FLIGHT SAFETY FOUNDATION
Aviation Mechanics Bulletin

SEPTEMBER–OCTOBER 1995

One Cure for Workplace Safety Complacency: Safety Checklists

FLIGHT SAFETY FOUNDATION

Aviation Mechanics Bulletin

Dedicated to the aviation mechanic whose knowledge, craftsmanship and integrity form the core of air safety.

Robert A. Feeler, editorial coordinator

September–October 1995 **Vol. 43 No. 5**

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AVIATION MECHANICS BULLETIN

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Subscriptions: US$35 (U.S.-Canada-Mexico), US$40 Air Mail (all other countries), six issues yearly. • Include old and new addresses when requesting address change. • Flight Safety Foundation, 2200 Wilson Boulevard, Suite 500, Arlington, VA 22201-3306 U.S. • Telephone: (703) 522-8300 • Fax: (703) 525-6047

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One Cure for Workplace Safety Complacency: Safety Checklists

Robert A. Feeler
Editorial Coordinator

In the United States, the U.S. Occupational Safety and Health Administration (OSHA) is the government agency that promulgates workplace safety regulations and provides oversight to ensure compliance. Its publication *OSHA Handbook for Small Businesses* includes some of the strictest and most detailed workplace-safety checklists. Many of the items found in these checklists apply to aviation maintenance facilities anywhere in the world.

For instance, some maintenance operations require the use of hazardous chemicals. Every maintenance manager will urge caution in working with hazardous chemicals, and there may be specific rules about how the chemicals are to be stored and used. But the OSHA handbook's checklist for hazardous-chemical exposure safety is extremely thorough. The checklist items go beyond the obvious, and include the following:

- Are contents of chemical piping systems clearly marked?
- Where needed for emergency use, are respirators stored in a convenient, clean and sanitary location?
- If hazardous substances are used in processes, is a medical or biological monitoring system in operation?

- Is ventilation equipment provided for removal of contaminants from such operations as: Production grinding, buffing, spray painting, and vapor degreasing, and is the ventilation equipment operating properly?

Throughout this article are boxed excerpts from some of the checklists in the OSHA handbook that apply to most aircraft maintenance shops: Medical Services and First Aid (page 3), Portable Ladders (page 3), Portable [Power-operated] Tools and Equipment (page 4), Flammable and Combustible Materials (page 4), Electrical Cautions (page 5) and Exit Doors (page 6). *These are not the complete checklists for these subjects*. For the full checklists pertaining to these and other subjects, the OSHA handbook should be consulted.

Aircraft maintenance shops in the United States will derive from the handbook useful knowledge of OSHA regulations and guidelines for ensuring compliance. But sections about the principles of a workplace safety program and guidelines for voluntary safety activity, as well as the checklists, will be useful regardless of what national regulations a maintenance facility operates under. The 57-page booklet includes the following sections:

- A four-point workplace program;
- Starting your voluntary activity;
- Self-inspection; and,
- Assistance in problem solving.

The four-point workplace program is voluntary and is based on safety and health management guidelines issued in 1989 by OSHA. The guidelines represent the agency's policy on how every work site should protect workers from occupational hazards, and reflect experience gained from voluntary protection programs adopted by employers.

Management Commitment and Employee Involvement Required

Management must have a clear commitment to job safety and health. If supervisors and managers do not promote injury and illness prevention, it is unlikely that employees will be motivated to participate fully in prevention programs.

Many companies have found it beneficial to form a joint employee-management safety committee. If the operation is small, consider rotating employees so that each can have an active part in the program. Some actions to be considered are:

- Posting a company policy/commitment statement about the

importance of workplace safety and health issues on the employees' bulletin board;

- Holding a meeting with all employees to communicate the policy and discuss its objectives;
- Ensuring that upper management is visible and participates in periodic meetings, and reviews inspection and accident/incident reports;
- Setting an example. If safety glasses are required in certain areas, ensure that managers and supervisors comply with the rules;

Medical Services and First Aid

- ❒ If medical and first-aid facilities are not in proximity to your workplace, is at least one employee on each shift currently qualified to render first aid?
- ❒ Are emergency phone numbers posted?
- ❒ Are first-aid kits easily accessible to each work area, with necessary supplies available, periodically inspected and replenished as needed?
- ❒ Have first-aid supplies been approved by a physician, indicating that they are adequate for a particular area or operation?
- ❒ Are means provided for quick drenching or flushing of the eyes and body in areas where corrosive liquids or materials are handled?

Portable Ladders

- ❒ Are nonslip safety feet provided on each ladder?
- ❒ Is it prohibited to place a ladder in front of doors opening toward the ladder except when the door is blocked open, locked or guarded?
- ❒ Are portable metal ladders legibly marked with signs reading "CAUTION – Do Not Use Around Electrical Equipment" or equivalent wording?
- ❒ Are employees prohibited from using ladders as guys, braces, skids, gin poles or for other than the intended purpose?
- ❒ Are employees instructed to only adjust extension ladders while standing at a base (not while standing on the ladder or from a position above the ladder)?

- Assigning employees to conduct inspections and participate in problem-solving discussions;
- Making safety and health responsibilities a part of everyone's job description;
- Providing on-the-clock time and resources for those with specific responsibilities to perform their duties under the safety and health program;
- Providing recognition and reward for those who do outstanding work and corrective counseling for those who fall short; and,

- Conducting at least an annual review of progress against objectives and establish goals for the next period.

Portable [Power-operated] Tools and Equipment

- ❒ Are rotating or moving parts of equipment guarded to prevent physical contact?
- ❒ Are all cord-connected, electrically operated tools and equipment effectively grounded or of the approved double-insulated type?
- ❒ Are effective guards in place over belts, pulleys, chains and sprockets on equipment?
- ❒ Are portable fans provided with full guards or screens having openings $^1/_2$ inch or less?
- ❒ Is hoisting equipment available and used for lifting heavy objects, and are hoist ratings and characteristics appropriate for the task?
- ❒ Are pneumatic and hydraulic hoses on power-operated tools checked regularly for deterioration or damage?

Worksite Analysis Should Pinpoint Hazards

An objective analysis identifies hazards and enables managers to determine actions to be taken to eliminate the hazard or to develop safe working practices. Employees and managers working together can usually conduct the assessment. If additional assistance is desired it can be obtained from private specialists or through the OSHA consultation program. The following factors are pertinent to a work-site analysis:

- Considering using outside expert assistance to conduct the analysis and develop changes to address identified hazards. Use of outside consultants

Flammable and Combustible Materials

- ❒ Are all connections on drums and combustible liquid piping, vapor- and liquid-tight?
- ❒ Do storage rooms for flammable and combustible liquids have explosion-proof lights?
- ❒ Are all solvent wastes and flammable liquids kept in fire-resistant covered containers until they are removed from the work site?
- ❒ Is vacuuming used whenever possible rather than blowing or sweeping combustible dust?
- ❒ Are fuel gas cylinders and oxygen cylinders separated by distance, fire resistant barriers, etc. while in storage?
- ❒ Are fire extinguishers selected and provided for the types of materials in areas where they are to be used?

  Class A —Ordinary combustible material fires.

  Class B —Flammable liquid, gas or grease fires.

  Class C —Energized electrical equipment fires.

helps keep managers current on newly recognized hazards and methods of dealing with them;

- Training employees to conduct a hazard analysis. Assign employees to review particular areas or tasks and periodically review each to ensure that no hidden hazards have crept into the operation;
- Conducting periodic self-inspections to make sure that the hazard controls are effective and that new hazards have not been introduced. *The OSHA handbook's detailed checklists are an excellent starting point for self-inspections.*
- Providing a means for employees to report safety hazards that they see; and,
- Establishing an accident/incident investigation procedure to ensure that when an accident does occur in which unsafe conditions are implicated, corrective or preventive action can be identified.

Put Hazard Prevention And Control in Place

After identifying hazards, management must prevent or control the hazards. For example, wherever possible, a chemical or equipment hazard should be eliminated by using a less toxic chemical or replacing a faulty piece of equipment. But this is sometimes not possible, and systems must be set up to control hazards. Some actions to be considered are:

- Establishing specific work procedures to be followed when working with the hazard and ensuring that employees follow them. This is easier if employees are involved in developing the enhanced procedures;

Electrical Cautions

- ❒ Are employees instructed to make preliminary inspections and/or appropiate tests to determine what conditions exist before starting work on electrical equipment or lines?
- ❒ Do extension cords have a grounding conductor?
- ❒ Are all temporary circuits protected by suitable disconnecting switches or plug connectors at the junction with permanent wiring?
- ❒ Are clamps or other securing means provided on flexible cords or cables at plugs, receptacles, tools, equipment, etc., and is the cord jacket securely held in place?
- ❒ In wet or damp locations, are electrical tools and equipment appropriate for the use or location, or otherwise protected?
- ❒ Are metal measuring tapes, ropes, handlines or similar devices with metallic thread woven into the fabric prohibited where they could come in contact with energized parts of equipment or circuit conductors?

- Enforcing the rules for safe work procedures. Include the employees in devising a disciplinary system that will be impartial;
- Providing personal protective equipment where needed and ensuring that employees are trained in its use;
- Conducting periodic drills and analyzing employee performance;
- Ensuring that medical facilities are readily available. If problems develop, the employer is expected to get medical help for the individual as well as to address the cause of the injury and/or illness. Emergency numbers should be posted and routes to the nearest medical facility plainly identified;
- Ensuring that one or more persons are adequately trained and available to render first aid. Adequate first-aid supplies must be readily available;
- Ensuring that any worksite with the potential for eye injury or toxic chemical exposure is equipped with eye wash facilities and/or showers; and,
- Considering retention of a local physician or occupational health nurse on a part-time or on-call basis to advise the company in first-aid planning and training.

Exit Doors

- ❒ Are doors that are required to serve as exits designed and constructed so that the way of exit is obvious and direct?
- ❒ Are windows that could be mistaken for exit doors made inaccessible by means of barriers or railings?
- ❒ Are exit doors openable from the direction of exit travel without the use of a key or any special knowledge or effort when the building is occupied?
- ❒ Where panic hardware is installed on a required exit door, will it allow the door to open by applying a force of 15 pounds or less in the direction of the exit traffic?

Training Key Employees, Supervisors And Managers

An effective accident prevention program requires that each individual understands the equipment and facilities he or she works with, knows what the hazards are and knows how those hazards are to be controlled. No employee should be assigned to do a job until he or she has received instructions on how to perform that task safely. An initial safety indoctrination should be a prerequisite before any

new employee begins work in a new facility.

Factors that should be considered in developing employee safety training include:

- Ensuring that employees have been trained on every hazard in the workplace and that they understand what has been taught.

- Paying particular attention to new employees, as well as any employee transferred to a new assignment that might involve new hazards; and,

- Ensuring that supervisors clearly understand all hazards that exist in their area of responsibility. Supervisors should reinforce employee training with periodic reminders and discipline those who fail to follow the standard safety procedures.

Someone in the organization must be designated to be responsible for the safety and health program. The person chosen should be one who is willing to take on the added responsibility and accountability. The success of the program will depend, to a large extent, on the person in charge, but he or she cannot succeed without the full cooperation and support of upper management.♦

Editorial note: *OSHA Handbook for Small Businesses*, Document no. 2209, is available from the U.S Government Printing Office, Superintendent of Documents, Mail Stop SSOP, Washington, DC 20402-9328. Call (202) 738-3238 for ordering information.

Composite Inspection And Repair Courses Scheduled for Late 1995

Courses for technicians interested in improving their skills and knowledge in composite inspection and repair are scheduled as follows:

Composite Structures: Fabrication and Damage Repair — Phase I: Dec. 11–15, 1995.

Composite Structures: Fabrication and Damage Repair — Phase II: Nov. 13–17, Dec. 18–22, 1995.

Adhesive Bonding of Advanced Composite Materials: Dec. 4–8, 1995.

All classes are held in Reno, Nevada, U.S. Other courses and dates may be established. Individuals interested in specialty training in composite technologies should contact ABARIS Training, 5401 Longley Lane, Suite 49, Reno, NV 89511 U.S. Telephone: 1-(800) 638-8441 in the U.S.

New Technology Offered in Airframe Ice Protection Systems

Innovative Dynamics Inc. has announced that it has perfected a new means of detecting airframe ice build-up, which is combined with new deicing technology for removal of the build-up. A prototype installation is planned on an aircraft in the near future.

The icing advisory system performs two critical functions: It alerts the pilot when the aircraft is in icing conditions, and continuously monitors proper operation of the pitot heater.

Ice build-up is detected by a capacitance sensor integrated into the pitot tube, which activates an annunciator light on the instrument panel to alert the pilot that the airplane has entered icing conditions. A heater on the sensor turns on automatically when the ice accretes to a detection threshold, melts the ice and begins the detection cycle again.

Once aware that icing conditions exist, the pilot activates what the manufacturer calls the Impulsive De-Icing System. This system has two components: actuators installed inside the leading edge of the wing and tail surfaces and a stainless steel erosion shield.

The system operates on the principle that two conductors carrying currents in opposite directions will repulse each other, producing a mechanical impulse. The interior modules contain actuator coils running the span

of the leading-edge sections. When pulsed with electrical current, the actuator produces a strong mechanical impulse which breaks the bond between the ice and the leading-edge surface, knocking the ice off. Pulsed electrical currents ensure that automatic deicing occurs frequently to avoid hazardous build-up.

U.S. Federal Aviation Administration (FAA) certification testing is in process. It is hoped that the system will be available for use in the 1995–96 icing season.

Similar technology is being developed for use in deicing helicopter rotor blades and large propeller blades. In this application, an alloy with a "memory shape" characteristic is used for the leading-edge covering. When the alloy sheet is electrically activated, it changes shape slightly, thus shedding ice build-up, then returns to its original aerodynamic contour when the activation is removed. Initial testing indicates that this system may provide deicing protection to rotating blades with a much lower power requirement than present systems.

Jeppesen Adds Flight Management Services

Jeppesen Co. has announced expansion of its aviation information services to include a fully functional flight operations management system. Jeppesen OnSight is intended to provide commercial airline and fleet operators timely flight dispatch information including flight planning, weather services, flight tracking and document display.

The system is modular, allowing users to select functions applicable to their needs. With the document display function, the user can view operating manuals, U.S. Federal Aviation Regulations (FARs) and other textual information. The company will soon add modules to provide runway analysis, flight release, chart viewing, crew scheduling, crew tracking, flow board and flight-management updates.

The system can accommodate data feeds directly from Jeppesen, the system user and a variety of third-party sources. Data feeds update the system information in intervals ranging from every few seconds for lightning data, to every 28 days for navigational data.

Pall Corp. Opens New Technical Center

The Pall Corp., which provides scientific and laboratory assistance in evaluating and solving complex fluid-contamination control and solids-recovery problems for aircraft maintenance hydraulic-testing units and filtration units, has recently opened a technical center in Port Washington, N.Y., U.S. The facility

will house state-of-the-art laboratories and will employ nearly 150 scientists, engineers and technical specialists in the company's Scientific Laboratory Services (SLS) department.

This SLS facility will be the largest of Pall's three central technical support facilities, with the others located in the United Kingdom and Japan. Twenty-one smaller facilities are located elsewhere. The SLS staff is prepared to work with customers that have unique requirements for advanced filtration solutions and can conduct in-plant seminars and training, as well as surveys of operator facilities, to assist in contamination-control problems. For more information, contact Pall's Scientific and Laboratory Services Department, 25 Harbor Park Drive, Port Washington, NY 11050 U.S. Telephone: 1-(800) 289-PALL in the United States; (516) 484-3600 outside the United States.♦

MAINTENANCE ALERTS

Uncontained High-pressure Compressor Spool Failure Aborts Takeoff of A-300

In April 1995, an Airbus A-300B4 aborted a takeoff at Cairo, Egypt, when the No. 1 engine sustained an uncontained failure of the stage-3 through stage-9 high-pressure compressor (HPC) rotor spool. The crew rejected the takeoff, stopping the aircraft on the runway, and conducted an emergency evacuation of all passengers. One passenger suffered a minor injury while sliding down the slide, but the other passengers and crew exited without mishap.

Postaccident investigation revealed substantial damage to the engine in the HPC area. Numerous pieces of the compressor were found scattered along the runway. The recovered pieces of the HPC stages 3–9 spool and the compressor case were subsequently sent to the U.S. National Transportation Safety Board (NTSB) for metallurgical examination.

The HPC stages 3–9 spool in the General Electric CF6-50C2 engine is a one-piece machined forging of Ti-6242 titanium alloy that contains the compressor disks. According to manufacturer's records, this part was made in 1982 and had accumulated a total of 15,544 hours and 8,264 flight cycles. It was last inspected

using fluorescent-penetrant techniques during an overhaul operation in March 1992.

Metallurgical examination revealed that the fracture of the HPC rotor spool was caused by a fatigue fracture in the stage-6 disk. The fatigue cracking initiated from a nitrogen-stabilized "hard alpha" inclusion located on the aft side of the disk web. (Nitrogen-stabilized hard alpha inclusions are anomalies in titanium alloys, which usually form during the initial melting of raw materials and are caused by localized excess amounts of nitrogen that have been introduced through atmospheric reaction with titanium in the molten state.)

After initiation, the crack propagated on a radial plane forward through the web thickness in both inboard and outboard (radial) directions until it had reached a critical size of about 1.54 inches (3.9 centimeters). The estimated number of fatigue striations on the fracture was approximately equal to the number of flight cycles on the spool, indicating that the crack began propagating very early in the part's life.

The manufacturer's records indicated that there had been three additional separations of this type in CF6 series engines, in 1974, 1979 and 1983, caused by hard alpha inclusions. Two additional fatigue cracks had been detected during inspection of other engines.

Each time that the compressor section is overhauled, the HPC stages 3–9 spool is subjected to a fluorescent-penetrant inspection in standard maintenance procedures. The NTSB has learned, however, that many operators do not use optimum inspection procedures and that portions of the spool that are not easily viewed, such as the web areas, may not receive adequate inspection.

In August 1995, the manufacturer sent a message to all CF6 operators, suggesting specific procedures to be used when conducting the fluorescent-penetrant inspection of the HPC stages 3–9 spool. The NTSB believes that the speedy implementation of these procedures is necessary to ensure that such cracks are detected before propagating to failure.

The NTSB found that although other HPC stages 3–9 spools have separated, those were not related to hard alpha inclusions. In 1995, a McDonnell Douglas DC-10 experienced an uncontained separation of the HPC stages 3–9 spool during takeoff in Bangkok, Thailand. In this instance, debris from the failure penetrated the right inboard elevator, but no systems were damaged and the airplane returned to the airport without incident. The part in this engine had accumu-

lated 8,438 cycles in service. This separation was attributed to a fatigue crack caused by a phenomenon known as "dwell time" fatigue.

Dwell time fatigue is a type of fatigue cracking that occurs when the peak cyclic load is sustained at a relatively low temperature. According to the manufacturer, dwell time fatigue occurs in colonies of alpha grains with a specific crystallographic orientation and is limited to a few titanium alloys. Ti-6242 is susceptible to dwell time fatigue when an aligned alpha colony is present. The fractures in dwell time fatigue do not contain crack-arrest positions, so the familiar fatigue striations are absent, making it difficult to determine the fatigue origin.

Two other instances of dwell time fatigue–initiated HPC spool separation were identified as occurring in 1985 and 1991. One other incident involving an uncontained separation of the HPC stages 3–9 spool occurred on a CF6-80C2 engine in 1993, but no pieces of the stage-6 disk were recovered. No defects in stages 3–5 and 7–9 of the spool that might have caused the stage-6 separation were found.

The HPC stages 3–9 spool for the CF6 series engine was first manufactured in 1971. Originally, the spool was forged from a 16-inch (40.6-centimeter) billet. Beginning in 1980, the billet diameter was reduced to 13 inches (33 centimeters) and at about the same time, the manufacturer began to produce two-piece spools from 12-inch and 13-inch (30.4-centimeter and 33-centimeter) billets. In the two-piece configuration, the forged and machined pieces are inertial welded together and then heat-treated. Production of the one-piece spools continued until 1988.

Currently, only two-piece spools from eight-inch (20.3-centimeter) diameter billets are produced. Until very recently, all two-piece spools received a postweld solution heat treatment followed by slow cooling. Tests have shown that the slow cooling caused excessive growth of alpha grains and, therefore an increased susceptibility to dwell time fatigue. Recent changes in the process specifications have replaced the solution heat treatment with a postweld stress-relief process.

Prior to the 1993 incident, all reported failures and crack indications were in the bore areas of the HPC stages 3–9 spools made from 16-inch billets. As a result, the manufacturer issued a series of service bulletins that defined better inspection techniques and the U.S. Federal Aviation Administration (FAA) subsequently adopted these recommendations as Airworthiness Directive (AD) 95-03-01. A large percentage of the subject spools have already been inspected, and

several of the 16-inch diameter billet spools have been found to contain cracks. One of the 13-inch diameter billet spools has been found cracked. None of the two-piece spools have been found defective, although being of more recent manufacture, they have accumulated fewer cycles.

The NTSB issued safety recommendations calling for the FAA to issue an AD requiring all operators of CF6 engines to incorporate the improved inspection techniques called out in the manufacturer's bulletins. It also recommended that an AD note be issued to require repeated inspections of all HPC stages 3–9 spools, except for those incorporating the two-piece spools that have not been solution heat-treated after welding.

Innovative Conversion Of Cessna Caravan Introduced

The Cessna 208B Grand Caravan has been widely used in light- and small-package cargo operations. The Soloy Corp., developer of several helicopter powerplant modifications, has completed the conversion of the prototype Grand Caravan, installing a pair of Pratt & Whitney Canada PT6D-114A engines. The "Dual-Pac" powerplant employs two of the popular PT-6s and a combining gearbox to drive the single propeller. Soloy hopes to have the conversion certificated as a twin-engine aircraft and be eligible for passenger-carrying operations under the U.S. Federal Aviation Regulations (FARs).

The conversion includes a fuselage extension of six feet (1.8 meters), addition of an integral aluminum belly cargo pod, and a cowling to house the dual-powerplant installation. Soloy plans to increase the maximum gross takeoff weight from 8,750 pounds to 10,500 pounds, and the longer fuselage is intended to accommodate up to 17 seats. The 1329 shaft horsepower powerplant(s) will drive a five-bladed propeller at 1,700 rpm. The combining gearbox enables either engine to operate independently and provides multiengine reliability in a single integrated package.

Propeller-blade Failure Results in Crash Landing of EMB-120 Commuter

On Aug. 21, 1995, an Embraer EMB-120 commuter airliner made an off-airport emergency landing about five miles southeast of the West Georgia (U.S.) Regional Airport. The flight had departed Hartsfield International Airport, Atlanta, Georgia (ATL), and was climbing through 18,000 feet (5,490 meters) when the pilots advised air traffic control (ATC) that the aircraft

had an engine problem. The crew aircraft intended to return to ATL, but a few minutes later advised ATC that they were unable to maintain altitude and needed to land immediately. The flight was about 10 miles (16 kilometers) from West Georgia Regional Airport, but the pilots had difficultly in maintaining altitude and directional control. The airplane continued its descent until hitting the ground. The captain and several of the 26 passengers died from impact injuries and the subsequent fire which engulfed the wreckage.

Examination of the wreckage revealed that a portion of one of the four propeller blades on the left engine had separated in flight. The resulting unbalance tore away the propeller and a portion of the engine reduction gearbox, which lodged in the leading edge of the wing.

Metallurgical examination of the failed propeller blade spar in U.S. National Transportation Safety Board (NTSB) laboratories disclosed that the blade had fractured about 13.2 inches (33.5 centimeters) outboard of the butt end. The fracture surface was typical of a fatigue failure, with the crack emanating from the taper bore hole of the blade. The fatigue cracking had progressed from the origin through about 75 percent of the spar cross-section before the remainder failed in overstress. Preliminary examinations indicated that the taper bore surface contained a series of circumferential abrasion marks and small corrosion pits in the bore surface adjacent to the fatigue-origin area.

The NTSB has investigated three other in-flight failures of Hamilton Standard models 14SF and 14RF propeller blades in the past two years. A Canada-based ATR-42-300 experienced an in-flight separation of the propeller and reduction gearbox assembly in March 1994. The airplane landed successfully without injuries to passengers or crew. The gearbox and propeller were recovered and examined by the Transportation Safety Board (TSB) of Canada, which revealed that one of the propeller blades had separated about 18.5 inches (47 centimeters) from the butt end. Examination showed that the fracture had initiated at a corrosion pit in the taper bore hole as well.

In March 1994, an EMB-120 operating in Brazil also lost a major portion of one propeller blade while in cruise at 22,000 feet (6,710 meters). The airplane was able to make an uneventful single-engine landing and there were no injuries to passengers or crew. In this instance, the fracture was located about 14.5 inches (36.8 centimeters) from the butt end of the blade, and the origin was determined to be at a corrosion pit in the taper bore area.

As a result of these two blade failures in 1994, the manufacturer issued

alert service bulletins and the U.S. Federal Aviation Administration (FAA) issued Airworthiness Directive (AD) 94-09-06, which called for ultrasonic inspection of the taper bore areas on the subject propellers. The propeller that failed in August 1995 had been inspected in accordance with the AD in May 1994 and was rejected because of an ultrasonic indication of a possible crack or other defect. The blade was sent to Hamilton Standard for further inspection and work. The manufacturer confirmed the indication that was located about blade station 18.5 in the bore area, on the face of the blade. The taper bore area was visually inspected using a borescope, and no cracks or corrosion pits were noted. The defect area was blended locally and a final ultrasonic inspection revealed that the indication was no longer present.

The NTSB is concerned that the abrasion marks found on the taper bore surface of this failed blade may have been created during the maintenance and inspection that took place in the manufacturer's shop in 1994. The NTSB is also concerned that other models 14SF and 14RF propeller blades may have fatigue cracking that has not been detected by current inspection procedures.

On Aug. 3, 1995, the major portion of another model 14RF propeller blade separated in flight from the right engine of a European commuter EMB-120. The propeller assembly and gearbox also separated from the airplane, although the airplane landed with no injuries reported. In this incident, the examination revealed that the blade had fractured in fatigue at station 9, substantially inboard of the other failures. It was determined that the fatigue crack had initiated at a "ding" on the exterior of the blade spar on the flat (face) side. The source of the external damage has not been confirmed, but it is suspected that the damage was created by improper handling of the propeller prior to installation when the propeller was placed on top of an open-ended metal drum with the shank of the blades in direct contact with the rim of the drum.

With three of the four blade failures having occurred on EMB-120 installations, the NTSB is concerned that the vibrational characteristics, propeller loading and resonant frequencies may not be fully understood.

Because of this history of blade failures, the NTSB has recommended that the FAA issue ADs calling for operators to immediately implement the ultrasonic inspection program cited in paragraph (a)(2) of AD 95-05-03, regardless of prior compliance with paragraph (d) of the AD. In addition, the NTSB is recommending an initial inspection before further flight on any blades that have accumulated

more than 1,250 cycles since the last ultrasonic inspection or since the visual and borescope inspections.

The NTSB has also called for the FAA to conduct a vibration and loads survey and analysis of the propeller installation on the EMB-120 and to extend the survey to other installations as appropriate, based upon these findings.

Finally, the NTSB has recommended that the FAA review the overhaul and inspection requirements for all Hamilton Standard series 14 propeller blades for which the taper bore hose has been shot peened, to determine whether additional inspections or maintenance should be required.

This series of propeller-blade failures once again highlights the critical importance of any surface flaw, defect or damage as a potential point of origin for a fatigue crack. Propeller blades are especially vulnerable to fatigue crack propagation because of the vibration frequencies and stress-loading variations to which they are subjected.♦

NEW PRODUCTS

Angle Grinder Includes New Safety Features

Fein Power Tools Inc. has introduced a 4.5-inch (11.4-centimeter) angle grinder with features intended to improve operator safety. According to the manufacturer, the MSf-640s Safety Angle Grinder is the first of its kind to include a wheel brake, restart interlock, quick wheel-change system and the ability to adjust the safety guard without extra tools.

Weighing just 3.3 pounds (1.5 kilograms), the unit is intended to be light enough for one-handed operation. When the unit is switched off, raising the wheel clamping lever slows the wheel from its normal 11,000 rpm to a standstill in less than two seconds. The clamping lever is locked out while the grinder is operating. The restart interlock prevents accidental start-up of the motor if the switch is left on when a power outage occurs. To reactivate, the user must switch the tool off, then on again.

MSf-640s Safety Angle Grinder from Fein Power Tools Inc.

The safety guard can be adjusted without tools when the unit is off, and the quick-change wheel system is said to allow the wheel to be changed without additional tools. For more information, contact: Fein Power Tools Inc., 3019 West Carson Street, Pittsburgh, PA 15204 U.S. Telephone: (412) 331-2325; Fax: (412) 331-3599.

Flame-resistant Tapes Available for Sealing Cargo Pits

A new line of #297 fiberglass cloth tapes produced by Polyken Technologies to meet U.S. Federal Aviation Regulations (FARs) Part 25.855 is claimed to offer additional convenience compared with previously used materials. The manufacturer says that this tape meets specifications for heat, flame and smoke resistance, with these additional qualities:

- Flexibility that makes form-fitting seals over irregular surfaces;
- Adhesion that prevents curling and lifting;
- Application ease, because a blue polyethylene liner facilitates efficient application; and,
- High tensile strength so that the tape does not rip easily under stress.

#297 and #290 Fiberglass Cloth Tapes from Polyken Technologies

The tape is available as #290 with preprinted backing indicating FARs approval. Tapes come in two-or three-inch (five- to 7.6-centimeter) widths in 36-yard (33-meter) rolls.

For more information, contact: Polyken Technologies, 15 Hampshire Street, Mansfield, MA 02048 U.S. Telephone: (508) 261-6267; Fax: 1-(800)-328-4822. In Europe, contact: H. Van Veldekesingel, 150/Box 29, B-3500, Hasselt, Belgium. Telephone: 32-11-870-850; Fax: 32-11-870-851.

Protective Covers for Hoses and Cords Avoid Work-area Hazards

The necessity for air lines, electrical cords and water hoses in hangar work areas creates hazards. Not only are the hoses and cords at risk of being damaged, but when strung across pedestrian walkways, they pose a trip-and-fall hazard to people passing through. Checkers Industrial Products

Inc. has recently introduced a series of protective cover strips which it says will solve these problems.

The cable protector strips come in three-foot (0.9-meter) sections and in sizes to accommodate three, four or five hoses or cords up to 1.25 inches (3.2 centimeters) in diameter. Each section is provided with a hinged stay-open cover to facilitate ease of use. Tapered end caps interlock to minimize the step at each end of the assemblies.

In addition to the standard small-cord/hose units, the company also offers a larger size that will accommodate a hose up to six inches [15.2 centimeters] in diameter. All of the protective covers have sufficient capacity to allow tugs or wheeled vehicles to easily pass over the protected lines without damaging them. For more information, contact: Checkers Industrial Products Inc., 2888 Bluff Street, Suite 129, Boulder, CO 80301-9002 U.S. Telephone: (303) 443-1052; Fax: (303) 438-9404.

Durable Protection for Fuel Servicing Equipment

Damaged or dirty fuel-servicing nozzles expose aircraft to damage or contamination in servicing. Fjord Aviation Fueling Products has introduced a line of protective covers for use with aircraft fueling nozzles and servicing equipment, which it says are more durable and effective than commonly used types. The company offers protective dust covers for 2.5/3 fuel-nozzle sizes, both overwing and single-point types, as well as in the four-inch (10.2-centimeter) size on large aircraft.

The company also offers a protective wing mat that is said to provide better protection for the aircraft wing and to be more durable and longer lasting. The company provides a three-year warranty on these protective mats. For more information, contact: Fjord Aviation Fueling Products, P.O. Box 580098, Nassau Bay, TX 77258-0098 U.S. Telephone: (713) 334-3081; Fax: (713) 334-5748.

Kit Provides Field Test to Detect Surfactants in Jet Fuel

Surface active agents (surfactants) in jet fuel can disable the coalescer elements in typical filter/separator units used in aviation fuel facilities. In the past, the presence of surfactants could only be determined by taking a sample of the fuel and sending it for a time-consuming laboratory test. Velcon Filters Inc. has introduced a portable kit called *SWIFT Kit*, which it says will enable the user to perform

a quick and accurate test for aviation jet fuel surfactants.

The kit determines the interfacial tension (IFT) of aviation jet fuel, which provides a general indication of the surfactant level. Higher IFT values indicate lower surfactant levels. The kit is especially useful to determine the condition of clay treatment cartridges by comparing the upstream and downstream values of IFT. An increase in IFT value confirms that the clay treatment is still effective.

Each kit includes supplies (including instructions, safety cautions and a data sheet) to perform 20 tests. A test can be accomplished in a few minutes and results are available immediately. According to the manufacturer, the test is accurate and has a repeatability within +/- 3 dynes/centimeter when compared with the American Society for Testing and Materials (ASTM) D971 ring method. For more information, contact: Velcon Filters Inc., 4525 Centennial Blvd., Colorado Springs, CO 80919-3350 U.S. Telephone: (719) 531-5855.

Protective Tape Now Includes Light Aircraft

Operators of large aircraft have long used transparent tape applied to leading edges, fairings, antennas, and other areas to reduce erosion caused by atmospheric elements. 3M Industrial Tape and Specialties Division has introduced a new line of polyurethane tape, specially formulated to provide similar protection for light aircraft.

The clear, light-stable tape is designed to help protect the leading edges of aircraft wings, as well as struts, gear legs and stabilizers from damage and erosion caused by insects and natural elements including rain, sand, snow, sleet and other airborne particles. The tape has been determined by the U.S. Federal Aviation Administration (FAA) to be a minor modification when properly installed in a light aircraft.

For most smaller aircraft, application of the tape kit requires less than two hours with no special tools, equipment or additional adhesives. The tape can be applied to clean metal or to commonly used aircraft paints over metal or fabric. The tape can be applied over new paint after the paint has cured for at least 48 hours. The tape is not suitable for application to propeller blades, rotor blades or balanced control surfaces. The manufacturer also cautions against use in areas forward of engine intakes, stall strips or vent holes.

The 3M 8672 tape kit includes a roll of six-inch (15.2-centimeter) width tape, 18 yards (16.5 meters) in length. For more information, contact: 3M Industrial Tape and Specialties

Division, 10701 Hampshire Avenue South, Bloomington, MN 55438 U.S. Telephone: (612) 736-0896.

New Type I Deicer Fluid Enters Market

Octagon Process Inc., a company long associated with commercial and military aircraft deicing/anti-icing products, has developed a new Type I product, OCTAFLO. According to the company, the product was developed and tested with the aid of a state-of-the-art cold booth and a wind tunnel provided by the University of Quebec, Canada.

The manufacturer says that the fluid is propylene glycol-based to enhance its environmental acceptance. In addition to a slightly longer holdover time in water-spray and high-humidity endurance tests, the fluid claims a number of other significant advantages over other Type I fluids. It

- Is nonfoaming in conventional equipment;
- Passes the crazing tests for aircraft acrylic windshields;
- Is less slippery when dripped onto tarmac areas; and,
- Is virtually odor-free.

For more information, contact: Octagon Process Inc. Telephone: 1-(800)-ICE-DESK in the U.S.♦

BLANK
INSIDE
BACK
COVER