

SECTION 4: AIRCRAFT OPERATING COSTS

4.1 INTRODUCTION

This section provides estimates of variable and fixed aircraft operating costs. Aircraft variable operating costs are important factors in the evaluation of FAA investment and regulatory programs that concern the time spent in air transportation. The variable operating costs of aircraft affect aircraft operators directly and users of air service indirectly in the form of higher or lower fares. Fixed aircraft costs may also be important in evaluating the effects of FAA investment and regulatory programs that affect fleet size, aircraft productivity, or cause aircraft to be out of service for extended periods of time.

To put airline costs in perspective, this section first shows the relationship of aircraft operating costs to total airline operating costs and then presents another disaggregation of total airline costs. After this, aircraft operating costs are presented in more detail. Costs in this section are shown for air carrier, general aviation, UAS, and military equipment types. Data are presented for aircraft categories identical to those in Section 3, with the exception of UAS, for which data are provided by weight category; utilization data by weight category were not available from the UAS survey that was used as a data source for Section 3.

Cost data are defined for air carrier and general aviation aircraft as variable or fixed. Variable costs change in proportion to aircraft usage, and include fuel and oil, maintenance, and crew costs.¹ Fixed costs show little or no change in proportion to changes in activity. For example, in the short-term, a change in activity may not affect an operator's decision about a specific aircraft or fleet of aircraft. In the longer-term, the operator could change its fleet and ownership costs.

4.1.1 Average Versus Incremental Cost

By necessity, the operating cost data presented in this chapter represent average costs. Cost categories such as ownership costs are reported separately so they can be included or excluded in a specific analysis. However, economists typically look at the concept of incremental costs (i.e., the changes in costs from small changes in levels of activity). Incremental costs may differ from the average costs used in this chapter, but the data from Form 41 / Form 298C and other sources using average costs are well-accepted industry standards. Analysts are cautioned, however, that average costs may not always be the most appropriate measure.

4.1.2 Changes in Airline Industry and Implications for Airline Operating Cost Trends

The U.S. airline industry has undergone considerable change since the previous Economic Values report was published in 2021. The Covid-19 pandemic of 2020-2021 resulted in an unprecedented decline in air travel. The sudden resurgence of air travel in 2021-2022 caused airline employee shortages, which contributed to large increases in airline costs in conjunction

¹ Some analysts assume that crew costs are fixed in the short run; this is especially the case for entities that operate one or a small number of aircraft.

with higher fuel prices that were driven by recovering demand along with supply restrictions due to geopolitical conflict.

U.S. airlines reduced capacity substantially during the pandemic; capacity returned with fewer flights operated by larger aircraft. Because the Form 41 data represent aggregations across the industry, reported costs may not accurately depict actual costs for individual carriers.

4.1.3 Direct and Indirect Costs

Table 4-1 shows direct and indirect operating expenses for Group III air carriers.² Direct costs are about 50 percent of total costs for major passenger air carriers and about 41 percent of total costs for all-cargo air carriers. The direct costs will be examined in more detail later in this chapter. However, this table provides a perspective on overall carrier costs and the relative magnitudes of each category of costs. Industry costs for carriers filing Form 41, Schedule P-7 totaled \$208.4 billion for passenger air carriers and \$57.0 billion for all-cargo air carriers in YE June 2023. Overall, the average total operating cost per block hour for passenger air carriers was \$11,515 and the average total operating cost per block hour for all-cargo air carriers was \$30,779 in YE June 2023.

Table 4-1: YE June 2023 Group III Part 121 Air Carrier Costs – Direct and Indirect Costs

Cost Group	Cost Type	Passenger			All-Cargo		
		Cost (millions)	Share of Cost	Cost per Block Hour	Cost (millions)	Share of Cost	Cost per Block Hour
Direct	Aircraft Operating Expense	\$104,380.2	50%	\$5,766	\$23,648.6	41%	\$12,768
	Subtotal Direct Expenses	\$104,380.2	50%	\$5,766	\$23,648.6	41%	\$12,768
Indirect	Advertising and Promotion Expenses	\$1,904.6	1%	\$105	\$156.0	0%	\$84
	Aircraft Servicing Expenses	\$12,629.5	6%	\$698	\$2,186.5	4%	\$1,180
	Amortization (non-flight equipment)	\$506.4	0%	\$28	\$56.7	0%	\$31
	Depreciation Expense - Maintenance Equipment	\$47.6	0%	\$3	\$249.5	0%	\$135
	General and Administrative Expense	\$21,415.6	10%	\$1,183	\$4,276.6	8%	\$2,309
	Maintenance and Depreciation (ground equipment)	\$3,225.3	2%	\$178	\$870.1	2%	\$470
	Passenger Service Expenses	\$16,229.2	8%	\$897	\$64.9	0%	\$35
	Reservations and Sales Expenses	\$9,330.5	4%	\$515	\$379.8	1%	\$205
	Traffic Servicing Expenses	\$17,163.7	8%	\$948	\$3,014.5	5%	\$1,628
	Subtotal Service, Sales, and General Operating Expenses	\$82,452.6	40%	\$4,555	\$11,254.5	20%	\$6,076
	Transport Related Expenses	\$21,601.3	10%	\$1,193	\$22,105.0	39%	\$11,934
Subtotal Indirect Expenses	\$104,053.8	50%	\$5,748	\$33,359.5	59%	\$18,011	
Total Operating Expenses		\$208,434.0	100%	\$11,515	\$57,008.1	100%	\$30,779

Source: YE June 2023 Form 41, Schedules P-7 and T2 Air Carrier Summary Data

² Group III air carriers are those with annual revenues of more than \$1 billion; direct and indirect costs are categories used Form 41, Schedule P.7.

Table 4-2 shows air carrier costs per block hour by operating expense grouping.³ These data are divided into passenger and all-cargo carriers and then into air carrier groups, as defined by DOT based on total annual operating revenue.⁴ In general, all-cargo carriers have higher total block hour costs than passenger carriers. Fuel is included in the “Materials” expense category.

Table 4-2: YE June 2023 Part 121 Air Carrier Operating and Other Expenses per Block Hour by Expense Category and Carrier Group

Expense Category	Passenger			All-Cargo			Total Carriers
	Group III	Group II	Group I	Group III	Group II	Group I	
Aircraft and Traffic Handling Personnel	\$506	\$223	\$211	\$781	\$240	\$78	\$503
Flight Personnel	\$1,380	\$898	\$1,115	\$1,735	\$1,128	\$979	\$1,369
General Management Personnel	\$37	\$64	\$207	\$278	\$107	\$620	\$62
Maintenance Labor	\$229	\$197	\$260	\$658	\$507	\$215	\$266
Other Personnel	\$542	\$156	\$282	\$665	\$208	\$106	\$517
Total Salaries	\$2,694	\$1,538	\$2,074	\$4,117	\$2,189	\$1,998	\$2,717
Total Fringe Benefits	\$1,024	\$460	\$694	\$1,490	\$889	\$398	\$1,017
Total Salaries and Benefits	\$3,718	\$1,998	\$2,767	\$5,607	\$3,078	\$2,397	\$3,734
Amortization	\$55	\$26	\$30	\$3	\$45	\$0	\$48
Depreciation	\$502	\$187	\$263	\$1,351	\$499	\$520	\$549
Landing Fees	\$225	\$16	\$100	\$315	\$93	\$91	\$215
Materials	\$3,186	\$479	\$2,539	\$6,464	\$3,344	\$2,230	\$3,257
Other	\$269	\$205	\$412	\$1,623	\$717	\$379	\$385
Rentals	\$618	\$280	\$880	\$1,259	\$1,046	\$657	\$654
Services	\$1,748	\$535	\$856	\$2,221	\$1,432	\$617	\$1,687
Transport Related Expenses	\$1,193	\$1	\$167	\$11,934	\$161	\$4	\$1,989
Total Operating Expenses	\$11,515	\$3,728	\$8,015	\$30,779	\$10,416	\$6,896	\$12,517
Total Other Expenses (Income)	\$52	(\$86)	\$174	\$44	\$89	\$66	\$42
Total Expenses	\$11,567	\$3,641	\$8,188	\$30,823	\$10,505	\$6,962	\$12,560

Source: YE June 2023 Form 41, Schedules P-6, P-1.2 and T2 Air Carrier Summary Data

As can be seen, transport-related expenses are a large proportion of total costs for Group III all-cargo carriers. Transport-related expenses are expenses applicable to the generation of transport-related revenues which include revenues generated from flights operated by code-share partners, on-board sales (e.g., food, drink, pillows, blankets, and entertainment), certain air cargo services, and other services (e.g., gift-shop sales, restaurant sales, fuel sales, rental revenues, and maintenance conducted for other carriers).

³ The block hour data in Tables 4-1 and 4-2 are not directly comparable because Table 4-1 contains only Group III carriers, while Table 4-2 contains Group I, II and III carriers.

⁴ Group III carriers have annual revenues of more than \$1 billion; Group II carriers have annual revenues of more than \$100 million; Group I carriers have annual revenues of less than \$100 million.

4.2 AIR CARRIER AIRCRAFT OPERATING COST DATA

Air carrier operating cost data were derived from Bureau of Transportation Statistics (BTS) Form 41 and Form 298C data. The air carrier sub-groupings are based on the reporting requirements of 14 CFR Part 241, which prescribe reporting requirements for large certificated air carriers.⁵

Air carriers with total annual operating revenues of \$100 million or more report aircraft operating costs on Form 41, Schedule P-5.2 and air carriers with total annual operating revenue of less than \$100 million report aircraft operating costs on Form 41, Schedule P-5.1. Small certificated air carriers⁶ report Form 298C data. The air carrier aircraft operating cost data are presented in four groups:

- Part 121 air carrier operations
 - Passenger air carriers
 - All-cargo air carriers
- Part 135 commuter air carrier operations
 - Passenger air carriers
 - All-cargo air carriers

For air carriers filing Schedule P-5.2, variable costs are categorized as fuel and oil, maintenance, and crew. Fixed costs are categorized as depreciation, rentals, insurance, and other. Most of the cost categories are comprised of multiple items from Form 41 Schedule P-5.2. The composition of the cost categories is shown in Table 4-3.

⁵ Large certificated air carriers hold Certificates of Public Convenience and Necessity issued by the U.S. Department of Transportation authorizing the performance of air transportation with annual operating revenues of \$20 million or more.

⁶ Small certificated air carrier means an air carrier holding a certificate issued under section 41102 of 49 U.S.C. Subtitle VII that provides scheduled passenger air service within and between only the 50 States of the United States, the District of Columbia, the Commonwealth of Puerto Rico, and the U.S. Virgin Islands with small aircraft (any aircraft originally designed to have a maximum passenger capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less).

Table 4-3: Air Carriers Filing Form 41, Schedule P-5.2 Aircraft Operating Cost Categories

Variable Costs		Fixed Costs	
Economic Values Cost Category	Form 41, Schedule P-5.2 Cost Item	Economic Values Cost Category	Form 41, Schedule P-5.2 Cost Item
Fuel and Oil	Aircraft Fuel	Depreciation	Depreciation - Airframes
	Aircraft Oil		Depreciation – Aircraft Engines
	Taxes – Other than Payroll*		Depreciation – Aircraft Parts
Maintenance	Labor - Airframes		Depreciation – Aircraft Engine Parts
	Labor – Aircraft Engines		Depreciation – Other Flight Equipment
	Airframe Repairs – Outside	Rentals	Aircraft Interchange Charges
	Aircraft Engine Repairs - Outside		Rentals
	Maintenance Materials – Airframes		Amortization Expense – Capital Leases – Flight Equipment
	Maintenance Materials – Aircraft Engines	Insurance	Insurance Purchased
	Airworthiness Allowance Provision – Airframes		Other
	Airframe Overhauls Deferred (credit)	Other Expenses	
	Airworthiness Allowance Provision – Aircraft Engines	Other Supplies	
	Aircraft Engine Overhauls Deferred (credit)	Professional and Technical Fees and Expenses	
	Applied Maintenance Burden – Flight Equipment		
	Net Obsolescence & Deterioration – Expendable Parts		
Crew	Pilots and Copilots Salaries		
	Other Flight Personnel		
	Trainees and Instructors		
	Personnel Expenses		
	Employee Benefits and Pensions		
	Taxes - Payroll		

* Non-refundable fuel taxes

** Excess of losses over insurance recoveries

Air carriers filing Schedule P-5.1 are not required to report aircraft operating costs in as much detail as air carriers filing Schedule P-5.2. Variable costs are categorized as fuel and oil, maintenance, and crew. The only fixed cost category is depreciation, which includes rentals. The other category includes all other costs associated with flying operations and may contain both variable and fixed costs. Table 4-4 shows the relationship of Schedule P-5.1 cost items to the cost categories used in this report.

Table 4-4: Air Carriers Filing Form 41, Schedule P-5.1 Aircraft Operating Cost Categories

Variable Costs		Fixed Costs	
Economic Values Cost Category	Form 41, Schedule P-5.1 Cost Item	Economic Values Cost Category	Form 41, Schedule P-5.1 Cost Item
Fuel and Oil	Aircraft Fuel	Depreciation	Depreciation and Rental – Flight Equipment
Maintenance	Maintenance – Flight Equipment	Other	Flying Operations - Other
Crew	Pilot and Copilot		

Air carriers filing Form 298C, Schedule F-2 report aircraft operating costs in a similar manner as carriers filing Form 41, Schedule P-5.1. Table 4-5 shows the relationship of Schedule F-2 cost items to the cost categories used in this report.

Table 4-5: Air Carriers Filing Form 298C, Schedule F-2 Aircraft Operating Cost Categories

Variable Costs		Fixed Costs	
Economic Values Cost Category	Form 298C, Schedule F-2 Cost Item	Economic Values Cost Category	Form 298C, Schedule F-2 Cost Item
Fuel and Oil	Fuel and Oil	Depreciation	Depreciation
Maintenance	Maintenance	Other*	Hull Insurance
Crew	Pilot and Copilot		Third Party Liability Insurance
			Passenger Liability Insurance

* The Other categories are reported separately for Alaskan carriers reporting F-2 and are combined for non-Alaskan carriers reporting F-2

Table 4-6 shows aggregate average aircraft operating cost per block hour and activity data for air carriers filing aircraft operating cost on Form 41 or Form 298C in YE June 2023. Part 135 commuter carriers represented a very small proportion of the air carrier industry. Block hours are the common industry measure for presenting operating cost data and are used in this report. Variable costs include all aircraft operating cost elements, except rentals, depreciation and insurance. Table 4-6 provides an industry-wide perspective for passenger and all-cargo operators combined.

Table 4-6: YE June 2023 Summary Air Carrier Average Aircraft Operating Costs and Block Hours

Aircraft Category	1	2	3	4	5	6	7	8	9
	Part 121 Carriers			Part 135 Commuter Carriers			Total		
	Average Variable Costs per Block Hour	Average Total Costs per Block Hour	Total Block Hours	Average Variable Costs per Block Hour	Average Total Costs per Block Hour	Total Block Hours	Average Variable Costs per Block Hour	Average Total Costs per Block Hour	Total Block Hours
Widebody 580k lbs or more MTOW	\$11,758	\$13,100	759,218	NR	NR	0	\$11,758	\$13,100	759,218
Widebody less than 580k lbs MTOW	\$9,170	\$10,195	1,434,234	NR	NR	0	\$9,170	\$10,195	1,434,234
Four-engine widebody	\$12,596	\$15,076	454,151	NR	NR	0	\$12,596	\$15,076	454,151
Three-engine widebody	\$16,594	\$19,490	194,409	NR	NR	0	\$16,594	\$19,490	194,409
Two-engine widebody	\$9,717	\$11,281	969,334	NR	NR	0	\$9,717	\$11,281	969,334
Narrowbody 165k lbs or more MTOW	\$5,093	\$5,770	10,887,559	NR	NR	0	\$5,093	\$5,770	10,887,559
Narrowbody less than 165k lbs MTOW	\$4,670	\$5,260	3,378,459	NR	NR	0	\$4,670	\$5,260	3,378,459
Regional jet 61-99 seats or equivalent	\$3,050	\$3,329	2,617,321	NR	NR	0	\$3,050	\$3,329	2,617,321
Regional jet less than 61 seats or equivalent	\$2,864	\$3,259	702,382	NR	NR	0	\$2,864	\$3,259	702,382
Turboprop more than 60 seats	\$4,140	\$4,928	43,069	NR	NR	0	\$4,140	\$4,928	43,069
Turboprop 20-60 seats or equivalent	\$2,488	\$3,321	35,728	NR	NR	0	\$2,488	\$3,321	35,728
Turboprop under 20 seats or equivalent	\$1,939	\$2,342	28,978	\$1,179	\$1,510	108,125	\$1,340	\$1,686	137,103
Piston	\$980	\$1,496	4,859	\$665	\$828	63,409	\$687	\$875	68,268
Helicopter	NR	NR	0	\$2,161	\$2,750	4,549	\$2,161	\$2,750	4,549
All Aircraft	\$5,672	\$6,422	21,509,701	\$1,019	\$1,296	176,083	\$5,634	\$6,380	21,685,784

Sources: Year Ended June 2023 Form 41 and Form 298C financial data and T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type

NR: Data not reported

Col 1: Average variable cost (weighted by block hours) for Part 121 passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

Col 2: Average total cost (weighted by block hours) for Part 121 passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

Col 3: Total block hours from T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type for Part 121 passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

Col 4: Average variable cost (weighted by block hours) for Part 135 commuter passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

Col 5: Average total cost (weighted by block hours) for Part 135 commuter passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

Col 6: Total block hours from T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type for Part 135 commuter passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

Col 7: Average variable cost (weighted by block hours) for passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

Col 8: Average total cost (weighted by block hours) for passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data'

Col 9: Total block hours from T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type for passenger and all-cargo carriers filing Form 41 or Form 298C aircraft operating expense data

4.2.1 Part 121 Passenger and All-Cargo Air Carriers Cost per Block Hour

Table 4-7 summarizes variable and fixed costs per block hour for Part 121 passenger air carriers. Total operating costs averaged \$5,799 per block hour while variable costs averaged \$5,161 per block hour. Variable costs accounted for an average of 89 percent of total costs.

Narrowbody aircraft of 165k pounds or more MTOW accounted for about 54 percent of total activity, measured in block hours.

Table 4-7: YE June 2023 Part 121 Passenger Air Carriers Direct Operating and Fixed Costs per Block Hour

Aircraft Category	1	2	3	4	5	6	7	8	9	10	11
	Cost per Block Hour										Block Hours
	Fuel & Oil	Maintenance	Crew	Total Variable	Depreciation	Rentals	Insurance	Other	Total Fixed	Total	
Widebody 580k lbs or more MTOW	\$7,248	\$2,041	\$2,469	\$11,758	\$918	\$417	\$5	\$3	\$1,343	\$13,100	759,218
Widebody less than 580k lbs MTOW	\$5,376	\$1,523	\$2,271	\$9,170	\$670	\$327	\$6	\$21	\$1,024	\$10,195	1,434,234
Narrowbody 165k lbs or more MTOW	\$2,663	\$954	\$1,378	\$4,994	\$342	\$297	\$6	\$11	\$656	\$5,650	10,648,682
Narrowbody less than 165k lbs MTOW	\$2,322	\$1,004	\$1,336	\$4,662	\$401	\$160	\$9	\$17	\$587	\$5,248	3,351,386
Regional jet 61-99 seats	\$1,480	\$667	\$904	\$3,050	\$133	\$133	\$1	\$11	\$279	\$3,329	2,617,321
Regional jet less than 61 seats	\$1,102	\$862	\$902	\$2,866	\$87	\$269	\$3	\$33	\$392	\$3,258	697,924
Turboprop more than 60 seats	\$893	\$1,339	\$1,044	\$3,276	\$481	\$53	\$0	\$18	\$552	\$3,828	32,065
Turboprop 20-60 seats	\$700	\$1,033	\$719	\$2,452	\$655	\$0	\$0	\$158	\$814	\$3,266	31,059
Turboprop under 20 seats	\$639	\$866	\$539	\$2,044	\$105	\$0	\$0	\$246	\$351	\$2,395	5,875
Piston	\$346	\$427	\$207	\$980	\$305	\$0	\$0	\$211	\$516	\$1,496	4,859
All Aircraft	\$2,760	\$1,005	\$1,396	\$5,161	\$362	\$256	\$6	\$13	\$638	\$5,799	19,582,623

Sources: Year Ended June 2023 Form 41 and Form 298C financial data and T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type

NR: Reported data are not reliable

Col 1: Fuel and Oil Costs (see Table 4-3) divided by total block hours; estimated (using actual fuel consumption and average fuel price) for carriers with minimal reported fuel and oil costs

Col 2: Maintenance Costs (see Table 4-3) divided by total block hours

Col 3: Crew Costs (see Table 4-3) divided by total block hours

Col 4: Columns 1 + 2 + 3

Col 5: Depreciation Costs (see Table 4-3) divided by total block hours

Col 6: Rental Costs (see Table 4-3) divided by total block hours

Col 7: Insurance Costs (see Table 4-3) divided by total block hours

Col 8: Other Costs (see Table 4-3) divided by total block hours

Col 9: Columns 5 + 6 + 7 + 8

Col 10: Columns 4 + 9

Col 11: Total block hours reported on T2 in Passenger or Combined Passenger and Freight on a Main Deck configuration

Table 4-8 reports operating cost data for Part 121 all-cargo air carriers. Total operating costs averaged \$12,754 per block hour while variable costs averaged \$10,859 per block hour. Variable costs accounted for an average of 85 percent of total costs. Widebody aircraft accounted for nearly 84 percent of activity, measured in block hours.

Table 4-8: YE June 2023 Part 121 All-Cargo Air Carriers Direct Operating and Fixed Costs per Block Hour

Aircraft Category	1	2	3	4	5	6	7	8	9	10	11
	Cost per Block Hour										Block Hours
	Fuel & Oil	Maintenance	Crew	Total Variable	Depreciation	Rentals	Insurance	Other	Total Fixed	Total	
Four-engine widebody	\$8,036	\$2,504	\$2,056	\$12,596	\$746	\$1,475	\$38	\$221	\$2,480	\$15,076	454,151
Three-engine widebody	\$6,825	\$6,573	\$3,196	\$16,594	\$2,017	\$81	\$33	\$765	\$2,896	\$19,490	194,409
Two-engine widebody	\$5,083	\$2,182	\$2,452	\$9,717	\$976	\$240	\$18	\$330	\$1,564	\$11,281	969,334
Narrowbody 165k lbs or more MTOW	\$3,019	\$3,343	\$3,116	\$9,479	\$1,153	\$56	\$35	\$371	\$1,615	\$11,094	238,877
Narrowbody less than 165k lbs MTOW	\$2,645	\$1,781	\$1,276	\$5,702	\$636	\$73	\$80	\$190	\$979	\$6,681	27,073
Regional jet less than 61 seat equivalent	\$1,032	\$344	\$1,228	\$2,604	\$616	\$0	\$42	\$130	\$787	\$3,391	4,458
Turboprop more than 60 seat equivalent	\$1,990	\$2,166	\$2,502	\$6,658	\$1,169	\$0	\$134	\$171	\$1,474	\$8,132	11,004
Turboprop 20-60 seat equivalent	\$877	\$492	\$1,357	\$2,727	\$775	\$0	\$0	\$188	\$963	\$3,690	4,669
Turboprop under 20 seat equivalent	\$636	\$825	\$451	\$1,912	\$184	\$0	\$0	\$233	\$416	\$2,328	23,103
All Aircraft	\$5,574	\$2,815	\$2,470	\$10,859	\$1,034	\$484	\$28	\$349	\$1,895	\$12,754	1,927,078

Sources: Year Ended June 2023 Form 41 and Form 298C financial data and T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type

NR: Reported data are not reliable

Col 1: Fuel and Oil Costs (see Table 4-3) divided by total block hours; estimated (using actual fuel consumption and average fuel price) for carriers with minimal reported fuel and oil costs

Col 2: Maintenance Costs (see Table 4-3) divided by total block hours

Col 3: Crew Costs (see Table 4-3) divided by total block hours

Col 4: Columns 1 + 2 + 3

Col 5: Depreciation Costs (see Table 4-3) divided by total block hours

Col 6: Rental Costs (see Table 4-3) divided by total block hours

Col 7: Insurance Costs (see Table 4-3) divided by total block hours

Col 8: Other Costs (see Table 4-3) divided by total block hours

Col 9: Columns 5 + 6 + 7 + 8

Col 10: Columns 4 + 9

Col 11: Total block hours reported on T2 in Freight configuration

4.2.2 Part 135 Commuter Passenger and All-Cargo Air Carriers Cost Per Block Hour

Table 4-9 presents operating cost per block hour data for Part 135 commuter passenger air carriers. The average total cost per block hour was \$1,265, while the variable cost per block hour was \$995. Turboprop under 20 seat aircraft comprised more than half of the total block hours.

Table 4-9: YE June 2023 Part 135 Commuter Passenger Air Carriers Direct Operating and Fixed Costs per Block Hour

Aircraft Category	Cost per Block Hour										Block Hours
	Fuel & Oil	Maintenance	Crew	Variable Costs	Depreciation	Rentals	Insurance	Other	Total Fixed	Total	
Turboprop under 20 seats	\$353	\$453	\$338	\$1,143	\$240	\$0	\$0	\$86	\$326	\$1,469	102,468
Piston	\$169	\$275	\$223	\$667	\$57	\$0	\$0	\$98	\$155	\$822	62,515
Helicopter	\$412	\$1,036	\$713	\$2,161	\$292	\$0	\$0	\$297	\$589	\$2,750	4,549
Grand Total	\$287	\$403	\$305	\$995	\$174	\$0	\$0	\$96	\$270	\$1,265	169,532

Sources: Year Ended June 2023 Form 41 and Form 298C financial data and T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type

Col 1: Fuel and Oil Costs (see Table 4-3) divided by total block hours

Col 2: Maintenance Costs (see Table 4-3) divided by total block hours

Col 3: Crew Costs (see Table 4-3) divided by total block hours

Col 4: Columns 1 + 2 + 3

Col 5: Depreciation Costs (see Table 4-3) divided by total block hours

Col 6: Rental Costs (see Table 4-3) divided by total block hours

Col 7: Insurance Costs (see Table 4-3) divided by total block hours

Col 8: Other Costs (see Table 4-3) divided by total block hours

Col 9: Columns 5 + 6 + 7 + 8

Col 10: Columns 4 + 9

Col 11: Total block hours reported on T2 in Passenger or Combined Passenger and Freight on a Main Deck configuration

Table 4-10 presents similar data for Part 135 commuter all-cargo air carriers. The average total aircraft cost per block hour was \$2,101, while the average variable cost per block hour was \$1,648. Turboprop under 20 seat equivalent aircraft comprised the majority of the total block hours.

Table 4-10: YE June 2023 Part 135 Commuter All-Cargo Air Carriers Direct Operating and Fixed Costs per Block Hour

Aircraft Category	Cost per Block Hour										Block Hours
	Fuel & Oil	Maintenance	Crew	Variable Costs	Depreciation	Rentals	Insurance	Other	Total Fixed	Total	
Turboprop under 20 seat equivalent	\$495	\$752	\$586	\$1,834	\$298	\$0	\$0	\$111	\$409	\$2,242	5,657
Piston	\$131	\$179	\$162	\$473	\$52	\$0	\$0	\$679	\$732	\$1,204	894
All Aircraft	\$446	\$674	\$528	\$1,648	\$264	\$0	\$0	\$188	\$453	\$2,101	6,551

Sources: Year Ended June 2023 Form 41 and Form 298C financial data and T2 U.S. Air Carrier Traffic and Capacity Statistics by Aircraft Type

Col 1: Fuel and Oil Costs (see Table 4-3) divided by total block hours

Col 2: Maintenance Costs (see Table 4-3) divided by total block hours

Col 3: Crew Costs (see Table 4-3) divided by total block hours

Col 4: Columns 1 + 2 + 3

Col 5: Depreciation Costs (see Table 4-3) divided by total block hours

Col 6: Rental Costs (see Table 4-3) divided by total block hours

Col 7: Insurance Costs (see Table 4-3) divided by total block hours

Col 8: Other Costs (see Table 4-3) divided by total block hours

Col 9: Columns 5 + 6 + 7 + 8

Col 10: Columns 4 + 9

Col 11: Total block hours reported on T2 in Freight configuration

4.3 GENERAL AVIATION OPERATING COSTS

4.3.1 Data Sources for Operating Costs

The source for the variable and fixed operating costs for general aviation aircraft was the *Aircraft Operating Cost and Performance Guide*, published by Conklin & de Decker.⁷ Costs assume an operator of one or two aircraft of a given model, and do not reflect lower prices which may be available through bulk purchases. The following variable cost categories were obtained from the *Aircraft Operating Cost and Performance Guide* for use in this study:

- Fuel & Oil⁸
 - Fuel (assuming fuel price of \$6.53 per gallon for avgas and \$6.28 for turbine fuel (Jet A)—costs based on a Conklin & de Decker survey of FBOs (Fixed Base Operators) at major general aviation airports in the United States)
 - Lubricants
- Maintenance
 - Maintenance Labor
 - Parts Airframe/Engine/Avionics
 - APU Allowance
 - Major Periodic Maintenance
- Reserves
 - Engine Reserves
 - Landing/Parking
 - ATC Navigation
 - Crew Expenses
 - Supplies/Catering
- Crew Salaries⁹ (based on the *NBAA Salary Survey* and other sources)
 - Captain
 - Co-pilot
 - Benefits

Maintenance labor costs represent the average cost of routine, scheduled, and unscheduled maintenance labor. Labor hours are based on data from operator experience, manufacturer data and surveys. Crew salaries are derived for each aircraft type from a recognized pilot salary survey, and benefits are typically an additional 30 percent of wages. Salaries are counted for the entire crew, which depending on the aircraft type can consist of a captain, copilot and cabin crew. Crew salaries and benefits are divided by Conklin & de Decker’s estimated annual flight hours for that

⁷ *Aircraft Operating Cost and Performance Guide*, accessed May 2024. <https://conklindedecker.jetsupport.com/>

⁸ Aviation fuel prices have shown unusual volatility during the past few years. Users may wish to adjust the Fuel & Oil cost element to match prices observed at another time. For example, if a user wanted to base operating costs on avgas at \$6 per gallon, he could multiply the Fuel & Oil cost element for a piston Economic Values Category by $(\$6 / \$6.53) = 0.919$.

⁹ Conklin & de Decker classify crew costs as fixed in *Aircraft Operating Cost and Performance Guide*. As noted earlier in this section, whether crew costs are best considered fixed or variable depends on the nature of the operation and the employment arrangements. GRA converted annual salary and benefit costs to an hourly rate by dividing them by C & D’s utilization rate (annual hours flown), on a per-model basis.

model in order to obtain hourly crew costs. The *Aircraft Operating Cost and Performance Guide* also provided the following fixed costs:

- Hangar Rental
- Insurance
 - Hull
 - Single Limit Liability
- Miscellaneous Overhead
 - Recurrent Training
 - Aircraft Modernization
 - Navigation Chart Services
 - Refurbishing
 - Computerized Maintenance Management Program
 - Weather Service
 - Other Fixed Cost

The *Aircraft Operating Cost and Performance Guide* provides different cost categories based on the type of operation for which an aircraft is used. It was assumed that piston, turboprop and jet aircraft (categories 1-11) are used in corporate operations, and rotorcraft (categories 12-15) are used in utility operations.

These costs are based on aircraft being operated by a professional flight crew. However, smaller aircraft are often operated by their owners. Therefore, all piston engine and turboprop airplanes for which air taxi hours are a small percentage of total hours flown (i.e., all piston and turboprop airplanes with fewer than 10 seats—see Table 3-19) use an hourly crew cost equal to the value of Intercity Business air travel time, or \$80.20 per hour.¹⁰ Air taxi hours are also a small percentage of total hours flown for piston rotorcraft. Therefore, it was assumed that the crew cost per hour equals the value of time (\$80.20 per hour).

4.3.2 Depreciation

In order to reflect general aviation aircraft ownership costs, estimates based on replacement costs were developed for this report. Depreciation is a significant component of the fixed costs for general aviation aircraft. In this report we use Conklin & de Decker's market-based depreciation values, which assume that aircraft lose a fixed percentage of their original purchase price each year, with no residual value. The percentage used varies by aircraft type, as follows:

- Jets: 5.5%
- Rotorcraft: 4%
- Turboprops 4.5%
- Pistons 4%

Table 4-11 summarizes general aviation aircraft operating cost per flight hour by each of the economic values categories. While the average total cost per hour is about \$2,500, it ranges

¹⁰ DOT, Office of The Secretary, *Benefit-Cost Analysis Guidance for Discretionary Grant Programs* (December 2023).

from about \$600 per hour to about \$11,600 per hour, depending on the size, complexity and age of the aircraft within each group. Average variable costs per hour including flight crews are \$1,614, while they are \$1,263 per hour if crew costs are not counted.

Operating cost and utilization hours shown in Table 4-11 are obtained from the *Aircraft Operating Cost and Performance Guide*. This source is oriented towards providing values for aircraft models likely to be operated commercially, and values assume an aircraft operated for commercial purposes. For piston and turboprop airplanes with fewer than 10 seats, and piston rotorcraft, overall fleet annual flight hours are significantly lower because of the population of aircraft which are owned and operated for personal use. Personal-use aircraft tend to see much lower utilization rates than commercial aircraft. For example, single-engine piston airplanes with 4+ seats averaged 114 annual flight hours according to the 2022 GA Survey, vs. the 348 annual flight hours shown in the table below.¹¹

¹¹ General Aviation and Part 135 Activity Survey, CY 2022, Table 2.1.

**Table 4-11: GA and Air Taxi Operating and Fixed Costs
(Weighted by Annual Hours)**

	1	2	3	4	5	6	7	8	9	10
Aircraft Category	Crew	Fuel & Oil	Maintenance & Reserves	Variable Operating Costs (Including Crew)	Variable Operating Costs (Excluding Crew)	Annual Fixed Cost Other (Without Depreciation)	Annual Depreciation	Fixed Cost Per Hour	Total Cost Per Hour (Including Crew)	Average Annual Hours
Piston engine airplanes, 1-3 seats	\$80	\$85	\$96	\$261	\$181	\$28,844	\$2,743	\$340	\$601	368
Piston engine airplanes, 4-9 seats one-engine	\$80	\$92	\$101	\$273	\$193	\$32,414	\$3,563	\$381	\$655	348
Piston engine airplanes, 4-9 seats multi-engine	\$80	\$232	\$228	\$540	\$460	\$44,909	\$5,565	\$545	\$1,085	263
Piston engine airplanes, 10 or more seats	\$292	\$359	\$547	\$1,197	\$905	\$95,021	\$6,779	\$502	\$1,699	482
Turboprop airplanes, 1-9 seats one-engine	\$80	\$166	\$258	\$504	\$424	\$52,792	\$8,003	\$466	\$971	333
Turboprop airplanes, 1-9 seats multi-engine	\$80	\$591	\$1,342	\$2,013	\$1,933	\$136,224	\$7,592	\$796	\$2,809	480
Turboprop airplanes, 10-19 seats	\$403	\$560	\$833	\$1,796	\$1,392	\$152,706	\$34,416	\$713	\$2,509	518
Turboprop airplanes, 20 or more seats	\$636	\$693	\$1,136	\$2,465	\$1,829	\$220,781	\$72,543	\$984	\$3,449	661
Turbojet/turbofan airplanes, <= 12,500 lbs	\$551	\$767	\$1,006	\$2,324	\$1,773	\$152,506	\$29,731	\$840	\$3,164	540
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	\$1,038	\$1,691	\$2,338	\$5,066	\$4,028	\$326,815	\$122,490	\$2,000	\$7,066	424
Turbojet/turbofan airplanes, > 65,000 lbs	\$1,290	\$3,275	\$3,787	\$8,352	\$7,061	\$623,528	\$206,898	\$3,267	\$11,619	417
Rotorcraft piston <= 6,000 lbs	\$80	\$96	\$186	\$362	\$282	\$63,507	\$4,832	\$371	\$733	483
Rotorcraft turbine <= 6,000 lbs	\$635	\$299	\$545	\$1,480	\$845	\$217,676	\$22,925	\$1,200	\$2,680	389
Rotorcraft piston > 6,000 lbs	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Rotorcraft turbine > 6,000 lbs	\$706	\$526	\$1,156	\$2,388	\$1,682	\$263,517	\$32,822	\$1,337	\$3,725	432
Other	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Experimental	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Light Sport	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
All Aircraft— Weighted Averages	\$351	\$539	\$723	\$1,614	\$1,263	\$129,518	\$34,551	\$849	\$2,463	385

Sources: GRA analysis of responses to the FAA's General Aviation and Part 135 Activity Survey CY2022, Conklin & de Decker's Aircraft Operating Cost and Performance Guide, accessed May 2024.

NR = Not Reported

Col 1: Crew: for piston and turboprop airplanes with fewer than 10 seats, and piston rotorcraft, crew cost = value of time = \$80.20; for other categories, crew cost includes salaries and benefits, divided by annual utilization hours, as reported by Conklin and deDecker

Col 2: Fuel, oil and additives used per hour, with fuel at \$6.53 per gallon for pistons and \$6.28 per gallon for all other economic values groups

Col 3: Total Maintenance cost, including labor, parts, engine allowances, propeller/thrust reverser overhaul, and APU overhaul if applicable

Col 4: Columns 1 + 2 + 3

Col 5: Columns 2 + 3

Col 6: Annual fixed cost including hangar cost, insurance cost, training cost, services typically used by air taxi and commercial operators (e.g., Weather service, maintenance programs, etc.)

Col 7: Average annual aircraft depreciation using Conklin and de Decker Market depreciation rates

Col 8: Fixed Cost per hour, assuming hours of utilization reported in Column 10 = (Column 6 + Column 7)/Column 10

Col 9: Total Cost per Hour: Column 4 + Column 8

Col 10: Average (weighted) annual hours of utilization for each Category. Based on Conklin & DeDecker estimates

Table 4-12 shows variable and total aircraft operating costs for aircraft under the various parts of the operating regulations. Among Economic Values Categories, Part 125 aircraft have the highest total cost per hour (\$9,567) because they are much larger than the aircraft in other groups. Part 91 costs per hour (\$1,660) are about one third of the costs per flight hour (\$5,270) for Part 135 aircraft operations.

Calculation of costs by operating rule part

- For each aircraft, multiply its operating cost elements (Columns 1, 2, 3 and 8) in Table 4-11) by the number of hours it operated under uses corresponding to each of the operating rule parts.
- Sum these products by Economic Values Category, producing a single value for each cost element, for each operating rule part.
- Divide these sums by the total hours flown by aircraft in that Economic Values Category under that operating rule part.

That is, for each operating rule part, the mean of a cost element is calculated reflecting only the hours flown under that rule part, not all hours flown by all aircraft. If flights under an operating rule part are conducted disproportionately by aircraft with higher operating costs within an Economic Values Category, the costs under that rule part in Table 4-12 will be higher than the overall costs for that Category shown in Table 4-11.

**Table 4-12: GA Operating and Fixed Costs by Operating Rule Part
(Weighted by Part Hours)**

Aircraft Category	1 2		1 2		1 2		1 2		1 2	
	PART 91		PART 125		PART 133		PART 135		PART 137	
	Variable Operating Costs (Including Crew)	Total Cost Per Hour (Including Crew)	Variable Operating Costs (Including Crew)	Total Cost Per Hour (Including Crew)	Variable Operating Costs (Including Crew)	Total Cost Per Hour (Including Crew)	Variable Operating Costs (Including Crew)	Total Cost Per Hour (Including Crew)	Variable Operating Costs (Including Crew)	Total Cost Per Hour (Including Crew)
Piston engine airplanes, 1-3 seats	\$261	\$601	NR	NR	NR	NR	\$264	\$609	NR	NR
Piston engine airplanes, 4-9 seats one-engine	\$272	\$653	NR	NR	NR	NR	\$373	\$765	\$543	\$986
Piston engine airplanes, 4-9 seats multi-engine	\$530	\$1,068	NR	NR	NR	NR	\$641	\$1,266	\$980	\$1,577
Piston engine airplanes, 10 or more seats	\$1,262	\$1,684	NR	NR	NR	NR	\$1,195	\$1,700	\$1,100	\$1,694
Turboprop airplanes, 1-9 seats one-engine	\$502	\$969	NR	NR	NR	NR	\$601	\$1,064	\$828	\$1,283
Turboprop airplanes, 1-9 seats multi-engine	\$1,956	\$2,747	NR	NR	NR	NR	\$2,531	\$3,326	\$3,453	\$4,494
Turboprop airplanes, 10-19 seats	\$1,900	\$2,695	NR	NR	NR	NR	\$1,697	\$2,335	\$1,914	\$2,677
Turboprop airplanes, 20 or more seats	\$4,514	\$6,065	\$2,142	\$3,019	NR	NR	\$3,543	\$4,928	NR	NR
Turbojet/turbofan airplanes, <= 12,500 lbs	\$2,293	\$3,128	NR	NR	NR	NR	\$2,601	\$3,489	\$2,718	\$3,831
Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs	\$4,879	\$6,792	\$6,524	\$9,233	NR	NR	\$5,086	\$7,091	\$4,107	\$5,522
Turbojet/turbofan airplanes, > 65,000 lbs	\$8,348	\$12,025	\$8,415	\$11,642	NR	NR	\$8,304	\$11,480	\$8,787	\$11,960
Rotorcraft piston <= 6,000 lbs	\$359	\$727	NR	NR	\$396	\$798	\$389	\$784	\$556	\$947
Rotorcraft turbine <= 6,000 lbs	\$1,396	\$2,544	NR	NR	\$1,415	\$2,578	\$1,544	\$2,790	\$1,391	\$2,488
Rotorcraft piston > 6,000 lbs	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Rotorcraft turbine > 6,000 lbs	\$2,294	\$3,586	NR	NR	\$3,176	\$4,673	\$2,444	\$4,014	\$2,081	\$3,115
Other	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Experimental	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Light Sport	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
All Aircraft—Weighted Average Cost per Hour	\$1,020	\$1,660	\$6,842	\$9,567	\$2,119	\$3,412	\$3,686	\$5,270	\$1,160	\$1,789

Sources: GRA analysis of responses to FAA's *General Aviation and Part 135 Activity Survey CY2022*, Conklin & de Decker's *Aircraft Operating Cost and Performance Guide (Spring, 2024)*

NR = Not Reported

Col 1: Variable operating costs include crew, fuel and oil, and maintenance costs

Col 2: Total costs per hour include variable costs (Col 1) and fixed costs

4.3.3 Fractional Ownership Operating Costs

Fractional ownership of aircraft is an arrangement in which a management company sells “shares” of an aircraft to two or more unrelated owners. Shares are generally in sizes from one-half (representing 400 flight hours per year) to one-sixteenth (representing 50 flight hours per year). The management company maintains, insures and operates the aircraft on behalf of the fractional owners. The fractional owner incurs an upfront purchase cost, a monthly maintenance fee and a fee per hour flown.

Previous editions of this report included a table listing these fees by Aircraft Category for the categories commonly operated in fractional ownership: Turboprop airplanes, 10-19 seats, Turbojet/turbofan airplanes, > 12,500 lbs and <= 65,000 lbs, Turbojet/turbofan airplanes, > 65,000 lbs and Rotorcraft turbine > 6,000 lbs. However, the sources used for this data are no longer available and no substitute sources were found. As a result, fractional ownership costs are no longer presented.

4.4 UNMANNED AIRCRAFT SYSTEMS OPERATING COSTS

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.

Table 4-13 provides an overview of the average UAS pilot salary and pilot training and certification costs by weight category. For UAS weighing less than 5 pounds, the fleet consists of 61,561 units. Pilots operating these UAS earn an average salary of \$47 per hour, and pilot training and certification costs are \$1,155. In the 5- to 55-pound category, which represents the largest fleet with 50,795 units, pilots earn the most at \$94 per hour, and the training and certification costs rise to \$1,659. For UAS weighing over 55 pounds, the fleet size is 49,113 units, with pilots earning an average salary of \$75 per hour, with the highest certification cost of \$2,047.

Table 4-13: Crew Costs

Weight Category (Lbs)	Fleet (Units)	Average UAS Pilot Salary Per Hour	Initial Pilot Training & Certification Cost
<5	61,561	\$47	\$1,155
5-55	50,795	\$94	\$1,659
>55	49,113	\$75	\$2,047
All UAS—Weighted Average Cost by Fleet	161,469	\$71	\$1,585

Source: Markets and Markets

Table 4-14 outlines annual operational costs for UAS across different weight categories, including spare parts, repairs, routine maintenance, battery charging, insurance, and software. UAS weighing less than 5 pounds have the lowest overall operating costs. In contrast, UAS in the 5- to 55-pound range experience a significant increase in costs, with insurance, spare parts, and software costs standing out as the most expensive components. For UAS over 55 pounds, operating costs are the highest, driven by higher expenses for spare parts, repairs, insurance, and software.

Table 4-14: Annual Operating Costs

Weight Category (Lbs)	Fleet (Units)	Software Cost	Maintenance Cost			Battery Charge Cost	Insurance Cost	Annual Operating Cost
			Spare Parts	Repair	Routine			
<5	61,561	\$ 731	\$191	\$76	\$38	\$1	\$382	\$1,419
5-55	50,795	\$1,283	\$521	\$209	\$104	\$3	\$1,043	\$3,160
>55	49,113	\$2,069	\$748	\$299	\$140	\$16	\$1,497	\$4,614
All UAS—Weighted Average Cost by Fleet	161,469	\$1,312	\$464	\$186	\$90	\$6	\$929	\$2,938

Source: Markets and Markets

4.5 MILITARY OPERATING COSTS

Data on military aircraft operating costs were sourced from public websites, including the Department of Defense (DOD) for FY2023 reimbursement rates, and from the Government Accountability Office (GAO), U.S. Air Force Safety Center, and Congressional Budget Office (CBO) for utilization data. In general, the values were applied on an aircraft type-by-aircraft type basis where there were cost observations from at least one military air service. In the table below, the average weighted total is based on the hourly weighted operating costs of each aircraft type.

Table 4-15: Estimated Military Operating Costs Per Hour

	1	2	3	4	5	6
Aircraft Category	Crew	Operations and Maintenance	Asset Utilization	Total Operating Costs (Excluding Crew)	Total Operating Costs (Including Crew)	Total Costs Per Hour (Including Crew)
Turbojet/fan 3+ Engine	\$438	\$22,007	\$897	\$22,007	\$22,444	\$23,342
Turbojet/fan Attach/Fighter	\$127	\$20,037	\$807	\$20,037	\$20,163	\$20,970
Turbojet/fan Other	\$156	\$6,990	\$286	\$6,990	\$7,146	\$7,432
Turboprop	\$284	\$5,641	\$237	\$5,641	\$5,926	\$6,163
Piston	\$105	\$42	\$6	\$42	\$147	\$153
Rotary Wing Aircraft	\$267	\$8,925	\$368	\$8,925	\$9,192	\$9,560
UAV	\$159	\$816	\$39	\$816	\$975	\$1,014
Glider	N/A	N/A	N/A	N/A	N/A	N/A
All Aircraft – Weighted Average Cost per Hour	\$231	\$11,347	\$463	\$11,347	\$11,578	\$12,041

This table includes aircraft data for which there were utilization data from the GAO report or other sources (such as the U.S. Air Force Safety Center or CBO report) and DOD reimbursement rate data.

Sources: Department of Defense (DoD), FY2023 Fixed Wing and Helicopter Reimbursement Rates.

Operating costs were weighted by 2023 Estimated Flight Hours, which were derived as described in chapter 3.

When FlightGlobal 2023 reports aircraft numbers without separating by variant, and the DOD data provides separate cost data for these variants, values from the GAO report FY2020 or FlightGlobal 2021 were used to estimate the composition of variants.

This table includes only those aircraft for which DOD operating cost data is available.

Col 1: Crew cost, average weighted by estimated 2023 fleet and estimated flight hours (by aircraft category).

Col 2: Operation and Maintenance costs (O&M), average weighted by estimated 2023 fleet and estimated flight hours (by aircraft category)

Col 3: Asset Utilization, average weighted by estimated 2023 fleet and estimated flight hours (by aircraft category)

Col 4: Same as Col. 2

Col 5: Columns 1 + 2

Col 6: Columns 1 + 2 + 3

The cost data were taken from data on aircraft reimbursement rates for various types of aircraft. Reimbursement rates are reported for four categories of users: DOD, Federal Agency, Foreign Military Sales (FMS) Users, and All Other Users. This report uses the ‘All Other’ category because it is the most complete cost metric. The aircraft operating costs include crews and reflect the varying sizes of crews for a specific aircraft. For example, most military rotary wing aircraft operate with a pilot, co-pilot and one or two other crew members. Some of the larger turbojet aircraft with three or more engines conduct electronic surveillance operations and have large

onboard crews. The crew costs reported in Table 4-15 reflect this. In addition to crew cost, the reimbursement costs include operations and maintenance costs and an asset utilization factor.¹²

DOD does not include an element of ownership costs in the reimbursement rates. Asset valuation for DOD aircraft is extremely complex because the assets are long lived and have had many major upgrades over the useful life. For example, the Boeing B-52 has been in operation by the military service since 1954, approximately 70 years. It has had upgrades to its engines, avionics, weapons systems and offensive and defensive electronic systems.

¹² The asset utilization factor is 4 percent times the sum of costs for: fuel, depot level repairables, depot maintenance, other and crew salary for each specific aircraft.

4.6 APPENDIX

As described in Section 3.1.3, aircraft were placed into groups likely to be relevant to conducting regulatory analyses. The air carrier sub-groupings for passenger and all-cargo are defined by aircraft operator. The average number of seats per aircraft in YE June 2023 (calculated using data reported to BTS by carriers) was used to assign air carrier aircraft to aircraft categories used in this report.

Table 4-16 shows the aircraft types assigned to the narrowbody and widebody aircraft categories. The BTS code (a unique code for each aircraft type) is shown to facilitate reproduction of tables in this report. As discussed in Section 3.2, the widebody aircraft categories are different for aircraft used in passenger versus all-cargo operations.

Table 4-16: Widebody and Narrowbody Aircraft Types by Aircraft Category

BTS Code	Aircraft Type	YE June 2023 Average Seats	Passenger Aircraft Category	All-Cargo Aircraft Category
614	737-800	170	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
622	757-200	182	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
623	757-300	234	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
634	737-900	178	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
694	A320	164	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
699	A321	187	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
715	727-200	134	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
721	A321neo	193	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
722	A320neo	184	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
838	737 MAX 8	172	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
839	737 MAX 9	179	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
888	737-900ER	179	Narrowbody 165k lbs or more MTOW	Narrowbody 165k lbs or more MTOW
608	717-200	112	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
612	737-700	141	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
616	737-500	99	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
617	737-400	154	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
619	737-300	149	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
620	737-100	60	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
635	DC-9-15F	43	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
640	DC-9-30	67	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
655	MD-80	155	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
678	E190	100	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
698	A319	132	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
723	A220-100	109	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
724	A-220-300	134	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW
748	E195	120	Narrowbody less than 165k lbs MTOW	Narrowbody less than 165k lbs MTOW

BTS Code	Aircraft Type	YE June 2023 Average Seats	Passenger Aircraft Category	All-Cargo Aircraft Category
819	747-400	411	Widebody 580k lbs or more MTOW	Four-engine widebody
820	747-4F	312	Widebody 580k lbs or more MTOW	Four-engine widebody
821	747-8	365	Widebody 580k lbs or more MTOW	Four-engine widebody
740	MD-11	301	Widebody 580k lbs or more MTOW	Three-engine widebody
359	A350-900	309	Widebody 580k lbs or more MTOW	Two-engine widebody
627	777-200	287	Widebody 580k lbs or more MTOW	Two-engine widebody
637	777-300	327	Widebody 580k lbs or more MTOW	Two-engine widebody
683	777-F	294	Widebody 580k lbs or more MTOW	Two-engine widebody
732	DC-10-30	341	Widebody less than 580k lbs MTOW	Three-engine widebody
339	A330-900	280	Widebody less than 580k lbs MTOW	Two-engine widebody
624	767-400	235	Widebody less than 580k lbs MTOW	Two-engine widebody
625	767-200	214	Widebody less than 580k lbs MTOW	Two-engine widebody
626	767-300	204	Widebody less than 580k lbs MTOW	Two-engine widebody
687	A330-300	283	Widebody less than 580k lbs MTOW	Two-engine widebody
691	A300-600	267	Widebody less than 580k lbs MTOW	Two-engine widebody
695	A300	9	Widebody less than 580k lbs MTOW	Two-engine widebody
696	A330-200	260	Widebody less than 580k lbs MTOW	Two-engine widebody
837	787-10	318	Widebody less than 580k lbs MTOW	Two-engine widebody
887	787-8	236	Widebody less than 580k lbs MTOW	Two-engine widebody
889	787-9	266	Widebody less than 580k lbs MTOW	Two-engine widebody

Table 4-17 shows the aircraft types assigned to the remaining air carrier aircraft categories. The BTS code (a unique code for each aircraft type) is shown to facilitate reproduction of tables in this report. As discussed in Section 3.2, these aircraft categories are the same for both passenger and all-cargo operations.

Table 4-17: Regional Jet, Turboprop, Piston, and Helicopter Aircraft Types by Aircraft Category

BTS Code	Aircraft Type	YE June 2023 Average Seats	Passenger Aircraft Category	All-Cargo Aircraft Category
317	HU-1H	9	Helicopter	Helicopter
325	A-119	7	Helicopter	Helicopter
340	AS360	6	Helicopter	Helicopter
345	BELL 212	9	Helicopter	Helicopter
355	HUGES-500/530	3	Helicopter	Helicopter
360	R44	3	Helicopter	Helicopter
362	BHT 206 L3	6	Helicopter	Helicopter
364	BHT 206 L4	6	Helicopter	Helicopter
366	BHT 407	6	Helicopter	Helicopter
368	BHT 412	10	Helicopter	Helicopter
370	BO-105	4	Helicopter	Helicopter
390	S-76	6	Helicopter	Helicopter
393	A139	9	Helicopter	Helicopter

BTS Code	Aircraft Type	YE June 2023 Average Seats	Passenger Aircraft Category	All-Cargo Aircraft Category
102	P2012 Traveler	8	Piston	Piston
110	Beech 18	9	Piston	Piston
125	Cessna C-402	9	Piston	Piston
131	BN2/A	9	Piston	Piston
194	PA-31	8	Piston	Piston
026	Gipps Aero GA8 AIR	6	Piston	Piston
030	Cessna 180	3	Piston	Piston
033	Cessna 185	3	Piston	Piston
034	H250	3	Piston	Piston
035	Cessna 206	5	Piston	Piston
036	Cessna 172	3	Piston	Piston
040	DHC2	6	Piston	Piston
042	CHC3	0	Piston	Piston
079	PA-32	5	Piston	Piston
091	FLT/AMPHIB Turbine	6	Piston	Piston
094	LAND-Turbine	6	Piston	Piston

BTS Code	Aircraft Type	YE June 2023 Average Seats	Passenger Aircraft Category	All-Cargo Aircraft Category
515	Challenger 350	9	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
530	CRJ550	50	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
575	LEARJET	9	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
609	Challenger 300	9	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
629	CRJ200	50	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
632	Dornier 328 Jet	31	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
636	Cessna Citation	8	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
639	Citation Jet/CJ	7	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
641	G-IV	13	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
642	Hawker 400XP	7	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
646	Cessna Citation III	8	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
647	Cessna Citation X	8	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
648	G200	9	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
653	Cessna CE-680	8	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
658	BD-700	12	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
665	HS-125	8	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
667	G-V	15	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
669	Challenger 604/605	17	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
671	G450	13	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
674	E135	30	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
675	E145	50	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
681	Falcon	9	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
685	Cessna 510	8	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
688	Global 5000	13	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
750	G650	13	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
751	Global	10	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
770	Falcon 900	14	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
771	Falcon 50	9	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
774	DA 2000	10	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
775	Dassault Falcon 7X	16	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
778	Global 6000	15	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent
833	Legacy 650	13	Regional jet less than 61 seats	Regional jet less than 61 seat equivalent

BTS Code	Aircraft Type	YE June 2023 Average Seats	Passenger Aircraft Category	All-Cargo Aircraft Category
150	Curtiss C46 Series	39	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
395	DHC-6-400	21	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
430	Convair CV-580	45	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
441	ATR-42	46	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
449	Dornier 328	30	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
456	Saab 340/B	31	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
459	Saab 340/A	34	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
483	DHC8-100	32	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
484	DHC8-300	50	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
489	Shorts 360	30	Turboprop 20-60 seats	Turboprop 20-60 seat equivalent
218	DC-6A	76	Turboprop more than 60 seats	Turboprop more than 60 seat equivalent
442	ATR-72	70	Turboprop more than 60 seats	Turboprop more than 60 seat equivalent
482	DHC8-Q400	76	Turboprop more than 60 seats	Turboprop more than 60 seat equivalent
556	L100-30	171	Turboprop more than 60 seats	Turboprop more than 60 seat equivalent
201	BN2A	8	Turboprop under 20 seats	Turboprop under 20 seat equivalent
405	Beech 1900	14	Turboprop under 20 seats	Turboprop under 20 seat equivalent
406	KINGAIR	9	Turboprop under 20 seats	Turboprop under 20 seat equivalent
412	CASA 212	2	Turboprop under 20 seats	Turboprop under 20 seat equivalent
415	Cessna C208B	9	Turboprop under 20 seats	Turboprop under 20 seat equivalent
416	Cessna 208	8	Turboprop under 20 seats	Turboprop under 20 seat equivalent
421	Cessna SkyCourier	2	Turboprop under 20 seats	Turboprop under 20 seat equivalent
431	TBM850	5	Turboprop under 20 seats	Turboprop under 20 seat equivalent
455	METRO 23	10	Turboprop under 20 seats	Turboprop under 20 seat equivalent
458	B-350	9	Turboprop under 20 seats	Turboprop under 20 seat equivalent
479	PC-12	8	Turboprop under 20 seats	Turboprop under 20 seat equivalent
485	DHC 6	15	Turboprop under 20 seats	Turboprop under 20 seat equivalent