

## **SECTION 5: UNIT REPLACEMENT AND RESTORATION COSTS OF DAMAGED AIRCRAFT**

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### **5.1 INTRODUCTION**

The cost of damage to aircraft in aviation accidents is borne directly by operators and indirectly by users and society in the form of higher fares and costs.<sup>1</sup> Determining these costs provides a measure for evaluation of FAA investment and regulatory programs that affect the likelihood of aircraft being damaged or destroyed.

#### **5.1.1 Replacement**

For the purpose of evaluating the cost of aircraft replacement, a destroyed aircraft is assigned the value of an equivalent replacement. This valuation assumption is consistent with the opportunity cost of the loss of the use of a typical aircraft; the value of a new aircraft would overstate the typical loss. (Even though a destroyed aircraft might be replaced by a new aircraft, the new aircraft provides additional value over the one it replaces.) The aircraft values reported below are based on transactions in the well-defined market for used aircraft. Current market values are also reported below. For general aviation aircraft, estimated market values are used. Due to a lack of available data, military aircraft values are not included in this section. Estimated UAS market values were provided by an independent market research firm as described below.

#### **5.1.2 Restoration**

The NTSB classifies aircraft involved in accidents as “destroyed,” having “substantial damage,” having “minor damage,” or having “no damage.” The cost incurred as a result of “minor damage” to aircraft is generally a negligible percentage of the market value and is not evaluated in this report. An aircraft with “substantial damage” is one that is damaged but repairable; industry data discussed below provide a means of estimating the relationship between the cost of damage and the total value of the aircraft.

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<sup>1</sup> Insurance represents a transfer payment between the insurance company and the insured and does not directly affect the economic losses in an accident.

## 5.2 AIR CARRIER AIRCRAFT

### 5.2.1 Replacement

Replacement values for air carriers were derived from the proprietary database developed by ch-aviation.<sup>2</sup> The first step in establishing an average fleet valuation was to develop an industry database covering each aircraft and aircraft type in the U.S. air carrier fleet that was in service as of November 2023. The average value was developed using an estimated current market value for each aircraft delivered in a given year, and then aggregating these values into the economic values aircraft categories.

The valuation database uses industry data on recent sales and asking prices of airplanes on the used market. There is an active market in used commercial aircraft, and thus it is possible to obtain reliable estimates of a destroyed aircraft.

The summary of values for passenger and all-cargo air carrier aircraft is shown in Table 5-1. The first column for each operator group reports the number of aircraft in the ch-aviation database that were used in developing weighted averages.<sup>3</sup> The second column reports current market (2023) values. The average market value of a passenger aircraft was about \$22.7 million in 2023, while the average market value of an all-cargo aircraft was \$39.2 million. The range in values among the individual aircraft groups was quite large reflecting the different average sizes and average ages of aircraft in each group.

**Table 5-1: 2023 Estimated Market Values of Air Carrier Aircraft**

Aircraft Category	1		2		3		4	
	Passenger		All-Cargo					
	Number of Aircraft	Weighted Average Current Market Value (millions)	Number of Aircraft	Weighted Average Current Market Value (millions)				
Widebody 580k lbs or more MTOW	195	\$34.0						
Widebody less than 580k lbs MTOW	311	\$55.0						
Four-engine widebody			120	\$65.8				
Three-engine widebody			86	\$3.7				
Two engine widebody			491	\$47.8				
Narrowbody 165k lbs or more MTOW	3,138	\$28.7	116	\$13.2				
Narrowbody less than 165k lbs MTOW	1,042	\$10.5	25	\$6.4				
Regional jet 61-99 seats or equivalent	1,053	\$12.4	NR	NR				
Regional jet less than 61 seats or equivalent	341	\$1.7	1	\$1.1				
Turboprop more than 60 seats or equivalent	9	\$9.8	14	\$2.4				
Turboprop 20-60 seats or equivalent	18	\$6.0	NR	NR				
<b>All Aircraft</b>	<b>6,107</b>	<b>\$22.7</b>	<b>853</b>	<b>\$39.2</b>				

Source: ch-aviation as of November 27, 2023 where Operator Type = "Scheduled Carrier" or "Cargo Carrier"

Col 1: Number of passenger aircraft in database

Col 2: The weighted average current market value of aircraft described in column 1

Col 3: Number of all-cargo aircraft in database

Col 4: The weighted average current market value of aircraft described in column 3

<sup>2</sup> <https://www.ch-aviation.com/aircraft>

<sup>3</sup> This differs from the fleet sizes reported in Section 3 because the coverage of operators and aircraft types differ between the two data sources (ch-aviation and BTS).

Table 5-2 provides current market values for passenger air carrier aircraft. It also shows the standard deviation of each aircraft group value, which is based on the number and value of each aircraft within the group. The average monthly lease rates for each aircraft group are also shown.

**Table 5-2: 2023 Passenger Air Carrier Fleet Sizes and Values**

	1	2	3	4	5	6
Aircraft Category	Number of Aircraft with Market Value Data	Weighted Average Current Market Value (millions)	Standard Deviation of Market Value (millions)	Number of Aircraft with Lease Rate Data	Weighted Average Monthly Market Lease Rate (thousands)	Standard Deviation of Monthly Market Lease Rate (thousands)
Widebody 580k lbs or more MTOW	195	\$34.0	\$41.3	195	\$314.1	\$317.6
Widebody less than 580k lbs MTOW	311	\$55.0	\$42.2	311	\$475.0	\$321.4
Narrowbody 165k lbs or more MTOW	3,138	\$28.7	\$20.2	3,138	\$254.4	\$173.9
Narrowbody less than 165k lbs MTOW	1,042	\$20.5	\$19.9	1,042	\$97.4	\$175.1
Regional jet 61-99 seats	1,053	\$12.4	\$5.1	1,053	\$118.0	\$36.3
Regional jet less than 61 seats	341	\$1.7	\$0.0	341	\$37.2	\$0.0
Turboprop more than 60 seats	9	\$9.8	\$3.8	9	\$95.3	\$22.6
Turboprop 20-60 seats	18	\$6.0	\$3.8	18	\$72.4	\$32.7
<b>All Aircraft</b>	<b>6,107</b>	<b>\$22.7</b>	<b>\$20.3</b>	<b>6,107</b>	<b>\$204.4</b>	<b>\$154.6</b>

Source: ch-aviation as of November 27, 2023 where Operator Type = "Scheduled Carrier"

Col 1: Number of aircraft in database with current market value data

Col 2: The weighted average current market value of aircraft described in column 1

Col 3: The standard deviation of current market value of aircraft described in column 1

Col 4: Number of aircraft in database with lease rate data

Col 5: The weighted average monthly market lease rate (net dry operating lease) of aircraft described in column 4

Col 6: The standard deviation of monthly market lease rate of aircraft described in column 4

Table 5-3 shows current market values and monthly lease rates for all-cargo air carrier aircraft. The values of all-cargo air carrier aircraft are generally lower than equivalent passenger aircraft, except for the widebody aircraft categories.

**Table 5-3: 2023 Cargo Air Carrier Fleet Sizes and Values**

	1	2	3	4	5	6
Aircraft Category	Number of Aircraft with Market Value Data	Weighted Average Current Market Value (millions)	Standard Deviation of Market Value (millions)	Number of Aircraft with Lease Rate Data	Weighted Average Monthly Market Lease Rate (thousands)	Standard Deviation of Monthly Market Lease Rate (thousands)
Four-engine widebody	120	\$65.8	\$49.2	120	\$715.6	\$371.0
Three-engine widebody	96	\$3.7	\$0.5	86	\$108.5	\$11.9
Two-engine widebody	491	\$47.8	\$35.9	491	\$520.6	\$332.0
Narrowbody 165k lbs or more MTOW	116	\$13.2	\$2.9	116	\$164.5	\$16.5
Narrowbody less than 165k lbs MTOW	25	\$6.4	\$1.2	25	\$98.4	\$10.9
Regional jet less than 61 seats equivalent	1	\$1.1	\$0.0	1	\$29.0	\$0.0
Turboprop more than 60 seats equivalent	14	\$2.4	\$0.1	14	\$46.6	\$0.9
<b>All Aircraft</b>	<b>853</b>	<b>\$39.2</b>	<b>\$38.7</b>	<b>853</b>	<b>\$437.3</b>	<b>\$353.3</b>

Source: ch-aviation as of November 27, 2023 where Operator Type = "Cargo Carrier"

Col 1: Number of aircraft in database with current market value data

Col 2: The weighted average current market value of aircraft described in column 1

Col 3: The standard deviation of current market value of aircraft described in column 1

Col 4: Number of aircraft in database with lease rate data

Col 5: The weighted average monthly market lease rate (net dry operating lease) of aircraft described in column 4

Col 6: The standard deviation of monthly market lease rate of aircraft described in column 4

## 5.2.2 Restoration

Restoration costs were estimated for commercial air carriers using the replacement costs previously described in conjunction with analysis of the aircraft accident portion of the Fleets Analyzer database developed by FlightGlobal.<sup>4</sup> The database included all commercial aircraft accidents throughout the world from July 1, 1998 to July 1, 2018. More recent data were not available at the time of this report's publication. Since this section of the report is meant to provide estimates of damage incurred by air carrier aircraft involved in accidents, a number of accidents were excluded from the analysis based on the following criteria:

- Accidents resulting from war, terrorism or other unlawful activity were excluded
- Accidents occurring while aircraft were engaged in types of service other than passenger or all-cargo operation were excluded
  - e.g., aircraft conducting crop dusting, parachuting, or training were excluded
- Accidents occurring while the aircraft was non-operational were excluded
  - e.g., aircraft that suffered weather-related damage while parked were excluded
- Accidents involving military or government operators were excluded

Aircraft that were destroyed were excluded from the analysis because the replacement cost is assumed to equal the current market value of the aircraft. Aircraft that suffered no damage and aircraft without an estimated loss percentage were also excluded from the analysis.

Table 5-4 shows the number of accident aircraft included in the passenger air carrier analysis and the average loss percentage for those aircraft. There were 798 accident aircraft

<sup>4</sup> <https://www.flightglobal.com/products/fleets-analyzer/>

included in the analysis, with an average loss percentage of 20 percent. The weighted average current market value for the U.S. fleet (as calculated in Section 5.2.1) is also shown. The average loss percentage was applied to the U.S. fleet average market value to calculate the average loss value for an accident involving an aircraft in the U.S. fleet. The average loss value for a U.S. passenger air carrier aircraft involved in an accident was \$4.4 million.

**Table 5-4: Restoration Costs – Passenger Air Carrier Aircraft**

	1	2	3	4
Aircraft Category	Number of Accident Aircraft	Average Loss Percentage	Weighted Average Current Market Value (millions) of U.S. Fleet	Average Loss Value (millions) for U.S. Fleet
Widebody 580k lbs or more MTOW	76	12%	\$34.0	\$4.1
Widebody less than 580k lbs MTOW	79	16%	\$55.0	\$8.6
Narrowbody 165k lbs or more MTOW	197	15%	\$28.7	\$4.2
Narrowbody less than 165k lbs MTOW	138	25%	\$10.5	\$2.6
Regional jet 61-99 seats	40	26%	\$12.4	\$3.2
Regional jet less than 61 seats	48	24%	\$1.7	\$0.4
Turboprop more than 60 seats	68	21%	\$9.8	\$2.0
Turboprop 20-60 seats	62	27%	\$6.0	\$1.7
Turboprop under 20 seats	88	28%	NR	NA
Piston engine	2	52%	NR	NA
<b>All Aircraft</b>	<b>798</b>	<b>20%</b>	<b>\$22.7</b>	<b>\$4.4</b>

Source: FlightGlobal Fleets Analyzer and ch-aviation

Col 1: Number of aircraft involved in accidents that met the criteria outlined in section 5.2.2

Col 2: The average loss percentage sustained by the aircraft described in column 1

Col 3: The weighted average current market value of the U.S. fleet, as described in column 2 of Table 5-1

Col 4: Column 2 multiplied by column 3

NR = Not reported; NA = not applicable

Table 5-5 shows the number of accident aircraft included in the all-cargo air carrier analysis and the average loss percentage for those aircraft. There were 128 accident aircraft included in the analysis, with an average loss percentage of 31 percent. The weighted average current market value for the U.S. fleet (as calculated in Section 5.2.1) is also shown. The average loss percentage was applied to the U.S. fleet average market value to calculate the average loss value for an accident involving an aircraft in the U.S. fleet. The average loss value for a U.S. all-cargo air carrier aircraft involved in an accident was \$12.0 million.

**Table 5-5: Restoration Costs – All-Cargo Air Carrier Aircraft**

	1	2	3	4
<b>Aircraft Category</b>	<b>Number of Accident Aircraft</b>	<b>Average Loss Percentage</b>	<b>Weighted Average Current Market Value (millions) of U.S. Fleet</b>	<b>Average Loss Value for U.S. Fleet</b>
Four-engine widebody	33	20%	\$65.8	\$13.4
Three-engine widebody	17	16%	\$3.7	\$0.8
Two-engine widebody	8	29%	\$47.8	\$13.9
Narrowbody more than 160 seats	16	30%	\$13.2	\$3.9
Narrowbody 160 seats and below	6	34%	\$6.4	\$2.2
Turboprop more than 60 seats	5	44%	\$2.4	\$1.1
Turboprop 20-60 seats	14	40%	NR	NA
Turboprop under 20 seats (Part 23)	28	43%	NR	NA
Piston engine (Part 25)	1	70%	NR	NA
<b>All Aircraft</b>	<b>128</b>	<b>31%</b>	<b>\$39.2</b>	<b>\$12.0</b>

Source: FlightGlobal Fleets Analyzer and ch-aviation

Col 1: Number of aircraft involved in accidents that met the criteria outlined in section 5.2.2

Col 2: The average loss percentage sustained by the aircraft described in column 1

Col 3: The weighted average current market value of the U.S. fleet, as described in column 4 of Table 5-1

Col 4: Column 2 multiplied by column 3

NR = not reported; NA = not applicable

## 5.3 GENERAL AVIATION AIRCRAFT

### 5.3.1 Replacement

Replacement values for general aviation (GA) aircraft were based on a methodology similar to that used for commercial air carriers. The primary source of data was the *Aircraft Bluebook (Spring, 2024)*.<sup>5</sup> For aircraft not covered in the *Aircraft Bluebook*, the acquisition cost from the *Aircraft Operating Cost and Performance Guide*<sup>6</sup> were used, where available.

The fleet is drawn from sample records and expansion factors (to match the Aircraft Registration Database) from the FAA's GA and Part 135 Activity Survey. Only the population of *active* aircraft (those flown at least once during the year, based on survey responses) was examined.

There have been significant changes in the composition of the general aviation fleet since the early 1980's which make it desirable to have additional information on aircraft values. There was a major decline in GA aircraft production—primarily smaller piston engine aircraft—after 1982. The fleet age profile for smaller piston aircraft is significantly different than that for larger turbine aircraft. In examining the population of aircraft in the GA Survey, it was possible to make some observations:

- More than two thirds (69%) of the fleet are piston fixed-wing aircraft
- Relatively few models compose large percentages of the fixed-wing piston fleet
- 76% of single-engine fixed-wing piston and 85% of multiengine fixed-wing piston aircraft are more than 40 years old (manufactured before 1983)
- These older fixed-wing piston aircraft tend to have similar values, within their Aircraft Category
- There is wide variation in the values of pre- and post-1983 aircraft

In order to devote more resources to investigating the values of newer, more valuable, and more varied aircraft populations, values were identified for the majority of pre-1983 piston-engine aircraft from the *Aircraft Bluebook*; the weighted mean values were calculated and applied to the entire class. Table 5-6 shows these classes, the mean values, and the percentage of the active fleet that the values are based on.

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<sup>5</sup> *Aircraft Bluebook*: <https://aircraftbluebook.com>

<sup>6</sup> *Aircraft Operating Cost and Performance Guide*: <https://conklindedecker.jetssupport.com>

**Table 5-6: Estimated Market Values of Pre-1983 General Aviation Piston Aircraft (\$2024)**

Aircraft Category	Market Value	Aircraft	Share of Aircraft	Weighted Value
Piston engine airplanes, 1-3 seats	Evaluated	18,403	78%	\$48,531
	Not Evaluated	6,262	22%	
Piston engine airplanes, 4-9 seats one-engine	Evaluated	63,125	83%	\$102,713
	Not Evaluated	12,129	17%	
Piston engine airplanes, 4-9 seats multi-engine	Evaluated	8,360	87%	\$155,767
	Not Evaluated	1,282	13%	

Sources: FAA's *General Aviation and Part 135 Activity Survey CY 2022*, *Aircraft Bluebook* (Spring, 2024).

For aircraft in other Aircraft Categories, and for piston-engine fixed-wing aircraft which were manufactured in 1983 or later, values were calculated as follows:

- Calculate the weighted mean year of manufacture of the registered fleet for each model (1983 and later production only for piston-engine fixed-wing aircraft)
- Identify the value for an aircraft of that year from the *Aircraft Bluebook*. Where no value for a model was available in the *Aircraft Bluebook*, a value from the *Aircraft Operating Cost and Performance Guide* was used, if available
- Apply that value to all examples of that model (examples manufactured in 1983 and later for piston-engine fixed-wing aircraft)

The summary of valuation for the general aviation aircraft groups is shown in Table 5-7. This valuation is provided in terms of an average value per aircraft, a minimum and maximum value per aircraft, and a statistical standard deviation that applies to the average value. Overall, the average GA aircraft has a value of \$1,155,826; the large standard deviations reflect the broad range of values in some aircraft categories.



**Table 5-7: Estimated Market Values of General Aviation Aircraft (\$2024)**

Aircraft Category	1	2	3	4	5	6
	All Years					
	Fleet Total	Average Value Per Aircraft	Minimum Value Per Aircraft	Maximum Value Per Aircraft	Standard Deviation of Average Value	Average Age
Piston engine airplanes, 1-3 seats	34,928	\$62,583	\$48,531	\$360,000	\$48,680	46
Piston engine airplanes, 4-9 seats one-engine	97,065	\$148,540	\$30,000	\$980,000	\$120,317	47
Piston engine airplanes, 4-9 seats multi-engine	11,368	\$208,828	\$130,000	\$1,200,000	\$155,996	45
Piston engine airplanes, 10 or more seats	345	\$227,279	\$125,000	\$1,495,000	\$295,358	53
Turboprop airplanes, 1-9 seats one-engine	5,229	\$1,051,709	\$145,000	\$2,505,677	\$699,143	17
Turboprop airplanes, 1-9 seats multi-engine	693	\$528,560	\$200,000	\$875,000	\$195,055	42
Turboprop airplanes, 10-19 seats	5,448	\$2,316,705	\$210,000	\$6,800,000	\$1,471,853	25
Turboprop airplanes, 20 or more seats	734	\$2,067,825	\$1,100,000	\$8,290,000	\$940,376	36
Turbojet/turbofan airplanes, <= 12,500 lbs	2,762	\$2,667,044	\$75,000	\$14,500,000	\$1,983,562	14
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	10,463	\$7,563,464	\$115,000	\$66,000,000	\$6,436,428	17
Turbojet/turbofan airplanes, > 65,000 lbs	2,956	\$25,940,606	\$425,000	\$78,000,000	\$17,904,630	13
Rotorcraft piston <= 6,000 lbs	2,639	\$316,077	\$50,000	\$460,000	\$157,340	25
Rotorcraft turbine <= 6,000 lbs	4,374	\$1,435,163	\$215,000	\$6,800,000	\$784,342	23
Rotorcraft piston > 6,000 lbs	2	NA	NA	NA	NA	70
Rotorcraft turbine > 6,000 lbs	2,078	\$2,581,709	\$350,000	\$25,700,000	\$2,697,965	28
Other	4,532	NA	NA	NA	NA	26
Experimental	17,921	NA	NA	NA	NA	20
Light Sport	6,002	NA	NA	NA	NA	12
<b>All Aircraft</b>	<b>209,540</b>	<b>\$1,155,826</b>	<b>\$30,000</b>	<b>\$78,000,000</b>	<b>NA</b>	<b>38</b>

Sources: GRA analysis of responses to the FAA's *General Aviation and Part 135 Activity Survey CY2022, Aircraft Bluebook* (Spring, 2024); *Aircraft Operating Cost and Performance Guide*, accessed May 2024.

NA=Not Available

Note: "Rotorcraft piston > 6,000 lbs", Other, Experimental and Light Sport Aircraft Categories are included in calculating fleet total and average age for all aircraft but not in calculating estimated market values.

Note: The primary source of aircraft market values is the Aircraft Bluebook. If no Aircraft Bluebook value was available, acquisition cost from the Aircraft Operating Cost and Performance Guide was used, where available.

Col 1: Total number of aircraft in GA Survey.

Col 2: Average aircraft value weighted by the number of aircraft.

Col 3: The lowest aircraft value reported for each economic values class.

Col 4: The highest aircraft value reported for each economic values class.

Col 5: Square root of  $(n \cdot (x - \text{average price})^2) / (n \cdot (n - 1))$  where n is the number of observations and x is aircraft price.

Col 6: Average aircraft age (weighted) in 2022.

As was noted previously, no data were available in certain aircraft categories. As a result, average values are less relevant for at least some economic evaluations. For example, FAA may be faced with an investment or regulatory decision that disproportionately affects GA piston or

GA turbine operators. In extreme cases, these decisions may affect only one group or the other. Other decisions may affect aircraft of only certain ages, such as a requirement to bring an old design up to a modern standard. The values relevant for use in such a benefit-cost study should reflect the aircraft actually affected. One way to reflect such value differences is to use either pre-1983 or 1983-and-later data depending upon which is most representative. Table 5-8 shows the estimated market values for the 119,792 registered aircraft manufactured before 1983. As can be seen, these aircraft are 55 years old on average and have an average market value of approximately \$118,000.

**Table 5-8: Estimated Market Values of Pre-1983 General Aviation Aircraft (\$2024)**

Aircraft Category	All Years					
	Fleet Total	Average Value Per Aircraft	Minimum Value Per Aircraft	Maximum Value Per Aircraft	Standard Deviation of Average Value	Average Age
Piston engine airplanes, 1-3 seats	24,665	\$48,531	\$48,531	\$48,531	\$0	57
Piston engine airplanes, 4-9 seats one-engine	75,254	\$102,713	\$102,713	\$102,713	\$0	55
Piston engine airplanes, 4-9 seats multi-engine	9,642	\$155,767	\$155,767	\$155,767	\$0	49
Piston engine airplanes, 10 or more seats	276	\$227,279	\$125,000	\$1,495,000	\$295,358	64
Turboprop airplanes, 1-9 seats one-engine	430	\$301,738	\$170,000	\$1,218,000	\$155,928	50
Turboprop airplanes, 1-9 seats multi-engine	587	\$473,984	\$200,000	\$725,000	\$172,891	43
Turboprop airplanes, 10-19 seats	1,273	\$953,544	\$210,000	\$2,000,000	\$483,159	45
Turboprop airplanes, 20 or more seats	266	\$1,894,112	\$1,100,000	\$2,400,000	\$633,843	50
Turbojet/turbofan airplanes, <= 12,500 lbs	244	\$499,110	\$75,000	\$575,000	\$147,364	45
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	681	\$763,426	\$115,000	\$5,100,000	\$555,168	47
Turbojet/turbofan airplanes, > 65,000 lbs	37	\$425,000	\$425,000	\$425,000	\$0	48
Rotorcraft piston <= 6,000 lbs	566	\$89,742	\$50,000	\$179,000	\$24,168	55
Rotorcraft turbine <= 6,000 lbs	1,080	\$409,427	\$215,000	\$1,650,000	\$141,976	47
Rotorcraft piston > 6,000 lbs	2	NA	NA	NA	NA	70
Rotorcraft turbine > 6,000 lbs	699	\$1,750,350	\$350,000	\$2,600,000	\$293,941	51
Other	1,059	NA	NA	NA	NA	50
Experimental	3,030	NA	NA	NA	NA	60
Light Sport	NA	NA	NA	NA	NA	NA
<b>All Aircraft</b>	<b>119,792</b>	<b>\$117,592</b>	<b>\$48,531</b>	<b>\$5,100,000</b>	<b>NA</b>	<b>55</b>

Sources: GRA analysis of responses to the FAA's General Aviation and Part 135 Activity Survey CY2022, Aircraft Bluebook (Spring, 2024); Aircraft Operating Cost and Performance Guide, accessed May 2024.

NA=Not Available

Note: "Rotorcraft piston > 6,000 lbs," Other and Experimental Aircraft Categories are included in calculating fleet total and average age for all aircraft but not in calculating estimated market values. There are no Light Sport aircraft built before 1982 in the GA Survey.

Note: The primary source of aircraft market values is the Aircraft Bluebook. If no Aircraft Bluebook value was available, acquisition cost from the Aircraft Operating Cost and Performance Guide was used, where available.

Col 1: Total number of aircraft in GA Survey.

Col 2: Average aircraft value weighted by the number of aircraft.

Col 3: The lowest aircraft value reported for each Aircraft Category.

Col 4: The highest aircraft value reported for each Aircraft Category.

Col 5: Square root of  $(n*(x-\text{average price})^2)/(n*(n-1))$  where n is the number of observations and x is aircraft price.

Col 6: Average aircraft age (weighted) in 2022

Table 5-9 shows the market values for the 89,747 GA aircraft that were manufactured in 1983 or later. These aircraft have an average age of 16 years and an average market value of \$3.4 million, which reflects both higher average values within each category as well as a higher proportion of turbine engine aircraft in the post-1983 fleet.

**Table 5-9: Estimated Market Values of General Aviation Aircraft Manufactured 1983 and Later (\$2024)**

Aircraft Category	1	2	3	4	5	6
	All Years					
	Fleet Total	Average Value Per Aircraft	Minimum Value Per Aircraft	Maximum Value Per Aircraft	Standard Deviation of Average Value	Average Age
Piston engine airplanes, 1-3 seats	10,262	\$170,500	\$50,000	\$360,000	\$86,057	18
Piston engine airplanes, 4-9 seats one-engine	21,810	\$322,532	\$30,000	\$980,000	\$176,610	19
Piston engine airplanes, 4-9 seats multi-engine	1,726	\$516,238	\$130,000	\$1,200,000	\$233,466	20
Piston engine airplanes, 10 or more seats	69	NA	NA	NA	NA	12
Turboprop airplanes, 1-9 seats one-engine	4,800	\$1,072,073	\$145,000	\$2,505,677	\$696,941	14
Turboprop airplanes, 1-9 seats multi-engine	106	\$740,319	\$365,000	\$875,000	\$115,285	38
Turboprop airplanes, 10-19 seats	4,175	\$2,688,380	\$375,000	\$6,800,000	\$1,431,285	19
Turboprop airplanes, 20 or more seats	467	\$3,188,902	\$2,400,000	\$8,290,000	\$1,596,176	28
Turbojet/turbofan airplanes, <= 12,500 lbs	2,519	\$2,849,000	\$575,000	\$14,500,000	\$1,958,404	12
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	9,782	\$7,862,494	\$185,000	\$66,000,000	\$6,411,941	15
Turbojet/turbofan airplanes, > 65,000 lbs	2,919	\$25,981,808	\$725,000	\$78,000,000	\$17,889,674	12
Rotorcraft piston <= 6,000 lbs	2,073	\$357,417	\$58,000	\$460,000	\$134,556	16
Rotorcraft turbine <= 6,000 lbs	3,294	\$1,610,036	\$315,000	\$6,800,000	\$711,816	15
Rotorcraft piston > 6,000 lbs	NA	NA	NA	NA	NA	NA
Rotorcraft turbine > 6,000 lbs	1,378	\$3,030,311	\$350,000	\$25,700,000	\$3,253,615	16
Other	3,473	NA	NA	NA	NA	19
Experimental	14,891	NA	NA	NA	NA	12
Light Sport	6,002	NA	NA	NA	NA	12
<b>All Aircraft</b>	<b>89,747</b>	<b>\$3,406,722</b>	<b>\$30,000</b>	<b>\$78,000,000</b>	<b>NA</b>	<b>16</b>

Sources: GRA analysis of responses to the FAA's General Aviation and Part 135 Activity Survey CY2022, Aircraft Bluebook (Spring, 2024); Aircraft Operating Cost and Performance Guide, accessed May 2024.

NA=Not Available

Note: "Rotorcraft piston > 6,000 lbs," Other and Experimental Aircraft Categories are included in calculating fleet total and average age for all aircraft but not in calculating estimated market values. There are no Light Sport aircraft built before 1983 in the GA Survey.

Note: The primary source of aircraft market values is the Aircraft Bluebook. If no Aircraft Bluebook value was available, acquisition cost from the Aircraft Operating Cost and Performance Guide was used, where available.

Col 1: Total number of aircraft in GA Survey.

Col 2: Average aircraft value weighted by the number of aircraft.

Col 3: The lowest aircraft value reported for each Aircraft Category.

Col 4: The highest aircraft value reported for each Aircraft Category.

Col 5: Square root of  $(n \times (x - \text{average price})^2) / (n \times (n - 1))$  where n is the number of observations and x is aircraft price.

Col 6: Average aircraft age (weighted) in 2022.

### **5.3.2 Restoration**

Restoration values for general aviation aircraft were estimated using the market values developed in the previous section and estimated restoration costs as a percentage of market value from a previous edition of this report.

In the 2007 Economic Values report, databases from Airclaims and AVEMCO provided average hull value of aircraft, average hull damage and the number of aircraft losses. Average hull value and average hull damage values were weighted by the number of aircraft with data to obtain averages for all aircraft. Average hull damage value was then divided by the average hull value, resulting in “damage/value” percentage for all aircraft as well as for each Economic Values Aircraft Category. For the categories not covered in the AVEMCO or Airclaims databases, the “damage/value” percentage for all aircraft was used.

In this report, the “damage/value” percentages from the 2007 report were applied to 2024 market values from Tables 5-7 through 5-9.<sup>7</sup> Restoration costs by Aircraft Category are shown in Tables 5-10 through 5-12. Table 5-10 shows restoration costs averaged across aircraft of all ages. Damage as a percentage of hull value ranges from 1 percent to 29 percent and is 20 percent overall.

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<sup>7</sup> For this report, no underwriters would provide data on loss percentages.

**Table 5-10: General Aviation Restoration Costs (\$2024)**

	1	2	3
Aircraft Category	Average of Hull Value	Average of Hull Damage	Damage/Value
Piston engine airplanes, 1-3 seats	\$62,583	\$18,140	29%
Piston engine airplanes, 4-9 seats one-engine	\$148,540	\$29,986	20%
Piston engine airplanes, 4-9 seats multi-engine	\$208,828	\$49,983	24%
Piston engine airplanes 10 or more seats	\$227,279	\$23,817	10%
Turboprop airplanes, 1-9 seats one-engine	\$1,051,709	\$214,334	20%
Turboprop airplanes, 1-9 seats multi-engine	\$528,560	\$107,718	20%
Turboprop airplanes, 10-19 seats	\$2,316,705	\$17,008	1%
Turboprop airplanes, 20 or more seats	\$2,067,825	\$421,413	20%
Turbojet/turbofan airplanes, <= 12,500 lbs	\$2,667,044	\$543,531	20%
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	\$7,563,464	\$1,557,274	21%
Turbojet/turbofan airplanes, > 65,000 lbs	\$25,940,606	\$1,584,688	6%
Rotorcraft piston <= 6,000 lbs	\$316,077	\$64,415	20%
Rotorcraft turbine <= 6,000 lbs	\$1,435,163	\$292,480	20%
Rotorcraft piston > 6,000 lbs	NA	NA	NA
Rotorcraft turbine > 6,000 lbs	\$2,581,709	\$526,141	20%
Other	NA	NA	NA
Experimental	NA	NA	NA
Light Sport	NA	NA	NA
<b>All Aircraft</b>	<b>\$1,155,826</b>	<b>\$235,552</b>	<b>20%</b>

\*Average Hull Value=Average Market Value from table 5-7; Average Hull Damage="Damage/Value" for All Aircraft (~20%) multiplied by Average Hull Value; "Damage/Value"="Damage/Value" for All Aircraft.

NA = Not Available

Col 1: Average aircraft hull value for each Aircraft Category.

Col 2: Column 1 times Column 3.

Col 3: Average of restoration cost as a percentage of hull value. Based on claims in databases from Airclaims and AVEMCO.

Table 5-11 shows general aviation restoration values for aircraft that were manufactured before 1983. Average hull damage is about 26 percent of average hull value, and ranges as high as 33 percent.

**Table 5-11: General Aviation Restoration Costs for Pre-1983 Aircraft (\$2024)**

Aircraft Category	1	2	3
	Average of Hull Value	Average of Hull Damage	Damage/Value
Piston engine airplanes, 1-3 seats	\$48,531	\$15,851	33%
Piston engine airplanes, 4-9 seats one-engine	\$102,713	\$21,774	21%
Piston engine airplanes, 4-9 seats multi-engine	\$155,767	\$38,234	25%
Piston engine airplanes 10 or more seats	\$227,279	\$23,817	10%
Turboprop airplanes, 1-9 seats one-engine	\$301,738	\$78,552	26%
Turboprop airplanes, 1-9 seats multi-engine	\$473,984	\$123,393	26%
Turboprop airplanes, 10-19 seats	\$953,544	\$7,000	1%
Turboprop airplanes, 20 or more seats	\$1,894,112	\$493,097	26%
Turbojet/turbofan airplanes, <= 12,500 lbs	\$499,110	\$129,934	26%
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	\$763,426	\$237,519	31%
Turbojet/turbofan airplanes, > 65,000 lbs	\$425,000	\$130,769	31%
Rotorcraft piston <= 6,000 lbs	\$89,742	\$23,363	26%
Rotorcraft turbine <= 6,000 lbs	\$409,427	\$106,587	26%
Rotorcraft piston > 6,000 lbs	NA	NA	NA
Rotorcraft turbine > 6,000 lbs	\$1,750,350	\$455,671	26%
Other	NA	NA	NA
Experimental	NA	NA	NA
Light Sport	NA	NA	NA
<b>All Aircraft</b>	<b>\$117,592</b>	<b>\$30,613</b>	<b>26%</b>

\*Average Hull Value=Average Market Value from table 5-8; Average Hull Damage="Damage/Value" for All Aircraft (~26%) multiplied by Average Hull Value; "Damage/Value"="Damage/Value" for All Aircraft.

NA = Not Available

Col 1: Average aircraft hull value for each Aircraft Category.

Col 2: Column 1 times Column 3.

Col 3: Average of restoration cost as a percentage of hull value. Based on claims in databases from Airclaims and AVEMCO.

Restoration values for the aircraft manufactured in 1983 or later are summarized in Table 5-12. Average hull damage is about 15 percent of average hull value, ranging as high as 20 percent. While the damage value percentages are lower, the absolute values of damages are higher in the post-1983 fleet, which reflects the higher values of the newer aircraft.

**Table 5-12: General Aviation Restoration Costs for 1983 and Later Aircraft (\$2024)**

Aircraft Category	1	2	3
	Average of Hull Value	Average of Hull Damage	Damage/Value
Piston engine airplanes, 1-3 seats	\$170,500	\$34,026	20%
Piston engine airplanes, 4-9 seats one-engine	\$322,532	\$46,324	14%
Piston engine airplanes, 4-9 seats multi-engine	\$516,238	\$90,488	18%
Piston engine airplanes 10 or more seats	NA	NA	NA
Turboprop airplanes, 1-9 seats one-engine	\$1,072,073	\$165,549	15%
Turboprop airplanes, 1-9 seats multi-engine	\$740,319	\$114,320	15%
Turboprop airplanes, 10-19 seats	\$2,688,380	\$415,138	15%
Turboprop airplanes, 20 or more seats	\$3,188,902	\$492,429	15%
Turbojet/turbofan airplanes, <= 12,500 lbs	\$2,849,000	\$439,941	15%
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	\$7,862,494	\$1,240,317	16%
Turbojet/turbofan airplanes, > 65,000 lbs	\$25,981,808	\$640,688	2%
Rotorcraft piston <= 6,000 lbs	\$357,417	\$55,192	15%
Rotorcraft turbine <= 6,000 lbs	\$1,610,036	\$248,621	15%
Rotorcraft piston > 6,000 lbs	NA	NA	NA
Rotorcraft turbine > 6,000 lbs	\$3,030,311	\$467,939	15%
Other	NA	NA	NA
Experimental	NA	NA	NA
Light Sport	NA	NA	NA
<b>All Aircraft</b>	<b>\$3,406,722</b>	<b>\$526,064</b>	<b>15%</b>

Average Hull Value=Average Market Value from table 5-9; Average Hull Damage="Damage/Value" for All Aircraft (~15%) multiplied by Average Hull Value; "Damage/Value"="Damage/Value" for All Aircraft.

NA = Not Available

Col 1: Average aircraft hull value for each Aircraft Category.

Col 2: Column 1 times Column 3.

Col 3: Average of restoration cost as a percentage of hull value. Based on claims in databases from Airclaims and AVEMCO.

## 5.4 UNMANNED AIRCRAFT SYSTEMS

The UAS data was gathered by independent market research firm MarketsandMarkets from a range of high-level sources, including FAA drone registrations; company brochures, websites and reports; software provider datasheets; insurance providers; use case analysis, and a MarketsandMarkets internal database. The models that were analyzed are the top 30 models, which represent 75 percent of the market.

The table below highlights the market value of UAS by weight category. UAS weighing less than 5 pounds have an average selling price of \$3,816. UAS in the 5- to 55-pound range are priced at \$10,429 on average. The heaviest UAS, over 55 pounds, have the highest average selling price at \$14,981.

**Table 5-13: Market Values**

Weight Category (lbs)	Fleet (units)	Average Selling Price (USD)
<5	61,561	\$3,816
5-55	50,795	\$10,429
>55	49,113	\$14,981
<b>All UAS – Weighted Average Cost by Fleet</b>	<b>161,469</b>	<b>9,292</b>

Source: MarketsandMarkets