

GAO

Report to the Ranking Democratic
Member, Committee on Transportation
and Infrastructure, House of
Representatives

March 2003

AVIATION SAFETY

FAA Needs to Update the Curriculum and Certification Requirements for Aviation Mechanics





Highlights of [GAO-03-317](#), a report to the Ranking Democratic Member, House Committee on Transportation and Infrastructure

Why GAO Did This Study

The safety of millions of airline passengers depends in part on aviation mechanics—known as A&P mechanics—that are certified to inspect, service, and repair the aircraft's body (airframe) and/or engine (powerplant). FAA establishes the requirements to become certified as an A&P mechanic.

Concerns have been raised in the aviation industry about having a sufficient number of A&P mechanics over the long term. GAO was asked to determine how many aircraft mechanics and service technicians the Bureau of Labor Statistics (BLS) projects will be employed in 2010, and the reasonableness of that projection; the sources that supply and train A&P mechanics and the likelihood that they will provide a sufficient number through 2010; and what is being done by FAA and the aviation industry to ensure that the skills of A&P mechanics are sufficient to work on technologically advanced aircraft?

What GAO Recommends

FAA should review the required curriculum at aviation maintenance technician schools, identify courses that do not reflect widely used aircraft technology and materials and either de-emphasize or replace them. Also, FAA should ensure that changes to the required curriculum are reflected on the A&P certification examination.

www.gao.gov/cgi-bin/getrpt?GAO-03-317.

To view the full report, including the scope and methodology, click on the link above. For more information, contact Gerald L. Dillingham (202) 512-3650 or dillinghamg@gao.gov.

AVIATION SAFETY

FAA Needs to Update the Curriculum and Certification Requirements for Aviation Mechanics

What GAO Found

BLS projects that there will be about 184,000 aircraft mechanics and service technicians employed in the United States in 2010, an increase of 17 percent from the number employed in 2000. We reviewed the methodology and assumptions used by BLS to make the employment projections and found the resulting projection to be reasonable.

A&P mechanics will continue to be supplied and trained by the civilian workforce, the military, and the 175 FAA-approved aviation maintenance technician schools. About 58 percent of the 47,500 A&P mechanics that were certified by FAA between 1996 and 2001 were trained in aviation maintenance in the military or on-the-job, and the remaining 42 percent attended FAA-approved schools. Officials of the major commercial air carriers anticipate a sufficient supply of A&P mechanics from these same sources through 2010, citing their ability to contract out work to repair stations and to adjust wages and benefits to attract the employees that they need. This latter approach is consistent with economic literature on labor markets, which indicates that most employers take such actions to attract and retain needed workers. Eleven of 15 participants on an industry/government panel we convened believe that employers may have difficulty hiring A&P mechanics in 2010. According to officials at major airlines, when such a situation has occurred in the past, their companies responded by raising salaries and improving benefits to attract the mechanics that they needed.

FAA develops the minimum curriculum requirements for A&P mechanics attending aviation maintenance technician schools. However, the curriculum has not changed significantly in over 50 years. Industry officials believe that the curriculum is obsolete geared toward smaller less complex aircraft, and does not provide enough instruction on the materials and technology used on modern aircraft that transports the majority of the flying public.

Aviation Maintenance Technician at Work



Source: Aircraft Mechanics Fraternal Association.

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Abbreviations

A&P	Airframe and Powerplant
BLS	Bureau of Labor Statistics
FAA	Federal Aviation Administration
DOD	Department of Defense
DOT	Department of Transportation

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United States General Accounting Office
Washington, D.C. 20548

March 6, 2003

The Honorable James L. Oberstar
Ranking Democratic Member
Committee on Transportation and Infrastructure
House of Representatives

Dear Mr. Oberstar:

The safety of millions of air passengers depends on the abilities of a specialized group of aviation mechanics who are responsible for ensuring the airworthiness of about 200,000 civilian aircraft. These aviation mechanics inspect, service, and repair the planes' bodies (airframe) and/or engines (powerplant). Mechanics who are certified to work on both the airframe and powerplant are commonly known as A&P mechanics. Airframe and/or powerplant mechanics have final authority in certifying that a plane is airworthy and approving its return to service. The Federal Aviation Administration (FAA) is responsible for establishing the minimum requirements to become an A&P mechanic, authorizing and providing oversight to the 175 schools that teach prospective A&P mechanics, and establishing the schools' core curriculum. In addition, FAA certifies private individuals, called designated mechanic examiners, to test aviation A&P candidates on their knowledge of servicing an aircraft's airframe and powerplant, and to issue temporary mechanic certificates that indicate the candidates have successfully met the requirements for certification. FAA issues permanent A&P certificates to mechanics.¹

Prior to September 11, 2001, there was concern within the aviation industry that there would not be a sufficient number of A&P mechanics available in the future. That concern abated temporarily with the decrease in air traffic and subsequent lay offs of mechanics, but may return as traffic levels begin to return to pre-September 11 levels. This report responds to your request for information on the prospects of having a continued adequate supply of qualified aviation mechanics. Specifically, we agreed to address the following questions: (1) How many aircraft mechanics and service technicians does the Bureau of Labor Statistics (BLS) project will be employed in 2010, and how reasonable is that projection? (2) What are the sources that supply and train A&P mechanics and the likelihood that they

¹Mechanics can also receive certification for either airframe or powerplant. This report focuses on mechanics who have the combined A&P certificate.

will provide a sufficient number of mechanics through 2010? and (3) What is being done by FAA and the aviation industry to ensure that the skills of A&P mechanics are sufficient to work on technologically advanced aircraft?

To address these questions, we obtained and analyzed information from a variety of sources. From BLS, we gathered data on how it develops estimates of current employment and projections of future employment for individual occupations, including aircraft mechanics and service technicians.² In addition, we examined legislative and administrative requirements for the A&P certification and curriculum and obtained and analyzed FAA data on the number of airframe and/or powerplant certificates that have been issued between 1996 and 2001. We also obtained data from the United States Coast Guard, Navy, Army, Air Force, and Marine Corps on the number of military personnel that have the designation of aviation mechanics and information on their duties and job requirements. In addition, we identified 17 industry and government organizations representing A&P mechanics; businesses that employ A&P mechanics; A&P schools; and FAA, which certifies the mechanics. Officials from these organizations participated on a stakeholder panel that provided their groups' views on the employment and training of A&P mechanics, the A&P curriculum of FAA-approved aviation maintenance technicians school, and A&P certification standards. To obtain information on certifying, hiring, training, and employing A&P mechanics, we interviewed officials from FAA, the Department of Defense (DOD), and eight major commercial carriers. In addition, we obtained information on hiring, training, and employing A&P mechanics from regional airlines, fixed-based operations,³ repair stations,⁴ and FAA-approved aviation maintenance technician schools in the Washington, D.C., area, Atlanta, Dallas, Seattle, Orlando, Daytona Beach, Fort Eustis, VA, and Oklahoma City. We conducted our review in accordance with generally accepted government auditing standards. Appendix I contains additional information on our scope and methodology.

²Service technicians repair, maintain, and service aircraft under the supervision of certified A&P mechanics. BLS uses the term service technicians, while FAA uses the term repairmen.

³Fixed-based operations are FAA-certified facilities, generally located at or near an airfield, that repair and service aircraft.

⁴Repair stations are FAA-certified facilities, generally larger than fixed-based operations, that repair and service aircraft.

Results in Brief

BLS projects that there will be about 184,000 aircraft mechanics and service technicians employed in the United States in 2010, which we believe is a reasonable estimate based on our review of the process used by BLS to make this projection. The aircraft mechanics and service technicians' category that BLS uses includes A&P mechanics that specialize in the maintenance and repair of an aircraft's airframe and powerplant, repairmen, and others who work on aircraft.⁵ BLS' projection amounts to a 17-percent increase over the number the agency reported employed in 2000, or an average annual average increase of about 2,600 aircraft mechanics and service technicians. BLS derived its projection from a multi-step process in which the employment of aircraft mechanics and service technicians is influenced by factors such as the projected demand for air travel. In addition, BLS considers trend data on hiring, enrollment in aviation maintenance technician schools, and information provided by aviation industry participants in making its projections. There is always uncertainty associated with projections such as those made by BLS because they depend on assumptions about key economic factors, and the actual values of these factors may differ from the estimated values.

The sources that will supply and train A&P mechanics are the civilian workforce, the military, and FAA-approved aviation maintenance technician schools. About 58 percent of the 47,500 A&P mechanics who were issued certificates between 1996 and 2001 were trained in aviation maintenance in the military or on-the-job, and the remaining 42 percent attended FAA-approved aviation maintenance technician schools. Officials of the major commercial air carriers, the largest employer of A&P mechanics, as well as officials from regional and business air carriers, anticipate there will be a sufficient supply of A&P mechanics from these same sources through 2010, citing their ability to contract out repair and servicing work to repair stations, and the ability to adjust wages and benefits to attract the employees that they need. This approach is consistent with economic literature on labor markets that indicates that most employers, regardless of the industry that they represent, take such actions to attract and retain the workers that they need. Many participants (11 of 15) in our stakeholder panel believe that employers may have difficulty hiring A&P mechanics in 2010. According to officials at major

⁵There is no estimate of employment made specifically for airframe and powerplant (A&P) mechanics. BLS' employment figures include all aircraft mechanics and service technicians, including airframe and/or powerplant mechanics and repairmen.

airlines, when such a situation has occurred in the past, their companies responded by raising salaries and providing other incentives to attract mechanics that they needed.

FAA is responsible for developing the minimum requirements for the A&P curriculum at the 175 FAA-approved aviation maintenance technician schools nationwide, but it has not made significant changes to the schools' curriculum in more than 50 years. According to most of the representatives of the aviation industry that we interviewed, overall, the curriculum provides a solid basic introduction to aircraft repair and maintenance. However, they also believe that the curriculum is outdated, and geared toward systems and materials on smaller, less complex aircraft that are rarely used by most of the flying public. Representatives of the major air carriers told us that since the aviation maintenance technician schools do not provide enough instruction on the materials and technology used by modern commercial aircraft, they provide on-the-job training to their mechanics. FAA proposed changes to the A&P curriculum and certification processes in 1994 and 1998, when it issued notices of proposed rulemaking but negative comments on specific items in the proposals, such as a requirement that mechanics have recurrent training, caused FAA to withdraw the proposals. FAA officials told us that there are no immediate plans to reissue the proposals. Since FAA is responsible for ensuring that minimum requirements taught at the aviation maintenance technician schools address current conditions, we are recommending that FAA review the minimum A&P curriculum required for FAA-approved aviation maintenance technician schools, and identify courses that do not reflect widely used aircraft technology and materials on commonly flown aircraft. These courses should be de-emphasized or replaced with courses that address current conditions. We also recommend that FAA ensure that changes to the A&P school curriculum are reflected on the mechanic's certification examination, thus ensuring that all candidates for the A&P certificate meet the same standards. FAA and BLS generally agreed with our findings and FAA agreed to consider our recommendation.

Background

Some members of the aviation industry expressed concern about a potential shortage of qualified aviation mechanics. Aviation mechanics (also called “airframe and powerplant” or “A&P” mechanics) who specialize in and are certified to inspect, service, and repair the bodies (airframe) and engines (powerplant) of civilian aircraft are a critical component of aviation safety because they are responsible for ensuring that aircraft are in peak operating condition and can be used to safely transport people and cargo. If an A&P mechanic fails to perform the required services before an aircraft departs, it could compromise the safety of the aircraft, passengers, and cargo. For example, in examining the January 2000 Alaska Airlines crash of Flight 261, the National Transportation Safety Board determined that maintenance irregularities were among the contributing factors to the crash. Concerns about the sufficiency of the number of specialized personnel in the aviation industry have not been limited to aviation mechanics. In a recent report on air traffic controllers, for example, we identified likely future attrition scenarios involving that workforce, and recommended that FAA better prepare for responding to them.⁶

A&P mechanics inspect and repair engines, landing gear, instruments, pressurized sections, and other parts of the aircraft. They are also responsible for providing routine maintenance and replacement of aircraft parts; repairing sheet metal or composite surfaces; and checking for corrosion, distortion, and cracks in the fuselage, wings, and tail. After completing the work, A&P mechanics must test parts and equipment to ensure that they work properly, and then they can authorize the aircrafts’ return to service. The mechanics often work under time pressure to maintain flight schedules.

To receive A&P certification, candidates must first successfully complete a minimum of 1,900 hours of classroom instruction at any of the 175 FAA-approved aviation maintenance technician schools or acquire documented evidence that they have at least 30 months of on-the-job training or experience working with aircrafts’ engines and bodies. FAA developed the core curriculum on repairing and maintaining aircraft used at the aviation maintenance schools. A&P candidates must then pass written and oral tests and demonstrate through a practical test that they can do the work

⁶U.S. General Accounting Office, *Air Traffic Control: FAA Needs to Better Prepare for Impending Wave of Controller Attrition*, [GAO-02-591](#) (Washington, D.C.: June 14, 2002).

authorized by the certificate. For example, candidates must show proficiency in working on items such as aircraft structures, landing gears and components, and powerplant maintenance.

FAA administers the written examination and certifies private persons, called designated mechanic examiners, located throughout the country to administer the oral and practical tests to candidates. When a candidate successfully completes the certification examination, the examiner issues a temporary A&P mechanic certificate. The examiner submits the newly certified A&P mechanic's file to an FAA field office for initial review and, if approved there, the file is sent to the FAA's Airman Certification Branch, in Oklahoma City. FAA issues the permanent A&P certificate to mechanics who successfully pass all parts of the examination. The examiners charge a fee, which is not set or regulated by FAA, to the applicants taking the examination. FAA is responsible for overseeing the examiners, and both FAA and the Department of Transportation (DOT) Inspector General found abuses in the past.⁷

While most aircraft mechanics are employed by the nation's air carriers, others work for repair stations, corporate flight departments, fixed-based operations,⁸ air taxi and charter services, the federal government, and aircraft manufacturers. Within the aviation industry, the major commercial airlines, corporate flight departments, and aircraft manufacturers offer the highest salaries for A&P mechanics, while salaries for mechanics who work in regional airlines, fixed-based operations, and training facilities tend to be lower. BLS estimates that the average salary of aircraft mechanics and service technicians nationwide was about \$41,000 in 2000. According to representatives of some major commercial air carriers, salaries for aviation mechanics vary within the occupation and are based on factors such as the number of certifications the mechanics possess and the sector of the aviation industry in which they are employed. Generally, mechanics who are A&P certified earn more than those having other types of aviation mechanic's certificates.⁹ According to BLS, the mean hourly

⁷In 1999, FAA found that designated mechanics' examiners in the Orlando, Florida, area had fraudulently indicated that hundreds of applicants had passed the certification examination. FAA retested many of the mechanics and instituted controls over the certification process.

⁸See footnote 3.

⁹Examples of other types of aviation mechanics certificates include repairmen certificates and avionics certificates, which are required to work on the electronic components of aircraft.

wage in 2000 for aircraft mechanics and service technicians was \$19.49. Officials of the eight major commercial air carriers that we spoke with told us that they offer A&P mechanics an hourly salary rate ranging between \$16.50 and \$37.00. The hourly salaries for aviation mechanics employed with nine regional airlines, repair stations, and fixed-based operations that we contacted ranged from \$11.50 to \$30.00.

FAA data show that as of May 2002, there were 268,996 certified A&P mechanics, 14,984 certified airframe mechanics, and 10,421 certified powerplant mechanics nationwide under the age of 70.¹⁰ In addition, 38 percent of these certified A&P mechanics are between the ages of 50 and 70 years old; 35 percent are between 39 and 49 years; and 27 percent are between 18 and 38 years old. There are also about 80,000 FAA-certified repairmen and an unknown number of noncertified repairmen that are supervised by A&P mechanics at FAA-approved repair facilities, fixed-based operations, and airlines. Neither government nor industry maintains data on the total number of noncertified repairmen who work in aviation maintenance.

BLS Projection of Increased Employment in 2010 Appears Reasonable

As the federal government's primary source of data on the national labor market, BLS determines the current employment in various occupations in a given year, and it makes biennial projections of the number of future employees nationwide in various occupations over a 10-year period. According to BLS data, at the end of 2000, about 77 percent (or about 122,000) of the nation's 157,884 aircraft mechanics and service technicians were employed in the aviation industry by entities such as air carriers, airports, and aircraft parts businesses. BLS' projection does not distinguish between certified and noncertified aircraft mechanics and service technicians. About 51 percent (or about 80,500) of the aircraft mechanics and technicians worked for the nation's air carriers, according to BLS. The remaining 49 percent worked outside of the air carrier industry.

¹⁰FAA data show the number of mechanics that have received an airframe and/or powerplant certificate, while BLS data show the number of all aircraft mechanics and service technicians that are, and are projected to be, employed.

In December 2001, BLS projected that the number of aircraft mechanics and service technicians employed in the United States would increase to about 184,000 in 2010, an overall 17 percent increase (or about 2,630 employees per year) over the 157,884 aircraft mechanics and service technicians that were employed in 2000.¹¹ In its projections for 2010, BLS estimates that the overall percentage of aircraft mechanics and service technicians employed in the aviation industry will increase to 80 percent, and the percentage of aircraft mechanics and service technicians employed by the air carriers would increase to about 54 percent.

BLS' Process for Projecting Future Employment Appears Reasonable

BLS' projection of future employment for aircraft mechanics and service technicians appears reasonable based on our review of the agency's process for making the projection. To estimate future employment in various occupations, BLS uses historical data, an input-output matrix¹² for the economy, and forecasts of key economic factors such as economic growth by sector of the economy and labor participation rates, to estimate the output of numerous industries and the number of people employed by those industries. As a result, projected employment in an industry is influenced by the projected demand for the goods and services produced by that industry. For example, the projected employment of aircraft mechanics and service technicians is influenced by the projected demand for air travel.

BLS produces a baseline estimate of employment by occupation in each industry by assuming that the industry's projected employment in the forecast year will be divided among occupations in the same proportions as it was divided in the last historical year available. For example, if employment in an industry is expected to increase by 10 percent, then the baseline estimate would show that employment for each occupation in that industry would increase by 10 percent. Total employment within an occupation is derived by adding the estimates for each industry in which members of that occupation are employed. BLS occupation specialists then consider whether the distribution of employment across occupations in the various industries will change by the forecast year. For the occupation

¹¹This is the most recent year for which actual figures are available.

¹²An input-output matrix shows how much of various inputs, including labor as well as materials, is used to produce a unit of various outputs (e.g., how much steel is used to produce a car).

category of aircraft mechanics and service technicians, the BLS occupation specialist obtains information on factors influencing the supply and demand of these workers from many sources, including trend data on hiring; enrollment in aviation maintenance technician schools; and discussions with various industry participants, including employers, workers, FAA officials, and operators of aviation maintenance technician schools. On the basis of this information, BLS concluded that by 2010 aviation mechanics and service technicians will be more productive due to greater use of automated inventory control and modular systems by air carriers, which will speed repairs and parts replacement. As a result, BLS adjusted its 2010 projection for aircraft mechanics and service technicians downward from its baseline. Since projections such as these depend on numerous assumptions, there is always uncertainty associated with them. For example, if the overall growth rate of the economy, one of the factors underlying BLS' projections, were to differ from the rate assumed in BLS' models, then actual employment in various occupations in 2010 will differ from the agency's expectations. Nevertheless, BLS has constructed its projection on a comprehensive set of factors and employed a sound methodology to analyze those factors.

Traditional Sources That Supply and Train A&P Mechanics Should Be Adequate through 2010

According to FAA and aviation industry officials, A&P mechanics will continue to come from FAA-approved aviation maintenance technician schools, the military, and the civilian workforce, and officials of the major commercial air carriers, the largest employer of A&P mechanics, as well as those from regional and business air carriers anticipate a sufficient number of mechanics from these sources through 2010. In addition, some air carriers will contract out their aircraft repair and servicing needs to repair stations, which can operate with fewer A&P mechanics. Most of our stakeholder panelists believe that employers may have difficulty hiring A&P mechanics in 2010. Aviation industry employers maintain that, as they have done in the past, they will adjust salaries and benefits to attract the mechanics that they need, consistent with economic literature on how labor markets typically operate.

Civilian Workforce, Military Service, and Aviation Maintenance Technician Schools Are Sources of Training for A&P Mechanics

According to FAA officials, A&P mechanics received their aviation maintenance training either in the civilian workforce, during military service, or after completing a prescribed curriculum at an FAA-approved aviation maintenance technician school. As table 1 shows, from 1996 through 2001,¹³ FAA issued nearly 47,500 A&P certificates, which represents about 7,900 A&P certificates annually. About 58 percent of these certificates were granted to A&P mechanics who were trained in the military or during civilian employment.¹⁴ The remaining 42 percent of the A&P certificate holders attended FAA-approved aviation maintenance technician schools.

Table 1: Number of A&P Certificates Issued to FAA-approved School Trained and Nonschool Trained Mechanics, 1996 – 2001

Year issued	Number of A&P certificates issued to FAA-approved school attendees	Number of A&P certificates issued to nonschool mechanics	Total A&P certificates issued
1996	2,792	4,776	7,568 ^a
1997	2,234	5,302	7,536
1998	3,003	5,142	8,145
1999	3,610	4,489	8,099 ^a
2000	4,187	4,155	8,342 ^a
2001	4,221	3,567	7,788 ^a
Total	20,047	27,431	47,478^a

Source: FAA.

^aAmount differs from that shown in table 2. According to FAA, the discrepancy was caused by database request dates. The database is continually changing to reflect the issuance of new or updated certificates.

Over the same period, FAA issued almost 20,000 individual airframe or powerplant certificates. Table 2 shows the number of aviation mechanics' certificates issued between 1996 and 2001.

¹³Prior to 1996, FAA's database did not distinguish the type of certification issued to mechanics; therefore, it was not possible to determine the number of certificates issued to airframe and/or powerplant mechanics and others. Since 1996, the database identifies the type of certificate issued.

¹⁴FAA classifies A&P certificate holders who were trained in the military or during civilian employment as "nonschool mechanics" in its database.

Table 2: Number of Certificates Issued by FAA, 1996 – 2001

Year issued	Number of airframe only certificates issued	Number of powerplant only certificates issued	Number of both A&P certificates issued	Total certificates issued
1996	1,973	883	7,569 ^a	10,425
1997	2,017	964	7,536	10,517
1998	2,292	947	8,145	11,384
1999	2,494	1,025	8,100 ^a	11,619
2000	2,393	1,094	8,349 ^a	11,836
2001	2,298	1,091	7,795 ^a	11,184
Total	13,467	6,004	47,494^a	66,965

Source: FAA.

^aAmount differs from that shown in table 1. According to FAA, the discrepancy was caused by database request dates. The database is continually changing to reflect the issuance of new or updated certificates.

Many A&P mechanics were trained initially while in the military and supplemented their experience with training on civilian aircraft in order to meet the requirements for taking the A&P certification examination. The combined branches of the U.S. military had about 93,000 aviation mechanics as of July 30, 2002, and, according to military officials, many of them are or could become eligible to take the A&P certification examination. However, no data are available on the number of current military aviation mechanics that have A&P certificates. Significant differences exist in the requirements for military personnel with an aviation mechanic’s designation and civilian aviation mechanics. Military aviation mechanics are not required to have an airframe and/or powerplant certificate, while civilian aviation mechanics must have a certificate (e.g., airframe and powerplant) that is appropriate for the work they are doing before they can attest that an aircraft is operating properly and is ready for departure. In addition, military aviation mechanics are often trained to perform a specialized task on the type of aircraft that is typically used by the mechanics’ branch of the service. In addition, according to military officials, a military aviation mechanics’ job is compartmentalized in that the mechanic is generally assigned to service or maintain a specific part of an aircraft or perform a specific task on an aircraft. In contrast, civilian A&P mechanics are trained to, and often conduct work on, various parts of the airframe and powerplant of different types of aircraft. Since the work performed by many military aviation mechanics is often so specialized, many of them have to supplement their on-the-job work experience with

knowledge and training on civilian aircraft before they can become eligible to take the A&P examination. Several A&P employers told us that former military aviation mechanics are highly sought after once they become A&P certified, because of their discipline and attention to detail.

Another major source for A&P mechanics are the 175 aviation maintenance technician schools nationwide that are authorized by FAA to teach a specified curriculum on inspecting, repairing, and maintaining an aircraft's airframe and powerplant. There are no current or historical data available on the number of enrollees and graduates of those schools, and FAA does not require the schools to report this information.¹⁵ Officials at four schools we contacted indicated that their enrollment was at capacity or increasing. In addition, the schools' officials told us that the majority of their graduates worked initially in the aviation industry after leaving the schools.

¹⁵The Aviation Technician Education Council, the organization that represents many FAA-approved aviation maintenance technician schools, conducts surveys each year on the schools' enrollment and graduation rates. However, according to the Council, the survey results cannot be used to provide trend information because the same schools do not respond each year.

Major Commercial, Regional, and Business Air Carriers Anticipate Adequate Supply of A&P Mechanics in the Future

Officials from the major commercial, regional, and business air carriers that we interviewed anticipated a sufficient number of A&P mechanics through 2010 for two primary reasons. First, the officials for the air carriers indicated that they could avoid a shortage of in-house mechanics by contracting out some of their aircraft maintenance to domestic and/or foreign-based repair stations.¹⁶ In a 1997 report on repair stations, we noted that the use of repair stations has grown substantially in recent years, particularly by airlines and cargo companies just entering the market.¹⁷ Many carriers have found it more economical to contract out much of their maintenance work to repair stations rather than hiring their own staffs and building extensive facilities. FAA is responsible for the certification and oversight of repair stations, and for specifying the type of maintenance that they can perform. While many repair stations have fewer than 15 employees and a limited range of activities that FAA has certified, some employ thousands of workers who completely overhaul engines and renovate aging airframes. As of December 2002, there were about 5,600 FAA-certified domestic and foreign repair stations.¹⁸ The stations can offset the need for large numbers of A&P mechanics by employing repairmen, who may or may not be supervised by A&P mechanics, to do the work. Neither FAA nor the aviation industry has established a requirement or guidance on the ratio of repairmen to A&P mechanics at those facilities, and we were unable to find any useable data on this issue.

Second, officials for the air carriers indicated that their companies would likely adjust salaries and benefits for A&P mechanics to attract and retain the number they need to operate effectively. Some of the officials stated that during the 1990s, their air carriers experienced periodic shortages of A&P mechanics and they responded by raising salaries and providing other incentives to attract the mechanics that they needed to their companies.

¹⁶Facilities certified by FAA to repair and service aircraft.

¹⁷U.S. General Accounting Office, *Aviation Safety: FAA Oversight of Repair Stations Needs Improvement* [GAO/RCED-98-21](#) (Washington, D.C.: Oct. 24, 1997).

¹⁸Officials for the major air carriers told us that the carriers require foreign repair stations to follow U.S. requirements in some areas as a condition of their contract.

Aviation Sectors' Expectations on Influencing Mechanics' Hiring through Salary and Benefit Adjustments Are Consistent with Literature on Labor Markets

The adjustment of salaries and benefits to attract workers is consistent with the economic literature that we reviewed on this issue. The literature confirmed the economic principle that businesses have typically responded to the potential of workplace shortages by taking action in several ways. First, if the number of employees in a given occupational specialty is insufficient to support an employer's operations at a given scale, the employer can take actions that are likely to attract more new employees, and to reduce attrition among incumbent employees. These actions include increasing wages, offering more generous nonwage benefits, and improving working conditions. Second, employers can devote additional resources to encouraging careers in the occupational specialty, such as advertising job openings and participating in job fairs. Third, an employer could respond to a shortfall in the number of employees in a given occupational specialty by altering business operations so that fewer employees are required. For instance, an employer could scale back operations, such as reduce the number of flights provided. Finally, in some instances, employers may be able to alter the technology to permit the substitution of other types of labor for workers in the occupational specialty that is in short supply. In the event that the number of qualified aviation mechanics should start falling below the level that the aviation industry believes it needs to properly conduct business, we expect that the industry will respond in the ways discussed above.

Most Panelists Believe That Hiring A&P Mechanics Will Be Difficult

While the primary employers of A&P mechanics expect a sufficient number of mechanics will be available through 2010, 11 of 15 panelists who responded to our question reported that employers may have difficulty in hiring them. The 11 panelists were from organizations that represent, employ, or train A&P mechanics. Furthermore, many panelists believe that more A&P retirees along with growth in air travel and the number of aircraft will increase the demand for aviation mechanics in 2010.

We identified no nationwide data on the rate at which A&P mechanics retire or leave the industry. In our discussions with some of the panelists, we were told that the attrition information they provided for A&P mechanics was based on anecdotal comments by their members. In addition, all but one of the major commercial air carriers in our review indicated that their annual turnover rate (which includes employees who have left the industry as well as those who have taken a job with another employer as an aviation mechanic) averaged about 3 percent in the 3 years

prior to September 2001. The other carrier had a turnover rate of about 7 percent during that time period.

FAA and Industry Have Initiatives to Influence the Skills of A&P Mechanics

Both FAA and the aviation industry have programs or activities that are designed to influence the number of A&P mechanics in the industry, and the skills they acquire. In addition to the initiatives described in table 3, FAA managers told us that local field offices conduct outreach efforts at schools to promote interest in careers in aviation.

Table 3: FAA Initiatives to Improve the Qualifications of Mechanics

FAA initiative	Program description
Aviation Safety Program	The FAA Accident Prevention Program was started in 1971 to decrease the number of general aviation accidents. In 1996, the program's name was changed to the Aviation Safety Program and its mission was expanded to include all aspects of aviation including air carriers and maintenance. The program consists of 160 program managers who have published safety-related audiovisual materials and publications and conducted a series of safety seminars and clinics for pilots and mechanics. FAA reports that surveys it has conducted show that the program is an effective way to provide mechanics updated information on regulatory requirements, technological advances, and changes in safety responsibilities. In a 1998 survey of aviation mechanics, FAA found that 30 percent (about 7,200) of respondents attended at least one seminar and 10 percent (about 2,400) attended two or more seminars.
Aviation Maintenance Technician Awards Program	The program was started in 1992 to encourage aviation mechanics to participate in employer-sponsored initial and recurrent training classes on a voluntary basis. Mechanics are eligible to receive certificates of recognition, lapel pins, and other prizes such as roundtrip airfare, computers, and scholarships. Employers providing training to their mechanics may also receive certificates of recognition under the program. In fiscal year 2000, 19,963 pins and 104 awards were given to mechanics and employers, respectively. For fiscal year 2001, numbers increased to 24,047 mechanic pins and 146 employer awards. Over the last 3 years, FAA estimates that participation in the program increased 5 to 7 percent.

Source: FAA.

The aviation industry is also pursuing a variety of initiatives to promote careers in aviation maintenance and to expand their own opportunities for recruiting qualified aviation mechanics. For example, an aviation industry employer offers cash incentives to its employees whose referral of an A&P mechanic results in his or her employment. In addition, airlines, including Continental, Northwest, Horizon, Delta, United, and America West, reported involvement with local aviation maintenance technician schools, through providing teaching aids, such as surplus aircraft parts and equipment, and by participating in local schools' recruiting fairs. Finally, some airlines reported engaging in other initiatives to recruit, hire, or retain qualified aviation mechanics, including participating in career days at middle and high schools in order to introduce students to aviation as a possible career, serving on the board of directors of aviation maintenance technician schools, and working with professional organizations that represent aviation mechanics. In addition, prior to September 11, 2001, Alaska Airlines had planned to establish a program that would offer internal apprenticeships and tuition assistance to employees who express an interest in earning an A&P certificate, provide mentors to high schools and trade schools, establish a direct hiring program in partnership with some A&P schools, and provide tuition assistance for A&P mechanics who want to attain advanced avionics¹⁹ training. Plans for these programs were deferred after September 11, 2001; however, a company representative told us that the airline might implement them on a limited basis in 2003.

FAA and DOD Have Initiatives to Assist Military Aviation Mechanics in Obtaining A&P Certificates

Military and FAA officials have established initiatives that are intended to assist military aviation mechanics in pursuing the A&P certification. The initiatives include computer-based training of A&P courses on selected military bases and a program that encourages FAA field offices to be more consistent in assessing the military's aviation maintenance training and experience.

Several military officials told us that there had been some concern about the potential for a shortage of military aviation mechanics because some mechanics left the service after their initial tour of duty. According to the officials, some mechanics chose to leave the service because the training needed to become A&P certified was not offered on the military bases where mechanics were stationed. The military wanted to devise a way to

¹⁹Avionics is the science and technology of electrical and electronic devices in aviation.

assist military aviation mechanics in pursuing A&P certification as an incentive for mechanics to extend their enlistment. Keeping military aviation mechanics beyond their first tour of duty was important because several branches of service do not have a full complement of aviation mechanics. For example, the Navy and Coast Guard told us that they have full complements of aviation mechanics; however, the Army, Air Force, and Marine Corps indicated that they needed to add thousands of mechanics before they reached full capacity. According to an FAA official, a problem with any plan to assist active duty military aviation mechanics in obtaining A&P certification is that the mechanics are not always stationed in areas where it is convenient to attend an FAA-approved aviation maintenance technician school to acquire the training needed to supplement their on-the-job experiences. Consequently, the military asked FAA to develop computer-based A&P courses that could be offered on military bases. This training would provide military mechanics with the same courses being offered at FAA-approved aviation maintenance technician schools and that are part of the requirements for A&P certification. FAA agreed and, with funding from the Air Force, initiated a pilot program in 2001 at three military bases. At the time of our review, approximately 1,600 military aviation mechanics, from all branches of the armed forces, were enrolled in this program.

FAA and DOD collaborated to address another major concern among current and former military aviation mechanics who believe that FAA field offices are inconsistent in assessing whether their military training and experiences meet the requirements to take the A&P certification examination. According to both FAA and DOD officials, FAA field offices lack consistency in assessing the training and work experiences of military aviation mechanics and determining whether credit should be given toward the requirements for A&P certification. While some FAA field offices gave credit for some experiences, others did not. Some FAA field office staff were unfamiliar with how to evaluate the duties of military aviation mechanics. For example, military officials told us that service personnel that had the designation of a military aviation mechanic perform duties as diverse as refueling a plane exclusively to working on an aircraft's powerplant. Although both service personnel are aviation mechanics, only the mechanic that worked on the powerplant should be given credit toward the A&P eligibility requirement, according to FAA field office staff. However, the documentation provided to the FAA field office personnel would not always describe the duties performed by military aviation mechanics, so a field office might credit the work of one mechanic, while another field office might deny credit. To assist the FAA field offices in

better assessing the experiences of military aviation mechanics, DOD identified occupation codes that meet specific A&P requirements and provided them to FAA. FAA field office personnel are instructed to refer to these codes as a starting point or indicator that the applicant met some requirements needed to become eligible for the A&P examination.

In December 2001, DOD and FAA developed a “certificate of eligibility,” which is issued to military aviation mechanics by their military trainers when they have completed the requirements needed to take the A&P certification examination. According to FAA and DOD officials, military aviation mechanics may present the certificate of eligibility to any FAA field office as proof that they are eligible to take the A&P exam. During our visits to FAA field offices in Atlanta, Seattle, and Dallas, however, we found that officials were either unaware of or had little information about the certificate of eligibility initiative. In one case, a field office official told us that he had been informed of the certificate initiative a week earlier. This official stated that in addition to accepting the certificate of eligibility, he would continue to question all applicants applying for the A&P certification examination as a quality control measure. We discussed the field offices’ apparent lack of familiarity with the certificate of eligibility with an official in FAA headquarters and a DOD consultant who worked on this program. Both acknowledged that all FAA field offices had not been informed of the initiative at the time of our visits, but had been by June 2002. According to the DOD consultant, three active duty military mechanics—all from the Coast Guard—have successfully used their certificates at FAA field offices to establish their eligibility to take the A&P certification examination.

FAA-developed Curriculum Does Not Cover Technologically Advanced Aircraft

FAA is responsible for developing the A&P core curriculum at 175 FAA-approved aviation maintenance technician schools nationwide, but it has not made significant changes to the curriculum of aviation maintenance technician schools in more than 50 years. Consequently, the training received by prospective A&P candidates at those schools is not relevant to most of the aircraft flown today. Most of our stakeholder panel and aviation industry representatives indicated that the current curriculum, which is required for A&P certification, provides a solid basic introduction to aircraft repair and maintenance. Major commercial aviation representatives believed that the curriculum is too focused on smaller, less complex aircraft and does not adequately prepare mechanics to work on the advanced technology and materials typically found on the aircraft that fly millions of passengers and cargo, and have consequently required their mechanics to take additional training.

FAA Establishes Core Curriculum but Has Not Made Significant Changes in Decades

FAA is responsible for developing the required or core curriculum for students attending aviation maintenance technician schools.²⁰ FAA established the present curriculum in the 1940s and, according to employers and school officials that we interviewed, the curriculum continues to reflect the technologies and material common to smaller, less complex aircraft of that era. Most of the industry employers with whom we interviewed indicated that the core curriculum at the A&P schools provided mechanics with a solid understanding of basic repair principles, but that some parts of the current curriculum are obsolete and cover aspects of aviation repair that are rarely needed or used by A&P mechanics. The curriculum does not provide A&P candidates with the training needed to maintain activities for aircraft that are used most prevalently today. The views of aviation employers about the curriculum are not new. Two studies (one sponsored by FAA) on the aviation mechanics' occupation, issued in 1970 and 1974, by the University of California, Los Angeles, indicated that the rapid rate of technological advances within the aviation industry made it necessary to update the instructional program then provided in most aviation maintenance technician schools.²¹ In addition, an FAA-sponsored report issued by researchers with Northwestern University's Transportation Center in 1999, concluded that aviation maintenance schools' core subjects on tasks involved with working with wood and dope and fabric structures²² and on soldering and welding should either be deleted or condensed because very few aviation mechanics performed tasks associated with these items frequently in any segment of the industry.²³ All three reports suggested changes in the A&P curriculum.

²⁰49 U.S.C. Sec. 44707.

²¹University of California, Los Angeles, *A National Study of the Aviation Mechanics Occupation* (1974) and the U.S. Office of Education and the California State Department of Education *Survey of the Aviation Mechanics Occupation* (Washington, D.C., and Sacramento, CA: 1970).

²²Dope and fabric are pre-World War II-era material used to cover the wings of older, general aviation aircraft such as crop dusters.

²³Northwestern University, The Transportation Center, *Job Task Analysis of the Aviation Maintenance Technician*, Evanston, Illinois: May 1999).

FAA Proposals to Change Curriculum and Certification Requirements Were Unsuccessful and the Agency Is Not Currently Considering Changes

FAA acknowledges that both the A&P curriculum and certification requirements are outdated and in need of revision. The agency attempted, in 1994 and 1998, to address both areas when it issued Notices of Proposed Rulemaking.²⁴ The 1994 proposal was the result of a series of recommendations made to FAA by a multiorganizational group convened for the purpose of reviewing existing regulations on the certification requirements for aviation mechanics. These recommendations included specifying all experience requirements in hours instead of months for initial certification and clarifying the procedures for taking the certification examination. Many of the recommendations in the 1994 proposed rule were incorporated in the 1998 proposed rule; however, FAA withdrew the proposals in 1999 after some organizations expressed concern about various items that were proposed. For example, according to an FAA-sponsored report,²⁵ the item on the withdrawn rule that drew the most negative comments specified recurrent training for aviation mechanics. In addition, the Air Force believed that the rule should have addressed the FAA process for the certification of military personnel more explicitly. According to an FAA official, new drafts of proposed revisions have been written, but their implementation is not part of the agency's current priority list for action.

In addition, the FAA-sponsored report concluded that the aviation mechanics' training and certification rules must reflect, among other things, the technology, certification levels, and training curricula needed by the domestic aviation industry. FAA officials indicated that the agency was taking the report's recommendations under advisement, but had no immediate plans to take action. The officials stated that FAA was reluctant to make significant changes to the curriculum, especially adding courses, because the cost of acquiring modern technologies for hands-on instruction would be cost prohibitive for some schools and they might close. In addition, FAA officials pointed out that aviation maintenance technician schools have some flexibility to make changes to their curriculum as long as they remain within FAA guidelines. Any additional courses would have to be approved by the local FAA inspectors and taken in addition to the

²⁴The announcements were made in the 59 *Federal Register* 42430, August 17, 1994, and 63 *Federal Register* 37172, July 9, 1998. They were withdrawn in the 64 *Federal Register* 42810, August 5, 1999.

²⁵R. Goldsby and A. Soulis, *Optimization of Aviation Maintenance Personnel Training and Certification* (Washington, D.C.: January 2002).

existing required 1,900-hour curriculum. However, school officials told us that adding hours to the current requirements might discourage some students from pursuing these advanced courses because of the additional cost to take them. In addition, many of the school officials agreed with FAA's contention that the cost of adding courses that focus on advanced technology and require expensive equipment would be cost prohibitive for some aviation maintenance technician schools.

Commercial Aviation Officials Believe that Curriculum Does Not Fully Prepare Mechanics to Work on Commonly Flown Aircraft and Have Added Training

According to officials from some major commercial airlines that we interviewed, the required curriculum at aviation maintenance technician schools does not fully prepare A&P mechanics to work on commonly flown, technologically advanced commercial aircraft. Those officials told us that today's modern aircraft require A&P mechanics to have a different set of skills than those being taught at aviation maintenance technician schools. Since A&P mechanics that are newly graduated from aviation maintenance technician schools lack the skills to work on modern aircraft, officials at some major airlines said they are reluctant to hire them directly from school.

In response to concerns about the curriculum, FAA officials said that while the schools provide some practical "hands-on" experiences, the agency does not require candidates for certification to develop a level of skill to work on or repair all the various aircraft, systems, and engines that exist. FAA officials concluded that the current A&P curriculum provides students with basic and theoretical knowledge of engines, aircraft structures, and other items that are necessary to make them eligible for FAA certifications. FAA's descriptions of the aviation schools' curriculum and mission generally echo those of some in the aviation industry, who also believe that the curriculum provides students with basic knowledge of some aircraft systems and structures. However, some commercial aviation industry officials are concerned that the basic courses are outdated and the systems and structures being taught to prospective A&P mechanics are for aircraft that do not transport the majority of the flying public.

The stakeholder panel and most of the employers that we interviewed identified several courses or technologies that they believe should be part of the aviation maintenance technician schools' A&P curriculum. Many of the panelists indicated that computer-related subjects should receive greater emphasis within the current curriculum. Other courses and technologies suggested by some officials with the commercial air carriers that we interviewed include composites,²⁶ repair of turbine engines, basic and technical writing, and reading comprehension. Officials frequently mentioned the need for training in composites. For example, aviation mechanics from BF Goodrich reported that the increasing use of composites in both the frames and engines of aircraft requires time-consuming and exacting techniques. They believed that mechanics need specialized training for working with composites, but it is not part of the required curriculum at aviation maintenance technician schools.

Officials from several commercial air carriers said that their suggestions were based on interactions with graduates of aviation maintenance technician schools and the lack of fundamental skills that they perceived from the schools' graduates. For example, a representative of one major commercial air carrier said that 75 percent of their newly hired A&P mechanics that graduated from aviation maintenance technician schools failed the air carrier's basic skills assessment test for mechanics.

The representatives of the major commercial airlines that we interviewed reported that some form of additional training was needed for newly hired A&P mechanics before they are allowed to work on aircraft, and none of the representatives indicated a problem with this approach. The airlines' practice has not changed since we initially reported it in a May 1991 report. At that time, we reported that representatives of the major airlines told us that their mechanics need 2 to 3 years of on-the-job training under close supervision, in addition to experience derived in an aviation maintenance school, to be fully productive.²⁷ Representatives of several major air carriers told us the training they provide is generally job and aircraft

²⁶Composites are a blend of materials used for the shell of aircraft. Composites replaced other types of materials, such as wood, aluminum, and dope and fabric, that were used to build aircraft because they were lighter, stronger, and more flexible than those other materials.

²⁷U.S. General Accounting Office, *Aircraft Maintenance: Additional FAA Oversight Needed of Aging Aircraft Repairs (Vol. 1)*, [GAO/RCED-91-91A](#) (Washington, D.C.: May 24, 1991).

specific. For example, Delta requires new hires to participate in classes that provide an introduction to commercial jets, instruction in basic maintenance, and safety rules. In addition, selected A&P mechanics also receive specialized training in hangar environments, aircraft systems, and troubleshooting for the specific types of aircraft in their fleet, as well as in other areas that may not be addressed by the aviation maintenance technician school curriculum. FAA officials stated that airlines have specific air carrier maintenance training requirements to ensure that aircraft maintenance personnel are competent.

In addition to initial training programs, many commercial airlines provide some form of ongoing or recurrent training to their mechanics, regardless of their level of experience. The airlines consider this additional training necessary, since aircraft equipment and components are constantly evolving as new technologies and maintenance techniques are developed. For example, Alaska Airlines reported that each mechanic typically receives at least 100 hours of formal company training each year in order to become familiar with new equipment and aircraft. However, while companies may voluntarily give ongoing training to their mechanics, it is encouraged but not required under current FAA regulations. Since many major commercial carriers already require ongoing training, such a requirement would have little impact on their mechanics.

Conclusions

FAA is responsible for setting the minimum requirements for the A&P mechanics' core curriculum, making sure that students are trained sufficiently to ensure aircraft safety, and reflecting the curriculum requirements in the mechanics' certification examination. However, the agency has made few substantive changes to the curriculum in decades. The required A&P curriculum at FAA-approved aviation maintenance technician schools is outdated and primarily geared to smaller less complex aircraft that do not transport significant numbers of passengers and, according to many in the aviation industry, not relevant to most of the aircraft flown today. Basic courses that train students to maintain and repair the body and engines of modern commercial aircraft are limited. FAA requires the schools to provide instruction on the repair of aircraft made from dope and fabric, while guidance on repairing aircraft made of composites and having sophisticated computer systems is limited. There are about 4,000 dope and fabric aircraft, many of them crop dusters, compared to tens of thousands of modern aircraft that transport millions of passengers and cargo in the United States.

Recommendations for Executive Action

We recommend that the Secretary of Transportation direct the FAA Administrator to review the minimum A&P curriculum required for FAA-approved aviation maintenance technician schools and identify courses that do not reflect widely used aircraft technology and materials on commonly flown major commercial aircraft. These courses should be de-emphasized or replaced with courses that address current conditions. We also recommend that the Secretary direct the Administrator to ensure that changes to the A&P school curriculum are reflected on the mechanic's certification examination, thus ensuring that all candidates for the A&P certificate meet the same standards.

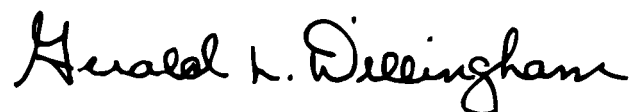
Agency Comments

We provided a draft of this report to the Departments of Transportation, Labor, and Defense for review and comment. FAA's Deputy Associate Administrator for Regulation and Certification and BLS's Assistant Commissioner, Office of Occupational Statistics and Employment Projections provided oral comments; the Department of Defense did not provide comments. FAA agreed to consider our recommendations and indicated it would work with the aviation community's ongoing efforts to review current and future skill requirements for aviation mechanics for commercial and general aviation. FAA noted that part of this review includes identifying skill requirements that may need to be revised. BLS indicated that the employment data used in this report and the description of their projection process were generally accurate. Both FAA and BLS provided clarifying comments and technical corrections, which we incorporated as appropriate.

As agreed with your office, unless you announce the contents of this report earlier, we plan no further distribution until 10 days from the report date. At that time, we will send copies of this report to other congressional committees; the Secretaries of the Departments of Transportation, Defense, and Labor; and the Administrator, FAA. Copies will also be

available to others upon request and at no cost on GAO's Website at www.gao.gov. If you or your staff have any questions about this report, please call me at (202) 512-3650. Major contributors to this report are listed in appendix IV.

Sincerely yours,

A handwritten signature in black ink that reads "Gerald L. Dillingham". The signature is written in a cursive style with a large, prominent initial "G".

Gerald L. Dillingham
Director, Physical Infrastructure Issues

Objectives, Scope, and Methodology

Our report focuses on the future supply and quality of training of aircraft mechanics. We addressed the following research questions: (1) How many aircraft mechanics and service technicians does the Bureau of Labor Statistics (BLS) project will be employed in 2010, and how reasonable is that projection? (2) What are the sources that supply and train A&P mechanics and the likelihood that they will provide a sufficient number of mechanics through 2010? and (3) What is being done by the Federal Aviation Administration (FAA) and the aviation industry to ensure that the skills of A&P mechanics are sufficient to work on technologically advanced aircraft?

To determine BLS' projected employment of aircraft mechanics and service technicians in 2010, we obtained the most recent projection reported by BLS, which was in December 2001. BLS developed this estimate as part of its biennial projection of nationwide employment in various occupations. BLS does not make separate employment projections for A&P mechanics. Rather, it uses the category "aircraft mechanics and service technicians" for people who are employed in the maintenance and repair of aircraft. To determine the reasonableness of the projection, we reviewed the process, methodology, and sources of information used by BLS to make the projection. We discussed this information in detail with BLS staff responsible for making the occupational projection. We did not verify the data that BLS collects and uses, and we did not evaluate the assumed values it uses for forecasting key economic and demographic factors.

To identify the sources that supply A&P mechanics and determine whether they would be able to provide a sufficient number of mechanics through 2010, we used a modified Delphi technique¹ to survey representatives of aviation maintenance technician schools and aviation mechanics' organizations and businesses; conducted case study work at several locations; and interviewed FAA and military officials. The modified Delphi technique we used involved getting the commitment of representatives of 17 government and industry organizations to serve on a stakeholder panel and developing and distributing 2 self-administered questionnaires to panel members. The 17 organizations represented on the panel are listed in table 4. Results from the first questionnaire were summarized in the second survey and used to develop additional questions. Fifteen panelists

¹We used a two-stage process in which initially, panelists are surveyed individually and are subsequently asked to respond to group's comments.

responded to the first questionnaire and 13 to the second. Panelists' responses to the questionnaires are shown in appendixes II and III.

Table 4: Organizations Represented on the Stakeholder Panel

Segment of aviation industry represented	Organization
Federal government	Federal Aviation Administration
Aviation maintenance technician schools	Aviation High School Pittsburgh Institute of Aeronautics Purdue University Westwood College of Aviation
Umbrella organization for aviation maintenance technician schools	Aviation Technician Education Council
Trade associations and unions for aviation mechanics	Aircraft Mechanics Fraternal Association Association for Women in Aviation Professional Aviation Maintenance Association International Association of Machinists and Aerospace Workers International Brotherhood of Teamsters
Industry groups whose members employ or use aviation mechanics	Aeronautical Repair Station Association Aircraft Owners and Pilots Association Air Transport Association National Air Transportation Association National Business Aviation Association, Inc. Regional Airline Association

Source: GAO.

To better understand the role of the U.S. military as a source of aviation mechanics, we obtained data on the current number of aviation mechanics for the Coast Guard, Navy, Army, Air Force, and Marine Corps. We also interviewed military and civilian officials at Fort Eustis, VA, and the Pentagon to obtain information on DOD initiatives to assist military aviation mechanics in pursuing A&P certification. We obtained and analyzed information and data on A&P and repairmen's certifications and the aviation maintenance technician schools' curriculum from FAA's headquarters and FAA's Mike Monroney Aeronautical Center in Oklahoma City.

In addition to the locations cited above, we also obtained information and data on aviation mechanics on visits to six locations: Atlanta, GA; Dallas, TX; Orlando and Daytona Beach, FL; Seattle, WA; Oklahoma City, OK; and Ft. Eustis, VA. We chose Atlanta, Dallas, and Seattle to obtain geographical

**Appendix I
Objectives, Scope, and Methodology**

diversity, and because located in each city are FAA field offices, aviation maintenance technician schools, commercial and regional airlines, repair stations, and fixed-based operations that we wanted to contact. Orlando and Daytona Beach were selected because they have an FAA field office and prominent aviation maintenance school, respectively. Oklahoma City is the location of FAA's A&P certification database and FAA-managed computer-based training program for military aviation mechanics. The cities and organizations where we conducted our work are shown in table 5.

Table 5: Interview Locations and Organizations

Location	Type of organization	Participant
Atlanta, GA	Commercial air carrier	Delta Airlines
	Regional air carrier	Atlantic Southeast Airlines
	Federal government	FAA's Atlanta field office
	Fixed-base operation	Epps Aviation
	Repair station	Raytheon Aircraft Services
	School	Atlanta Technical College
Dallas, TX	Commercial air carrier	American Airlines
	Regional air carrier	American Eagle Airlines
	Federal government	FAA's Dallas field office
	Fixed-base operation	Hank's Corporate Maintenance, Inc.
	Repair station	Texas Pneumatic Systems, Inc.
	School	Aviation Maintenance Training, Inc.
	Training facility	Bombardier
Fort Eustis, VA	Federal government	U.S. Army Aviation Logistics School
Oklahoma City, OK	Federal government	FAA's Mike Monroney Aeronautical Center
Orlando, FL	Federal government	FAA's Orlando field office
Daytona, FL	School	Embry-Riddle Aeronautical University
Seattle, WA	Commercial air carrier	Alaska Airlines
	Regional air carrier	Horizon Airlines
	Federal government	FAA's Seattle field office
	Fixed-base operation	Galvin Flying Services
	Repair station	Goodrich Aviation Technical Service, Inc.
	School	South Seattle Community College
	Training facility	Boeing

Source: GAO.

To obtain information on the adequacy of the supply of mechanics through 2010, we conducted interviews with representatives from eight major commercial air carriers: Alaska Airlines, American Airlines, Continental Airlines, Delta Airlines, Federal Express, Inc., Northwest Airlines, Southwest Airlines, and United Airlines. We obtained information and data on their A&P mechanics, salaries, perceptions of their ability to hire qualified mechanics in the future, and other issues relevant to this assignment. In addition, we obtained information on employment issues from PlaneTechs Aircraft Maintenance and AirMate, companies that provide contract mechanics to employers. We also interviewed a representative of the Aircraft Electronics Association, to obtain information on the future supply of aviation mechanics. We also obtained and analyzed numerous articles on the supply of aviation mechanics and the supply and demand principles for the overall employment market.

To obtain information on the likelihood that there will be a sufficient number of qualified mechanics through 2010, we also developed questionnaires for A&P students and A&P mechanics that asked about their immediate and long-term career plans in aviation mechanics. We distributed the questionnaires for A&P students at the aviation maintenance technician schools that we visited in Dallas, Atlanta, and Seattle to a few students. We also asked the officials of the commercial and regional carriers, repair stations, and fixed-based operations that we visited in those cities to make the questionnaire available to their A&P mechanics for completion. We received 121 and 53 responses from the students and mechanics, respectively. This information is anecdotal and cannot be generalized to other students and mechanics. The responses to these questionnaires are shown in appendixes IV and V.

To obtain information about the effect that a shortage of skilled aviation mechanics would have on aviation safety, we met with representatives of the National Transportation Safety Board. In addition, we talked with staff from the Department of Transportation's Office of Inspector General, about their previous investigation of designated mechanic examiner violations and about current efforts under way to study the issue.

To identify government and private sector initiatives to impact the quality and supply of aviation mechanics, we obtained information from the stakeholder panel. We also interviewed FAA and DOD officials, and aviation industry representatives, particularly employers, to determine their agencies' plans to promote interest in the aviation field. In addition, we analyzed the federal regulations that govern the certification of A&P

mechanics and repairmen, and give FAA authority to approve aviation maintenance technician schools and establish their curriculum. We conducted a comprehensive literature search and analyzed various reports addressing aviation maintenance issues and their recommendations.

We conducted our review from October 2001 through February 2003 in accordance with generally accepted government auditing standards.

Survey of Aviation Mechanics Stakeholder Panel—Overall Responses to Survey Questions



U.S. General Accounting Office

Survey of Aviation Mechanics Stakeholder Panel – Overall Responses to Survey Questions

INTRODUCTION

Thank you for agreeing to be on GAO's stakeholder panel for discussion about issues related to the future need for aviation mechanics and repairpersons. Please note we are not including avionics technicians in this survey. We will be calling on you twice to respond to questions about these issues.

In this, the first request for opinions, we ask that you fill out the attached questionnaire, paying particular attention to the "short answer" questions. For our second request, we plan to summarize the results of these "short answer" questions and other questions, and ask everyone on the panel to respond to each other's ideas.

We encourage you to have others in your organization help respond if you believe they have some additional knowledge.

Please complete and return this survey within two weeks by **faxing it** to (202) 512-3766, attention Phillis Riley. If you have any questions, please call Phillis Riley at 202-512-9229 (email: riley@gao.gov).

BACKGROUND

1. Please provide your name and identifying information in case we want to ask you more about your responses.

Name _____

Organization _____

Phone _____

Email _____

2. Which of the following categories best describe your industry affiliations for the purposes of GAO's stakeholder panel? (*Check all that apply.*)

- 1. Major passenger air carriers
- 2. Regional or commuter passenger air carriers
- 3. Cargo air carriers
- 4. General aviation
- 5. FAA-approved aviation maintenance schools
- 6. Trade association
- 7. Union
- 8. Repair stations
- 9. FAA
- 10. Other (Please specify.)

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

EMPLOYMENT TRENDS

3. Prior to September 11, 2001, concerns were expressed that employers would have difficulty in the future finding people to fill jobs as aviation mechanics. In your opinion, how much of a concern was this prior to September 11, 2001? *(Check one.)*

- 1. 4 Very great concern
- 2. 5 Great concern
- 3. 4 Moderate concern
- 4. 1 Somewhat of a concern
- 5. 1 Little or no concern
- 6. 0 No opinion; no basis to judge

4. In your opinion, how much of a problem was turnover among aviation mechanics before September 11, 2001? *(Check one for each.)*

- 1. 0 Major problem
- 2. 12 Moderate problem
- 3. 3 Minor problem
- 4. 0 Not a problem → Skip to Question 6
- 5. 0 No basis to judge; no opinion → Skip to Quest.6

5. Please describe the nature of any turnover problems prior to September 11, 2001.

6. In your opinion, how much of a problem has turnover among aviation mechanics been since September 11, 2001? *(Check one for each.)*

- 1. 2 Major problem
- 2. 5 Moderate problem
- 3. 3 Minor problem
- 4. 4 Not a problem → Skip to Question 8
- 5. 1 No basis to judge; no opinion → Skip to Quest.8

7. Please describe the nature of any turnover problems since September 11, 2001.

8. Are you aware of any instances in the five years prior to September 11, 2001 when a specific employer or employers had problems hiring certified mechanics for positions they were seeking to fill? *(Check one.)*

- 1. 4 No
- 2. 10 Yes → *Please describe the nature of the problem and how it was solved.*
- 3. 0 No basis to judge; no opinion

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

FUTURE DEMAND FOR AVIATION MECHANICS

9. The current demand for aviation mechanics has been significantly affected by the terrorist attack of September 11, 2001. In your opinion, about when will the demand for air travel return to “normal” if there are no further terrorist attacks on aviation? (*Enter month and year or check “no opinion”.*)

_____ 3—2002; 6—2003; 1—2004
(month, year)
4 No opinion

10. FAA (the Federal Aviation Administration) estimates that aviation passengers will reach 1 billion by 2013. In your opinion, how reasonable or unreasonable is the FAA estimate? (*Check one.*)

- 1. 3 Very reasonable
- 2. 6 Moderately reasonable
- 3. 3 Neither reasonable nor unreasonable
- 4. 1 Moderately unreasonable
- 5. 0 Very unreasonable
- 6. 2 No opinion

11. The U.S. Department of Labor’s Bureau of Labor Statistics (BLS) reports that about 160,000 aviation mechanics were employed in 2000. BLS estimates that in 2010 there will be about 185,000 employed aviation mechanics. In your opinion, how reasonable or unreasonable is the BLS estimate for 2010? (*Check one.*)

- 1. 2 Very reasonable
- 2. 5 Somewhat reasonable
- 3. 5 Just as reasonable as not
- 4. 2 Somewhat unreasonable→Please explain.
- 5. 0 Very unreasonable→Please explain.
- 6. 1 No opinion

12. In your opinion, which of the following is the most likely employment situation for aviation mechanics in 2010? (*Check one.*)

- 1. 11 Employers will have difficulty filling aviation mechanics positions
- 2. 1 Trained aviation mechanics will have difficulty finding jobs in the field
- 3. 2 There will be a rough balance between aviation mechanics positions offered and jobs sought
- 4. 1 No opinion

13. BLS is projecting that productivity improvements between now and 2010 will reduce the amount of time it takes to repair an aircraft. Two examples are automated inventory controls and greater use of modular systems in airplanes. In your opinion, how likely or unlikely is it that such productivity improvements will occur by 2010? (*Check one.*)

- 1. 1 Very likely
- 2. 4 Moderately likely
- 3. 3 Just as likely as not
- 4. 4 Moderately unlikely
- 5. 3 Very unlikely
- 6. 0 No opinion

14. In your opinion, how reasonable or unreasonable is it to project that fewer mechanics will be needed per plane as a result of these productivity improvements? (*Check one.*)

- 1. 0 Very reasonable
- 2. 1 Moderately reasonable
- 3. 3 Neither reasonable nor unreasonable
- 4. 7 Moderately unreasonable
- 5. 4 Very unreasonable
- 6. 0 No opinion

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

15. In your opinion, what recent technological changes, if any, will affect the demand for aviation mechanics or the skills they require? *(Describe the changes under one of the impacts listed below.)*

A. Changes that will increase demand for mechanics

- 1.
- 2.
- 3.
- 4.

B. Changes that will decrease demand for mechanics

- 1.
- 2.
- 3.
- 4.

C. Changes that will significantly alter the skills mechanics need

- 1.
- 2.
- 3.
- 4.

**Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions**

SUPPLY OF AVIATION MECHANICS

16. Based on your knowledge, how important to mechanics considering jobs in the aviation industry are each of the following factors? *(Check one for each factor.)*

	Extremely important (1)	Very important (2)	Moderately important (3)	Somewhat important (4)	Not at all important (5)	No basis to judge (6)
1. Initial salary or wage	8	4	3	0	0	0
2. Opportunities for salary/wage increases	5	9	1	0	0	0
3. Opportunities for career advancement	2	9	4	0	0	0
4. Health insurance	5	6	3	1	0	0
5. Sick leave	2	7	4	2	0	0
6. Vacation leave	2	8	2	3	0	0
7. Pension or retirement benefits	3	9	2	1	0	0
8. Free air travel	0	4	5	5	1	0
9. Other benefits (e.g., insurance, child care)	1	6	7	1	0	0
10. Opportunity to work around airplanes	6	5	4	0	0	0
11. Challenging nature of the work	2	12	1	0	0	0
12. Work schedules that do not include nights or weekends	3	4	7	1	0	0
13. Potential liability for workmanship/errors	3	7	1	0	0	0
14. Ability to work indoors in bad weather	1	3	7	3	1	0
15. Desire to work in a particular location	2	4	6	3	0	0
16. Amount of training/time required for certification	2	6	3	4	0	0

17. In your opinion and/or experience, what other factors are at least moderately important to mechanics considering jobs in the aviation industry? *(Please describe in the space below.)*

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

18. Based on your knowledge, when aviation mechanics consider leaving the aviation industry for a job in another industry, how important is each of the following as a reason for leaving? *(Check one for each reason.)*

Reasons	Extremely important (1)	Very important (2)	Moderately important (3)	Somewhat important (4)	Not at all important (5)	No basis to judge (6)
1. Increased salary	10	4	1	0	0	0
2. More opportunity for overtime	1	1	7	2	4	0
3. Opportunities for career advancement	4	9	1	0	0	0
4. Health insurance	2	5	3	2	3	0
5. Better sick leave benefits	2	4	3	3	3	0
6. Better vacation leave benefits	2	4	3	3	3	0
7. Better pension or retirement benefits	2	7	1	2	3	0
8. Other benefits (e.g., insurance, child care)	2	3	3	5	2	0
9. More challenging work	0	3	8	2	2	0
10. Less taxing work	2	4	4	4	1	0
11. Work schedules that don't include nights/weekends	5	7	1	2	0	0
12. Reduced or no liability for errors or workmanship	5	4	1	4	1	0
13. No outdoor work in bad weather	2	2	8	2	1	0
14. Quieter workplace	1	1	5	7	1	0
15. Opportunities to update skills	2	5	2	2	4	0
16. Desire to work in a particular location	1	4	5	5	0	0

19. In your opinion and/or experience, what other reasons are at least moderately important to aviation mechanics considering changing jobs to another industry? *(Please describe in the space below.)*

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

TRAINING

20. Based on your knowledge, where do most aviation mechanics receive their training prior to initial employment in your segment of the aviation industry? *(Check the single most common source of training for new hires.)*

- 1. 12 FAA-approved aviation maintenance school
- 2. 1 Military aviation training
- 3. 1 Civilian on-the-job training
- 4. 0 Other (Please specify.)
- 5. 1 No basis to judge

21. Based on your knowledge, please rank the following 3 sources in terms of the quality of initial training they provide for aviation mechanics. *(Assign the number 1 to the source that provides the best training, 2 for the second best training, 3 for the third best training.)*

Average Rank Source of Training

- 1. FAA-approved aviation maintenance schools
- 2. Military aviation training
- 3. Civilian on-the-job training
- 4. No basis to judge

14 total respondents

22. Based on your knowledge, which of the following methods best describes how aviation mechanics typically learn about **equipment upgrades**? *(Check one.)*

- 1. 7 On-the-job training
- 2. 5 Special training classes
- 3. 1 Printed materials (e.g., manuals, regulation updates, etc.)
- 4. 1 Other *(Please specify.)*
- 5. 1 No basis to judge

23. Based on your knowledge, which of the following methods best describes how aviation mechanics typically learn about **technological advances**? *(Check one.)*

- 1. 5 On-the-job training
- 2. 3 Special training classes
- 3. 5 Printed materials (e.g., manuals, regulation updates, etc.)
- 4. 1 Other *(Please specify.)*
- 5. 1 No basis to judge

24. In your opinion, to what extent do FAA-approved aviation maintenance schools make changes to address technological advances in aviation maintenance (e.g., curriculum changes, equipment upgrades, etc.)? *(Check one.)*

- 1. 5 Little or no extent
- 2. 6 Some extent
- 3. 2 Moderate extent
- 4. 1 Great extent
- 5. 0 Very great extent
- 6. 1 No basis to judge; no opinion

**Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions**

25. In your opinion, how much do each of the following factors encourage or discourage enrollment at FAA-approved aviation maintenance schools? *(Check one for each factor.)*

Factor	Greatly discourages (1)	Somewhat discourages (2)	No effect (3)	Somewhat encourages (4)	Greatly encourages (5)	No opinion (6)
1. Prospects for future employment	0	3	0	4	8	0
2. Likely future salary or wage	2	1	0	5	7	0
3. Availability of training in the military	0	1	9	4	0	1
4. Location of the school	0	1	2	11	0	1
5. Tuition and other costs	0	5	6	3	1	0
6. Breadth of curriculum	0	1	2	9	2	1
7. Focus on latest technologies	0	0	4	4	5	2
8. Other <i>(Please specify.)</i>	0	1	0	0	3	0

26. What actions, if any, have FAA-approved aviation maintenance schools taken to address declining enrollments or to maintain high enrollment levels? *(Please describe specific actions that individual schools have taken.)*

27. Overall, how would you rate the quality of training that is currently provided by FAA-approved aviation maintenance schools? *(Check one.)*

- 1. 1 Excellent
- 2. 5 Good
- 3. 6 Average
- 4. 1 Below Average
- 5. 0 Poor
- 6. 2 No opinion; no basis to judge

28. In your opinion, how much does the quality of training vary across FAA-approved aviation maintenance schools? *(Check one.)*

- 1. 2 Varies extremely
- 2. 3 Varies greatly
- 3. 4 Varies moderately
- 4. 4 Varies somewhat
- 5. 0 Varies hardly or not at all
- 6. 2 No opinion; no basis to judge

29. In what ways, if any, could the quality of training in FAA-approved aviation maintenance schools be improved? *(Please describe below.)*

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

FAA REGULATIONS AND PROGRAMS

30. How familiar are you with FAA's regulation on the certification of aviation mechanics (FAR Part 65—Certification of Airmen Other Than Flight Crewmembers)? *(Check one.)*

1. 10 Very familiar
2. 4 Moderately familiar
3. 1 Somewhat familiar
4. 0 Not at all familiar →Skip to Q32

31. In your opinion, which aspects of FAR Part 65 have been working well and which need to be modified? *(Please identify and explain.)*

A. Working well

- 1.
- 2.
- 3.

B. Modifications needed

- 1.
- 2.
- 3.

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

32. How familiar are you with FAA's regulation on the certification of aviation maintenance schools (FAR Part 147—Aviation Maintenance Technician Schools)?
(Check one.)

1. 5 Very familiar
2. 4 Moderately familiar
3. 3 Somewhat familiar
4. 3 Not at all familiar →Skip to Q34

33. In your opinion, which aspects of FAR Part 147 have been working well and which need to be modified? (Please identify and explain.)

A. Working well

- 1.
- 2.
- 3.

B. Modifications needed

- 1.
- 2.
- 3.

34. How familiar are you with FAA's Aviation Maintenance Technician Awards Program?
(Check one.)

1. 6 Very familiar
2. 4 Moderately familiar
3. 3 Somewhat familiar
4. 2 Not at all familiar →Skip to Q37

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

35. In your opinion, how much of an incentive does the Aviation Maintenance Technician Awards Program provide **to mechanics** to seek training? *(Check one.)*

- 1. 4 Little or no incentive
- 2. 6 Some incentive
- 3. 1 Moderate incentive
- 4. 1 Great incentive
- 5. 0 Very great incentive
- 6. 1 No opinion; can't say

36. In your opinion, how much of an incentive does the Aviation Maintenance Technician Awards Program provide **to employers** to offer training? *(Check one.)*

- 1. 5 Little or no incentive
- 2. 2 Some incentive
- 3. 4 Moderate incentive
- 4. 1 Great incentive
- 5. 0 Very great incentive
- 6. 2 No opinion; can't say

37. Would you support or oppose a requirement from FAA that aviation mechanics must receive annual training in order to keep their certifications? *(Check one.)*

- 1. 7 Strongly support
- 2. 3 Moderately support
- 3. 1 Neither support nor oppose
- 4. 0 Moderately oppose
- 5. 3 Strongly oppose
- 6. 1 No opinion

Appendix II
Survey of Aviation Mechanics Stakeholder
Panel—Overall Responses to Survey
Questions

38. In your opinion, how many hours of annual training should aviation mechanics receive in order to keep their certifications? *(Enter number of hours or zero. If you have no opinion, check the box below.)*

_____ hours 0 hrs—3; <20 hrs—4; ≥ 20 hrs—4

No opinion

39. In your opinion, what practical steps, if any, can **FAA** take to make employment in the aviation industry more attractive to mechanics? *(Please describe in the space below.)*

40. In your opinion, what practical steps, if any, can **the aviation industry** take to make employment in the aviation industry more attractive to mechanics? *(Please describe in the space below.)*

41. Please provide any additional observations or comments you may have on issues related to aviation mechanics.

Thank you for your assistance.

Survey of Aviation Mechanics Stakeholder Panel—2nd Round



U.S. General Accounting Office

Survey of Aviation Mechanics Stakeholder Panel—2nd Round

INTRODUCTION

Thank you for participating in the GAO Panel on Aviation Maintenance. As we expected, the initial responses raised some new issues that are included in the attached survey. As promised some summary information about the initial responses is also included. This survey is our last formal data request for you as a panelist.

Please complete the survey within two weeks so we can summarize this important information for our report to Congress. Please fax your completed survey to Phillis Riley at (202) 512-3766. Do not mail the survey. If you have any questions or your response will be delayed, please contact Phillis Riley at (202) 512-9229 (email: riley@ga.gov).

Thank you again for your public service.

BACKGROUND

1. Please provide your name and identifying information in case we want to ask you more about your responses.

Name _____

Organization _____

Phone _____

Email _____

EMPLOYMENT TRENDS

Your views

In our first inquiry, the majority of our 15 panelists reported

- prior to September 11, 2001, there were at least moderate concerns over the future availability of aviation mechanics (13 panelists);
- turnover was a moderate problem prior to September 11, 2001 (12 panelists) and is still a problem now although less of one (only 4 panelists said it was not a problem now);
- the Bureau of Labor Statistics' assumption that productivity improvements will reduce the number of mechanics needed per plane is unreasonable (11 panelists); and
- a belief that in 2010 employers will have difficulty filling aviation mechanics' positions (11 panelists).

**Appendix III
Survey of Aviation Mechanics Stakeholder
Panel—2nd Round**

2. Panelists identified changes listed below that they believe will affect the future demand for aviation maintenance technicians (AMTs). A. Please indicate whether you agree or disagree that the change will occur by 2010. B. If you agree, rate the effect of the change on the demand for AMTs by 2010. Do you think the change will increase or decrease or have no overall effect on the demand for AMTs by 2010?

Possible Change by 2010	A. Change by 2010 <i>(check one for each change)</i>			B. Effect on demand for AMTs in 2010 <i>(check one for each change you agreed would occur by 2010)</i>					
	Agree	Dis-agree	Not certain	Increase greatly	Increase some	No effect	Decrease some	Decrease greatly	No opinion; no basis to judge
1. More retirees	12	0	2	6	6	0	0	0	0
2. More aircraft	12	1	1	5	6	2	0	0	0
3. More flights/passengers	13	0	1	5	7	1	0	0	0
4. Fewer air carriers	7	2	5	0	2	3	2	0	0
5. Increased federal regulation	9	1	4	2	3	4	0	0	2
6. Increased wages and/or benefits for mechanics	9	1	4	2	3	2	1	0	1
7. Work schedule limitations for AMTs	4	4	6	1	2	2	0	0	1
8. More specialization of mechanics	8	4	2	2	4	2	0	0	1
9. Use of technologically sophisticated diagnostic tools	11	3	0	0	6	4	1	0	0
10. Continued use of aging aircraft	12	1	1	4	6	2	0	0	0
11. Increased dependence on electronics and computers in aircraft	13	0	1	3	1	6	1	0	1
12. More complex passenger entertainment systems	10	1	3	2	4	4	0	0	0
13. Use of new, low maintenance materials	8	4	2	0	1	4	3	0	0
14. Increase in aircraft system complexity	11	1	2	2	7	2	0	0	0
15. Increased use of foreign repair stations by U.S. carriers	4	4	6	1	1	0	2	0	1

SUPPLY OF AVIATION MECHANICS

Your views

In our initial inquiry about the factors that are important to mechanics, the majority of panelists in each industry segment (representatives of employers, employees, and schools) reported

A) the following factors were very to extremely important to mechanics considering jobs in the aviation industry:

- initial salary or wage
- opportunities for salary/wage increases
- the opportunity to work around airplanes
- the challenging nature of the work

B) the following factors were very to extremely important to mechanics considering leaving the aviation industry for a job in another industry:

- increased salary or wage
- opportunities for career advancement
- work schedules that do not include nights or weekends

3. A recurring theme among panelists was the view that while aviation maintenance has become a highly skilled trade, it continues to be perceived, within and outside the industry, as unskilled or semi-skilled labor. In your opinion, how much would a change in perception from unskilled or semi-skilled to skilled labor improve the image/respect for AMTs? (*Check one.*)

1. 1 Hardly or not at all improve
2. 0 Somewhat improve
3. 4 Moderately improve
4. 8 Greatly improve
5. 1 Very greatly improve

4. In your opinion, how much does the perception of aviation maintenance as unskilled or semi-skilled labor discourage qualified people from **entering the field**? (*Check one.*)

1. 2 Discourages hardly or not at all
2. 2 Somewhat discourages
3. 7 Moderately discourages
4. 3 Greatly discourages
5. 0 Very greatly discourages

5. In your opinion, to what extent does the perception of aviation maintenance as unskilled or semi-skilled labor discourage qualified people from **staying in the field**? (*Check one.*)

1. 5 Discourages hardly or not at all
2. 3 Somewhat discourages
3. 5 Moderately discourages
4. 1 Greatly discourages
5. 0 Very greatly discourages

**Appendix III
Survey of Aviation Mechanics Stakeholder
Panel—2nd Round**

6. Several panelists raised concerns over the safety of the AMTs' and repairpersons' working environment as well as the safety of the aircraft. In your opinion, to what extent do the following employment conditions affect (a) the personal safety of the AMTs and/or repairpersons and (b) the safety of the aircraft they work on? *(Check one for each row.)*

Employment condition	A. Affects the personal safety of AMTs and/or Repairpersons					
	Little or no extent	Some extent	Moderate extent	Great extent	Very great extent	No opinion
1. Routine overtime for AMTs and/or repairpersons (e.g., more than 40 hours per week)	5	4	3	0	0	1
2. Working outdoors after sunset and before sunrise	4	5	1	1	0	2
3. Working outdoors in adverse weather conditions	0	5	4	2	2	0
4. Hiring workers with little or no experience and placing them on the job	1	2	1	4	3	1
5. AMTs and/or repairpersons routinely working more than 8 hours per day	3	6	3	0	0	1
6. Productivity stress (e.g., taking shortcuts to meet schedules)	2	2	2	4	2	1
7. Interpersonal stress (among coworkers or with management)	2	0	7	2	1	1
8. Other (specify)	0	0	0	0	1	1

Employment condition	B. Affects the safety of aircraft serviced by AMTs and/or Repairpersons					
	Little or no extent	Some extent	Moderate extent	Great extent	Very great extent	No opinion
1. Routine overtime for AMTs and/or repairpersons (e.g., more than 40 hours per week)	6	4	2	1	0	0
2. Working outdoors after sunset and before sunrise	4	6	1	1	0	1
3. Working outdoors in adverse weather conditions	1	6	3	1	2	0
4. Hiring workers with little or no experience and placing them on the job	0	3	2	4	4	0
5. AMTs and/or repairpersons routinely working more than 8 hours per day	4	5	2	0	2	0
6. Productivity stress (e.g., taking shortcuts to meet schedules)	1	3	3	4	2	0
7. Interpersonal stress (among coworkers or with management)	1	3	5	3	1	0
8. Other (specify)	0	0	1	0	0	1

Appendix III
Survey of Aviation Mechanics Stakeholder
Panel—2nd Round

7. Also, based on your knowledge, how prevalent or rare are these employment conditions, industry-wide? (Check one for each row.)

Employment Condition	Rarely used	Sometimes used	Moderately prevalent	Very prevalent	No basis to judge
1. Routine overtime for AMTs and/or repairpersons (e.g., more than 40 hours per week)	0	3	5	5	0
2. Working outdoors after sunset and before sunrise	1	1	6	5	0
3. Working outdoors in adverse weather conditions	1	3	4	5	0
4. Hiring workers with little or no experience and placing them on the job	2	6	3	2	0
5. AMTs and/or repairpersons routinely working more than 8 hours per day	0	3	4	6	0
6. Productivity stress (e.g., taking shortcuts to meet schedules)	1	7	2	3	0
7. Interpersonal stress on the job (e.g. among coworkers, or between workers and management)	2	3	6	2	0
8. Other (specify)	0	0	0	1	0

Appendix III
Survey of Aviation Mechanics Stakeholder
Panel—2nd Round

Your views

- The majority of panelists ranked FAA-approved aviation maintenance schools above both military aviation and civilian on-the-job training in quality of training (for civilian employment implied).
- The majority of panelists rated the quality of training at FAA-approved schools as average or good. Only one panelist rated quality at FAA-approved schools excellent and one, below average.
- The most common criticism of the schools by the panelists was that they only make changes that address technological advances to a limited extent.
- When we asked panelists how to improve the quality of training in FAA-approved schools, the most commonly identified improvement was updating the curriculum to focus on new technologies. Updating the curriculum

was also suggested frequently as an action that FAA should take.

8. In your opinion, how much do FAA regulations help or hinder FAA-approved aviation maintenance schools from continuously updating their curriculum as new technologies emerge? (*Check one.*)

1. 0 Greatly help
2. 1 Somewhat help
3. 2 Neither help nor hinder
4. 6 Somewhat hinder
5. 5 Greatly hinder
6. 0 No basis to judge

9. In your opinion, to what extent, if at all, do the curriculum requirements in FAR Part 147 (e.g., the appendices) need to be revised?

1. 1 Little or no extent
2. 3 Some extent
3. 4 Moderate extent
4. 1 Great extent
5. 4 Very great extent
6. 1 No basis to judge

Appendix III
Survey of Aviation Mechanics Stakeholder
Panel—2nd Round

10. Listed below are some of the technologies panelists suggested should be included in the training curriculum for AMTs and repairpersons. In your opinion, how important is it for new AMTs and repairpersons to be able to work with these technologies when they are first hired? *(Check one for each technology.)*

Technology	Hardly or not at all important	Somewhat important	Moderately important	Very important	Extremely important	No opinion
1. New engine technologies	1	1	2	6	3	0
2. Propeller and rotor systems	0	3	4	5	1	0
3. Digital electronics	1	0	2	4	6	0
4. Composite materials and metal	0	1	3	3	6	0
5. Computerized or automated systems in aircraft	0	1	1	7	4	0
6. Computerized diagnostic tools	0	3	3	4	3	0
7. Avionics	0	2	1	7	3	0
8. New aircraft design	1	5	3	2	1	0

**Appendix III
Survey of Aviation Mechanics Stakeholder
Panel—2nd Round**

FAA Regulations and Programs

Your views:

- Ten of the 12 panelists who responded to our questions on the AMT Awards Program thought the incentive it provided for mechanics to seek training was some, little or none.
- Five panelists rated the Awards Program's incentive to employers to offer training as moderate or great but the majority (7) rated that incentive as some, little or none.
- Ten out of 14 panelists supported a requirement from FAA that AMTs receive annual training in order to keep their certifications. The suggested hours of annual training ranged from 0 to 80.

These are some of the suggestions panelists had for FAA :

- Update regulations (including curriculum) to reflect modern aviation needs
- Promote the need for continuous education
- Increase the number of seminars offered
- Help with recruitment
- Increase partnerships/visibility with AMT groups, schools, and employers
- Require foreign repair stations to meet U.S. standards for AMT certification

These are some of the panelists' suggestions for the aviation industry:

- Increase professional respect for the responsibilities of the job (e.g., salary, benefits, job titles, career development and training opportunities, better working conditions—hours and schedules)
- Increase job security
- Increase safety of the working environment
- Improve recruitment efforts (e.g. partnering with technical schools, visibility in elementary and high schools, more flattering recruitment ads)

**Appendix III
Survey of Aviation Mechanics Stakeholder
Panel—2nd Round**

11. Some panelists proposed additions to FAA regulations. In your opinion, would you support or oppose each of the following proposed additions to FAA regulations? (*Check one for each proposed regulation.*)

Proposed regulation	Strongly support	Generally support	Neither support nor oppose	Generally oppose	Strongly Oppose	No opinion
1. A mandatory recurrent training requirement	7	4	1	0	1	0
2. A training/exam requirement for English as a second language	4	7	1	1	0	0
3. Work-hours limitation for maintenance personnel	1	4	5	2	0	1
4. Training required in aircraft maintenance record keeping	5	5	3	0	0	0
5. A training option for military personnel to acquire FAA certification	6	6	1	0	0	0
6. Require AMTs to maintain current address information in FAA's Civil Aviation Registry	5	7	1	0	0	0
7. Provide a mechanism for communicating new regulatory information to AMTs and repairpersons	7	4	2	0	0	0

12. Please provide any additional comments or clarifications you would like to make at this time.

Thank you again for your cooperation.

Responses from A&P Mechanics

RESPONSES FROM A&P MECHANICS

1. Type of facility where employed (e.g., repair station, FBO¹, airline).

Airline - 74% (39)
 FBO - 15% (8)
 Repair Station - 9% (5)

2. Does this facility deal primarily with commercial or general aviation aircraft?

66% (35) – commercial 25% (13) – general aviation

3. Type of mechanic:

96% Certificated A&P
 1% Certificated Airframe
 1% Certificated Powerplant
 1% Certificated Inspector
 1% Certificated repairperson
 _____ Non-certificated repairperson. (Go to question 4).
 _____ Other

4. Do you plan to become certificated? How do you plan to get the training or education that is needed to become certificated?

No responses.

5. What led you to choose a career as an aviation mechanic?

Code number	Discussion topic	% respondents out of 53 who gave this response in Q5
1	Like airplanes	49
2	Mechanical aptitude/interest	32
3	Military experience	15
4	Family background in aviation	13
5	Salary/pay	6
6	Job benefits	0
7	Free air travel	2
8	Challenging work	9
9	Other job in aviation	0
10	Small amount of training required	2
11	Advertisements	4
12	On the job training	0
13	Diversity of work	4
14	Responsibility of job	0
15	Hours/work schedule	0
16	Location	0
17	Job security	2
18	Good job market	0
19	Good career/transferable skills	0
20	Other (specify)	13

¹ Fixed-based operations.

Appendix IV
Responses from A&P Mechanics

6. Where did you receive your initial aviation mechanic's training (e.g., military, A&P school, on-the-job)?

A&P school: 70% (37)
 Military: 21% (11)
 On-the-job training: 2% (1)
 Other: 8% (4)

7. Where did you find employment immediately becoming certificated (type of facility)?

Airline: 57% (30)
 FBO: 23% (12)
 Repair Station: 11% (6)
 Other: 6% (3)

8. How many years have you been employed in the aviation industry?

Median years in aviation: 13 Range 2 to 30 years

9. What are some of the things that you like or dislike about your job? And

10. Have you thought about leaving the aviation field? If so, why?

Code numbers	Discussion topic	% respondents who gave this response in Question 9	% respondents who gave this response in Question 10
1	Management problems	21	2
2	Stress, frustration	4	6
3	Lack of, or expensive, parts	8	0
4	Pay	36	36
5	Responsibility too much for pay	21	13
6	Lack of respect	13	9
7	Workload issues	13	0
8	Poor training	8	0
9	Liability issues	6	8
10	Pursue other career	0	4
11	Work schedule	13	8
12	No retirement program	8	8
13	No job security/stability	2	2
14	Working in heat/cold extremes	11	0
15	Location	2	2
16	Hazardous materials	4	0
17	Poor benefits	0	2
20	Other (specify)	21	6

11. Do you plan on being an aviation mechanic through the year 2010?

74% (39) planned to stay through 2010; but 17% (9) of those attached a condition. 17% (9) were not planning to stay; 8% (4) of those attached a condition. 9% (5) were uncertain.

Responses from Aviation Mechanics Students

RESPONSES FROM AVIATION MECHANICS STUDENTS

1. Name and location of school that student attends:
2. What certifications are you currently pursuing? Check all that apply.
 - Airframe only: 5%
 - Powerplant only: 5%
 - Airframe and Powerplant (A & P): 89%
 - Inspection Authorization (IA): 6%
3. How long have you been studying at this school?

Median time in school: 12 months; range 1 month to 5 years.
4. When is your expected year of graduation?
 - 2002: 32%
 - 2003: 46%
 - 2004: 20%
 - 2005: 1%
5. Are you planning to work as an aircraft mechanic when you graduate? If the answer is no, skip to question 9.

78% - Yes 12% - No 6% - uncertain
6. What led you to pursue training as an aviation mechanic?

Code number	Discussion topic	% respondents (out of 121) who gave this response to Question 6	% respondents who gave this response to Question 10
1	Like airplanes	25	18
2	Mechanical aptitude/interest	17	17
3	Military experience	1	0
4	Family background in aviation	7	3
5	Salary/pay	14	55
6	Job benefits	2	33
7	Free air travel	0	5
8	Challenging work	0	2
9	Other job in aviation	12	4
10	Small amount of training required	0	2
11	Advertisements	1	1
12	On the job training	0	0
13	Diversity of work	0	2
14	Responsibility of job	0	1
15	Hours/work schedule	0	0
16	Location	1	8
17	Job security	3	2
18	Good job market	0	5
19	Good career/transferable skills	7	8
20	Other (specify)	20	15

Appendix V
Responses from Aviation Mechanics Students

7. Did you have previous experience working on aircraft? If so, describe.
- 54% - No 34% - yes
8. Do you plan to seek employment initially in general or commercial aviation?
- 50%: commercial
14%: general aviation
8%: uncertain
7%: commercial and general aviation
1%: neither
9. Please explain why you are not planning to seek work as an aircraft mechanic upon graduation?
10. What factors most influenced your decision to become an aircraft mechanic (for example, salary, benefits, location, etc.)?
- See responses in question 6.
11. Do your long-term career plans include staying in the aviation maintenance field?
- Yes: 74%
No: 8%
Uncertain: 13%

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