National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: April 23, 2004

In reply refer to: A-04-29 through -33

Honorable Ann M. Veneman
Secretary
Department of Agriculture
Washington, D.C. 20250

Honorable Gale A. Norton
Secretary
Department of Interior
Washington, D.C. 20240

Honorable Marion C. Blakey
Administrator
Federal Aviation Administration
Washington, D.C. 20591

Background

Accident History – In-Flight Breakups of Firefighting Aircraft

On August 13, 1994, a Lockheed C-130A Hercules, N135FF, experienced an in-flight separation of the right wing near Pearblossom, California, while responding to a forest fire near the Tahachapi Mountains. The airplane was registered to Aero Firefighting Service Company, Inc., and was being leased by Hemet Valley Flying Service, Inc., to the U.S. Department of Agriculture's Forest Service (Forest Service) for public firefighting flights. All three flight crewmembers were killed, and the airplane was completely destroyed.

Metallurgical examination of the recovered portion of the right wing revealed two fatigue cracks. The first crack was in the lower wing skin and extended about 0.6 inch. The crack initiated from a rivet hole between stringer[1] 14 and 15, which was created for installation of a

[1] A stringer is a longitudinal structural member designed to give shape to, and stiffen, the aircraft skin and resist shear and bending loads.

doubler[2] that was attached to the wing skin; the fatigue crack was covered by the doubler. The second crack was in the doubler itself and extended about 0.8 inch.[3] The National Transportation Safety Board determined that the probable cause of the accident was the inflight failure of the right wing due to fatigue cracking in the underside right wing skin and overlying doubler. The Board determined that a factor contributing to the accident was inadequate maintenance procedures to detect fatigue cracking.

According to maintenance records, the accident airplane was delivered new to the U.S. Air Force in December 1957 and was retired from military service in 1978 and placed into storage for several years. In August 1988, it was transferred to the Forest Service, and, in November 1989, it was sold to HemetValley. In May 1990, the Federal Aviation Administration (FAA) issued a restricted-category special airworthiness certificate authorizing the airplane to be used only for "carriage of cargo, forest (wildlife conservation), and agriculture and pest control." At the time of the accident, the airplane had a total of 20,289 flight hours, 19,547 of which were acquired during its military service.

On June 17, 2002, another Lockheed C-130A Hercules, N130HP, experienced an in-flight breakup that was initiated by separation of the right wing, followed by separation of the left wing, while executing a fire retardant drop over a forest fire near Walker, California. The airplane was registered to Hawkins and Powers Aviation, Inc. (Hawkins and Powers), of Greybull, Wyoming, and was being operated by the Forest Service as a public firefighting flight. Both wings detached from the fuselage at their respective center wing box-to-fuselage attachment locations. All three flight crewmembers were killed, and the airplane was completely destroyed.

Metallurgical examination of the center wing box lower skin revealed a 12-inch long fatigue crack on the lower surface of the right wing, with two separate fatigue crack initiation sites at stringer attachment rivet holes. The cracks from both initiation sites eventually linked up to create a single crack. The portion of the wing skin containing the fatigue crack was covered by a manufacturer-installed doubler, which would have hidden the crack from view and, therefore, prevented detection of the crack from a visual inspection of the exterior of the airplane. The Safety Board determined that the probable cause(s) of this accident was the in-flight failure of the right wing due to fatigue cracking in the center wing lower skin and underlying structural members. The Board determined that a factor contributing to the accident was inadequate maintenance procedures to detect fatigue cracking.

According to the maintenance records, the accident airplane was delivered new to the U.S. Air Force in December 1957 and was retired from military service in 1986. The airplane was transferred to the Forest Service, along with six other C-130A airplanes, on May 24, 1988, through the General Services Administration (GSA). According to the GSA transfer order, at that time the airplane had 19,547 hours since new. On August 12, 1988, the Forest Service sold the airplane to Hemet Valley Flying Service, which installed the retardant tanks. On December 5, 1988, Hemet Valley sold the airplane to Hawkins and Powers, which developed a

[2] A doubler is a piece of sheet metal placed against an aircraft skin to provide stiffness or additional strength.

[3] It is possible that the fatigue cracks were larger than was evident from the recovered wreckage; because only a small portion of the right wing was recovered, the total size of the fatigue crack could not be determined from the wreckage. According to Lockheed, the critical crack length is 0.86 inch in stringers, and 1.72 inch in the aircraft skin.

statement of conformity certifying that the airplane met the requirements of type certificate A15NM, revision 2. The FAA thereafter issued a restricted-category special airworthiness certificate.[4] Records indicated that at the time of the accident, the airplane's total time was 21,863 flight hours, which included 2,316 hours of non-military time.

On July 18, 2002, a Consolidated Vultee P4Y Privateer, N7620C, experienced an in-flight separation of the left wing while maneuvering to deliver fire retardant over a forest fire near Estes Park, Colorado. The airplane was registered to Hawkins and Powers and was being operated by the Forest Service as a public firefighting flight. The left wing detached from the fuselage just inboard of the No. 2 engine. Both flight crewmembers were killed, and the airplane was destroyed.

Metallurgical examination of the left wing revealed that it failed at the wing-to-fuselage attachment point along the forward lower spar cap. A fatigue crack measuring approximately 21 inches had propagated from the lower portion of the forward spar cap members upward into the spar web. The crack initiated in rivet holes used to attach three "L"-shaped spar cap members to the spar web. The portion of the wing containing the fatigue crack was obscured by the retardant tanks and would not have been detectable by an exterior visual inspection. The Safety Board determined that the probable cause of this accident was the in-flight failure of the left wing due to fatigue cracking in the left wing's forward spar and wing skin. The Board determined that a factor contributing to the accident was inadequate maintenance procedures to detect fatigue cracking

Little is known about the accident airplane's military service except that it was manufactured and delivered to the Navy in 1944 and left military service in 1956. No maintenance or flight hour records were available. Therefore, it is unknown how many hours the airplane accumulated during its military service. The FAA issued a restricted-category type certificate and a restricted-category airworthiness certificate in 1958.[5] Hawkins and Powers subsequently acquired the airplane and registered it in 1969. Records indicated that the airplane accumulated 8,200 flight hours since then.

Firefighting Aircraft

Both the Forest Service and the U.S. Department of the Interior (DOI) conduct firefighting flights on behalf of the U.S. Government.[6] These flights are public (as distinguished from civil) operations and, therefore, are not required by the FAA to comply with many of the federal aviation regulations codified in 14 *Code of Federal Regulations* (CFR). For example, regulations pertaining to aircraft certification and maintenance and flight crew training and

[4] The airworthiness certificate and the type certificate data sheet specified that the airplane be maintained and inspected in accordance with the Air Force technical orders that were available at the time the Forest Service took possession of the airplane in 1988. Hawkins and Powers' maintenance program for the accident airplane was based on these documents.

[5] Neither the type certificate data sheet nor the airworthiness certificate included any maintenance or inspection specifications. Hawkins and Powers' maintenance and inspection program for the accident airplane was based on P4Y military manuals dating from the 1950s.

[6] The following agencies within the Department of the Interior conduct firefighting flights: Bureau of Land Management, Fish and Wildlife Service, National Park Service, and Bureau of Indian Affairs.

licensing are not applicable to public operations. However, aircraft used for public firefighting flights may also be used for civil flights during the portion of the year that they are not under contract to the Forest Service or the DOI.[7] During the firefighting season, the Forest Service and the DOI operate a total of about 700 aircraft, including both small and large air tankers and helicopters that carry and drop fire retardant, and lead airplanes and surveillance planes to guide the missions.

Aircraft used in public operations (including firefighting operations) are not required to be equipped with flight data or cockpit voice recorders. However, the Safety Board has advocated the installation of video recorders on certain types of aircraft that are used in public operations. Specifically, in Safety Recommendation A-99-64, the Board recommended that the DOI require all internally owned or vendor-contracted turbine powered aircraft to be equipped with a crash-protective video system, once an applicable technical standard order has been issued.[8] In Safety Recommendation A-99-69, the Board recommended that the GSA and the Interagency Committee for Aviation Policy (ICAP) urge Federal aviation program managers to require installation of an FAA-approved crash-protective video recording system on all turbine-powered aircraft that are not currently required to be equipped with a crashworthy flight recorder device once an applicable technical standard order has been issued.[9] Experience has shown that recorders can be a valuable investigative and accident-prevention tool.

Before 2003, the Forest Service and the DOI used about 40 large air tankers seasonally. As a result of the two in-flight structural breakups that occurred during the 2002 firefighting season, those agencies no longer contract for the use of C-130A or PB4Y airplanes. About 30 large air tankers remain available to those agencies for firefighting. Many of these large air tankers are surplus military aircraft that have been issued restricted-category type certificates[10]

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[7] It should also be noted that many of the pilots who fly public firefighting flights are employed by civilian operators that have contracted with the Forest Service or DOI to make their aircraft available for the firefighting season.

[8] In Safety Recommendation A-99-59, the Safety Board recommended that the FAA develop a technical standard order for a crash-protective video recording system. That recommendation is currently classified "Open—Acceptable Response."

[9] The DOI stated in a November 6, 2000, letter that Safety Recommendation A-99-64 could only be achieved upon mandatory compliance with a new FAA regulation requiring all Part 135 operators to install this type of equipment for all operations. On the basis of this reply, Safety Recommendation A-99-64 is currently classified "Open—Unacceptable Response." In response to Safety Recommendation A-99-69, the GSA and ICAP urged Federal agencies to install approved video recorders once an applicable technical standard order was issued and such a device is economically available for use. Accordingly, Safety Recommendation A-99-69 was classified "Closed—Acceptable Action."

[10] The requirements for issuance of a restricted-category type certificate to surplus military aircraft are contained in 14 CFR 21.25(a)(2) and state, in part:

> (a) An applicant is entitled to a type certificate for an aircraft in the restricted category for special purpose operations if he shows…that no feature or characteristic of the aircraft makes it unsafe when it is operated under the limitations prescribed for its intended use, and that the aircraft –
>
> (2) Is of a type that has been manufactured in accordance with the requirements of and accepted for use by, an Armed Force of the United States and has been later modified for a special purpose.

and airworthiness certificates[11] (although, as noted above, no such certification is required for public firefighting operations). According to the FAA:

> FAA-restricted type design certification of these surplus military aircraft is primarily based on military records and service history, unlike certification of normal or transport-category aircraft, which must be certificated to applicable FAA airworthiness standards (e.g. 14 CFR Part 23 or Part 25.)
>
> Because these aircraft have not been shown to meet standard-category airworthiness standards, they have numerous restrictions placed on them. These restrictions are implemented through the operating limitations attached to the airworthiness certificate, as well as the operating limitations in 14 CFR.[12]

The Safety Board notes that the operating restrictions contained in the restricted-category airworthiness certificates and type certificates of such surplus military aircraft typically do not include any enhanced maintenance requirements beyond those that applied when the aircraft left military service.

The Safety Board's investigation of the accidents discussed above focused on airworthiness and maintenance issues associated with the large air tankers. However, because all aircraft engaged in firefighting operations are exposed to the same harsh environment and increased stresses and are likely operating outside the manufacturers' original design intent, the Board notes that the deficiencies identified may well apply to all aircraft in the firefighting fleet.

Operational Environment

Frequent and aggressive low-level maneuvers with high acceleration loads and high levels of atmospheric turbulence are an inherent part of firefighting operations.[13] A 1974 report by the National Aeronautics and Space Administration (NASA)[14] found that:

[11] The requirements for issuance of a restricted-category airworthiness certificate to surplus military aircraft are contained in 14 CFR 21.185(b) and state, in part:

> (b) An applicant for a restricted category airworthiness certificate for an aircraft type certificated in the restricted category, that was either a surplus aircraft of the Armed Forces or previously type certificated in another category, is entitled to an airworthiness certificate if the aircraft has been inspected by the Administrator and found by him to be in a good state of preservation and repair and in a condition for safe operation.

[12] Letter dated November 15, 2002, from Ronald T. Wojnar, Deputy Director, FAA Aircraft Certification Service, to Tony Kern, USDA Forest Service National Aviation Officer.

[13] Turbulence levels are increased at lower altitudes and in the vicinity of high levels of heat, such as is generated by forest fires.

[14] National Aeronautics and Space Administration, *Operating Experiences of Retardant Bombers During Firefighting Operations* (1974).

> The severity of the maneuver loads experienced by airplanes involved in firefighting operations is well illustrated by comparison with the maneuver load experience for aircraft flown in commercial transport service. Where the firefighting aircraft exceeded both the maneuver limit and ultimate load factors, the aircraft flown in commercial transport service, with almost six times as many flight hours, recorded no maneuvers at, or above, the maneuver limit load factor. The rate that maneuver load factors between 2.0 and 2.4 were experienced by firefighting aircraft was almost 1,000 times that for aircraft flown as commercial transports. Because the maneuver loading, in both the repeated and high-magnitude applications, is so severe relative to the design loads, shortening of the structural life of the aircraft should be expected.

Similar findings were included in a November 1996 Supplemental Structural Inspection Document issued by Conair[15] (a Canadian manufacturer and operator of firefighting aircraft), which stated:[16]

> The F27 Firefighter aircraft operated in a firefighting role is exposed to a harsher loading environment than initially intended for a typical transport role aircraft. The increased severity of the loading environment is accounted for by introducing a "Damage Rate Factor." The airframe time that the aircraft accumulates in the firefighting role is multiplied by the Damage Rate Factor, thereby increasing the accumulated airframe time compared to a typical transport role aircraft.
>
> For the F27 Firefighter, the time spent in the firefighting role is 5.7 times more severe than typical Fokker F27 transport role operation, i.e., the Damage Rate Factor for the F27 Firefighter is 5.7.
>
> The Damage Rate Factor applies to [maintenance and inspection] time intervals and limitations specified in Fokker F27 SIP document no. 27438, part 1, as supplemented and modified by this document.

These repeated and high-magnitude maneuvers and the repeated exposure to a turbulent environment hasten the initiation of fatigue cracking and increase the growth rate of cracking once it exists. The Safety Board recognizes that aerial firefighting is an intrinsically high-risk operation. However, the risk of in-flight structural failure should not be considered an unavoidable risk of firefighting. This increased risk of fatigue cracking and accelerated crack propagation can and should be addressed through maintenance programs.

Adequacy of Existing Maintenance Programs for Firefighting Aircraft

The primary purpose of aircraft maintenance programs is to ensure the aircraft is airworthy, that is, in safe condition and properly maintained for its intended operation.

[15] Conair Aviation Ltd., *Supplemental Structural Inspection Document*, F27 SSID-535 (November 22, 1996).

[16] For more information about the operating environment encountered by air tankers engaged in firefighting operations, see the Blue Ribbon Panel Report to the Chief, USDA Forest Service and Director, USDI Bureau of Land Management, *Federal Aerial Firefighting: Assessing Safety and Effectiveness*, (Washington, DC: 2002) 14-16.

Historically, service experience has demonstrated that it is essential to have regularly updated knowledge concerning the structural integrity of the airframe. The structural integrity of aging airplanes is of particular concern since factors such as fatigue and corrosion manifest themselves with age. Accordingly, the owner or operator should be alert to the possibility that the airplane is being used in a manner significantly different from the originally intended mission profile and should continuously monitor the maintenance program for necessary changes. Therefore, airplanes should be maintained and inspected in accordance with a program that is continuously evaluated and updated based on technical and engineering support, including the manufacturer's knowledge of in-service experience.

However, for many aircraft used in firefighting operations, very little, if any, ongoing technical and engineering support is available. This is because either the manufacturer no longer exists or does not support the airplane, or the military no longer operates that type of aircraft.[17] Further, the current operators of these firefighting aircraft are typically unable to structure a maintenance program that accounts for the new mission profile because: 1) the airplane's design and service life information (such as service reports and maintenance data) is not readily available; 2) the operator lacks the necessary engineering expertise; 3) the magnitude of maneuver loading and level of turbulence in the firefighting environment is not defined; and 4) the effects of this operating environment on the service life of the aircraft structure are undefined.

Therefore, it is apparent that no effective mechanism currently exists to ensure the continuing airworthiness of these firefighting aircraft. Specifically, the maintenance and inspection programs currently being used do not adequately account for the increased safety risks to which these aircraft are now exposed as a result of their advanced age and the more severe stresses of the firefighting operating environment. The Safety Board notes that the inspection and maintenance programs used by Hawkins and Powers for the C-130A and the P4Y accident airplanes, which were based on military standards, included general visual inspections for cracks but did not include enhanced or focused inspections of highly stressed areas, such as the wing sections, where the fatigue cracks that led to those accidents were located. The Board's investigation revealed that Hawkins and Powers did not possess the engineering expertise necessary to conduct studies and engineering analysis to define the stresses associated with the firefighting operating environment and to predict the effects of those stresses on the operational life of the airplanes. Further, no infrastructure was in place to provide independent oversight of the continuing airworthiness and maintenance programs for these airplanes.

A dynamic continuing airworthiness maintenance program is especially critical in the case of surplus military aircraft. The Safety Board is aware that the military often decides to surplus aircraft because of the high costs of maintaining aging aircraft and conducting extensive overhauls. However, the Safety Board is aware that the Air Force refurbished the wings and center sections of the C-130A that was later involved in the Walker, California, accident approximately 1,500 flight hours before it was retired from service.[18] The airplane had been

[17] Even when the military is still operating one or two of a particular type of airplane (as, for example, is the case with the C-130A), it provides little, if any, ongoing technical support for non-military users of that airplane.

[18] The original Air Force maintenance program for its C-130A airplanes called for detailed inspections of the center sections every 42 months. As the airplanes aged, however, the Air Force required a complete refurbishment of the center sections every 42 months. As part of the refurbishment, every skin panel in the center section was

operated only 2,500 flight hours in non-military service before the accident occurred. It should be noted that in its post-military use as a firefighting airplane, the airplane was subjected to a more severe operating environment and failed even with the benefit of refurbished wings and center section, which was deemed necessary for continued operation in the (less severe) Air Force environment.

At a minimum, a dynamic continuing airworthiness program for aircraft used for firefighting operations should take into account and be based on: 1) the airplane's original design requirements and its intended mission and operational life; 2) the amount of operational life that has been used before entering firefighting service; 3) the magnitude of maneuver loading and the level of turbulence in the firefighting environment and their effect on the remaining operational life; 4) the impact of all flight hours (both public and civil) on the airplane's remaining operational life; and 5) a detailed engineering evaluation and analysis to predict and prevent fatigue separations such as those involved in the three accidents discussed above. A dynamic continuing airworthiness maintenance program might well have identified the areas of fatigue cracking on the accident airplanes as high-risk points that warranted frequent and/or enhanced inspections for signs of potential cracking.

Role of the Forest Service and Department of the Interior

As previously mentioned, public firefighting flights are not statutorily required to comply with most FAA regulations (including those pertaining to airworthiness and maintenance) nor, accordingly, are they subject to FAA oversight in those areas.[19] Therefore, the Forest Service and the DOI, as the operators of these flights, are primarily responsible for ensuring the safety of these operations. Although they attempt to compel safe operations through the use of contract requirements,[20] the Board's investigation revealed that their oversight and infrastructure simply are not adequate to assure safe operations. The Safety Board concludes that these agencies must ensure the continuing airworthiness of their firefighting aircraft, which necessarily includes monitoring the adequacy of their maintenance programs.

Therefore, the Safety Board believes that the Forest Service and the DOI should each develop maintenance and inspection programs for aircraft that are used in firefighting operations that take into account and are based on: 1) the airplane's original design requirements and its intended mission and operational life; 2) the amount of operational life that has been used before entering firefighting service; 3) the magnitude of maneuver loading and the level of turbulence in the firefighting environment and the effect of these factors on remaining operational life; 4) the impact of all previous flight hours (both public and civil) on the airplane's remaining operational life; and 5) a detailed engineering evaluation and analysis to predict and prevent fatigue separations such as those involved in the three accidents discussed above. In addition, the Safety

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removed and examined with nondestructive inspection techniques and, if any cracks were detected, replaced with a new skin panel.

[19] The Safety Board notes that in 1998, a GSA advisory board recommended that the FAA be made responsible for regulation, oversight, and enforcement relating to public aircraft, but no action was taken on this recommendation.

[20] Forest Service and DOI contracts usually require that the company supplying the aircraft comply with "all applicable Federal Aviation Regulations pertaining to civil aircraft," including the maintenance provisions contained in 14 CFR Parts 43 and 91.

Board believes that the Forest Service and the DOI should require that aircraft used in firefighting operations be maintained in accordance with these maintenance and inspection programs. Further, the Safety Board believes that the Forest Service and the DOI should hire personnel with aviation engineering and maintenance expertise to conduct appropriate oversight to ensure these maintenance requirements are met.

The Safety Board is aware that the Forest Service has recently embarked on a multiyear plan to evaluate and improve the airworthiness of its air tanker fleet, including modification of its maintenance program so that it more closely reflects the firefighting mission. The Board supports this initiative and looks forward to learning more about the progress and results of this plan.

Role of the FAA

Many of the aircraft used for public firefighting flights are also used for non-public (that is, civil) flights, which are governed by FAA maintenance and airworthiness standards and are subject to FAA oversight. For example, some of the aircraft owned by Hawkins and Powers that are under contract to the Forest Service or Bureau of Land Management and are therefore considered public aircraft (for approximately 3 months of the year) are used for civil operations (and are therefore subject to FAA oversight) during the remaining 9 months of the year.

FAA oversight of certificated entities that own or operate restricted-category aircraft used for public firefighting missions during part of the year (such as Hawkins and Powers) will be of limited safety value if the oversight associated with the non-public use of those aircraft does not take into account the flight hours, structural stresses, and other factors associated with the public firefighting operations. As discussed previously, these factors can have a direct bearing on airworthiness. Therefore, the Safety Board believes that the FAA should require that restricted-category aircraft used for any part of the year in firefighting operations be maintained in accordance with appropriate maintenance and inspection programs that take into account and are based on: 1) the airplane's original design requirements and its intended mission and operational life; 2) the amount of operational life that has been used before entering firefighting service; 3) the magnitude of maneuver loading and the level of turbulence in the firefighting environment and the effect of these factors on remaining operational life; 4) the impact of all previous flight hours (both public and civil) on the airplane's remaining operational life; and a detailed engineering evaluation and analysis to predict and prevent fatigue separations such as those involved in the three accidents discussed above.

Finally, the Safety Board notes that the collection and dissemination of continuing airworthiness information about surplus military aircraft is particularly problematic. There is currently no convenient method for obtaining information about the ongoing service history and maintenance issues associated with these aircraft. For example, service bulletins, updates, results of accident/incident investigations, and manual changes are not disseminated to the current operators because no financial motivation or incentive exists for the military to supply this information. Because the original manufacturer no longer exists and the military is not equipped to support civilian or public use operations, the FAA seems to be a logical organization to serve as a clearinghouse for this type of information. The Board notes that in the early 1990s FAA staff initiated efforts to take on this function. However, this initiative was never completed. Therefore, the Safety Board believes that the FAA should assume the responsibility to serve as

the focal point for collecting continuing airworthiness information about surplus military aircraft from the organization that last provided technical or engineering support (for example, the original manufacturer or the military) and disseminating that information to subsequent owners and operators.[21]

Therefore, the National Transportation Safety Board makes the following recommendations:

—To the U.S. Department of Agriculture, Forest Service and the U.S. Department of the Interior:

> Develop maintenance and inspection programs for aircraft that are used in firefighting operations that take into account and are based on: 1) the airplane's original design requirements and its intended mission and operational life; 2) the amount of operational life that has been used before entering firefighting service; 3) the magnitude of maneuver loading and the level of turbulence in the firefighting environment and the effect of these factors on remaining operational life; 4) the impact of all previous flight hours (both public and civil) on the airplane's remaining operational life; and 5) a detailed engineering evaluation and analysis to predict and prevent fatigue separations. (A-04-29)
>
> Require that aircraft used in firefighting operations be maintained in accordance with the maintenance and inspection programs developed in response to Safety Recommendation A-04-29 (A-04-30).
>
> Hire personnel with aviation engineering and maintenance expertise to conduct appropriate oversight to ensure the maintenance requirements specified in Safety Recommendation A-04-29 are met. (A-04-31)

—To the Federal Aviation Administration:

> Require that restricted-category aircraft used for any part of the year in firefighting operations be maintained in accordance with appropriate maintenance and inspection programs that take into account and are based on: 1) the airplane's original design requirements and its intended mission and operational life; 2) the amount of operational life that has been used before entering firefighting service; 3) the magnitude of maneuver loading and the level of turbulence in the firefighting environment and the effect of these factors on remaining operational life; 4) the impact of all previous flight hours (both public and civil) on the airplane's remaining operational life; and 5) a detailed engineering evaluation and analysis to predict and prevent fatigue separations. (A-04-32)

[21] In discussions with Safety Board staff, FAA officials responded favorably to the concept of an FAA focal point and indicated that they were considering implementing such an arrangement. The officials indicated that the same office that would be designated as the focal point for collecting and disseminating airworthiness information would also review all type certificates granted to surplus military aircraftto ensure consistency.

Assume the responsibility to serve as the focal point for collecting continuing airworthiness information about surplus military aircraft from the organization that last provided technical or engineering support (for example, the original manufacturer or the military) and disseminating that information to subsequent owners and operators. (A-04-33)

Chairman ENGLEMAN CONNERS, Vice Chairman ROSENKER, and Members GOGLIA, CARMODY, and HEALING concurred in these recommendations.

Original Signed

By: Ellen Engleman Conners
Chairman

Enclosures: Briefs of Accident for Pearblossom, California,
Walker, California, and Estes Park, Colorado

National T. ortation Safety Board
Washington, DC 20594

Brief of Accident

LAX94FA323
File No. 2073 | 08/13/1994 | PEARBLOSSOM, CA | Aircraft Reg No. N135FF | Time (Local): 1331 PDT

Make/Model: LOCKHEED / C-130A
Engine Make/Model: ALLISON / T-56-A-9D
Aircraft Damage: Destroyed
Number of Engines: 4
Operating Certificate(s):
Name of Carrier: JAMES A. VENABLE
Type of Flight Operation: Public Use
Reg. Flight Conducted Under: Part 137: Agricultural

	Fatal	Serious	Minor/None
Crew	3	0	0
Pass	0	0	0

Last Depart. Point: HEMET, CA
Destination: Local Flight
Airport Proximity: Off Airport/Airstrip

Condition of Light: Day
Weather Info Src: Weather Observation Facility
Basic Weather: Visual Conditions
Lowest Ceiling: None
Visibility: 50.00 SM
Wind Dir/Speed: Calm
Temperature (°C): 39
Obstr to Vision: None
Precipitation: None

Pilot-in-Command Age: 61

Certificate(s)/Rating(s)
Airline Transport; Commercial; Multi-engine Land; Multi-engine Sea; Single-engine Land; Helicopter
Instrument Ratings
Airplane

Flight Time (Hours)

Total All Aircraft: 11000
Last 90 Days: Unk/Nr
Total Make/Model: 2000
Total Instrument Time: 5250

While in level flight, the airplane's right wing separated and, during the separation sequence, wing fuel ignited. Subsequent laboratory examination of right-side, center-wing fragments revealed two fatigue cracks that propagated to overstress fractures. One of the cracks was within the underside wing skin below a doubler, and the other was withi the doubler itself. The total size and origin of the fatigue regions could not be determined due to damage to fracture surfaces and a lack of available material. The airplane v delivered new to the U.S. Air Force in December 1957 and was retired from military service in 1986. In May 1990, the FAA issued a restricted-category special airworthiness certificate authorizing the airplane to dispense aerial fire retardant. At the time of the accident, the airplane had a total of 20,289 flight hours, 19,547 of which were acquire during its military service. The inspection and maintenance programs used by the operator, which were based on military standards, included general visual inspections for cracks but did not include enhanced or focused inspections of highly stressed areas, such as the wing sections, where the fatigue cracks that led to those accidents were loc The operator did not possess the engineering expertise necessary to conduct studies and engineering analysis to define the stresses associated with the firefighting operati environment and to predict the effects of those stresses on the operational life of the airplanes.

LAX94FA323
File No. 2073 08/13/1994 PEARBLOSSOM, CA Aircraft Reg No. N135FF Time (Local): 1331 PDT

Occurence #1 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation CRUISE

Findings
1) WING - FAILURE,TOTAL
2) (C) WING,SPAR - FATIGUE
3) (C) WING,SKIN - FATIGUE
4) (F) MAINTENANCE,INSPECTION - INADEQUATE - COMPANY/OPERATOR MANAGEMENT

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Occurence #2 LOSS OF CONTROL - IN FLIGHT
Phase of Operation DESCENT - UNCONTROLLED

Findings
5) AIRCRAFT CONTROL - NOT POSSIBLE

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Occurence #3 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation DESCENT - UNCONTROLLED

Findings
6) TERRAIN CONDITION - MOUNTAINOUS/HILLY

Findings Legend: (C) = Cause, (F) = Factor

The National Transportation Safety Board determines the probable cause(s) of this accident as follows.
the inflight failure of the right wing due to fatigue cracking in the underside right wing skin and overlying doubler. A factor contributing to the accident was inadequate maintenance procedures to detect fatigue cracking.

National Tr[illegible]ortation Safety Board
Washington, DC 20594

Brief of Accident

LAX02GA201
File No. 14459 | 06/17/2002 | Walker, CA | Aircraft Reg No. N130HP | Time (Local): 1445 PDT

Make/Model: Lockheed / C-130A
Engine Make/Model: Allison / T56A-9D
Aircraft Damage: Destroyed
Number of Engines: 4
Operating Certificate(s):
Type of Flight Operation: Aerial Application
Reg. Flight Conducted Under: Public Use

	Fatal	Serious	Minor/None
Crew	3	0	0
Pass	0	0	0

Last Depart. Point: Minden, NV
Destination: Local Flight
Airport Proximity: Off Airport/Airstrip

Condition of Light: Day
Weather Info Src: Weather Observation Facility
Basic Weather: Visual Conditions
Lowest Ceiling: None
Visibility: 10.00 SM
Wind Dir/Speed: 190 / 015 Kts
Temperature (°C): 24
Obstr to Vision: Smoke
Precipitation: None

Pilot-in-Command Age: 42

Certificate(s)/Rating(s)
Airline Transport; Flight Instructor; Commercial; Flight Engineer; Multi-engine Land; Single-engine Land; Glider; Helicopter
Instrument Ratings
Airplane

Flight Time (Hours)

Total All Aircraft: 10833
Last 90 Days: 108
Total Make/Model: Unk/Nr
Total Instrument Time: Unk/Nr

The airplane was making a fire retardant drop over a mountain drainage valley when the wings separated from the fuselage. A videotape of the accident sequence showed the airplane as it flew down the valley and proceeded to make a fire retardant drop. When the drop was almost completed, the airplane's nose began moving up, and the airplane started to arrest its descent and level out. The nose of the airplane continued to rise, and the airplane's wings folded upward until they detached from the fuselage at the cer wing box beam-to-fuselage attachment location. Close examination of the video revealed that the right wing folded upward first, followed by the left wing about 1 second late Metallurgical examination of the center wing box lower skin revealed a 12-inch long fatigue crack on the lower surface of the right wing beneath the forward doubler, with two separate fatigue crack initiation sites at stringer attachment rivet holes (which join the external doubler and the internal stringers to the lower skin panel). The cracks from t initiation sites eventually linked up to create a single crack. The portion of the wing skin containing the fatigue crack was covered by a manufacturer-installed doubler, which would have hidden the crack from view and, therefore, prevented detection of the crack from a visual inspection of the exterior of the airplane. The investigation found that tl airplane was probably operated within the maximum takeoff gross weight limits specified in the airplane flight manual. The airplane was delivered new to the U.S. Air Force (USAF) in 1957 and was retired from military service in 1978. The U.S. Forest Service (USFS) acquired it from the USAF in 1988 for use as a fire suppression tanker. Betwe 1978 and 1988, it was kept in a desert storage facility. It was transferred to a civilian contractor for firefighting operations and modified for that role, then sold to a Part 135 operator. The airplane was certificated by the FAA in the restricted category under a type certificate held by the USFS. A Lockheed study concluded that firefighting mission were substantially more severe than typical military logistics operations and aircraft operated in this role would require inspection intervals as much as 12 times more freque

than typical military transport usage for meeting damage tolerance requirements. Concerning the detectability of the cracks, Lockheed reported that nondestructive x-ray inspection methods in current industry and military depot level maintenance processes could have detected, with high confidence, the fatigue cracks when they were 0.50 to 0.75 inch long. Inspection intervals appropriate for this detectable crack size can be determined from a damage tolerance crack growth analysis; however, this requires an extensive knowledge of the operational loads environment and internal stresses of the C-130A wing such as would be found in a military depot level maintenance program. The operating limitations accompanying the restricted certificate specified that it be flown and maintained in accordance with the then-current (1988) USAF technical orders for the C-130A. The USAF depot level maintenance program was not included in the maintenance technical orders and was not individually specified on the certificate's operating limitations. The limitations letter did not specify compliance with USAF maintenance program modifications/amendments in technical orders issued after 1988. The operator devised a maintenance and inspection program based on the specified USAF maintenance technical order but did not develop a depot level inspection requirement to ensure continued long-term airworthiness and damage tolerance that would account for the stresses on the airplane resulting from its new firefighting role and the increasing age of the airplanes. Investigation found that there are five separate FAA-issued type certificates owned by five separate firms for the C-130As used as tankers. Although the five certificates have similar maintenance requirements, none are standardized, there is no depot level maintenance program specified for any of them, and none require full compliance with all military airworthiness technical orders. In 1991, the Department of Interior (DOI) began to doubt the continued airworthiness of the C-130A firefighting tanker fleet and was specifically concerned that the lack of a depot level maintenance program or any requirement for compliance with all military airworthiness technical orders could compromise the safety of the airplane. The DOI asked the FAA to standardize the type certificate for the C-130A and mandate improvements in the maintenance and inspection requirements. In a written opinion, the USAF agreed and urged the FAA to mandate that operators establish a depot level type continuing airworthiness program for the airplane and mandate compliance with all technical orders. In a series of meetings held in 1993, FAA management internally agreed that the DOI and USAF positions held merit and began to develop requirements. In late 1993, in a meeting between the FAA, DOI, USFS, and the airplane operators, the USFS and the operators objected to the idea of depot level maintenance programs and full compliance with all technical orders on the basis of the potential economic impact of these requirements. As of the time of the accident, the FAA had not standardized the existing five type certificates nor had they imposed any additional maintenance or inspection program requirements.

LAX02GA201
File No. 14459 06/17/2002 Walker, CA Aircraft Reg No. N130HP Time (Local): 1445 PDT

Occurence #1 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation MANEUVERING - AERIAL APPLICATION

Findings
1) WING - FAILURE,TOTAL
2) (C) WING,SPAR - FATIGUE
3) (C) WING,SKIN - FATIGUE
4) (F) MAINTENANCE,INSPECTION - INADEQUATE - COMPANY/OPERATOR MANAGEMENT

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Occurence #2 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation DESCENT - UNCONTROLLED

Findings
5) AIRCRAFT CONTROL - NOT POSSIBLE

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Occurence #3 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation DESCENT - UNCONTROLLED

Findings
6) TERRAIN CONDITION - MOUNTAINOUS/HILLY

Findings Legend: (C) = Cause, (F) = Factor

The National Transportation Safety Board determines the probable cause(s) of this accident as follows.
the inflight failure of the right wing due to fatigue cracking in the center wing lower skin and underlying structural members. A factor contributing to the accident was inadequate maintenance procedures to detect fatigue cracking.

National Trans[illegible]ation Safety Board
Washington, DC 20594

Brief of Accident

DEN02GA074
File No. 13174 | 07/18/2002 | Estes Park, CO | Aircraft Reg No. N7620C | Time (Local): 1840 MDT

Make/Model: Consolidated-Vultee / P4Y-2
Engine Make/Model: Wright / R2600-35
Aircraft Damage: Destroyed
Number of Engines: 4
Operating Certificate(s):
Type of Flight Operation: Aerial Application
Reg. Flight Conducted Under: Public Use

	Fatal	Serious	Minor/None
Crew	2	0	0
Pass	0	0	0

Last Depart. Point: Broomfield, CO
Destination: Local Flight
Airport Proximity: Off Airport/Airstrip

Condition of Light: Day
Weather Info Src: Weather Observation Facility
Basic Weather: Visual Conditions
Lowest Ceiling: 12000 Ft. AGL, Broken
Visibility: 30.00 SM
Wind Dir/Speed: 040 / 008 Kts
Temperature (°C): 34
Obstr to Vision: None
Precipitation: None

Pilot-in-Command Age: 39

Certificate(s)/Rating(s)
Flight Instructor; Commercial; Multi-engine Land; Single-engine Land
Instrument Ratings
Airplane

Flight Time (Hours)

Total All Aircraft: 3658
Last 90 Days: 217
Total Make/Model: 1328
Total Instrument Time: Unk/Nr

The airplane was maneuvering to deliver fire retardant when its left wing separated. Aircraft control was lost and the airplane crashed into mountainous terrain. A witness on the ground took a series of photographs that showed the airtanker's left wing separating at the wing root and the remaining airplane entering a 45-degree dive to the ground in a counterclockwise roll. An examination of the airplane wreckage revealed extensive areas of preexisting fatigue in the left wing's forward spar lower spar cap, the adjacent spar web, and the adjacent area of the lower wing skin. The portion of the wing containing the fatigue crack was obscured by the retardant tanks and would not have been detectable by an exterior visual inspection. An examination of two other airtankers of the same make and model revealed the area where the failure occurred on the accident airplane was in a location masked by the airplane's fuselage construction. The airplane was manufactured in 1945 and was in military service until 1956. It was not designed with the intention of operating as a firefighting airplane. In 1958, the airplane was converted to civilian use as an airtanker and served in that capacity until the time of the accident. The investigation revealed that the owner developed service and inspection procedures for the airtanker; however, the information contained in the procedures did not adequately describe where and how to inspect for critical fatigue cracks. The procedures were based on U.S Navy PB4Y-2 airplane structural repair manuals that had not been revised since 1948.

DEN02GA074
File No. 13174 | 07/18/2002 | Estes Park, CO | Aircraft Reg No. N7620C | Time (Local): 1840 MDT

Occurence #1 AIRFRAME/COMPONENT/SYSTEM FAILURE/MALFUNCTION
Phase of Operation MANEUVERING - AERIAL APPLICATION

Findings
1) -WING - FAILURE,TOTAL
2) (C) WING,SPAR - FATIGUE
3) (C) WING,SKIN - FATIGUE
4) (F) MAINTENANCE,INSPECTION - INADEQUATE - COMPANY/OPERATOR MANAGEMENT

.....

Occurence #2 LOSS OF CONTROL - IN FLIGHT
Phase of Operation DESCENT - UNCONTROLLED

Findings
5) AIRCRAFT CONTROL - NOT POSSIBLE

.....

Occurence #3 IN FLIGHT COLLISION WITH TERRAIN/WATER
Phase of Operation DESCENT - UNCONTROLLED

Findings
6) TERRAIN CONDITION - MOUNTAINOUS/HILLY

Findings Legend: (C) = Cause, (F) = Factor

The National Transportation Safety Board determines the probable cause(s) of this accident as follows.
the inflight failure of the left wing due to fatigue cracking in the left wing's forward spar and wing skin. A factor contributing to the accident was inadequate maintenance procedures to detect fatigue cracking.