APPENDIX A

METHODOLOGY FOR THE 2007 GENERAL AVIATION AND PART 135 ACTIVITY SURVEY

Purpose of Survey

The purpose of the General Aviation and Part 135 Activity (GA) Survey is to provide the Federal Aviation Administration (FAA) with information on general aviation and on-demand Part 135 aircraft activity. The information obtained from the survey enables the FAA to monitor the general aviation fleet so that it can anticipate and meet demand for National Airspace System (NAS) facilities and services, assess the impact of regulatory changes on the fleet, and implement measures to assure the safe operation of all aircraft in the NAS. The data collected are also used by other government agencies, the general aviation industry, trade associations, and private businesses to pinpoint safety problems and to form the basis for critical research and analysis of general aviation issues.

Background and History

Prior to the first implementation of the annual GA Survey in 1978, the FAA used the Aircraft Registration Eligibility, Identification, and Activity Report (AC Form 8050-73) to collect data on general aviation activity. The form was sent annually to all owners of civil aircraft in the United States and served two purposes: (1) Part 1 was the mandatory aircraft registration revalidation form, and (2) Part 2 was voluntary and applied to general aviation aircraft only, asking questions on the owner-discretionary characteristics of the aircraft such as flight hours, avionics equipment, base location, and use. The FAA used this information to estimate aircraft activity.

In 1978, the FAA replaced AC Form 8050-73 with a new system. Part 1 was replaced by a triennial registration program. In January 1978, the FAA implemented a new procedure, known as triennial revalidation, for maintaining its master file. Instead of requiring all aircraft owners to revalidate and update their aircraft registration annually, the FAA only required revalidation for those aircraft owners who had not contacted the FAA Registry for three years. This less frequent updating of the master file affected its accuracy and representativeness:

1. The accuracy of current owners and their addresses deteriorated.

2. The master file combined a residue of aircraft, which under the old revalidation system would have been reregistered and purged from the file, but now remain under the new system.

Part 2 of AC Form 8050-73 was replaced by the General Aviation Activity Survey. Conducted annually, the survey was based on a statistically selected sample of aircraft, and it requested the same type of information as Part 2 of AC Form 8050-73. The first survey took place in 1978 and collected data on the 1977 general aviation fleet.

In 1993, the name of the survey was changed to the General Aviation and Air Taxi Activity Survey to reflect that the survey included air taxi (that is, on-demand Part 135) aircraft. Starting in 1999, the avionics section, which had been included only every other year, was asked every year. As a result, the survey's name was changed to the General Aviation and Air Taxi Activity

and Avionics Survey. In 2006, “Part 135” replaced the term “Air Taxi” in the survey title, the word “Avionics” was removed (though avionics data were still collected annually), and the survey was named the General Aviation and Part 135 Activity Survey. This is the name under which the 2007 survey was conducted.

The GA Survey has undergone periodic revisions to content, implementation, and definition of the GA population in order to remain current with regulations, activity patterns, and general aviation community. The table below summarizes changes in survey content.

Year	Description of change to survey content
1993	Added sightseeing and external load to use categories
1996	Added public use (i.e., flights for the purpose of fulfilling a government function) to use categories
1999	Significant re-design of the entire survey form to reduce item non-response, add new content, and be compatible with optical scanning Added air medical services to use categories Discontinued the use of a catch-all ‘other’ category as used in previous years Began collecting avionics data every year, rather than every other year
2000	Public use asked as a separate question, independent of other use categories (e.g., personal/recreation, business transportation), because it was not mutually exclusive with respect to other flight activity
2002	Use categories refined to be mutually exclusive and exhaustive and match definitions used by NTSB for accident reporting
2004	Air medical services was divided into two separate types to capture air medical flights under Part 135 and air medical flights not covered by Part 135 A more clearly defined ‘other’ category was reintroduced
2005	Fractional ownership question was changed from yes/no to a percentage Reduced the number of fuel type response categories by removing obsolete options Added question asking for average fuel consumption (in gallons per hour) Revised avionics page by adding and rearranging items
2007	Location of aircraft was revised to ask the state or territory in which the aircraft was “primarily flown” rather than where it was "based” Percentage of hours flown in Alaska was added Questions on percentage of hours flown under different flight plans, flight conditions, and day/night were revised into a single tabular format Number of types of landing gear systems was expanded Ice protection equipment was revised and prohibition from flight in icing conditions was added Avionics equipage was significantly revised to reflect changes in technology

The table below summarizes changes in survey implementation.

Year	Description of change to survey implementation
1999	Non-respondent telephone survey conducted to adjust active aircraft and hours flown estimates[1]
2000	Discontinued non-respondent telephone survey because of the variability of telephone non-respondent factors Added Internet response option
2003	Added a reminder/thank-you postcard between the first and second mailings
2004	Introduced "multiple aircraft" summary form to allow owners/operators of multiple aircraft to report aggregate data for their entire fleet on a single form Phone calls placed by PA and aviation associations to encourage participation by large fleet operators

The table below summarizes changes to the definition of the general aviation population and sample design.

Year	Description of change to definition of the GA population and sample design
1993	Number of aircraft types classified by the sample was expanded from 13 to 19
1999	Sample design revised to stratify by aircraft type (19 categories) and FAA region (9 categories)[2]
2003	Aircraft with known incorrect addresses and identified as "Postmaster Return" status on the Registry were retained in the definition of the survey population and were eligible for selection into the survey sample
2004	Aircraft reported as "registration pending" or sold (if sold status less than 5 years) on the Registry were retained in the definition of the survey population and were eligible for selection into the survey sample Sample design revised to stratify by aircraft type (19 categories), FAA region (9 categories), and whether or not the aircraft is owned by an entity certified to fly Part 135 (2 categories) Introduced 100% sample of the following groups: turbine aircraft, rotorcraft, on-demand Part 135 aircraft, and Alaska-based aircraft
2005	Sample design and reporting revised by introducing Light-sport aircraft as a 20th aircraft type sampled at 100%
2006	Sample design simplified by reducing the number of aircraft types to 14 (removed distinctions based on number of seats and eliminated "Other" subcategories of Piston, Turboprop, and Turbojet aircraft)[3] Sample design included 100% sample of aircraft manufactured in the past five years

[1] Telephone surveys of non-respondents also were conducted in 1977, 1978, 1979, 1997, and 1998. Please refer to the 1999 GA Survey report for a full discussion of the telephone survey of non-respondents.

[2] Before 1999, the sample was stratified by aircraft type (19 categories) and state/territory (54 categories).

[3] Published estimates continue to distinguish 17 aircraft categories by engine type, number of engines, and number of seats.

The 2007 statistics in this report were derived from the thirtieth GA Survey, which was implemented in 2008.

Improvements to the 2007 Survey

As part of ongoing efforts to improve the survey data, five key changes were made to the 2007 survey:

1. The field period opened on March 10, 2008, which matches the fielding date of the 2006 GA Survey (March 9, 2007). For two consecutive years, data collection began at the earliest date since the large-scale survey re-design in 1999.

2. To obtain better information on the geographic distribution of aircraft activity, a new question on percentage of total hours flown in Alaska was asked and wording was revised to identify where aircraft were primarily flown rather than "based."

3. To gather more accurate data on flight activity under different conditions, questions about flight plans, flight conditions, and day/night flying were revised to minimize complexity and respondent burden.

4. To improve data on measures to improve the safe operation of aircraft under adverse conditions, questions on ice protection equipment and prohibition of flight under icing conditions were added.

5. To remain current with technological advances, the avionics section was revised. Many new or more precisely worded items were added, several items were deleted, and material was rearranged to reflect more logical groupings.

Each of these improvements is discussed in subsequent sections of this Appendix.

Survey Population and Survey Sample

The survey population for the 2007 General Aviation and Part 135 Activity Survey includes all civil aircraft registered with the FAA that are based in the US or US territories and that were in existence and potentially active between January 1 and December 31, 2007.[4] This includes aircraft operating under:

- Part 91: General operating and flight rules.

- Part 125: Certification and operations: Airplanes having a seating capacity of 20 or more passengers or a maximum payload capacity of 6,000 pounds or more (but not for hire).

- Part 133: Rotorcraft external load operations.

- Part 135: On-demand (air taxi) and commuter operations not covered by Part 121.

- Part 137: Agricultural aircraft operations.

[4] According to the FAA Aircraft Registration Master File – the sample frame for the survey (discussed below) – over 99 percent of the aircraft in the 2007 survey population were registered to owners in the 50 states, the District of Columbia, Puerto Rico or other US territories, such as American Samoa, Guam, and the Virgin Islands.

Aircraft operating under Part 121 as defined in Part 119 are excluded from the survey population. Foreign air carriers, which operate under Part 129, are also not part of the survey population. Civil aircraft that are known not to be potentially active during the survey year are also excluded from the population – i.e., aircraft displayed in museums, aircraft destroyed prior to January 1, 2007.

The Aircraft Registration Master File, maintained by the FAA's Mike Monroney Aeronautical Center in Oklahoma City, serves as the sample frame or list of cases from which a sample of civil aircraft is selected. The Registration Master File ("Registry") is the official record of registered civil aircraft in the United States. For the purpose of defining the 2007 survey population, we used the Registry's list of aircraft as of December 31, 2007.

The Registry, like all sample frames, is an imperfect representation of the survey population. While it may exclude a very small number of aircraft that operate under the FAA regulations governing the operation of general aviation and on-demand Part 135 aircraft, it also includes aircraft that are not part of the survey population. Prior to sample selection, several steps are taken to remove ineligible aircraft from the sample frame. Specifically, this includes removing the following:

- Aircraft missing key identifiers that are necessary for classification or merging with other data sources (e.g., N-number, serial number, make/model information)
- Aircraft whose registration has been cancelled or revoked
- Aircraft based in Europe or registered to a foreign company that have not returned flight hour reports
- Aircraft that operate under Part 121
- Aircraft destroyed or moved to museums prior to January 1, 2007
- Aircraft reported sold before 2002 (5 years prior to survey year)[5]
- Aircraft that are flagged Postmaster Return (known to have incorrect address information) since before 1997 (10 years prior to survey year)
- Aircraft that are missing information on the registrant's name (i.e., the field is blank) (Aircraft for which the registrant is listed as "Pending" are retained in the survey population[6])
- Aircraft that lack information necessary to execute the sample design (i.e., aircraft type, FAA region)

The Registry included 373,366 aircraft as of December 31, 2007. This represents an increase of 2.6 percent over the Registry file from 2006 (363,977 records). This increase is more than 1 percentage point larger than previous years[7] and largely reflects an influx of Light-sport aircraft. Large numbers of previously existing aircraft that flew under exemptions as Ultra-light aircraft

[5] Prior to 2004, aircraft were excluded if reported sold more than 1 year prior to the survey year.

[6] Prior to 2004, aircraft with "Registration Pending" were excluded from the population.

[7] The number of aircraft listed on the Registry increased by 1 percentage point between December 31, 2004 and December 31, 2005; the increase was 1.2 percentage points between the same dates in 2005 and 2006. See Appendix A in the reports for the 2005 and 2006 GA Surveys.

could register as Experimental Light-sport until January 31, 2008. New rules governing the operation of Ultra-light aircraft would make the operation of these aircraft illegal after that date.

After excluding the aircraft described in the bulleted list above, 311,288 records remain. This represents 83.4 percent of the original Registry as of December 31, 2007, a percentage that is similar to previous years. The 2007 survey population of 311,288 represents an increase of 2.8 percent from 2006 (302,832). Again, this is a larger increase than previous years (more than 1 percentage point) due primarily to the registration of aircraft as Light-sport prior to the January 31, 2008 deadline for registering exempted Ultra-lights.

The 2007 GA Survey Sample

The 2007 survey sample design is unchanged from 2006.[8] The survey sample is stratified by aircraft type (14), FAA region in which the aircraft is registered (9), whether the aircraft operates under a Part 135 certificate (2), and whether the aircraft was manufactured in the past 5 years (2). Aircraft operated under a Part 135 certificate were identified using the FAA's Operations Specifications Subsystem (OPSS) database that was merged with the Registry by N-number. The four stratifying variables yield a matrix of 504 cells.

Although aircraft types are reduced to 14 for the purpose of sampling, statistical estimates are reported for 17 aircraft types. The sample design retains distinctions by engine and major aircraft type but size differences (as defined by number of seats) within major aircraft types are collapsed. Charts A.1 and A.2 list the aircraft types that are used for sampling and how the more detailed set of types, for which statistical estimates are presented, map to those used for sampling.

Chart A.1 also shows the elimination of three "Other" categories that was initiated with the 2006 GA Survey. Improvements in the Registry over the years have left relatively few aircraft assigned to three residual categories: Fixed Wing Piston – Other, Fixed Wing Turboprop – Other, and Fixed Wing Turbojet – Other. Because these categories are relatively small and unable to support reliable statistical estimates, the aircraft are reassigned to the modal category in the corresponding larger group.

[8] The 2006 survey year initiated changes in the sample design that are retained in 2007. For a complete discussion, see "Appendix A: Methodology for the 2006 General Aviation and Part 135 Activity Survey."

Chart A.1
Aircraft Types Used for Reporting

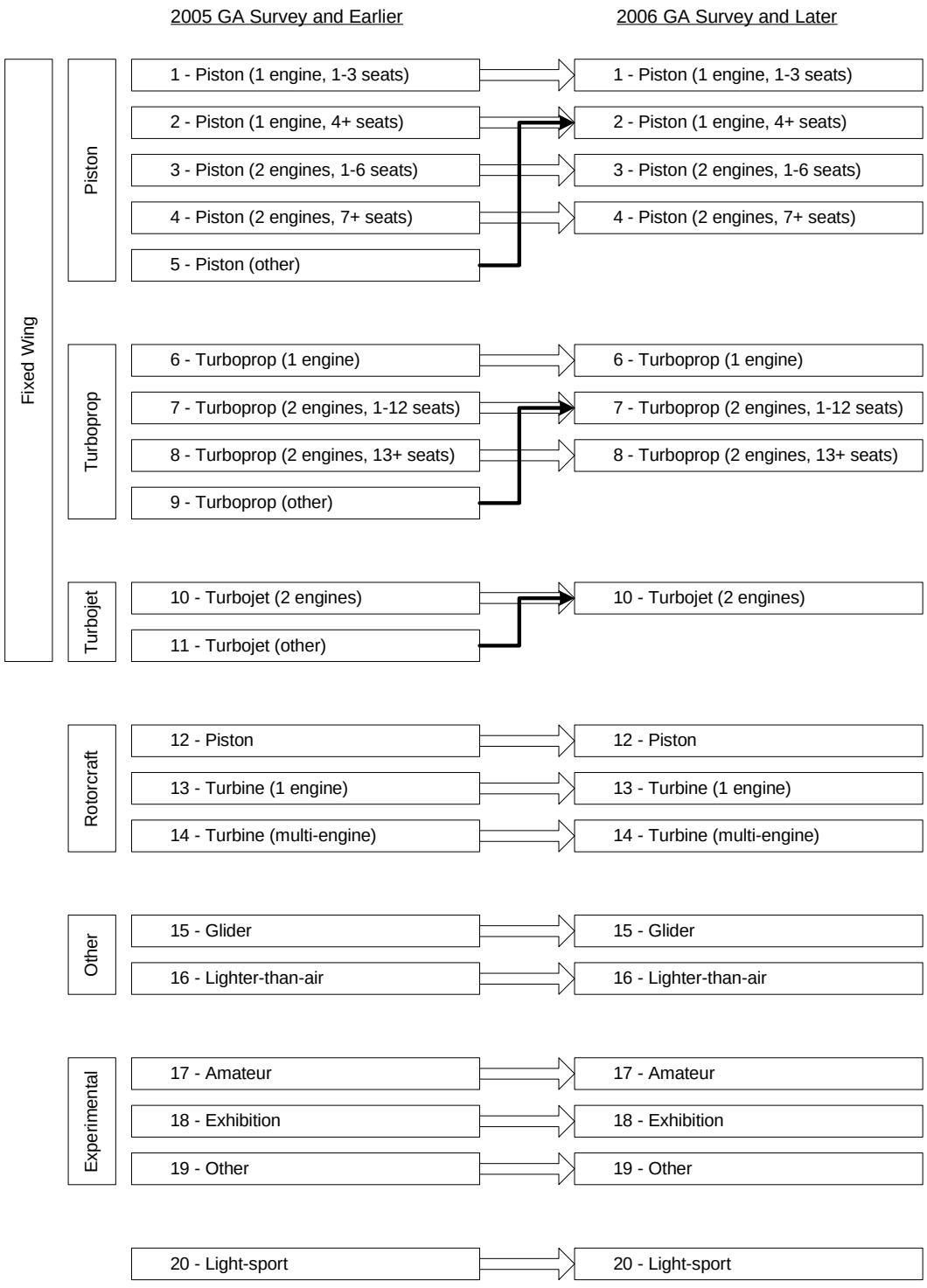
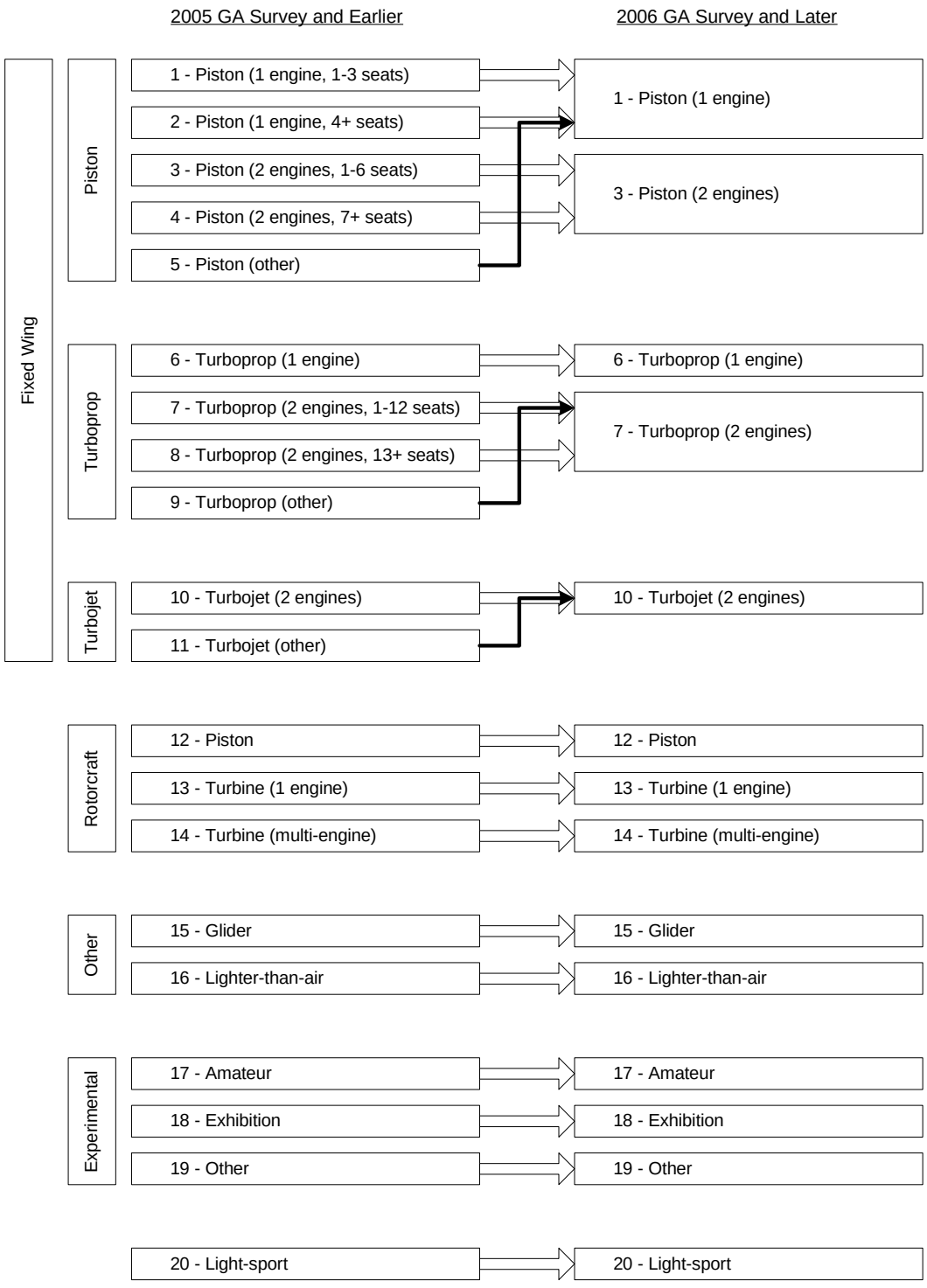


Chart A.2
Aircraft Types Used for Sample Design



The 2007 survey sample included several types of aircraft that were sampled at a rate of 1.0 (i.e., 100 percent sample). Because of the FAA's interest in better understanding the operation of these aircraft, all such aircraft listed in the Registry were included in the survey sample to ensure a sufficient number of survey completes to support analysis and provide more precise estimates of fleet size and aircraft activity. These include:

- 100 percent sample of turbine aircraft (turboprops and turbojets)
- 100 percent sample of rotorcraft
- 100 percent sample of aircraft operating on-demand Part 135 (or, informally "Air Taxi" aircraft)
- 100 percent sample of aircraft based in Alaska[9]
- 100 percent of Light-sport aircraft
- 100 percent sample of aircraft manufactured within the past 5 years (since 2002 inclusive)

Since 2004, the survey design has included the first four 100 percent samples listed above. In 2005, we added the 100 percent sample of Light-sport aircraft. In 2006, we added the 100 percent sample of recently manufactured aircraft. Altogether, these aircraft contributed 68,934 observations to the 2007 survey sample. Other aircraft that are not part of a 100 percent sample are subject to selection based on sampling fractions defined for each cell in the sample design matrix. Average annual flight hours is the primary measure needed by the FAA to address survey goals. Sample fractions for each sample strata are defined to optimize sample size to obtain a desired level of precision for an estimate of flight activity. Data from the previous survey year on average hours flown, variability in hours flown by region and aircraft type, and response rates are used to set precision levels and identify the optimal sample size for each strata. Aircraft are randomly selected from each cell in the matrix, subject to the desired sample size. Strata that yield a very small sample size are examined and adjusted to include all observations in the strata if necessary. In 2007, an additional 15,636 aircraft were sampled at a rate of less than 1.0. The number of aircraft sampled at a rate of less than 1.0 is 63 percent smaller than the 2006 survey when 25,494 such aircraft were included in the sample. The large increase in number of aircraft captured by the 100 percent samples made it necessary to sample other aircraft at lower rates due to constraints on total sample size. The total sample for the 2007 GA Survey included 84,570 aircraft. Table A.1 shows the distribution of aircraft in the survey population and survey sample by aircraft type.

Table A.1: Survey Sample and Population Figures by Aircraft Type

[9] Alaska-based aircraft are identified by the state listed in the Registry file, not survey data on where the aircraft is operated.

Aircraft Type	Population	Sample Size	Sample as Percent of Population
Fixed Wing - Piston	**215,396**	**22,224**	**10.3**
1 engine, 1-3 seats	63,492	5,164	8.1
1 engine, 4+ seats	128,808	13,700	10.6
2 engines, 1-6 seats	15,566	1,826	11.7
2 engines, 7+ seats	7,530	1,534	20.4
Fixed Wing - Turboprop	**10,556**	**10,556**	**100.0**
1 engine	4,462	4,462	100.0
2 engines, 1-12 seats	4,912	4,912	100.0
2 engines, 13+ seats	1,182	1,182	100.0
Fixed Wing - Turbojet	**11,894**	**11,894**	**100.0**
2 engines	11,894	11,894	100.0
Rotorcraft	**12,514**	**12,514**	**100.0**
Piston	4,439	4,439	100.0
Turbine: 1 engine	6,561	6,561	100.0
Turbine: Multi-engine	1,514	1,514	100.0
Other Aircraft	**10,317**	**5,238**	**50.8**
Glider	3,204	2,395	74.8
Lighter-than-air	7,113	2,843	40.0
Experimental	**42,154**	**13,687**	**32.5**
Amateur	36.687	9,582	26.1
Exhibition	3,184	1,917	60.2
Experimental: Other	2,283	2,188	95.8
Light-sport	**8,457**	**8,457**	**100.0**
Total	**311,288**	**84,570**	**27.2**

Weighting the Survey Data

Data from completed surveys are weighted to reflect population characteristics. The weights reflect the proportion of aircraft sampled from the population in each sample strata and differential response as well as a small adjustment for aircraft that are not part of the survey population.

Initially, each aircraft for which we receive a completed survey is given a weight that reflects sampling fraction and differential response. That is:

WEIGHT = (Population N_{ijkl}/Sample N_{ijkl}) * (N Respondents$_{ijkl}$/Sample N_{ijkl})

where i, j, k, and l represent the four sample strata of aircraft type, FAA region, Part 135 status, and whether an aircraft was manufactured in the past 5 years.

The weight is subsequently adjusted to reflect new information about non-general aviation aircraft. That is, survey responses that identify an aircraft as not being part of the survey population – destroyed prior to January 1, 2007; displayed in a museum; operated primarily as an air carrier under Part 121 or 129; or a military aircraft – are used to remove aircraft proportionally from the sample and from the population. This adjustment is done at the level of the 14 aircraft types. The procedure assumes that non-GA aircraft occur in the same proportion among survey respondents and non-respondents. To the extent that non-GA aircraft are less likely to receive and complete a survey, this approach will underestimate the adjustment for aircraft that are not part of the general aviation population.

Errors in Survey Data

Errors associated with survey data can be classified into two types – sampling and non-sampling errors. Sampling errors occur because the estimates are based on a sample of aircraft rather than the entire population and we can expect, by chance alone, that some aircraft selected into the sample differ from aircraft that were not selected.

Non-sampling errors can be further subdivided into a) errors that arise from difficulties in the execution of the sample (e.g., failing to obtain completed interviews with all sample units), and b) errors caused by other factors, such as misinterpretation of questions, inability or unwillingness to provide accurate answers, or mistakes in recording or coding data.

Sampling Error

The true sampling error is never known, but in a designed survey we can estimate the potential magnitude of error due to sampling. This estimate is the standard error. The standard error measures the variation that would occur among the estimates from all possible samples of the same design from the same population.

This publication reports a standard error for each estimate based on survey sample data. An estimate and its standard error can be used to construct an interval estimate ("confidence interval") with a prescribed level of confidence that the interval contains the true population figure. In general, as standard errors decrease in size we say the estimate has greater precision (the confidence interval is narrower), while as standard errors increase in size the estimate is less precise (the confidence interval is wider). Table A.2 shows selected interval widths and their corresponding confidence.

Table A.2: Confidence of Interval Estimates

	APPROXIMATE CONFIDENCE THAT INTERVAL INCLUDES

WIDTH OF INTERVAL	TRUE POPULATION VALUE
1 Standard error	68%
2 Standard error	95%
3 Standard error	99%

This report presents a "percent standard error" for each estimate, which is the standard error relative to the mean. The percent standard error is the ratio of the standard error to its estimate multiplied by 100. For example, if the estimate is 4,376 and the standard error is 30.632, then the percent standard error is (30.632/4,376) * 100 = 0.7. Reporting percent standard errors makes it possible to compare the precision of estimates across categories.

Estimates and percent standard errors reported in Table 2.1 provide an example of how to compute and interpret confidence intervals. To obtain a 95 percent confidence interval for the estimated number of total hours flown for turbojets in 2007, where the total hours flown is estimated to be 3,938,215 and the percent standard error of the estimate is 0.8, the following computation applies:

Lower confidence limit: 3,938,215 – 2(0.8/100)(3,938,215) = 3,875,204

Upper confidence limit: 3,938,215 + 2(0.8/100)(3,938,215) = 4,001,226

In other words, if we drew repeated samples of the same design, 95 percent of the estimates of the total hours flown by turbojets would fall between 3,875,204 and 4,001,226.

Non-sampling Error

Sampling error is estimable and can be reduced through survey design (e.g., by increasing sample size), but it is difficult, if not impossible, to quantify the amount of non-sampling error. Although extensive efforts are undertaken to minimize non-sampling error, the success of these measures cannot be quantified.

Steps taken to reduce non-sampling error include strategies to reduce non-response and efforts to minimize measurement and coding errors. To this end, implementation and design of the 2007 GA Survey incorporated the following steps to maximize cooperation among sample members:

- Two modes of administration to facilitate access to the survey – a postcard invitation to complete the survey on the Internet followed by a mail survey to be completed by pen or pencil
- Three mailings of the survey to individuals who had not yet responded, as well as a reminder/thank-you postcard
- Cover letters accompanying each survey mailing clearly explained the purpose of the survey as well as the endorsement (organizational logos) of several aviation associations[10]

[10] The following associations' logos appeared on the 2007 cover letter or on-line introduction: Aircraft Owners and Pilots Association (AOPA), Experimental Aircraft Association (EAA), General Aviation Manufacturers Association (GAMA), Helicopter Association International (HAI), National Agricultural Aviation Association (NAAA), National Air Transportation Association (NATA), National

- Cover letters assured owners of the confidentiality of their responses and informed them: “Names of individuals are never associated with responses. There is an identification number on your survey only so [survey contractor] knows who should receive the survey.”

- Use of additional sources to obtain updated contact information and help ensure the mail survey reaches the sample member (e.g., National Change of Address, updates from aviation associations)

- Use of a toll-free 800 telephone number and email address to respond to questions

- Collaboration with aviation organizations and industry groups to encourage cooperation of owners or operators of multiple aircraft

The survey efforts also minimize measurement error by increasing the likelihood that respondents share a common understanding of survey questions and reducing errors in data coding. These include:

- Close collaboration with the FAA, other federal agencies and aviation groups to refine and clarify question wording as well as definitions to questions. The questionnaire is re-examined each year to identify ambiguities or revisions necessary to remain consistent with aviation regulations and definitions.

- Significant reviews and re-designs of the questionnaire have been undertaken periodically (see “Background” section of this report). Each re-design is thoroughly pre-tested with a sample of aircraft owners or operators and, if necessary, modified on the basis of the pre-test results.

- Comprehensive editing and verification procedures to ensure the accuracy of data transcription to machine-readable form as well as internal consistency of responses.

We undertake extensive effort to reduce measurement error, particularly where we can anticipate systematic or repeated error on the part of survey respondents, but it impossible to eliminate all measurement error. Survey participants may misunderstand questions or misreport flight activity in ways that cannot be anticipated or prevented through survey or questionnaire design. Where survey reports appear nonsensical or contradict FAA regulations (e.g., Light-sport aircraft operating with a paid flight crew), we manually verify that the data were processed accurately. However, no additional steps are taken to “cleanse” the data of apparently illogical reports or assign them to other categories. To do so would introduce additional and systematic error that would be misleading and would affect other uses of the data, such as assessing the risk of accidents among aircraft types or by use of aircraft.

Survey Content

The 2007 GA Survey questionnaire, shown in figure B.1 of Appendix B, requests the aircraft owner or operator to provide the following information on the sampled aircraft’s characteristics and uses:

1. Number of total hours flown in 2007 and hours flown by use

Business Aviation Association (NBAA), Regional Air Cargo Carriers Association (RACCA), Small Aircraft Manufacturers Association (SAMA).

2. Airframe hour reading and where the aircraft was flown most of the survey year

3. Hours flown by flight plan and flight conditions, including flight under Instrumental Meteorological Conditions (IMC) and Visual Meteorological Conditions (VMC) during the day and night

4. Type of landing gear and number of landings in 2007

5. Fuel type and average fuel consumption

6. Percentage of hours flown in 2007 as part of a fractional ownership program, rented or leased, or used to fulfill a government function

7. Avionics equipage

The survey questionnaire changed from the 2006 survey in the following ways:

- The question asking location of aircraft activity (Q3) was reworded to ask where the aircraft was "primarily flown" during 2007; previously the question asked where the aircraft was "based" as of December 31st of the survey year. The revised question wording will better reflect the geographic area of aircraft activity.

- To gather more accurate information on the operation of aircraft in Alaska, we added a question on the percentage of hours flown in Alaska. These data will support the FAA's need to understand aviation activity in an area that faces climate and terrain conditions different from other parts of the US.

- We revised the format and structure of questions about activity under different flight plans and flight conditions. Previously asked as three separate questions, this information is now gathered in a single item using a tabular format that is simpler, reduces respondent burden, and should yield more accurate information (Q11). At the same time, it preserves all detail on percentage of hours flown by flight plan (IFR, VFR, no flight plan), flight conditions (IMC, VMC), and during the day or night.

- We expanded the number of types of landing gear systems. The 2007 survey distinguishes among fixed wheels, retractable wheels, amphibious floats, straight floats, other (e.g., skis), or no landing gear (Q13). Previously, the survey only identified fixed, retractable or no landing gear.

- Based on recommendations by the FAA and industry experts, we added another fuel type by distinguishing between Jet Fuel – Turbine and Jet Fuel – Piston.

- In collaboration with the FAA and the FAA's engineering experts, we added two questions on icing. These questions will provide information on prohibition of aviation activity under icing conditions and the extent to which the fleet is specially equipped to operate in icing.

- To remain current with technological advances, the avionics section was revised. Items were added, deleted, listed with refined or more detailed definitions, and rearranged into more logical groupings. In addition, the 2007 survey only asks about *installed* avionics

equipment; usage of hand-held devices is no longer collected. Changes in the avionics section are summarized below.

The following items were added to the 2007 survey:

Datalink disaggregated into three separate items: SATCOM (Comsat, Inmarsat), ACARS (AFIS), and FANS
ADS-B (UAT) disaggregated into two items: Transmit Only (Out) and Transmit and Receive (In)
IFR-approved from non-precision (LNAV) approach operation (TSO C-129/129A)
Electronic Primary Flight Display (PFD)
Emergency Locator Transmitter (121.5 MHz capable)
Emergency Locator Transmitter (406 MHz capable)
Air Bag and Ballistic Parachute
Image Recorder
IFR-approved for en route & terminal operation only (TSO C-129/129A)
IFR approved for Baro VNAV
Approved for LNAV approach only (WAAS Class 1)
Approved for LNAV and LNAV/VNAV (WAAS Class 2)
Approved for LPV approach (WAAS Class 3)
ILS
DME/DME-based Area Navigation Equipment (RNAV) (AC 90-100A)
Intertial Reference/Navigation System
Terminal & Enrute Baro-VNAV
Heads Up Display (HUD)
Enhanced Vision System (EVS)
Synthetic Vision System (SVS)

The following items were deleted from the 2007 survey:

Analog Air-to-Ground Telephone
Digital Air-to-Ground Telephone
Localizer
Marker Beacon
Glide Slope
Automatic Direction Finder (ADF)
LORAN C: VFR only
LORAN C: IFR en route-approved
Other navigation equipment (Doppler, INS)
IFR LPV approach (WAAS)
Autopilot-Axis Controls: Wing Leveler
Autopilot-Axis Controls: Alititude Hold
Autopilot-Axis Controls: Autoland
Autopilot-Axis Controls: Altitude Preselect
Attitude & Heading Reference System (AHRS)
Integrated All-Glass Cockpit
Ice Protection System
Laptop Computer or Tablet (not in panel)

Survey Method

Appendix B presents the materials used to conduct the 2007 survey. The standard survey form is shown in Figure B.1. The postcard invitation to the Internet component and the reminder/ thank-you postcard are shown in Figure B.2. Each of the three mailings for the standard survey was accompanied by a cover letter, shown respectively in Figures B.3, B.4, and B.5.

The protocol used for the 2007 survey is similar to that used since the 2000 survey. The survey data were collected from owners and operators of the sampled aircraft through two venues – the Internet and mailings of the questionnaire. The Internet component was implemented before the mailing portion to collect as many responses electronically as possible. Sampled aircraft were first sent a postcard inviting them to participate in the Internet version of the survey. The postcard was sent on March 10, 2008, and the Internet component continued through August 18, 2008.

There were three mailings of the standard questionnaire, and a reminder/thank-you postcard sent between the first and second mailings. The first questionnaire mailing, sent on April 7, 2008, included only those aircraft in the sample that had not completed a survey via the Internet or had not received a final disposition due to a returned postcard (refused, respondent deceased, undeliverable with no new address, etc.). The reminder/thank-you postcard was sent on April 26, 2008, and included only those aircraft in the sample that had not yet responded to the survey and were not part of the non-active sample. The second survey mailing was sent on May 23, 2008, and included only those aircraft in the sample that had not yet responded to the survey and were not part of the non-active sample. The third mailing was sent on July 2, 2008, to owners and operators of the sampled aircraft who had not responded to the first or second mailings.

Alternative Survey for Reporting on Multiple Aircraft

The 2007 GA Survey continued the effort initiated in 2004 to increase cooperation among respondents who own or operate multiple aircraft. To achieve this objective, the 2007 survey employed the data collection tools and methods introduced in 2004.

The responses of multiple-aircraft owners/operators are extremely important for accurately estimating general aviation activity. Because of the increased burden of reporting for multiple aircraft, there was a concern that these high-end, high-use operators were less likely to respond to the survey. Therefore, after the sample was selected, the FAA's Operations Specifications Subsystem (OPSS) was used to group aircraft belonging to the same operator's fleet. Operators with three or more aircraft were classified as "multiple owners/operators" for survey purposes, regardless of the number of their aircraft present in the survey sample.

To avoid confusion among respondents, aircraft were assigned to a single data collection track. The 15,129 aircraft in the "multiple owner/operator" track followed an independent protocol developed in 2004. The remaining 69,441 aircraft followed the same protocol used in previous years and is described above.

In order to minimize the reporting burden on operators of multiple aircraft, a summary survey was developed with the cooperation of several aircraft operators and aviation associations to enable an operator to report activity for an entire fleet on a single condensed form, instead of completing the longer questionnaire for each individual aircraft. This survey form (Appendix B, Figure B.6) allows operators to report on key variables for major classes of aircraft – i.e., hours flown, how flown, fuel consumption, fractional ownership, and number of landings. The form did not collect data on flight conditions, fuel type, or avionics.

Data collection for multiple-aircraft owners/operators followed the same timing as the standard data collection track. Like the standard survey protocol, an Internet survey that matched the mail questionnaire allowed respondents to report on-line.

To maximize the survey response rate, follow-up phone calls were placed to all multiple-aircraft owners/operators. These calls focused not only on encouraging survey participation, but also on ensuring survey mailings were reaching the appropriate person in the operator's organization. In many cases, aviation associations with which operators had an existing relationship made these telephone calls.

Benefits resulting from the new systems of data collection implemented since 2000 include quicker processing of the results, improved data quality, and considerable savings of time and money to both the public and the federal government.

Response Rate

The response rate is calculated conservatively following guidelines published by the American Association for Public Opinion Research (AAPOR), a professional association that establishes standards, "best practice" guidelines, and a code of ethics for professional survey researchers and research firms.[11] Specifically, the response rate is computed as the number of completed

[11] The American Association for Public Opinion Research. 2000. *Standard Definitions: Final Dispositions of Case Codes and Outcome Rates for Surveys*. Ann Arbor, MI: AAPOR.

and partial surveys returned divided by the total number of eligible aircraft in the sample using the following formula.

RR = (C + P) / (C + P) + (NR + INS + REF + PMR + UNK)

Where

RR = Response Rate

C = Completed survey

P = Partial survey

NR = No response

INS = Insufficient complete; a partial survey that is not sufficient to count as a complete

REF = Refused

PMR = Post Master Returned, no new address

UNK = Unknown eligibility

The numerator is comprised of completed surveys and partial surveys that provide enough information to be used for analysis. Partial surveys must include information on hours flown to be included in the numerator.

In addition to completed and partial surveys, the denominator includes cases for which no response was received, insufficiently completed surveys (i.e., no data reported for hours flown), refusals, surveys returned as undeliverable by the USPS, and cases of unknown eligibility. The last category includes aircraft in which the owners cannot be identified or cannot report about aircraft activity (e.g., owner is deceased and the survivors cannot report on the aircraft activity, survey recipient does not own the aircraft listed).

The denominator includes aircraft that were sold or destroyed during the survey year. The survey collects data on flight activity for the portion of the year the aircraft was eligible to fly, and data collection efforts attempt to identify and mail surveys to new owners.

The denominator excludes aircraft known not to be part of the general aviation fleet or known not to be eligible to fly during the survey year. These are aircraft that were destroyed prior to the survey year, displayed in a museum, operated primarily as an air carrier or air cargo carrier, registered outside the US, exported overseas, or owned and operated by the military.

As shown in Table A.3, the overall response rate for the 2007 survey was 46.6 percent.[12] The response rate for the Internet portion of the survey was 23.0 percent and accounted for 49.4 percent of the total responses to the survey. The first mailing had a response rate of 15.1 percent and accounted for 32.4 percent of the total responses to the survey. The second mailing had a response rate of 5.3 percent, which accounted for 11.4 percent of the total responses to

[12] Although the 2007 response rate of 46.6 percent represents a decrease from response rates reported prior to 2003, this decrease is attributable to changes in survey methodology that have occurred over the past 8 years. The inclusion of bad addresses in the response rate calculation, adding more aircraft registered as “Sale Reported” or “Registration Pending” to the survey population, and other factors have resulted in the decrease to the response rate.

the survey. The third mailing produced a response rate of 5.4 percent, approximately 11.6 percent of the total responses to the survey.

Table A.3: Summary of Response Rate Information

Phase	Valid Sample[13]	Completes[14]	Response Rate	% Total Response
Internet	78,489	19,268	23.0%	40.4%
1st Mailing	67,825	12,725	15.1%	32.4%
2nd Mailing	50,442	4,442	5.3%	11.4%
3rd Mailing	44,122	4,591	5.4%	11.6%
Overall	84,570	38,920	46.6%	100.0%

Table A.4 illustrates the steady increase in the Internet response as a percentage of all returned surveys from 2000 to 2007 (32.8 percent for 2000 compared with 49.5 percent for 2007). This increase in response illustrates an increasing effectiveness of utilizing the Internet for data collection, thereby improving the efficiency and cost savings of the data collection process.

Table A.4: Percentage of All Completed Surveys Responding by Internet

	2000	2001	2002	2003	2004	2005	2006	2007
Total Completes	15,689	16,432	15,254	14,471	32,056	34,248	38,973	38,920
Internet Completes	5,144	5,954	5,304	6,059	13,441	14,555	17,266	19,268
Internet % of Total	32.8%	36.2%	34.8%	41.9%	41.9%	42.5%	44.3%	49.5%

Table A.5 shows response rates by aircraft type.

[13] Even though efforts are made to remove non-GA aircraft from the population before the sample is selected, a small number of surveys are returned each year indicating that the aircraft should not be part of the survey population (e.g., the aircraft was used primarily as a Part 121 air carrier, or was a museum piece the entire survey year). The Total Valid Sample Size used to compute the overall survey response rate excludes such aircraft.

[14] The total number of completes is not an exact sum of the separate components due to a small number of aircraft that did not receive a mailing but that were reported by a large fleet and therefore received a complete disposition.

Table A.5: Response Rate by Aircraft Type

Aircraft Type	Sample	Invalid Sample[15]	Completes	Response Rate
Fixed Wing - Piston				
1 engine, 1-3 seats	5,164	24	2,204	42.9%
1 engine, 4+ seats	13,700	109	5,955	43.8%
2 engines, 1-6 seats	1,826	16	857	47.3%
2 engines, 7+ seats	1,534	12	759	49.9%
Fixed Wing - Turboprop				
1 engine	4,462	98	2,180	50.0%
2 engines, 1-12 seats	4,912	54	2,032	41.8%
2 engines, 13+ seats	11,182	36	440	38.4%
Fixed Wing - Turbojet				
2 engines	11,894	328	5,461	47.2%
Rotorcraft				
Piston	4,439	50	1,344	30.6%
Turbine: 1 engine	6,561	36	2,428	37.2%
Turbine: Multi-engine	1,514	15	642	42.8%
Other Aircraft				
Glider	2,395	16	1,130	47.5%
Lighter-than-air	2,843	27	1,065	37.8%
Experimental				
Amateur	9,582	114	5,719	60.4%
Exhibition	1,917	41	882	47.0%
Experimental: Other	2,188	27	980	45.3%
Light-sport	8,457	37	4,842	57.5%
Total	84,570	1,040	38,920	46.6%

[15] Even though efforts are made to remove non-GA aircraft from the population before the sample is selected, a small number of surveys are returned each year indicating that the aircraft should not be part of the survey population (e.g., the aircraft was used primarily as a Part 121 air carrier, or was a museum piece the entire survey year). The Invalid Sample represents such aircraft, which are excluded from response rate calculations.