7. LABOR COST FACTORS

7.1 INTRODUCTION

Many changes to FAA investment or regulatory programs require the expenditure of labor hours to construct, manufacture, modify, operate or service aviation facilities or equipment. In addition, regulations can require additional education or training of personnel. While many of these costs are embedded in other cost factors (e.g., flight crew costs are typically included in aircraft operating costs), there may be a need to separately place a value on labor hours expended. This section of the report summarizes data on labor costs for typical aviation industry employees. It also suggests ways of including these and related costs in benefit-cost analyses. There are many types of labor that could be affected by FAA investments or regulations, and labor rates for even the same occupation can vary widely by industry segment, years of experience, and geographic location, among other factors.

Labor costs can be stated in a variety of ways, including the direct salary or wage cost of a unit of labor (annual or hourly), the direct cost plus the cost of benefits, or the "fully loaded" cost, which includes the enterprise's overhead costs that are allocated to labor as well as the direct costs and the cost of benefits. Which cost should be used depends on the regulatory impact of interest; in particular, whether the impact would include the hiring of additional staff or capital investments along with labor impacts. Impacts that are modest in terms of additional labor hour requirements can be best estimated using direct labor costs alone. An impact that includes the hiring of some new workers arguably should include fringe benefits[1] costs as well, and an impact that involves significant expansion of operations and equipment along with employment should also include overhead costs in the labor rates used.

7.2 LABOR COSTS IN AIRCRAFT MANUFACTURING INDUSTRIES

Aircraft and aeronautical manufacturers may be affected by some changes in aviation regulations or investments due to changes they must make to manufacturing processes or related procedures for in-production aircraft or other aeronautical products. Making these changes will usually require specific actions by engineers and production workers within the affected firm. Survey data on labor compensation levels for aerospace and aeronautics firms is used to provide the basis for cost estimates of such impacts. These data are reported as hourly compensation levels for sectors within the aeronautical industry.

Table 7-1 contains data on aircraft manufacturing labor rates and benefits costs per hour in 2008, 2013 and 2018 (all in constant 2018 dollars). These rates include wages and salaries as well as fringe benefits. However, they do not include overhead costs or general and administrative (G&A) costs. Real labor rates fell at a Compound Annual Growth Rate of -1.6% from 2013 to 2018.

[1] Fringe benefits can include medical and other insurance costs paid for by company as well as holiday, sick and vacation time.

Table 7-1: Aircraft Manufacturing Industry Hourly Labor Rates ($2018)

	2008	2013	2018
Wages and Salaries	$47.75	$47.45	$42.11
Benefits	$36.50	$35.89	$34.65
Total Compensation	**$84.25**	**$83.34**	**$76.76**

Source: Bureau of Labor Statistics, Employer Costs for Employee Compensation, Employment Cost Index[2]

Overhead levels in aircraft manufacturing vary. They can range from about 50 to 100 percent of total compensation. Therefore, the above numbers should be multiplied by 1.5 or 2.0 if consideration of overheads is appropriate.

Table 7-2 reports average 2018 production worker hourly wages for the "Aerospace Product and Parts Manufacturing" industry (NAICS 336400). This table reports compensation only.

Table 7-2: Average Hourly Earnings, Aircraft Industry Production Workers ($2018)

Sector of Aircraft Industry	Average Hourly Earnings (2018)
Aerospace Product and Parts Manufacturing (NAICS 336400)	$26.38

Source: Bureau of Labor Statistics, Occupational and Employment Statistics, May 2018[3]

The terms used to specify aerospace engineering specialties often have an unclear relationship to the types of tasks typically undertaken. Table 7-3 provides data on the relationship between the most common aerospace engineering fields and the type of work usually undertaken by those in the field.

[2] *Employer Costs for Employee Compensation*, Table 18, "Aircraft Manufacturing", adjusted to $2018 using *Employment Cost Index– Volume III*, Tables 9 and 12, "Aircraft Manufacturing" Employment Cost Trends
[3] For SOC Code 51-0000, "Production Occupations", Occupational Employment Statistics

Table 7-3: Types of Work Done Within Aerospace Engineering Fields

Engineering Field	Type of Work
Avionics Electrical	Electrical Design
	Equipment Lines
	Electrical Applications
Mechanical Systems	Crew and Equipment
	Hydraulics
	Auxiliary Mechanics
	Flight Controls
	Reliability
Propulsion Systems	Power Plant
	Environmental Control Systems
Structures	Stress
	Contour Development
	Structural Design
Support	CAD Applications
	Check
	Certification
	Document Control
	EMU
Flight Science	Acoustics
	Propulsion
	Stability and Control
	Aerodynamics
	Loads and Dynamics
Project Engineering	

Source: General Aviation Manufacturers Association.

7.3 SALARIES, BENEFITS AND TRAINING COSTS FOR GA PILOTS

Table 7-4 also reports per-pilot flight crew training costs for each of the general aviation aircraft categories. These data are also taken from the Conklin & de Decker Aircraft Cost Evaluator database, and refer to the cost of "flight crew training using a professional, simulator-based training program (if available) or the equivalent." These training cost data represent the level of training to remain qualified and current on a specific aircraft type. These data are reported because regulatory changes that would cause operators of these types of aircraft to hire and train additional pilots do impose new training costs as well as the more direct costs of employing a new pilot.

Table 7-4: Disaggregated GA Flight Crew Compensation and Training Costs ($2018)

Aircraft Category	Certification	Average Total Crew Cost	Pilot Direct	Pilot Benefits	Co-Pilot Direct (When Applicable)	Co-Pilot Benefits	Training Costs (Per Crewmember)
Turboprop airplanes, one-engine	Part 23	$129	$99	$30	NA	NA	$9,554
Turboprop airplanes, multi-engine	Part 23/25	$265	$190	$57	$205	$61	$10,819
Turbojet/turbofan airplanes	Part 23/25	$911	$343	$103	$274	$82	$24,627
Rotorcraft turbine, one-engine	Part 27/Part 29	$232	$186	$47	NA	NA	$6,000
Rotorcraft turbine, multi-engine	Part 27/Part 29	$312	$231	$58	$187	$47	$17,917

Sources: Tabulated from data for individual aircraft in Conklin & de Decker's Aircraft Cost Evaluator (v18.2.0, 2018). Data represent weighted average costs for population, based on FAA's 2017 Aircraft Registration Database. The column "Average Total Crew Cost" is taken from the "Crew" cost column of Table 4-10.

NA = Not Available

Only the largest multi-engine turboprops (7% of costed fleet) have co-pilots. Among multi-engine turboprops with co-pilots, average pilot salaries and benefits are $262 and $79 per hour, respectively.

7.4 AIR CARRIER FLIGHT CREW TRAINING COSTS

In July 2013, FAA issued a new rule which increased the training requirements for a first officer (copilot) in Part 121 operations. Before this, a first officer was required only to hold a Commercial pilot license and have 250 flight hours. The new rule requires that they hold an Air Transport Pilot (ATP) license, the same type the captain must have, and have 1,500 flight hours. They must also be certified to fly the specific type of aircraft in which they are acting as the first officer. This certification is called a "type rating" and adds to the cost of becoming a pilot. It is discussed in more detail below. Regulatory changes could also cause air carriers to hire additional flight crew, and this would result in new training costs as well as the direct costs of employing a new pilot. As part of its comments on a past FAA NPRM in 1996, the Air Transport Association of America (ATA) reported results from a survey of its members regarding training costs.[4] The estimate reported by ATA for the average cost of an initial training session for pilots moving to a new rung on the seniority ladder was $23,384 in 1995, or $39,321 in 2018 dollars. This is consistent with a review of training providers in 2019, which revealed costs for an initial type rating in the range of $40,000 to $50,000, depending on model and location.[5] These costs are somewhat higher than the $25,000 shown for training in Table 7-4, but that value reflects all turbofan/turbojet aircraft, and is weighted towards smaller business jets.

Costs of pilot training and of the maintaining of type currency by pilots come about because of the many "types" of commercial aircraft and the need for type-specific training and skills for pilots. Pilots (captains or first officers) undergo specific training to achieve a specific "type rating," which will apply to one or more aircraft that qualify as a single "type." For

[4] Air Transport Association, *Benefit & Cost Analysis: Pilot Flight Time and Duty Time*, Washington, DC, 1996, pp. 22-23.

[5] These costs are for carrier-provided training (where the student is already drawing a pilot salary), on a carrier-class aircraft, in the United States. Type ratings for smaller jets, or where training is done overseas, may cost less.

example, the Airbus A330 shares a common type rating with the A350XWB, and the entire A320 series, both the classic and the A320neo variants, share a single type rating. Similarly, the Boeing 737-600/-700/-800/-900(NG) series have a common type rating. To operate the aircraft for which they have a type rating, pilots must receive recurrent training within that type rating twice annually as well as an annual line check for one or two flights in the aircraft. Pilot recurrent training generally lasts one to three days per training session (two to six days per year), and involves at least one simulator refresher training session.

A more significant pilot training cost that could be imposed on operators through their compliance with changed regulations is that associated with "type transition training." This training, which can take from 11 to 25 days, is required for pilots who are becoming "type rated" for a different type of aircraft, such as the transition from being type rated on the Airbus A320 aircraft to becoming type rated on the Boeing 777 aircraft. The economic impact of this type of training for operators depends on the frequency with which pilots make such transitions and on the fleet complexity chosen by a given operator. Since the Great Recession, carriers have made efforts to reduce fleet complexity. On the other hand, reduced operating costs from new-technology aircraft tend to outstrip savings from fleet commonality, where commonality is achieved by retaining older models.[6]

Regulatory changes that cause operators to hire additional pilots will lead to an increase in these pilot training costs, as pilots are hired across an operator's fleet. The costs associated with these lengthy type transition training sessions include not only the compensation and benefits provided to the pilots undergoing training, but also opportunity costs incurred when pilots are removed from revenue service, housing and other accommodation costs, and costs associated with the operation of the training facilities (which may be owned by the operator or contracted from an outside provider of training services).

Transition training may be significantly shorter for transition between aircraft that share some degree of commonality. When there is a degree of commonality allowing for shorter training periods, type transition training is sometimes referred to as "differences training." Adjustments to the length of a transition training session vary with the specific differences transition. For example, getting a type rating for an Airbus A330 or A340 may take only eight days for a pilot who is already type rated for an A320. Similarly, differences training for a transition from the Boeing 737 Classic series to the 737NG takes nine days, while the transition from the Boeing 757 to the 767 takes only four hours.

Paying to meet these training requirements makes up an important share of the costs associated with regulatory changes that caused operators to adjust their pilot ranks. Due to the multiplicity of aircraft types and the importance of fleet complexity for the costs faced by any given operator, it is not possible to specify costs associated with flight crew adjustments; the impact of any given regulatory change would have to be analyzed on an individual basis. However, general information on these training alternatives is summarized in Table 7-5.

[6] "Fleet Commonality and Sub-Fleets: The Economics of Operating Two Fleet Types" Fleet Commonality and Sub-Fleets

Table 7-5: Flight Crew Training Categories for Commercial Airline Operations

Training Category	Duration	Frequency
Initial Type Rating	23 to 25 days	Start of career
Recurrent Training	1 to 3 days	Twice a year
Type Transition Training	8 to 25 days (lower end of range applies if there are commonalities between the aircraft types)	Depends on airline fleet complexity and size (for example, unnecessary if airline operates only one type rated aircraft)

Source: Online review of training providers, 2019.

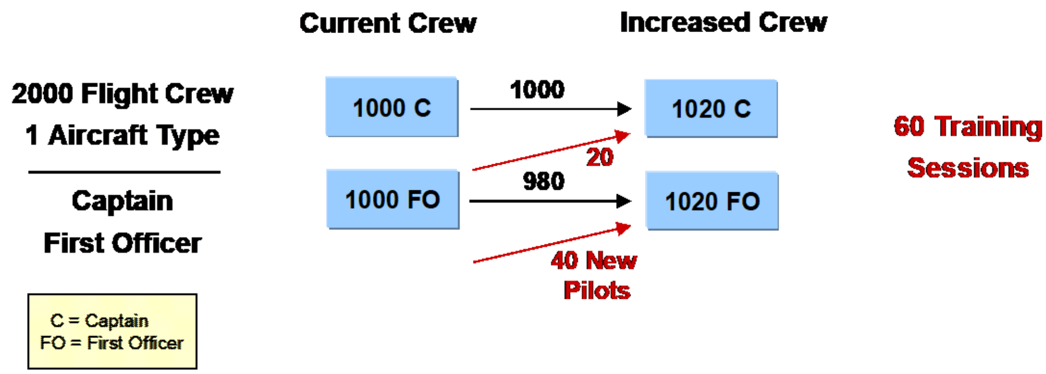
The cost impact of changes in FAA regulations or investment requirements that cause commercial air carriers to need additional flight crew for some or all of the aircraft types in their fleet can be further complicated by labor agreements. While the net effect of such changes is the hiring of a number of new pilots, each of whom would need initial training for the aircraft to which they were assigned, the nature of pilot contracts can result in a need for additional training sessions. This is because within a given airline, pilots move up a seniority ladder that is sequenced by aircraft type and seat position (captain or first officer), depending on the airline's pilot contract. If there is a need to increase the number of pilots by a given percentage, the number of training sessions required by a specific airline depends on the number of pilots an airline currently employs and the complexity of the airline's fleet.

This relationship between an airline's need to hire new pilots and the consequent need for training sessions within the airline's seniority ladder is also related to the airline's fleet structure. Suppose a regulatory change, such as one regarding flight and duty time requirements, results in all affected airlines needing to increase their flight crew rosters by two percent. For an airline with a current flight crew roster of 2,000 pilots, this means 40 new pilots must be hired. However, the number of initial training sessions that will be required to meet this need depends on the complexity of the airline's fleet, since pilot labor agreements generally specify a strict seniority ladder by which pilots move from one position to the next, with any newly hired pilot required to start her career at the bottom rung of the seniority ladder.[7]

The following three figures illustrate this relationship by depicting three contrasting scenarios. Consider first an airline that uses a flight crew roster of 2,000 pilots (1,000 captains and 1,000 first officers), and uses a single (two seat cockpit) aircraft type. This scenario is illustrated in Figure 7-1. Increasing the airline's pilot roster by two percent means that it will need 1,020 captains and 1,020 first officers. Pilot seniority rules require that the 20 new captain slots be filled from the ranks of current first officers, each of whom will need a training session to become qualified for the new position. The airline will also need 40 new first officers, 20 to replace the first officers who have moved up the seniority ladder and 20 to cover the new flight crew requirement. Thus, while there will be only 40 newly hired pilots, there will be 60 initial training sessions required to integrate these new hires into the airline's new flight crew rosters.

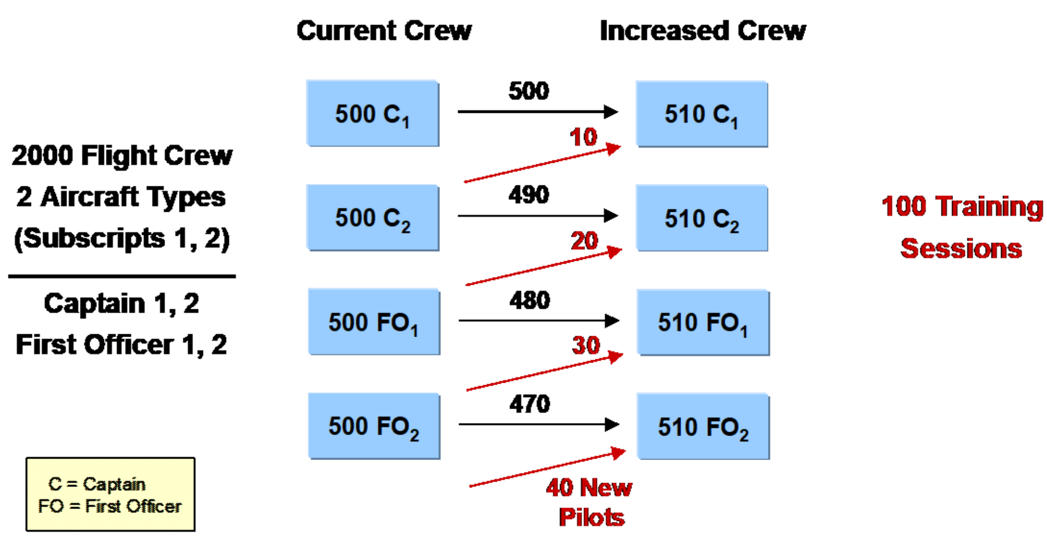
[7] Not all pilots will choose to exercise their seniority to bid up to a higher level assignment. For example, such a change might require a change in domicile. Or, being the most senior pilot in a lower category may provide more flexibility and value to a pilot than being the most junior pilot in a higher group.

Figure 7-1: Interaction of Regulatory Requirements for New Flight Crew and Flight Crew Seniority Ladder: Example 1 – 2,000 Current Flight Crew Members to be Increased by Two Percent, One Aircraft Type



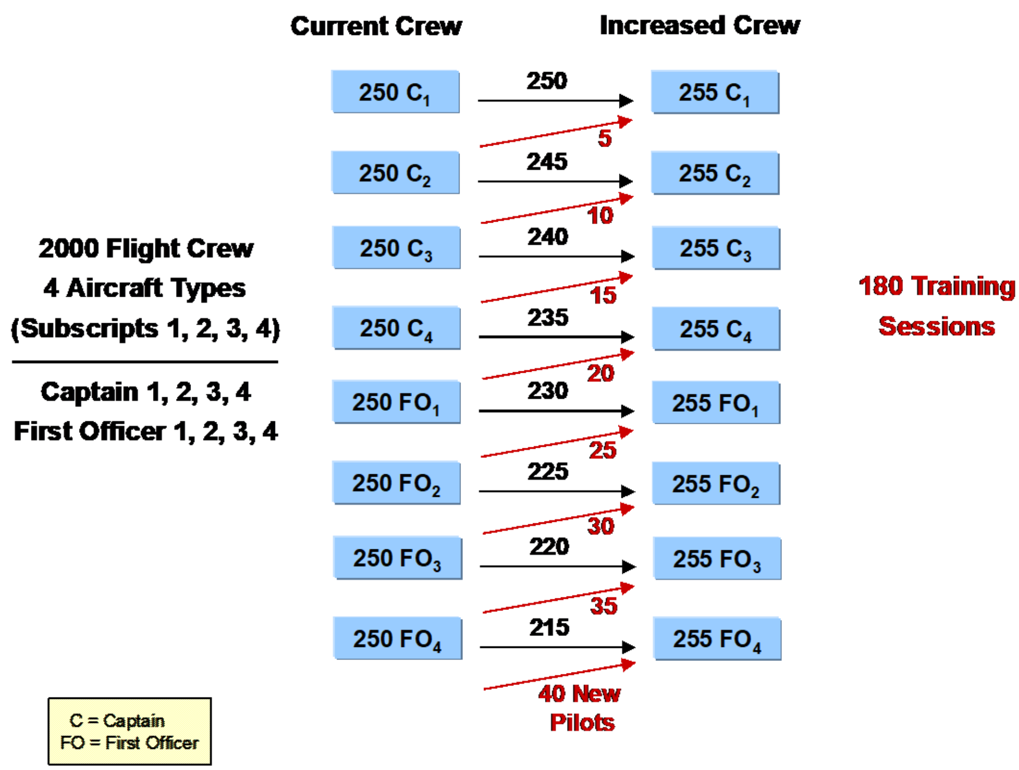
In Figure 7-2, the situation for an airline that uses a pilot roster of 2,000 to operate a fleet made up of equal members of two types of (two seat cockpit) aircraft is presented. In this example, the pilot seniority system is presented as taking pilot employees through the first officer seats and then on to the captain seats; other airlines may rely on bargaining agreements that have differently designed seniority sequences. In the simplified example, the airline is also shown as having a symmetrical fleet in the sense that for each of the two aircraft types, it employees 500 captains and 500 first officers. Of course, fleets for actual airlines may not have this symmetry. For the airline in the example, a two percent increase in pilot requirements means that each new flight crew category must take on 10 new members. As the example in Figure 7-3 shows, the pilot seniority ladder means that the 10 new captains for the senior type of aircraft come from those pilots who are qualified to serve as captains on the junior aircraft, each of whom must take part in a training session, and so forth. With a symmetrical fleet of this type, adding 40 new hires leads to 100 new training sessions (40 + 30 + 20 +10).

Figure 7-2: Interaction of Regulatory Requirements for New Flight Crew and Flight Crew Seniority Ladder: Example 2—2,000 Current Flight Crew Members to be Increased by Two Percent, Two Aircraft Types



A final example, as shown in Figure 7-3, illustrates the effect of the seniority ladder on the training requirements associated with a two percent pilot increase for an airline with 2,000 flight crew members who are equally distributed within a fleet evenly divided among four types of two seat cockpit aircraft. Thus, a two percent increase to 255 in the roster of 250 pilots currently serving as captains in the most senior aircraft would come from the 250 pilots serving as captains on the aircraft one rung down in seniority, and so forth. As the figure illustrates, for a 2,000 pilot airline with the four aircraft fleet as shown, adding two percent more pilots across its fleet leads to 40 new hires, but this requires 180 new training sessions as captains and first officers move up the seniority ladder.

Figure 7-3: Interaction of Regulatory Requirements for New Flight Crew and Flight Crew Seniority Ladder: Example 3—2,000 Current Flight Crew Members to be Increased by Two Percent, Four Aircraft Types



The examples in the figures above are somewhat idealized, since actual airlines would not operate a fleet partitioned so evenly among types of aircraft. These simplified examples do illustrate, however, the complications that a pilot seniority ladder adds to the problem of increasing an airline's ranks of pilots. As the airline's fleet complexity grows, the more steps there will be in the overall seniority ladder, and the more total training sessions may be required for the airline to satisfy a given requirement to increase its pilot ranks. The example also implies that any change that leads to such changes in pilot rosters can be more expensive for an airline with a more complex fleet than for an airline with a less complex fleet.

Other factors that can affect the number of training sessions required within overall pilot ranks for accommodating new pilot requirements include contractual restrictions on the frequency of pilot advancement along seniority ladders (pilots may be required to spend a minimum length of time at a training level before advancing further) at individual airlines and the willingness of pilots to elect to move up seniority ladders, for personal or lifestyle reasons. In its 1996 comment on the 1995 Flight and Duty NPRM, the ATA estimated, based on a survey of its members, that on average, a new pilot hire necessitated five pilot training sessions as existing pilots moved their way up the airline's seniority ladder.[8] However, since then average fleet complexity has declined and pilot contract provisions have changed, so this average will be somewhat lower. For this reason, analyses of regulatory changes that are likely to lead to significant changes in pilot requirements should include case-by-case investigations of the likely number of pilots who would shift among aircraft equipment types as a consequence of the regulatory change.

7.5 OTHER AVIATION-RELATED LABOR COST DATA

There are many other aviation-related professions and skilled trades that could be affected by changes in regulations or investment requirements. Wage and salary data for these occupations were gathered from industry and government sources. The data in Table 7-6 are the most recent available. They are reported as annual compensation and represent national averages. There is probably variation within each category, depending on such factors as region of country, years of employee experience, whether the position is in an urban or rural setting, and other factors. To the extent that a particular analysis dictates a specific labor category, the analyst should use salary data most closely corresponding to that labor category. While BLS data will generally be sufficient for this purpose, other data sources should be explored to ensure that the salary data used in the analysis most closely corresponds to the labor category in question.

The average annual labor costs are reported for flight attendants (air carrier and corporate), air traffic controllers, airfield operations specialists, and certain categories of aircraft maintenance labor. For each annual salary category, the source of the data is also reported. Because of the variety of sources and occupations, the reported salaries do not include fringe benefits, overheads, or other non-salary cost components.

An exception to this is the value shown for Air Traffic Controllers at Contract Towers. The value shown comes from FAA's FY 2016 Contract Tower costs, being simply the total costs ($144 million) divided by the number of controllers to be provided under contract (1,323), indexed to 2018 dollars. This $116,000 therefore represents not only salaries, but the contractor's charge to FAA for the costs of supplying each controller.

[8] Air Transport Association, *Benefit & Cost Analysis: Pilot Flight Time and Duty Time*, Washington, DC, 1996, pp. 22-23.

Table 7-6: Salary Data for Aviation Occupations ($2018)[9]

Job Title	SOC Code	Average Annual Salary	Year	Source
Pilot				
Airline (Scheduled)	53-2011	$173,270	2018	BLS National Compensation Survey
Airline (Nonscheduled)	53-2011	$117,450	2018	BLS National Compensation Survey
Commercial	53-2012	$96,530	2018	BLS National Compensation Survey
Flight Attendant				
Airline (Scheduled)	53-2031	$56,910	2018	BLS National Compensation Survey
Airline (Nonscheduled)	53-2031	$50,180	2018	BLS National Compensation Survey
Air Traffic Controller				
Federal	53-2021	$120,830	2018	BLS National Compensation Survey
Contract Tower (Contract Costs/ Controllers)		$115,735	2016	FAA Contract data*
Airfield Operations Specialist	53-2022	$56,760	2018	BLS National Compensation Survey
Aircraft Maintenance and Technicians				
A&P Maintenance Technician		$88,777	2018	NBAA Compensation Survey
Maintenance Technician Helper		$56,181	2018	NBAA Compensation Survey
Director of Maintenance		$124,774	2018	NBAA Compensation Survey
Manager of Maintenance		$119,904	2018	NBAA Compensation Survey
Maintenance Foreman		$112,072	2018	NBAA Compensation Survey
Avionics Technician	49-2091	$65,330	2018	BLS National Compensation Survey
Aircraft Mechanic / Service Technician	49-3011	$65,230	2018	BLS National Compensation Survey

*Indexed to 2018 dollars using BLS Employment Cost Index, Table 4, "Transportation and Material Moving workers". Represents full contract cost per controller to FAA, and therefore includes benefits and overheads.

[9] Bureau of Labor Statistics, *Occupational Employment and Wages*, May 2018 Occupational Employment Statistics