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Robert A. Feeler, editorial coordinator

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Fall-protection Equipment Safeguards Maintenance Personnel Working at Height

Protective systems, including guardrails, safety lanyards and shock-absorbing safety harnesses, are designed to prevent falls.

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FSF Editorial Staff

Aviation maintenance personnel often work above ground level where a fall could result in serious injury or death. Nevertheless, systems are available to prevent falls from height (falls to a lower level) and/or to limit injuries after such a fall.

Although national and global data are limited about falls from height by aircraft maintenance personnel, in the United Kingdom, the Health and Safety Executive (HSE) included airports among the job sites targeted by a 2003 campaign to prevent falls from height — one of eight priority areas for reducing injury in the workplace.[1]

Moreover, in Israel, a five-year study of work-related accidents among 2,000 aviation ground workers at one airline found that 40 percent of the 523 accidents involved slips, trips and falls.[2] (Those data, however, did not differentiate between falls from height and slips, trips and falls that occurred on the ground.)

In the general workplace, falls from height have been cited in a substantial number of injuries and deaths. For example, among on-the-job accidents in the United Kingdom, falls from height are the greatest single cause of fatal injuries and the second-greatest cause of major injuries. In 2001–2002, 68 people died and 3,996 received "major injuries" as a result of on-the-job falls from height.[3]

In the United States, falls were the second-leading cause of work-related fatalities in 2002, when 714 people (13 percent of the 5,524 work-related fatalities) died as a result of falls at work. Of the 714 workers who died in falls, 89 percent died in falls from height.[4]

Although government data among these resources did not cite the number of aviation maintenance personnel who died as a result of falls from height, fall-protection specialists said that fall hazards are not uncommon in maintenance hangars.

Ron Cox, vice president for global strategic marketing (fall-protection) for Bacou-Dalloz, a manufacturer of fall-protection equipment, said, "I don't think I've been in an airport in the past 10 years where I haven't seen fall hazards or people who were working on airplanes without adequate fall-protection equipment."[5]

Regulations in Different Countries Share Many Similarities

In many countries, regulations require the installation and use of fall-protection equipment. Various regulatory authorities have detailed regulations that are similar in their intent but differ in many of their specifics.

For example, in New Zealand, fall-protection systems *must* be provided and *must* be used "in any place where an employee is at risk of a fall of three meters [10 feet], although the New Zealand Occupational Safety and Health Service says that fall protection *should* be used "where a fall from any height could result in harm."[6]

In the United States, the Occupational Safety and Health Administration (OSHA) requires that workers on surfaces "with an unprotected side or edge which is 6.0 feet (1.8 meters) or more above a lower level shall be protected from falling by the use of guardrail systems, safety-net systems or personal fall-arrest systems."[7] Other regulations prescribe rules and requirements for the design, construction and use of mobile work platforms[8] and for personal fall-arrest systems used by workers on powered platforms.[9]

In the United Kingdom, where fall protection traditionally has been required for any work performed above 2.0 meters (6.6 feet), a proposal was being considered midyear in 2004 to revise the requirement.

"Research … has shown that around 60 percent of all major injuries are caused by falls from heights below two meters," the U.K. Health and Safety Commission said in its *Proposals* *for Work at Height Regulations.* "We propose, therefore, to cover all work at height where there is a risk of personal injury. The extent of what is required to address the risks will depend on the duty holder's risk assessment."[10]

Airline facilities and large maintenance shops typically have the required fall-protection equipment, but despite the regulatory requirements, many smaller maintenance facilities do not, said Robert A. Feeler, a Flight Safety Foundation safety auditor and administrator of the FSF Q-Star Charter Provider Verification Program.[11]

"It's a weak area — weak in terms of not complying with the regulations," said Feeler, who estimated that, in 20 years of conducting safety audits, he has inspected more than 200 aviation maintenance facilities. In some of them, operators have appeared unaware of requirements for fall protection, he said.

In facilities that have fall-protection equipment, most maintenance personnel "are conscientious about using it as it's intended and when it's intended," Feeler said.

Some workers avoid using the equipment, however, either because they believe that it is cumbersome and that it restricts their mobility or because of complacency and a belief that a serious accident is unlikely, he said.

"Aircraft mechanics are usually well trained, they know how to work safely, and they generally don't do stupid or dangerous things," Feeler said. "But you only need one accident to crack your skull. Even though nothing happens very often, the consequences are so severe, it's worth that little inconvenience of using fall-protection equipment."

Safety Equipment Determined by Work-specific Conditions

In aviation maintenance — as in other professions — fall protection equipment varies, depending on the task being performed and the setting in which the work is done.

"The biggest challenge is to take fall protection and make sure it integrates nicely with the work they're doing," said Peter Kavia, director of safety applications for CAI Safety Systems, which designs fall-prevention systems for a variety of applications, including aircraft maintenance hangars. "The people who are going to be designing the system need to not just understand the engineering aspects but also understand the way the people are going to be working. Basically, they have to say, 'We're going to comply with [the relevant regulations] to keep you safe, but we're also going to make sure that we do everything we can so we don't make you less productive.'"[12]

Bruce Duden, business development manager for Evan Corp., which also designs fall-protection systems for use in aircraft maintenance hangars and other applications, said that developing systems for maintenance hangars used for smaller aircraft "can be a real challenge.

"Aircraft hangars are really tricky for a lot of reasons. In some of the maintenance hangars, they try to maintain a number of different types of aircraft, so they're all different sizes, all different configurations, all in different locations within the hangar."[13]

Cox said that typically, the fall-protection system involves a worker wearing a full-body safety harness equipped for attaching a lanyard (a rope or cord used to link two objects together); at its opposite end, the lanyard attaches to a horizontal lifeline — a cable that connects at each end to an anchor, often on an overhead beam. Other types of systems, including some portable systems with anchorage points that are installed temporarily on aircraft, also are used.

Design Protection For the Work Area

Development of a fall-protection program begins with an assessment of the work area to identify situations in which workers are exposed to fall hazards. The Air Transport Association of America (ATA), in its *Fall Protection Guidelines For Aircraft Maintenance Within the Airline Industry,* defined a fall-hazard exposure as "any situation in which an individual is working from an elevated surface, as defined by applicable regulatory agencies."[14]

Fall hazards can be identified not only by examining work areas to determine the height of the work surfaces but also by reviewing the maintenance facility's injury records.

"To assist in hazard assessments, exposures should be categorized into either 'work from platforms' or 'work from aircraft surfaces,'" the *Fall Protection Guidelines* said. "The division between these two categories originates with the nature of the exposure along with the factors involved in addressing those exposures. Work from platforms involves the working surface of a structure used to access the aircraft, while work from aircraft surfaces has only the aircraft surface involved."

The following methods are currently used to lessen exposure to fall hazards:[15,16,17]

- Fall *prevention* involves engineering controls (modifications to the workspace) to minimize a worker's exposure to a hazard. For example, protective railings can be built to lessen exposure, or the area can be accessed from mobile work platforms specifically designed with protective aids for workers;

- Fall *restraint* involves the use of protective equipment that has been designed to stop a fall from height. For example, a fixed-length lanyard can be attached at one end to an anchor point or an overhead cable system and at the other end to a safety harness worn by a worker; and,

- Fall *arrest* involves the use of protective equipment to stop a fall in progress. For example, a worker's safety harness can be attached to a shock-absorbing lanyard or a self-retracting lifeline; the lifeline is attached to an anchorage connector to provide a secure base connection.

Fall-protection specialists describe full-body safety harnesses as perhaps "the most fundamental component of any personal fall-arrest system"[18] (see "Guidelines for Inspecting Personal Fall-protection Equipment").

Protection Update, the newsletter of the International Safety Equipment Association, said, "A good quality, well-designed harness should retain its shape when taken off to avoid tangling and snagging. It should be comfortable to wear throughout the workday and offer adjustability across the chest, shoulders and leg straps. … Most importantly, the best harnesses will effectively spread the impact forces of a fall to the areas of the body best able to take the strain."[19]

The full-body harnesses direct impact forces to the thighs, buttocks,

Guidelines for Inspecting Personal Fall-protection Equipment

Safety harnesses and lanyards should be inspected daily to ensure that they are in good working condition:[1]

- Hold the webbed material of a safety harness or lanyard in both hands, with the hands six inches to eight inches (15 centimeters to 20 centimeters) apart and bend the webbing in an inverted "U" to make damaged fibers easier to see. Look for frayed edges, broken fibers, pulled stitches, cuts or chemical damage;

- Examine the buckle for grommets that are loose, distorted or broken, and for rivets that are loose, bent, cracked or pitted;

- Examine rope lanyards for areas that have become fuzzy or worn or that have broken fibers or cut fibers. A rope should be replaced when its diameter is no longer uniform; and,

- Examine forged-steel snaps and "D" rings for cracks or other defects.

If any of these defects are observed, or if there is doubt about the safety of any equipment, do not use it.

Replace any equipment that has been involved in a fall.♦

Note

1. Canadian Centre for Occupational Health and Safety. *Safety Belts, Harnesses and Lanyards*. <www.ccohs.ca/oshanswers/prevention/ppe/belts.html>. June 23, 2004.

chest and shoulders; before these harnesses were developed, workers who required fall protection often wore "body belts," which directed the impact forces from a fall toward the spine or the midsection.

Fall-protection specialists say that workers are most likely to wear a safety harness if the safety harness is comfortable, easy to don and easy to adjust. Some safety harnesses are made of stretchable webbing to allow more comfortable movement. Many safety harnesses are manufactured in "universal" sizes to fit most — but not all — workers; these harnesses may have chest straps that cannot be used by short workers, however.[20] Because standards for fall-arrest products, including safety harnesses, provide guidelines for use by workers weighing less than 310 pounds (141 kilograms), workers who weigh more than 310 pounds should be provided with full-body safety harnesses (and other fall-protection products) that have been approved for their weight.[21]

A D-ring on the safety harness is the connection point where a lanyard or lifeline is attached. The type of work being performed determines the best location for the D-ring — in front, on the back or on the side.

The type of lanyard or lifeline used to complete the fall-arrest system depends on the type of work being done and the location of the work station:[22]

- Shock-absorbing lanyards manufactured from synthetic webbing can absorb some of the impact forces during a fall, thus limiting the impact forces on the worker's body;
- Self-retracting lifelines, which are encased in protective housing, extend and retract automatically to lessen the likelihood of tripping the worker;
- Anchorage connectors are the connection points for lanyards and/or lifelines. They often are bolted, welded or wrapped around beams. One type of anchorage connector, designed specifically for aviation maintenance, uses suction cups and vacuum technology to attach to an aircraft;[23] and,
- Horizontal lifelines usually require two anchorage connectors with a cable running between the two. The lanyard is connected to the cable.

Rails, Walls Safeguard Work Platforms

Specialists in fall protection say that when maintenance tasks are performed from work platforms (including aircraft docking systems, scissor lifts or mobile elevating work platforms), the equipment should be positioned to ensure that there are no gaps between the platforms and the aircraft.[24]

A horizontal lifeline secured to two anchorage connectors helps protect against a fall from an airplane's wing. (Photo: DBI/SALA)

Rails and/or walls around the edges usually are the preferred method of fall protection on work platforms, but sometimes safety nets are positioned beneath the work surface to catch a worker in the event of a fall. The ATA said that, although safety nets may be effective, they are "not preferred, as individuals may be injured during the impact with the net itself."

Personal fall-arrest systems and fall-restraint systems also may be used by maintenance personnel on work platforms, "when engineering controls are either ineffective or impractical," the ATA said.

In work-platform situations in which engineering controls, fall-restraint systems and fall-arrest systems all are considered ineffective, a controlled-access zone (CAZ) can be imposed to restrict access to the work surface to personnel participating in a specific maintenance task. Compliance with strict safety rules is then required to limit the fall-exposure risk. Nevertheless, the ATA said, "These [CAZs] are very seldom used in aircraft maintenance for work from platforms."

Different Risks Accompany Work From Aircraft Surfaces

Different risks are involved when maintenance personnel perform tasks from aircraft surfaces — wings, horizontal stabilizers, fuselages or engines.

When a fall-arrest system is in use for workers on an aircraft surface, operators must have plans for the recovery of a worker who falls. The ATA said that other cautions for fall-arrest systems include their possible interference with the maintenance process and their possible damage to the aircraft. In addition, fall-arrest systems often must be aircraft-specific, and systems with components at foot level may create trip hazards.

When a fall-restraint system is in use for workers on an aircraft surface, similar cautions apply: The fall-restraint system may interfere with maintenance, may damage the aircraft, may be required to be aircraft-specific and — if there are components at foot level — they may create trip hazards. The fall-restraint system also may be difficult to implement while still allowing access for leading-edge work, the ATA said. Because a fall-restraint system restricts the wearer's range of movement to prevent him or her from moving beyond the edge of the work surface, however, the system eliminates the need for fall-recovery plans.

In some situations involving workers on an aircraft surface, nets are positioned around the surface to catch a worker in the event of a fall. Nevertheless — as in situations involving work platforms — nets often are not appropriate. When the work is being done from an aircraft surface, there often is no surrounding structure to be used to mount a net; in addition, the placement of a net may interfere with other maintenance tasks. Like nets, guardrails also are often inappropriate when work is being performed from an aircraft surface because the guardrails may interfere with the maintenance task being performed or may damage the aircraft.

In situations in which other fall-protection methods would be ineffective for work being performed from an aircraft surface, a CAZ could be imposed. (CAZs are used more frequently in these situations than in situations involving work platforms.) The ATA's recommendation for developing a CAZ for work performed from aircraft surfaces includes assessing — before work begins — all fall hazards that could be encountered during a maintenance task. Each fall hazard must "either be addressed so that it cannot contribute to a fall, or protection must be supplied to arrest a fall in progress"; if this is not possible, "surface access must be denied, and the [maintenance] process rescheduled until one of the controls [is] instituted," the ATA said.

All workers entering the CAZ must review the assessment before entering to ensure that they understand which aircraft surface they have access to, what hazards could be encountered and what protective measures should be taken, what distractions might arise and how to express concerns about the situation.

Correct Use of Equipment Depends on Adequate Training

Simply having fall-protection equipment is not enough to eliminate fall risks; training is essential to ensure that the equipment is used correctly.

"People often aren't trained properly," Duden said. "In some cases, fall-protection equipment is being provided, but the user is not familiar with how to use the equipment.

"It wasn't too long ago that I walked into an aircraft hangar where a gentleman was working on the rear stabilizer of a plane. He was roughly seven [feet] or eight feet [slightly more than two meters] off the ground. He had a lanyard, and the lanyard was tied off to the horizontal stabilizer. It was a six-foot [slightly less than two meters] lanyard, so he could stand up and do his work. But he was only eight feet off the ground, so a six-foot lanyard wasn't going to do much. He was going to hit the ground before that line became taut."

Companies that design fall-protection systems typically provide training on how to use it.

"When we design a system," Kavia said, "we go on site, ask specific questions about how they're working, and tailor our training to reflect that."

In addition to providing instruction on how to use the fall-protection system and how to wear and maintain safety harnesses, other topics include how to access the fall-protection system safely, so that workers are protected before they step onto the work surface.

As recently as 10 years ago, there typically was no fall protection in aircraft maintenance hangars. Today, equipment is increasingly available but is sometimes misused, primarily because of inadequate training, Duden said.

Nevertheless, when appropriate fall-protection equipment — and appropriate training — are available, many fall injuries can be prevented.♦

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8. OSHA. 29 CFR 1910.29, *Manually Propelled Mobile Ladder Stands and Scaffolds (Towers).*

9. OSHA. 29 CFR 1910.66 Appendix C. *Personal Fall Arrest System.*

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    Feeler, who was the manager of the FSF safety audit programs from 1992 through 1999, also is the editorial coordinator of *Aviation Mechanics Bulletin.*

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Further Reading From FSF Publications

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FSF Editorial Staff. "Knowledge of Hazardous Chemicals in the Aviation Workplace Can Help Prevent Work-related Illness and Injury." *Aviation Mechanics Bulletin* Volume 45 (July–August 1997).

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MAINTENANCE ALERTS

B-747 Thrust-reverser Section Separates

The Boeing 747-240B, being operated in scheduled passenger service, touched down on Runway 24R at Manchester (England) International Airport, and reverse thrust was selected on all engines at about 75 percent power. When the aircraft had been slowed to about 80 knots, reverse thrust was cancelled. The thrust reversers for engine no. 1, engine no. 2 and engine no. 4 stowed normally but flight deck indications showed that the thrust reverser for the no. 3 engine remained unlocked.

The first officer on another aircraft noticed a large piece of engine cowling separating from the B-747 and falling onto the runway during the landing roll. He notified air traffic control (ATC), which issued instructions to prevent other aircraft from landing on the runway. ATC offered emergency services to the captain of the B-747, who chose to continue taxiing the aircraft to its designated gate. Following engine shutdown, the passengers were disembarked. There were no injuries to the 16 crewmembers and 303 passengers in the incident on June 13, 2002.

The debris removed from the runway included the outboard half of the no. 3 engine thrust-reverser transcowl and the lower-screwjack clevis fitting.

"The transcowl drive system consists of three synchronized and evenly spaced screwjacks, also mounted on the C-duct [the core engine cowling and the inner wall of the fan-stream], which control its fore-and-aft position and maintain its orientation at right angles to the engine axis," said the report by the U.K. Air Accidents Investigation Branch (AAIB). "When the reverser transcowl is in the stowed position (forward), it comprises the outer wall of the fan stream and the nacelle outer skin and encloses the reverser cascades between the two skins. When reverse thrust is selected, the transcowl moves aft and, as the reversing cascades become exposed, blocker doors close off the rearward flow of the fan stream and divert it through the cascades."

The transcowl had separated from the C-duct, along with four blocker doors. All three clevis fittings had separated from the transcowl.

The report said, "The most probable cause of separation was either misrigging or a misalignment resulting from loss of transcowl positional control. … Comparing the failure modes of the three clevis-fitting attachments to the transcowl, the upper two were clearly single-event-overload failures consistent with the transcowl separating rearwards from the jacks. By contrast, the local evidence of fatigue in the flange joggle and persistent movement of the clevis fitting relative to the transcowl structure showed that the lower-clevis-fitting separation had occurred over a considerable number of [thrust-]reverser deployments. …

"The thrust reverser is a very hostile structural environment, and the severe buffeting and vibration to which it is continually subjected will degrade imperfectly secure attachments more rapidly than in other aircraft zones. Even with rigorous maintenance, with age the durability of the structural joints will become less secure. Although, historically, the clevis attachments have not been troublesome within the [General Electric CF6 turbofan]-powered fleet, this incident may indicate that their deterioration manifests itself as a loss of correct rigging."

There had also been incorrect maintenance of the lower clevis attachment, the report said, although the operator's records showed no indication of any work on the attachment in the previous three years.

The report said, "It was, however, evident that at some time in the recent past, the lower clevis fitting riveted-flange attachment had failed. This had probably resulted in the rivet heads, visible from the outside, becoming loose or dropping out, and it would appear that an attempt to replace the missing rivets had been made. The attempted repair was not in accordance with any instructions in the manual, and it was apparent that the incorrect blind rivets had been installed with no understanding of their full purpose. It is also probable that the holes into which they were installed were already damaged … .

"It … seems that the installer of the new and incorrect rivets considered them so unimportant that their installation was not recorded or mentioned to anyone who might record it. The subsequent nondetection of the erroneous and ineffective rivets led eventually to the separation of the [thrust-]reverser transcowl half."

Restricted Oil Flow to Connecting-rod Bearing Downs Hughes 269C

The pilot of the Hughes 269C helicopter and one passenger were on a private flight. Shortly after takeoff from Doornlaagte Farm, near Debern, South Africa, a reduction in engine power was experienced, followed by an in-flight engine failure. The pilot conducted a forced off-airport landing in a densely wooded area.

Attempting to select a suitable landing area, the pilot allowed the main-rotor revolutions per minute (rpm) to decay substantially, and a hard landing followed. The helicopter's rear cross-tube assembly failed on impact, causing the main-rotor blades to sever the tail boom. There were no injuries in the March 18, 2002, accident.

The report by the South African Civil Aviation Authority said that the probable cause was "the loss in engine power and subsequent engine failure [that] could be attributed to the seizure of the no. 3 connecting-rod big-end bearing. It is considered that the failure was a result of restricted oil flow over a period to the big-end bearing."

Wrong Lubricant Cited in Bolt-thread Corrosion

An Australian operator identified operational problems with a Pratt & Whitney Canada PW118 engine, which ranged from hung starts resulting in rejected hot starts to sub-idle vibration and noise from the high-pressure (HP) rotor. The problems occurred during a period of several days, and to resolve the problems, the engine was removed from the aircraft (whose type was not specified in the report by the Australian Transport Safety Bureau [ATSB]) for disassembly and investigation.

"Disassembly revealed that the bolted joint between the HP turbine disk and turbine stub shaft had failed," said the report. "Of the five bolts used in the assembly, two had fractured in the threaded section. The remaining three bolts exhibited varying degrees of bending and thread damage."

The engine manufacturer examined the bolts and concluded that the fractures and damage in the bolt threads were caused by corrosion fatigue, with sulfur identified as the corrosive agent. The operator called the attention of ATSB to the bolt failure and to the manufacturer's report, and ATSB conducted an examination of the physical evidence and an analysis of the bolt failure.

"Examination of the threaded sections of all bolts revealed the presence of a compound or the residue of a compound on the thread surfaces under the nuts and within the bolted joint," said the report. "Fine nodular deposits of a compound containing both sulfur and silver along with silicon and carbonaceous material were apparent when the threads were examined at high magnifications in a scanning electron microscope."

The reaction of a compound or compounds based on silver and sulfur caused abnormal oxidation of the bolt threads, the report said.

Investigators considered the possible origins of the silver and sulfur deposits on the bolt threads.

The report said, "The nature of deposits on the threaded sections of the bolts is consistent with the application of a silver-based thread lubricant. [It is a manufacturer's requirement that a thread lubricant be applied to the bolt threads during assembly.] This [silver-based] form of thread lubricant differs from the lubricant specified in the engine-assembly procedures — turbine-engine oil.

"The origin of sulfur in the thread deposits could not be determined with certainty. There are two possibilities: sulfur was present in material applied to the threads, or the sulfur-containing compounds in the compressor bleed air infiltrated the bolted joint and reacted with the thread lubricant."

The engine-service center that assembled the engine alerted its staff to the adverse consequences of applying thread lubricants that differ from those specified by the engine manufacturer, the report said.

'Electric' Odor on Flight Deck Traced to Overheating Lamp

The flight from Düsseldorf, Germany, to Zürich, Switzerland, had just been ordered by air traffic control to enter a holding pattern. The first officer of the Embraer 145 reported "electric smell and smoke," and the captain (the pilot flying) also detected an electrical smell. The flight crew declared an emergency and was given vectors to Runway 16 at Zürich. An uneventful landing was conducted, the aircraft was taxied to the gate, and the passengers were disembarked normally. There were no injuries to the four crewmembers and the 21 passengers in the Aug. 20, 2002, incident.

"A thorough inspection of all wiring and the whole cockpit area was carried out," said the incident report by the Swiss Aircraft Accident Investigation Bureau. "All electrical fans and equipment were checked. No trace of any burned equipment or wiring was found."

Investigators performed "an extensive run-up" without any signs of odor or smoke, the report said, but a thorough search of the flight deck by a maintenance supervisor the day after the incident revealed that the right-hand (first officer's) torch lamp (flashlight) was switched "ON," with the lens and torch-lamp holder showing strong indications of overheating, including a deformed lens.

The torch-lamp set (part no. P2-07-009-120) includes a holder in which the lamp can be stowed when not in use. The report said, "The torch lamp is equipped with a rechargeable battery of six volts and a bulb which is [recharged] when the on/off switch is switched 'ON.' When the lamp is placed in the holder without being switched 'OFF,' the lamp will continue to operate. There is no mechanical restraint to prevent the lamp [from being] stowed with the switch in the 'ON' position. …

"Normally, the battery would be depleted after a certain time or at least be discharged [at] a lower voltage. Through the installed recharging circuit, the time of full bright light is extended and the lens and cover heated up more and for [a] longer time. Therefore, the lens and cover were starting to melt and started developing an acrid odor which was interpreted by the crew as 'electric smell.'"

All torch lamps installed in the operator's Embraer 145 aircraft were inspected, and two more lamps were found with deformed plastic lenses. The operator then carried out a modification, drilling a hole in the upper cover of each holder. This was intended to dissipate any heat build-up and allow the crew to see the light if it has not been switched "OFF." On June 16, 2003, Embraer issued a service letter (SNL 145-33-0011) on the subject.

Movement of Fuel Cell in Bell 206B Cited in Power Loss

During agricultural spraying operations, the Bell 206B had a momentary power loss, then a total power loss, and was subsequently landed hard at Beaumont Station, New Zealand. There was no injury to the pilot, the single occupant, in the Nov. 26, 2003, incident.

Investigation by the Civil Aviation Authority of New Zealand (CAA) found that the fuel cell had shifted forward from the rear bulkhead, interfering with the upper fuel-sender unit and causing erroneous indications.

"The fuel cell was a type applicable to helicopters serial no. 3567 and subsequent, and it was of a more rigid construction, replacing the use of lacing to retain the tank shape," said the CAA report. "It is recommended that the operators of Bell 206 helicopters serial no. 3567 and subsequent take steps to ensure the integrity of the fuel-cell installation."♦

NEWS & TIPS

Heavy-duty Hose Goes to Waste

A crush-proof urethane (CPU) hose designed for removing aircraft-lavatory waste, Hi-Tech CPU Hose is said by the manufacturer to withstand vehicular traffic and being dragged over surfaces such as asphalt.

The thermoplastic-polyurethane reinforced hose features thermally bonded cuffs that provide a tight seal for all types of fittings, the manufacturer says. The product is said to be highly flexible with a smooth interior that improves flow-through, and is described as chemical-resistant, moisture-resistant and ozone-resistant.

Crush-proof Urethane Hose

Standard lengths are 12 feet, 15 feet and 25 feet (3.0 meters, 3.7 meters and 4.6 meters), and other lengths can be specially ordered.

For more information: Hi-Tech Hose, 400 East Main St., Georgetown, MA 01833 U.S. Telephone: (800) 451-5985 (U.S.); +1 (978) 352-2077.

Marking Equipment Exhibits Striking Performance

The Technomark Multi 4 can apply permanent marks to many types of surface — tempered steel, untempered steel or stainless steel, aluminum, copper, bronze, brass, plastics, wood or ceramics — whether flat, concave or convex. Using a succession of dots, the device can create figures, letters, special characters and data matrixes in varying sizes and depths. Because the machine indents the material, the marking is permanent.

The technology is described as electromagnetically controlled micro-impact marking. The equipment, which is battery-powered, consists of a mechanical marking head with a stylus that strikes 50 times per second and a keyboard-operated electronic control unit. Its character fonts comply with aeronautical industry standards, the manufacturer says.

For more information: Technomark, 27, rue François Gillet B.P.31, 42405 Saint-Chamond Cedex, France. Telephone: +(33) 04 77 22 25 91. U.S. and Canadian distributor: Dapra Marking Systems, 66 Granby St., Bloomfield, CT 06002 U.S. Telephone: (800) 442-6275 (U.S.); +1 (860) 286-8728.

Noise Filters Reduce Sound Overload

The Clarity line of earmuffs from Bilsom features technology that filters out harmful or distracting noise while allowing users to hear warnings, alarms and coworkers' voices in environments such as noisy shop floors. Sound is blocked uniformly across a series of octave bands, but human-voice frequencies pass through more easily.

The three models in the Clarity line, C1, C2 and C3, provide noise reduction ratings (NRRs) of 20, 23 and 27, respectively. The range of available noise reduction allows users to choose the right level for their environment, avoiding overprotection where it might be dangerous, the manufacturer says.

Earmuffs

Clarity earmuffs' sound management capability is based on design and material technology, rather than sophisticated but expensive electronic noise canceling, the manufacturer says. The product uses a dielectric design that is said to protect against shock in environments where electrical equipment is used.

For more information: Bacou-Dalloz Hearing Safety Group, 7828 Waterville Road, San Diego, CA 92154 U.S. Telephone: (800) 327-1110 (U.S.); +1 (619) 661-8383.

Software Opens Windows to Maintenance Management

Trax Maintenance is a software suite designed to manage all information generated by a maintenance organization. It is currently in use, the company says, by airlines with fleets that include airliners from Airbus, Boeing and Canadair Regional Jets.

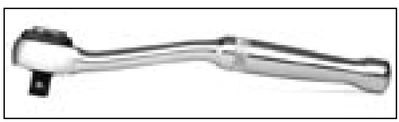
The software, which uses Microsoft Windows, consists of modules. Some modules can be implemented individually, but all are designed to work together. The modules include, among others, the following:

- Engineering: Documents such as manufacturers' service bulletins and regulatory airworthiness directives can be recorded and maintained within the system;
- MX [Maintenance] Controller: Minimum equipment list (MEL) items and defect reports are logged;
- Production: Detailed cost recording takes place and can be charged out to individual aircraft or components;
- Planning: Deferred maintenance items on aircraft can be monitored, along with all other aircraft-related, time-controlled items; and,
- Inventory: Complete control and management of aircraft components and non-aircraft materials are provided for. Standard transactions include bin transfer, adjustments, return to stock, return to vendor, transfers and rentals.

For more information: Trax USA Corp., 2665 South Bayshore Drive, Grand Bay Plaza, Suite 501, Coconut Grove, FL 33133 U.S. Telephone: +1 (305) 662-7400.

Ratchet Goes Around the Bend

The design of the S•K Fine Tooth Angle Ratchet permits access to spaces that normally cannot be reached by hand tools. An 18-degree angled handle, combined with a 72-tooth mechanism and a compact ratchet-head design, makes the tool useful for applications involving fasteners with difficult access or little clearance, the manufacturer says. The ratchet's swing arc is five degrees.



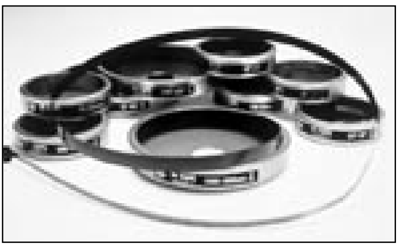
Fine Tooth Angle Ratchet

Torque is transferred through 17 teeth during use, with each tooth bearing 6 percent of the drive load, which is said to provide strength and versatility. A thumbwheel reversing mechanism enables one-handed change of direction, and a freewheeling back plate allows application of steadying pressure without accidental reversing.

For more information: S•K Hand Tool Corp., 9500 West 55th St., Suite B, McCook, IL 60525 U.S. Telephone: +1 (708) 485-4574.

Measuring Tape Gets Around

Measuring accurately the inside diameter or outside diameter of a rounded form such as a duct is simple with Pi Tape measurement tape, the manufacturer says. The product is said to be less expensive and faster to use than micrometers, calipers or laser-type distance-measuring devices.



Diameter-measurement Tape

The tape's graduated markings are engraved and acid-etched on a ground surface and are fixed, so that periodic calibration is not necessary. The tape gauges are available in inches or millimeters. Tapes marked in inches read to a diameter of 0.001 inch with an accuracy of plus or minus 0.001 inch up to 144 inches. Tapes marked in millimeters read to a diameter of 0.01 millimeter with an accuracy of plus or minus 0.03 millimeter up to 3,600 millimeters.

Models are designed specifically for measuring inside diameter or outside diameter, and can be manufactured to custom specifications for particular applications.

For more information: Pi Tape Corp., P.O. Box 463087, Escondido, CA 92046 U.S. Telephone: (866) 474-8273 (U.S.); (760) 746-9830.

Flaw Detection Comes to an End

A portable ultrasonic flaw-detection system for large shafts such as those in aircraft-engine turbines, the ShafTest requires access only to the shaft end. Test results can be analyzed off-line

Portable Flaw-detection System

to minimize equipment out-of-service time, and stored shaft signatures allow monitoring of crack growth.

The ShafTest system uses a scanning mode to divide the shaft into a grid pattern, then performs an ultrasonic exam for each grid location. Software combines the individual grid-location scans into a three-dimensional volumetric map of the shaft.

Results are reported in graphical format. Analysis software highlights cracks and provides tools to plot ultrasonic cross-sections through the shaft at any depth, which the operator can choose by moving a slider along a screen image of the shaft.

For more information: Uni-Tech Engineering, P.O. Box 510, Pelham, AL 35124 U.S. Telephone: +1 (205) 685-9431.

Maintenance Software Goes With the Flow

Corridor software is designed to improve process flow and information flow throughout a maintenance organization by eliminating manual operations, reducing redundancy, lowering costs, improving speed and enabling employees to improve service.

The software consists of interacting modules that include company database, contact management, inventory, sales order, work order, rotable management, accounting integration, line sales and management, regulatory compliance, and others.

Version 6.0 of Corridor introduces a work-order quoting module, expanded direct interaction with parts distributors and other systemwide improvements, the company says.

For more information: Continuum Applied Technology, 9601 Amberglen Blvd., Suite 109, Austin, TX 78729 U.S. Telephone: +1 (512) 918-8900.

Cleaner Has Surface Appeal

A cleaning solution for the exterior and interior of aircraft, DLT-600 RTU from Eldorado Solutions is said by the manufacturer to meet the most stringent disposal standards. It can be used safely to clean Plexiglas, painted surfaces, aluminum, magnesium, ferrous alloys and high-strength steel.

The solution can be applied by foam, spray, steam or pressure-washer equipment. The cleaned surface will be nonsticky and residue-free after rinsing, the manufacturer says. DLT-600 RTU is nontoxic, biodegradable, nonflammable and meets Boeing specifications.

For more information: Eldorado Solutions, 11611 North Meridian, Suite 600, Carmel, IN 46032 U.S. Telephone: (800) 531-1088 (United States); +1 (317) 818-9500.♦

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