777-200	GE90-85B	545.00	445.00	72.9	87.6	25*	8,15,57
BOEING	B-777-200	GE90-85B	545.00	445.00	72.9	88.5	30	8,15,57
BOEING	B-777-200	GE90-85B	632.50	460.00	78.7	87.7	25*	8,15,57
BOEING	B-777-200	GE90-85B	632.50	460.00	78.7	88.7	30	8,15,57
BOEING	B-777-200	GE90-85B(BLK IV)	545.00	445.00	72.5	87.6	25*	8,15,58
BOEING	B-777-200	GE90-85B(BLK IV)	545.00	445.00	72.5	88.5	30	8,15,58
BOEING	B-777-200	GE90-85B(BLK IV)	632.50	470.00	78.0	87.8	25*	8,15,58
BOEING	B-777-200	GE90-85B(BLK IV)	632.50	470.00	78.0	88.8	30	8,15,58
BOEING	B-777-200	GE90-90B	545.00	445.00	71.8	87.6	25*	8,15,57
BOEING	B-777-200	GE90-90B	545.00	445.00	71.8	88.5	30	8,15,57
BOEING	B-777-200	GE90-90B	656.00	460.00	78.7	87.7	25*	8,15,57
BOEING	B-777-200	GE90-90B	656.00	460.00	78.7	88.7	30	8,15,57
BOEING	B-777-200	GE90-90B(BLK IV)	545.00	445.00	70.6	87.6	25*	8,15,58
BOEING	B-777-200	GE90-90B(BLK IV)	545.00	445.00	70.6	88.5	30	8,15,58
BOEING	B-777-200	GE90-90B(BLK IV)	656.00	470.00	78.1	87.8	25*	8,15,58
BOEING	B-777-200	GE90-90B(BLK IV)	656.00	470.00	78.1	88.8	30	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	580.00	445.00	72.0	87.6	25*	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	580.00	445.00	72.0	88.5	30	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	656.00	470.00	77.0	87.8	25*	8,15,58
BOEING	B-777-200	GE90-94B(BLK IV)	656.00	470.00	77.0	88.8	30	8,15,58
BOEING	B-777-200	PW4074	440.90	440.90	71.3	88.7	25*	8,15
BOEING	B-777-200	PW4074	440.90	440.90	71.3	89.5	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-777-200	PW4074	535.00	445.00	77.5	88.7	25*	8,15
BOEING	B-777-200	PW4074	535.00	445.00	77.5	89.5	30	8,15
BOEING	B-777-200	PW4077	445.00	440.90	70.8	88.7	25*	8,15
BOEING	B-777-200	PW4077	445.00	440.90	70.8	89.5	30	8,15
BOEING	B-777-200	PW4077	545.00	445.00	77.5	88.7	25*	8,15
BOEING	B-777-200	PW4077	545.00	445.00	77.5	89.5	30	8,15
BOEING	B-777-200	PW4090	545.00	445.00	74.9	88.5	25*	8,15,59
BOEING	B-777-200	PW4090	545.00	445.00	74.9	89.1	30	8,15,59
BOEING	B-777-200	PW4090	656.00	470.00	81.3	89.0	25*	8,15,59
BOEING	B-777-200	PW4090	656.00	470.00	81.3	89.5	30	8,15,59
BOEING	B-777-200	PW4090 at PW4074 rating	447.40	445.00	71.3	88.5	25*	8,15,59
BOEING	B-777-200	PW4090 at PW4074 rating	447.40	445.00	71.3	89.1	30	8,15,59
BOEING	B-777-200	PW4090 at PW4074 rating	535.00	470.00	77.5	89.0	25*	8,15,59
BOEING	B-777-200	PW4090 at PW4074 rating	535.00	470.00	77.5	89.5	30	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	447.50	445.00	70.7	88.5	25*	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	447.50	445.00	70.7	89.1	30	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	545.00	470.00	77.5	89.0	25*	8,15,59
BOEING	B-777-200	PW4090 at PW4077 rating	545.00	470.00	77.5	89.5	30	8,15,59
BOEING	B-777-200	RR TRENT 875	458.00	445.00	72.1	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 875	458.00	445.00	72.1	89.6	30	8,15
BOEING	B-777-200	RR TRENT 875	545.00	470.00	79.0	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 875	545.00	470.00	79.0	90.0	30	8,15
BOEING	B-777-200	RR TRENT 877	458.00	445.00	71.3	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 877	458.00	445.00	71.3	89.6	30	8,15
BOEING	B-777-200	RR TRENT 877	555.00	470.00	79.0	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 877	555.00	470.00	79.0	90.0	30	8,15
BOEING	B-777-200	RR TRENT 884	545.00	445.00	76.1	88.6	25*	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOEING	B-777-200	RR TRENT 884	545.00	445.00	76.1	89.6	30	8,15
BOEING	B-777-200	RR TRENT 884	632.50	470.00	82.5	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 884	632.50	470.00	82.5	90.0	30	8,15
BOEING	B-777-200	RR TRENT 892	545.00	445.00	74.6	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 892	545.00	445.00	74.6	89.6	30	8,15
BOEING	B-777-200	RR TRENT 892	656.00	470.00	82.1	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 892	656.00	470.00	82.1	90.0	30	8,15
BOEING	B-777-200	RR TRENT 895	632.50	445.00	79.7	88.6	25*	8,15
BOEING	B-777-200	RR TRENT 895	632.50	445.00	79.7	89.6	30	8,15
BOEING	B-777-200	RR TRENT 895	656.00	470.00	81.2	89.1	25*	8,15
BOEING	B-777-200	RR TRENT 895	656.00	470.00	81.2	90.0	30	8,15
BOEING	B-777-300	PW4090	450.00	445.00	69.2	88.2	25*	8,15,59
BOEING	B-777-300	PW4090	450.00	445.00	69.2	89.0	30	8,15,59
BOEING	B-777-300	PW4090	660.00	524.00	83.3	89.6	25*	8,15,59
BOEING	B-777-300	PW4090	660.00	524.00	83.3	90.2	30	8,15,59
BOEING	B-777-300	PW4098	550.00	445.00	74.4	88.8	25*	8,15
BOEING	B-777-300	PW4098	550.00	445.00	74.4	89.7	30	8,15
BOEING	B-777-300	PW4098	660.00	524.00	81.0	90.1	25*	8,15
BOEING	B-777-300	PW4098	660.00	524.00	81.0	91.0	30	8,15
BOEING	B-777-300	RR TRENT 884	550.00	445.00	76.5	88.4	25*	8,15
BOEING	B-777-300	RR TRENT 884	550.00	445.00	76.5	89.5	30	8,15
BOEING	B-777-300	RR TRENT 884	660.00	524.00	85.0	89.8	25*	8,15
BOEING	B-777-300	RR TRENT 884	660.00	524.00	85.0	90.7	30	8,15
BOEING	B-777-300	RR TRENT 892	550.00	445.00	75.0	88.4	25*	8,15
BOEING	B-777-300	RR TRENT 892	550.00	445.00	75.0	89.5	30	8,15
BOEING	B-777-300	RR TRENT 892	660.00	524.00	82.9	89.8	25*	8,15
BOEING	B-777-300	RR TRENT 892	660.00	524.00	82.9	90.7	30	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
BOMBARDIER	BD-700-1A10 (Global Express)	BR700-710-A2-20	93.50	78.50	73.6	83.2	30	8,15
BOMBARDIER	BD-700-1A10 (Global Express)	BR700-710-A2-20	96.00	78.50	74.6	83.2	30	8,15
BOMBARDIER	CL-600-2C10 (CRJ700)	CF34-8C1	72.50	66.90	68.2	82.5	45	8,15
BOMBARDIER	CL-600-2C10 (CRJ700)	CF34-8C1	75.00	66.90	69.1	82.5	45	8,15
BOMBARDIER	DHC-6	PT6A-27	12.50	12.50	67.0	78.0		4
BOMBARDIER	DHC-6	PT6A-27	12.50	12.50	67.0	78.0	-	4
BOMBARDIER	DHC-7	PT6A-50	45.50	42.00	69.0	84.0	25	15
BOMBARDIER	DHC-8 102	PW120	34.50	33.90	66.7	81.2	35	15
BOMBARDIER	DHC-8 103	PW121	34.50	33.90	65.7	81.2	35	15
BOMBARDIER	DHC-8 106	PW121	36.30	33.90	66.4	81.2	35	15
BOMBARDIER	DHC-8 201/202	PW123	36.30	33.90	66.4	81.2	35	15
BOMBARDIER	DHC-8 311	PW123	43.00	42.00	65.4	80.7	35	8,15
BOMBARDIER	DHC-8 314	PW123	43.00	42.00	67.1	80.6	35	8,15
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	61.70	60.50	61.0	81.6	35	8,15,42
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	61.70	60.50	61.0	83.4	15	8,15
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	65.20	62.00	62.5	81.7	35	8,15,42
BOMBARDIER	DHC-8-400 (Q400)	PWC 150A	65.20	62.00	62.5	83.3	15	8,15
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	61.70	60.50	61.0	81.6	35	8,15,42
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	61.70	60.50	61.0	83.4	15	8,15
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	65.20	62.00	62.5	81.7	35	8,15,42
BOMBARDIER	DHC-8-401 (Q400)	PWC 150A	65.20	62.00	62.5	83.3	15	8,15
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	61.70	60.50	61.0	81.6	35	8,15,42
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	61.70	60.50	61.0	83.4	15	8,15
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	65.20	62.00	62.5	81.7	35	8,15,42
BOMBARDIER	DHC-8-402 (Q400)	PWC 150A	65.20	62.00	62.5	83.3	15	8,15
BRITTEN-NORMAN	ISLANDER BN-2B	O-540-E4C5	6.20	6.20	68.0	73.0	-	11
CANADAIR	CHALLENGER CL-600	ALF-502L	40.40	36.00	66.9	81.7	45	12

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
CANADAIR	CHALLENGER CL-600	ALF-502L	41.25	36.00	67.5	81.7	45	15
CANADAIR	CHALLENGER CL-601	CF34-1A	43.10	36.00	66.4	80.4	-	15
CANADAIR	CHALLENGER CL-601	CF34-1A	45.10	36.00	67.0	80.4	45	15
CANADAIR	CHALLENGER CL-601	CF34-3A/A1/A2	45.10	36.00	66.5	80.4	45	15
CANADAIR	RJ (CL-600-2B19)	CF34-3A1	47.50	44.70	62.7	81.4	45	15
CANADAIR	RJ (CL-600-2B19)	CF34-3A1	53.00	47.00	67.2	81.4	45	15
CASA AIRCRAFT	C-212-CC	TPE 331-10/10R-501C/511C	16.98	16.42	65.7	79.7	40	15
CASA AIRCRAFT	C-212-CD	TPE 331-10R-512C/502C	16.98	16.42	64.7	80.5	40	15
CASA AIRCRAFT	C-212-CE	TPE 331-10R-512C/502C	16.98	16.42	64.7	80.5	40	15
CASA AIRCRAFT	C-212-CF	TPE 331-10R-501C/511C	16.98	16.42	65.7	79.7	40	15
CASA AIRCRAFT	C-212-DE	PT6A-5B	16.98	16.42	68.0	76.9	40	15
CASA AIRCRAFT	C-212-DF	TPE 331-10R-502C/512C/513C	16.98	16.42	64.7	80.5	40	15
CASA AIRCRAFT	C-295	PW 127 GM	46.30	45.63	69.9	81.6	15	15
CASA AIRCRAFT	CN-235-100	CT7-9C	33.29	32.85	68.8	80.8	23	15
CASA AIRCRAFT	CN-235-200	CT7-9C	34.83	34.39	70.1	79.9	40	15
CASA AIRCRAFT	CN-235-300	CT7-9C3	34.83	34.39	69.1	80.2	15	15
CESSNA	150	0-200-A	1.60	1.60	56.0	59.0	-	11
CESSNA	150M	O-200-A	1.60	1.60	55.0	59.0	-	11
CESSNA	152	0-235-L2C	1.70	1.70	55.0	59.0	-	11
CESSNA	170B	C-145-2H	2.20	2.20	68.0	61.0	-	11
CESSNA	172	O-320-E2D	2.30	2.30	61.0	61.0	-	11
CESSNA	172N	0-320-H2AD	2.30	2.30	63.0	62.0	-	10
CESSNA	177RG	I0-360-A1B6	2.80	2.80	65.0	62.0	-	11
CESSNA	180	O-470-J	2.80	2.80	69.0	63.0	-	11
CESSNA	182P	O-470-S	3.00	3.00	70.0	56.0	-	10,11
CESSNA	182Q	0-470-U	3.00	3.00	69.0	56.0	-	10,11
CESSNA	185F	I0-520-D	3.40	3.40	66.0	64.0	-	11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
CESSNA	206	IO-520-A	3.30	3.30	70.2	63.5	-	11
CESSNA	206H	IO-580-AIA	3.60	3.60	69.3	63.7	-	11,21
CESSNA	207	IO-520-F	3.80	3.80	74.3	63.8	-	11
CESSNA	210	IO-520-L	3.80	3.80	71.4	67.1	-	10,11
CESSNA	310Q	I0-470-V0	5.20	5.20	68.0	73.7	-	10,11
CESSNA	310R	TSIO-520-BB	5.50	5.50	65.0	73.0	-	11
CESSNA	320C	TSI0-470-D	5.20	5.20	70.0	73.0	-	11
CESSNA	337H	IO-360-G	4.60	4.60	70.0	72.0	-	11
CESSNA	340A	TSIO-520-MB	6.00	6.00	66.0	73.0	-	11
CESSNA	401	TSIO-520-E	6.30	6.30	67.0	73.0	-	11
CESSNA	402C	TSIO-520-VB	6.90	6.90	68.0	74.0	-	11
CESSNA	404	GTSIO-520-M	8.40	8.40	61.0	74.0	-	11
CESSNA	414A	TSIO-520-N	6.80	6.80	67.0	73.0	-	11
CESSNA	421C	GTSIO-520-L	7.50	7.50	61.0	74.0	-	11
CESSNA	500	JT15D-1	10.90	10.90	67.0	77.7	40	15
CESSNA	560	JT15D-5A	15.90	15.20	68.7	80.5	35	8,15
CESSNA	CARAVAN I	PT6A-114	7.30	7.30	64.9	73.0	-	
CESSNA	CITATION BRAVO (550)	PW530A	14.80	13.50	61.3	82.3	40	8,15
CESSNA	CITATION ENCORE (560)	PW535A	16.63	15.20	58.3	83.0	35	8,15
CESSNA	CITATION EXCEL (560XL)	PW545	20.00	18.70	60.6	85.0	35	8,15
CESSNA	CITATION I	JT15D-1A	11.90	11.40	67.3	77.7	40	8,15
CESSNA	CITATION II (550)	JT15D-4	13.30	12.70	62.6	79.3	40	8,15
CESSNA	CITATION II (550)	JT15D-4	14.60	13.50	67.4	79.8	40	8,15
CESSNA	CITATION III (650)	TFE731-3B-100S	21.50	19.00	68.8	81.1	20*	8,15
CESSNA	CITATION III (650)	TFE731-3B-100S	22.00	20.00	69.3	81.4	20*	7,8,15
CESSNA	CITATION III (650)	TFE731-3B-100S	22.00	20.00	69.3	84.8	37	7,8,15
CESSNA	CITATION JET (525)	FJ44-1A	10.40	9.70	60.3	81.7	35	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
CESSNA	CITATION JET II (525A)	FJ44-2C	12.38	11.50	62.7	80.3	35	8,15
CESSNA	CITATION ULTRA (560)	JT15D-5D	16.30	15.20	67.1	78.0	35	8,15
CESSNA	CITATION V (560)	JT15D-5A	16.30	15.20	69.4	80.5	35	8,15
CESSNA	CITATION VI (650)	TFE731-3C-100S	22.00	20.00	69.3	84.8	40	8,15
CESSNA	CITATION VII (650)	TFE731-4C-3S	23.00	20.00	65.7	78.0	20*	8,15
CESSNA	CITATION VII (650)	TFE731-4C-3S	23.00	20.00	65.7	81.6	40	8,15
CESSNA	CITATION VII (650)	TFE731-4R-3S	22.45	20.00	65.4	81.6	40	8,15
CESSNA	CONQUEST I	PT6A-112	8.20	8.20	63.0	75.0	-	10,11
CESSNA	CONQUEST II	TPE-331-8	9.80	9.80	63.0	76.5	-	5,11
CESSNA	S550 (SII)	JT15D-4B	15.10	14.40	64.8	79.6	35	8,15
CESSNA	T206H	TIO-540-AJ1A	3.60	3.60	65.6	63.8	-	11,21
CESSNA	T210L	TSI0-520-R	3.80	3.80	73.0	64.0	-	11
CESSNA	T210M	TSI0-520-R	3.80	3.80	71.0	64.0	-	11
CESSNA	TU206G	TSI0-520-M	3.60	3.60	71.0	64.0	-	11
CIRRUS DESIGN CORP.	SR 20 (2 Bladed Prop)	IO-360-ES	2.90	2.90	72.3	61.9	-	11,21
CIRRUS DESIGN CORP.	SR 20 (3 Bladed Prop)	IO-360-ES	2.90	2.90	72.1	61.9	-	11,21
CIRRUS DESIGN CORP.	SR 22	IO-550-N	3.40	3.40	73.6	63.8	-	11,21
CLASSIC AIRCRAFT	WACO CLASSIC F-5	R-755-B2	2.70	2.70	57.8	63.4	-	11
CONCORDE	CONCORDE	O-593/M-602	400.00		112.9	109.5	-	4,8
DASSAULT	FALCON 10	TFE731-2	19.30	17.64	69.4	81.8	30*	8,15
DASSAULT	FALCON 10	TFE731-2-1C	19.30	17.64	69.4	85.3	52	8,15
DASSAULT	FALCON 20	CF700-2D-2	28.60	27.30	77.0	90.1	25*	8,15
DASSAULT	FALCON 20-Basic/D/E	CF700-2D-2	28.66	27.32	77.0	90.3	40	8,15
DASSAULT	FALCON 20-Basic/D/E/F (M2851)	CF700-2D-2Q	28.66	27.32	71.4	88.9	40	8,15
DASSAULT	FALCON 20-C5/D5/E5 (M3500)	TFE731-5AR-2C	29.10	27.73	72.0	81.8	40	8,15
DASSAULT	FALCON 20-C5/D5/E5 (M3530)	TFE-731-5BR-2C	29.10	27.73	69.2	81.8	40	8,15
DASSAULT	FALCON 20-C5/D5/E5 (M3547)	TFE731-5BR-2C	30.50	28.88	72.1	82.2	40	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
DASSAULT	FALCON 20-F5	TFE731-5AR-2C	29.10	27.76	70.6	79.4	25*	8,15
DASSAULT	FALCON 20-F5 (M3500)	TFE731-5AR-2C	29.10	27.73	70.6	81.0	40	8,15
DASSAULT	FALCON 20-F5 (M3530)	TFE-731-5BR-2C	29.10	27.73	68.1	81.0	40	8,15
DASSAULT	FALCON 20-F5 (M3547)	TFE731-5BR-2C	30.50	28.88	71.4	81.3	40	8,15
DASSAULT	FALCON 20-G (M2500)	ATF3-6-2C	32.00	27.56	71.7	84.1	40	8,15
DASSAULT	FALCON 50	TFE731-3-1C	38.80	35.70	70.9	82.0	20*	8,15
DASSAULT	FALCON 50	TFE731-3-1C	38.80	35.72	70.9	87.6	48	8,15
DASSAULT	FALCON 50 (M1810)	TFE731-40-1	40.79	35.72	70.6	84.5	48	8,15
DASSAULT	FALCON 50 (M1230)	TFE731-3-1C	40.78	35.71	72.6	82.0	20*	8,15
DASSAULT	FALCON 50 (M1230)	TFE731-3-1C	40.78	35.71	72.6	87.3	48	8,15
DASSAULT	FALCON 50 (M2193)	TFE731-40-1	40.79	35.72	70.6	84.5	48	8,15
DASSAULT	FALCON 200	ATF3-6A-4C	32.00	27.60	71.7	84.1	40	8,15
DASSAULT	FALCON 900	TFE731-5AR-1C	45.50	42.00	69.2	81.0	20*	8,15
DASSAULT	FALCON 900	TFE731-5AR-1C	45.50	42.00	71.2	82.6	40	8,15
DASSAULT	FALCON 900 (M1196)	TFE731-5AR-1C	46.50	42.00	72.2	82.6	40	8,15
DASSAULT	FALCON 900B (M1200)	TFE731-5BR-1C	46.50	42.00	69.9	82.6	40	8,15
DASSAULT	FALCON 900EX (M3000)	TFE731-60-1	49.00	44.50	68.2	82.9	40	8,15
DASSAULT	FALCON 2000	CFE738-1-1B	36.50	33.00	64.0	83.8	40	8,15
DASSAULT	FALCON 2000EX (M1826)	PW308C	41.30	39.30	67.3	81.6	40	
DASSAULT	FALCON 2000EX (M1842)	PW308C	42.20	39.30	68.3	81.6	40	
DASSAULT	FALCON 7X (SFI)	PW307A	69.00	62.40	70.5	84.0	40	
DASSAULT	FALCON 900DX (M4000, M3755, M3758)	TFE731-60(-1C)	46.70	42.20	66.4	82.5	40	
DASSAULT	FALCON 900LX (M5281)	TFE731-60(-1C)	49.00	44.50	66.5	82.5	40	
DOUGLAS	DC-3	R-1830-90C	25.20	24.40	85.0	84.0	-	5
EMBRAER	EMB 110-P2	PT6A-34	12.50	12.50	71.0	76.0	-	4
EMBRAER	EMB-120 BRASILIA	PW115	21.20	21.20	63.2	81.8	45	12
EMBRAER	EMB-145ER	AE3007A	45.41	41.22	65.9	82.9	45	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
EMBRAER	EMB-145LR	AE3007A1/1	48.50	42.54	68.0	82.5	45	8,15
ESTUMKEDA LTD d.b.a MICCO AIRCRAFT CO.	MAC-145B	IO-540-T4B5	2.85	2.74	72.5	63.1	-	11,21
EXTRA FLUGZEUGBAU	EA 400	TSIOL-550-A	4.41	4.41	67.9	64.0	-	11,21
FAIRCHILD	F-27-F	RR DART MK529	38.50	36.70	77.3	87.0	-	11
FAIRCHILD DORNIER	328-100 Mod 10	PW 119B	30.84	29.17	66.6	83.0	12	15,38
FAIRCHILD DORNIER	328-100 Mod 20	PW 119C	30.84	29.17	67.0	83.0	12	15,38
FAIRCHILD DORNIER	328-300	PW306B	33.51	31.06	62.2	79.5	32	8,15
FAIRCHILD DORNIER	328-300 Mod 10	PW306B	34.52	31.72	62.7	80.3	32	8,15
FAIRCHILD DORNIER	DORNIER 228	TPE-331-5-252D	13.10	12.60	66.3	74.7	-	
FAIRCHILD DORNIER	SA226-AC METRO III	TPE-331-11U	14.50	14.00	69.2	78.5	-	10,11
FAIRCHILD DORNIER	SA226-AT	TPE-331-3U-303G	12.50	12.50	71.0	76.0	-	4
FAIRCHILD DORNIER	SA226-T	TPE-331-3U-303G	12.50	12.50	71.0	76.0	-	4
FAIRCHILD DORNIER	SA226-T(B) MERLIN IIIB	TPE-331-10U	12.50	12.50	68.9	78.5	-	5,11
FAIRCHILD DORNIER	SA226-TC METRO II	TPE-331-3UW-303G	12.50	12.50	71.0	76.0	-	4
FAIRCHILD DORNIER	SA227-AT MERLIN III C	TPE-331-10U	13.20	13.20	69.5	78.5	-	5,11
FAIRCHILD DORNIER	SA227-AT MERLIN IV C	TPE-331-11U	14.50	14.00	69.2	78.5	-	10,11
FOKKER	F100	RR TAY MK620-15	95.00	88.00	72.0	83.3	42	8,15
FOKKER	F100	RR TAY MK650-15	98.00	88.00	69.9	82.1	25*	8,15
FOKKER	F100	RR TAY MK650-15	98.00	88.00	69.9	82.8	42	8,15
FOKKER	F-27 MK500/600	MK552-7R	45.00	41.00	75.3	79.1	40	15,16
FOKKER	F-27 MK500/600	MK552-7R	45.90	43.50	76.0	79.4	40	15,16
FOKKER	F-27-100	RR DART6 MK514	39.00	37.50	76.0	82.6	-	11
FOKKER	F-27-200	MK532-7	43.50	41.00	78.0	88.1	-	5
FOKKER	F-27-500/600	MK532-7R	43.50	42.00	78.0	86.8	-	5
FOKKER	F-28 MK1000	SPEY MK555-15	65.00	59.00	79.2	94.1	42	4
FOKKER	F-28 MK1000	SPEY MK555-15	65.00	59.00	79.2	94.7	42	4
FOKKER	F-28 MK4000	SPEY MK555-15H	73.00	64.00	75.5	86.3	-	

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
FOKKER	F70	RR TAY MK620-15	81.00	75.00	65.4	78.6	42	8,15
FOKKER	F70	RR TAY MK620-15	92.00	81.00	69.2	79.0	42	8,15
FOUND AIRCRAFT CANADA	FBA-2C1	IO-540-D4A5	3.20	3.20	75.9	63.1	-	11,21
GENERAL DYNAMICS	CV-440	R-2800	48.00	47.20	86.0	84.0	-	5
GENERAL DYNAMICS	CV-580	501-D13	54.60	52.00	74.3	85.7	-	10
GULFSTREAM	112	IO-360-C1D6	2.70	2.70	63.0	62.0	-	11
GULFSTREAM	500S	IO-540-E1B5	6.80	6.80	76.0	77.0	-	10
GULFSTREAM	560E	GO-480-C1B6	6.50	6.50	59.0	73.0	-	11
GULFSTREAM	680FL	IGSO-540-B1A	8.50	8.00	64.0	74.0	-	11
GULFSTREAM	690B	TPE-331-5-251K	10.30	9.70	66.0	76.0	-	10
GULFSTREAM	690C COMMANDER 840	TPE-331-5	10.30	9.70	61.3	77.4	-	5,11
GULFSTREAM	690D COMMANDER 900	TPE-331-5	10.70	10.60	61.7	77.4	-	10
GULFSTREAM	695	TPE-331-10	10.30	9.70	62.0	77.4	-	5,15
GULFSTREAM	695 COMMANDER 980	TPE-331-10	10.30	9.70	62.0	77.4	-	5,11
GULFSTREAM	695A COMMANDER 1000	TPE-331-10	11.20	10.60	61.6	77.9	-	5,11
GULFSTREAM	AA-1B	O-235	1.60	1.60	57.1	59.0	-	11
GULFSTREAM	AA-5A	O-320-E2G	2.20	2.20	60.0	61.0	-	11
GULFSTREAM	AA-5B TIGER	O-360-A4K	2.20	2.20	57.4	52.0	-	10,11
GULFSTREAM	G100	TFE731-40R-200G	24.65	20.70	67.0	81.2	40	8,15
GULFSTREAM	G200	PW306A	34.85	28.00	74.0	81.4	40	8,15,45
GULFSTREAM	G200	PW306A	34.85	28.00	74.0	83.1	40	8,15,44
GULFSTREAM	GA-7	O-320-D1D	3.80	3.80	63.0	72.0	-	4
GULFSTREAM	GII (QTA STC ST03621AT)	SPEY MK 511-8	62.00	58.50	70.2	89.4	39	8,15,16
GULFSTREAM	GII (QTA STC ST03621AT)	SPEY MK 511-8	64.80	58.50	71.6	89.4	39	8,15,16
GULFSTREAM	GII TT (QTA STC ST03621AT)	SPEY MK 511-8	65.50	58.50	71.9	89.4	39	8,15,16
GULFSTREAM	GIIB/GIII (HAT STC ST01567LA)	SPEY MK 511-8	68.20	58.50	72.5	86.3	39	8,15,16
GULFSTREAM	GIIB/GIII (HAT STC ST01567LA)	SPEY MK 511-8	69.70	58.50	73.2	86.3	39	8,15,16

**ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES**

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
GULFSTREAM	GIIB/GIII (QTA STC ST03621AT)	SPEY MK 511-8	68.20	58.50	72.4	89.5	39	8,15,16
GULFSTREAM	GIIB/GIII (QTA STC ST03621AT)	SPEY MK 511-8	69.70	58.50	73.0	89.5	39	8,15,16
GULFSTREAM	GIISP (HAT STC ST01567LA)	SPEY MK 511-8	62.00	58.50	70.6	86.1	39	8,15,16
GULFSTREAM	GIISP (HAT STC ST01567LA)	SPEY MK 511-8	64.80	58.50	71.8	86.1	39	8,15,16
GULFSTREAM	GULFSTREAM I	RR DART MK529	35.10	33.60	71.0	85.9	-	15
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	62.00	58.50	80.1	83.9	20*	8,15,16
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	62.00	58.50	82.6	83.9	20*	8,15
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	62.00	58.50	82.6	90.6	39	8,15
GULFSTREAM	GULFSTREAM II	SPEY MK511-8	65.50	58.50	84.2	90.7	39	8,15,16
GULFSTREAM	GULFSTREAM IIB/GIII	SPEY MK511-8	69.70	58.50	82.8	82.5	20*	8,15,16
GULFSTREAM	GULFSTREAM IIB/GIII	SPEY MK511-8	69.70	58.50	82.8	89.7	39	8,15,16
GULFSTREAM	GULFSTREAM IV	RR TAY 611-8	73.20	58.50	64.2	80.7	39	8,15
GULFSTREAM	GULFSTREAM IV - SP	RR TAY 611-8	74.60	66.00	64.9	81.3	39	8,15
GULFSTREAM	G-V	BR700-710A1-10	90.50	75.30	68.0	82.0	39	8,15
IAI	1121 COMMODORE	CJ610-5	18.50	18.50	89.7	100.0	-	4
IAI	1123 WESTWIND	CJ610-9	20.70	19.00	89.7	99.0	-	4
IAI	1124 WESTWIND	TFE731-3-1G	22.90	19.00	67.4	84.0	40	8,15
IAI	1124A WESTWIND II	TFE731-3-1G	23.50	19.00	70.3	84.2	40	15
IAI	1124IW WESTWIND IW	TFE731-3-1G	23.50	19.00	71.7	84.0	40	15
IAI	1125 ASTRA	TFE731-3A-200G	23.50	20.70	70.3	80.4	40	8,15
IAI	1125 ASTRA	TFE731-3A-200G	24.65	20.70	72.1	80.4	40	8,15
LEARJET	LEARJET 23	CJ610-1	12.50	11.90	84.7	89.7	-	4,8
LEARJET	LEARJET 24B/D W/RAISBECK	CJ610-6	13.50	11.90	77.8	92.0	40	8,13
LEARJET	LEARJET 24D	CJ610-6	13.50	11.90	80.6	89.4	40	8
LEARJET	LEARJET 24D	CJ610-6	13.50	11.90	80.6	94.7	40	4,8,17
LEARJET	LEARJET 24E	CJ610-6	12.90	11.90	73.1	88.3	40	4,8
LEARJET	LEARJET 24F	CJ610-6	12.90	11.90	74.6	88.3	40	4,8

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
LEARJET	LEARJET 25 B/C/D/F XR	CJ610-6/8A	16.30	13.30	82.3	92.0	40	8,13
LEARJET	LEARJET 25B/C	CJ610-6	15.00	13.30	82.8	93.8	40	4,8,18
LEARJET	LEARJET 25D	CJ610-6	15.00	13.30	79.7	88.2	40	8,13
LEARJET	LEARJET 25F	CJ610-6	15.00	13.30	79.7	88.2	40	4,8
LEARJET	LEARJET 31	TFE731-2-3B	17.00	15.30	68.9	82.9	40	13,15
LEARJET	LEARJET 35	TFE731-2	17.00	14.30	70.4	83.1	40	4
LEARJET	LEARJET 35 W/CENTURY III	TFE731-2	17.00	14.30	65.6	81.6	40	8,15
LEARJET	LEARJET 35A	TFE731-2	18.00	15.30	71.6	81.7	40	15
LEARJET	LEARJET 35A/36A	TFE731-2	18.30	15.30	65.1	81.7	40	8,15
LEARJET	LEARJET 36	TFE731-2	17.00	14.30	70.6	83.1	40	4
LEARJET	LEARJET 36 W/CENTURY III	TFE731-2	17.00	14.30	65.6	81.6	40	8,15
LEARJET	LEARJET 36A	TFE731-2	18.00	15.30	71.6	81.7	40	15
LEARJET	LEARJET 45	TFE731-20R-1B	20.50	19.20	60.7	81.5	40	8,15
LEARJET	LEARJET 55	TFE731-3B	20.50	17.00	67.0	81.5	40	15
LEARJET	LEARJET 55B	TFE731-3A-2B	21.50	18.00	68.4	81.9	40	
LEARJET	LEARJET 60	PW305A	23.10	19.50	60.9	77.4	40	8,15
LEARJET	LEARJET 60	PW305A	23.50	19.50	60.9	77.4	40	8,15
LOCKHEED	1329 JETSTAR	JT12A-8	42.00	35.00	88.7	101.0	50	8,13
LOCKHEED	1329-23 JETSTAR w/STAR 3	TFE731-3	44.25	36.00	74.7	88.3	59	8,15,33
LOCKHEED	1329-25 JETSTAR	TFE731-3-1E	43.80	36.00	82.3	88.3	50	4
LOCKHEED	1329-25 JETSTAR w/STAR 3	TFE731-3	44.50	36.00	75.0	88.3	59	8,15,34
LOCKHEED	L-1011	RB211-22B	430.00	358.00	85.1	91.3	33*	4,5
LOCKHEED	L-1011	RB211-22B	430.00	358.00	85.1	92.1	42	4,5
LOCKHEED	L-1011-1	RB211-22C	396.00	358.00	85.2	90.0	33*	4,8
LOCKHEED	L-1011-1	RB211-22C	416.00	358.00	85.3	90.8	33*	8
LOCKHEED	L-1011-1	RB211-22C	422.00	358.00	86.9	91.4	33*	
LOCKHEED	L-1011-1	RB211-22C	430.00	358.00	87.1	92.7	42	

**ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES**

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
LOCKHEED	L-188	501-D13	116.00	95.70	81.3	89.5	-	4,8
MAULE	MX7-235	0540-J1A5D	2.50	2.50	63.2	62.7	-	11
MCDONNELL DOUG.	DC-08-50 (QNC QN)	JT3D-3B	309.80	240.00	90.3	94.5	-	8,12
MCDONNELL DOUG.	DC-08-61 (BAC/BAC II)	JT3D-3B	325.00	240.00	88.8	91.2	35	8,15,16
MCDONNELL DOUG.	DC-08-61 (QNC QN)	JT3D-3B	309.80	240.00	90.3	94.5	-	8,12
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-3B	335.00	240.00	90.0	89.8	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-3B	335.00	250.00	90.0	90.0	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-3B	348.00	240.00	91.1	89.8	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-7	335.00	250.00	87.8	93.1	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/BACII)	JT3D-7	350.00	240.00	88.8	93.0	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-3B	335.00	250.00	88.8	89.3	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-3B	350.00	240.00	90.0	88.9	35	8,15,16
MCDONNELL DOUG.	DC-08-62 (BAC/R1)	JT3D-7	335.00	250.00	87.8	93.1	35	8,15,16
MCDONNELL DOUG.	DC-08-63 (ADC QN)	JT3D-3B	355.00	245.00	91.7	96.0	50	8,15
MCDONNELL DOUG.	DC-08-63 (BAC/BACII)	JT3D-7	353.00	258.00	89.2	93.2	35	8,15,16
MCDONNELL DOUG.	DC-08-63 (BAC/BACII)	JT3D-7	353.00	275.00	89.2	93.5	35	8,15,16
MCDONNELL DOUG.	DC-08-63 (BAC/R1)	JT3D-7	355.00	275.00	89.2	93.5	35	8,15,16
MCDONNELL DOUG.	DC-08-63 (TNC QN)	JT3D-3B	350.00	250.00	90.5	95.4	50	8,15
MCDONNELL DOUG.	DC-08-63 (TNC QN)	JT3D-7	355.00	275.00	89.6	95.2	35	8,15
MCDONNELL DOUG.	DC-08-63F (ADC QN)	JT3D-7	355.00	245.00	91.0	95.9	50	8,15
MCDONNELL DOUG.	DC-08-71	CFM56-2-C1	337.00	245.00	84.1	88.8	46	
MCDONNELL DOUG.	DC-08-72	CFM56-2-C1	362.50	245.00	85.6	88.6	46	
MCDONNELL DOUG.	DC-08-73	CFM56-2-C1	362.50	245.00	85.6	88.6	46	
MCDONNELL DOUG.	DC-09-10	JT8D-7	90.70	81.70	78.6	89.1	50	1,8,15
MCDONNELL DOUG.	DC-09-10	JT8D-7	90.70	81.70	79.7	95.7	50	8,15
MCDONNELL DOUG.	DC-09-10 (ABS STC1563GL)	JT8D-7	90.70	81.70	76.3	86.7	40	8,15,16
MCDONNELL DOUG.	DC-09-20 (ABS STC1613GL)	JT8D-9	100.00	93.40	78.3	86.8	40	8,15,16

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
MCDONNELL DOUG.	DC-09-30	JT8D-15	114.00	101.00	85.8	90.9	50	1,8,15
MCDONNELL DOUG.	DC-09-30	JT8D-17	121.00	101.00	88.2	92.2	50	1,8,15
MCDONNELL DOUG.	DC-09-30	JT8D-7	108.00	99.00	85.5	89.9	50	1,8,15
MCDONNELL DOUG.	DC-09-30	JT8D-7	108.00	99.00	87.1	96.0	50	8,15
MCDONNELL DOUG.	DC-09-30	JT8D-9	108.00	99.00	85.4	90.6	50	1,8,15
MCDONNELL DOUG.	DC-09-30	JT8D-9	108.00	99.00	86.5	93.8	50	8,15
MCDONNELL DOUG.	DC-09-30	JT8D-9	110.00	99.00	86.3	90.8	50	1,8,15
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-7	103.00	99.00	80.2	87.0	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-7	105.00	101.00	81.0	87.1	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-9	103.00	99.00	79.3	87.0	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC1613GL)	JT8D-9	105.00	101.00	80.0	87.1	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-11	111.00	101.00	79.9	87.2	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-7	105.00	101.00	79.8	87.1	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-7	108.50	101.00	81.1	87.1	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-9	105.00	99.00	78.8	87.0	40	8,15,16
MCDONNELL DOUG.	DC-09-30 (ABS STC165CH)	JT8D-9	111.70	102.00	81.3	87.2	40	8,15,16
MCDONNELL DOUG.	DC-09-40	JT8D-11	107.00	102.00	84.8	90.0	50	1,8,15
MCDONNELL DOUG.	DC-09-40	JT8D-11	114.00	102.00	87.5	90.9	50	1,8,15
MCDONNELL DOUG.	DC-09-40	JT8D-15	114.00	102.00	85.8	90.9	50	1,8,15
MCDONNELL DOUG.	DC-09-40 (ABS STC165CH)	JT8D-11	111.00	99.00	80.1	87.3	40	8,15,16
MCDONNELL DOUG.	DC-09-40 (ABS STC165CH)	JT8D-9	111.70	101.00	81.3	87.4	40	8,15,16
MCDONNELL DOUG.	DC-09-50	JT8D-15	110.00	110.00	84.3	89.5	-	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-15	121.00	110.00	88.4	89.5	40*	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-15	121.00	110.00	88.4	92.0	50	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-17	115.00	104.00	85.9	89.5	-	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-17	121.00	110.00	88.2	89.5	40*	1,8,15
MCDONNELL DOUG.	DC-09-50	JT8D-17	121.00	110.00	88.2	92.3	50	1,8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
MCDONNELL DOUG.	DC-10-10	CF6-6D	410.00	363.50	85.2	90.3	35*	15
MCDONNELL DOUG.	DC-10-10	CF6-6D	410.00	363.50	85.2	95.1	50	15
MCDONNELL DOUG.	DC-10-10	CF6-6D	440.00	363.50	88.5	91.1	35*	15
MCDONNELL DOUG.	DC-10-10	CF6-6D	440.00	363.50	88.5	95.7	50	15
MCDONNELL DOUG.	DC-10-10	CF6-6D1	386.50	363.50	80.9	89.8	35*	15
MCDONNELL DOUG.	DC-10-10	CF6-6D1	386.50	363.50	80.9	94.7	50	15
MCDONNELL DOUG.	DC-10-10	CF6-6D1	440.00	363.50	85.3	95.7	50	15
MCDONNELL DOUG.	DC-10-30	CF6-50A	519.60	403.00	91.4	93.0	35*	15
MCDONNELL DOUG.	DC-10-30	CF6-50A	519.60	403.00	91.4	96.0	50	15
MCDONNELL DOUG.	DC-10-30	CF6-50A	565.00	403.00	95.7	93.4	35*	15
MCDONNELL DOUG.	DC-10-30	CF6-50C	565.00	411.00	94.1	96.2	50	15
MCDONNELL DOUG.	DC-10-30	CF6-50C1	562.00	403.00	93.9	97.1	50	15
MCDONNELL DOUG.	DC-10-30	CF6-50C1	572.00	421.00	94.6	93.5	35*	15
MCDONNELL DOUG.	DC-10-30	CF6-50C1	590.00	411.00	96.4	97.3	50	15
MCDONNELL DOUG.	DC-10-30	CF6-50C2	555.00	403.00	84.4	94.2	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2	590.00	411.00	87.2	95.1	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2B	555.00	424.00	83.6	94.2	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50C2B	590.00	411.00	86.7	95.1	50	8,15
MCDONNELL DOUG.	DC-10-30	CF6-50CA	565.00	424.00	95.7	96.3	50	15
MCDONNELL DOUG.	DC-10-30	CF6-6K	410.00	403.00	82.6	88.7	35*	8,15
MCDONNELL DOUG.	DC-10-30	CF6-6K	455.00	403.00	88.8	94.2	50	15
MCDONNELL DOUG.	DC-10-40	JT9D-20	430.00	403.00	85.0	94.5	50	15
MCDONNELL DOUG.	DC-10-40	JT9D-20	484.00	403.00	88.4	89.4	35*	15
MCDONNELL DOUG.	DC-10-40	JT9D-20	484.00	403.00	88.4	94.5	50	15
MCDONNELL DOUG.	DC-10-40	JT9D-20	530.00	403.00	91.7	90.2	35*	15
MCDONNELL DOUG.	DC-10-40	JT9D-20	530.00	403.00	91.7	94.9	50	15
MCDONNELL DOUG.	DC-10-40	JT9D-59A	555.00	403.00	90.6	94.9	35*	15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
MCDONNELL DOUG.	DC-10-40	JT9D-59A	555.00	403.00	90.6	97.1	50	15
MCDONNELL DOUG.	DC-10-40	JT9D-59A	572.00	403.00	91.8	94.9	35*	15
MCDONNELL DOUG.	DC-10-40	JT9D-59A	572.00	403.00	91.8	97.1	50	15
MCDONNELL DOUG.	MD-80	JT8D-209	140.00	128.00	80.3	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-209	140.00	128.00	80.3	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-209	149.50	130.00	83.2	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-209	149.50	130.00	83.2	83.9	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	140.00	128.00	78.7	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	140.00	128.00	78.7	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	149.50	130.00	81.4	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217	149.50	130.00	81.4	83.9	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	140.00	128.00	78.7	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	140.00	128.00	78.7	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	160.00	150.00	83.7	83.9	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217A	160.00	150.00	83.7	85.0	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	140.00	128.00	78.3	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	140.00	128.00	78.3	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	160.00	150.00	83.1	83.9	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-217C	160.00	150.00	83.1	85.0	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	140.00	128.00	77.5	83.5	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	140.00	128.00	77.5	83.8	40	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	160.00	150.00	82.1	83.9	28*	8,15
MCDONNELL DOUG.	MD-80	JT8D-219	160.00	150.00	82.1	85.0	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	125.00	120.00	74.7	83.3	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	125.00	120.00	74.7	83.7	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	149.50	130.00	81.2	83.6	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-217A	149.50	130.00	81.2	84.3	40	8,15

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
MCDONNELL DOUG.	MD-87	JT8D-217C	125.00	120.00	74.5	83.3	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	125.00	120.00	74.5	83.7	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	149.50	130.00	80.6	83.6	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-217C	149.50	130.00	80.6	84.3	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	140.00	128.00	77.4	83.5	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	140.00	128.00	77.4	84.2	40	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	149.50	130.00	79.7	83.6	28*	8,15
MCDONNELL DOUG.	MD-87	JT8D-219	149.50	130.00	79.7	84.3	40	8,15
MCDONNELL DOUG.	MD-90-30	V2525-D5	156.00	142.00	71.1	83.3	40	8,15
MCDONNELL DOUG.	MD-90-30	V2525-D5	166.00	142.00	73.0	83.3	40	8,15
MCDONNELL DOUG.	MD-90-30	V2528-D5	156.00	142.00	69.0	83.3	40	8,15
MCDONNELL DOUG.	MD-90-30	V2528-D5	166.00	142.00	71.0	83.3	40	8,15
MESSERSCHMITT	HFB-320 HANSA	CJ610-9	20.30	19.40	89.7	99.0	-	13
MITSUBISHI	MU-2B-26A	TPE-331-5-252M	10.00	10.00	64.0	76.0	-	4
MITSUBISHI	MU-2B-36A	TPE-331-5-252M	11.00	10.20	66.0	76.0	-	4
MITSUBISHI	MU300 DIAMOND I	JT15D-4	14.10	13.20	71.9	77.2	30	12
MITSUBISHI	MU300-10 DIAMOND II	JT15D-5	15.80	14.20	71.8	83.0	-	15
MOONEY	M20C	0-360-A1D	2.60	2.60	65.0	62.0	-	11
MOONEY	M20F w/MODWORK STC# SA02204AT	IO-360-E5	2.74	2.74	74.4	62.0	-	11,21
MOONEY	M20J	I0-360-A1B6D	2.70	2.70	58.0	62.0	-	4
MOONEY	M20M	TIO-540-AF1A	3.20	3.20	63.9	63.3	-	11,21
MOONEY	M20M	TIO-540-AF1A	3.37	3.37	64.8	63.3	-	11,21
MORANE-SAULNIER	MS 760B (PARIS II)	MARBORE VI C2	8.65	6.96	80.9	91.5	55	19
NIHON	YS-11A-200	DART MK 542	54.00	52.90	81.0	90.0	-	5
OSTMECKLENBURGISCHE FLUGZEUGBAU	OMF-100-160	O-320-D2A	1.96	1.96	61.0	61.0	-	11,21
PIPER	601P	IO-540-S1A5	6.00	6.00	70.0	73.0	-	11
PIPER	CHEYENNE 400LS	TPE-331-14	12.05	11.10	57.0	78.5	-	11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
PIPER	PA-18-150	0-320-A2B	1.80	1.80	53.0	61.0	-	11
PIPER	PA-23-250	IO-540-C4B5	5.20	4.94	68.0	73.0	-	11
PIPER	PA-24-260	IO-540-B1A5	3.20	3.20	65.0	63.0	-	11
PIPER	PA-28-140	O-320-E3D	2.20	2.20	60.0	61.0	-	11
PIPER	PA-28-151	O-320-E3D	2.20	2.20	60.0	61.0	-	11
PIPER	PA-28-161	O-320-D3G	2.40	2.40	59.0	61.0	-	11
PIPER	PA-28-181	O-360-A4M	2.55	2.50	60.0	62.0	-	11
PIPER	PA-28-200	I0-360-C1C	2.70	2.70	63.0	61.0	-	
PIPER	PA-28-235	O-540-B4B5	3.00	3.00	72.0	63.0	-	11
PIPER	PA-28-236	O-540-J3A5D	3.00	3.00	68.0	63.0	-	11
PIPER	PA-28RT-201(2BLD)	I0-360-C1C6	2.80	2.80	67.0	62.0	-	11
PIPER	PA-28RT-201T(3BLD)	TSIO-360-FB	2.90	2.90	67.0	62.0	-	11
PIPER	PA-30 TWIN COMANCHE	IO-320-B	3.60	3.60	56.0	70.6	-	11
PIPER	PA-31-310	TI0-540-A2C	6.50	6.50	69.0	73.0	-	11
PIPER	PA-31-325	TIO-540-F2BD	6.50	6.50	70.0	74.0	-	11
PIPER	PA-31-350	TI0-540-J2BD	7.00	7.00	71.0	74.0	-	11
PIPER	PA-31T	PT6A-28	9.00	9.00	62.0	74.0	-	4
PIPER	PA-32-300	IO-540-K1G5D	3.40	3.40	71.0	64.0	-	
PIPER	PA-32R-300	IO-540-K1G5D	3.60	3.60	71.0	64.0	-	11
PIPER	PA-32R-301	IO-540-K1G5D	3.60	3.60	70.0	64.0	-	11
PIPER	PA-32R-301T	TIO-540-S1AD	3.60	3.60	69.0	64.0	-	11
PIPER	PA-32RT-300	IO-540-K1A5D	3.60	3.60	71.0	64.0	-	11
PIPER	PA-34-200T	TSI0-360-E	4.80	4.50	64.0	72.0	-	11
PIPER	PA-34-220T	TSIO-360-KB	4.75	4.50	64.0	72.0	-	11
PIPER	PA-38-112	O-235-L2C	1.70	1.70	56.0	60.0	-	11
PIPER	PA-42 CHEYENNE	PT6A-41	10.50	9.40	70.3	77.1	-	10,11
PIPER	PA-44-180	O-360-E1A6D	3.80	3.80	62.0	71.0	-	11

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
PIPER	PA-44-180T(2BLD)	TO-360-E1A6D	3.90	3.90	62.0	71.0	-	11
PIPER	PA-44-180T(3BLD)	TO-360-E1A6D	3.90	3.90	60.0	71.0	-	11
PIPER	PA-46-31P MALIBU	TSIO-520-BE	4.10	4.10	70.0	63.9	-	11
PIPER	PA-602P	IO-540-AA1A5	6.00	6.00	66.0	73.0	-	11
PIPER	PA-60-600	IO-540-K1J5	5.50	5.50	66.0	73.0	-	11
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	21.20	19.55	70.4	83.3	25*	8,15
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	21.20	19.55	70.4	85.8	45	8,15
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	21.70	19.55	71.2	83.3	25*	8,15
RAYTHEON	HAWKER 125- 1A	TFE731-3-1H	21.70	19.55	71.2	85.8	45	8,15
RAYTHEON	HAWKER 125- 1A	VIPER-522	21.20	19.60	83.1	98.5	50	8,15
RAYTHEON	HAWKER 125- 3A	TFE731-3-1H	21.70	20.00	71.2	83.5	25*	8,15
RAYTHEON	HAWKER 125- 3A	TFE731-3-1H	21.70	20.00	71.2	86.0	45	8,15
RAYTHEON	HAWKER 125- 3A/R	VIPER-522	22.70	20.00	84.8	98.7	50	8,15
RAYTHEON	HAWKER 125- 3A/RA	TFE731-3-1H	23.60	20.00	72.4	83.0	25*	8,15
RAYTHEON	HAWKER 125- 3A/RA	TFE731-3-1H	23.60	20.00	72.4	85.5	45	8,15
RAYTHEON	HAWKER 125- 3A/RA	VIPER-522	22.70	20.00	84.8	98.7	45	8,15
RAYTHEON	HAWKER 125- 400A	TFE731-3-1H	23.60	20.00	72.4	83.0	25*	8,15
RAYTHEON	HAWKER 125- 400A	TFE731-3-1H	23.60	20.00	72.4	85.5	45	8,15
RAYTHEON	HAWKER 125- 400A	VIPER-522	23.60	20.00	85.3	98.7	45	8,15
RAYTHEON	HAWKER 125- 600A	TFE731-3-1H	25.50	22.00	75.8	83.6	25*	8,15
RAYTHEON	HAWKER 125- 600A	TFE731-3-1H	25.50	22.00	75.8	86.1	45	8,15
RAYTHEON	HAWKER 125- 600A	VIPER 601-22	25.50	22.00	81.9	96.0	45	8,15,16
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	24.20	22.00	75.4	83.6	25*	8,15,26
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	24.20	22.00	75.4	86.1	45	8,15,26
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	25.50	22.00	75.8	83.6	25*	8,15,26
RAYTHEON	HAWKER 125- 700A	TFE731-3-1H	25.50	22.00	75.8	86.1	45	8,15,26
RAYTHEON	HAWKER 125- 700A	TFE731-3R-1H	25.50	22.00	76.1	83.5	25*	8,15,20,26

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
RAYTHEON	HAWKER 125- 700A	TFE731-3R-1H	25.50	22.00	76.1	86.0	45	8,15,20,26
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	27.40	23.35	69.7	82.5	25*	8,15
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	27.40	23.35	69.7	82.5	25*	8,15,20
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	27.40	23.35	69.7	85.0	45	8,15
RAYTHEON	HAWKER 125- 800A	TFE731-5R-1H	27.40	23.35	69.7	85.0	45	8,15,20
RAYTHEON	HAWKER 125- 800XP	TFE731-5BR-1H	28.00	23.35	68.2	82.6	45	8,15
RAYTHEON	HAWKER 125-1000A	PW305	31.00	25.00	71.8	82.2	25*	8,15
RAYTHEON	HAWKER 125-1000A	PW305	31.00	25.00	71.8	82.9	45	8,15
SAAB	2000	AE2100A	49.60	47.40	63.5	78.9	20	8,15
SAAB	SF340A (Dowty props)	GE CT7-5A2	27.27	26.50	62.7	75.8	20	8,15
SAAB	SF340A (Dowty props)	GE CT7-5A2	28.00	27.20	62.9	82.0	20	8,15
SAAB	SF340B (Dowty props)	GE CT7-9B	28.50	28.00	63.4	82.0	20	8,15
SAAB	SF340B (Dowty props)	GE CT7-9B	29.00	28.50	64.1	82.0	20	8,15
SAAB	SF340B (HS14RF-19 props)	GE CT7-9B	28.50	28.00	63.5	78.8	20	8,15
SAAB	SF340B (HS14RF-19 props)	GE CT7-9B	29.00	28.50	64.2	78.8	20	8,15
SAAB FAIRCHILD	SF340	GE CT7-5A2	27.30	26.50	65.3	80.0	35	12
SABRELINER CORP.	SABRE 40A	JT12A-8	19.60	17.50	83.4	92.0	-	8,12
SABRELINER CORP.	SABRE 60	JT12A-8	20.10	17.50	84.7	92.0	24	8,12
SABRELINER CORP.	SABRE 60A	JT12A-8	22.70	20.60	83.8	95.4	-	8,12
SABRELINER CORP.	SABRE 65	TFE731-3R-1D	24.00	21.80	70.8	81.7	-	8,12
SABRELINER CORP.	SABRE 70	JT12A-8	21.00	18.50	87.9	93.8	-	8,12
SABRELINER CORP.	SABRE 75A	CF700-2D-2	23.00	22.00	77.7	90.3	25	4
SABRELINER CORP.	SABRE 80	CF700-2D-2	23.30	22.00	79.6	90.3	25	12
SABRELINER CORP.	SABRE 80A	CF700-2D-2	25.50	22.00	80.5	91.0	-	12
SHORTS	3-30	PT6A-45A	22.40	22.10	71.2	81.8	-	8,15
SHORTS	3-60	PT6A-65R	26.40	26.10	67.9	80.1	30	8,15
SHORTS	SD3-60-300	PT6A-67R	27.10	26.50	68.3	84.0	30	13

ESTIMATED MAXIMUM A-WEIGHTED SOUND LEVELS
MEASURED IN ACCORDANCE WITH PART-36 APPENDIX -C- PROCEDURES

MANUFACTURER	AIRPLANE	ENGINE	TOGW 1000 LBS	MLW 1000 LBS	TO dBA	APP dBA	APP FLAPS	NOTES
SHORTS	SKYVAN	TPE-331-201	12.50	12.50	71.6	77.3	46	
VICKERS ARMSTRONGS	VISCOUNT 745	RR DART6 MK510	72.50	64.00	78.1	84.6	-	11

Reference Notes

* Less than maximum flap setting.
1. Engines equipped with P-36 acoustical treatment.
2. Quiet nacelles and double wall fan duct treatment.
3. Double wall fan duct treatment.
4. Retain from AC 36-3A.
5. Estimated using non-certification measurement data.
6. Nacelle with fixed lip inlet.
7. Increased takeoff thrust rating.
8. Thrust cutback used.
9. ICAO Annex 16 certification data source.
10. DOT/FAA noise measurements.
11. Propeller noise estimation model.
12. Certification spectra analyzed to obtain dBA.
13. Estimated using certification data from aircraft with similar engines.
14. Estimated using the Integrated Noise Model (INM).
15. Based on manufacturer's data.
16. Equipped with hushkit.
17. Equipped with Learavia engine suppressor nozzle and ECR 936.
18. Equipped with Learavia engine suppressor nozzle.
19. DGAC noise measurements.
20. Equipped with thrust reversers.
21. Estimated using 14 CFR part 36, Appendix G certification data.
22. Airbrake open on approach.
23. Equipped with Noise Reduction Inlet.
24. Fed Ex lightweight hushkit
25. Fed Ex heavyweight hushkit
26. Data for TFE-731-3R-1H also applies to TFE-731-3-1H
27. Equipped with modification M3530
28. Equipped with Boeing inlet.
29. Equipped with Burbank Aeronautical Corporation inlet.
30. AvAero lightweight hushkit
31. AvAero heavyweight hushkit
32. AvAero heavyweight hushkit with lightweight hushkit nozzle
33. Equipped with STAR3 STC ST00258SE
34. Equipped with STAR3 STC ST00259SE
35. Engines equipped with 48 fan outlet guide vanes
36. Engines equipped with 70 fan outlet guide vanes

Reference Notes

37. Re-engined with JT8D-200 series engines and MD-80 nacelles in the outboard positions. Original JT8D engine retained in center position with new internal exhaust gas mixer and new acoustically treated tailpipe.
38. Auxiliary power unit off for approach.
39. Data for PW2037 (BG-3) also applies to PW2037 (BG-12).
40. Engines equipped with Cutback Fan Blades and Quiet Fan Case.
41. Engines equipped with non-Cutback Fan Blades and Quiet Fan Case.
42. Mod Sup 39; Propeller RPM limited to 850 for approach.
43. Equipped with Modification HCM00020R
44. Equipped with auxiliary power unit.
45. Not equipped with auxiliary power unit.
46. Data also applies to center engine JT8D-9A/-15/-15A/-17/-17A/-17R/-17AR(APR Deactivated) derated to JT8D-9 thrust rating.
47. Data also applies to center engine JT8D-15A/-17/-17A/-17R/-17AR(APR Deactivated) derated to JT8D-15 thrust rating.
48. Data also applies to center engine JT8D-17A/-17R/-17AR(APR Deactivated) derated to JT8D-17 thrust rating.
49. Data also applies to center engine JT8D-9A/-15/-15A/-17/-17A/-17R/-17AR(APR Deactivated) derated per AFM Supplement.
50. Data also applies to center engine JT8D-15A/-17/-17A/-17R/-17AR(APR Deactivated) derated per AFM Supplement.
51. Center Engine Takeoff Thrust Is Derated.
52. Original Production configuration (treated tailcone).
53. Modified Production configuration (hardwall tailcone).
54. DAC Engines (Dual Annular Combustor).
55. 737-700 IGW (Increased Gross Weight).
56. Equipped With Winglets (W).
57. Engine build G01 through G06.
58. Engine build G07, G08, G09, G12, G13 or G15.
59. Engine build configuration PW4090 or PW4090-3.
60. Short Field Performance (SFP).

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HEARING LOSS PROTECTION FOR AGRICULTURAL WORKERS

David W. Smith, Extension Safety Program

Farm environments and farm equipment can be quite noisy. Tractors, machinery, and animal confinement areas are common sources of loud noise. An agriculture worker exposed to this noise over an extended period of time is more likely to develop serious hearing loss. Knowing the typical sound levels of various sources of sounds will help you to recognize hazardous situations and take precautions to prevent hearing damage.

TYPICAL NOISE LEVELS

Sound is measured in decibels, designated as dB(A), using a tool called a decibel meter. The decibel meter can be used to identify those noise sources that exceed a safe level. The decibel level chart illustrates the typical noise levels from various sources. For example, while a tractor at idle speed produces about 85 decibels, a tractor at work will produce up to 100 decibels. According to the Occupational Safety and Health Administration, sounds of 85 decibels or higher can damage hearing.

As a general rule, the permissible safe noise exposure decreases as sound levels increase. For example, without adequate hearing protection, a farmer operating a tractor at work (typically generating 100 decibels), may begin to experience hearing loss after only two hours. With each 5-decibel increase, the "safe" exposure time is cut in half.

DID YOU KNOW?

It is common for a farmer to lose hearing in one ear faster than the other. Typically, one ear is facing the tractor exhaust or loud towed machinery more than the other as he or she frequently looks back toward the working equipment.

DECIBEL LEVEL CHART

Decibel	Sound
0	Lowest sound audible to the human ear
30	Crickets, distant frogs, whisper
40	Kitten meowing, songbirds, distant dog bark
50	Refrigerator running, babbling stream, quiet empty barn
60	Average conversation level
70	Chicken coop, busy restaurant. At this level, noise may begin to affect your hearing if exposed over a long period of time.
80	Tractor idling, barn cleaner, conveyors, elevators. These noises can damage hearing if exposed for more than eight continuous hours.
90	Tractor at 50 percent load, blower, compressor, combine. As noise levels increase, the "safe" exposure time decreases; damage can occur in less than eight hours.
100	Tractor at 80 percent load, pig squeal, power tools. Even two hours of exposure can be dangerous. With each 5-decibel increase, the "safe time" is cut in half.
120	Tractor at full load, bad muffler, old chain saw. The danger is immediate.
140	Gunshot, backfire, dynamite blast. Any length of exposure time is dangerous. At this level, the noise may actually cause pain in the ear.

SAFETY ISSUES

Agricultural workers rely greatly on their ability to hear in order to detect machinery operation problems. For example, experienced mechanics can detect *missing* or misfiring in engines. Tractor

operators operating hay balers rely upon sound pitch and sound variations in drive chains as a signal that it's time to oil or lubricate mechanical parts.

The ability to hear is essential for agricultural workers who rely upon verbal communication to avoid placing themselves or coworkers in danger. This is especially important when coworkers share hazardous tasks such as harvesting, loading, and conveying field crops.

Brief periods of excess noise have only minor effects, such as tinnitus (ringing or buzzing in your ears) or muffled hearing for a few hours after leaving work. Repeated exposure to loud noise may cause permanent hearing loss. First, you may have trouble hearing high-frequency sounds like phones ringing or high pitched voices. Next, you may lose speech frequencies, consonants, and then vowels. Finally, all verbal communication, including television, radios, and phone conversations may be difficult to hear.

Exposure to elevated noise is known to cause other health problems. It can cause fatigue, tension, and nervousness. It can also increase pulse rate, increase blood pressure, and narrow blood vessels. Over time, these conditions can stress the heart.

HEARING PROTECTION

Hearing protection is designed to reduce noise exposure to a safe level. Two types of protection, acoustical muffs and ear plugs, are most common. Acoustical muffs are placed over the ear to provide a sound barrier to the entire ear. Because they do not block out all sound, conversation for instruction or safety purposes can still be heard. Ear muffs will generally reduce decibel levels by 20 to 30 decibels.

Ear plugs are made to fit inside the ear canal, and come in formable or preformed designs. Formable plugs are compressed and placed inside the ear canal where they expand to fit. Preformed plugs come in many sizes and must be selected to fit the individual's ear. Ear plugs typically reduce decibel levels by 26 to 33 decibels. Ear muffs and ear plugs worn together can add another 3 to 5 decibels of protection.

NOISE REDUCTION TIPS

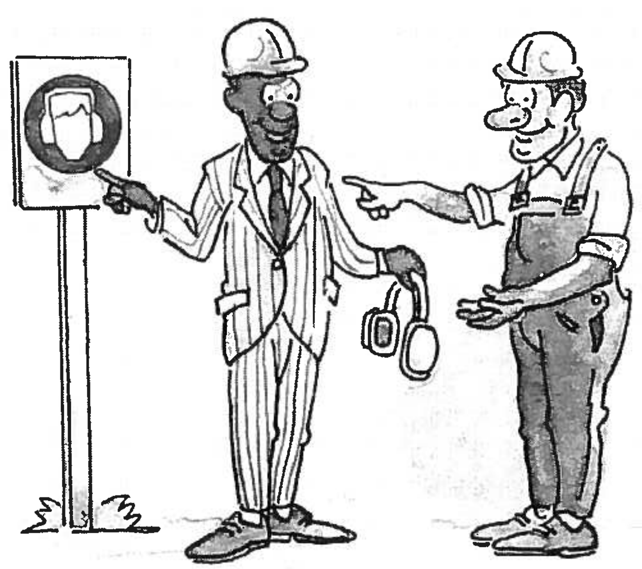
To reduce noise exposure levels on the farm:

- Keep machinery and equipment well lubricated
- Replace defective mufflers and exhaust parts
- Don't use "straight pipe" exhausts for tractors or any other engines
- Enclose noisy machine components
- Build acoustic barriers to loud machines
- Limit the duration of elevated noise exposure
- Stay away from noise when you don't need to control or tend the equipment
- Purchase power tools and equipment such as chain saws and lawnmowers that have built-in noise reduction systems.

Anyone experiencing hearing difficulty should get a hearing test so existing problems can be identified and monitored.

OSHA HEARING CONSERVATION STANDARD

Employers are required by law to implement a "Hearing Conservation Program" if the noise exposure meets or exceeds an eight-hour time-weighted average of 85 decibels [29 CFR 1910.95(c)].



Decibel Levels of Common Sounds

Sound intensities are typically measured in decibels (dB). A decibel is defined as 10 times the logarithm of the power ratio (power ratio is the ratio of the intensity of the sound to the intensity of an arbitrary standard point.) Normally a change of 1 dB is the smallest volume change detectable by the human ear.

Sound intensity is also defined in terms of energy (ergs) transmitted per second over a 1 square centimeter surface. This energy is proportional to the velocity of propagation of the sound.

Decibels (dB)	Degree	Sound Source
225	Deafening	12" Cannon @ 12' in front and below
195	Deafening	Saturn rocket
180	Deafening	Aircraft at take-off
160	Deafening	Ram jet
150	Deafening	Turbo jet
140	Deafening	Artillery fire
130	Deafening	Threshold of pain, decibels at or above 130 cause immediate ear damage. Hydraulic press, pneumatic rock drill
120	Deafening	Riveter, chipper, thunder, diesel engine room, fireworks display
110	Deafening	Punch press, close to a train, ball mill

100	Very Loud	Passing truck, home lawn mower, car horn @ 5 meters, wood saw, boiler factory
90	Very Loud	Decibels at or above 90 regularly cause ear damage. Noisy factory, truck without muffler
80	Loud	Noisy office, electric shaver, alarm clock, police whistle
70	Loud	Average radio, normal street noise
60	Moderate	Conversational speech
50	Moderate	Normal office noise, quiet stream
45	Moderate	To awaken a sleeping person
40	Faint	Average residence, normal private office
30	Faint	Recording studio, quiet conversation
20	Very Faint	Whisper, empty theater, ticking of watch
10	Very Faint	Threshold of good hearing
0		Threshold of excellent youthful hearing

Understanding Sound and Noise

Generation Propagation and Reduction

What is Sound and How Do We Hear It?

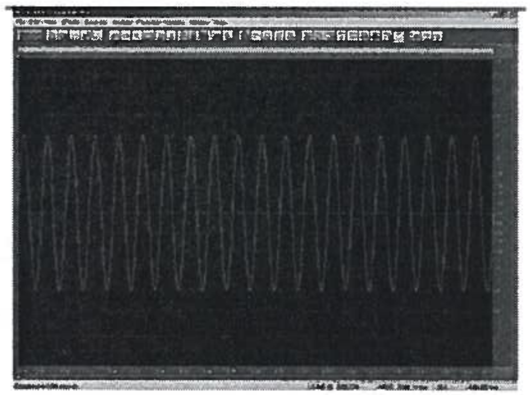
Noise is simply unwanted sound. So first we might want to look at sound and how it is generated. Sound is actually changing air pressure. That is, a generator of sound must move the air back and forth, creating "sound waves" that can be heard (presumably by humans). One way to picture this is to think of a large concert bass drum. When the mallet strikes the drum head, the head begins to move back and forth, or vibrate. As it does, it "pulls" some air in front of it towards itself, and then as the head moves out it pushes that same air away from it again. In doing so, the drum head creates small changes in air pressure that move (or propagate) through the air. These ripples in the air move out in all directions (though not always equally), eventually striking our eardrum. The human eardrum is like a very small drum head itself that can be moved by these minor changes in air pressure. As it moves back and forth, we perceive sound.

In the simple example above, we can imagine the bass drum head moving in and out, and we might be able to imagine the waves in the air moving towards us, eventually striking our own ear drum, which moves in harmony with the waves, and our brain "hears" the sound the bass drum made. In real life however, it can get somewhat more complex, even though following the same basic principles.

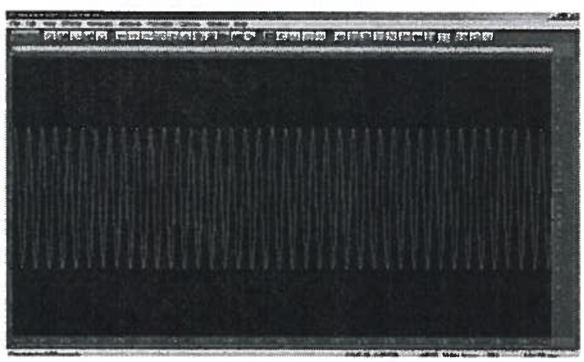
Frequency and Volume

The bass drum has a very low pitched sound. A flute may have a high-pitched sound. We perceive both differently because each one causes the air around them to vibrate differently. This is often referred to as frequency (or pitch) and is measured in Hertz. Essentially, the faster the air vibrates the higher the frequency. Conversely, the slower the air vibrates the lower the frequency. Different instruments and voices generate sounds at different frequencies.

Here is another example of frequency. In the diagram below, a 20Hz sound is shown for one second of time. Notice that during the one second of time we can count 20 complete cycles. The waveform shown is a simple sinusoidal wave, or sine wave for short.

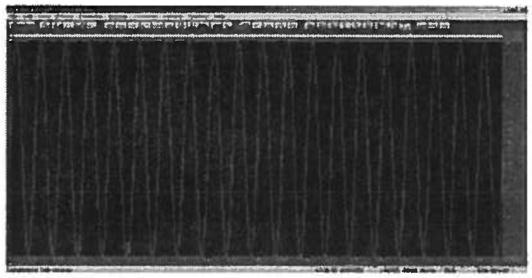


Here we show a 40Hz sine wave. Note that there are twice as many complete cycles because the frequency (pitch) is twice as high as the 20Hz pitch. In music, this is also called an octave (as in this pitch is an octave higher than the last one).

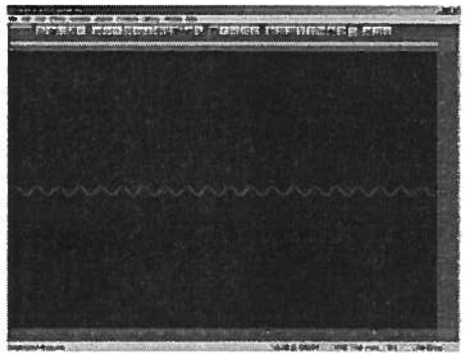


Now that we understand how sound is generated as well as a basic understanding of frequency, we need to understand loudness (or volume) of sounds. While frequency (pitch) is how fast the air pressure changes, loudness is determined by how much the air pressure changes. This can be illustrated in the example below.

Here is the same 20Hz sine wave we saw earlier, but this is now much louder. Note that the number of complete cycles is still 20 but highest points are higher and the lowest points are lower...thus creating larger swings in air pressure and a higher perceived volume, even though the frequency is exactly the same.



And again, we see a 20Hz wave, but this time it is obviously very soft. The high peaks are not very far away from the lowest peaks. In this way, we can depict small changes in air pressure (and thus a softer volume) even though the frequency is exactly the same.



In real life, there are few things that generate single frequencies at a time. Even musical instruments have a fundamental tone, as well as "overtones". These "overtones" are frequencies that are generated in addition to the main frequency that is generated, and help us differentiate a violin from a flute, even if they are playing the same note. Moreover, other common objects, such as motors or engines generate a host of frequencies all at once with each moving part generating its own sound and adding it to the other sounds. The resulting sound is called a complex sound wave, and these make up virtually all of the sounds we hear.

- The important points of this section are:
- Sound is generated by changing air pressure
- The pitch is how fast the air pressure changes
- The volume is how much the air pressure changes
- Most sounds we hear are complex sine waves

What are Decibels?

The volume (or loudness) of a sound is measured in decibels (or dB). Think of it as the pressure (or energy) behind the volume. The general range of human hearing is from ~0dB to 120dB. A quiet library is about 30dB, while 120dB is considered the threshold of pain, where the ears begin to feel pain from the volume.

The following table shows some common generators of sound and their typical Decibel levels as well as OSHA exposure limits:

Maximum Exposure per day (OSHA)	Sound level	Decibel Level	Examples
	No Sound	0	Threshold of hearing...essentially no sound
		10	Breathing
		15	A sof t whisper in someone's ear.
	Very Quiet	20	Whisper, rustling leaves
		25	Recording Studio
		30	Quiet rural area, Very quiet library.
		40	Very Quiet Residence
		45	Typical neighborhood.
	Quiet	50	Quiet suburb, conversation at home. Private office.
		60	Normal conversation (3-5 feet), sew ing machine, typewriter.
	Annoying	70	Freeway Traffic at 50 feet, vacuum cleaner
		75	Typical car interior on highway
	Loud	80	Garbage disposal, dishwasher, average factory. Telephone dialtone, Noisy office
16 hours		85	City Traffic (inside car).
8 hours		90	Power drill, shop tools, Busy urban street, diesel truck, food blender

6 hours		92	Clarinet, Oboe at 10 feet
4 hours		95	Subway train at 200 feet
3 hours		97	French Horn at 10 feet
2 hours	Very Loud	100	Jet takeoff 1000 feet, Outboard motor, farm tractor, garbage truck, Very heavy Traffic
1.5 hours		102	Motorcycle
1 hour		105	Power mower
		108	Home Theater (loud peaks)
0.5 hours		110	Chainsaw, pneumatic drill, typical rock concert, Steel Mill, riveting, auto horn at 3 feet
0.25 hours		115	Jackhammer
0 hours	Pain Threshold	120	Loud thunderclap, typical live rock music
Hearing damage occurring		125	Pneumatic riveter at 4 feet
Ear drum distortion		130	Jet takeoff (300 feet), Noise level during a stock car race.
Permanent hearing damage		132	Very loud rock concert, 50 feet in f ront of speakers
		140	Gun muzzle blast
		140	Prop aircraft on takeoff , gun muzzle blast, aircraft carrier deck, jet engine at 100 feet
Ear drum rupture		150	Jet takeoff 75 feet
		155	Shot from a handgun (.38 or .44) at 1 foot
		160	Jet aircraft on Takeoff at 30 feet
Immediate death of tissue		180	Jet engine at 1 foot
		194	Loudest sound in air, air particle distortion (sonic boom)

Noise Propagation

Sound waves reflect off of other surfaces, so the sound coming from one source can easily fill every corner of a room by propagating out in all directions and by reflecting off of the surfaces in the room. So how does the sound get into one room from another above it?

The first thing to understand is that changes in air pressure not only move our eardrums back and forth, but also move other objects back and forth. For instance, if we were to make a wall out of cellophane, and stretch it from floor to ceiling in a doorway, sealing off all the airflow from one side to the other, do you think you could hear someone banging a bass drum on the other side? The answer is, of course you can, even though no air is flowing between the bass drum and you. That means that the bass drum vibrating generated rapid changes in air pressure (sound waves) that hit the cellophane, vibrating the cellophane in an almost identical fashion. The cellophane vibrating creates rapid changes in air pressure on your side (just as the bass drum would have directly done), which travel and hit your eardrum. Because the cellophane essentially reproduced the vibrations of the bass drum, you hear the bass drum, as if the cellophane were not there.

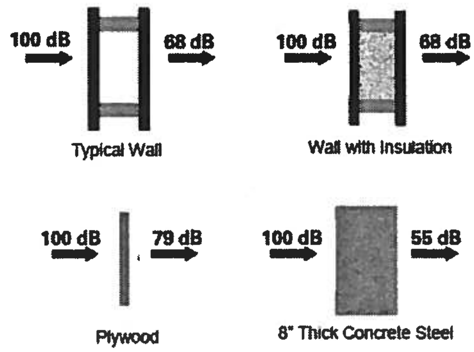
The cellophane can cause some distortions in the original sound. This occurs for many reasons. First of all, the cellophane has a certain mass that, like most materials, is larger than air. It requires more energy to move the cellophane back and forth than air, and that energy is dissipated as (or converted into) immeasurable amounts of heat energy.

Now, as we move farther away from any sound source, that sound generally gets softer. This is due to sound waves not only spreading out in every direction, but also the fact that the rapid changes in air pressure that make sound dissipate energy through the air, because even air has some mass. This loss of energy, through air, and more so through objects, causes the sound to get softer and thus, a lower dBA level.

In our cellophane example, we still hear the bass drum through the cellophane, but it should be a bit softer (due to the mass of the cellophane) than if we had no cellophane in the way.

Now let's suppose we remove the cellophane from the doorway and close the door. The door has much more mass than the cellophane, and thus will dissipate more energy. Yes, the door itself will vibrate as the bass drum does, re-generating the bass drum sound on the other side. However, the loss through the door will be more than the cellophane.

The diagrams below demonstrate a variety of sound propagation through common materials and the amount of sound on 1 side versus the other:



Sound waves, like water, will find any leak to get through. Since air offers less resistance to sound than a piece of metal, much of the sound energy will exit any structure through air openings in the barriers. So, a 5-foot square 1" thick lead wall might reduce the noise traveling from 1 room to another. However, if there were three ½" holes for wires in the lead wall, the majority of sound will exit through those holes, reducing the effectiveness of the wall. Hence, the total system must be considered in any noise reduction problem.

Reducing Noise

When considering reducing noise in any system (from a lawnmower to a car to a machine to a home to an apartment), four major tradeoffs need to be considered. These are primarily weight, space, cost, and aesthetics. Given enough money, and unlimited weight and space, one could construct a 10-foot thick lead barrier, welded on all sides. Given the mass of this barrier, it would take considerable sound energy to make it vibrate, so the loss through it would be significant. This concept is called "mass loading". The idea is to place extra mass between the noise source and you.

However, few places have an extra 10 feet to spare, let alone the cost (exceeding a few hundred thousand dollars) and the weight (exceeding 20 tons) to support a sound reducing method like the one mentioned above. Mass loading, while 200+ year old (technology wise), is not a very efficient method of dissipating noise and vibration, and most applications cannot afford the significant cost or weight it requires.

There are many examples of mass loaded materials for sound reduction including Mass Loaded Vinyl (typically at 1 pound per square foot) as well as Asphalt Based Mats.

Another method is by creating many surfaces for the sound to vibrate, each one having little loss, but in aggregate, absorbing a fair amount of sound. Closed-cell foams are popular for this, they are good for reducing sound WITHIN a room; however, they don't do a good job of preventing noise from passing through them so they do not make good barriers. One can imagine the sound waves passing (and vibrating) each little cell of foam. There may be hundreds of cells that need to be vibrated before the sound has passed all the way through the material, thus causing a small amount of reduction, but a large amount of reduced reflections.

The newest technology in the noise-barrier field exploits the viscoelastic properties of some materials. By formulating special chemicals that are very viscoelastic, they can be deformed by sound waves, take time returning to normal, and within a range of temperatures and frequencies, reduce noise and vibration by 10-20dBA per layer or more. Think of a "Tempur-Pedic" mattress, which uses a viscoelastic foam material, it is deformed by weight and heat of your body when you lay on it, yet will return to its normal shape in 5-10 seconds after you get off of it. Viscoelastic materials work in a similar fashion. They are deformed by the sound wave but after awhile they return to their normal shape. In other words, viscoelastic materials dampen noise.

There are two ways to dampen sound with viscoelastic materials. Free (unconstrained) layer damping is one method and is the simplest way of introducing sound damping into a structure. The treatment consists of a layer of sound damping material bonded to the surface of the sound generating source or a sound barrier (such as metal or plastic). The coating moves with the sound barrier but due to its "noise absorbing" like qualities it helps to slowly dissipate sound wave energy. The material is low cost, low density (typically 1mm thick), and low weight.

The second method for dampening sound is through constrained layer viscoelastic damping. It is among the most efficient ways of introducing sound damping into a structure. This requires the viscoelastic material to be placed between 2 other rigid materials (such as metal, plastic, wood, drywall etc.). It must also have adhesive qualities to bond directly to both outer layers to work effectively.

QuietRock, a multi-layer laminated gypsum wall product from Serious Materials, Inc., is engineered around constrained layer viscoelastic damping. Because QuietRock simply hang it like standard drywall, it is eliminates the need for expensive, difficult and non standard sound isolation construction techniques. There are also materials (typically foams and fabrics) for sound absorption within a room. These work primarily by reducing reflections of sounds from surfaces (such as walls and ceilings). They do not stop sound from passing through them. Materials that work well for reducing reflections often are not very good at reducing sound transmission (through them). For instance, while some foams make excellent sound absorbers within a room, they don't make a very good sound barrier. Vinyl (mass loaded), makes a fine barrier, but a poor absorber. So the right material needs to be chosen for the right result.

As we saw in the last section, various materials (such as concrete or gypsum) have a certain amount of sound transmission loss. This loss is mostly due to its mass. But what about adding some viscoelastic material, rather than mass? The results can be excellent.

For example, the diagram below represents standard 2" x 4" - 24" OC construction between two rooms. QuietRock is effective over both wood and metal standard studs.

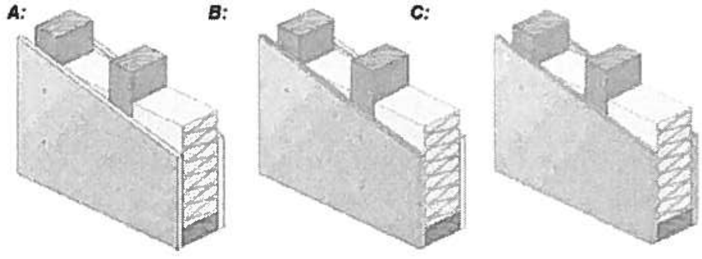


Figure 1: Three Scenarios

A. Represents existing/typical acoustical wall partition. Using 24" OC studs and R13 insulation, with one layer of gypsum on both sides, this wall has an average STC rating of 39.
B. Represents the same wall partition framing as in diagram a), but with QuietRock 525 as a replacement for the gypsum on one side. The STC rating is improved by 14dB over A, to 53.
C. Represents that same wall with QuietRock 525 as a replacement for the gypsum on both sides. The STC rating can be improved by 17dB over diagram A to STC 56.
The viscoelastic glue in QuietRock works by converting acoustic and vibrational energy into minute amounts of heat. This is very different than mass-loading or wall-fill techniques, and is easily achieved in existing construction at a low cost.

It is critical in every noise reducing application that all air gaps are filled. Otherwise, noise will always take the path of least resistance, which inevitably will be the air. In construction, a good acoustical sealant (one that never dries) is the best bet. Every wall seam must be completely airtight, between panels, and between floor and ceiling, as well as around wall outlets.

Conclusion

There are a variety of techniques to reduce noise and vibration in a variety of structures today. Every method relies on 1 of 2 principals, mass or viscoelasticity. Both methods can be effective, depending on how much material one would want to use. However, noise propagation is very complex, and even though materials are tested to absorb structural vibration it does not mean they will eliminate any particular noise problem. The more the source can be isolated with air-tight barriers treated with viscoelastic materials or mass-loaded techniques, the opportunity to meet your needs for quiet are enhanced.

Decibel (Loudness) Comparison Chart

Here are some interesting numbers, collected from a variety of sources, that help one to understand the volume levels of various sources and how they can affect our hearing.

Environmental Noise	
Weakest sound heard	0dB
Whisper Quiet Library	30dB
Normal conversation (3-5')	60-70dB
Telephone dial tone	80dB
City Traffic (inside car)	85dB
Train whistle at 500', Truck Traffic	90dB
Subway train at 200'	95dB
Level at which sustained exposure may result in hearing loss	*90 - 95dB*
Power mower at 3'	107dB
Snowmobile, Motorcycle	100dB
Power saw at 3'	110dB
Sandblasting, Loud Rock Concert	115dB
Pain begins	*125dB*
Pneumatic riveter at 4'	125dB
Even short term exposure can cause permanent damage - Loudest recommended exposure WITH hearing protection	*140dB*
Jet engine at 100', Gun Blast	140dB
Death of hearing tissue	180dB
Loudest sound possible	194dB

OSHA Daily Permissible Noise Level Exposure	
Hours per day	Sound level
8	90dB
6	92dB
4	95dB
3	97dB
2	100dB
1.5	102dB
1	105dB
.5	110dB
.25 or less	115dB

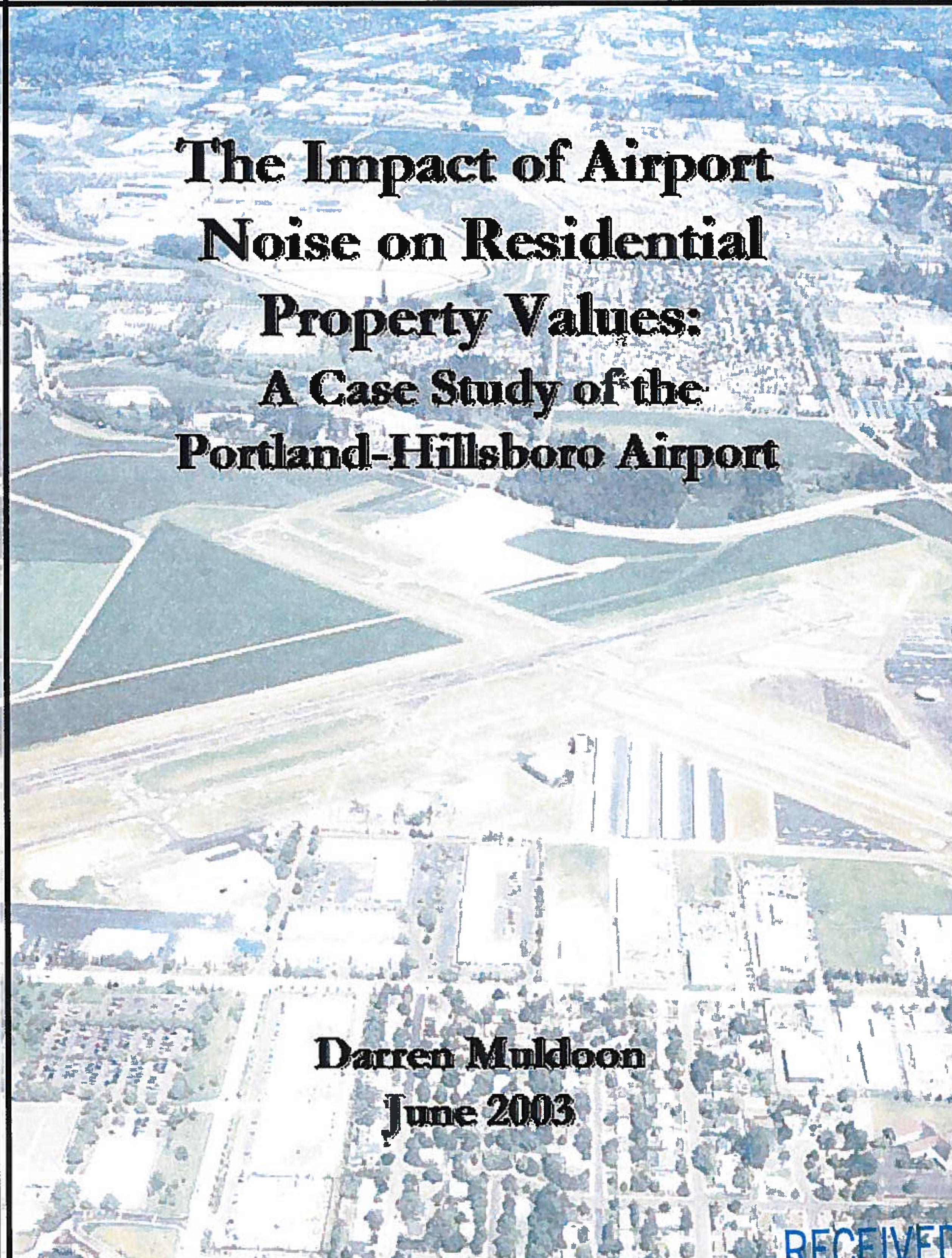
Perceptions of Increases in Decibel Level	
Imperceptible Change	1dB
Barely Perceptible Change	3dB
Clearly Noticeable Change	5dB
About Twice as Loud	10dB
About Four Times as Loud	20dB

Sound Levels of Music	
Normal piano practice	60 -70dB
Fortissimo Singer, 3'	70dB
Chamber music, small auditorium	75 - 85dB
Piano Fortissimo	84 - 103dB
Violin	82 - 92dB
Cello	85 -111dB
Oboe	95-112dB
Flute	92 -103dB
Piccolo	90 -106dB
Clarinet	85 - 114dB
French horn	90 - 106dB
Trombone	85 - 114dB
Tympani & bass drum	106dB
Walkman on 5/10	94dB
Symphonic music peak	120 - 137dB
Amplifier rock, 4-6'	120dB
Rock music peak	150dB

NOTES:

- One-third of the total power of a 75-piece orchestra comes from the bass drum.
- High frequency sounds of 2-4,000 Hz are the most damaging. The uppermost octave of the piccolo is 2,048-4,096 Hz.
- Aging causes gradual hearing loss, mostly in the high frequencies.
- Speech reception is not seriously impaired until there is about 30 dB loss; by that time severe damage may have occurred.
- Hypertension and various psychological difficulties can be related to noise exposure.
- The incidence of hearing loss in classical musicians has been estimated at 4-43%, in rock musicians 13-30%.

Statistics for the Decibel (Loudness) Comparison Chart were taken from a study by Marshall Chasin , M.Sc., Aud(C), FAAA, Centre for Human Performance & Health, Ontario, Canada. There were some conflicting readings and, in many cases, authors did not specify at what distance the readings were taken or what the musician was actually playing. In general, when there were several readings, the higher one was chosen.



The Impact of Airport Noise on Residential Property Values: A Case Study of the Portland-Hillsboro Airport

Darren Muldoon

June 2003

FIELD AREA PAPER

This Field Area Paper was completed in June of 2003. Dr. Jennifer Dill served as the primary reader. Dr. Jim Strathman served as the second reader.

This paper was completed to fulfill a curriculum requirement for the Master of Urban and Regional Planning degree at Portland State University.

NOTE:

- This report is based on noise contour data provided by the Port of Portland for educational purposes only, and is not a formal finding by the Port of Portland. With new aircraft technology, flight track changes, weather patterns, and other factors, noise contours are constantly changing. Due to errors in measurement, data collection, transferring of data from one form to another, methodologies, and the age of the noise contours (1995) used in this report, the Port of Portland does not accept the results or conclusions in this report. This report was completed for educational purposes only.

A SPECIAL THANKS TO:

- Dr. Jennifer Dill in the Urban Studies and Planning Department at Portland State University for being this report's primary reader and for all her guidance and help.

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- The Port of Portland, specifically the Aviation Planning and Development Department and the General Aviation Department at PDX for providing the necessary resources to complete this report and for giving me the opportunity to learn about aviation planning.

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ABSTRACT

This work builds on previous studies researching airport noise and residential property values. The hedonic price method is used to explore the relationship between residential property values and airport noise in the vicinity of the Portland-Hillsboro Airport, a general aviation airport in Hillsboro, Oregon. Controlling for the year the property sold, empirical results suggest that there is no statistically significant negative relationship between airport noise and residential property values.

INTRODUCTION

A number of studies have examined the relationship between airport noise and residential property values. Several studies provide data on an estimated percentage loss in residential real estate values due to airport noise of varying intensity. Most studies have concluded that aircraft noise decreases the value of residential property sale prices located near airports. While previous studies analyzed large commercial airports, little research has been completed for smaller general aviation airports. This study uses the hedonic pricing technique to determine the impact of both airport noise and the proximity to the airport on residential property values in the vicinity of the Portland-Hillsboro Airport in Hillsboro, Oregon.

There are hundreds of detrimental conditions (DCs) that may impact property market values. Airport noise is an externality that is imposed onto property owners and generally on a permanent basis (Bell 2001). For most people, noise is a significant issue and there is a segment of the population that will not live under a flight path. At the other extreme, there is a certain segment of the population that will purchase a property close to an airport if enticed by a reduced property price. In the middle of the spectrum are the people that own or purchase property in the vicinity of an airport that is impacted by airport noise. Since this study focuses on property sale values near an airport, the results may indicate the willingness to pay of people in the middle of the spectrum for residential property near an airport.

Relative to many other detrimental conditions such as environmental contamination and geotechnical issues, airport noise is more straightforward to study and assess (Bell, 1997). The most fundamental aspect of real estate valuation studies is that conclusions must be based upon market data. In very few cases will the market value be significantly less than the assessed value since the property owner has the right to appeal any such determination. Real estate law in most states requires sellers to reveal noise and other nuisance factors, including airports, so prospective buyers are warned. Realtors have reported cases where offers were withdrawn or lowered in the vicinity of airports as a result of airport activity (Kranser, 1997). Actual market value is the statistic that is most impacted by airport noise.

If an airport were nonpolluting, land rentals would be expected to decline with increased distance from the airport, and proximity to an airport may have certain positive effects on residential property values. These effects may include transportation network improvements, accessibility to jobs, and reduction in travel costs. Because of the positive and negative effects, the larger the airport, the more affect these effects will have on surrounding properties. Therefore, the larger the airport, the net effect on housing may not be negative because of the accessibility to jobs and other factors (Crowley, 1973). Employment opportunities exist at airport sites as well as commercial and industrial facilities that develop in the vicinity of an airport. For individuals that might work at or near an airport, or use the airport for travel, the benefits of proximity can be reflected in property values. Therefore, the net effect of property values can be positive or negative. Failure to account for accessibility to an airport could lead to bias in the hedonic estimated price for airport noise. Most people do not use general aviation airports travel, so accessibility is not a positive factor for general aviations.

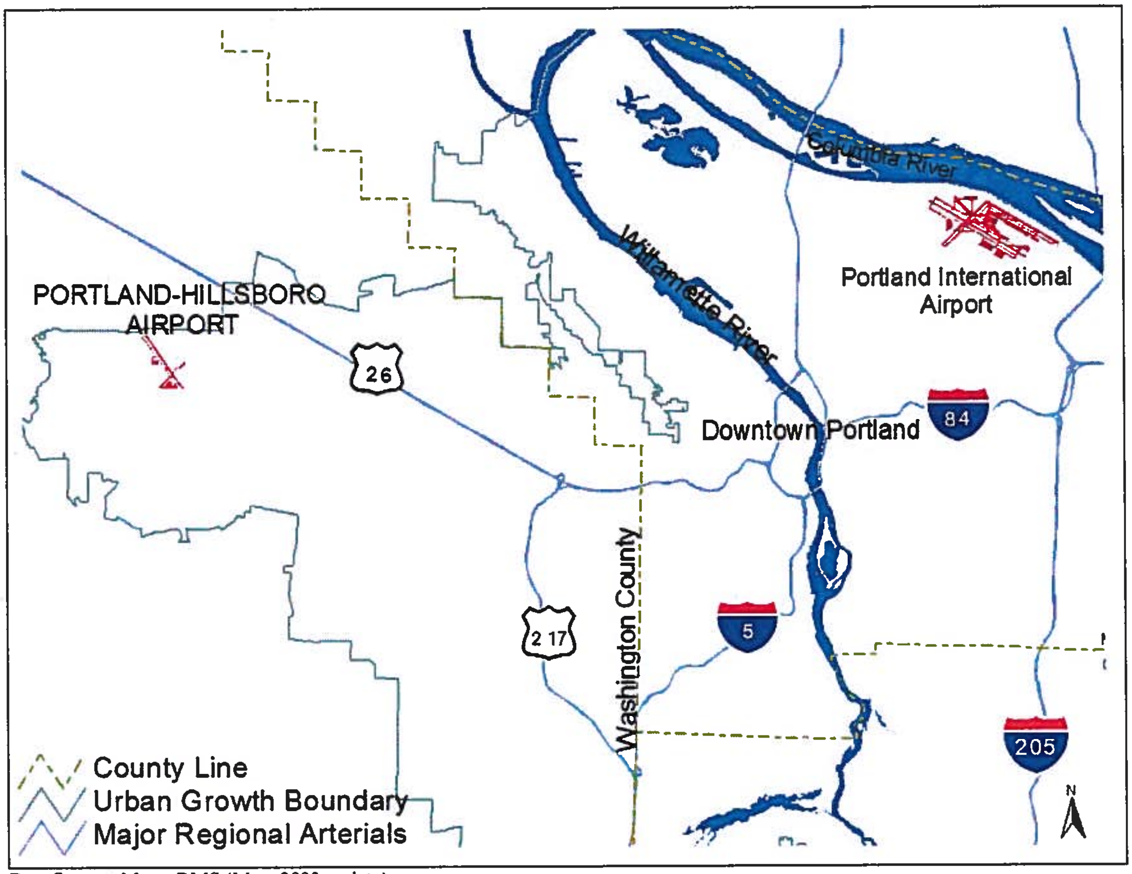
Since an airport produces transport services as well as air and noise pollution, it is reasonable to expect external economies for industrial/commercial use and external diseconomies for residential use. Another factor in studying the impact of airports is the question of whether property values are significantly less for non-residential purposes; however, it is difficult to obtain data on commercial/industrial sales on the same basis as on residential because of difficulties in determining precisely what was sold and obtaining data

on non-residential properties (Crowley, 1973). For residential uses, if a diminution in value is concluded, and if the home could be physically transported to an identical location on an identical lot in another part of the area, its value would increase, and the amount of its increase is the depression in value caused by proximity to the airport (Lane, 1994).

The Portland-Hillsboro Airport is a general aviation airport located in Hillsboro, Oregon a suburb to the west of Portland (Figure 1). Hillsboro and surrounding areas experienced double-digit population growth in the 1990's. Before thia large population growth, Hillsboro-Portland Airport was largely surrounded by open farmland, especially underneath the flight paths for both airport runways. However, as the area increased in population, open land near the airport developed with mostly single-family residential. Additionally, the airport experienced an increase in the number of operations at the airport. In terms of the number of airplane operations in Oregon, the Portland-Hillsboro Airport ranks second to Portland International Airport. With increased operations and new development around the airport, Hillsboro citizens have recently expressed their concerns of airport noise on the livability of the area on their property values.

This report analyzes home sales in an area near the airport, an approximate half-mile buffer of the airport's noise contours, an area underneath the airport flight paths with higher noise level than areas not near the airport. Although noise is probably the most important single impact that results from living under and airport's approach/departure flight tracks, the analysis of this paper does not fully confirm causality between noise effects and reduced property values. It is important to remember that the following analysis addresses the issue of depressed but not declining land values. Depressed land values means the value of the land is increasing, but the rate is less compared to land values not impacted by airport activity.

Figure 1: Location of the Portland-Hillsboro Airport



Data Source: Metro RLIS (May, 2003 update)

This report is divided into nine main sections: (1) Airport Noise Background; (2) Airport Land Use Planning; (3) Aviation and Airport Background; (4) Literature Review; (5) Explanation of the Hedonic Theory; (6) Methodology; (7) Models and Empirical Results; (8) Discussion of Results; and (9) Conclusion.

AIRPORT NOISE BACKGROUND

Because of its routine and everyday occurrence, noise is usually perceived as the most significant adverse impact of airport activity. The Federal Aviation Administration (FAA) develops noise exposure maps by using a computer model called the Integrated Noise Model (INM). The INM depicts the airport's noise environment by integrating the aircraft

flight tracks, the number of annual operations, the type and mix of airplanes serving the airport, and the time of day the aircraft are flown (Booz-Allen & Hamiliton, 1994).

One way to describe the sound environment is to measure the maximum sound level, such as a passing automobile or bus, in decibels (dB). Because the ear's pattern of response is more logarithmic in nature, decibels are measured on the log scale. The perception of noise doubles in loudness for every 10 dB increase in sound level. Therefore, an 80 dB is perceived to be four times louder than a 60 dB sound. Table 1 illustrates common sounds and their noise levels in dB (FAA Office of Environment and Energy, 1999).

Table 1: Common Sounds and Their Noise Levels

dB	Sound
110	Rock Band
100	Gas Lawn Mower at 3 ft.
90	Food Blender at 3 ft.
80	Garbage Disposal at 3 ft.
70	Vacuum Cleaner at 10 ft.
60	Ordinary Conversation
50	Dishwasher in Next Room
40	Small Theater
30	Watch Ticking
20	Quiet Rural Nighttime
10	Rustling Leaves

Source: Oregon Department of Aviation, Airport Land Use Compatibility Guidebook, 2003

A typical background noise level in urban areas is about 55 dB during daytime hours and 40 dB during nighttime hours. Because the noise level in urban areas is 55 dB, the noise impact threshold for study ought to be greater than or equal to 55 dB. At noise levels above 75 dB, the Environmental Protection Agency (EPA) cautions that more severe health effects may occur for some portion of the population, including temporary hearing loss. Aircraft noise is continuous, meaning the maximum sound level is not at one point, but

instead over duration of time. Studies have shown that human response to noise involves both the maximum level and its duration, so the maximum sound level in decibels alone is not sufficient to evaluate the effect of aircraft noise on people (FAA Office of Environment and Energy, 1999).

A second way to describe sound environment other than in decibels is to measure the Sound Exposure Level (SEL). The SEL is the total sound energy of a single sound event and takes into account both its intensity and duration. SEL is the sound level experienced if all sound energy of a sound event occurred in one second. Normalizing to a duration of one second allows the direct comparison of sounds of different durations. A more effective way to describe both the number of events and the sound exposure level of each event is the time-average of the total sound energy specified over a period, referred to as the equivalent sound level (Leq) (FAA Office of Environment and Energy, 1999).

An additional factor important in measuring the sound environment is the occurrence of sound events during the nighttime. Studies have concluded most people are more sensitive to sound events at night because the background sound levels are normally lower at night because of decreased human activity. Therefore, a "penalty" may be added to sound levels that occur during night hours. A 10 dB penalty is added to sound levels occurring between 10:00 PM and 7:00 AM. The 24-hour average sound level, including the 10-dB penalty is known as the day-night average sound level (DNL). The 10-dB penalty means that one nighttime sound event is equivalent to 10 daytime events at the same sound level (FAA Office of Environment and Energy, 1999).

Noise impact areas for an airport are identified by noise contours. The methodology to define aircraft noise levels involves the use of the FAA's Integrated Noise Model. The model computes the associated noise exposure level for the specific aircraft and engine thrust at that point along the route of the flight. Noise exposures are summed for each grid located and indicated by a series of contour lines on a map of the airport and its environs. Although lines on the map tend to be viewed as definitive, the contour lines are only a planning tool. Noise contours for an airport allow a planner to identify areas that are likely

to be impacted by aircraft noise, to estimate the amount of noise, and plan accordingly (Oregon Department of Aviation, 2003).

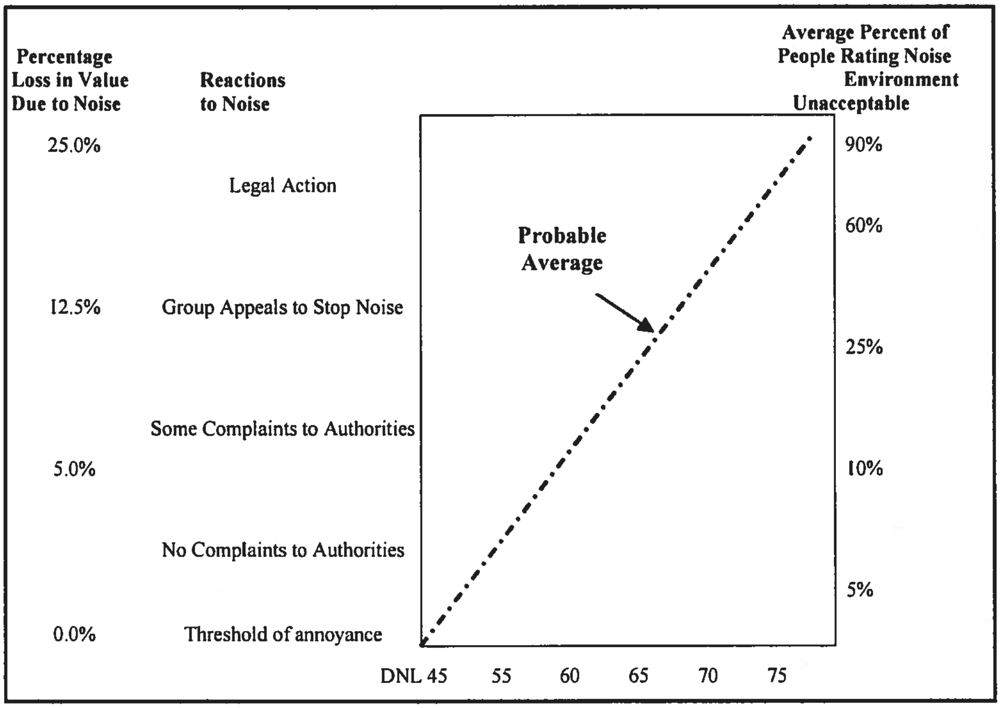
Noise contours expressed in DNL is the preferred manner to measure noise by the FAA. The higher the DNL level the greater the average noise exposure. DNL contours are used to provide guidance in the development of land use controls, such as zoning and building codes (Hillsboro Airport Master Plan, 1996). Aircraft noise contours for the Portland-Hillsboro Airport in this report are from 1996 Hillsboro Airport Master Plan, and the noise contours are 1995 noise conditions using the DNL descriptor.

AIRPORT LAND USE PLANNING

The development of land uses that are not compatible with airports and aircraft noise is a growing concern across the United States. In addition to aircraft noise, there are other issues, such as safety and environmental impacts around airports that need to be considered when addressing the overall issue of land use compatibility (FAA, Land Use Compatibility and Airports, 1998). The objectives of compatible land use planning are to encourage land uses that are generally considered to be incompatible with airports to locate away from airports, and to encourage land uses that are more compatible to locate around airports. Aircraft noise continues to be an issue at many airports, especially where airport capacity and aircraft operations are increasing. The problem of aircraft noise has been dealt with through operating requirements and quieter aircraft and also by soundproofing structures. As a result, the number of people exposed to noise levels of 65 dB or more has dramatically declined in the last twenty-five years (FAA Office of Environment and Energy, 1994). Because airport noise is the number one environmental concern at major airports, capacity and operation expansion is often slowed by public concern with noise exposure. Figure 2 illustrates people's response to aircraft noise and the estimated percentage loss in value due to noise. The line on the graph is the probable percent average of people rating the noise environment unacceptable and probable average percentage loss in value to due to noise. For example, at a DNL of 55, the percentage loss in value due to noise is about 2 percent,

the average percent of people rating noise environmental unacceptable is about 7 percent, but there are no complaints to authorities.

Figure 2: Response to Noise and Impact on Property Values



Source: Booz-Allen & Hamilton, Inc., "The Effect of Airport Noise on Housing Values: A Summary Report," Office of Environmental and Energy, Federal Aviation Administration (September, 1994).

Figure 2 highlights the importance of the economic valuation of noise. Although the federal government cannot dictate local land use policies, it can play a role in facilitating the coordination between airports, local, county, and regional planning agencies to ensure that compatible land use planning occurs around airports (Oregon Department of Aviation, 2003). The benefits of noise monitoring include the following:

- Build a noise level database that can be used to evaluate noise over time
- Spot trends in aircraft procedures that may impact the local community
- Measure impact of proposed operational changes
- Assist with complaint research
- Assist with airport planning

There are many entities involved in implementing programs related to land use compatibility around airports. At the federal level, the primary agency responsible for aviation related land use compatibility is the FAA. The FAA is responsible for federal laws and regulations affecting the aviation industry. The FAA has been actively supporting programs to minimize noise impacts. These include phase out of noisier older aircraft, supporting airport noise compatibility programs, and funding of mitigation measures. The FAA is the primary funding source for land acquisition to provide open space around airports and noise related mitigation measures (Oregon Department of Aviation, 2003). Other entities include state government, local government, or the owner and operator of the airport.

FEDERAL LEGISLATION

The Aviation Safety and Noise Abatement Act of 1979 (ASN) required that a single system be developed for measuring noise and determining noise exposure caused by airport operations and required identification of land uses normally compatible with exposure to noise. The FAA issued noise guidelines to land use planning near airports as part of its Airport Compatibility Program found in Part 150 of the *Federal Aviation Regulations*. Under FAR Part 150, local jurisdictions can prepare and submit to the FAA a noise exposure map for the airport environs and a noise compatibility plan. This voluntary program applies to all publicly owned, public use airports that are included in the National Plan of Integrated Airport Systems (NPIAS). The NPIAS identifies the type and estimated costs of airport development eligible for FAA Airport Improvement Program (AIP) funds (Oregon Department of Aviation, 2003). Other provisions established by FAR Part 150 include:

- Making the decibel the universal noise measurement tool
- Making the DNL the universal noise contour measure
- Defining land uses that are acceptable for areas within each DNL noise contour.

After DNL noise contours are developed for an airport, three basic noise impact areas can be identified. The severe noise impact areas include those areas contained within the 70 DNL noise contour and above. The substantial noise impact categories are areas impacted

by the 65 DNL to the 70 DNL contour. Areas impacted by the 55 DNL up to the 65 DNL contour are within the moderate noise impact category. Areas exposed to 55 DNL or less are not considered seriously impacted by noise. FAR Part 150 describes acceptable types of land uses for each DNL sound level. Land uses that should not be located within areas exposed to 65 DNL and above include all residential development. When public institutions such as schools, hospitals, and churches are constructed within noise contours of 65 DNL or higher, measures should be taken to achieve reduced noise levels (Oregon Department of Aviation, 2003). Additional FARs that impact airport land use compatibility includes:

- *FAR Part 36*: Categorizes aircraft by level of noise the aircraft generates (Stage 1, Stage 2, Stage 3), and outlines a timeline of when louder aircraft (Stage 1) need to be retired.
- *FAR Part 91*: Mandated a deadline of December 31, 1999 for the retirement of all Stage 2 aircraft. Waivers authorizing extensions may be granted, but Stage 2 aircraft will no longer be permitted to operate after December 31, 2003. This transition to a quieter fleet mix will result in smaller noise contours, reducing the noise impacts in areas surrounding airports.
- *FAR Part 161*: Defines requirements and procedures for airports to follow when implementing Stage 3 aircraft noise and access restrictions (Oregon Department of Aviation, 2003).

These FARs have less impact on general aviation airports, especially general aviation airports without jet service. The Portland-Hillsboro airport has some private jets.

Since 1979, with the Part 150 study, federal agencies have considered the DNL sound level of 75 dB or greater as incompatible with all residential land uses. Lands exposed to DNL 64-75 dB are regarded as "normally" incompatible with residential use, while lands exposed to a DNL of less than 65 dB are regarded as "normally" compatible with residential use, based on the Safety and Noise Abatement Act of 1979, the FAA adopted noise compatibility standard. Furthermore, the FAA considers 1.5 dB or more above 65 dB as a significant addition of noise. A federal action resulting in such a noise increase requires

an environmental impact statement. Commercial and industrial zoned land uses are compatible but should require additional insulation to structures to reduce noise levels. The DNL measure was used in the Part 150 study because it correlates with degree of human response such as annoyance, communication interference, and hearing loss (FAA Office of Environment and Energy, 1994).

OREGON LAND USE AND AIRPORT PLANNING

Since 1974, Oregon's Land Use Planning Act has required all cities and counties to develop and adopt comprehensive plans. These plans must be updated through periodic review to ensure that the plan continues to meet the policies of the state of Oregon. Statewide Planning Goal 12 is the goal directly applicable to airport planning in the context of periodic review. Goal 12 promotes safe, convenient, and economic statewide transportation networks, including passenger and air freight transportation. In order to comply with Goal 12, city and county comprehensive plans must include a transportation element that addresses state requirements for airport planning and compatibility with surrounding land uses. To aid in implementing Goal 12, the Oregon Department of Land Conversation and Development (DLCD) adopted the Airport Planning Rule (APR). The APR establishes a series of local government requirements pertaining to aviation facility planning (Oregon Department of Aviation, 2003).

The Statewide Transportation Planning Rule (TPR) also contains language that is applicable to airport planning. Transportation System Plans (TSPs) are required to contain elements intended to preserve local components of the state's public use aviation system. The TPR requires local jurisdictions to adopt land use regulations for land uses within airport noise corridors. The Oregon Department of Transportation (ODOT) prepared and adopted the 2000 *Oregon Aviation Plan* (OAP) as part of the *State Transportation System Plan.* The purpose of the OAP is to provide state policy guidance and a framework for planning and operation of public use airports (Oregon Department of Aviation, 2003).

Cities and counties are responsible for ensuring compatibility of land uses and establishing appropriate zoning requirements around airports. The impact of land use decisions that

result in incompatible land uses by allowing residential development to occupy noise impact areas can limit an airport's ability to expand facilities or expand operations. Oregon's Transportation Planning Rule contains strong language requiring local jurisdictions to develop land use regulations and adopt measures to protect public use airports by controlling land uses within airport noise corridors (Oregon Department of Aviation, 2003).

State Department of Environmental Quality (DEQ) standards for noise abatement, control, and mitigation are outlined in the Oregon Aviation Rules (OAR). These rules define and establish parameters for the Airport Noise Abatement Program, airport noise standards, and airport noise impact boundaries. The State of Oregon accepts the DNL noise contour method as the primary method for measuring noise around an airport. Since the 55 DNL noise contour can extend well beyond airport boundaries, the OAR also identifies noise abatement methods, such as soundproofing and land acquisitions (Oregon Department of Aviation, 2003).

The State of Oregon regards the 60 DNL and 55 DNL contours as significant noise levels, different from the FAA's standards. Therefore, the State recognizes that in some instances, land use controls and restrictions that apply to the 65 DNL may be appropriate for applications to areas impacted by the 55 DNL contour or greater. The Oregon Department of Environmental Quality (DEQ) finds that noise pollution associated with Oregon airports threatens the public health and welfare of residents living near airports. DEQ has adopted Oregon Administrative Rule Chapter 340, Division 35: "Noise Control Regulations" and an "Airport Noise Control Procedure Manual." This rule establishes procedures for an airport sponsor to use when a noise contour map or airport land use plan is needed, and also establishes the 55 DNL as a study boundary for planning and zoning measures (Oregon Department of Aviation, 2003). Therefore, this study examines home sales affected by airport noise by using the 55 DNL contour as the noise threshold for nuisance.

The purpose of noise compatibility planning is to minimize the extent to which noise impacts create an annoyance. The best approach is to allow as few people as possible to

occupy highly noise-impacted areas as possible. Alternatives include shielding people from noise, educating people of noise issues, and allowing land uses that are not particularly noise sensitive.

AVIATION AND AIRPORT BACKGROUND

GENERAL AVIATION

The FAA classifies the Portland-Hillsboro Airport as a General Aviation Airport, and more specifically, a Reliever Airport. General aviation is defined as all aviation other than commercial airlines and military aviation. General aviation carries 166 million passengers annually on general aviation aircraft ranging from two-seat training aircraft to intercontinental business jets. Facts about general aviation include:

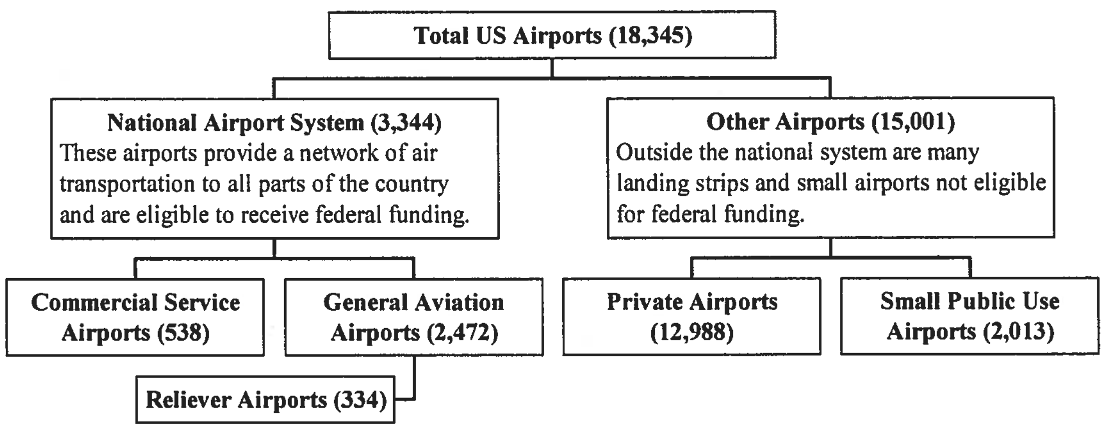
- 75 percent of all US flights are made on general aviation aircraft
- Of the entire US civilian aircraft fleet, 96 percent are general aviation aircraft
- There are 25.4 million flight hours annually and 35.8 million takeoffs and landings.
- There are 18,200 US landing facilities, including 13,175 airports
- More than 5,400 communities rely on general aviation for their air transportation needs, compared to 600 communities served by scheduled service (Aircraft Owners and Pilots Association, 2002).

Airports in the United States are divided into two groups: those airports that are part of the National Airport System, and Other Airports. National Airport System airports provide a network of air transportation to all parts of the country and are eligible to receive federal funding. Other airports are smaller airports, private or public, that are not eligible for federal funding. A *Commercial Service Airport* boards at least 2,500 passengers a year in scheduled passenger airline service. These airports are labeled primary if they have more than 10,000 passengers a year and non-primary if they have fewer. Some Commercial Service Airports are further defined as *Hub Airports* based on what percentage of all

passengers flying in the current year use them. Hub airports are then classified as Small, Medium, or Large Hub Airports.

A Large Hub Airport handles more than 1 percent of all passengers flying during a given year (Aircraft Owners and Pilots Association, 2002). The figure below illustrates the categories of airports as defined by the FAA.

Categories of Airports in the United States



Source: Federal Aviation Administration, 2002

General Aviation Airports comprise the largest single group of airports. There are 2,806 General Aviation airports in the United States. These airports are eligible for public funding depending on its size. A subcategory of General Aviation Airports are *Reliever Airports* that are designated by the FAA to relieve congestion at Commercial Service Airports, usually in a major urban area, to provide more General Aviation access to the local community (Aircraft Owners and Pilots Association, 2002). The FAA officially classifies the Portland-Hillsboro Airport as a reliever airport of PDX.

PORTLAND-HILLSBORO AIRPORT BACKGROUND AND HISTORY

The Portland-Hillsboro Airport is located in the northeastern corner of the City of Hillsboro on the west side of the Portland-Metropolitan region in area known as the Sunset Corridor. The airport was first built as a private facility in 1928. The City of Hillsboro purchased the airport in 1935 and built two paved 4,000-foot runways during World War II. Through land

acquisition, the property grew from 280 acres to 424 acres by 1965 when the airport was transferred to the Port of Portland. The Port of Portland added parallel taxiways in the 1960's, and a major property expansion, the extension of the primary runway, a terminal building, and an air traffic control tower in the 1970's (Hillsboro Master Plan, 1996).

The airport plays an integral role as a general aviation reliever airport of Portland International Airport (PDX). The airport currently encompasses 877 acres, and is by far the busiest general aviation airport in Oregon and the second busiest to PDX in annual operations (Hillsboro Airport Master Plan, 1996). Table 2 illustrates the top ten airports in terms of number of operations in Oregon. An operation is defined as a takeoff or a landing.

Table 2: Annual Operations of Oregon Airports (2001)

City	Airport Name	Operations
Portland	Portland International	277,082
Hillsboro	**Portland-Hillsboro**	**222,300**
Troutdale	Portland-Troutdale	107,460
Eugene	Mahlon Sweet Field	95,902
Aurora	Aurora State	73,895
Klamath Falls	Klamath Falls Regional	68,087
Medford	Rogue Valley Intl	67,258
McMinnville	McMinnville State	63,500
Scappoose	Scappoose Industrial	60,155
Redmond	Roberts Field	57,214

Source: State of Oregon Department of Aviation Land Use Compatibility Guidebook, 2002

The number of annual operations is typically used in the aviation industry to classify an airport's size. An alternate and less common measure is the number of based aircraft at the airport. This measure is more common for general aviation airports like Hillsboro, and not common for commercial airports such as PDX. Table 3 below illustrates the top ten airports in Oregon in terms of the number of based aircraft. As of 2000, there were over 350 aircraft based at the Portland-Hillsboro Airport (Oregon Department of Aviation, 2003).

Table 3: Based Aircraft by Airport in 2000

City	Airport Name	Based Aircraft
Hillsboro	**Portland-Hillsboro**	**355**
Aurora	Aurora State	353
Medford	Rogue Valley Intl	175
Troutdale	Portland-Troutdale	171
Eugene	Mahlon Sweet Field	160
Klamath Falls	Klamath Falls Regional	140
Independence	Independence State	137
Scappoose	Scappoose Industrial	130
Corvallis	Corvallis Municipal	123
Bend	Bend Municipal	120

Source: State of Oregon Department of Aviation Land Use Compatibility Guidebook, 2003

The annual number of operations at the Portland-Hillsboro Airport has generally increased since the early 1980's. The number of operations peaked in 2000 (Table 4).

Table 4: Portland-Hillsboro Airport Activity for Select Years

Year	Total Operations
2002	223,751
2000	244,531
1998	223,724
1996	207,778
1994	206,374
1992	199,433
1990	211,609
1988	188,566
1986	177,214
1984	139,252

Source: Port of Portland, FAA Tower Reports, 2002

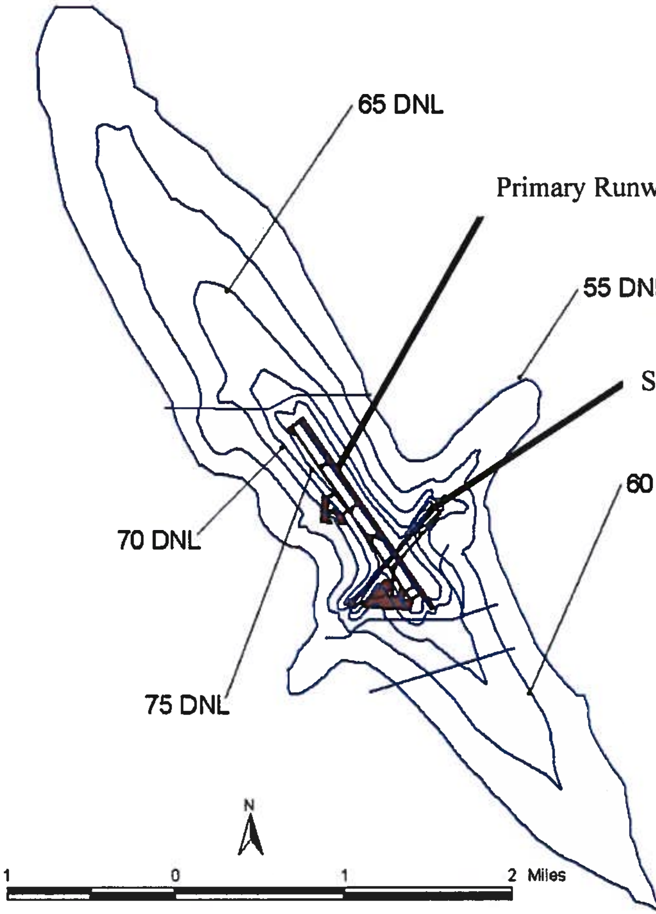
The airport has two runways. Runway 12/30 (primary runway) is 6,600 feet long, and Runway 2/20 is 4,050 feet long (secondary runway). Due to weather conditions, about 90 percent of aircraft arrive from the north, and depart to the south. Because departing aircraft

creates more than twice the amount of noise as an arriving aircraft, the areas to the southeast of the airport is the area most affected by aircraft noise.

To reduce noise impacts to areas west of the airport, the 1993 *Hillsboro Airport Compatibility Study* recommended restricting the use of the secondary runway to "those times when dictated by specific wind conditions for reasons of flight safety." Flight patterns on the secondary runway (Runway 2/20) take aircraft over more densely populated areas. A successful noise management program can be achieved by avoiding unnecessary residential overflights. Limiting operations on this runway reduces noise impacts to those areas. By limiting the number of operations on the secondary runway, the number of operations on the primary runway increased and extended the noise contours out to cover a larger area. The shifting of most operations to the primary runway (Runway 12/30) has resulted in noise contours extending out beyond where they would have otherwise been if flights were not restricted, as recommended by the 1993 study (*Hillsboro Airport Compatibility Study*, 1993). The elongated nature of the airport's noise contours is illustrated in Figure 3.

Aircraft noise has become an increasing problem with people living near the airport. Recent development in the area has focused near the airport. A survey conducted by Riley Research Associates for the Port of Portland in 2002 concluded in an unaided awareness (first thing to come to mind) question that ten percent of survey respondents associated the airport with noise. When the ten percent who mentioned noise were asked to rate their level of annoyance (on a one-to-ten sale, where ten means extremely annoying), the mean level of annoyance was 5.64. The annoyance ratings were represented by three distinct groups: low annoyance ratings of one to three (29%), moderate annoyance ratings of four to seven (38%), and high annoyance ratings of eight to ten (33%). A map illustrating the geographic location of those who associated the airport with noise shows concentrations around the southeast portion of Hillsboro. The rating of the airport as an asset to Washington County was a mean of 7.13 on the same type of scale. The rating of the airport as an asset to Hillsboro was slightly higher at 7.43 (Riley Research Associates, 2002).

Figure 3: Noise Contours for the Portland-Hillsboro Airport



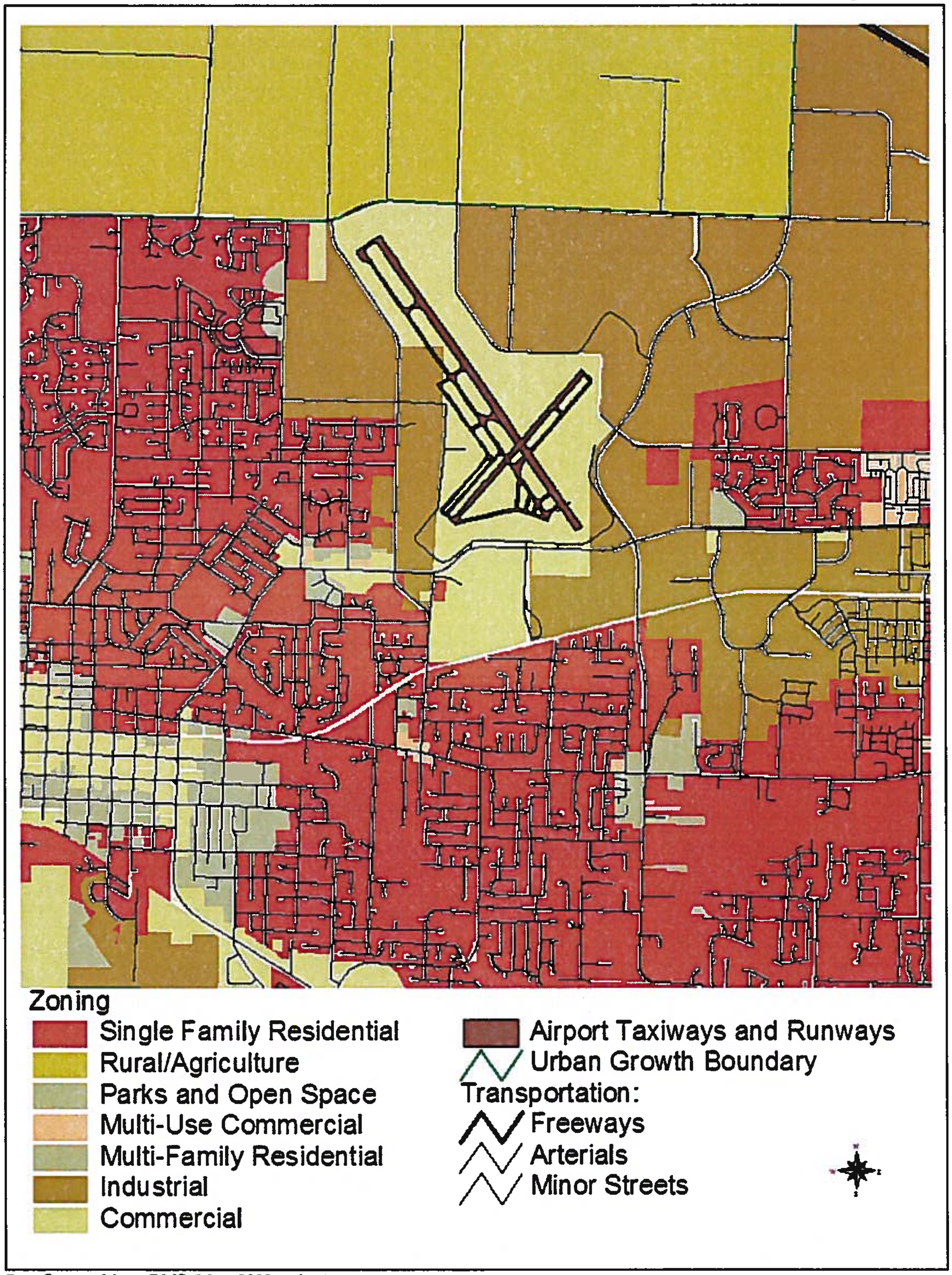
Noise Contour Source: Port of Portland, Aviation Planning and Development Department

Aircraft operators are encouraged to help maintain a good neighbor relationship with surrounding communities by following the recommended noise abatement procedures in the *Fly Neighborly* guidebook. This guidebook outlines recommended flight path procedures for aircraft departing or arriving at the Portland-Hillsboro Airport; however, safety always supersedes noise abatement patterns, and the procedures described in the guide are not intended to preempt the responsibilities of the pilot in command for aircraft operation (Port of Portland, 2002).

As outlined in the introduction, most land around the airport is zoned residential, which presents with airport activities. Zoning near the airport is depicted in Figure 4.

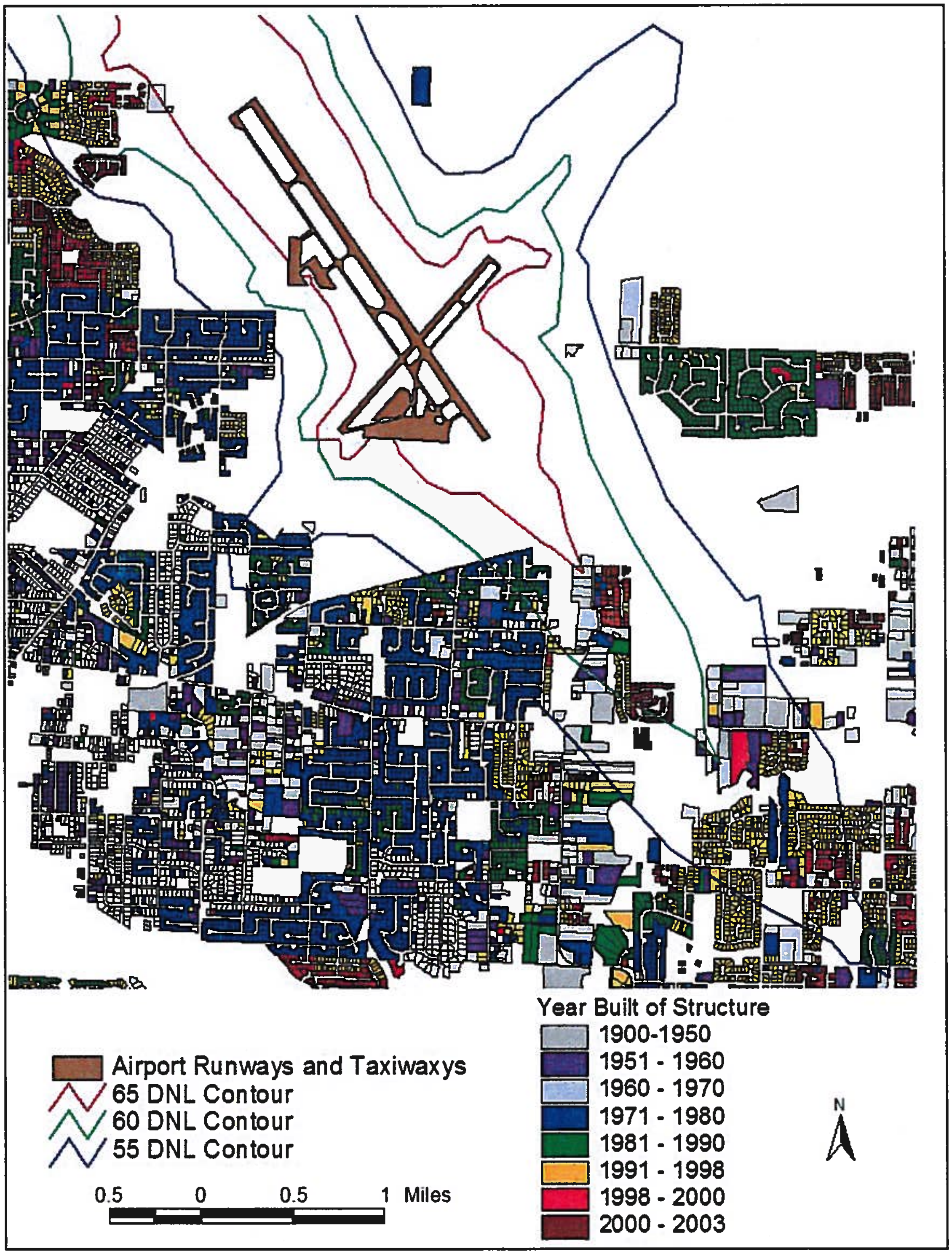
As described in the introduction and illustrated in Figure 5, with the area to the north as an exception, the land use surrounding the Hillsboro Airport is mostly developed or is in the process of becoming developed, where development is allowed. Extensive residential subdivisions were developed in the 1970's to the south and west of the airport, and recently there has been extensive development to the south and southeast of the airport.

Figure 4: Zoning Near the Portland-Hillsboro Airport



Data Source: Metro RLIS (May, 2003 update)

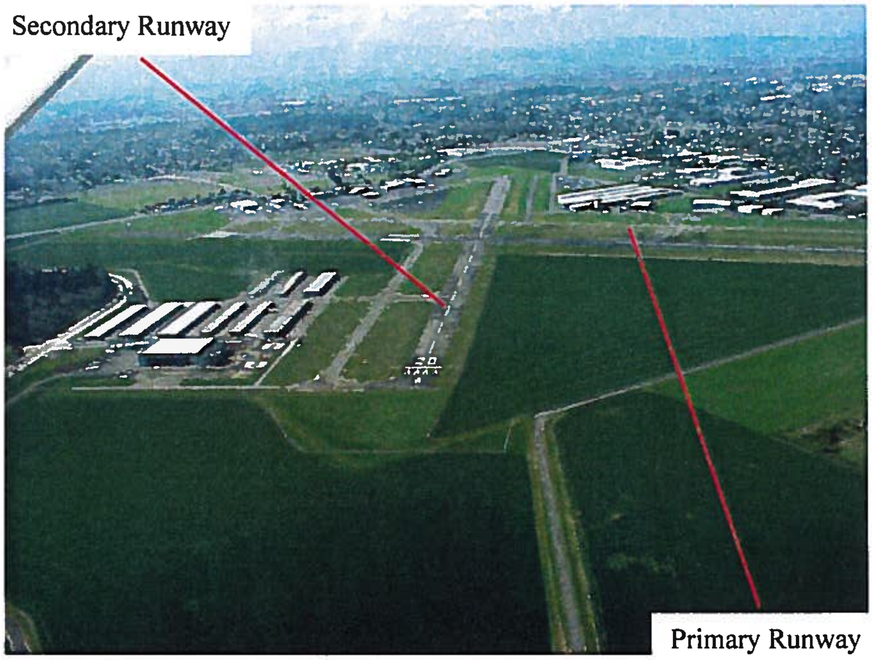
Figure 5: Year-Built of Single Family Residential Structures



Noise Contour Source: Port of Portland, Aviation Planning and Development Department
Other Data: Metro RLIS (May, 2003 update)

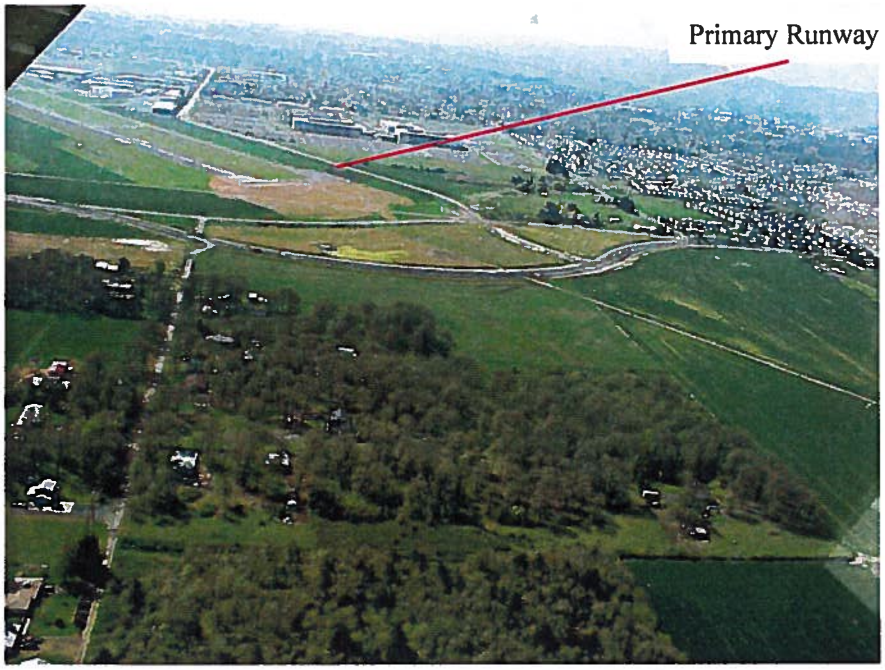
Picture 1 through Picture 5 illustrate the areas near the airport and underneath the flight path. Notice the new development near the runways and flight path in Picture 2, 4, and 5.

Picture 1: Secondary Runway Flight Approach Path (View to SE)

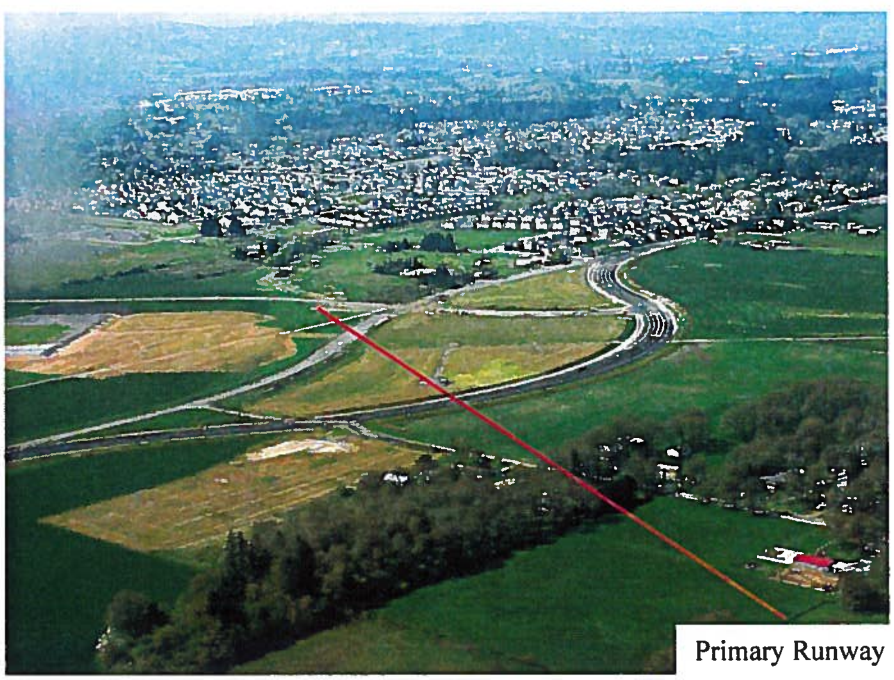


Picture 2: Newer Development Near Primary Runway (View to NE)

Picture 3: Area Near Primary Runway (View to SE)



Picture 4: Newer Development Near Primary Runway (View to Southwest)

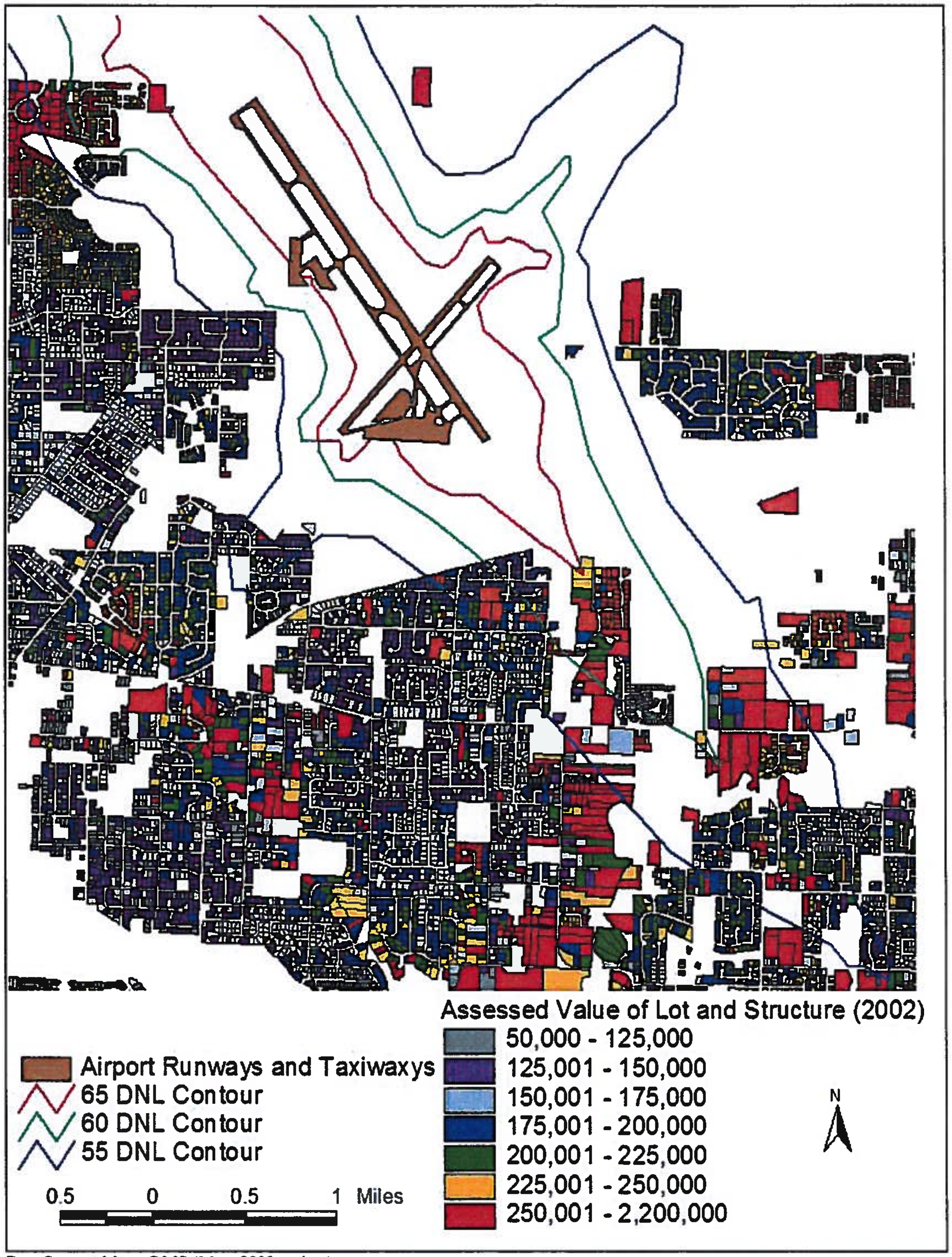


Picture 5: Newer Development Near Primary Runway (View to Northwest)

Picture 1 through 5 Source: Port of Portland, General Aviation Department

Figure 6 illustrates the assessed value of single-family properties near the airport. The assessed values are for 2002.

Figure 6: Assessed Value of Single Family Taxlots near the Portland-Hillsboro Airport



Data Source: Metro RLIS (May, 2003 update)

LITERATURE REVIEW

The presence of aircraft noise is one of many considerations the consumer must evaluate in buying or selling a residence. Researchers have been careful to consider other effects on sale prices and to normalize their influences in research studies. Although there are many factors that must be considered when evaluating home values, nearly all research conducted in this area found negative effects from aviation noise. Given differences in statistical methods, samples, time periods, and urban locations, empirical studies have not produced a singular value for the effects of airport noise on property values. With the number of various noise measurement methods available, no single standard methodology exists, adding to the complexity of comparing previous studies. In the context of various methods, consistent themes and correlations emerge. In general, studies have shown that airport noise has a negative impact on residential property values. This section reports on those studies.

Some have speculated that the convenience and economic revenues from an airport serve to offset any diminution in value; however, nothing in the body of published literature supports this notion (Bell, 1994). Approximately six million Americans currently reside on 900,000 acres of land exposed to levels of aircraft noise that creates a significant annoyance for residents. Over 600,000 Americans reside in areas that are severely impacted by aircraft noise (DNL 55+) (Bell, 2001). Despite the magnitude of noise problems, no single or universal criterion defines a "noisy" airport and there is no preferred methodology to study the problem (Booz-Allen & Hamilton, 1994). Additionally, there are over 200 types of variables that impact real estate values, such as the presence and size of a garage, air conditioning, and heating, so each study uses a different combination of conditions (Bell, 1997).

Airports may depress residential property values in two ways. First, the airport's operations may depress property values from the *proximity to an airport's runway* below the level real estate markets would produce if the airport did not exist. Therefore, if a single-family residence located in the proximity to an airport were physically transported to an identical location on an identical lot in a community of identical status and prestige but elsewhere in

the region, its value would increase (Lane, 1994). The amount of the increase represents the depression in real estate value caused by the proximity to the airport.

A second way in which an airport may impact the value of real estate is the variation in value among properties caused by their *proximity to the airport's flight paths* for arriving and departing aircraft. This phenomenon is usually referred to as the "shadow effect", the noise pollution, visual pollution, possible air quality pollution, and the degraded environment for human habitat caused by living under low flying aircraft (Lane, 1994). While tremendous economic benefits and revenue clearly are associated with a large airport, studies conclude that those under or nearby the flight path tend to suffer a net negative impact (Bell, 1997).

Most studies of direct adverse impacts of airports have concentrated on measuring noise impacts on property values and proximity to the airport's flight paths as opposed to proximity near an airport. These studies employ a cross-section of property value data along with information on characteristics of housing and some measure of aircraft noise exposure. The most commonly used noise measure in published literature is the Noise Exposure Forecast (NEF). The NEF is the total noise exposure produced at a given point may be viewed as the sum of noise levels produced by different aircraft flying different flight paths. When summed on an energy basis over all aircraft types and flight paths, noise exposure is a function of the average perceived noise level, time of day, and number of operations (Bell, 1997). The primary noise criterion to describe the existing noise environment is the Decibel Noise Level (DNL) a noise measure that other published studies have examined in place of NEF.

Early studies used census data as a primary data resource to estimate the impacts of airport noise on residential property values. Aircraft noise impacting residential properties began in the 1960's with suburbanization and airport expansion. Table 5 summarizes the impact to property values for aircraft noise studies in 1960 and 1970 at several major airports.

Table 5: Summary Empirical Damage Estimate Studies for Aircraft Noise and Property Values in 1960 and 1970

Study Area (Year, Mean Property Value)	Range of Noise Levels	NDI-NEF Estimate* (Percent)
New York City (1960, $16,656)	55-75	1.9%
Los Angeles (1960, $19,772)	55-75	1.8%
Dallas (1960, $18,011)	55-75	2.3%
Minneapolis (1967, $19,683)	55-85	0.6%
San Francisco (1970, $27,600)	60-80	1.5%
San Jose (1970, $21,000)	60-80	0.7%
Boston (1970, $13,000)	60-80	0.6%
Toronto (1970, $32,500)	55-70	0.9%
Dallas (1970, $22,000)	55-80	0.6%
Washington D.C. (1970, $32,725)	55-70	1.0%

Source: Nelson (1979)
* NDI = Noise Depreciation Index. The NDI-NEF is the percentage decrease in a given property value per unit increase in the DNL
Source: Aviation Noise Effects (FAA Document, 1985)

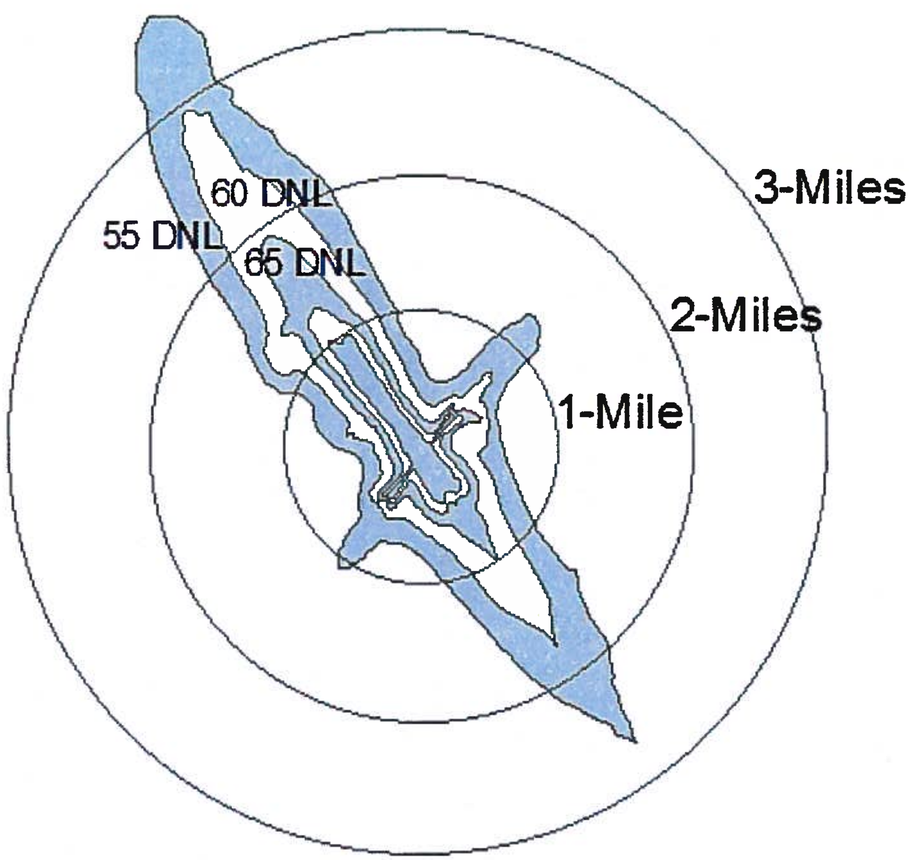
Gautrin (1961) was one of the first to research the effects of airport noise on property values. Gautrin examined the fall in price as a function of the valuation of transportation savings and the valuation of noise for Gatwick Airport in London. No effect on residential land values was ascertained, but the author accounted for the non-significance of the results mainly as a function of the small sample size, dissimilar areas, and the fact that variance within an area was greater than between areas (Gautrin, 1961). In an additional paper, Gautrin surveyed real estate agents and reported that if noise were eliminated the agents thought that prices of houses would increase on average 10 percent.

Nelson (1979) addressed the noise versus accessibility problem based on the elongated shape of noise contours and sampling within limited areas with more or less the same degree of separation. Nelson chose two similar neighborhoods with equal access to the airport, but with different noise environments. With the noise variable in the hedonic function, the effects of noise were determined. Other studies have studied access to major airports. In particular, Tompkins (1998) used a straight-line distance to the airport as a measure of accessibility. Tompkins concluded that the effect of accessibility was greater for

certain properties, so the net effect of the airport on property values was positive for some properties without accounting for noise.

The purpose of this study is to isolate the effect of noise on property values. Many studies exploit the elongated nature of noise contours and select a sample area that holds accessibility constant and noise levels to vary. Figure 7 below illustrates noise contours and proximity to an imaginary airport. Note that some properties can have a high degree of accessibility to the airport, but a low noise level. In this example, areas over 3 miles from the intersection of the airport runways are still affected by airport noise, but are not as accessible as some other areas closer to the airport that are not affected by airport noise. Therefore, the correlation between noise and access may not be high.

Figure 7: Noise Contours and Proximity to Airport



One of the most important published studies concerning airports and property values was a report prepared for the FAA entitled *The Effect of Airport Noise on Housing Values: A Summary Report* (1994). The FAA was clearly concerned with the potential effects of airport noise and property values. The results of the report indicated a consistent negative impact on residential property market values located near the airport and/or underneath the flight track. This report found that the impact on property values of airport noise varied from negligible amounts ($627 for housing units around Baltimore-Washington International Airport) to significant ($60,800 for moderately priced housing units around Los Angeles International Airport) (Booz-Allen & Hamilton, 1994). The study concluded that entry-level homes are impacted less as compared to moderately priced homes, and the loss in market value of low priced homes is generally minimal. The study also shows that the loss to moderately priced homes is as high as 19 percent. Finally, it was concluded the reduction in value of a high priced home would be approximately 2.5 times that of a moderately priced home (Booz-Allen & Hamilton, 1994). Because of the federal sponsorship of the FAA study, many studies have used the results of this study, such as the 1.33 percent estimate in diminution of property value per decibel, as a calculation for other studies.

The conclusions in the FAA study are fairly consistent with a variety of other published studies. Nelson (1979) concluded that an increase of NEF 5 over threshold noise levels would decrease the market value by 2.5 percent. Abelson (1979) concluded that a loss in property value of 0.67 percent per NEF and refers to other studies with losses of 1 percent or more per NEF. Additional insights are added by a study that indicates that a one-unit increase in NEF results in a diminution in value of 0.65 percent (Uyeno, 1993). Frankel concluded that a loss of market value ranging from 1.2 percent of low-impact properties to 21.5 percent for severely impacted properties (Frankel, 1991). In a report to the Orange County Board of Supervisors, Randall Bell concluded that the impact on single family residences near Los Angeles International, Ontario and John Wayne airports ranged from –15.0 to –42.6 percent, with an average of –27.4 percent (Bell, 1997). Nelson surveyed the results from 10 earlier studies covering 11 airports for the period between 1967-1976. The percentage decrease in property values per decibel ranged from 0.29 percent for Cleveland

to 0.74 percent for San Diego (Nelson, 1985). Nelson also concluded in a separate case study of Atlanta Hartsfield International Airport a property depreciation of 0.67 percent per decibel (Nelson, 1985).

A study prepared for the Port of Seattle in 1994 examined noise effects by comparing the assessed values of 32 residences located within the Seattle-Tacoma International "Noise Remedy Area" boundary. The study compared 16 residences that were within the Noise Remedy Area and 16 other residences that were outside the Noise Remedy Area boundary (Shapiro, 1994). The study incorporated variables such as the area of the lot, the size of the house, the number of bedrooms and bathrooms, and the city in which the house was located. The study concluded that neither the existence nor the magnitude of any general effect on rates of appreciation of property values from airport noise was demonstrated.

An additional study on noise impacts in the Seattle area in 1994 funded by a grant from the State of Washington found that the proposed expansion of Seattle-Tacoma International Airport would cost five nearby cities $500 million in total property values and $22 million in real estate tax revenue. This study also found based on empirical evidence that a housing unit in the immediate vicinity of the airport would sell for 10.1 percent more if it were located elsewhere. By accessing property tax revenue and the price and location of homes, Lane (1994) was able to estimate the effects of airport noise on property tax revenue. Lane concluded that all things remaining equal, the value of a house and lot increases by about 3.4 percent for every quarter of a mile the house is farther way from being directly underneath the flight track of the airport. The study also concluded that the value of a single family residential home increases by about $17,784 for every quarter a mile it is farther away from being directly underneath a flight track. This study concluded that the airport's most adverse impacts occur in areas immediately surrounding the airport (Lane, 1994).

In an economic analysis based on empirical evidence of a conversion of a former military base to a commercial airport in Orange County, California, the impact of noise was determined to reduce the actual market value of real estate owned by residents and businesses in Orange County by $1.1 billion to $3.5 billion. This study was similar to

Lane's Seattle study (1994), which estimated the effects of noise on property tax revenue. The high estimate of $3.5 billion is more than double the cost of estimated cost to convert the airport to commercial use. The loss in market value was estimated to be $11 to $35 million in annual loss of property tax revenue (Bales, 2002).

A hedonic analysis of residential home prices in Austin, Texas provided a comprehensive analysis at the costs and benefits of the closure of a commercial airport and the conversion a military base to a commercial airport. The findings indicated that house prices near the old airport changed little with early announcement of the new airport, but changed more with the groundbreaking than with the final switch to the new airport. This finding suggests that homeowners expected airport noise and adjust to the relocation of the airport before the aircraft noise actually began (Konda, 2002). Additionally, estimates from the old airport indicate that the infrastructure development remains an amenity even after the airport is removed, causing a net gain to neighbors of the old airport. A summary of certain studies cited in this section is in Table 6 below.

Table 6: Summary of Previous Literature

Author	Location	Year Studied	Unit of Measurement	Examples of Variables (Hedonic Price Model)	Findings
Bales (2002)	El Toro, CA	2002	Decibel and DNL	Property tax rates, assessed value, location (city), distance to airport and flight tracks	Estimated decrease property tax revenue based on FAA noise data (Booz-Allen)
Booz-Allen (1994)	LA, Baltimore, NY	1994	Decibel and DNL	House size, age, number of floors, access to employment, city center, zoning	1.33% diminution of value per decibel
Lane (1994)	Seattle	1994	Distance from Airport	Lot size, structure size, number of bedrooms and baths, city location	Home values increase by $17,000 for every .01 mi from airport
Kranser (1997)	Seattle	1994	Distance from airport	Condition of home, number of bedrooms and baths, presence of air conditioning, access to	Value increases by 3.4% for every 0.25 mi from airport

Author	Location	Year Studied	Unit of Measurement	Examples of Variables (Hedonic Price Model)	Findings
				jobs	
Nelson (1985)	Atlanta	1985	Decibels	Year sold, square feet, bathrooms, basement, air-conditioning, rooms, percent minority, ownership type	A decrease of .64% in sale prices with a one unit increase in dB
Crowley (1973)	Toronto	1973	Distance to airport Compared similar neighborhoods	Population density, age of housing, transportation infrastructure, access to employment, percent minority	Mean price of airport area was consistently lower than similar neighborhoods
Nelson (1979)	SF, St. Louis, Cleveland, San Diego	1970	NEF	Number of rooms, percent black population, built before 1939, distance to airport, percent owner occupied	Consistently negative values, ranging from 0.6% to 2.3% per NEF

Please see References section for sources.

The early period of travel by commercial jet was associated with a transitional period of adjustment in residential housing markets that had essentially ended by the late 1960s. Additionally, with technology and noise abatement measures, the impact of airport noise has declined since earlier studies. Therefore, it is expected that studies older than a decade ago would yield different results. This time span encompasses a number of major airport expansions, the introduction of jets, and a general growth in aviation activity.

Various studies indicate that there is a correlation between noise levels, as measured by noise contours, and the diminution in value. More expensive homes tend to be impacted more than less expensive homes. While published reports in this review solely evaluate property near large commercial airports, there have been no published studies completed for general aviation airports such as the Portland-Hillsboro Airport; however, because cited literature concludes that the noise level, in NEF or DNL, is a key variable in determining a diminution in value of residential properties, the type of airport (commercial or general aviation) should not be a key variable since a home located in the 55 DNL contour for a commercial airport and a home located in the 55 DNL contour for a general aviation airport have the same average noise level. Additionally, the number of flights is less important than the loudness and variability of the loudness of single events because the noise level in DNL

is based on the average noise level. Several loud flights could be just as loud as many passing flights. It is therefore hypothesized that the results of this analysis for the Portland-Hillsboro Airport will correlate with the results of the literature cited in this section. In other words, it is expected that aircraft noise does cause a diminution in value of property affected by airport noise; however, for basis of research, the null hypothesis will be that there is no significant difference in sale prices.

HEDONIC PRICE THEORY

Hedonic analysis is the most common method for estimating the effects of numerous amenities and disamenities on the value of residential housing. Hedonic models exploit the differentiation that exists in housing markets in terms of locational attributes. It is rare that two residential properties will be identical in all respects, except for the aircraft noise pollutant in question. In order to isolate a given hedonic price, it is necessary to control statistically for other influences on property values.

Each house and lot represents a unique combination of characteristics so the decision to purchase a given property is complex. The price a buyer is willing to pay depends on location, attributes of the neighborhood and community, local taxes, and local provided services. Since these characteristics are sold as a package, it is difficult to infer from one or two sales the incremental effect of one characteristic or attribute on the final selling price of a dwelling. However, if characteristics are provided in various combinations of selected attributes, it is possible to estimate a hedonic price relationship that gives the price of any variable as a function of quantities of various characteristics. An example of the functional form of a hedonic price model is:

$$\textbf{Selling Price}_i = \mathbf{f(H_i, E_i, S_i)}$$

The selling price of a home (i) is dependent on the home's attributes (H_i), the environmental attributes of the area around the home (E_i) and the socioeconomic characteristics of the

neighborhood (S_i). The price of any one of these vectors will be determined by the particular combination of characteristics it displays.

Attributes of every property can be described by the qualities or characteristics of its structure, environs and location. Therefore, any house could be described by a vector, effectively a list of different quantities of each characteristic of the property. Properties possessing larger quantities of good qualities are expected to command higher prices and those with larger quantities of bad qualities are expected to command lower prices. This function is known as the hedonic price function. It is possible to estimate the hedonic price function by observing the selling prices of properties in a market. If there is enough information on the selling prices of properties exhibiting different characteristics, then it is possible tease out how much each individual characteristic influences the total price of a property. The principle underlying the analysis is that the 'airport factor' can be deduced by accurately determining the difference in value of two essentially identical dwellings, one close to the airport, while the other is not (Shapiro and Associates, 1994).

Measurement of the economic value of quietude has traditionally focused on the effect of significant noise exposure on residential property values. Early studies employed aggregate census tract and census block data. Recent studies have used sales data for individual properties. The next generation of hedonic price studies will use geographical information system (GIS) methods, which has already been applied to noise generated by road traffic.

Despite frequent reliance upon hedonic analysis in property value estimation, it is not an exact science. Constructing a regression model that reflects all of the impacts of property value and sale price is impossible. There are a number of unique factors influencing sale prices to a particular area. The availability of data for a given study determines what factors can be included. For the best estimate of property values, all variables should be incorporated into the regression that would influence a sale price, but lack of data prevents this. Variables that are difficult to include are the condition of the home, the presence of air conditioning, the presence and number of fireplaces, and the finished products inside the home that may increase the value.

METHODOLOGY

STUDY PURPOSE

The purpose of the analysis is twofold:

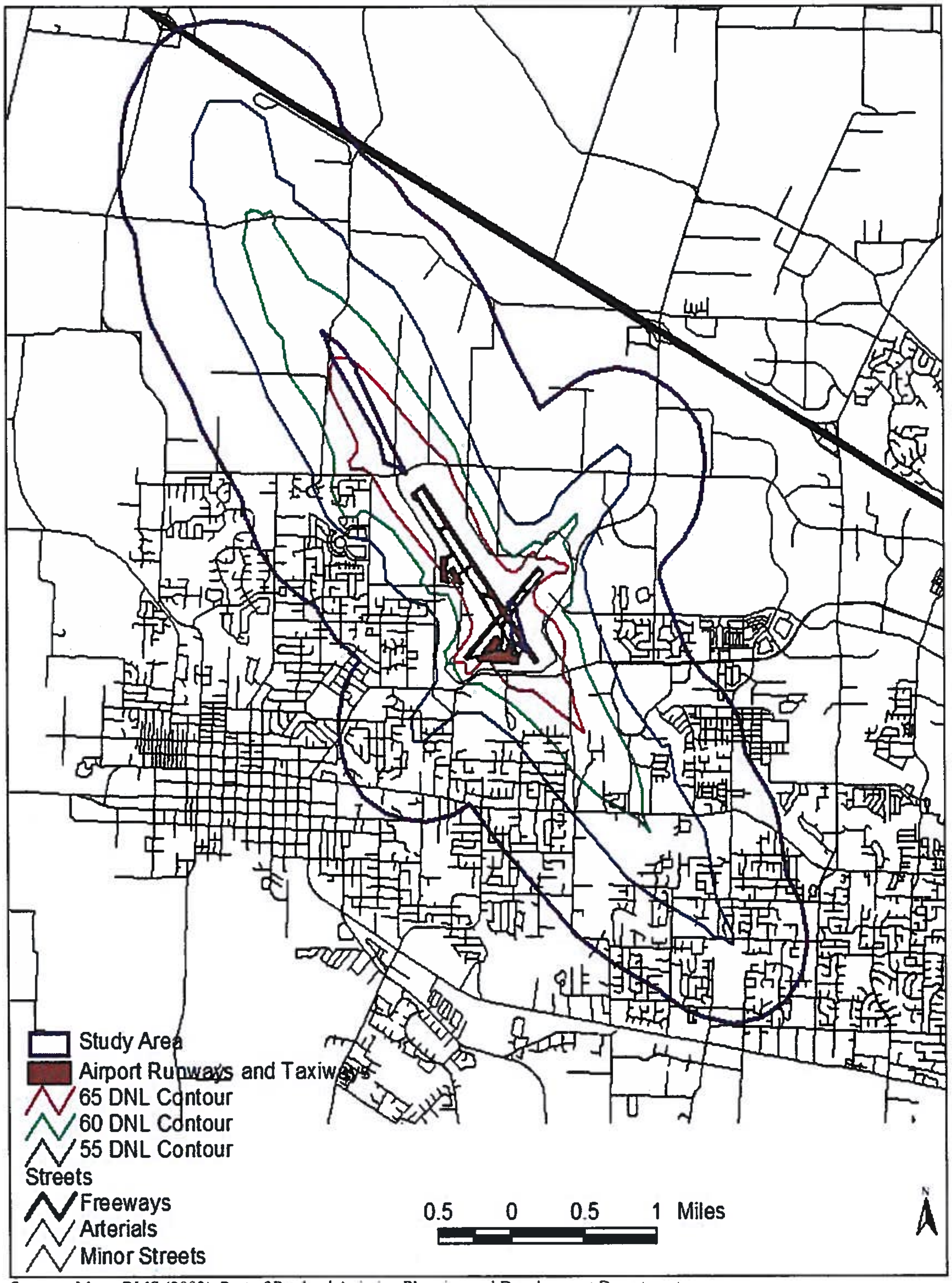
- To determine if there is a significant difference between single-family residential property sale values in proximity to the airport (Proximity to Airport's Runways), and;
- To determine if there is a significant difference between single-family residential property sale values in proximity to the airport's 55 DNL contour or higher (Proximity to Airport's Flight Tracks).

Study results will estimate the percent decrease in property values with increasing distance to the airport and increasing distance from the airport's flight tracks. The results will also conclude which has more of an effect on housing values: the proximity to airport or proximity to the airport's flight tracks.

STUDY AREA

A study area was selected to capture the variety of properties in vicinity of the airport and its flight tracks, but not to extend far beyond properties that were not in proximity of the airport or the airport's flight tracks. Therefore, the study area encompasses an area entirely within the City of Hillsboro. The study area was restricted to the area within the 55 DNL noise contour of the Portland-Hillsboro Airport and a 0.5- mile buffer from the 55 DNL contour. The half-mile buffer was created outside of the 55 DNL noise contour to allow for a control group of housing in the sample. The null hypothesis tested was that airport operations have no effect on residential sale prices with decreasing distance from the airport and the airport's flight tracks. Figure 8 below illustrates the study area. The methodology to select these taxlots is explained in more detail in the process section below.

Figure 8: Study Area



Sources: Metro RLIS (2003), Port of Portland Aviation Planning and Development Department

DATA

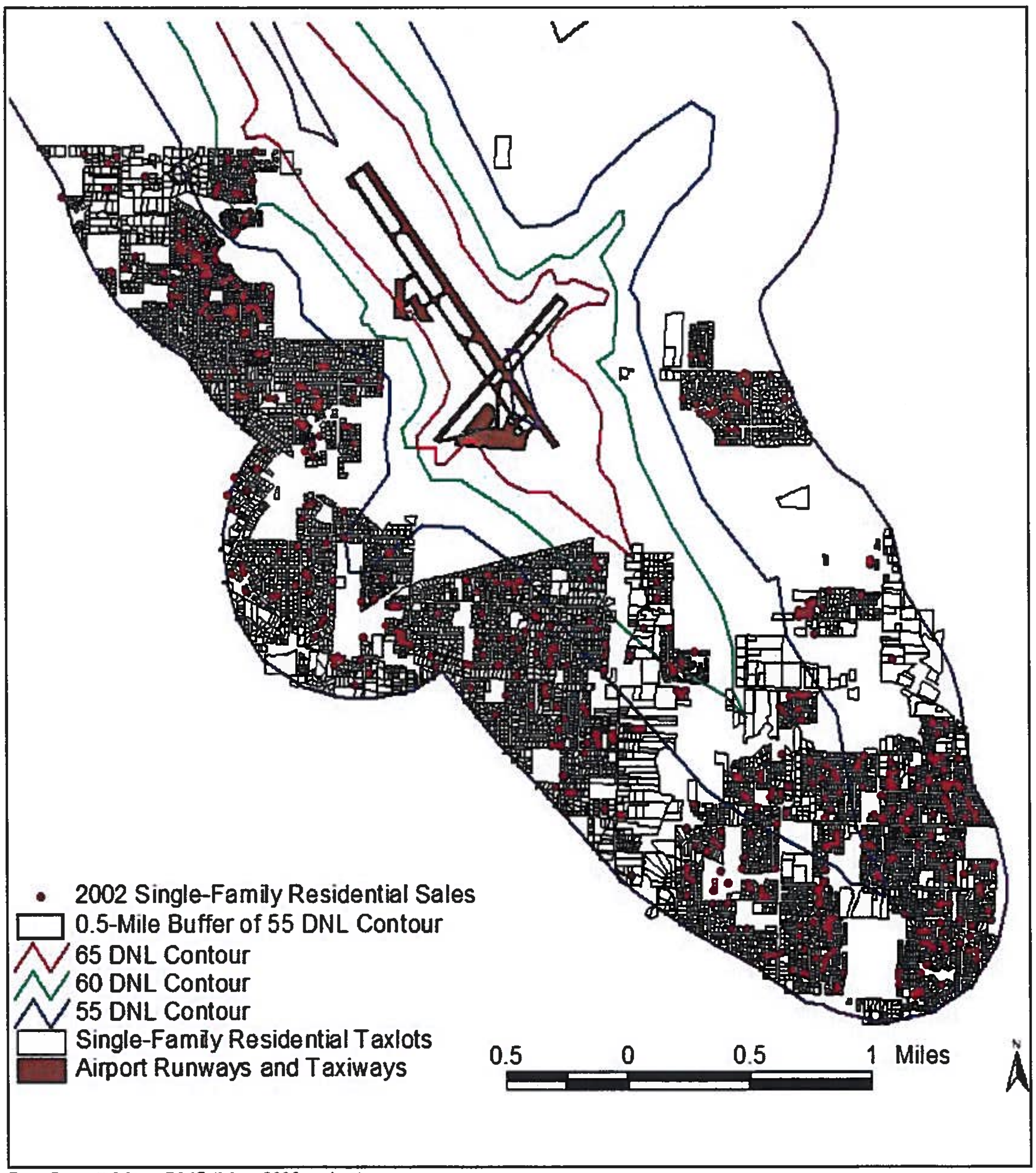
Data used for analysis and referenced in this study was acquired from Regional Land Information System (RLIS) (2002). This database is maintained and updated by Metro, the regional government for three Oregon counties located in the Portland metropolitan area. RLIS data provided sale prices, square footage of structures, lot size, year built, and sale date of property. The Washington County Assessor's Office provided information for the number of bedrooms and bathrooms for each structure. The dollar amount of actual sales data in Washington County is a matter of public record. This source also contained the same data as RLIS and was used to check for accuracy. Traffic count data was obtained from the City of Hillsboro to determine the most heavily used roads. Noise contours (1995) for the Portland-Hillsboro Airport were obtained from the Port of Portland, the owner of the Portland-Hillsboro Airport. Noise levels are 1995 conditions, measured and calculated as part of the 1996 *Portland-Hillsboro Airport Master Plan*, the most recent master plan for the Portland-Hillsboro Airport. The 1995 noise contour data is the most recent noise data for the airport, but the contours have not likely changed significantly. The noise contour maps illustrate the 55, 60, 65, 70, and 75 DNL contours. With help of GIS, the data was used to derive information about the location of properties with respect to the noise contours and in relation to other features. This is explained in more detail below.

PROCESS

Using GIS, all single-family residential zoned taxlots with a sale date in 2002 were identified. Parcels with property values less than $50,000 were determined to be uninhabitable and were excluded from the sample. A parcel of land with a habitable structure in the area valued at $50,000 or less is highly unlikely for this area. As previously described in the literature review section, it is the sale price and not the assessed value that is hypothesized to affect residential property values near the airport. Therefore, a sale date for one year was necessary for analysis because the noise contour data is based on one year of noise data. Next, using Metro's RLIS database (2002), all single family residences without data in all of the following categories were excluded: area of taxlot, land value, building value, total value, building square feet, construction date of structure, and sale

price. There are a total of 7,192 single-family residential properties in the study area. The total number of sites studied in this report defined by using the above process was 495 (number of homes sold in 2002 in study area), representing 6.8 percent of the total study area. A total of 42 sites were excluded due to incomplete data. Figure 9 below illustrates the location of the 495 studied properties in this study.

Figure 9: Location of Properties Studied



Data Source: Metro RLIS (May, 2003 update)

MODELS FOR PROXIMITY TO AIRPORT RUNWAYS

Using a statistical package (SPSS, Version 10.0), a regression analysis was performed to determine a regression equation for sale price of areas near the airport. The value of single-family residential properties was estimated using the following regression model:

Model 1:

$$(Y) = \alpha + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u$$

Where:

Y = 2002 Sale Price of Lot and Structure (dollars)

α = Constant

X_1 = Area of Lot (square feet)

X_2 = Structure Size (square feet)

X_3 = Age of Structure (years)

X_4 = Number of Bedrooms

X_5 = Number of Bathrooms

X_6 = Distance to Light Rail Station (miles) (straight line)

X_7 = Distance to Downtown Hillsboro (miles) (straight line)

X_8 = Network Distance to Highway 26 (miles)

X_9 = Location Adjacent to Busy Street

X_{10} = Noise Level (DNL)

X_{11} = Distance to Airport Runway (miles)

u = Stochastic Error Term

Explanation of Variables

The following describes the variables used in the hedonic equation in more detail:

- **Area of Lot:** The square footage of the single-family residential zoned property (taxlot). Data was obtained from Metro's RLIS (2002) and/or Washington County's Assessors Office.

- **Structure Size:** The total square footage of the structure located on the property. Data was obtained from Metro's RLIS and/or Washington County's Assessors Office.

- **Age of Structure:** The age of the structure on the property relative to 2002. For instance, a structure built in 1999 would have an age of 3 years. Data was obtained from Metro's RLIS database.

- **Number of Bedrooms:** Total number of bedrooms in the structure, identified by Taxlot ID number for each property. Bedrooms are defined as enclosed rooms with a closet and operable window. Data was obtained from the Washington County Assessors Office.

- **Number of Bathrooms:** Total number of full bathrooms in the structure, identified by Taxlot ID number for each property. Full bathrooms consist of a shower and/or bathtub, a toilet, and a sink. Data was obtained from Washington County Assessors Office.

- **Distance to Light Rail Station:** The straight-line distance in tenths of a mile from the center of the property to the nearest MAX light rail station. MAX is the regional light rail system for the Portland metropolitan area. The MAX line (Blue Line) to Hillsboro was completed and opened in 1998. This line connects downtown Hillsboro with downtown Portland and areas to the east of downtown Portland. The Blue Line terminates in Downtown Hillsboro at the Hatfield Government Center. Straight-line distance was used instead of network distance because there are often routes other than streets to walk to and from a light rail station. Distance was calculated using GIS.

- **Distance to Downtown Hillsboro:** The straight-line distance in tenths of a mile from the center of the property to Downtown Hillsboro to measure accessibility. Because Hillsboro is the county seat for Washington County, downtown Hillsboro is a large employment and retail area. Distance was calculated using GIS.

- **Network Distance to Highway 26:** The network distance from the center of the property to the Cornelius Pass intersection of Highway 26, the closest interchange to the study area. This variable estimates accessibility to Highway 26, the main route to the downtown Portland and the east side of the Portland metropolitan area. Distance was calculated using GIS.

- **Location Adjacent to Major Street**: A dummy variable was assigned to properties located on or adjacent to a busy street, which may be affected by excess noise from vehicular traffic. For this study, busy streets were defined as streets with average daily traffic (ADT) of more than 5,000 vehicles/day. Traffic count data for 2002 was obtained from the City of Hillsboro. A dummy variable was assigned instead of actual traffic count data for each property because ADT was not available for all streets in the city. Only major streets are included in the City's traffic count data. The 5,000 vehicles/day threshold represents the top 10 percent of busiest streets in the defined study area. Streets that met the criterion of at least 5,000 vehicles/day and located in the defined study area were:

    - E Main Street
    - NE 25th Ave
    - NE 28th Ave
    - NW Evergreen Parkway
    - SE Cypress Street

- **Noise Level in DNL:** Noise level was estimated using the noise contour map by assigning an estimated noise level for each property. This map shows the noise contours for the 55, 60, 70, and 75 DNL areas. Individual properties used in this analysis were coded with a DNL noise level according to estimated noise exposure they fell into on the noise contour map. Noise levels were estimated using noise contour data provided by the Port of Portland. Distance (miles) for each studied property was calculated from the 55 DNL noise contour. Distance for each studied property from the airport's runways was also calculated.

While city services and tax structure are important in choosing a home, all properties are located within Hillsboro city limits. Therefore, a variable for city services and tax level was unnecessary. Summary statistics of the data used in all models are shown in Table 7.

Table 7: Summary Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum	Number of Observations (=1 for Dummy Variables)
Sale Price	$192,528	$54,435	$50,000	$812,500	495
Area of Lot	7,974.1	6,154.4	2,589.9	77,728.3	495
Structure Size	1,761.80	482.1	864	3,980	495
Age	13.6	14.4	0	112	495
Bedrooms	3.33	0.65	2	7	495
Bathrooms	2.51	0.75	1	6	495
Dist to Light Rail	0.96	0.51	0.01	1.96	495
Dist to Downtown	1.98	0.83	0.31	3.37	495
Dist to Hwy 26	2.83	0.46	1.57	3.98	495
Busy Street	0.04*	0.19	0	1	35
Dist from 55 DNL	0.23	0.12	0.00	0.50	414
Dist from Runway	1.58	0.76	0.31	3.01	495

*=percent "yes" (located adjacent to a major street)

Model 2:

An interaction variable was added in Model 2 in place of the Distance to Runway variable. The description s of variables is the same as in Model 1.

$$\mathbf{Y = \alpha + b_1X_1 + b_2 X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u}$$

Where:

Y = 2002 Sale Price of Lot and Structure (dollars)

α = Constant

X_1 = Area of Lot (square feet)

X_2 = Structure Size (square feet)

X_3 = Age of Structure (years)

X_4 = Number of Bedrooms

X_5 = Number of Bathrooms

X_6 = Distance to Light Rail Station (miles) (straight line)

X_7 = Distance to Downtown Hillsboro (miles) (straight line)

X_8 = Network Distance to Highway 26 (miles)

X_9 = Location Adjacent to Busy Street

X_{10} = Noise Level (DNL)

X_{11} = (Distance from Airport (miles)) * (Noise Level (DNL))

u = Stochastic Error Term

- **Interaction Variable:** The effect on housing value of proximity to the airport is measured through the use of two variables: a distance variable that measures distance from the airport, and an interaction variable (X_{11}) defined as airport noise level multiplied by the distance from the airport. The addition of the interaction term may improve the accuracy of the results due to the collinearity between distance and noise. Distance was calculated by using GIS.

MODELS 3 AND 4: PROXIMITY TO AIRPORT'S FLIGHT TRACKS

While proximity to an airport may play a role in sale price devaluation, the alignment of runways and the flight paths' associated noise levels are hypothesized to have a greater effect on sale price, based on cited literature in the Literature Review section. As previously described, the 55 DNL noise contour is the noise level where airport noise begins to disrupt residential properties located near an airport, as defined by the FAA, and the airport land use compatibility as defined by the State of Oregon. An important purpose of this study is not only between different noise level contours within which housing units are located, but also between a residential housing unit's distance from being directly under the flight track of approaching and departing aircraft. A distance variable (Distance from airport's 55 DNL contour) was introduced into the regression equation to explain the '*aircraft* factor'. The descriptions of the variables are the same as described above in Model 1.

Model 3:

$$\mathbf{Y = \alpha + b_1X_1 + b_2 X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u}$$

Where:

Y = 2002 Sale Price of Lot and Structure (dollars)

α = Constant

X_1 = Area of Lot (square feet)

X_2 = Structure Size (square feet)

X_3 = Age of Structure (years)

X_4 = Number of Bedrooms

X_5 = Number of Bathrooms

X_6 = Distance to Light Rail Station (miles) (straight line)

X_7 = Distance to Downtown Hillsboro (miles) (straight line)

X_8 = Network Distance to Highway 26 (miles)

X_9 = Location Adjacent to Busy Street

X_{10} = Noise Level (DNL)

X_{11} = Distance from Airport's 55 DNL contour (miles)

u = Stochastic Error Term

Similar to Model 2 above, an interaction term was introduced in the equation for Model 4. Since noise and distance from the airport's 55 DNL contour are closely related, the introduction of the interaction term may confirm more accurate results since the collinearity between distance and noise is reduced with the addition of the interaction term. The descriptions of variables are the same as described above in Model 1.

Model 4:

$$\mathbf{Y = \alpha + b_1X_1 + b_2 X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 + b_{10}X_{10} + b_{11}X_{11} + u}$$

Where:

Y = 2002 Sale Price of Lot and Structure (dollars)

α = Constant

X_1 = Area of Lot (square feet)

X_2 = Structure Size (square feet)

X_3 = Age of Structure (years)

X_4 = Number of Bedrooms

X_5 = Number of Bathrooms

X_6 = Distance to Light Rail Station (miles) (straight line)

X_7 = Distance to Downtown Hillsboro (miles) (straight line)

X_8 = Network Distance to Highway 26 (miles)

X_9 = Location Adjacent to Busy Street

X_{10} = Noise Level (DNL)

X_{11} = (Distance from Airport's 55 DNL Contour (miles)) * (Noise Level (DNL))

u = Stochastic Error Term

The effect on housing value of proximity to the airport is measured through distance variables that measure distance from the airport and an airport noise level variable (interaction variable). A negative sign on the noise coefficient in all models would indicate that airport noise has a negative impact on the market value of homes. Summary statistics for Models 3 and 4 used the same data as Models 1 and 2 and are shown in Table 4 above. Table 8 below illustrates the hypothesized signs of regression model variables.

Table 8: Hypothesized Signs of Regression Model Variables

Variable	Hypothesized Sign
Area of Lot	+
Structure Size	+
Age of Structure	-
Number of Bedrooms	+
Number of Bathrooms	+
Distance to Light Rail Station	-
Distance to Downtown Hillsboro	-
Distance to Highway 26	-

Variable	Hypothesized Sign
Location Adjacent to Busy Street	-
Noise Level	-
Distance to Runway	-
Distance to 55 DNL Contour	-

MODELS AND EMPIRICAL RESULTS

Several different functional forms have been estimated in previous studies of airport noise-property value relationship. Since not all of these forms are directly comparable and since there is no justification for favoring one form over the other, the coefficients are estimated using the linear, semi-log and double log functional forms. The linear model estimates a regression equation with a straight linear line. If some of the variables are in log form and some are not, then the model is called "semi-log". If all variables are in log form, then the model is called a "double-log", meaning, both independent and dependant variables are in log forms. Table 10 and Table 11 illustrate model results for proximity to the airport. Note in that for Model 1 in Table 9, the constant and all of the following variables are significant at the 90 % level: area of lot, structure size, age of structure, number of bedrooms, distance to light rail, distance to downtown Hillsboro, distance to Highway 26, location adjacent to a busy street, and distance to runway. Table 12 and Table 13 illustrate results for proximity to airport's flight tracks. Full results are shown in Appendix A. Not all variables had the expected sign in each model.

Table 9: Liner Results for All Models

Coefficient	Model 1	Model 2	Model 3	Model 4
Constant	132,408	154,538	115,981	112,147
	(-2.96)*	(3.19)*	(2.65)*	(2.58)*
Area of Lot	1.77	1.77	1.79	1.79
	(6.85)*	(6.87)*	(6.91)*	(6.90)*
Structure Size	83.82	83.77	85.73	85.74
	(20.95)*	(20.91)*	(21.94)*	(21.94)*

Coefficient	Model 1	Model 2	Model 3	Model 4
Age of Structure	-700.17	-698.10	-687.62	-688.1
	(-5.18)*	(-5.16)*	(-5.04)*	(-5.05)*
Number of Bedrooms	-12,295	-12,295	-12,218	-12,222
	(-4.41)*	(-4.41)*	(-4.37)*	(-4.37)*
Number of Bathrooms	-979.49	-911.9	-1,318	-1,314
	(-0.33)	(-0.31)	(-0.45)	(-0.45)
Distance to Light Rail Station	9,200	9,178	15,151	15,127
	(2.31)*	(2.30)*	(4.93)*	(4.92)*
Distance to Downtown Hillsboro	-15,806	-15,783	-3,107	-3,111
	(-2.63)*	(-2.62)*	(-1.61)	(-1.71)*
Distance to Highway 26	-23,958	-23,962	-13,592	-13,592
	(-4.30)*	(-5.16)*	(-4.31)*	(-4.30)*
Location Adjacent to Busy Street	-6,493	-6,536	-5,934	-5,935
	(-4.41)*	(-0.94)	(-0.85)	(-0.85)
Noise Level	263.05	-147.95	-25.08	44.94
	(0.35)	(-0.19)	(-0.33)	(0.59)
Distance to Runway	17,323	---	---	---
	(2.19)*	---	---	---
Interaction Term	---	319.4	---	-299.5
	---	(2.18)*	---	(-1.48)
Distance to 55 DNL	---	---	-16,498	---
	---	---	(-1.51)	---

Table 10: Model 1 Results (Proximity to Airport)

Coefficient	Linear	Semi-Log	Double-Log
Noise Level	-263.05	-0.0013	0.043
	(-0.35)	(-0.11)	(0.24)
Distance to Runway	17,323	0.022	-0.062
	(2.19)	(1.53)	(2.56)
Adjusted R^2	0.717	0.763	0.763

(T-statistics are in parentheses)

Table 11: Model 2 Results (Proximity to Airport)

Coefficient	Linear	Semi-Log	Double-Log
Noise Level	-147.95	-.0038	-0.022
	(-0.19)	(-0.805)	(-0.123)
Interaction Term	319	0.0030	0.0749
	(2.18)	(0.843)	(3.11)
Adjusted R^2	0.711	0.764	0.773

(T-statistics are in parentheses)

Table 12: Model 3 Results (Proximity to Airport's Flight Tracks)

Coefficient	Linear	Semi-Log	Double-Log
Noise Level	-25.08	-0.00055	0.0087
	(-0.33)	(-0.46)	(0.47)
Distance to 55 DNL Contour	-16,498	-0.043	-0.0115
	(-1.51)	(-2.24)	(-1.77)
Adjusted R^2	0.715	0.764	0.761

(T-statistics are in parentheses)

Table 13: Model 4 Results (Proximity to Airport's Flight Tracks)

Coefficient	Linear	Semi-Log	Double-Log
Noise Level	-44.94	-0.00039	-0.0192
	(0.59)	(-0.27)	(-0.81)
Interaction Term	-299.5	-0.00079	0.0628
	(-1.48)	(-2.21)	(2.57)
Adjusted R^2	0.715	0.764	0.763

(T-statistics are in parentheses)

DISCUSSION OF RESULTS

PROXIMITY TO AIRPORT'S RUNWAYS (MODEL 1 AND MODEL 2)

The estimated hedonic regression in the two models for proximity to the airport suggests that there is no significant relationship between airport noise and property values at the 90

percent level. The noise coefficient in for one of the functional forms implies that for a one-decibel increase in airport noise, there is approximately a $148 (linear form) reduction in property value. Since the mean sale price of homes in the study area is $197,000, a decrease of $148 per decibel is a negligible amount. Residential properties are not allowed at or beyond the 65 DNL contour. Therefore, the maximum depressed property value is $1,480, if a property had a noise value of 64 DNL. This value accounts for only 0.7% of the mean sale price. The semi-log model estimated a 0.13% reduction in property values per decibel increase, but is not statistically significant. The distance to runway coefficient in Model 1 suggests that there is an increase of about $17,300 (linear form) as distance increases by one tenth (0.1) of a mile from the airport. This value is statistically significant at the 90 percent level. The semi-log form indicates an increase of 2.2 percent per tenth of a mile as distance increases from the airport.

Proximity to Airport's Flight Tracks (Model 3 and Model 4)

The estimated hedonic regression in the two models for proximity to the airport's flight tracks suggests that there is no significant relationship between airport noise and property values at the 90 percent level. The noise coefficient in all but one of the functional forms implies that for a one-decibel increase in airport noise, there is approximately a $25 (linear form) reduction in property value. The mean sale price of homes in the study area is $197,000. A decrease of $25 per decibel is a negligible amount. This value accounts for very low percent of the mean sale price, and the noise coefficient is not statistically significant in all cases. The distance to flight track coefficient in Model 3 suggests that there is a *decrease* of about $16,500 (linear form) as distance increases by 0.1 mile from the airport. This value is statistically not significant at the 90 percent level. The semi-log form indicates an increase of 4.4 percent per 0.1 mile as distance increases from the airport. This value is statistically significant at the 90 percent level.

The results for this study outlined above do not correlate with findings of previous studies. A key factor in the sale price of homes is the price that a buyer is willing to pay for a property. While the location and possible environmental effects of large airports such as PDX may factor into the price that a buyer is willing to pay, the location and environmental

effects (noise, air pollution) of general aviation airports is normally not considered when purchasing property. Most consumers do not use general aviation airports and are likely unaware of the negative environmental effects that a general aviation airport may cause. Therefore, the presence of the airport and the effects of the airport may be unknown when a buyer purchases a property. This theory may have influenced the results in this study. While many know the location of PDX in the Portland area and the associated noise effects from the airport's operations, the Portland-Hillsboro Airport serves a smaller percentage of people and likely does not heavily influence the price a buyer is willing to pay for a property; however, as Hillsboro continues to grow with development steered towards the airport due to decreased land supply in the Portland metropolitan area, the effects of noise on property values may become an increasing problem with residents and therefore may affect sale prices of residential property near the airport and its flight tracks.

CONCLUSION

There have been a number of studies examining the relationship between airport noise and residential property values. No published research has studied noise and property values near general aviation airports. Reviewed literature indicates that the impact of noise from practically all studied airports on residential properties was universally negative on residential property market values under or near a flight corridor and near the airport's runway. While more people will likely choose to not live in a home that is impacted by airport noise than the population that would accept airport noise, the results from this study indicate that the sale prices of homes are not affected by airport operations and aircraft noise from a general aviation airport.

The hedonic pricing technique is used in this study to determine the impact that airport noise and proximity to the airport have on residential property values in the vicinity of the Portland-Hillsboro Airport in Hillsboro, Oregon. This report incorporated distance from the airport's runways and distance from the airport's flight tracks. This study concluded that sale prices of homes are not significantly affected with increased noise level, decreasing distance from the airport, and decreasing distance from the airport's flight tracks. Sale

prices are statistically higher with increasing distance from the airport's runways. The findings of this report indicate that noise is not main the factor of decreasing property values with decreased distance from the airport's runways.

Prior studies indicate that the price per decibel of noise is usually between 0.4 percent to 1.1 percent (Nelson, 1980). This study indicated a decreased price with increasing noise level, but unlike other studies, the noise value per decibel coefficient is not statistically significant. Other studies concluded that the disamenity value associated with a one-decibel increase in airport noise diminished as the distance a property is located from the airport increases. This study concluded that a one-decibel increase in noise does not statistically affect the market sale value of residential properties.

Information about the impact of airports on residential property value can be valuable, especially to officials associated with airports experiencing increasing flights or expansion. Such growth may not have been anticipated at the time of purchase and the homeowner may be negatively impacted by the changes. This study does not account for future expectations, but it does provide some new information for the Port of Portland, owner and operator of the airport and for others in the area around the airport, including homeowners. This report and other airport-land use related studies may aid in broad policy decisions for noise abatement alternatives and estimates based on property value data.

FURTHER STUDY

This study forms the foundation for a future study to further explore the relationship between general aviation aircraft noise, and residential sale values near a general aviation airport. The analysis in this paper can be improved along several research avenues. First, the regression would probably benefit from the addition of additional independent variables since the price of homes is determined by many factors. Examples of possible independent variables include the number of floors, the presence of a fireplace, heater, or air-conditioning, and the presence and size of a garage. Further analysis of the Portland-Hillsboro Airport can also analyze a time period of several years to determine a trend in

sale prices and compare with operations and noise levels at the airport. Additional analysis could also examine other land uses other than single-family residential.

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APPENDIX A: MODEL RESULTS

MODEL 1

Coefficient	Linear	Semi-Log	Double-Log
Constant	132,408	5.12	2.88
	(-2.96)*	(63.67)*	(8.89)*
Area of Lot	1.77	0.0000039	0.19
	(6.85)*	(7.51)*	(10.59)*
Structure Size	83.82	0.00016	0.54
	(20.95)*	(22.65)*	(15.85)*
Age of Structure	-700.17	-0.0017	-0.062
	(-5.18)*	(-7.31)*	(-7.92)*
Number of Bedrooms	-12,295	-0.012	-0.045
	(-4.41)*	(-2.52)*	(-1.09)
Number of Bathrooms	-979.49	-0.0036	0.031
	(-0.33)	(-0.69)	(1.08)
Distance to Light Rail Station	9,200	-0.018	0.031
	(2.31)*	(2.49)*	(3.44)*
Distance to Downtown Hillsboro	-15,806	-0.016	-0.052
	(-2.63)*	(-1.47)	(-2.29)*
Distance to Highway 26	-23,958	-0.038	-0.24
	(-4.30)*	(-3.79)*	(-5.09)*
Location Adjacent to Busy Street	-6,493	-0.024	-0.021
	(-4.41)*	(-2.11)*	(-2.94)*
Noise Level	263.05	0.000013	0.043
	(0.35)	(0.11)	(0.24)
Distance to Runway	17,323	0.022	-0.062
	(2.19)*	(1.53)	(2.56)*

***90% significance level, two-tailed test. Sample size is 495. Dependent variable is sale price in one of the above functional forms.**

MODEL 2

Coefficient	Linear	Semi-Log	Double-Log
Constant	154,538	5.33	2.86
	(3.19)*	(20.13)*	(8.99)*
Area of Lot	1.77	0.000003	0.189
	(6.87)*	(7.50)*	(10.96)*
Structure Size	83.77	0.00016	0.556
	(20.91)*	(22.44)*	(16.38)*
Age of Structure	-698.10	0.0017	-0.0595
	(-5.16)*	(-7.18)*	(-7.73)*
Number of Bedrooms	-12,295	-0.0126	-0.0506
	(-4.41)*	(-2.518)*	(-1.24)
Number of Bathrooms	-911.9	-0.0299	0.0177
	(-0.31)	(-0.57)	(0.63)
Distance to Light Rail Station	9,178	0.0171	0.0274
	(2.30)*	(2.39)*	(3.13)*
Distance to Downtown Hillsboro	-15,783	-0.0161	-0.0607
	(-2.62)*	(-1.49)	(-2.69)*
Distance to Highway 26	-23,962	-0.0384	-0.274
	(-5.16)*	(-3.85)*	(-5.84)*
Location Adjacent to Busy Street	-6,536	-0.0246	-0.058
	(-0.94)	(-1.96)*	(-4.55)*
Noise Level	-147.95	-0.0038	-0.022
	(-0.19)	(-0.805)	(-0.123)
Interaction Term	319.4	0.00301	0.0749
	(2.18)*	(0.843)	(3.11)*

***90% significance level, two-tailed test. Sample size is 495. Dependent variable is sale price in one of the above functional forms.**

MODEL 3

Coefficient	Linear	Semi-Log	Double-Log
Constant	115,981	5.11	2.82
	(2.65)*	(65.43)*	(8.69)*
Area of Lot	1.79	0.0000035	0.183
	(6.91)*	(7.61)*	(10.69)*
Structure Size	85.73	0.00016	0.57
	(21.94)*	(23.64)*	(16.88)*
Age of Structure	-687.62	-0.0017	-0.065
	(-5.04)*	(-7.07)*	(-8.28)*
Number of Bedrooms	-12,218	-0.012	-0.051
	(-4.37)*	(-2.49)*	(-1.19)
Number of Bathrooms	-1,318	-0.0041	0.027
	(-0.45)	(-0.78)	(0.94)
Distance to Light Rail Station	15,151	0.026	0.038
	(4.93)*	(4.65)*	(4.43)*
Distance to Downtown Hillsboro	-3,107	0.00037	-0.0067
	(-1.61)	(1.08)	(-0.48)
Distance to Highway 26	-13,592	-0.025	-0.155
	(-4.31)*	(-4.36)*	(-4.61)*
Location Adjacent to Busy Street	-5,934	-0.023	-0.025
	(-0.85)	(-1.84)*	(-1.72)*
Noise Level	-25.08	-0.00055	0.0087
	(-0.33)	(-0.40)	(0.47)
Distance to 55 DNL Contour	-16,498	-0.043	-0.0115
	(-1.51)	(-2.24)*	(-1.77)*

***90% significance level, two-tailed test. Sample size is 495. Dependent variable is sale price in one of the above functional forms.**

MODEL 4

Coefficient	Linear	Semi-Log	Double-Log
Constant	112,147	5.11	2.88
	(2.58)*	(65.77)*	(8.89)*
Area of Lot	1.79	0.0000035	0.187
	(6.90)*	(7.61)*	(10.59)*
Structure Size	85.74	0.00016	0.549
	(21.94)*	(23.64)*	(15.85)*
Age of Structure	-688.1	-0.0017	-0.0621
	(-5.05)*	(-7.08)*	(-7.92)*
Number of Bedrooms	-12,222	-0.0124	-0.0456
	(-4.37)*	(-2.49)*	(-1.09)
Number of Bathrooms	-1,314	-0.0041	0.0373
	(-0.45)	(-0.78)	(1.08)
Distance to Light Rail Station	15,127	0.0255	0.0307
	(4.92)*	(4.63)*	(3.45)*
Distance to Downtown Hillsboro	-3,111	0.00036	-0.0525
	(-1.71)*	(0.11)	(-2.29)*
Distance to Highway 26	-13,592	-0.0246	-0.241
	(-4.30)*	(-4.35)*	(-5.09)*
Location Adjacent to Busy Street	-5,935	-0.029	-0.031
	(-0.85)	(-1.84)*	(-1.01)
Noise Level	44.94	-0.00039	-0.0192
	(0.59)	(-0.27)	(0.81)
Interaction Term	-299.5	-0.00079	0.0628
	(-1.48)	(-2.21)*	(2.57)*

***90% significance level, two-tailed test. Sample size is 495. Dependent variable is sale price in one of the above functional forms.**

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Airport expansions and property values: the case of Chicago O'Hare Airport

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Abstract

The paper adds to the empirical literature by providing up-to-date estimates of the effect of airport noise on property values around one of the world's busiest airports, Chicago O'Hare. The results indicate that home values were about 9% lower within a 65 dB noise contour band of O'Hare in 1997. Opponents of airport expansions argue that increased noise will reduce property values and lower tax bases. The results of this paper suggest that aircraft are becoming so much quieter that the airport can be expanded without causing a drop in local property values or tax bases. Estimates suggest that house prices may *rise* by as much as $284.6 million in the densely populated area around O'Hare after a new runway is added to the airport.

Keywords: Hedonic; Airports; Noise; Housing; Amenities

1. Introduction

Empirical studies are in near unanimous agreement that airport noise reduces residential property values. As reviewed in [14], many of these studies date from the 1970s and rely on aggregated census tract data. While confirming the results of early studies, recent studies have focused on smaller airports with only moderate noise problems. A key contribution of this paper is to use recent transactions data to provide up-to-date estimates of noise impacts for one the world's busiest airports, Chicago O'Hare. I find that home values are about 9.2% lower in the area that is subject to severe noise. This estimate is on the high side of recent empirical results. But a high noise discount is not surprising: O'Hare serves

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a tremendous amount of airline traffic and is surrounded by a densely populated ring of primarily suburban municipalities.

Current plans call for the construction of a new runway at O'Hare along with reconfiguration of the seven existing runways. The expansion is capable of handling an additional 700,000 flights a year. Despite recent downturns in air traffic, O'Hare is far from alone in having expansion plans. According to the Federal Aviation Administration, 18 of the 31 large hub primary airports in the US are planning to add runways in the next decade.[1] As of 2001, the 31 large hub airports accounted for 70% of US air passengers and the top 25 of these airports accounted for 86% of all severe air traffic delays. The local benefits of hub airports include significant tax revenues and employment opportunities. For example, Brueckner [2] estimates that the O'Hare expansion would raise service-related employment in the Chicago area by 185,000 jobs.

Public opposition to airport expansion is often vocal and strident. Airports generate air pollution and severe traffic congestion. Although many airports have invested heavily in noise reduction programs, nearby residents continue to complain bitterly about aircraft noise. Such costs are borne locally while local residents often feel excluded from the planning process. Through both the legal and political process, local opposition groups have been effective at delaying and increasing the cost of airport expansions. Near O'Hare, local residents are lobbying instead for an alternative new airport in south suburban Peotone, whereas the City of Chicago much prefers the O'Hare expansion. The estimated noise discount of 9.2% helps to explain the opposition to the expansion of O'Hare.

While much of the opposition to airport expansions focuses on aircraft noise, it is ironic that airports are actually becoming significantly quieter over time. New aircraft are much quieter than older planes, and the older aircraft are being retired. Indeed, a single model, the B72Q, which is being phased out by the major airlines, generated over 70% of the incidents of "severe noise" at O'Hare in 2001. In addition, airports have become quieter as night flights are reduced. Nevertheless, opponents of airport expansions continue to cite increased noise as a major complaint.

Projections of noise contour lines for the time after the proposed O'Hare expansion allow me to make predictions regarding the future level of home prices in the area. In 1997, the area around O'Hare that is subject to severe noise covered nearly 57 square miles. By 2000, the severe-noise area was reduced to slightly less than 38 square miles. After the expansion and reconfiguration, the area falling within the severe-noise contour is projected to fall to about 27 square miles as a result of new flight paths and quieter aircraft. My estimates suggest that the market value of all homes in the vicinity of O'Hare airport may *rise* by nearly $300 million after the O'Hare expansion. While the expansion will increase air traffic, aggregate aircraft noise is nonetheless projected to be lower in the future, leading to an increase in property values.[2]

[1] The source for this information is "Report to the US Congress on environmental review of airport improvement projects" from the US Department of Transportation.

[2] Indeed, this estimate may be conservative in not taking into account the effects of increased employment and improved access to O'Hare if plans for a new western entrance to the airport are realized. Property values may rise further if new employees choose to live near the airport.

These results undermine one of the primary arguments against airport expansions. Aircraft are becoming so much quieter that even a large expansion of the world's busiest airport can be accomplished without causing a drop in local property values or tax bases. Of course, property values might rise still further if there were no additional flights at all. But most nearby residents will still enjoy a reduction in noise levels even after flights increase by as much as 50%.

2. Recent studies

The effect of aircraft noise on property values has been of interest since the first wave of hedonic house price studies during the 1970s. The results of these early studies are reviewed in Nelson [9], who concludes that "a survey of evidence from thirteen studies suggests noise discounts in the range of 0.4 to 1.1% per decibel" ([9, p. 46]). Whereas most of the early studies use census tract data, Mieszkowski and Saper [7] obtain similar results using transactions data.

The results of salient recent studies are summarized in Table 1. All current studies use transactions data, with the exception of Feitelson et al. [5], who analyze the results of contingent valuation surveys. Collins and Evans [3] use an artificial neural network approach, whereas other studies use a standard hedonic approach.

The most important methodological difference between the studies is the treatment of the measure of aircraft noise. Three standard measures exist—the *noise and number index* (*NNI*), the *noise exposure forecast* (*NEF*), and the annual energy mean sound level (L_{dn}). The *NNI* is the most commonly used measure in the United Kingdom.[3] However, the utility of the *NNI* measure for housing studies is questionable given Tomkins et al. [15] finding that the *NNI* tends to produce insignificant results even when the other measures imply significant noise discounts.

The *NEF* once was the most commonly used noise measure in North America. It aggregates the noise produced by individual flights over a day into a single statistic. The central component of *NEF* is $EPNL(i, j)$, which is the *effective perceived noise level* produced by flight i using flight path j. Additional penalties are then built into the formula for the number of daytime (N_d) and nighttime (N_n) flights, with daytime defined as the hours from 7:00 am to 10:00 pm. The *NEF* for an individual flight is

$$NEF(i, j) = EPNL(i, j) + 10[\log N_d + 16.67 N_n] - 88,$$

which is aggregated into a single index using the formula

$$NEF = 10 \log \sum_i \sum_j \exp\left(\frac{NEF(i, j)}{10}\right).$$

[3] The *NNI* is defined as $NNI = L_{\max} + 15 \log N - 67$, "where N is the number of noisy events exceeding or equal to 80 perceived decibels (PNdB) between 7:00 am and 7:00 pm during an average summer's day; $L_{\max}$ is the average of the peak noise levels for the N events, which occur at the 'closest point of approach' or 'minimum slant distance' for aircraft movements" ([15, p. 255]).

Table 1
Summary of recent literature

Paper	Airport	Data	Noise measure	Noise discount
Collins and Evans [3]	Manchester, England	3472 sales, 1985–1986	$NNI = 27, 40$	8.02–9.54% for detached houses
Espey and Lopez [4]	Reno–Tahoe, NV	1417 sales, 1991–1995	$L_{dn} = 65$	2.4%
Feitelson et al. [5]	"Major Hub"	Contingent valuation surveys	Occasional/frequent; minor/severe	1.5–2.5% per dB
Levesque [6]	Winnipeg, MB	1635 sales, 1985–1986	*NEF* average; number events > 75; std. dev.	1.3% per dB
O'Byrne et al. [10]	Atlanta, GA	126 sales 1979–1980; census blocks, 1970	$L_{dn} = 65$–80	0.64–0.67% per dB
Pennington et al. [11]	Manchester, England	3472 sales, 1985–1986	$NNI = 40, 45, 50$; average by postal zone	Statistically insignificant
Tomkins et al. [15]	Manchester, England	568 sales, 1992–1993	$NNI = 35$–60 $L_{dn} = 57$–69	*NNI*: insignificant L_{dn}: 7.96%, 60+ 5.25%, 57+ or 0.84% per dB
Uyeno et al. [16]	Vancouver, BC	1987–1988 700 houses 919 condos 319 vacant land sales	$NEF = 25$–40	0.65% per dB for houses; 0.90% for condos; 1.66% for vacant land

Note. With the exception of [3] and [5], the studies use a standard hedonic approach. Collins and Evans [3] use an artificial neural network approach. Feitelson et al. [5] use a contingent valuation approach.

According to Nelson [9, p. 41], "case histories in residential areas suggest that there is little or no individual or community annoyance between 15 and 25, some to much annoyance from 25 to 40, and considerable annoyance above *NEF* 40."

More recently, L_{dn} has become the most common measure of noise for North American airports. It measures average sound levels over the course of a year, including a 10 decibel penalty for nighttime. The FAA and HUD define areas exposed to L_{dn} levels of 65 or over as incompatible with residential housing. This measure is now the standard, and it is the one used here.

Apart from the underlying noise measure, the studies also differ in how the variable is measured in the hedonic equation. Some airports publish only simple maps showing a single noise contour, which naturally leads to a discrete explanatory variable indicating whether a house is within the noise contour. Other maps are more elaborate, showing several distinct bands. The alternative bands may be indicated by multiple dummy variables, or they may be combined into a single pseudo-continuous explanatory variable.[4]

[4] For example, O'Byrne et al. [10] create a continuous variable from a noise contour map showing four ranges of L_{dn}—60–65, 65–70, 70–75, and 75–80—presumably by recording the midpoints.

The results shown in Table 1 indicate significant noise discounts. Apart from the *NNI* measures, the noise discounts are uniformly significant, ranging from 0.64 per decibel to as much as 2.4% per decibel for studies using the hedonic approach. However, the sometimes significant variation across studies indicates that results may vary across airports. The variation in results for a single airport, Manchester, suggests that the results may be sensitive to the estimation procedure, empirical specification, and noise measure. These findings suggest that it is important to estimate the noise discount using data from the local market. They also suggest that care needs to be given to the empirical specification of the hedonic model.

3. Data and empirical approach

The basic empirical approach is straightforward. I use a standard hedonic price function to estimate the noise discount. Theoretical underpinnings for the hedonic approach are provided by Polinsky and Shavell [12]; Bartik and Smith [1] and Sheppard [13] provide reviews of the theory and relevant applications. I use transactions data to estimate the noise discount, and then apply this estimate to the full sample of assessments to predict the effect of the airport expansion on aggregate property values. The remainder of this section provides details on the construction of the data set and the model specification.

The primary data source for the study is the Cook County Assessor's Office, which provided information on every building in the county in 1997, or about 1.6 million units. Of these, 1,287,943 are single-family residential homes. With assessment data, transactions, and a noise contour map all originating in 1997, this year is the natural base time for the study. Since the effects of noise are likely to be confined to a much smaller area near the airport, the sample is restricted to homes that are within 2 miles of the 1997 noise contour line. This sample includes 119,243 single-family homes.

The Assessor's file includes the parcel identification number, which indicates the quarter section in which a property is located. Quarter sections, which apart from occasional anomalies are a quarter square mile or 160 acres in area, are too large for a study of airport noise. However, the Assessor's file also provides the billing address for the property. I used a Geographic Information Systems program to find the geographic coordinates for each billing address. Unfortunately, billing addresses are not necessarily the same as the actual address. Indeed, some of the billing addresses are outside of Illinois. Whereas the billing address will be the same as the property itself for owner-occupied homes, locations may be highly inaccurate for rental properties.

To ensure that the identified owner locations are accurate, I use only those addresses with coordinates falling in the same quarter section as listed in the Assessor's file. Using this procedure, the worst we can do is to have the billing address at one corner of the quarter section while the property is at the opposite corner. Since a quarter section is $1/2$ mile by $1/2$ mile, this procedure runs the risk that the location of a property will be wrong by as much as $\sqrt{2 \times 0.5^2} = 0.71$ miles. However, it is a marked improvement over alternatives such as assigning the quarter section midpoint to all homes. Of the 119,243 observations in the full sample, 11,632 (9.8%) had to be discarded because the software could not locate the address or because the billing address was not in the same quarter section as the property. Importantly, no observations had to be discarded in areas with changes in the noise contour status.

The Assessor's Office file provided standard housing characteristics such as building area, land area, age, and the number of bedrooms. The geographic coordinates were used to measure proximities to standard amenities—the Chicago central business district (CBD), the entrance to O'Hare (the intersection of I-294 and the Kennedy expressway), stops on the elevated train line, commuter train stations, and highway interchanges. Other explanatory variables for the hedonic price equations include a dummy variable indicating that a home is within an eighth of a mile of a rail line (the regular length of a city block in Chicago's grid street system), and the median income in 1990 for the census block.

Cook County tends to under-assess residential properties. Whereas homes are supposed to be assessed at 16% of market value, data from the Illinois Department of Revenue show that single-family homes were typically assessed at 9.5% of market value in 1997. The variation around the mean is large: the 1st and 3rd quartiles of assessment for single-family homes were 5.65 and 15.17% in 1997. Given this assessment variability, transactions data are necessary to estimate noise discounts accurately. Thus, I use the subsample of homes that sold in 1997 to estimate the noise discount, and then apply this estimate to the full sample of assessments to predict the effect of the airport expansion on aggregate property values.

The Illinois Department of Revenue provided transactions data for all single-family home sales in Cook County for 1997. Of these sales, 4442 were homes located within 2 miles of the 1997 noise contour, of which 4012 had billing addresses in the same quarter section as the property. In keeping with county-wide averages, these properties were assessed at 9.4% of their market value, with a range of 2.0 to 50.1%. Homes are reassessed every three years according to a timetable that varies geographically. All homes within the city limits of Chicago were reassessed in 1997; no homes in the rest of Cook County were reassessed during this year. I include a dummy variable for homes within the city limits of Chicago to control for differences in assessment schedules, as well as for other fiscal differences.

The City of Chicago Department of Aviation has released noise contour maps for 1997 and 2000. It also has published projections of the noise contour lines after the proposed O'Hare expansion. The maps show one line, a 65 decibel annual average sound level (L_{dn}), which is the level that the FHA and HUD define as incompatible with residential housing. The maps are shown in Fig. 1. The area lying within the noise contour was much smaller in 2000 than in 1997: the area was reduced by 19 square miles, or 33%. The noisy area is projected to decline by another 11 square miles after the expansion.[5] Two pairs of parallel east–west runways are expected to carry most of the flights, which accounts for the predominantly east–west shape of the long-range contour. Large tracts of land north of the airport that now lie within the noise contour band are projected to change to the quiet side of the contour after the expansion. These areas include many single-family homes, which I project will increase in value after the expansion.

[5] Hereafter, I refer to the area inside the 65 decibel noise contour band as the "noisy" area, and the area outside the band as the "quiet" area. Although the terms are not strictly literal, they are a useful shorthand.

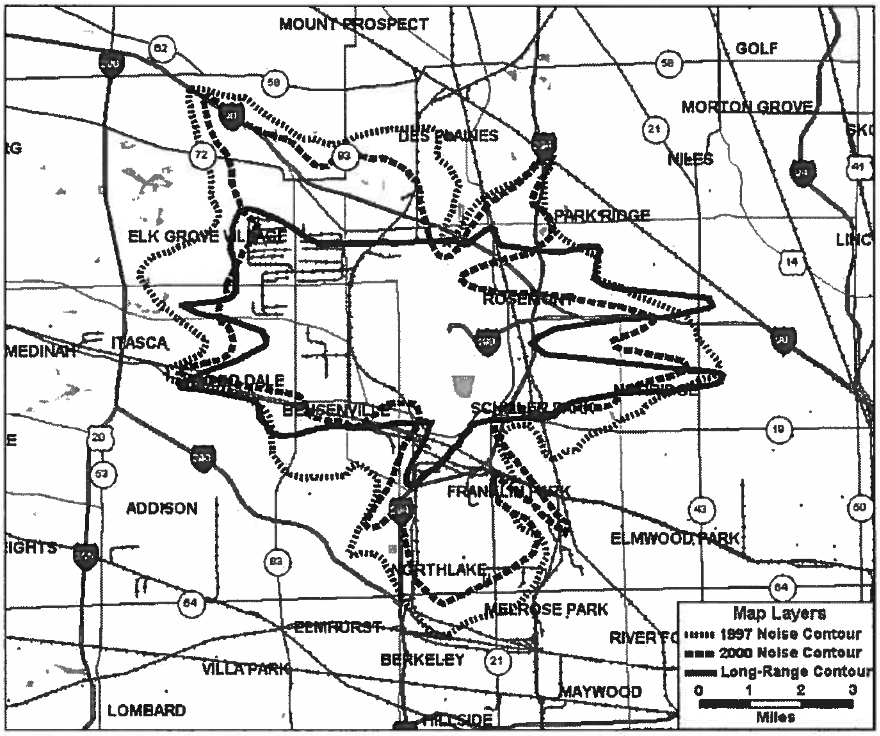

Fig. 1. Noise contours.

Table 2 presents cross-tabs of the number of homes falling on each side of the noise contours in 1997, 2000, and based on the long-range projection (or LR). In 2000, 13,311 homes that had been on the noisy side of the contour in 1997 were now on the quiet side. In contrast, only 1167 homes switched to the noisy side of the contour in 2000. The trend is projected to continue after the expansion, with another 9889 switching to the quiet side of the contour, compared with 4079 switching to the noisy side. In 1997, 23.2% of the homes fell on the noisy side of the contour. This percentage fell to 11.9% in 2000, and is projected to fall to 6.5% after the expansion. Results are similar for the subset of observations for which sales price data are available.

In the existing empirical literature, most authors include a simple discrete variable indicating a location on the noisy side of the contour. Let y represent the natural logarithm of either assessed value or the actual sales price, X be the vector of housing and locational characteristics, and *NOISE* be the noise contour variable. The estimating equation is

$$y_i = X_i'\beta - \delta\, NOISE_i + u_i. \tag{1}$$

This equation provides a direct estimate of the discount associated with switching from the quiet to noisy side of the contour: when *NOISE* changes from 0 to 1, property values are

Table 2
Noise contours and the number of single-family homes

	Quiet 2000	Noise 2000	Quiet LR	Noise LR	Total
Quiet, 1997	81529	1167	81677	1019	82696
	3103	31	3101	33	3134
Noise, 1997	13311	11604	18973	5942	24915
	445	433	694	184	878
Quiet, 2000			90761	4079	94840
			3431	117	3548
Noise, 2000			9889	2882	12771
			364	100	464
Total	94840	12771	100650	6961	107611
	3548	464	3795	217	4012

Note. The first entry in each cell represents assessments, and the second entry is the number of observations for which sales prices are available.

predicted to fall by approximately $100\delta\%$. In contrast, a property that currently falls inside the noise contour already has incurred a $100\delta\%$ decline in value. Adjusting for the lower base, its price is projected to rise by $100\delta/(1-\delta)$ percent.

At this point it becomes necessary to resort to assessments because sales data are only available for a subsample of the full set of properties. We simply reduce the assessed values of all properties that switch from the quiet to noisy side of the contour by $100\delta\%$ and raise the assessed values of properties that switch from the noisy to quiet side by $100\delta/(1-\delta)$ percent. The final step in the calculation is to transform the aggregate assessed value estimate to market values. We use two assessment rates for this calculation—the statutory value of 16% and the actual value for our sample of 9.42%.

4. Regression results

Descriptive statistics are presented in Table 3 and regression results are presented in Table 4. The estimated equation fits the data well: the R^2 indicates that the explanatory variables account for about 68% of the variation in sales prices, and most coefficient estimates are highly significant with the expected signs. The estimated noise discount is 9.2%. This figure is higher than those found for Reno–Tahoe by Espey and Lopez [4], and is similar to results for Manchester by Collins and Evans [3] and Tomkins et al. [15]. A large noise discount is to be expected for an airport as large and busy as O'Hare. However, accessibility to the airport entrance also is valuable: sales prices are estimated to decline by 2.5% with each mile from the intersection of I-294 and the Kennedy expressway.

Other results are generally as expected. Prices are higher near stops on the elevated train line, but are lower nearer the Chicago CBD, highway interchanges, and commuter train stations. Prices are lower for houses near rail lines. Estimated elasticities are 0.38 for building area and 0.16 for land area. The estimated annual depreciation rate for housing is 0.2%. Prices rise with the number of bedrooms, and are higher for multi-level homes with a garage, fireplace, and central air conditioning. Slab foundations, partial basements,

Table 3
Descriptive statistics: single family homes selling in 1997

	Mean	Std. dev.	Min	Max
Assessment	15762.780	5287.307	4352	78389
Sales prices	171227.200	66027.020	30000	975000
Within 1997 noise contour	0.219	0.414	0	1
Distance from Chicago CBD	14.298	3.821	8.694	23.794
Distance from O'Hare entrance	5.042	1.310	1.557	8.500
Distance from el stop	3.096	1.792	0.085	8.565
Distance from highway interchange	1.500	0.720	0.063	3.545
Distance from commuter train station	1.122	0.610	0.015	3.755
Within 1/8 mile of a train line	0.080	0.272	0	1
Building area (sq. ft.)	1307.841	440.539	400	5644
Land area (sq. ft.)	6380.951	3388.535	840	83635
Age	46.138	17.618	1	122
Number of bedrooms	3.012	0.737	1	7
More than one story	0.347	0.476	0	1
Multi-level	0.079	0.269	0	1
Masonry construction	0.692	0.462	0	1
Slab foundation	0.104	0.305	0	1
Partial basement	0.214	0.410	0	1
Crawlspace	0.091	0.288	0	1
Basement is finished	0.281	0.449	0	1
Attic	0.412	0.492	0	1
Attic is finished	0.141	0.348	0	1
Central air conditioning	0.361	0.480	0	1
One car garage	0.344	0.475	0	1
Two or more car garages	0.524	0.499	0	1
Garage is attached	0.265	0.441	0	1
Fireplace	0.186	0.389	0	1
1990 Census median income (1000s)	40.981	8.404	25.741	69.516
Within Chicago City limits	0.280	0.449	0	1

Note. The sample includes 4012 single-family homes that are in Cook County and within two miles of the 1997 noise contour.

and crawlspaces are less valuable than the default category of full basements. Prices are higher in census blocks with higher median incomes. Controlling for other variables, prices are higher within the Chicago city limits, although it should be noted that the sample area includes only a small and highly desirable area on the extreme northwest side of the city.

The next step in the analysis is to use the estimated value for δ of 0.092 to calculate the effect of the change in the noise contour after the O'Hare expansion. Table 5 presents the results. The model predicts that aggregate assessments will rise by \$26.8 million between 1997 and the time after the expansion. For houses in areas whose noise contour status changes, these figures translate into average increases in assessments \$1341. Assessments rise from 1997 to the time after the O'Hare expansion because retirements of older aircraft lead to less noise around the airport even after an increase in the number of flights.

The assessment forecasts can be converted into an estimate of market value using the statutory assessment rate of 16% or the market average value of 9.4%. These calculations are shown in the second and third rows of results in Table 5. The model implies that

Table 4
Regression results for sales of single-family homes

	Coefficient	T-value
Within 1997 noise contour	−0.092	−9.570
Distance from Chicago CBD	0.020	8.353
Distance from O'Hare entrance	−0.025	−7.454
Distance from el stop	−0.081	−16.226
Distance from highway interchange	0.053	9.651
Distance from commuter train station	0.023	3.721
Within 1/8 mile of a train line	−0.059	−5.384
Log of building area	0.377	22.087
Log of land area	0.162	18.005
Age	−0.002	−8.601
Number of bedrooms	0.029	4.812
More than one story	−0.030	−3.785
Multi-level	0.072	5.114
Masonry construction	−0.011	−1.447
Slab foundation	−0.048	−4.473
Partial basement	−0.053	−6.004
Crawlspace	−0.156	−13.044
Basement is finished	−0.005	−0.700
Attic	0.003	0.458
Attic is finished	−0.027	−2.478
Central air conditioning	0.008	1.207
One car garage	0.026	2.559
Two or more car garages	0.072	7.479
Garage is attached	0.022	2.410
Fireplace	0.086	9.716
1990 Census median income (1000s)	0.011	21.665
Within Chicago City limits	0.124	12.968
Constant	7.428	60.092
R^2, No. of obs.	0.681	4012

Note. The dependent variable is the natural logarithm of the sales price. The sample includes 4012 sales.

Table 5
Estimated change in residential property values 1997, LR

	Total	Average per home
Assessments	26,811,019	1341
Market value (16%)	167,568,870	8382
Market value (9.4%)	284,564,124	14,234

aggregate home values will rise by between $167.6 and $284.6 million from 1997 to the time after the expansion. The larger figure is much more reliable because Cook County assessments are systematically biased downward. Thus, the best estimate for the aggregate increase in market values after the expansion is $284.6 million.

5. Extensions and caveats

The analysis so far has focused entirely on residential properties. This focus is logical because most of the opposition to the airport's expansion comes from people living in the area. However, many of the properties around O'Hare are commercial or industrial. Is there any evidence that noise also reduces the value of non-residential properties? A scarcity of transactions data for commercial and industrial properties probably explains why there are no studies addressing this issue. However, assessment data provide limited evidence that only residential properties are negatively affected by airport noise.

The Cook County Assessor's Office provided assessment data for commercial and industrial properties located near O'Hare airport. I used the same procedure as before to identify locations for these properties. However, the only characteristics of commercial and industrial properties that are available other than location are the land area of the parcel and the age of the building. Table 6 presents the results of assessment regressions that mimic the specification for single-family homes using all available explanatory variables. Single-family homes are included in Table 6 as a basis of comparison. The estimated value of the noise discount rises to 18.2% when structural characteristics are omitted from the equation for single-family homes because part of the apparent noise discount is due to the lower

Table 6
Assessment regression results by land use

	Residential	Commercial	Industrial
Within 1997 noise contour	−0.182	0.208	−0.018
	(77.513)	(4.548)	(0.512)
Distance from Chicago CBD	0.062	0.014	0.013
	(128.246)	(1.457)	(1.584)
Distance from O'Hare entrance	0.006	0.002	−0.095
	(8.362)	(0.147)	(8.752)
Distance from el stop	−0.168	−0.027	0.017
	(154.278)	(1.402)	(1.021)
Distance from highway interchange	0.128	0.038	0.050
	(98.589)	(1.502)	(2.486)
Distance from commuter train station	0.022	−0.014	0.109
	(14.818)	(0.594)	(5.739)
Within 1/8 mile of a train line	−0.125	−0.118	−0.033
	(47.457)	(3.310)	(1.531)
Log of land area	0.419	0.922	0.845
	(209.231)	(79.528)	(101.628)
Age	−0.006	0.009	0.010
	(119.871)	(11.784)	(11.512)
Within Chicago City limits	0.211	0.406	0.611
	(94.800)	(9.702)	(9.503)
Constant	5.630	1.865	2.705
	(330.906)	(11.306)	(22.036)
R^2	0.523	0.635	0.813
No. of obs.	107,611	4781	3532

Note. The dependent variable in each column is the natural logarithm of assessed property value. Absolute t-values are in parentheses. All properties are in Cook County and are within two miles of the 1997 noise contour.

quality of housing characteristics in high-noise areas.[6] But Table 6 provides no evidence that commercial and industrial property values are lower within the 1997 noise contour. Indeed, locations within the noise contour are associated with *higher* commercial property values after controlling for available explanatory variables. Table 6 suggests that adverse effects of noise are confined to residential properties.

The analysis so far has also neglected a more direct effect of the airport expansion on aggregate property values in the area. To accommodate the new runway, the City of Chicago plans to purchase 433 acres of land, comprising 539 residential and 109 commercial or industrial properties. The estimated market value of these properties is $168 million in 2000, or about the same as my lower estimate of the aggregate increase in value of residential homes in the area. Thus, one way to interpret my estimate of the increase in aggregate homes values after the expansion is that it is at least enough to pay for the acquisition of the properties that are to be demolished.

The effects of the expansion are not distributed evenly through the area around the airport. It can be seen from Fig. 1 that homeowners south and northwest of the airport are most likely to experience a reduction in noise as a result of the reconfiguration of the runways, whereas some homeowners to the east are experience an increase in noise. Table 7 shows the distribution of gains and losses across Cook County municipalities. The calculations are constructed the same way as in the last entry of Table 5, using an assessment rate of 9.4% of market value. Losses occur in only four municipalities—Chicago, Harwood Heights, Norridge, and Park Ridge. Of these, only Park Ridge

Table 7
Distribution of gains and losses in estimated property values

Municipality	No. of homes with increased value	Average gain per home with gain	No. of homes with decreased value	Average loss per home with loss
Arlington Heights	27	21,631	0	
Chicago	2365	20,154	574	17,450
Des Plaines	4054	16,668	0	
Elk Grove Village	3602	16,748	0	
Franklin Park	1094	13,395	0	
Harwood Heights	586	17,753	206	16,186
Melrose Park	2236	12,935	0	
Mount Prospect	37	27,661	0	
Norridge	1074	19,498	1	25,735
Northlake	2815	12,188	0	
Norwood Park	210	22,685	0	
Park Ridge	95	27,607	238	21,973
Schiller Park	380	13,504	0	
Stone Park	298	10,677	0	

Note. All calculations are based on an assessment rate of 9.4% of market value.

[6] The larger estimated value for the noise discounted is not caused by systematic biases in assessments across areas. Using the same specification as in Table 4 for assessments produces an estimated noise discount of 8.8%, or about the same value as obtained using transactions data.

experiences a net decrease in market value: with 95 homes increasing in value and 238 experiencing a decline, the net average decrease is $7828 in Park Ridge.

Despite these distributional effects, the O'Hare expansion looks to be a potentially Pareto-improving policy. Enough homes will experience a reduction in noise that aggregate values will increase by more than enough to compensate for losses. This claim is not the same as saying that the plan is the most efficient way of dealing with airport noise. Morrison et al. [8] argue that a direct tax on aircraft noise is a much more efficient means of reducing noise levels. It also is worth repeating that property values might rise still further if older aircraft continue to be retired and O'Hare adds no new flights at all. The limitations of the noise contour maps shown in Fig. 1 make it impossible to disentangle the effects of the airport reconfiguration from noise reduction per se. However, the results do present a strong argument for the expansion in that additional flights can be accommodated without causing significantly higher levels of noise on the surrounding population.

6. Conclusion

Chicago O'Hare is still the world's busiest airport. Although much of the area around the airport is industrial or devoted to forest preserve, thousands of homes are severely affect by noise from flights in and out of the airport. Using transactions data from 1997, I find that home prices are 9.2% lower in the area affected by severe noise. This estimate is higher than most recent studies, which focus on smaller airports.

Controversial plans are underway to expand the number of flights at O'Hare airport by as much as 50%. The striking result of this paper is that O'Hare can be expanded significantly without reducing property values in the surrounding area. This result is partly due to a significant reconfiguration that allows the runways to be used more efficiently. But another source of the result is the general decline in airport noise as older airplanes are retired and the number of night flights is reduced. Between 1997 and 2000, with no change in the number or configuration of runways, the area within the 65 dB noise contour around O'Hare airport declined by a third. Nearly every home in the vicinity of the airport experienced less noise than before. This trend is continuing, and it allows the airport to be expanded while the area covered by the 65 dB noise contour band is reduced still further.

Basing the estimates on a very conservative assumption that values will change in the future only for those properties that cross from one side of the noise contour line to another, I find that the total assessed value of single-family homes in the area around O'Hare will rise by $26.8 million between 1997 and the time after the O'Hare expansion. Based on actual assessment ratios, this figure translates into an increase in total market value of $284.6 million.

The implications of these results extend well beyond Chicago. The effect of increased noise on property values is frequently cited as one of the reasons for expanding airports. State and local governments frequently view large hub airports as an engine for economic growth. Brueckner's [2] evidence suggests that employment growth is indeed driven in part by the number of flights originating in a metropolitan area's airport. In contrast, most of the costs of large airports are incurred by nearby residents. The results of this paper suggest that newer aircraft and flight patterns greatly reduce the costs associated with large airports, and most neighboring residents will be subject to fewer incidents of severe noise even after the expansion of one of the world's largest airports.

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Where can I find airport delay information?

Airport delay information is available on the two website links listed below: Real-time airport status can be found at the Flight Delay Information Air Traffic Control System Command Center at www.fly.faa.gov/. This site provides a graphic of the United States with the three letter identifiers of the major airports. Enter real time flight tracking into your web browser to identify the many sites that provide tracking of flights by region, airports, airlines or individual flights.

Why can't airplanes reduce their engine power until they reach higher **altitudes**?

Aircraft need more engine power in order to attain a safe level of flight. Also, if aircraft fly at lower power levels they will remain closer to the ground for longer periods of time, thus more noise exposure to larger area.

Why is my neighbor eligible for sound insulation and I am not?

Sound insulation eligibility is dependent on the location of a house in comparison to the 65 DNL contour around the airport. There are also other stipulations involved in selection of houses eligible for home insulation that vary from airport to airport. Your neighbor may be within the 65 DNL contour and meet the other stipulations, whereas your house may not meet the same requirements

Why can't the airplanes fly over some other neighborhood?

Airports often have certain traffic **patterns** that aircraft must follow in order to avoid collision with aircraft, buildings, or other landmarks. Traffic patterns are dependent on which **runways** are in use.

Why are airplanes flying over my house this week when they haven't for months?

Due to weather or wind conditions, aircraft are forced to use the most suitable runway to make safe landings. This, occasionally, causes the planes to shift traffic patterns and land on runways that are not often used. Also, when runways are closed for various reasons, aircraft must use other runways that bring them over different neighborhoods.

Why can't airplanes fly in from a different direction and then turn to land, instead of flying right over my house?

Traffic patterns are designed for efficient and safe runway use at an airport. Aircraft must follow these paths in order to land safely. Transport aircraft are not physically designed to make sharp turns without creating certain safety hazards.

Will the noise ever go away?

Noise will never go away. However, there are efforts being made by all involved parties to reduce the sound of aircraft and engines.

How do I know if an aircraft is flying over my house at the correct altitude?

Generally speaking unless an aircraft is operating over sparsely populated areas it is required to operate 1000 feet above property on the ground except during take off or landing. For operations over sparsely populated areas the requirement is 500 feet. See Flight/Air Traffic Control Procedures.

Who can I talk to and what can I do to have my noise issues addressed?

Many airports have someone in charge of noise issues who you can talk with about your problem. The noise officer has valuable information that could either help solve your problem or provide explanations as to why the problem exists. The problem may have been an isolated incident and the noise officer will be able to tell you if that is the case. If your problem persists, the noise officer may be able to suggest different solutions or put you in contact with additional people. However, not all problems can be solved—airplanes must fly in order to move people and things such as food and medicine from place to place.

Is the value of my house going to decrease because of this airport or aircraft noise?

The value of your house should not decrease because of its proximity to the airport or the aircraft noise; however, you should talk to a real estate agent that is familiar with land value around airports to get an accurate evaluation for your location.

Why are planes flying in MY airspace right over my house?

Individuals do not have specific rights to the airspace above their houses. There are any number of reasons why an aircraft may be operating over a particular house. Aircraft operations over any particular house are ordinarily appropriate with respect to altitude provided that the operations do not violate FAR Section 91.119 which prescribes the minimum safe altitudes at which aircraft can operate.

Why do some airplanes make noises that sound different or are louder than other airplanes?

There are many different types of aircraft that fly today. Each type has different features and capabilities. Some aircraft make more noise than others because of the type of engines they have. Also, larger aircraft tend to make more noise than smaller aircraft, though this is not always the case. Your proximity to the aircraft affects the volume of sound you hear. The volume of noise also depends on the age of the aircraft creating the noise. Newer aircraft have newer engines and designs which are quieter due to evolved technology. Different engines and airframes have entirely different noises associated with flight. Please refer to Sources of Aviation Noise and Noise 101 for more information.

Why do some aircraft rumble, whine, and make my house vibrate?

Some aircraft tend to make a rumbling sound because their engines produce a lower frequency noise. This lower frequency is what causes vibrations. Please see Noise 101.

Can the airport legally buy my house?

Under eminent domain, an airport can buy a house for fair market compensation if it decides that the house is a public need. back to top

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Why do the aircraft fly so low?

Aircraft have to fly low in order to properly line up with the runways and execute safe landings. Aircraft may, however, appear to be lower than they actually are because their large sizes make them look closer. Also, when the airspace is crowded, aircraft may spend time flying a holding pattern at relatively low altitude in order to ensure a suitable flow of traffic. This may make is seem as though they are flying lower than usual. In general, air traffic is restricted by local airspace limitations. Contact your local airport for more information.

What are the authorities doing to mitigate the noise?

Noise can be mitigated through a variety of procedures. The airport can implement noise-reducing flight patterns to control the source of noise, implement curfews which limits the duration of noise after daylight hours, install home and building insulation to limit the penetration of noise into a home, build noise berms () to prevent the noise from ground operations from impacting surrounding neighborhoods, and build ground **run up** enclosures to keep the noise from engine run ups localized to within the airport.

Why can't planes fly only during the day?

Some traffic needs to fly at night in order to meet today's business needs. Some examples of companies that rely on night flights are FedEx, UPS, and DHL. These types of companies are an essential part of our fast-paced business environment that guarantees overnight delivery to satisfy the needs of customers. Some traffic flies later at night in order to compensate for time differences in other parts of the world. Some airports can implement a curfew to control the number of aircraft that fly at night, while others, because of local needs, cannot.

What happens with my complaints?

Each airport has its own way of handling complaints. Contact your local airport for more information.

If our local airport expands will there be more noise and more airplanes flying overhead?

Airport expansion may be needed in order to alleviate some traffic problems and associated annoyance. The airport might expand to increase the efficiency and amount of aircraft traffic to meet growing demands. This does not necessarily mean that the noise will increase. That will depend on the type of aircraft flying into the airport. It, also, does not mean that the frequency of flights over your house will increase. Your local airport office will be able to explain the reason for expansion and its effect on your area.

Why are the planes flying over my house?

Varying weather and operational conditions influence the flight patterns of aircraft near airports. Wind has the greatest impact on flight paths as aircraft need to land and take-off into the wind. As the wind changes, the flight paths change accordingly. This explains an airport's need to have multiple runways pointing in different directions. See Weather Effects on Aviation Operations. Also, depending on aircraft volume, air traffic control will put aircraft in holding patterns, increase aircraft spacing, or set aside noise abatement procedures in the interest of safety. This may also occur because of air traffic limitations within your local airspace, possibly relating to neighboring airports. Aircraft are limited to where they can fly because of established flight paths, approach paths, and departure paths. These paths are established and published to enhance safety during flight. See Air Traffic Control.

I am nowhere near the airport. Why are the airplanes flying so low over my house?

Aircraft are limited in the direction they fly because they must land into the wind. Therefore, the flexibility of air traffic is dependant on the wind patterns of the day or, even, the hour, as winds can change rapidly. If the winds change, the air traffic controllers may need to change runway usage and, thus, the flight paths. See Weather Effects on Aviation Operations.

Why do planes always come from the same direction?

To enhance safety and ensure an efficient flow of traffic, airports follow an established pattern and, therefore, cannot change flight paths. There are also restrictions due to airspace limitations. An aircraft's speed and weight determines how far in advance it must line up with the runway to execute a safe landing. Typically, aircraft must be in line with the runway at least ten miles out. See Airport Operations.

Who regulates airplane noise?

The **Federal Aviation Administration (FAA)**, under **FAR Part 36**, governs the certification of aircraft as it relates to noise levels. Depending on the type of aircraft, FAR Part 36 determines the maximum allowable noise level. The FAA also follows the model of the International Civil Aviation Organization (ICAO) which sets global aircraft noise standards known as **Stages**. Currently, the FAA mandates that nearly all aircraft that fly within the United States comply with **Stage 3** requirements. See Federal Aviation Regulations.

What can I do to get the noise over my house to stop or, at least, decrease?

Depending on your proximity to the airport, it is likely that the aircraft noise over your house varies from day to day. Varying weather conditions and air traffic control volumes often cause aircraft's flying patterns to differ. Reducing the noise level at your house may be possible through programs such as soundproofing, altered flight paths, and/or noise abatement procedures. However, many of these programs depend on your local airport's noise mitigation programs. Contact your local airport's noise office for more information.

What are some of the things being done to stop the noise?

Over the past few decades, improved aircraft engine technology has greatly reduced the amount of noise produced by engines. Airports across the country are utilizing extensive noise abatement procedures including delayed turn-outs and higher departure altitudes. Depending on the location of your house and the programs in place at your local airport, you may be eligible for home sound insulation. Your airport may offer other mitigation programs in which residents can participate. Contact your airport's noise office for more information.

Why are some airplanes louder than others?

Several factors affect the noise level produced by aircraft. Older aircraft tend to be louder due to less advanced engine and airframe technology. Also, larger airplanes are often louder because they require larger (and sometimes noisier) engines. However, just because an aircraft is larger does not necessarily mean that it will be louder. Aircraft that weigh less than 12,500 lbs do not fall under the Stage requirements established by ICAO and implemented by the FAA. Because of this, smaller aircraft may be even louder than larger aircraft.

Why do we need an airport in the first place?

Airports provide numerous benefits to local and regional economies. The aviation industry itself is often considered to be a valuable business due to its direct impact on the health of our national and international economies. Airports contribute billions of dollars per year to local economies and create tens of thousands of jobs, either directly or indirectly. The benefit of travel afforded by a local airport is equaled in importance by the mail, packages, and even exotic foods that are delivered across the country by the aviation system. See General Airport Operations.

Can my house be sound insulated to help with the noise?

Sound insulation are in place at various airports across the country. If this program exists at your local airport and your house meets the necessary requirements, you may be eligible for sound insulation to help reduce the noise in your home. Eligibility is most often determined by a homeowner's proximity to the airport. See Residential Sound Insulation Programs. Contact your local airport or noise advisory board for details.

Why do planes have to fly over residential areas?

Aircraft must fly over residential areas because of the small distances between some airports and neighborhoods. Therefore, it is sometimes necessary for aircraft to fly over these residential areas in order for aircraft to safely reach the airports. Air traffic control procedures often try to minimize the number of aircraft flying over homes. Unfortunately, in the interest of safety, this is not always possible.

Who has the ultimate control of the air above my house?

The federal government has jurisdiction over United States airspace. No individual may claim ownership of airspace over his or her property. Airspace is considered to be public domain and may be used by anyone as long as they do not interfere or endanger the people and property on the ground below. Aircraft are generally restricted to flight at altitudes of at least 500 feet unless they are taking off or landing. Once an aircraft departs from an airport, the airport no longer controls the movements or actions of the aircraft. The responsibility is shifted to the pilots and Air Traffic Control (ATC). Air Traffic Controllers are employed by the U.S. government or by private companies who are contracted by the U.S. government. See Federal Aviation Regulations. However, noise concerns and inquiries should always first be directed to the airport whose operations are causing any disturbance.

Why are the aircraft flying so low that so I can see the pilots' faces?

The only reason aircraft would be flying low enough for you to see the faces of the pilots is if they were about to land. In this case, the aircraft should be directly over the runway and not near any residential areas Therefore, it is unlikely that the aircraft would ever be that close.

Why is the airport's expansion necessary and why does it have to affect me?

The reasoning behind airport expansion is determined by airport officials. There is never one general reason an airport may elect to expand. One reason often cited is the need for larger facilities. Like any facility, an airport must expand to meet demands. Lack of growth at an airport may lead good tenants, such as airlines, to move elsewhere, taking large revenues and jobs away from the local economy. Airports are large economic engines for the cities in which they are located. If an airport is lost, the city may lose as well.

The effect an airport expansion project has on residents around it varies from airport to airport. Growth always has the potential to affect residents, whether it is the positive effects of economic growth, or the negative effects of increased traffic and noise. Depending on the project, residents closest to the airport may be more affected by the project than those further away.

Why are airplanes flying at 2:00AM? Is there a curfew?

There are no rules that govern when airplanes can fly. One reason the United States Postal Service and other mail carrier services work efficiently is because of the schedule they keep. Mail collection is often completed late in the afternoon. It is then sorted and directed to its final destination. At the end of each day, some packages and letters must fly late at night or very early in the morning in order to reach their destinations on time. A curfew would create a burden on interstate commerce which is illegal by the FAA regulations. See Federal Aviation Regulations. Additionally, passenger airlines offer their services at all times of the day. International passengers traveling to Europe must leave the U.S. in the evening in order to get to Europe the next morning. Because legal curfews are difficult to put in place, most curfews are voluntary.

What does/can the noise office do to help me with all these noisy airplanes?

The policy of each individual noise office is different. Some offices only report the number of complaints they receive. Others are more proactive, holding outreach programs in an effort to inform the residents around their airport about noise, current projects at the airport, and any future problems they may anticipate. To find out what your local airport's noise office does, contact them directly.

What is the reason for the repetition of aircraft after aircraft overhead?

The most efficient way airports can operate is to land and depart aircraft on certain runways for an extended period of time. This means that while the winds are blowing from a constant direction the aircraft will always be flying into the wind. While approaching the airport, the aircraft will be in a line several miles apart flying into the wind getting ready to land. The repetition of aircraft you hear from the ground is the noise the "lined up" aircraft are making while on their approach or, in the opposite case, taking off.

Are there consequences for pilots who do not follow noise abatement procedures?

Pilots' responsibilities are to follow the directions of air traffic controllers. If that requires a pilot to fly lower than usual, then that is what he/she must do. See Flight Air Traffic Control (ATC). Noise abatement measures are adhered to on a purely voluntary basis. They are, by no means, enforceable. A proactive noise office will regularly remind air traffic controllers of the policies and may monitor their compliance. In an uncontrolled environment, it is not uncommon for the airport to find out who owns the offending aircraft and send a letter to remind them of certain policies. But, again, aircraft cannot be banded () due to the undue burden it may place on interstate commerce.

What are the health effects of aviation operations in my area or over my house?

Many studies have been done on the physiological health effects of aviation operations. However, none have confirmed that aviation related operations expose the public to severe health problems. Some people in the vicinity of airports might find themselves more prone to noise and other related annoyances. However, the effects this has on a person will vary by individual.

Who should I call if I have a noise complaint?

Many airports across the nation have set up noise complaint hotlines that community members can call to express their concerns. Some airports have also made noise complaint forms available to the public on their websites. Airports usually require individuals to leave their name, phone number, and address along with the complaint. Contact your local airport noise office or community outreach program for more details.

Why can't planes descend at a steeper angle so they fly higher over my house?

Aircraft must follow the glide slope approach when coming in to land. The **glide slope** is an imaginary line that extends out from the end of the runway at a 3 degree angle. For safety reasons, aircraft cannot fly higher or lower than this line.

Glossary Words:

Air Traffic Control (ATC), altitude, DNL, FAR Part 36, Federal Aviation Administration (FAA). Federal Aviation Regulations (FAR), frequency, glide slope, noise abatement, noise, pattern, pilot, run-up, runway, sound insulation, Stage 3

For definitions of words used in this section go to the NoiseQuest Glossary of Terms.

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A TECHNICAL NOTE ON AIRCRAFT NOISE AND ITS COST TO SOCIETY

April 19, 2006

Prepared by:

Aleksandra Lazic and Richard Golaszewski

AIRCRAFT NOISE AND ITS COST TO SOCIETY

I. INTRODUCTION

The purpose of this paper is to summarize the main findings of recent literature* on the impact of aircraft noise on property values. In general, the results of these studies can be used to assess the impact of changes in flight activity on the surrounding community. The literature is considered to be recent if it was published after the year 1990. The empirical estimates of the cost of aircraft noise, expressed as a percentage of property value, vary from study to study.

II. LITERATURE REVIEW

Aircraft noise disturbance is considered the most important concern for people who live or work close to an airport. During recent years, air traffic has been growing rapidly and this growth was accompanied by rising concerns about aircraft noise pollution in residential areas. Numerous aircraft noise studies have emerged as a result of an increased need for a greater understanding of the social costs of aircraft noise disturbances. Aircraft noise disturbance costs are most commonly expressed as a percentage change in residential property values per decibel of noise exposure. The reviewed literature points out a few important issues to be considered when estimating the costs that aircraft noise imposes on society.

* For a list of reviewed literature, please refer to Attachment A

Schipper, Nijkamp and Rietveld (1998) [2] produced an influential study of aircraft noise impact using a meta-analysis of 30 previously completed hedonic price studies. The use of this study lies in the possibility of value transfer. Hedonic price studies are costly to conduct as well as time consuming making a value transfer from previous study results to new locations an attractive option. However, considering that there is a significant variation of the estimated noise depreciation index (NDI) values between studies, a meta-analysis is especially useful in preventing the selection of "extreme" values that would cause overestimating or underestimating costs and benefits that would be used in policy planning. The mean NDI based on results from 30 previous studies was estimated to be 0.83.

Schipper, et al[2] also concluded that studies using samples with higher relative average house prices obtained higher noise depreciation indices implying that peace and quiet are luxury goods (i.e. the impact in percentage terms is bigger for more valuable properties). The finding was supported by the results of Booz-Allen & Hamilton, Inc (1994)[6] and Uyeno et al (1993) [1].

Levesque (1994)[5] took a unique approach to estimating the aircraft noise impacts by decomposing the noise effects into loudness and event frequency. He concluded that while the NDI is about 1.3 percent, the NDI for the number of events is much smaller implying that adding more flights is less noticeable than raising average loudness. The NDI for the number of events varies from -0.2 to -0.1 as the number of events increases from 80 to 400. The results further suggested that variability in the background level of noise is preferred to a constant noise level.

Uyeno, Hamiltion and Biggs (1993)[1] show that, when estimating the percent change in property value per unit of sound exposure, it is important to differentiate between the different property types. Three types of property were considered: vacant land, detached houses and multiunit residential condominiums. The distinction was made between detached houses and condominiums because it was assumed that aircraft nose would have less effect on the residents of condominiums since they are generally more mobile and discount less for the noise effect and since condominiums are usually better soundproofed. It was estimated that percent change in property value per one decibel increase in noise level for detached houses, condominiums and vacant land is 0.65 percent, 0.90 percent, and 0.16 percent respectively. The research site for this study was Canada's Vancouver International Airport.

Collins and Evans (1994)[**] demonstrate the powerful pattern recognition ability of artificial neural networks (ANN) and their applicability to noise disturbance estimates. ANNs are useful in an economic analysis because they are capable of learning linear and non-linear functions operating in multi-dimensional space. They should be used as an addition to rather than a substitute for other economic analyses.

Navrud (2002)[7] states that the cut-off point for valuing noise by transportation authorities in Europe and North America is generally 55 decibels. However, evidence suggests that noise annoyance is high even at noise levels below the cut-off point and in order to avoid underestimating the benefits of noise reduction the cut off point should

[**] Collins and Evans, 1994 study is one of the studies analyzed by Stale Navrud in a Final Report to European Commission,"A State-Of-The-Art on Economic Valuation of Noise".

be lowered to at least 50dB. This point is well demonstrated by Brian Pearce and David Pearce (2000)[3] who show that when background noise target is reduced from 55 dB to 50dB, total noise nuisance cost at London's Heathrow airport is increased from £37.4 to £66.2 million per year.

Feitelson, et al (1996)[4] examined the effects of aircraft noise on willingness to pay for local residents using the contingent valuation method. The results of this study imply a willingness to pay between 2.4 and 4.2 percent of house prices by homeowners and from 1.8 to 3.0 percent of housing rents for a one-decibel reduction in noise. The large difference in results between hedonic regression and contingent valuation methods is that the latter includes loss of use value while the former identifies only market premiums.

III. CONCLUSION

There is plethora of literature on the impact of aircraft noise on property values. They vary based on research methods employed, geographic areas studied, and based on research implications.

Most of the studies use one of the three methods in estimating the impacts of aircraft noise: hedonic price method, meta-analysis or contingent valuation method (based on the willingness to pay). Of the three methods, hedonic price method is the most often used in the existing studies. Although it is the most accepted valuation method for aircraft impact studies, NDSI (Noise Depreciation Sensitivity Index) estimates from hedonic price studies are hard to transfer from one location to another or from one time period to another. Meta-analysis alleviates some of the value transfer problems by eliminating a possibility of using extreme values. The literature reviewed did not focus on a particular geographic area but are rather an agglomeration of studies in United States, Canada and Europe.

The empirical estimates of the impact of aircraft noise range from about 0.6 percent to more than 1.0 percent decrease in property values per one dB increase in noise levels. As such, while the use of any estimate should reflect the variability in prior research about the costs of aircraft noise, a decline in property value of about one percent per one dB increase in noise would be a reasonable economic value.

ATTACHMENT A

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2. "Why do Aircraft Noise Estimates Differ? A Meta-Analysis" by Youdi Schipper, Peter Nijkamp, Piet Rietveld. Journal of Air Transport Management 4: 117-124, April 1998.

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Car crashes into house

Thu, 10/21/2010 - 9:58am | The News-Gazette (/author/news-gazette)

CHAMPAIGN — A man drove his car into a house on East Bradley Avenue early Thursday morning.

Tony L. Brock, 28, who listed an address in the 1600 block of Valley Road, C., was driving north on Fifth Street at Bradley Avenue at 2:15 a.m., according to a Champaign police report. He drove through the intersection and into a yard at 422 E. Bradley Ave. Brock's car crashed into a wooden sign and then into the house.

Police said Brock was taken to Carle Foundation Hospital. A spokeswoman at the hospital had no information on Brock.

Brock was ticketed for driving under the influence of alcohol and improper lane usage.

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Car crashes into St. Charles house

By ASHLEY RHODEBECK - arhodebeck@kcchronicle.com

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ST. CHARLES – A man in his 50s was taken to Delnor Hospital this morning after St. Charles police said his car hit a house on the city's east side.

Spokesperson Paul McCurtain said police are investigating why the Toyota left the roadway and struck a house near the intersection of Fox Chase Boulevard and Huntington Road at about 7:18 a.m. today.

The car reportedly hit a vehicle in the driveway before striking the attached garage. The St. Charles Fire Department was called to the scene because the accident took out a support beam in the garage, McCurtain said.

None of the house's occupants were injured, McCurtain said. He did not know the nature of the driver's injuries but said he was taken to Delnor for treatment.

The driver's identity was not immediately available.

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Posted On: **January 8, 2008** by Dave Abels

Illinois Car Accident - 15 Year Old Crashes Vehicle Into House, Later Cleared of Wrongful Death

In Downstate Illinois, a 15 year old girl crashed a car into a house in the town of Shiloh on Saturday night, according to the Belleville News Democrat. After the auto accident police discovered a woman dead in the house. Sheriff investigators believed that the woman was struck and killed in the car crash. The girl, who had another teenage passenger with her, was taken to the sheriff's department to be interviewed.

The girl was soon released to her parents when the Sheriff's Department determined that the woman was already dead at the time of the car crash. They are not exactly sure when she died, but at least several hours before the crash.

The woman was in her 50s and lived with her boyfriend who was at work at the time of the crash. The investigation is ongoing but no foul play is suspected.

These comments were posted by David Abels & Associates, P.C., a personal injury law firm that represents clients throughout the Chicago area and the entire State of Illinois. Many of our clients come from Cook County, Lake County, DuPage County, McHenry County, Kane County, and Will County, as well as nearby towns and neighborhoods such as Joliet, Aurora, Kankakee, Orland Park, Saint Charles, Evanston, Skokie, Waukegan, North Chicago, Elgin, and Rockford.

Accident lawyers from our firm handle all kinds of injuries resulting from vehicle collisions, including fractures (some that require surgical repair), lacerations, back & neck injuries, and traumatic brain injuries. They also handle wrongful death cases for families who have lost loved ones because another person was negligent and caused a fatal motor vehicle accident.

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Guide to Obtaining Community Support for Your Local Airport

Airport Noise, Safety, and Airport Land Use Planning

The Facts About Airport Noise

Airport safety, noise, and land use planning have always gone hand in hand. The problem is that, in the past, most elected officials and airport sponsors just didn't understand this interaction. And even today, many of these decision makers still don't understand these important issues or their responsibility to the airport and their communities. Many of the problems existing at airports today are the direct result of poor or non-existent airport land use planning decisions made by elected officials.

Although many who complain about the airport cite aircraft noise as disturbing them, the reality of their complaint is often based in fear — the fact that if they can hear an airplane, the craft must be too close to them. If those responsible for administering land use in areas surrounding their airport facility had implemented a long-term approach to responsible land use zoning of areas surrounding the airport, many of the problems experienced by airports and their users simply wouldn't exist in today's world.

Every concern a community expressed about an airport relating to noise and safety could be eliminated with responsible land use planning.

The Facts About Airport Safety

In recent years, opposition to new airport development, expansion of existing airports, and continued operations of airports conveniently located within or close to urban areas has grown remarkably.

Most often, the opposition was based on objections to aircraft noise or fears regarding safety — and quite often, the noise generated the fear. The concern for safety was based on the contention that the airport was, or would be, a threat to the safety of those who lived or worked in the vicinity of the airport's location — airplanes would crash into houses, schools, shopping centers, office buildings, etc. How real has this threat been? What is the evidence of airplanes actually colliding with residences, schools, and working places?

The following information presents the results of a study made to provide some answers based on the accident record experienced by general aviation from 1976 through 1990. The limitations expressed in the preceding sentence should not be overlooked. This study presents the general aviation record. It does not cover similar accidents related to air carrier or military aircraft operations. Therefore, it is not a complete record. However, because general aviation accounts for more than 90% of the pilots, aircraft, and airports and more than 85% of the aircraft operations, it covers a major part of the record.

"General aviation" is a term encompassing all aviation activity except that of the airlines and the military. It includes not only business and recreational flying but a lot of other flying as well. Instruction and training (even for the airlines), air taxi, aerial application for agriculture and forestry, aerial mapping and photography, aerial fire control operations, aircraft testing and demonstration, highway traffic advisory and police flying, power and pipeline patrol, air shows, and similar activities are examples. General aviation flying may be commercial or noncommercial in nature.

An Overview

Between 1976 and 1990, according to FAA and National Transportation Safety Board (NTSB) data, there were 333 general aviation Building and Residence (B&R) Accidents, or an average of fewer than 23 a year. Seventy of these accidents resulted in a fatality, either aboard the aircraft or in a building/residence on the ground, while 12 of these resulted in an injury to persons on the ground. On average, only about 10 general aviation B&R accidents a year result in a serious injury and/or death to individuals either in the aircraft or in a building/residence on the ground.

Over the 15-year period studied, only seven general aviation B&R accidents involved fatalities on the ground (see Table 1). On average, less than one general aviation accident a year results in a fatality or serious injury to persons in a building or residence on the ground.

All in all, only nine individuals between 1976 and 1990 were killed when a general aviation aircraft "fell" on the building or residence in which they were located. And between 1985 and 1990, there were absolutely no fatalities or injuries to individuals on the ground as the result of a general aviation B&R accident.

To put things in perspective, during 1985 alone, more than 7,750 pedestrians were killed by motorists on the highways, more than 1,100 people lost their lives in boating accidents, and more than 900 were killed while riding on bicycles. In 1984, 11,600 were killed in falls, 4,800 by fires, and 1,800 by firearms.

During 1985, general aviation, according to the FAA, conducted more than 44.3 million departures, or almost 1.5 takeoffs for every hour flown. Using this methodology, general aviation conducted more than 500 million departures between 1976 and 1985. Considering that only 12 of these estimated 500 million departures resulted in a fatality or serious injury to persons in a building or residence on the ground, this is a pretty impressive safety statistic. To state it positively, 99.999998% of all general aviation departures do not result in a fatality or serious injury to individuals in a building or residence on the ground.

The drone of an airplane overhead may be music to your ears, but for the slumbering non-flier next door, it can be as grating as the gleeful band of trash collectors seeking to finish a day's work between 5 and 6 a.m.

As cities and suburbs have spread, airports and residences have become increasingly wedged together. The fact that "the airport was here first" presents an unconvincing argument to homeowners and apartment dwellers who have established their homes a mile off the departure end of a runway. Maybe they knew the airport was there and felt it would be no problem. Others acquired housing ignorant of the nearby airfield.

Most people can live with airplane noise — particularly the sounds generated at a general aviation airport. Those sounds are less obnoxious than the cacophony of trucks, sirens, construction sites, and motorcycles that one confronts walking down a street.

But for some people the intrusion of airplane sounds into their home, particularly late at night, is a source of irritation that becomes magnified because airplanes are conspicuous, unfamiliar, and perceived by some as unnecessary.

In some cases, too, people may transfer a subconscious fear of an airplane crash in their neighborhood into anxiety over the airplane's noise.

Those who are finding aircraft sounds distasteful have been mounting surprisingly effective fights to get at the source of their frustration. Their efforts are leading to bans on jet flights at some airports, night closings of fields, and legal restrictions on flight training.

The FAA has set standards for machines that fly, and all users of airspace agree that noise standards or limitations should be applied uniformly throughout the country. Most pilots would argue, too, that any noise standards set in a community should be applied equally and fairly to all noise sources — not just airplanes.

This section of the packet provides information about aircraft noise levels and compares aircraft noise to other aircraft noise sources.

Description of Noise

Noise is, very simply, unwanted sound or any sound that is undesirable because it interferes with normal speech and hearing or is intense and annoying. The best way to describe noise and the problems relating to each individual's response to noise is to view airport noise as a system of integral parts including, but not limited to, the following:

- Nature and intensity.
- Number and fleet mix of aircraft using the airport.
- Distribution of operations.
- Time of day.
- Adjacent land uses (compatible vs. noncompatible).
- Background or ambient noise levels in adjacent residential communities.

Each one of these factors plays a major role in the definition of the overall airport noise impact.

There are no less than 25 different methods to define noise; however, the aviation industry uses four basic methodologies to specifically describe aircraft noise:

1. *dBA*
   A-weighted sound level (using a decibel base) that discriminates against lower frequencies according to a relationship approximating the auditory sensitivity of the human ear.
2. *EPNdB*
   Effective perceived noise levels measured in decibels, which provides a subjective assessment of the human perception of the noisiness of the aircraft.
3. *SEL*
   Single event level measures the precise dBA of one activity and considers duration and frequency. The noise produced by an individual aircraft over-flight, takeoff or landing is usually measured in SEL.
4. *Ldn/CNEL*
   Day-night average sound level defines the average A-weighted sound level during a 24-hour period, with a penalty applied to nighttime sound levels, and is applicable to the measurement of all community noise sources. The CNEL value is used exclusively in California and includes a penalty for evening and nighttime operations. Ldn/CNEL values are used to develop noise contours. Typically, Ldn and CNEL values are measured in increments of 5 dBA with 55 Ldn being insignificant, and 65 Ldn and greater being termed significant exposure. Ldn or CNEL 65 is used to identify compatible and noncompatible land uses, as residential development in areas located within 65 Ldn or greater are generally incompatible.

FAA Advisory Circular 36-3F is a compilation of aircraft noise generation for takeoff and approach configurations of various makes and models of aircraft. All stipulations presented in the text of this advisory circular are applicable to dBA noise levels. The circular also dictates specific placement criteria for the noise sensors used during the aircraft noise data collection process.

The noise levels presented in the circular are associated with the aircraft certification process and are NOT INTENDED TO BE USED BY AIRPORT

OPERATORS to make arbitrary assessments of what aircraft are and are not suitable for access to the airport. Individual site-specific studies of airport noise are performed under the authority of Federal Aviation Regulations Part 150 and are most often federally funded.

The accompanying tables depict the decibel levels produced by various propeller-driven and jet aircraft. By comparing the noise levels indicated for particular aircraft to the "noise thermometer," one can clearly see where general aviation aircraft fit into the overall noise picture.

TYPICAL ESTIMATED NOISE LEVEL FOR SELECTED AIRCRAFT			
		DBA	
MANUFACTURER	DESIGNATION	TAKEOFF	LANDING
Turbojet/Turbofan Category			
Boeing	747-100	105.8	105.8
British Aerospace	HS125-800	77.8	86.1
Canadair	Challenger	66.4	80.4
Cessna	Citation I	67.3	77.7
	Citation II	69.0	79.3
	Citation III	70.6	70.6
Concorde	Concorde	112.9	109.5
Dassault Breguet	Falcon 50	70.8	82.0
Gates Learjet	Lear 25F	79.7	88.2
	Lear 35A	71.6	82.2
	Lear 55	N/A	81.5
Gulfstream Beechjet	GIII	83.0	82.5
Mitsubishi	Diamond 1A	71.9	77.2
Sabreliner	Sabre 75A	77.7	81.7
Turboprop Category			
Beechcraft	BE99/C99	73.0	74.0
	Super King Air-200	68.8	77.8
	Super King Air-300	68.8	77.8
British Aerospace	Jetstream 31	63.7	74.7
Cessna	C441-Conquest II	63.0	76.5
deHavilland	DHC-8	N/A	N/A
	DHC-6 Twin Otter	67.0	78.0
	DHC-7-Dash 7	69.0	84.0
Embraer	EMB 110-Bandierante	71.1	76.0
Fairchild/Swearingen	Merlin IIIC	69.5	78.5
	Metroliner III	69.2	78.5
Fokker	F-27	78.0	86.8
Mitsubishi	Marquis (MU2B-60)	66.0	76.0
	Solitaire (MU2B-40)	64.0	76.0

Piper	Cheyenne (PA-42)	70.3	77.1
	Mojave (PA31P-350)	63.0	73.0
Shorts	SD3-30	71.2	80.1
	SD3-60	67.9	80.1
Reciprocating Engine Category			
Beechcraft	Baron (BE55)	63.0	72.1
	Bonanza (BE35/36)	61.0	65.2
	Duke	63.0	80.0
	Duchess (BE76)	62.0	71.0
Bellanca	Citabria (CH10)	51.0	60.0
	Decathlon (BL30)	58.0	62.0
	Viking (BL26)	65.0	64.0
Cessna	Centurion (C210)	63.0	64.0
	Cessna 150 (C150)	56.0	59.0
	Cessna 152 (C152)	55.0	59.0
	Cessna 170	68.0	61.0
	Cessna 310 (C310)	65.0	73.7
	Cessna 401 (C401)	67.0	74.0
	Cessna 414 (C414)	67.0	73.0
	Skyhawk (C172)	63.0	62.0
	Skylane (C182)	69.0	56.0
	Skymaster (C336)	70.0	72.0
Mooney	Mark 10 (MO10)	68.0	62.0
	Mark 20 (MO20)	65.0	62.0
Piper	Aztec (PA27)	68.0	64.0
	Cherokee (PA28)	60.0	61.0
	Arrow (PARO)	63.0	62.0
	Cherokee Six (PA32)	61.0	64.0
	Cub (PA2)	51.0	59.7
	Seminole (PA44)	62.0	71.0
	Seneca (PASE)	64.0	73.0
	Tomahawk (PA38)	56.0	60.0
	Tripacer/Colt (PA22)	52.0	61.2
	Navajo (PA31)	62.8	72.8
	Chiefton (PA31-350)	70.0	74.0

Airport noise: We can make a difference

Through a concerted effort, and by demonstrating your sensitivity to the concerns expressed by the community as it relates to airport noise, your relationship with those affected by airport noise can be significantly improved. But we must be willing to VOLUNTARILY take the steps necessary to be thoughtful to our fellow community members. Should voluntary efforts not be considered important to the airport, you may find your airport facing local legislation to fix the problem, and this solution isn't always in the best interest of the airport or its users.

Here are some ideas that might be applied voluntarily to improve the noise impact at your local airport.

Pilots —

- Be aware of noise sensitive areas, particularly residential areas near airports you use, and avoid low flight over these areas.
- Fly traffic patterns tight and high, keeping your airplane in as close to the field as possible.
- In constant-speed-propeller aircraft, do not use high rpm settings in the pattern. Prop noise from high-performance singles and twins increases drastically at high rpm settings.
- On takeoff, reduce to climb power as soon as safe and practical.
- Climb after liftoff at best-angle-of-climb speed until crossing the airport boundary, then climb at best rate.
- Depart from the start of the runway, rather than intersections, for the highest possible altitude when leaving the airport vicinity.
- Climb out straight ahead to 1,000 feet or so (unless that path crosses a noise-sensitive area). Turns rob an aircraft of climb ability.
- Avoid prolonged runups, and do them inside the airport area, rather than at its perimeter.
- Try low-power approaches, and always avoid the low, dragged-in approach.
- If you want to practice night landings, stay away from residential airports. Do your practice at major fields where a smaller airplane's sound is less obtrusive.

Instructors —

- Teach noise abatement procedures to all students, including pilots you take up for a biennial flight review. Treat noise abatement as you would any other element of instruction.
- Know noise-sensitive areas, and point them out as you come and go with students.
- Assure that your students fly at or above the recommended pattern altitude.
- Practice maneuvers over unpopulated areas, and vary your practice areas so that the same locale is not constantly subjected to aircraft operations.
- During practice of ground-reference maneuvers, be particularly aware of houses or businesses in your flight path.
- Stress that high rpm prop settings are reserved for takeoff and for short final but not for flying the pattern. Pushing the prop to high rpm results in significantly higher levels of noise.
- If your field is noise sensitive, endorse your students'logbooks for landing at a more remote field, if available within a 25-nm range, to reduce touch-and-go activity at our airport.

Fixed-Base Operators —

- Identify noise-sensitive areas near your airport, and work with your instructors and customers to create voluntary noise abatement procedures.
- Post any noise abatement procedures in a prominently visible area, and remind pilots who rent your aircraft or fly from your airport of the importance of adhering to them.
- Mail copies of noise abatement procedures with monthly hangar and tiedown bills. Make copies available on counter space for transient pilots.
- Assure that your instructors are teaching safe noise abatement techniques.
- Call for use of the least noise sensitive runway whenever wind conditions permit.
- Try to minimize night touch-and-go training at your airport if it is in a residential area. Encourage the use of nonresidential airports for this type of training operation.
- Initiate pilot education programs to teach and explain the rationale for noise abatement procedures and positive community relations.

And For the Surrounding Community —

- Send a copy of the noise abatement pattern established for your airport, along with a brief explanation of its purpose, to the local newspaper. Let the public know PILOTS ARE CONCERNED.
- See that the pattern, approach, and departure paths are designated on official ZONING AND PLANNING MAPS so real estate activity is conducted in full awareness of such areas.
- Lobby for land use zoning and building codes in these areas that are compatible with airport activity and will protect neighboring residents.
- Stress, publicize, and communicate the value of the airport to the community and how its operation adds to the safety, economy, and overall worth of the area.
- Sponsor "airport days" at the airport to involve nonfliers with the business and fun of aviation and possibly attract potential new pilots.
- Encourage beautification projects at the airport. Trees and bushes around the runup and departure areas have proven effective in absorbing ground noise from airplanes.

FAA Noise Policies

The FAA's mission is the development and maintenance of a safe, efficient, and environmentally compatible air transportation system. The aircraft noise issue is a major factor in the success of this mission; therefore, the FAA must respond to industry in three basic areas:

1. Control of air traffic into and out of airports.
2. Control of noise at the source — the aircraft itself.
3. Technical and financial assistance to airport sponsors.

The success of any airport noise program is contingent upon a cooperative working relationship between the airport sponsor, local government, users of the airport, and the adjacent community. Without this vital relationship, the airport noise problem remains just that — a problem. To this end, the FAA has developed guidelines and regulations to foster this cooperative effort while at the same time establishing a systematic policy addressing the issue of controlling noise. A few of the major FAA regulations and advisory circulars include the following documents:

1. Federal Aviation Regulations Part 150, "Airport Noise Compatibility Planning." Established in 1983, this FAR implements Title I of the Airport Safety and Noise Abatement Act of 1979 by establishing regulations for airport operators who elect to develop an airport noise compatibility plan.
2. Advisory Circular 150/5020-1, "Noise Control and Compatibility Planning For Airports" (1983).
3. Advisory Circular 36-1D, "Noise Levels for U.S. Certification and Foreign Aircraft" (1985).
4. Advisory Circular 36-3C, "Estimated Airplane Noise Levels in A-Weighted Decibels" (3-27-86).
5. Advisory Circular 36-4A, "Noise Certification Test and Analysis Procedures" (1986).
6. Advisory Circular 91-36C, "Visual Flight Rules (VFR) Near Noise-Sensitive Areas" (1984).
7. Federal Aviation Regulations Part 36 — specifies maximum noise levels for turbojet aircraft during approach, takeoff and along the runway sideline.

8 Advisory Circular 150/5050-6, "Airport Land Use Compatibility Planning" (1977)

The objectives of each of the above documents are to reduce and prevent noncompatible land uses around airports, establish standardized methods of measuring aircraft noise, and provide specific guidelines to evaluate land use compatibility.

Zoning and Land Use Planning

As discussed earlier in this section, almost every complaint imposed against the airport and based on either safety concerns or airport noise can be attributed to poor, inadequate, or non-existent land use planning and zoning of property in close proximity to the airport.

This failure to protect the airport environs has led to the loss of many airports from our national inventory of landing facilities. In the past five years, 135 public-use landing facilities have been lost. And today we continue to hear calls to close airports for the above reasons. In virtually each and every one of these cases, the culprit is zoning laws-or the lack thereof.

Residential Encroachment — An Airport's Death Warrant

Residential encroachment on the airport places the most stress on an airport to close. In many cases, politicians, in an effort to expand the tax base of local government, turn their backs on the airport, opting instead for short-term financial gains. Seldom do these elected officials have any understanding of the airport's economic impact on the community at large.

Additionally, oftentimes property values are lower for residential areas surrounding an operating airport. New residents move into the area, knowing that the airport exists. However, once the subdivision begins to flourish, these same residents organize and begin to pressure elected officials to do something about the noisy airport. Thus, the value of their property will probably go up.

For example, examine the case of Montgomery County Airpark in Gaithersburg, Maryland, a designated reliever airport to Washington National, Dulles, and Baltimore-Washington airports.

No airport is safe from the threat of encroachment unless good zoning decisions and advance planning documents are put in place before a problem arises.

Advance Planning

Land use and development plans, based on an in-depth compatibility study, are among the most potent and affordable ways to protect an airport while still allowing development near an airport. Done right, this process could save local taxpayers many dollars by avoiding the purchase of additional property by the airport sponsor.

If the airport is federally obligated, that is, has accepted federal Airport Improvement Program (AIP) funds, the airport sponsor is required to sign a contract with the FAA. This contract, also known as "Airport Sponsor Grant Assurance clauses," places certain obligations on the airport sponsor.

One of the most important and compelling obligations placed on the airport sponsor by the FAA is that the sponsor "...take appropriate action, including the adoption of zoning laws, to the extent reasonable, to restrict the use of land adjacent to or in the immediate vicinity of the airport to activities and purposes compatible with normal airport operations, including the landing and taking off of aircraft."

But remember, these obligations only apply to airports that have received federal airport funding.

Land Use Controls

There are a number of measures that may be implemented to protect property around airports from incompatible land use. Some of the more common controls that might be implemented include:

A Comprehensive Plan
This may also be referred to as the community's "master" or "general" plan. It is a policy guide to decisions that affect physical development of property within the control of the local governmental body. It generally deals with land use management practices.

Zoning
Zoning regulations can only be effective if the Comprehensive Plan has been implemented. Zoning is the most popular method of regulating land development, and it is a legal technique that dictates various aspects of land development. Zoning laws legally dictate what uses are permitted for each parcel of land within the control of the local governmental body. Most cities and larger towns have zoning authority; however, many counties have only limited or no zoning authority.

Zoning has a number of limitations, not the least of which is that it isn't necessarily permanent. As the local legislative body changes, so can zoning. Also, most zoning laws allow an appeal process for the issuance of variances from zoning requirements.

Building Codes
Building codes are designed to protect the health, safety, and welfare of the community. They adopt minimum standards for the construction of structures and are legally adopted by local government. Building codes can legally require structures to meet certain interior noise limits for structures built near airports. However, because they are local laws, building codes may differ from city to city.

Real Estate Disclosure

Disclosure of the airport location and potential noise impacts from the airport is becoming increasingly common. A number of states have legislation in place that requires real estate agents and developers to disclose the location and traffic patterns of the airport.

Land Acquisition

Another common land use control technique is for the airport sponsor to acquire ownership of the land surrounding the airport. When applied as an afterthought to fix earlier incompatible land uses near the airport, this method can be a costly one for local residents as well as the airport.

This is but a brief discussion of some of the methods that can be put in place to protect the airport from incompatible land use. There are others available such as land banking, navigation easements, tax incentives, and development rights.

In general, it is quite difficult to fix the problem once it exists. However, as discussed above, there are remedies available that, if applied properly, can protect not only the airport, but the community at large, while maintaining the full economic benefits of the airport.

Your Role — Be Alert, Be Informed

As an airport advocate, you should investigate what measures the local governmental authority has taken in advance land use planning and zoning regulations. Obtain a copy of the local zoning map. This map will show how parcels of land near the airport are currently zoned. With this in hand, you'll have a good idea of where problem areas are located or will be located in the future.

A strategy can then be developed to seek zoning changes of these parcels of land before they become a problem for the airport. Then, follow through. Meet with local officials who are legally empowered to make and implement changes to zoning laws. Take a proactive stance and stick to it.

You or other members of your airport support group should attend planning commission meetings. This is the place where a request for a variance from applicable zoning laws will arise. The agenda for these meetings is usually published in advance of the meeting, so it's a good idea to have your name added to the list of those receiving this agenda.

And most importantly, be knowledgeable and prepared to speak up at these meetings with factual data that will convince the decision makers to protect the airport and the surrounding areas.

Advance planning of compatible land uses for parcels surrounding the airport with airport operations will go a long way in solving many of tomorrow's airport noise and safety complaints.

GENERAL AVIATION BUILDING AND RESIDENCE (B&R) ACCIDENTS
1976-1990

YEAR	TOTAL B&R ACCIDENTS	FATAL B&R ACCIDENTS	TOTAL B&R ACCIDENTS THAT HURT PEOPLE ON THE GROUND	FATAL B&R ACCIDENTS THAT KILLED PEOPLE ON THE GROUND
1976	31	0	0	0
1977	34	5	3	2
1978	27	3	2	1
1979	27	7	1	1
1980	26	5	2	1
1981	23	4	0	0
1982	31	6	1	0
1983	31	5	1	1
1984	18	5	1	1
1985	10	6	1	0
1986	14	6	0	0
1987	20	5	0	0
1988	25	10	0	0
1989p	12	1	0	0

1990	4	2	0	0
TOTAL	333	70	12	7
AVG.	22.2	4.7	0.8	0.5

P — preliminary

Noise in the Animal Shelter Environment: Building Design and the Effects of Daily Noise Exposure

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Sound levels in animal shelters regularly exceed 100 dB. Noise is a physical stressor on animals that can lead to behavioral, physiological, and anatomical responses. There are currently no policies regulating noise levels in dog kennels. The objective of this study was to evaluate the noise levels dogs are exposed to in an animal shelter on a continuous basis and to determine the need, if any, for noise regulations. Noise levels at a newly constructed animal shelter were measured using a noise dosimeter in all indoor dog-holding areas. These holding areas included large dog adoptable, large dog stray, small dog adoptable, small dog stray, and front intake. The noise level was highest in the large adoptable area. Sound from the large adoptable area affected some of the noise measurements for the other rooms. Peak noise levels regularly exceeded the measuring capability of the dosimeter (118.9 dBA). Often, in new facility design, there is little attention paid to noise abatement, despite the evidence that noise causes physical and psychological stress on dogs. To meet their behavioral and physical needs, kennel design should also address optimal sound range.

Noise in an animal shelter has previously been discussed (Key, 2000; Milligan, Sales,& Khirnykh, 1993; Sales, Hubrecht, Peyvandi, Milligan, & Shield, 1997). Sales et al. reported that sound levels regularly exceeded 100 dB. Sound is measured in decibels (dB) and the scale is logarithmic, meaning that 90 dB is 10 times the intensity of 80 dB and is 100 times the intensity of 70 dB. A noise level over 70 dB(A) is considered "loud" (Baker, 1998). To put this into context, 95 dB(A) is comparable to a subway train, 110 dB(A) is a jackhammer, and 120 dB(A) is a propeller aircraft; any sound in the 90 to 120 dB(A) range is considered to be in the critical zone and can be felt as well as heard (Key, 2000). No single method or process exists for measuring occupational noise. A noise dosimeter is preferred for measuring noise levels when the noise levels are varying or intermittent and when they contain impulsive components such as barking. One consideration when using a noise dosimeter is that the microphone is within the hearing zone of individuals being monitored.

It has long been documented that audible sound has profound physiological and psychological effects on nonhuman animals and disturbs the healthy equilibrium of the body (Wei, 1969). Noise has been found to be a physical stressor on animals that can lead to behavioral, physiological, and anatomical responses. Noise-induced cortisol increases can cause immunosuppression, insulin resistance, cardiovascular diseases, catabolism (molecular decomposition), and intestinal problems (Spreng, 2000). The hearing of animals differs from that of humans; dogs (Canis familiaris) have much better hearing and can hear sounds up to four times quieter than can the human ear. Recent research shows that noise in dog kennels may be a welfare concern for the animals (Sales et al., 1997), but currently no policies regulate noise levels in dog kennels.

The objective of this observational case study was to evaluate the levels of noise to which dogs are exposed on a continuous basis and to determine the need for noise regulations. Regulations may emphasize the necessity to control levels through building design and materials instead of trying to reduce the noise produced by the animals. The facility where this study was conducted was designed and built in the last 7 years. However, as is often typical, there were no obvious preventative measures in the design to reduce noise and, in fact, design may have had the opposite effect due to animal arrangement, the use of concrete block, and exposed metal roofing.

Materials and Method

Noise levels were measured at an animal shelter constructed in 1999. The facility has five main indoor areas for holding dogs and two main areas for holding cats. Measurements were taken in all indoor dog-holding areas and included large adoptable, large stray, small adoptable, small stray, and front intake (Figure 1). Measurements were recorded using a noise dosimeter (Q-200, Quest Technologies, Oconomowoc, Wl) continuously for 84 hr over 2 weekdays and both weekend days. Noise dosimeters were placed in each room and mounted to a wall. The walls were nonporous, producing reverberations experienced by the animals and measured by the dosimeters. Proximity of the nearest and furthest dog to the dosimeter varied between rooms but was well within the hearing zone of all animals within each holding area. The overall ambient sound measured by the dosimeter was that being experienced by all animals in the area. Noise measurements reported here were the max levels with slow response and "A" weighting. This type of dosimeter and weighting are commonly used to measure sound levels in work environments and to enforce Occupational Safety and Health Administration regulations.

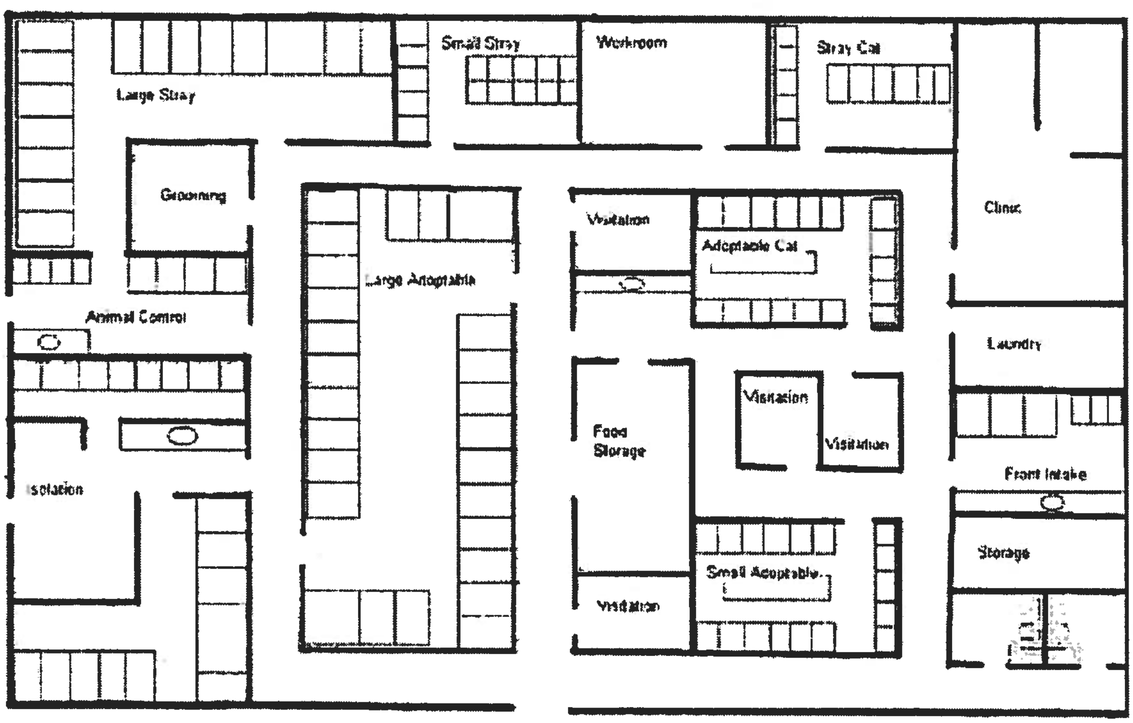

FIGURE 1: Diagram ofthe humane society (66 ft x 120 ft)

The large adoptable and large stray areas are constructed of epoxy-painted cinder block walls and seamless floors on a concrete slab. The dog runs in the large adoptable and the large stray areas are separated by cement partitions (82 in.) and have chain link doors. Both of these areas have an exposed steel ceiling (> 20 ft), Noise dosimeters were mounted on the wall in these rooms at a height of 12 ft.

The large adoptable area is a smaller area within a larger area enclosed by a cement perimeter wall (82 in.). The larger room is connected by two hallways, eight doors to other areas (including large stray and small adoptable), and one exterior door. This area contains 26 runs with Plexiglas view windows on one end. The dog kennels line all four perimeter walls. There is an employee work area (food preparation, washing dishes) in the middle of the room. The large stray area is a separate room adjacent to the large adoptable area. This area has two doors and contains 15 kennels. The dog kennels line the south and east walls.

The small adoptable, small stray, and front intake areas are all separate rooms with a suspended nonacoustical tile ceiling (8 ft) and plasterboard walls. Noise dosimeters were mounted on the wall in these rooms at a height of approximately 7 ft.

The small adoptable and small stray areas each have one door, a concrete slab floor, and contain metal cages. The cages in the small adoptable area face the interior of the room and the exterior has Plexiglas windows; there is an employee work area in the middle of the room. The cages in the small stray area line the cast wall and are also placed down the middle of the room. The front intake area contains cages and runs separated by sheet metal (60") and a linoleum floor. All kennels and cages are on the south wall. The room also has a refrigerator and a counter in each area with a sink and cabinets. The number of kennels and average number of animals during the study period are summarized in Table 1.

Statistical Analyses

The noise data were analyzed using a frequency procedure (SAS Institute Inc., 2002) to determine the frequency of noise above and below each threshold level (70, 80, 90, and 100 dBA) in each dog-holding area. The data were also analyzed using the Genmod procedure (SAS Institute Inc., 2002) to determine if there were any significant differences between the five dog-holding areas at each threshold level (70, 80, 90, and 100 dBA). Each area was treated as a fixed effect, class variable, and repeated subject. The analysis was appropriate for outcomes with a binary distribution and an auto-regressive covariance structure to account for the relation between measures in the same room.

Results

The amount of time spent above each threshold level during the 84-hr study period is shown in Figure 2. The large adoptable area was by far the loudest and some of the readings for other rooms were, in part, a result of sound reflection from the large adoptable area. Peak levels regularly exceeded the measuring capability of the dosimeter (118.9 dBA) in the large adoptable area. When the dogs were not vocalizing and the rooms "seemed" quiet, the noise readings were still above 50 to 60 dBA. Although there were numerical differences between rooms, there were no statistical differences at any threshold level ($p > .05$).

TABLE 1: Summary of Animal Holding Areas and Kennel Numbers

Holding Area	Average No. of Animals	No. of Kennels	Area[a]
Large adoptable	34.25 dogs	26 runs	880
Large stray	15 dogs	15 runs	485
Small adoptable	9.8 dogs	28 cages	285
Small stray	9 dogs	17 cages	258
Front intake	4 dogs, 9.75 cats	4 runs, 4 cages	240

[a] Given in square feet.

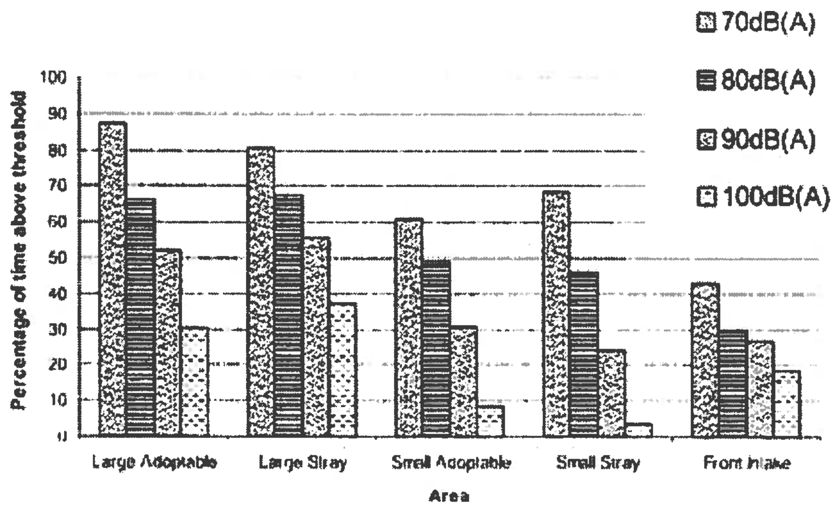

FIGURE 2: Percentage of time during the study period above each threshold level (70, 80, 90, and 100 dBA) for large adoptable, large stray, small adoptable, small stray, and front intake areas.

Discussion

Unfortunately, elimination of noise stressors is often disregarded, despite the evidence that noise places physical and psychological stress on dogs. In our study, the large adoptable area that holds the greatest number of animals was the loudest, which was not unexpected. This area receives a large amount of human traffic from those adopting dogs. Although not testable, given the nature of a functioning shelter, we suspect noise from this area overflows into all other areas. There are hallways leading from the large adoptable area that serve as noise conduits to the other areas -- one stopping at cat adoptable and cat stray and the other ending at the small adoptable room (Figure 1). In addition, noise produced by an individual dog barking can reach levels well over 100 dBA (Sales, Hubrecht, Peyvandi, Milligan, & Shield, 1996) and this exceeds OSHA regulation for workers (90 dBA). However, the animals live in this environment without the hearing protection that is available to people. The noise effect is three-fold:

1. The animals housed in the shelter.
2. The employees working at the shelter.
3. The public at the shelter looking for an animal to adopt.

The animals' mental and physical states are compromised; the employees may develop hearing damage and poor states of mind in caring for the animals. Our observations indicate that visitors sometimes are so bothered by the noise that visiting time is reduced during their search for an animal to adopt.

The large adoptable area is designed so that every dog can see every other dog if the dogs are at their kennel doors. The work area for this room also is located in the center of the rectangle, making it an additional source of stimulation. We observed that this layout allows for constant stimulation and may increase barking, as any activity within the large adoptable area stimulates every dog in the area. The result is virtually constant barking.

The design and building materials used do not allow for noise absorption, with the exception of rooms with suspended ceilings (small stray, small adoptable, and front intake). These do allow for absorption and somewhat reduced noise levels, although this difference was not statistically significant. The current public viewing design also contributes to the amount of stimulation for the dogs. The viewing windows start half-way up the perimeter wall. The placement of the viewing windows and the use of partitions between every kennel results in dogs that are constantly being surprised by people walking by and abruptly coming into view.

In the shelter environment, cortisol levels have been documented to be above normal, in some cases three times that of household pets (Hennessey, Davis, Williams, Mellott, & Douglas, 1997). We also found that in this instance (Coppola, Grandin, & Enns, 2006). Not all stress-induced elevations in cortisol are due to noise levels, but they are a contributing factor.

An increasingly popular way to design dog housing is to have self-contained rooms instead of the traditional kennels or runs. These rooms are typically enclosed within a larger area either with or without a community play area attached. Noise is absorbed and contained within the smaller room. These designs may also permit social housing of dogs, which research has shown to decrease noise caused by animal vocalization and increase the time animals spend sleeping (Hetts, Clark, Calpin, Arnold, & Mateo, 1992; Mertens & Unshelm, 1996). The incorporation of areas for play groups can contribute to noise abatement, as a mentally and physically exercised dog usually is a quiet one (personal communication, November 17, 2005; San Francisco Society for the Prevention of Cruelty to Animals, American Society for the Prevention of Cruelty to Animals, Humane Society at Lollypop Farm, Denver Dumb Friends League, North Shore Animal League). The American Society for the Prevention of Cruelty to Animals in New York has recently renovated both its holding and adoption areas to embrace these concepts and the San Francisco Society for the Prevention of Cruelty to Animals has been housing their adoptable dogs in "apartment-style" quarters since 1998.

Animal Welfare Implications

As previous scientists noted, kennels should be designed to meet the behavioral and physical needs of dogs, including attention to optimal ranges for sound(Key, 2000; Sales et al., 1997: Sales, Milligan, & Khirnykh, 1993). Unfortunately, even in new kennel construction, noise abatement designs are often ignored because of cost restrictions, making noise a hazard to the animals, employees, and potential adopters. Because of its unpredictable and uncontrollable nature, the shelter is a stressful environment for a dog, and any stress-inducing stimuli that can be reduced or eliminated should be addressed if possible. If one were to follow the standards for human dwellings, a mean sound level of 45 dBA would be the norm for animal houses. Without regulations regarding noise levels in animal shelters, noise may continue to be an overlooked variable and contribute to reduced overall welfare.

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