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National Transportation Safety Board

Washington D.C. 20594

Safety Recommendation

Date: December 20, 1996

In reply refer to: A-96-142 through -149

Honorable Linda Hall Daschle
Acting Administrator
Federal Aviation Administration
Washington, D.C. 20591

On August 21, 1995, about 1253 eastern daylight time, an Empresa Brasileira de Aeronautica S. A. (Embraer) EMB-120RT, N256AS, airplane operated by Atlantic Southeast Airlines Inc., (ASA) as ASE flight 529, experienced the loss of a propeller blade from the left engine propeller while climbing through 18,100 feet. The airplane then crashed during an emergency landing near Carrollton, Georgia, about 31 minutes after departing the Atlanta Hartsfield International Airport, Atlanta, Georgia.[1]

The flight was a scheduled passenger flight from Atlanta to Gulfport, Mississippi, carrying 26 passengers and a crew of 3, operating according to instrument flight rules, under the provisions of Title 14 Code of Federal Regulations (CFR) Part 135. The flightcrew declared an emergency and

[1]For more detailed information, read Aircraft Accident Report--"In-flight Loss of Propeller Blade, Forced Landing, and Collision with Terrain, Atlantic Southeast Airlines, Inc., Flight 529, Embraer EMB-120RT, N256AS, Carrollton, Georgia, August 21, 1995" (NTSB/AAR-96/06)

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initially attempted to return to Atlanta. The flightcrew then advised that they were unable to maintain altitude and were vectored by air traffic control toward the West Georgia Regional Airport, Carrollton, Georgia, for an emergency landing. The airplane continued its descent and was destroyed by ground impact forces and postcrash fire. The captain and four passengers sustained fatal injuries. Three other passengers died of injuries in the following 30 days. The first officer, the flight attendant, and 11 passengers sustained serious injuries, and the remaining 8 passengers sustained minor injuries.

The National Transportation Safety Board has determined that the probable cause of this accident was the in-flight fatigue fracture and separation of a propeller blade resulting in distortion of the left engine nacelle, causing excessive drag, loss of wing lift, and reduced directional control of the airplane. The fracture was caused by a fatigue crack from multiple corrosion pits that were not discovered by Hamilton Standard because of inadequate and ineffective corporate inspection and repair techniques, training, documentation, and communications. Contributing to the accident was Hamilton Standard's and the Federal Aviation Administration's (FAA's) failure to require recurrent on-wing ultrasonic inspections for the affected propellers. Contributing to the severity of the accident was the overcast cloud ceiling at the accident site.

As discussed in the Safety Board's report on this accident, in 1994, there were two failures of Hamilton Standard composite-type propeller blades that were found to have resulted from cracks that originated from inside the taper bore. The first event took place on March 13, 1994, on an Inter-Canadien[2] Aerospatiale-Aeritalia ATR 42 equipped with a model 14SF propeller blade. The second event occurred on March 30, 1994, on a Nordeste[3] Embraer EMB 120 equipped with a model 14RF blade.

Laboratory examination of the failed blades indicated the presence of chlorine-based corrosion pits in both instances. The chlorine source was traced to a bleached cork installed in the taper bore to retain the lead

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[2]Inter-Canadien is a regional air carrier based in Montreal, Canada.

[3]Nordeste Linhas Aereas Regionals S.A. is a regional air carrier based in Salvador, Bahia, Brazil.

balance wool. These findings were corroborated by Hamilton Standard engineers and the FAA.

As a result of the two propeller blade failures in March 1994, and the resulting ultrasonic inspections of the taper bore mandated by the FAA[4] in May 1994, there was a sudden increase in the number of propeller blades requiring inspection and repair in May and June 1994. The accident propeller blade was one of the blades returned to Hamilton Standard as a result of the inspection. The taper bore inspection and repair of the accident blade was performed at Hamilton Standard's Customer Support Center in Rock Hill between June 7, and June 9, 1994.

Early in the process of inspecting returned blades, Hamilton Standard discovered that some ultrasonic indications were caused by visible mechanical damage. Although no cracks were found, the mechanical damage was in excess of what engineers thought was acceptable. Hamilton Standard reviewed the shop practices and concluded that the mechanical damage was a result of tools and techniques used during the installation and removal of balance wool lead. As a result, Hamilton Standard developed repair procedures to blend locally visible mechanical damage and eliminate ultrasonic indications that had no associated cracks. This repair was described in Hamilton Standard repair procedure PS960 and was approved by the FAA on April 8, 1994. PS960 was subsequently amended by PS960A to include procedures to eliminate the taper bore cork and to replace it with a sealant. PS960A was approved by the FAA on April 18, 1994.

Hamilton Standard Repair Practices and Procedures

The evidence in this investigation disclosed that the technician who inspected and repaired the accident blade first confirmed the rejectable ultrasonic indication, and then visually examined the taper bore for evidence of corrosion, pits or cracks using a white light borescope. He wrote on the shop traveler, "No visible fa[u]lts found, blend rejected area," and used the blending repair procedure set forth in PS960A to remove the ultrasonic

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[4]Airworthiness Directive (AD) 94-09-06 required an ultrasonic inspection of the taper bore.

indication. The blended area was later found to be the site of a crack originating in corrosion pits.

The evidence also revealed that Hamilton Standard's FAA-approved propeller blade repair procedures (PS960A) required that the blended area of the blade be restored to its original surface finish. However, the sanding marks in the blended area of the accident blade were much rougher than the original surface finish. Those sanding marks appeared to have smeared some of the corroded surface, suggesting that the sanding took place after the corrosion had formed.

In its report on this accident, the Safety Board has concluded that the failure to restore the taper bore surface to the original surface finish, as required by PS960A, was a factor that caused the reduction of the ultrasonic indication that allowed the blade to pass the final ultrasonic inspection and to be returned to service. Moreover, the borescope inspection procedure developed and used by Hamilton Standard in June 1994 to inspect returned blades that had rejectable ultrasonic indications for evidence of cracks, pits, and corrosion was inadequate and ineffective. The Safety Board has also concluded that the introductory technical training to prepare the new, inexperienced workforce at Hamilton Standard's Rock Hill Customer Service Center might have been adequate; but the training initially given to technicians, who inspected blades that were returned to Rock Hill as a result of on-wing ultrasonic inspections, including the accident blade, was inadequate to ensure proficiency in the detection of taper bore corrosion or associated cracks.

Although the PS960A blend repair is no longer being used, Hamilton Standard uses blending (sanding) in a variety of other propeller repair procedures. In view of the potential for improperly performed blend repairs to mask existing corrosion and cracks, the Safety Board believes that the FAA should require Hamilton Standard to review and evaluate the adequacy of its tools, training and procedures for performing propeller blend repairs, and ensure that those blend repairs are being performed properly.

"Buy Back" of Work Performed by Uncertificated Mechanics

The evidence in this accident found that the technician who performed the blend repair on the accident blade was neither an FAA-certificated mechanic nor, as an employee of a 14 CFR Part 145 repair station, was he required to be certificated. The technician stated that he was permitted to sign off the work that he was qualified to perform. The shop traveler form, which listed the requirement specified in PS960A for the 63 RMS[5] surface finish, showed that the technician had signed off that he had accomplished the PS960A taper bore blend repair. However, except for the subsequent ultrasonic inspection that was to determine if the rejectable indication had been eliminated, there were no other inspections of the accident blade. 14 CFR Part 65.87 states, in part, that a certificated mechanic may return a propeller blade to service after he has repaired and inspected, or supervised the repair and inspection of, that part. 14 CFR Part 145.45 specifies that a repair station must have an inspection system with qualified personnel to determine the airworthiness of the parts being altered or maintained. Therefore, the Safety Board believes that the FAA should review the need to require inspection ("buy back") after the completion of work that is performed by uncertificated mechanics at Part 145 repair stations to ensure the satisfactory completion of the assigned tasks.

Vibratory Stress Testing

On April 19, 1993, the Safety Board investigated a propeller in-flight separation on an MU-2B-60 in Zwingle, Iowa.[6] As indicated in the accident report, the Safety Board discovered that during certification testing of the Hartzell HC-B4 propeller on this airplane, a reactionless mode of vibration[7]

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[5]The surface roughness in the blended area was measured as Ra 125, whereas the surface finish requirement of PS960A is 63 RMS, which converts to approximately Ra 50. ("Ra" denotes arithmetically averaged roughness.)

[6]See Aircraft Accident Report—"In-flight Loss of Propeller Blade and Uncontrolled Collision with Terrain, Mitsubishi MU-2B-60, N86SD, Zwingle, Iowa, April 19, 1993" (NTSB/AAR-93/08)

[7]The reactionless mode of vibration is characterized when two blades of a four-bladed, rotating propeller, 180 degrees apart, reach a negative vibratory stress peak at the same time that the other two blades reach their positive stress peak. This type of propeller vibration is called reactionless because the bending loads of the four blades are

was identified with the peak stress occurring at a propeller speed of 1,079 revolutions per minute (rpm). As a result, the propeller was prohibited from continuous operation on the ground below 1,145 rpm. The Safety Board attributed the loss of the propeller to a reduction in the fatigue strength of the hub material combined with exposure to higher-than-normal cyclic loads during ground operations when the propeller vibrated in the reactionless mode.

In Advisory Circular (AC) 20-66, Vibration Evaluation of Aircraft Propellers, the FAA recommends that propeller diameters be tested at various lengths throughout the diameter range, including the maximum and minimum diameters, and the cutoff repair limit. Although AC 20-66 includes a detailed discussion of the propeller vibratory phenomenon, it does not explain that a propeller blade's natural vibratory response can vary with conditions, such as mass gain, mass loss, and variations in airfoil shape, and that adequate margin from a potentially coincident excitation frequency should be maintained. Consequently, the Safety Board has concluded that the AC does not provide guidelines for adequate margin between a propeller blade's natural frequencies and its potentially coincident excitation frequencies over the life of the blade. Therefore, the Safety Board believes that the FAA should revise AC 20-66 to include the vibratory testing of composite propeller blades that have been previously operated for a substantial number of service hours, and composite blades that have been altered to the limits set forth in FAA-approved repair manuals to determine the expected effects of age on propeller vibration and provide guidelines for rpm margin between a propeller blade's natural frequencies and the excitation frequencies associated with propeller operation.

Potential Long-term Atmospheric-Induced Corrosion

Embraer's postcertification (September 1984) testing determined that the nacelle would not withstand a mid-blade or full-blade segment loss. To date, there have been four blade separations--three from fatigue cracks that initiated in the taper bore. The first blade separation (Inter-Canadien)

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canceled at the propeller hub which consequently transmits little or no vibratory loading to the propeller mounting structure.

resulted in RGB and propeller separation, and the assembly fell to earth. During the second blade separation (Nordeste), the RGB and propeller assembly remained in place. During the third separation (a Luxair accident)[8], in which a fracture occurred in the blade shank area, the RGB and propeller assembly again fell from the airplane. During the fourth blade failure (this accident), the RGB rotated out of position, and resulted in degraded aerodynamic performance and a fatal accident.

Although in two of the occurrences, the RGB and propeller fell clear and did not seriously compromise the airplane or degrade its performance, all of the occurrences clearly placed the airplane and its occupants at serious risk. On four occasions, stresses on blades with flaws (corrosion pits or mechanical damage) have produced a blade separation even though the propeller was certificated based on the assumption of an unlimited life. Because the current regulations do not require that an airframe survive if a blade breaks, and because Embraer has determined that the EMB-120 cannot survive the loss of a mid-blade or full-blade segment, minimizing the possibility of a propeller blade separation is imperative. To prevent future failures, it is essential that stress risers in the form of corrosion or mechanical damage are not permitted to occur on any propeller blade.

The Safety Board concurs that the taper bore repair procedure specified in Hamilton Standard's March 1996 service bulletins (and required by airworthiness directives) should have restored the surface of the taper bore of all existing propellers to a nearly new condition. Also, because Hamilton Standard has prohibited the use of the mechanical lead-removal tools during routine blade balancing, the likelihood of future inadvertent mechanical damage has been greatly reduced.

However, while the terminating taper bore repair procedure should detect and eliminate any chlorine-induced corrosion or mechanical damage, the Safety Board is concerned that exposure to small amounts of moisture or other atmospheric elements during routine maintenance, the recurring inspection procedure set forth in the Component Maintenance Manual (CMM), periods of low utilization, or long-term storage may allow

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[8]Luxair is a regional air carrier based in Luxembourg City, Luxembourg. The propeller was on an EMB-120 airplane; the accident occurred on August 3, 1995.

atmospheric-induced corrosion to begin in the taper bore. The Safety Board is aware of reports of corrosion and cracking in the taper bores of P-3 and C-130 propellers associated with long-term storage. Because of this, the Safety Board has concluded that despite all the actions taken by Hamilton Standard and the FAA to date, there is a continuing potential for corrosion to develop in taper bores of the affected Hamilton Standard propeller blades. Therefore, the Safety Board believes that the FAA should require that Hamilton Standard consider long-term, atmospheric-induced corrosion effects and amend the CMM inspection procedure to reflect an appropriate interval that will detect any corrosion within the taper bore.

Hamilton Standard Communication Policies and Procedures

Apparently, Hamilton Standard engineering originally intended PS960A only to remove possible sources of stress concentration by blend-repairing mechanical damage (visible tool marks) within the taper bore of any blade, without regard for whether the surface was shotpeened or not. The instructions in PS960A with regard to the surface finish of the taper bore specifically stated, "No unblended mechanical damage is allowed." The FAA reviewed and approved the repair for this purpose. However, the use of PS960A blending repair was expanded by Hamilton Standard engineering to blend the area of ultrasonic indications even when there was no apparent mechanical reason (visible tool mark) associated with the ultrasonic indication.

The Safety Board considered whether it was appropriate, from an engineering perspective, for Hamilton Standard to extend the applicability of PS960A beyond its original purpose (blending of mechanical damage), and to authorize its use for removing ultrasonic indications caused by shotpeen impressions. Surface irregularities created by shotpeening are, in effect, a form of mechanical surface alteration, and the concept of blending mechanical damage is not per se objectionable, so long as there are no cracks or other defects in the area being blended.[9] Based on the prior blade separations (both of which involved cracks originating from corrosion),

[9]The blending process could mask the existence of a crack if done improperly or if enough of the crack is removed by the blending so that the ultrasonic indication is reduced to a nonrejectable height.

Hamilton Standard had no reason to believe that mechanical damage in taper bores was causing cracks. Therefore, the Safety Board has concluded that Hamilton Standard's engineering decision to use the PS960A blending repair to remove ultrasonic indications caused by a shotpeened taper bore surface was technically reasonable.

Although the decision by Hamilton Standard engineers to extend the applicability of PS960A to impressions in shotpeened taper bores was technically reasonable, the procedure by which that decision was communicated to others within Hamilton Standard was deficient. The decision was communicated during a conference call involving top engineering managers, but it was not discussed with the Designated Engineering Representative (DER) or the FAA. It was then documented in a memorandum that contained no indication that it represented an extension of PS960A, and made no reference to shotpeened taper bores. The memorandum stated only that blades returned as a result of an ultrasonic inspection should be reworked "per PS960A." The substance of the decision was then verbally transmitted by the engineering manager of the Rock Hill facility to his staff but, as evidenced by the technician's belief that he was authorized to use the PS960A blend repair to remove ultrasonic indications on both shotpeened and unshotpeened blades, it was either misstated or misunderstood.

Although Hamilton Standard management asserted that this expansion of the use of the PS960A blending repair procedure applied only to ultrasonic indications in shotpeened taper bores, it was understood, at least by the technician who worked on the accident blade, as being applicable to unexplained ultrasonic indications in unshotpeened taper bores as well. Given that unexplained ultrasonic indications in the taper bore area represent an unknown condition suggestive of cracking and, further, that (according to statistical data provided by Hamilton Standard) blades without shotpeened taper bores are susceptible to earlier corrosion and to cracking once corrosion begins, Hamilton Standard management (both in Windsor Locks and in Rock Hill) should have made certain that the technicians performing the repair clearly understood that the extension of PS960A was intended for shotpeened taper bores only.

If the technician had clearly understood that he was not authorized to blend unexplained ultrasonic indications in unshotpeened taper bores, he would have rejected the accident blade, or at least sought additional guidance from his engineering manager as to how to handle the unexplained ultrasonic indication. In either case, the accident blade would not have been subjected to the PS960A blend repair, which masked the existence of the crack and would not likely have been returned to service.

Accordingly, the Safety Board concludes that Hamilton Standard's failure to seek FAA approval of the extension of PS960A blending repair hindered the FAA's ability to oversee Hamilton Standard's handling of the taper bore crack and corrosion problem, and led to an inadequate documentation of the extension that caused confusion and misapplication of the repair. Further, the manner in which the unapproved extension of PS960A was documented and communicated within Hamilton Standard, and the lack of training on the extension, created confusion and led to misapplication of the blending repair to unshotpeened blades with unexplained ultrasonic indications, allowing the accident blade to be placed back into service with an existing crack. Although the DER stated that this lapse in communication was atypical, the Safety Board is concerned--especially in light of the inadequate manner in which Hamilton Standard communicated the information to its managers and technicians--that it may represent a deficiency in Hamilton Standard's corporate communication. Specifically, it suggests that Hamilton Standard placed insufficient emphasis on proper communication of vital safety information. Accordingly, the Safety Board believes that the FAA should require Hamilton Standard to review and, if necessary, revise its policies and procedures regarding 1) internal communication and documentation of engineering decisions, and 2) involvement of the DER and FAA, and to ensure that there is proper communication, both internally and with the FAA, regarding all significant engineering decisions.

ATC Notification of Crash, Fire, and Rescue Personnel

In its report on this accident, the Safety Board has concluded that the timing of the handoff to Atlanta approach control by the Atlanta center controller was not a factor in the accident. However, the Safety Board remains concerned about the failure of air traffic control (ATC) controllers to notify crash, fire, and rescue (CFR) services once the controllers were aware of the emergency situation. At 1644:25, the flightcrew of ASE 529 notified the Atlanta center ATC that they had experienced an engine failure and declared an emergency. Two minutes later, the flightcrew advised that they needed to "land quick" and requested the controller to "roll the trucks and everything for us." The controller then advised the flightcrew that West Georgia Regional Airport (CTJ), Carrollton, Georgia, was the closest airport and directed the aircraft to CTJ. Although ATC was aware of the emergency situation and destination airport, ATC did not notify the fire and emergency services covering CTJ, the Carroll County Fire Department, of the incoming aircraft.

Atlanta center should have immediately advised the appropriate CFR services or instructed Atlanta approach of the pilot's request so that they could have made timely airport emergency services notification. The accident had already occurred when the Atlanta approach controller made the call to the Carroll County Sheriff, and it had already been reported by a citizen on 911. In its report on this accident, the Safety Board has concluded that if the Atlanta center had placed a call for emergency services as soon as the pilot requested, which was 10 minutes before the accident, personnel would have responded sooner, and the rescue efforts might have been more timely and effective. Therefore, the Safety Board believes that the FAA should include an article in the Air Traffic Bulletin and provide a mandatory formal briefing to all air traffic controllers regarding the necessity and importance of notifying crash, fire and rescue personnel upon a pilot's request for emergency assistance. Further, the FAA should ensure that air route traffic control center (ARTCC) controllers are aware that such a request may require them to notify local emergency personnel.

Communication of Time Management Information During Emergencies

In this accident, the Safety Board recognizes that the flightcrew was attempting to control the aircraft. However, the Safety Board is concerned that the flight attendant neither received nor sought information about the time remaining to prepare the cabin or to brace for impact. The cockpit voice recorder (CVR) transcript revealed that the flightcrew informed her 7 minutes before impact that they had experienced an engine failure, that they had declared an emergency for return to ATL, and that they had advised her to brief the passengers. There were no further communications to the flight attendant. Specifically, the flight attendant was never told that the airplane would not be able to make ATL, and would instead be making an off-airport crash landing. The flight attendant stated that while preparing the cabin and passengers, she saw the tree tops from a cabin window. She immediately returned to her jump seat and shouted her commands. A passenger commented that the flight attendant was barely in the brace position when the impact occurred.

The Safety Board is concerned that the flight attendant and the flightcrew did not discuss a brace signal and the time available to prepare the cabin, and that the flightcrew did not announce a brace command on the public address system. Further, if the flight attendant had not had sufficient time to fasten her safety belt and shoulder harness, she might have received more serious or fatal injuries, and she might have been incapable of directing an evacuation.

The FAA has recognized that communication and coordination between cockpit crewmembers and flight attendants continue to challenge air carriers and the FAA. AC 120-51B, "Crew Resource Management Training," suggests several methods of addressing this problem. Paragraph 15, Evolving Concepts of CRM: Extending Training Beyond the Cockpit, addresses specific subjects for joint training but does not specifically deal with the communication of critical information during an emergency.

The Safety Board's special investigation report on flight attendant training[10] describes another accident on page 28:

> The lead flight attendant in the DC-10 stated that she knew emergency procedures required her to determine the amount of time available to prepare the passengers and the cabin. However, she chose not to ask the flightcrew about the time. Additionally, the second item on the flight attendant checklist was "Determine Time," but none of the flight attendants followed this checklist procedure.

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[10]See Special Investigation Report--"Flight Attendant Training and Performance During Emergency Situations" (NTSB/SIR-92/02)

Although the FAA issued Air Carrier Operations Bulletin 1-91-11 in response to Safety Board Safety Recommendation A-90-173, which called for inspectors to reiterate the importance of time management in the preparation of the cabin in a planned emergency, the Safety Board has concluded that this accident illustrates that critical information regarding time available to prepare the aircraft for an emergency landing or impact is not being considered and communicated among flight and cabin crewmembers. Therefore, to improve the interactions between the cockpit and cabin crews, the Safety Board believes that the FAA should amend AC 120-51B to include guidance regarding the communication of time management information among flight and cabin crewmembers during an emergency.

Crash Axes

The investigation revealed that the captain and first officer were trapped in the cockpit by fire that had ignited on the cabin side of the cockpit door. When the first officer found it impossible to open his cockpit sliding window, he unsuccessfully attempted to chop a hole in the hardened Plexiglas side window using the airplane crash ax. It was apparently intended for use as a woodworking tool because it consisted of a blade and nail puller attached to a wooden handle. Given the resilient composition of the cockpit window material, it was difficult to make a hole in the window panel; however, if the ax had been equipped with a pry bar rather than a nail puller, the first officer might have been successful in wedging the pry bar between the window and the track or frame and prying or forcing the window open. Although regulations exist that require most passenger-carrying aircraft to be equipped with a crash ax,[11] there is no FAA or other civil technical standard regarding the design and use of crash axes. This accident demonstrates the importance of an adequate crash ax design.

The crash ax carried aboard military transport aircraft conforms to a special design. Large commercial transport airplanes manufactured in the United States are equipped with crash axes of similar design. Additionally, firefighter axes that have a wedge and pry bar tool features are in use by airport rescue and fire fighting personnel and municipal emergency medical

[11]See 14 CFR 91.513(e), 135.177(a)(2), and 121.309(e).

technicians. The Safety Board has concluded that there should be standards governing the design of crash axes required to be carried aboard passenger-carrying aircraft. Therefore, the Safety Board believes that the FAA should evaluate the necessary functions of the aircraft crash ax, and provide a technical standard order or other specification for a device that serves the functional requirements of such tools carried aboard aircraft.

Therefore, as a result of its investigation of this accident, the National Transportation Safety Board recommends that the Federal Aviation Administration:

> Require Hamilton Standard to review and evaluate the adequacy of its tools, training, and procedures for performing propeller blend repairs, and ensure that those blend repairs are being performed properly. (A-96-142)
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> Review the need to require inspection ("buy back") after the completion of work that is performed by uncertificated mechanics at Part 145 repair stations to ensure the satisfactory completion of the assigned tasks. (A-96-143)
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> Revise Advisory Circular 20-66 to include the vibratory testing of composite propeller blades that have been previously operated for a substantial number of service hours, and composite blades that have been altered to the limits set forth in FAA-approved repair manuals to determine the expected effects of age on propeller vibration and provide guidelines for rpm margin between a propeller blade's natural frequencies and the excitation frequencies associated with propeller operation. (A-96-144)
>
> Require that Hamilton Standard consider long-term, atmospheric-induced corrosion effects and amend the Component Maintenance Manual (CMM) inspection procedure to reflect an appropriate interval that will detect any corrosion within the taper bore. (A-96-145)

Require Hamilton Standard to review and, if necessary, revise its policies and procedures regarding 1) internal communication and documentation of engineering decisions, and 2) involvement of the Designated Engineering Representative (DER) and FAA, and to ensure that there is proper communication, both internally and with the FAA, regarding all significant engineering decisions. (A-96-146)

Include an article in the Air Traffic Bulletin and provide a mandatory formal briefing to all air traffic controllers regarding the necessity and importance of notifying crash, fire and rescue personnel upon a pilot's request for emergency assistance. Ensure that air route traffic control center (ARTCC) controllers are aware that such a request may require them to notify local emergency personnel. (A-96-147)

Amend Advisory Circular 120-51B (Crew Resource Management Training) to include guidance regarding the communication of time management information among flight and cabin crewmembers during an emergency. (A-96-148)

Evaluate the necessary functions of the aircraft crash ax, and provide a technical standard order or other specification for a device that serves the functional requirements of such tools carried aboard aircraft. (A-96-149)

Chairman HALL, Vice Chairman FRANCIS, and Members HAMMERSCHMIDT, GOGLIA, and BLACK concurred in these recommendations.

By: Jim Hall
Chairman