The FAA's Continued Operational Safety Program for General Aviation

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INTRODUCTION

Federal statutes require the Federal Aviation Administration (FAA) to promote aviation safety through regulations and minimum standards for the design, construction, operation, and maintenance of aircraft. To that end, the FAA's Aircraft Certification Service manages major elements of Continued Operational Safety (COS) for the nation's civil aircraft fleet. As its highest priority, the Service maintains the U.S. aircraft fleet at the high level of safety that the public has come to expect.

The Aircraft Certification Service established COS management programs for the nation's fleet. The Service uses a three-pronged approach toward its COS programs:

- Adequate Standards
- Proper Certification
- Continuous Monitoring

Aircraft certification is essential to maintaining in-service aircraft in a safe condition. The Service establishes minimum design standards needed to maintain the proper level of safety. Design and production approval holders are responsible for ensuring that designs or products comply with those standards. The Service oversees the design and production approval holders' compliance with the standards by conducting certification programs and audits. Continuous monitoring provides (1) the feedback essential to know that the design or production systems maintain the safety prescribed with the standards and expected with the approval; and (2) important indicators that help identify unforeseen design or manufacturing deficiencies before they develop into safety concerns.

Even though aircraft designs undergo the rigorous certification process to meet the suitable level of safety, the process cannot guarantee that level for the entire life of the product. Variations from intended usage, unknown manufacturing defects, and latent deficiencies not considered (or addressed in the regulations) during design contribute to the risk of an unsafe condition surfacing during service. Thus, monitoring a product's service history is essential.

After a product enters service, the approval holder must monitor the product for problems. If problems occur, the approval holder must work with the FAA to determine the safety impact and develop procedures to correct the problem. Maintaining and monitoring service difficulty databases, issuing service documents, or changing the continued airworthiness instructions are ways to accomplish this. If the problem is a safety concern, the type certificate holder must provide the FAA the appropriate information necessary for developing an Airworthiness Directive (AD). ADs are regulations that mandate actions to fix an unsafe condition.

The Service's COS management programs address several continued airworthiness concerns, most of which relate to airframe structural problems. After the 1988 Aloha accident, Congress mandated that the FAA establish an Aging Aircraft Program to focus on these structural problems for the air carrier fleet. The FAA worked closely with industry to address several of these aging issues. Congress specifically excluded general aviation (GA) aircraft from the mandate.

THE GENERAL AVIATION FLEET

The GA aircraft fleet is vastly different from the air carrier fleet. The nation's GA fleet consists of approximately 220,000 aircraft. This includes corporate jets; air taxis and commuters; personal, agricultural, aerobatic and public use aircraft; antiques; warbirds; sailplanes; balloons; airships; and rotorcraft. It also includes a wide variety of homebuilt and ultralight aircraft that are largely unregulated.

The Small Airplane Directorate manages COS for much of the GA aircraft fleet. The Directorate regulates fixed-wing aircraft designs that weigh less than 12,500 pounds, commuter category airplanes that carry 19 passengers or less, and all lighter-than-air aircraft. This excludes rotorcraft, almost all business jets, some "commuter class" turboprop airplanes, and homebulits and ultralights. The information in this report covers the 84 percent of GA aircraft that the Small Airplane Directorate manages plus the experimental fleet.

Almost three-fourths (or 151,000 aircraft) of the GA fixed-wing fleet are single-engine piston airplanes. Multi-engine piston airplanes and experimental airplanes each account another 10 percent. Turboprops, jets, lighter-than-air aircraft, and gliders make up the remainder. Figure 1 (page 3) shows this percentage breakdown of the GA fleet by airplane class.

GA usage is equally as diverse. Sixty percent of the fleet is used for personal use and another 20 percent for business. Instruction, agricultural, and observation usage make up another 10 percent. The remainder is scattered in air taxi, public use, and miscellaneous other uses. Figure 2 (page 3) shows the percentage breakdown by usage.

In addition to the broad range of airplane class and usage, the certification standards of GA aircraft vary widely. The bulk of the fleet (75 percent) is designed to CAR 3 standards that were established in the 1950's, or earlier, and were produced prior to the 1980's. Less than 5 percent are designed to newer 14 CFR Part 23 (FAR Part 23) standards. Ten percent are experimental, mostly amateur-built, and have no certificated design standards. Many World War II and Korea war era military airplanes and other exhibition airplanes, such as air-racers and competition gliders, also carry experimental certificates. A small part of the fleet was designed to early standards – Bulletin 7a, CAR 4, and CAR 4a. These are vintage, or classic, airplanes from prior to WW II. Many are constructed from wood or tube and fabric.

Special-use airplanes, such as agricultural, firefighting, or aerial surveillance, are certificated to special regulations and restricted to limited use. Gliders, balloons, and airships have their own design certification standards.

GENERAL AVIATION CONTINUED OPERATIONAL SAFETY ISSUES

Because of the large number and the wide variety of uses and design standards, oversight of the GA aircraft fleet poses special problems for continued operational safety. This makes it impossible to address aging issues the same for all segments.

Design

Early designs have few or no continued airworthiness requirements. Requirements for more recent designs vary depending on the aircraft model's type certificated category and what

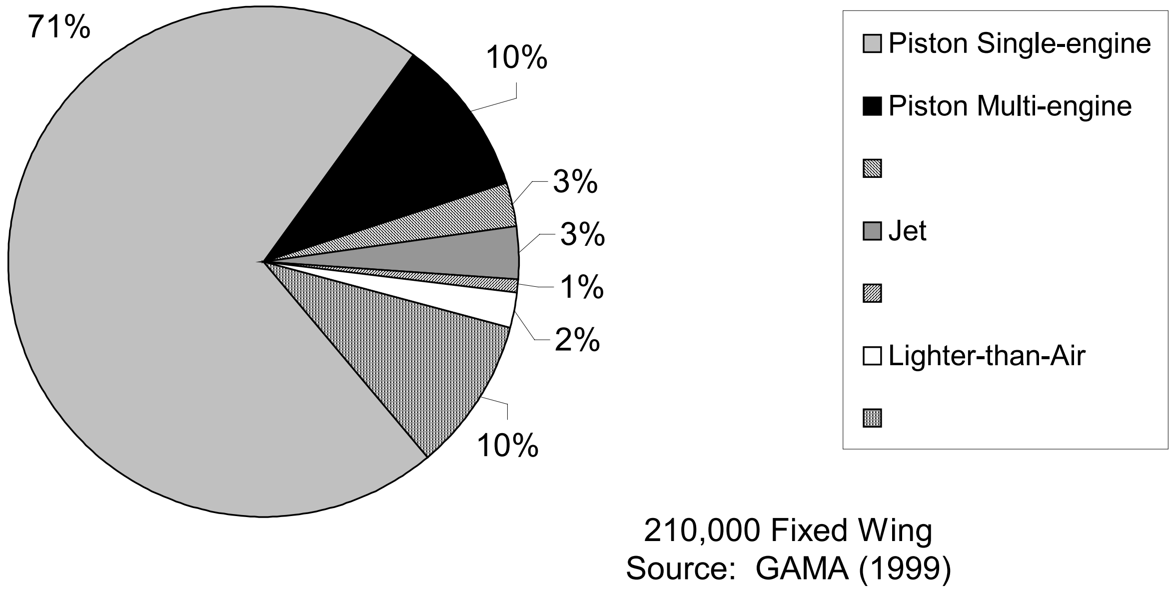

Figure 1: Breakdown of General Aviation Fleet

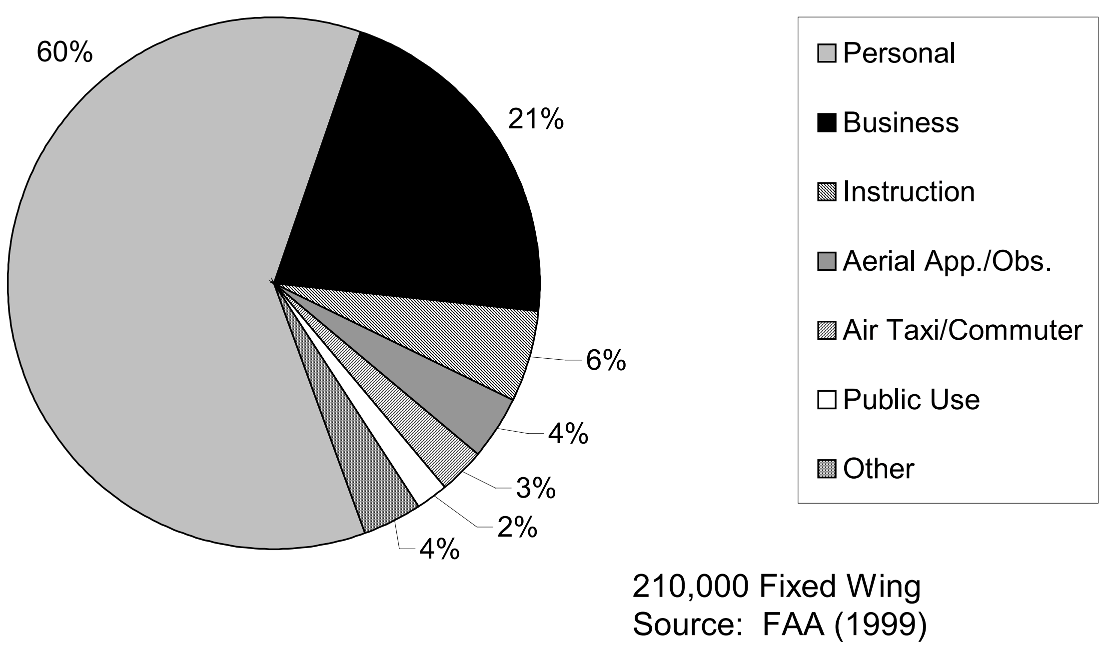

Figure 2: Breakdown of General Aviation Usage

standards were in place at the time of certification. The designs vary from the newest composite technology to wood, tube, and fabric. Deterioration of wood and its adhesives pose special aging concerns for the many airplanes of that construction. The Small Airplane Directorate is working with several applicants to define continued airworthiness requirements for primary structure made of composites. These models use different techniques in their design and construction, so the challenge is addressing the variety of continued airworthiness approaches for composites.

Most tube and fabric airplanes were designed and constructed without significant corrosion protection. Since most of these airplanes are very old, attention to corrosion is critical.

The most popular material is metal, predominantly 2024-T3 aluminum with its favorable corrosion and fatigue cracking resistance. The designs also operate at low stress levels. However, certification regulations prior to 1969 did not include fatigue requirements. As noted above, most of the current fleet was designed to these older standards so the aircraft manufacturer paid little or no attention to fatigue. Little fatigue test experience exists to help determine fatigue prone design details. Attention was placed on ease of fabrication; many critical load paths consist of built-up layers of sheet metal that are difficult if not impossible to inspect.

Other examples of unique design concerns related to COS include deteriorating tear strength of balloon and airship material.

Manufacturers

Vastly contrasting from the transport fleet, the small airplane fleet consists of designs from over 100 manufacturers. A few manufacturers (Cessna, Raytheon-Beech, and Piper) have produced most of the fleet. These companies maintain sizable engineering staffs and provide adequate customer support. They report continued airworthiness concerns to the FAA as appropriate and are committed to provide some support for even the oldest of their models.

Some manufacturers produce very limited numbers of aircraft, and maintain a very limited engineering staff. Their customer support is limited and their reporting of continued airworthiness concerns is often not representative of their model fleet.

The manufacturers of many older designs no longer exist (called “orphan” designs). The type certificate (TC) holder may be an estate, holding company, other entity, or the FAA itself. Often, these TC holders are not aware of their regulatory obligation to the FAA regarding continued airworthiness. These models pose the most difficult challenge to the FAA regarding continued operational safety.

Operators

GA operator capability is similar to manufacturer capability. Some companies operate large fleets of airplanes, operate them often, and maintain the aircraft under programs similar to the airlines. They employ large maintenance staffs, use current repair and inspection techniques, possess the latest technological equipment, communicate often with the manufacturer, and report continued airworthiness concerns in a timely manner. These are typically commuter airlines and air cargo businesses.

The GA fleet also includes small companies with strained financial resources that operate a few airplanes in air taxi, charter service, training, rental, or other business use. These operators maintain their airplanes adequately, but often do not take the time to properly report concerns to the manufacturer or FAA. Usage varies widely, including regular short taxi flights, instruction, crop dusting, forest fighting, pipeline patrol, fish spotting, traffic monitoring, or sporadic rental usage (just to name a few).

By far, the airplane owner operates the largest portion of the GA fleet. Local FAA-certified mechanics typically maintain these airplanes. This maintenance is usually high quality, but reporting of service difficulties is sporadic due to the mechanics' time involved to complete the paperwork and the lack of a specific requirement to report service problems. Maintenance capability varies from facilities using the latest inspection and repair techniques to shops with only basic capabilities.

Usage varies greatly with this segment. Some fly regularly for business transportation purposes and others infrequently for sport or pleasure. Most owners of these personal use airplanes maintain their airplanes beyond the minimum required maintenance. The owners of older airplanes routinely form clubs, especially those where the manufacturer no long exists or provides little customer support. These "type clubs" share information and are often the best source of continued airworthiness concerns that could either be or develop into safety problems.

The large fleet of amateur-built aircraft is normally maintained by owner-builders, who usually meticulously maintain their airplanes. However, sometimes these owner-builders are unaware that their designs may incorporate latent age-related safety problems. Their main source of safety related information is through the Experimental Aircraft Association (EAA). The EAA provides guidance and expertise on virtually all aspects of aircraft design and maintenance. Sharing this wealth of information with owner-builders is the main method of maintaining safety of this portion of the fleet. The EAA also acts as an information clearing house for the small fleet of "classics" and warbirds.

Modifiers

A modifier is defined as a company or entity that provides an improvement design or comfort addition design to the aircraft. The role of modifiers in GA adds to the complexity of COS. Modifiers have been designing FAA-approved improvement "kits" for much of the fleet for years and few airplanes exist without some sort of modification. The average age of the fleet is now over 30 years. This increasing age poses a paradox of issues.

For example, cockpit modifications are now popular because of the rapid advances in avionics and associated affordability. Our GA aircraft fleet accident history, over 20 times greater than the air carrier fleet, shows that the most common cause of these accidents is pilot loss of control due to weather, disorientation, etc. Because of this, the FAA is focusing on providing better situational awareness for the pilot. This is in the form of weather, traffic, and terrain information. Avionics that use GPS and other advanced technologies make this practical for all segments of GA. Companies are producing affordable products that can be retrofitted for existing aircraft.

These cockpit modifications into older airplanes are the most viable option to many pilots. There are few new aircraft models that provide added value in areas such as comfort, range, and speed. Spending a few thousand dollars to upgrade the panel with state-of-the-art avionics allows the pilot to make better decisions and consequently makes a safer airplane. The FAA is streamlining the approval process to enable modifiers to install this advanced equipment in the cockpits of the existing fleet. This will increase the pilot's ability to make proper decisions, which in turn should reduce the large number of accidents now attributed to pilot error.

The consequence of this is that the current GA aircraft fleet will continue to age. The 40-year-old, 4-place airplane with new avionics can remain productive for years to come with periodic avionics upgrades as this technology advances. The FAA is addressing the collateral effects of this. Even though the airplanes were conservatively designed and no major service problems have surfaced, the FAA is concerned that continued airworthiness concerns will become more common as the projected average fleet age reaches 40 years in 2010 and close to 50 years in 2020.

The negative aspect of the modified airplane is that most of the design modifications to airframes inadequately address aging issues. Wing tip modifications that improve performance a few knots introduce additional fatigue loading on the wing. More powerful engines provide better performance but at the expense of higher loads. The effects of these modifications are unknown. The FAA has difficulty determining if modifications to the airplane were a cause of certain service problems when problems go unreported or, when reported, do not specify that the specific problem airplane has modifications.

To further complicate this issue, many of the modification design approval holders no longer exist and the FAA cannot locate the current design data owner.

THE SMALL AIRPLANE DIRECTORATE'S COS MANAGEMENT PROGRAM

As stated in the introduction, Congress specifically excluded GA aircraft from the mandate to establish an Aging Aircraft Program. However, the physics of aging ignore regulatory boundaries. A significant number of the Small Airplane Directorate's COS actions address aging problems. Structural aging problems continually appear and as the aircraft get older, the Directorate is becoming more proactive in addressing them.

In the past, the FAA has primarily reacted to a continued operational safety problem. For instance, as a result of an accident, the FAA would mandate actions to preclude repeat occurrences (e.g., AD action). Today, in addition, the FAA is taking a more proactive approach to COS, especially with aging issues, and is looking to the GA community to help.

General Aviation Aging Summit

In early 2000, the Small Airplane Directorate held an Aging Summit to address existing and future COS concerns. Participants included representatives from the FAA, manufacturers, GA repair facilities, type clubs, individual owners and mechanics, and representative organizations such as the Aircraft Owners and Pilots Association (AOPA), EAA, and the General Aviation Manufacturers Association (GAMA).

Surprisingly to the FAA, the issues raised were not "aging" related in the technical engineering sense. Instead, one issue that consistently surfaced during this conference was concern about FAA approval of modifications and restorations. Availability of the design data for older or "orphan" designs is also a concern. For example, individuals asked how to replace corroded or broken parts when no design data is available. In these situations, developing a method to construct a replacement part involves a burdensome FAA airworthiness approval process. Aircraft owners are tempted to install parts that may not meet needed capability, creating the potential for an unsafe condition. This problem specifically affects the restoration of classic and warbird airplanes. As GA aircraft continue to age and as more designs become "orphaned," the problem will become more widespread.

The conference participants also discussed ways to streamline FAA approval of safety enhancements (modifications such as installation of shoulder harnesses, updated electrical systems, etc.). As discussed earlier, we believe that we can achieve large reductions in the accident rate through new technology modifications. The FAA is presenting to applicants several new processes to reduce the time and paperwork involved for common (but clearly safety enhancing) installations.

The participants also shared concerns about sustaining FAA and industry expertise for maintenance of small airplanes. They shared experiences about the difficulty in finding mechanics who are experienced with wood, steel tube, and "dope and fabric" construction. Attrition has caused this type of experience to diminish within the FAA also.

As a result of the Summit, the Small Airplane Directorate leads an ad hoc committee that meets periodically to address the most pressing continued airworthiness issues. The committee consists of a small group of manufacturers, type clubs, small airplane repair facilities, AOPA, and EAA.

Airworthiness Concerns Process

First, the ad hoc committee developed a plan to implement the Small Airplane Directorate's Airworthiness Concerns Process. The FAA worked closely with the GA industry to develop this systematic method to evaluate COS concerns. The FAA, with the support and cooperation of the key industry groups of the ad hoc committee, published a guide that describes the steps FAA certification engineers should take when assessing any small airplane airworthiness concern.

The Airworthiness Concerns Process is intended to provide the GA community a standardized approach to resolve airworthiness issues. FAA certification engineers are expected to utilize the methods in the guide to develop, prioritize, and administer solutions to airworthiness concerns on small airplane products. These methods facilitate early coordination between the FAA, the affected manufacturers, and aviation interest groups (such as type clubs, industry associations, etc.) in the exchange of technical, operational, and economic data. FAA engineers utilize this additional information during their risk assessment. This process will result in more responsive and more effective decisions pertaining to airworthiness issues.

The first step of the process is to systematically monitor the fleet for concerns. This is achieved by periodic review of available accident, incident, and service difficulty databases. These are primarily the FAA's Service Difficulty Reports Database, the FAA's database of existing ADs, and the NTSB Aviation Accident Database. The Small Airplane Directorate uses a computer program called "Aviation Safety Accident Prevention" (ASAP). ASAP is a database program developed by FAA engineers who monitor rotorcraft COS and it has been very successful for them. It contains a history of incidents or problems of the GA fleet. It monitors databases for new reports and analyzes the data for trends. The user can use ASAP to query the databases for information that provides the means for engineers to input key parameters used to identify trends in service problems.

As additional input, the certification engineers also convene periodic reviews with the large manufacturers to share COS information and trend data. They monitor aviation maintenance documents for service problems also.

In the second step of the process the FAA certification engineer uses all this information to perform a simple risk assessment. Currently, the risk assessment is based on output from the ASAP program and quantified answers to several basic, but subjective, questions. The result is a gross categorization of the type of action that should be taken to address the concern.

The third step is to solicit the expertise of specific airplane user groups as a base of knowledge. This is facilitated through AOPA and EAA and the applicable type club, if one exists. These groups often know the most about a model's specific service problems, best methods of inspection, and most effective repairs. The FAA engineer uses this knowledge, especially for older "orphan" models, to help determine the seriousness of the concern and evaluate alternative solutions. The FAA then uses this additional information to reevaluate its risk assessment and adjust its proposed action accordingly.

The fourth step for the FAA is to take appropriate action. If an unsafe condition exists, the FAA will issue an AD in accordance with the applicable regulations. These actions are usually inspections, part replacements, or modifications. Normally, the FAA issues a Notice of Proposed Rulemaking (NPRM) for the AD. This allows for public comment prior to issuance of a Final Rule for the AD. Coordination with user groups, as mentioned above, reduces the number of public comments and streamlines the process. (In some instances, the FAA determines that the unsafe condition is so immediate that we will issue an AD prior to considering public comment.) If an unsafe condition does not exist but there is still a potential safety concern, the FAA will issue a Special Airworthiness Information Bulletin or a General Aviation Alert. Manufacturers also often issue Service Letters or Bulletins to address these concerns. Often, after reviewing all the information and assessing the risk, no further action is required.

The final step in the process is to continue monitoring the concern. When we have issued an AD, this step shows whether the problem is solved. If we recommended an action or took no action, this step would reveal if the situation escalates to a more serious problem or even an unsafe condition. ASAP allows the FAA engineer to flag key parameters that would indicate dangerous trends.

Another key aspect of this step is for the airworthiness authorities of all countries to share information. This continuous communication of information reinforces the proactive approach in that each airworthiness authority does not have to wait for incidents or failures to occur within its country before taking the appropriate action.

Challenges to Successful COS Management

The Small Airplane Directorate's proactive COS management program is in its early stages of development. As we implement such initiatives as the Airworthiness Concerns Process, we recognize attendant challenges. We now rely on service difficulty data to help with our risk management. Manufacturers have a regulatory obligation to report service difficulties but in some cases are unaware of these difficulties. GA operators are not required to report service difficulties (large air carriers are required to do this). The FAA estimates that reported service difficulties represent only about 10 percent of those that actually occur. Obviously, some unreported service problems will go unnoticed. The available information will dictate the effectiveness of the FAA's airworthiness monitoring and corrective actions.

This is why it is essential that industry assist the FAA with better reporting of service problems. We recognize that there is little incentive for overburdened mechanics to take time away from actually working on airplanes to complete non-required paperwork. We recognize that approval holders of older designs have no regulatory obligation to provide updated continued airworthiness instructions. We also know that FAA must take the lead to make design data more readily available for "orphan" designs and continue our efforts to make approval of safety enhancing modifications or repairs easier.

The Small Airplane Directorate's Future Plans for COS

Increasing attention to COS is a high priority for the Small Airplane Directorate. The Airworthiness Concerns Process is our first step with risk management. We intend to closely monitor the use of the process and adjust it accordingly. Its success depends on full cooperation from members of the GA industry and their recognition of FAA's obligations regarding safety.

We intend to expand our use of existing databases and explore ways to use other information for risk assessment. We are studying ways to evolve our current risk management from simple risk assessments to approaches that include more sophisticated risk assessment techniques.

The FAA is increasing its efforts to educate industry about their responsibilities in maintaining a safe GA fleet. We will increase our efforts with manufacturers to collaborate on safety-related service issues. By working more closely with our Flight Standards offices (responsible for overseeing maintenance and operations), we will continue to explore ways to make GA repair and modification approvals more efficient.

We will continue to lead the GA ad hoc committee mentioned earlier to address the most pressing issues. Part of that effort will include educating the GA community about its responsibilities. The importance of reporting service difficulties, the obligation of design approval holders to support their product, and the benefits of providing updated continued airworthiness instructions are three areas where the FAA can provide clearer guidance and better advice. We will continue to work with the GA associations to make sure we target our educational efforts to the right groups.

The Small Airplane Directorate will continue to coordinate with our offices that oversee COS for engines, rotorcraft, and transport aircraft. We will apply lessons learned from others' risk management approaches that also make sense for small airplanes. We will make sure that our certification engineers have the knowledge of, and are trained to use, any new processes or procedures we develop.

We will remain active in the Aging Aircraft Program and leverage knowledge gained from its research and our regulatory action.

SPECIAL AGING AIRCRAFT ISSUES FOR GA

Applying Technology to Aging GA

The FAA is increasing its education of the GA community about how to use results from the FAA's Aging Aircraft Program to increase the safety of the GA fleet. Application of state-of-the-art technology is helping us address certain aging GA problems. Damage tolerance concepts, improved inspection procedures, structural inspection programs, and usage monitoring are among the methods that are gaining favor.

Advances in inspection techniques are very applicable and important to GA aircraft. The design philosophy for many of the older designs was to add layers of sheet metal where additional strength was needed. Therefore, recent improvements that detect cracks or corrosion in multi-layer structure are especially pertinent to older small airplanes. The improved ability to detect very small cracks benefits GA aircraft because the scale of the structure is much smaller than for transport airplanes and critical crack sizes are often very small.

Inspection techniques developed through the Aging Airplane Research Program have been applied to GA situations. An enhanced ultrasonic thickness gage technique proved successful in finding corrosion in the wing lift struts of an old agricultural plane – the Piper Pawnee. A similar ultrasonic thickness measurement method was developed to inspect for corrosion thinning of all Piper airplanes of similar design. Ultrasonic inspection is also used to find corrosion in Twin Commander wing spars. An eddy current inspection has replaced an unreliable X-ray inspection for Fairchild Metro wing spar cracking. We are currently evaluating a combination of eddy current and ultrasound methods to improve the reliability and substantially increase the efficiency of this critical wing inspection. In response to a need to distinguish between Cessna 400 series steel and inconel engine exhaust parts, the FAA developed an improved chemical spot test procedure.

The next step is to make this new inspection equipment more affordable and training to become qualified to use it more practical for mechanics who service GA aircraft.

Research to develop better analytical tools has improved the capability to evaluate continued airworthiness concerns. As part of the Aging Aircraft program, the FAA developed software to enable fast static strength and damage tolerance analysis of certain repairs. This program, RAPID (Repair Assessment Procedure and Integrated Design), is user-friendly and significantly aids the engineer through the work associated with design and verification of a damage tolerant repair. The FAA continues to add useful features to the program.

Sophisticated fracture mechanics software such as NASGRO and FLAGRO are now available to engineers to assist with their evaluations. These tools are now often used to support solutions to GA structural aging problems.

As mentioned earlier, GA aircraft usage varies widely. Some owners/operators may fly their airplanes little while others may fly very often and in severe environments, such as aerial surveillance or fish spotting. The FAA has researched usage monitoring and is making progress with simple, affordable systems. These will prove helpful to operators who want to set up inspection schedules different from those blanket requirements that cover the most severe usage for a particular model airplane.

The FAA learned from the Aging Aircraft program that structural inspection and corrosion control programs are the two best methods of minimizing the effects of structural aging. The FAA requires that transport airlines have these inspection programs in place. In the process of determining characteristics of good programs, the FAA is developing guidance to manufacturers and operators of smaller airplanes. Although primarily targeted to commuter airplanes, the concepts are valid for light-twins and single-engine airplanes also. A structural inspection program for the Cessna 402, a medium-sized piston twin, has been developed and has demonstrated success in Australia. In the years to come, elements of inspection and corrosion programs will become more common and viable for GA aircraft.

EXAMPLES OF AGING ISSUES UNIQUE TO GENERAL AVIATION

This paper has touched on the main COS issues facing general aviation. Warbirds and agricultural airplanes highlight some of the concerns unique to the GA aircraft fleet. Certain fundamental aspects of aging apply to the entire GA fleet, but the diversity of it also means that each segment has its unique problems. The challenge is proactively addressing all of these unique concerns.

Warbirds

Many models of the warbirds fleet, mainly World War II era aircraft, operate with FAA-approved TCs. That means that the TC holders are obligated to address COS issues, and the

FAA has the responsibility to address unsafe conditions in those models. Models like the B-17, B-25, P-38, P-51, T-6, and T-34 all have TCs. Design data for this fleet is difficult to find. There are no records of military usage. Most all of the fleet is now well maintained and used carefully. However, some of them still fly acrobatics; they all fly mostly at low levels, which is a high gust environment, and accumulate high numbers of flight cycles.

The fleet of these airplanes is a high risk for unsafe conditions because of this wide range of usage, no records of past usage, possible very severe usage, and little or no design data. Many of these airplanes have been structurally modified without the benefit of an evaluation of the effects.

Recently, multiple fatigue cracks in the wing caused a fatal accident of one of these warbird airplanes. Conditions for this failure include a fatigue-prone and hard-to-inspect design detail in an old airplane and severe acrobatic usage. The manufacturer addressed this unsafe condition in accordance with its TC holder obligations. The manufacturer constructed finite element models, did an extensive fracture mechanics analysis, and developed detailed inspection procedures using state-of-the-art eddy current techniques.

The "Warbirds of America," a division of EAA, provided additional input to the FAA. Owners of this model formed a group to explore better options. This group conducted flight tests, constructed finite element models, and also did an extensive fracture mechanics analysis to design a permanent repair to eliminate the unsafe condition. The group is now exploring, with the FAA, the viability of monitoring usage of these aircraft. The warbird community, at large, is considering ways to set up inspection programs for other models in its fleet.

All of this work was a reaction to an accident. However, many of the elements that make up the proper way to solve an aging problem were used. The most notable is cooperation between the users, manufacturer, and FAA.

Agricultural-Use Airplanes

The usage profile of agricultural-use airplanes (crop dusters) compares to that of fighter jets. They operate in the most severe environment of any GA airplane and are designed accordingly. However, some of the older design requirements for these planes did not include fatigue substantiation. These airplanes are sometimes loaded beyond their certificated gross weight and then fly high-g maneuvers. The chemicals dispersed subject the airplanes to corrosive effects.

Fatal accidents have spurred the existing manufacturers to conduct fatigue evaluations, including fatigue tests. They also have conducted usage surveys to better determine the loading environment of their fleet. They have imposed FAA-approved life limits and inspection programs on their wing structures.

However, one of these agricultural airplane models was modified to allow higher gross weights. Modifications to the wing increased the lift capability of the wing, but no significant structural beef-ups were made. The modifier did only a cursory fatigue evaluation and did not lower the life limit on the wing. The FAA is currently addressing this issue and will not approve any modifications without a proper fatigue evaluation.

Agricultural airplanes are another example of how an inspection program or usage monitoring would benefit the users. This modification incident is an example of how the lack of communication between the FAA, original designer, and modifier can increase the risk of a potential unsafe condition.

CONCLUSION

Management of Continued Operational Safety is a high priority for the FAA. It begins with adequate standards and proper certification of aircraft designs. Continuous monitoring is essential to maintaining the safety built into the designs. The FAA's Aircraft Certification Service has COS management programs for the aircraft it regulates.

General Aviation COS is a major concern for the industry and the FAA. The diversity of the fleet makes dealing with continued airworthiness difficult. The wide variety of designs and uses poses problems unique to GA.

The GA aircraft fleet is old and the FAA is taking a more proactive role in managing the anticipated increase of aging concerns. At the same time, safety studies have shown that the biggest safety concern for GA is pilot situational awareness. The FAA is encouraging modifications to the GA fleet to install safety enhancing equipment, most notably advanced avionics that provide increased situational awareness. These improvements will increase safety, and allow much of the existing fleet to be used well into the 21st century. The fleet will continue to age.

The Small Airplane Directorate is taking a more proactive approach to aging concerns with its COS program. We started by opening a frank exchange of opinions regarding what are the most acute continued airworthiness problems facing the GA community. We have begun a risk management approach to in-service safety concerns. A key element of this approach is cooperation between the FAA, manufacturers, and owners or operators.

The Small Airplane Directorate will continue to expand its COS management program by utilizing available service related databases to build improved risk assessments. Continued communication with industry is key to the program's development and success.

The FAA is leveraging the lessons learned from our Aging Aircraft Program by applying them to GA. The GA industry is using analysis, inspection, and maintenance techniques developed for the air-carriers with FAA research.

The FAA is obligated to oversee the safety of the nation's civil aircraft fleet. To that end, we continue to explore ways to improve GA safety. That can happen only if we monitor the fleet for potential problems and act accordingly. In cooperation with our industry, we can manage the risk to keep general aviation a viable and safe method of transportation, business use, and recreation well into the future.