

# Static Electricity in Flight Threatens Aircraft Safety

*by*

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Aircraft accumulate electrical charges created by static electricity under various flight conditions and discharge of that electricity can generate radio frequency interference (RFI). RFI can threaten the safety of flight because it can interfere with aircraft communications and navigation equipment that operate in very low frequency (VLF), high frequency (HF) and very high frequency (VHF) ranges (Figure 1, page 2) by increasing equipment ambient noise levels and making reception difficult or impossible.

Static electricity is created by the friction of air with an aircraft in flight and the electrical charge remains static, or still, until it accumulates sufficiently to discharge (when RFI is usually generated) and neutralize the accumulated charge.

When the atmosphere contains particulates such as rain, snow, dust, sand or volcanic ash, more RFI (precipitation static) is generated as the materials are struck by aircraft surfaces, especially antennas. Flying in rain

# Broadband Radio Frequency Interference (RFI)

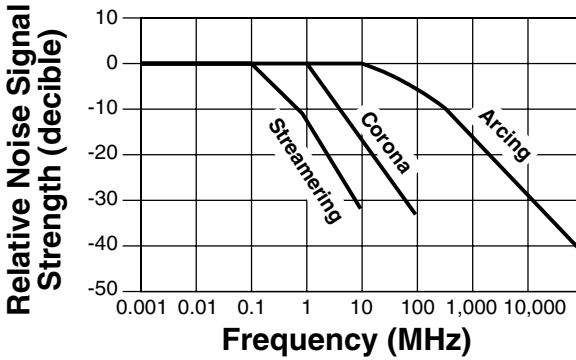


Figure 1

generally produces only moderate discharges, but heavy discharges can occur when an aircraft is flying in clear air near or between electrically charged clouds or while penetrating storms with electrical activity.

Dry snow also leads to discharges; the colder and dryer the snow the greater the discharge. At higher altitudes, the ice crystals found in cirrus clouds can produce massive discharges on aircraft, as can crystals in cold arctic air masses at lower altitudes. Again, the colder and dryer the crystals, the greater the potential for discharge.

Another source of RFI that often goes unrecognized is created by the discharge of selectively ionized particles in the engine exhaust. While not as common or as strong as other discharges, it creates RFI that can

vary from aircraft to aircraft and engine type to engine type.

RFI is most commonly caused by three types of discharges: corona, streamering and arcing.

A corona discharge is luminous and can be audible. A corona — a faint luminous glow adjacent to the affected surface of an aircraft — is created by an electrical discharge that causes ionization of the air in the presence of a strong electrical field. Ionization is caused when the atmosphere is broken down and normally balanced atoms, with equal positive and negative charges, become unbalanced and carry a positive charge or a negative charge and become capable of carrying an electrical current. The corona on nonmetallic composite radomes, winglets, windshields and propellers, for example,

is also known as St. Elmo's fire.

When the charge on an aircraft reaches 100,000 to 200,000 volts, the electrical fields on the aircraft become concentrated on its extremities — wing tips, tail surfaces, etc. (The voltage is not lethal because the current level is extremely low.) Air is ionized at the sharpest points on these surfaces and current discharges into the surrounding air, resulting in RFI that causes a hissing noise in a radio receiver.

Antennas, particularly those with sharp points, discharge currents that present a strong signal to the VHF receiver. This can cause the automatic gain control (AGC) to de-sensitize the receiver, which will remain quiet and be temporarily useless for reception. This is likely to go unrecognized by the pilot until the charge level dissipates sufficiently to allow the receiver to operate properly, and the flight crew may be queried by air traffic control for not responding to radio calls. This situation occurs more often than commonly recognized and results in removal of equipment for a suspected intermittent receiver problem and a "could-not-duplicate" shop report.

Streamering is usually a brilliant electrical discharge that may trail from the aircraft, including dielectric surfaces (an insulating material that can contain an electrical field

and undergo electrical polarization) such as composite radomes and composite winglets, as well as glass and ceramics. The discharge may stream (jump) several inches from a composite material to a metal airframe or into the air. Or a charge can build up on a painted surface before it streams to a nearby unpainted screw or rivet head. Streamering can be reduced by coating nonconductive areas with a high resistance paint that allows the charge to be bled to the airframe.

Arcing can create a brilliant luminous glow, similar to streamering, but it is usually limited to jumping point to point in distances of an inch or less. Often it is barely visible, but when observable it has the appearance of a curved line. Arc discharges are almost always the result of a part of the aircraft being electrically insulated from the main structure, so that when a charge accumulates on the isolated part, it arcs to the main structure.

Arcing is usually caused by the failure of some device installed to reduce precipitation static noise, such as broken bonding straps at control surface hinge points, gear doors, access panels, fuselage cargo and entrance doors. Cracked radome lightning diverter straps and static discharger bases cause arcing. (Bonding straps at control surface hinge points are critical. The U.S. Federal

Aviation Administration (FAA) has published many reports of control surfaces with missing or broken bonding straps that were welded at hinge points or blown completely off the aircraft by lightning strikes.)

RFI is reduced by preventing the uncontrolled discharge of static electricity from the aircraft to the surrounding air; i.e., the charge is bled into the air mass around the aircraft at a controlled rate by using a discharge device.

One of the earliest such devices was the carbon-impregnated cotton or nylon wick device that spawned the generic name "static wick." The carbon provided a high resistance path through the wick, and the individual carbon crystals provided a multitude of small, sharp discharge points through which small individual currents could discharge into the air. As air movement and weather eroded the wick and depleted the carbon in the exposed area, the core began to turn light gray and then white. Then the outer shield was cut back, exposing a new carbon surface, and the faded portion of the wick was removed by a square cut.

Chelton Electrostatics Ltd., founded in England in 1947, approached the design of aircraft static dischargers using the same theories, but with a slightly different twist. In their basic design, the discharger tips are

composed of a number of fine nichrome wires with each providing a discharge path for static build-up.

In the late 1960s and early 1970s, Shaw Aero Devices developed a discharger composed of crystallized carbon, based on the theory that the carbon would provide the required localized resistance and the points of the crystals would provide a multitude of discharge points that would bleed off low currents, resulting in less noise generation. These units worked very well and were adopted for use on several fleet types.

While all of the various dischargers provided adequate quieting during normal electrostatic charging, airframe damage continued to occur when charge levels accumulated faster than the dischargers could dissipate them or when an aircraft was struck by lightning. [A major U.S. airline's recurrent training publication recently reported that "commercial pilots experience an average of one lightning strike per 3,000 flight hours and airlines average one hit per aircraft per year." Editor.] The small needle points could not dissipate such massive currents, which often resulted in the destruction of the discharger and damage to the aircraft.

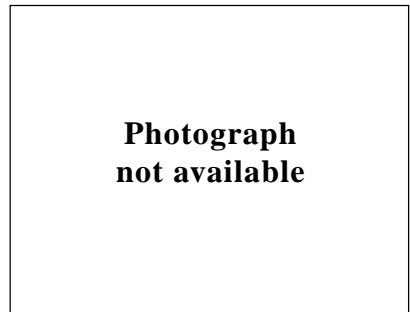
A discharger device was developed that would operate at low-charge levels, but could direct massive currents into the atmosphere. A metal sleeve

was placed around the carbon rod (similar to that on the top three dischargers in Figure 2), and it was tested in a high-voltage laboratory. Under normal conditions, the device discharged with minimal RFI; when massive currents were applied, the charge jumped the gap between the base of the discharger and the bypass sleeve, traveled along the sleeve and discharged into the atmosphere at the upper end of the sleeve. Instead of aircraft metal being destroyed, the sleeve melted, ionized and evaporated into the air. Some devices have continued to effectively discharge low-level charges even with the sleeve completely destroyed.

Dischargers lower the aircraft static charge without creating RFI by eliminating uncontrolled discharges from aircraft structure and preventing corona. However, the dischargers are very intolerant of poor maintenance and they must make a good electrical bond with the airframe.

They must be inspected frequently, not just to confirm their presence but to check them for cracks in the mounting bases, loose mounting bases, corrosion near or under the mounting bases, burned or missing needle points, and missing parts. If a sealant is used between the discharger mounting base and aircraft structure, it must be a conductive sealant recommended or approved by the airframe and discharger manufacturers.

Static dischargers probably provide the best return on investment for every dollar spent on installation and maintenance of any device on the aircraft. For example, a major airline noted an abnormally high usage of quartz landing-light lamps. Failed units were examined and it was noted that the filaments were fractured and that the normally sharp corners of



**Figure 2**

the small curved shields mounted within the lamps to eliminate glare in the cockpit were melted. One theory was that when the filament failed, the hot wire (which is coiled like a spring) flailed around and arced on contact with the metal shields, which are connected to the ground terminal of the lamp assembly.

Further examination revealed that in some cases the remaining section of filament was connected to the ground side of the lamp and would not have arced on failure. It was also difficult to believe that a flailing filament would only contact the corners of

the shield and nowhere else. There had to be another cause for these effects. Discussions with two different lamp manufacturers only raised more questions and a number of failed lamps were sent to them for examination and evaluation.

When their reports came back, both manufacturers said that the filaments had failed after only a few hours rather than near their rated life of 50 hours. (The hours a lamp has been in actual use can be determined by measuring the depletion of tungsten from the filament.) In addition, both manufacturers reported that high voltage apparently caused the filaments to fail.

The filament problem occurred during the same period of research on the bypass sleeve project. The melted corners of the shields resembled the melted sleeves. Were they related? Could the high voltages present in the static build-up on an aircraft be the high voltages the lamp manufacturers suspected were causing the filament failures? The melted corners of the shields could have been the result of high currents entering or leaving these sharp points.

Several new lamps were forwarded to a high-voltage laboratory and were subjected to high levels of static electricity applied to the face of the lamps. The filaments failed and examination showed that the corners of the

shields were melted. Field failures were duplicated in the laboratory. But what was the solution to the problem? If the bypass sleeve functioned on a discharger, would some form of bypass device function on these landing lights? A one-eighth-inch-thick by one-quarter-inch wide strip of aluminum was installed diagonally across the face of the lamp and attached to the landing-light housing using the same screws that held the lamp in place.

Identical tests were conducted in the laboratory with this strap in place and no lamp failures occurred. Flight tests showed that the proximity of the strip to the focal point of the lamp resulted in no shadow or measurable reduction in illumination. When all aircraft were modified with this strip, landing-light lamp usage was greatly reduced.

During modification of the landing lights, it was discovered that the glass lenses on aft-facing, white, high intensity wingtip lights appeared to be delaminating and small chips of glass were missing. Mechanics in the overhaul shop reported that this was a common occurrence and lens replacement was high. Close examination of removed lenses showed evidence of melting and flaking.

The glass lenses of these lights were the farthest point aft on the wings and would therefore be subject to

discharge from static build-up. An aluminum strip similar to that used on the landing light was installed on the inboard side of the aft-facing light lens, running from the base where it was attached to the airframe, just aft of where the lens began to curve. The strip became the most aft point and higher discharges bypassed the lens. After the changes were made, lens replacement costs were reduced substantially.

Maintenance technicians need to make sure that static electricity discharge devices on aircraft are in good working condition. The devices are important tools in controlling discharges that cause RFI disruption of

communication and navigation equipment functions and in preventing physical damage to the aircraft. ♦

### ***About the Author***

*John F. O'Neill Jr. is president of JAYFON Enterprises, an aviation consulting company. O'Neill was employed for 28 years at USAir, where he served in a variety of positions, including director of development engineering and manager of avionics, systems and equipment engineering. He is a frequent contributor to technical aviation publications and is an FAA-designated engineering representative.*

### **Sioux Tools Publishes New Aerospace Brochure**

Sioux Tools, one of the leading manufacturers of air-driven power tools, recently published a four-page brochure of tools for the manufacture and repair of aircraft. Products such as air drills, flat-head angle drills, 45- and 90-degree drills, riveting hammers, rivet shavers and skin-clamp runners are fully illustrated with specifications for each item.

Contact Sioux Tools Inc., Box 507, Sioux City, IA 51102 U.S. Telephone (712) 252-0525.

### **Quiet UPS Freighter Makes First Flight**

A United Parcel Service (UPS) Boeing 727 powered by three Rolls-Royce Tay 651 engines recently made its maiden flight following an engine retrofit by the Dee Howard Co. The flight lasted one hour and reached an altitude of 23,00 feet.

The Tay engine conversion is intended to allow the aircraft to easily meet the U.S. Federal Aviation Ad-

ministration (FAA) Stage 3 noise regulations. Additional benefits are expected to be reduced fuel consumption and lower emissions. Final certification is targeted for November 1992. UPS has placed orders for modification of 40 aircraft with options for an additional 40. The modification, which dubs the completed aircraft as the "B727QF" for quiet freighter, is expected to give the venerable Boeing 727s an extended service life.

### **SAE Aerotech '92 Conference Scheduled**

The Society of Automotive Engineers (SAE) has announced the schedule for Aerotech '92. The annual meeting will be at the Disneyland Hotel in Anaheim, Calif., Sept. 23-26, 1992. The conference and exposition involves the total spectrum of aerospace engineering, with the main focus on the commercial aerospace industry.

The conference agenda will include the technologies applied to the design, development, manufacturing, integration, testing, operation, maintenance and support of aircraft, powerplants and systems.



Contact SAE Communications Division, 400 Commonwealth Drive, Warrendale, PA 15096 U.S. Telephone (412) 772-7131.

## **Course Offered in Repair of Composite Structural Components**

Texas Aero Tech, an airframe and powerplant maintenance technology school based at Love Field in Dallas, Texas, now offers an advanced course on composite repair. The course is open to any certified technician with an airframe mechanic rating.

The course, which is conducted over a five-day period, involves topics related strictly to structural airframe repair of composite components. Among the topics covered are:

- A history of composites;
- Types of materials;
- Types of repairs and repair methods; and,
- Fiber science, including carbon and kevlar materials.

During the course, students will spend about 50 percent of the time in the classroom and the remainder of the time in laboratory/shop work

involving hands-on experience in composite repair techniques.

Contact Randy Long, admissions director, Texas Aero Tech. Telephone (214) 263-9780.

## **Ryder Airline Services To Disassemble an Airworthy Boeing 747**

Ryder Airline Services in Ardmore, Okla. has announced that it will perform what may be the first disassembly of an airworthy Boeing 747 for parts. R. Frank Leftwich, Ryder executive vice president, said, "This is a case where the sum of the parts is valued greater than the whole."

The aircraft was purchased through Polaris Leasing from General Electric Credit Corp. after returning from a lease to now-bankrupt Pan American World Airways.

## **FAA Mandates GPWS For Commuter Aircraft**

The U.S. Federal Aviation Administration (FAA) on March 17, 1992, issued a final regulation that requires all turboprop airplanes with 10 or more seats to be equipped with ground proximity warning systems (GPWS). Such

systems have been mandatory in the United States on large jet aircraft since 1974 and on small jets since 1978.

The new rule was issued following a study of accidents in which fully qualified crews flew their aircraft into the ground with no apparent awareness of impending disaster.

The study showed that 64 percent of the accidents between 1970 and 1988 involving altitude control might have been averted if the aircraft had been equipped with GPWS and the crew had responded to a warning.

Under the rule, aircraft must be equipped with an approved warning device within two years of the effective date. The regulation is expected to affect more than 800 currently operating aircraft.

## **ANSI Catalog Lists Safety and Health Standards**

Products and equipment standards that aim to help safeguard individuals in the workplace are listed in the American National Standards Institute's (ANSI) *1992 Safety and Health Catalog*.

The nearly 1,200 standards listed provide authoritative guides for industrial safety and individual protection.

They cover items ranging from flashlights to fire alarms, and from machine tools to mining equipment.

Founded in 1918, the institute is a private, not-for-profit membership organization that coordinates the U.S. system of voluntary consensus standards. It is the only U.S. organization with the authority to approve American National Standards. Free copies of the catalog can be obtained by contacting ANSI's Publications Department at (212) 642-4916.

## **Pratt & Whitney Becomes TV Producer**

Extensive training requirements associated with being a major manufacturer of turbine aircraft engines have led the Pratt & Whitney Group of United Technologies to install an extensive video production facility. The powerplant supplier for aircraft manufacturers such as McDonnell Douglas, Boeing and Airbus is responsible for developing and conducting technician training for engineers and service personnel who work on its engines.

The complexity of the powerplants and the technical nature of the training demands high quality and clear definition video images. To achieve those standards, the company installed digital production and duplicating

equipment. Use of digital technology ensures that the tapes suffer loss in audio or visual quality when copied

repeatedly. The video department is comprised of a 1,000-square-foot studio and three editing suites. ♦

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## MAINTENANCE ALERTS

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*This information is intended to provide an awareness of problem areas so that occurrences may be prevented in the future. Maintenance alerts are based upon preliminary information from government agencies, aviation organizations, press information and other sources. The information may not be entirely accurate.*

### Older Magnetos Continue to Cause Accidents

In a recent series of Safety Recommendations, the U.S. National Transportation Safety Board (NTSB) cited a number of fatal and serious accidents attributed to magneto failure. In one accident, a small amphibian aircraft suffered a total loss of engine power about 10 minutes after takeoff and crashed while attempting an emergency landing. The airplane struck a tree stump after touchdown, nosed over and was destroyed. The pilot flying was seriously injured and the instructor pilot was killed.

A subsequent investigation found

that both the left and right magnetos were capable of producing adequate ignition sparks at ambient temperature but they would not operate when heated to normal in-flight engine operating temperatures. The ignition coil in each unit was cracked, and the insulation would break down when heated, resulting in faulty operation of the magneto.

This problem is not new. The U.S. Federal Aviation Administration (FAA) issued an Airworthiness Directive (AD) in 1973 (applicable to all Bendix S-20, S-200, S-600 and S-1200 series magnetos) that required mandatory compliance with Bendix Service Bulletin No. 560A. The AD calls for replacement of rotating magnets and ignition coils prior to the accumulation of 2,000 hours of flight time on the unit. In the instance cited above, however, the airplane (used primarily for sport and pleasure flying) had only accumulated a total of 1,295 hours. As a result of this low utilization, it was not mandatory for the magnetos to be modified **even though they were more than 35 years old.**

Similar experiences have been documented in many accidents involving various types of airplanes. Since 1985, the NTSB has cited magnetos as a cause or contributing factor in 92 accidents involving 22 fatalities and 21 serious injuries. Numerous Service Difficulty Reports (SDRs) have been submitted to the FAA, including 130 reports referencing cracking, burning, arcing, leaking or other deficiencies in magneto ignition coils.

## Routine Inspections May Not Disclose Defects

Normal procedures for annual and 100-hour inspections usually consist only of a timing check and an operational test to assure that each magneto is functioning properly. The magneto is usually not removed unless the operational check reveals a problem. It is not uncommon, therefore, for a unit to remain in service for 10, 20 or even 30 years without ever having been subjected to a teardown inspection.

SDRs and accident investigation findings continue to confirm that this level of inspection and maintenance is inadequate to ensure that the magnetos will continue to function as designed when subjected to the normal effects of heating and vibration.

Magneto manufacturers have issued service bulletins and service instructions prescribing specific overhaul and inspection intervals, but most of these are not mandatory and there is no specific regulatory requirement for routine, periodic removal, overhaul or comprehensive inspection of magnetos. One manufacturer has issued a service bulletin that recommends:

- A specific visual inspection of the magneto whenever it is found necessary to adjust timing;
- A 500-hour inspection of the impulse coupling; and,
- A complete overhaul of the magnetos at each engine overhaul or at **four-year intervals regardless of accumulated time in service.**

As a result of the high number of serious accidents, the NTSB has issued recommendations to the FAA calling for issuance of ADs that would:

- Require mandatory compliance with Bendix Service Bulletin No. 560A at the next annual or 100-hour inspection, whichever occurs first;
- Require that all Teledyne Continental Motors, Bendix, and Slick Aircraft Products mag-

netos be subjected to a teardown inspection at the next annual or 100-hour inspection and at every 500 flight hours thereafter; and,

- Require mandatory compliance with all manufacturer's recommended overhaul intervals and instructions.

## **Wear of Propeller Control Unit Cited as Cause of Fatal Crash**

On April 15, 1991, an Embraer EMB-120 commuter aircraft crashed during landing approach at Brunswick, Georgia. The airplane was destroyed. The two pilots, one flight attendant and all 20 passengers were killed.

The U.S. National Transportation Safety Board (NTSB) determined that the probable cause of this accident was the loss of control in flight as a result of a malfunction of the left engine propeller control unit (PCU), which allowed the propeller blade angles to go below the flight idle position. The circumstances of this accident indicated that a severe asymmetric lift and thrust condition caused a left roll that led to loss of control of the airplane.

The powerplant and propeller examinations indicated that the engines

were operating normally but that a propeller system malfunction occurred, causing abnormally low propeller blade angles and a high drag condition with loss of lift on the left side of the airplane.

Tests of the left propeller components indicated a propeller blade angle of about 3 degrees at impact, while the PCU ballscrew position was consistent with a commanded blade angle of 79.2 degrees. The discrepancy between the ballscrew position and the position of the pitchlock acme screw is a strong indication that a disconnect between these two components occurred before impact and that the left propeller had gone into an uncommanded low blade angle below the normal flight range. The right propeller components were found to be at the expected positions and properly connected.

Examination of the left PCU disclosed extreme wear on the quill spline teeth that normally engaged the titanium-nitrided splines of the propeller transfer tube. It was found that the titanium-nitrided surface was much harder and rougher than the nitrided surface of the quill. Therefore, the transfer tube splines acted like a file and caused abnormal wear of the gear teeth on the quill. Using measurements and the inspection procedures for the quill and transfer tube that are in the manufacturer's

service instructions, it was determined that the left PCU quill spline was worn to the extent that its gear teeth did not engage the transfer tube spline. Test cell and flight testing showed that the propeller blade angle could not be controlled by the PCU with a disengaged transfer tube.

During the subsequent investigation, it was found that the original spline tube-quill components were nitrided for protection against wear. Although there had been no SDRs of adverse wear, the manufacturer changed the process in June 1990 to call for the application of titanium-nitride coating to further enhance the wear resistance. Subsequent test cell runs and certification tests disclosed no problems or any visible signs of wear. Because this spline-to-quill connection is not subject to a high torque load (only about 7 inch-pounds), wear was not considered a factor.

The failure mode and effects analysis of all propeller components assign possible failures to two categories. The first group included failures that had a predicted probability of occurrence of less than  $10^{-9}$ , and the second group included failures with a predicted probability of greater than  $10^{-9}$ . The transfer tube and quill interface were listed in the first group and were assigned as an "on condition" component, i.e., inspection is only required after a problem is found during service.

During the investigation, the NTSB became aware of other incidents involving the PCU. On three occasions involving different airplanes, the operators found that a propeller would not feather during ground tests. In these instances, it was found that the ballscrew teeth that engage the quill were extremely worn and would not engage the gear teeth on the quill. Although different from the situation found on the accident airplane, these incidents were found to be further instances of wear conditions not considered in certification.

As a result of these investigation findings, the NTSB issued Safety Recommendations to the U.S. Federal Aviation Administration (FAA) which call for:

- A certification review of the Hamilton Standard model 14RF propeller system and modification(s) to ensure that the system complies with the certification standards;
- Examination of the certification basis of other model propeller systems that have the same design characteristics as the model 14RF and ensure that the fail-safe features of those propeller systems will function properly in the event of unforeseen wear of components in the system; and,

- Establishment of a periodic inspection time requirement for the transfer tube splines, servo ballscrew and ballscrew quill on the Hamilton Standard model 14RF and other propeller systems of similar design.

## **NTSB Issues Safety Recommendation on Teledyne Continental Motors 0-200 Engines**

The U.S. National Transportation Safety Board (NTSB) recently issued two safety recommendations pertaining to the 0-200 series of Teledyne Continental Motors (TCM) piston engines used on many light aircraft. The investigation of a fatal Cessna 150G crash disclosed that the rocker shaft bosses had failed on the number three cylinder, resulting in no valve action and a severe loss of power. While attempting an emergency landing, the student pilot was killed and the instructor seriously injured.

Examination of the failed part disclosed evidence of fatigue cracks through the rocker shaft bosses. The crack initiation was at the stamped characters on the top of the center boss. After this boss failed, the outer portions quickly failed and resulted in complete separation and release

of the rocker shaft for both valves in this cylinder.

These cylinder heads are made of cast iron and the original installation was without any bushings. As the cast iron boss wears, the manufacturer's manuals permit reaming oversize for installation of a bushing. However, technicians are cautioned to ensure that the minimum wall thickness of the boss is no less than 0.25 inches prior to reaming and at least 0.18 inches after reaming. One portion of the rocker shaft boss on the failed engine was found to have a wall thickness less than 0.18 inches.

Laboratory examination further revealed that a portion of the fracture on the exhaust valve side boss contained several casting flaws. Baked-on oil residue was present in this area, which suggests that a portion of this boss had been separated for some time, but had gone undetected.

Other instances of similar failures were investigated and the NTSB found that fatigue cracking had initiated from longitudinal scratches that occurred when bushings were installed in reworked bosses. The NTSB has not determined the number of hours of operation needed to propagate a crack in a cylinder head boss from a detectable size to failure, but it believes that these bosses should, at least, be subjected to non-

destructive testing at each cylinder or engine overhaul.

As a result of these findings, the NTSB has sent recommendations to the U.S. Federal Aviation Administration (FAA), suggesting that:

- An Airworthiness Directive (AD) be issued to require that the rocker shaft bosses on P/N 641917 cylinders and earlier versions of the cylinder be subjected to periodic nondestructive testing to detect the presence of cracks or other defects; and,
- An AD be issued to require compliance with the provisions of TCM Service Bulletin M73-13 when bushings are installed in the rocker shaft bosses.

## **Pylon Cracks Result in Engine Separations From Boeing 707s**

On April 25, 1992, the number 3 engine and pylon separated from the right wing of a Boeing 707-324C cargo aircraft during takeoff at Miami, Fla. After separation from the wing, the number 3 engine struck the number 4 engine nose cowl, impacted the runway and came to rest on the grass adjacent to the runway. The airplane was able to continue the takeoff and safely returned

to the airport without incident.

On March 31, 1992, the number 3 and number 4 engines separated from a Boeing 707-321C while climbing through 31,000 feet over southern France. The airplane landed safely at a military airbase and the two engines were located about 90 miles from the landing site.

Both aircraft had relatively high time and cycles: 53,257 hours/20,399 cycles and 60,779 hours/17,873 cycles, respectively. In each case, the investigation disclosed that the failure initiated in a fatigue crack in the number 3 engine inboard midspar pylon support fitting. The potential for cracks in these fittings was known and U.S. Federal Aviation Administration Airworthiness Directive (AD) 88-24-10, which incorporates Boeing Service Bulletin No. 3183 (Rev. 2), addresses the inspection of fittings in the number 2 and 3 positions of Boeing 707-300 series aircraft. Although the two aircraft had previously been inspected in accordance with the AD, the presence of a small fatigue crack had apparently gone undetected and the crack continued to grow to the point of eventual failure.

As a result of these incidents, the U.S. National Transportation Safety Board (NTSB) issued a Safety Recommendation calling for a revision to AD 88-24-10 to:



- Significantly decrease the times between inspection intervals; and,
- Require an improved means of inspection to detect small cracks.

## **Open Baggage Door Results in Fatal Crash**

The Canadian Transportation Safety Board (TSB) recently issued an Aviation Occurrence Report detailing the investigation and findings following the crash of a Piper PA-23-250 aircraft.

The report stated that the Piper Aztec had just become airborne when the aircraft's nose baggage door opened. When attempting to return to the field, the aircraft nosed down and crashed, killing all five occupants on board.

The TSB determined that the nose baggage door locking mechanism was defective because of inadequate maintenance, which allowed the door to open in flight. The report indicates that the pilot may have been preoccupied with the open baggage door and the possibility of the baggage bin contents falling out and, as a result, allowed airspeed to decrease

to below stall speed, and he lost control of the aircraft. The noise and vibration created by the open door may have distracted the pilot and could have masked the warnings of the approaching aerodynamic stall.

The nose compartment baggage door on this type of aircraft opens upward and is located on the right-hand side of the nose forward of the cockpit. The door latch mechanism operates two lock arms which, when in the locked position, protrude from the fore and aft edges of the door and fit into recesses in the frame.

Although the luggage door was torn from the aircraft in the crash, investigators were able to determine that two screws were missing from the forward lock arm bracket and that the one remaining screw had been loose. The aft lock arm mechanism was severely worn and the entire latching mechanism exhibited wear and lack of maintenance.

Although the aircraft should have been controllable and the open door should not have created aerodynamic drag or control problems beyond the aircraft rudder authority, it was obvious that the accident chain of events was initiated by a lack of maintenance on this simple, but critical, door latching mechanism. ♦

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## NEW PRODUCTS

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### **Oxygen Booster Enables More Complete Use of Filler Bottles**

The complete use of all the oxygen in a high pressure bottle has always been a problem for technicians. When the bottle is depleted below the full system pressure, it is often useless, even though it may have had 1600 or 1700 pounds per square inch (PSI) remaining pressure. A new unit introduced by Tronair is intended to solve that problem.



**Photograph  
not available**

Tronair claims that this simple, lightweight booster unit operated by shop air pressure can allow the use of a refill bottle down to as little as 500 PSI while refilling a system to 1800 PSI.

Contact Tronair, 1740 Eber Road,

Holland, OH 43528 U.S. Telephone (419) 866-6301.

### **Product Reduces Exposure to Stripped Screw Heads**

ND Industries has introduced a product called Drive Grip, which is said to reduce tool wear and rounding or stripping of screw heads. The manufacturer claims that a single drop of this product provides a positive grip and increases the grip strength between the screwdriver and the screw by as much as 400 percent. The product can also be used on hex head/allen wrench screws as well as any type screw head.

Drive Grip is said to reduce fatigue and potential technician injury by eliminating the need to hold excessive pressure on the tool to prevent slipping. The product is odorless, nontoxic and noncorrosive. It is immediately usable without mixing and has an unlimited shelf life. According to the manufacturer, Drive Grip does not irritate normal skin and wipes clean with no staining or residue.

For a free sample and additional information, contact ND Industries,

1893 Barrett Road, Troy, MI 48084  
U.S. Telephone (313) 362-1209.

## **LPS Develops Corrosion Control Manual for Aviation Maintenance**

LPS Laboratories Inc. recently published *Aviation Corrosion Protection Manual*. The comprehensive document details the company's 30 years of experience in manufacturing corrosion preventive compounds and methods of application. It is designed to help aviation maintenance technicians establish and implement corrosion prevention programs for modern as well as aging aircraft. However, the document does not address corrosion removal or rework and is only intended to provide assistance in preventing corrosion.

The manual includes generally recognized procedures obtained from aircraft manufacturers, industry experts, the U.S. Federal Aviation Administration (FAA), and maintenance personnel. It provides information on each of the LPS corrosion preventive compounds, cross-references specifications, reviews application procedures and presents recommendations for application equipment and methods.

The document is divided into 10

sections referencing corrosion control recommendations for commercial, corporate, light aircraft and helicopters. Aviation maintenance technicians may obtain a free copy by submitting a request in writing to: *LPS Aviation Corrosion Protection Manual*, 4647 Hugh Howell Road, Tucker, GA 30084 U.S.

## **Paint Stripper Said to Be Environmentally Safe**

Research Chemicals Inc. has introduced a product that it claims is effective in removing paint and coatings from paint guns and equipment used in paint application, yet is safe to use and friendly to the environment.

RC 10 NC Stripper does not contain methylene chloride, acetone, methyl ethyl ketone, toluene or phenol and is said to be nonflammable and slow evaporating. The material has a high flash point of 195 degrees F. and washes off with water. The manufacturer claims that RC 10 NC safely removes gel-coat polyesters, elastomers, lacquers, enamels and some urethanes and epoxies, and is safe to use on aluminum.

Contact Research Chemicals Inc.,  
P.O. Box 1492, Fort Worth, TX 76101  
U.S. Telephone (817) 451-7565.

## **Multipurpose Tool Handy for Line Technicians**

Disstim Corp., a U.S. manufacturer of hand tools and other products, is now offering a combination screwdriver and nutdriver that it claims is unlike anything else currently available. The hand screwdriver-like tool has adjustable jaws that the manufacturer states can accommodate metric size nuts from 3.5 mm up to 6 mm, U.S. standard nuts for No. 4 through 1/4 size fasteners, plus standard slotted, Phillips-head and Torx-head screws.

**Photograph  
not available**

The snap lock swivel cap allows all bits to be stored in the handle and thus provides technicians, such as line mechanics, with the ability to service a number of fasteners with a single tool. The materials and construction are claimed to be of exceptional quality, and the manufacturer states that testing proved the capability to apply sufficient torque to strip the threads of a 10-32 fastener.

Contact Disstim Corp., 217 S. Hurffville Road, Deptford, NJ 08096  
U.S. Telephone (609) 227-7904.

## **Battery Condition Monitor Reported to Eliminate Failures**

A battery monitoring unit, the Batstat Monitor, has been developed by Batcon Inc. The unit is said to prolong battery life and reduce maintenance and water service requirements when installed on ground service equipment.

The monitor can be installed on any vehicle or machine that uses a battery for primary power or engine starting. When permanently connected to the battery, a light-emitting diode (LED) panel visible to the operator displays a green light under normal operating conditions. Whenever the voltage falls below a predetermined level, even momentarily, a red warning light illuminates and remains on until manually reset.

The manufacturer claims that this unit automatically identifies a weak or defective battery, even in multiple battery installations. Time consuming hydrometer checks are said to be eliminated, and load checks are no longer required. According to Batcon, the use of this monitor per-

mits maximum use of batteries and reduces downtime due to unexpected battery failures.

Contact Batcon Inc., 107 South Avenue, Fort Walton Beach, FL 32547 U.S. Telephone (904) 863-8828.

## **Primer Claimed Safer, Healthier Than Zinc Chromate Paint**

Tempo Products Co. has introduced a zinc oxide primer it says provides equivalent protection and bonding for aluminum and steel with less toxic irritants than zinc chromate primer paints.

The zinc oxide primer is supplied in pressurized cans containing no fluo-

rocarbon propellant gases. The product is said to have improved abrasion resistance and to dry in about one-half the time required for the zinc chromate products.

Also available from Tempo Products is an epoxy propeller coating. The coating is claimed to remain adhered to the blade for more flying hours than standard lacquer and enamel products, thus reducing the effects of corrosion and erosion on blade life. The coating is available in a standard medium gray to match the original propeller color as well as a bright red or yellow to provide contrast and visibility of the blade path.

Contact Tempo Products Co., P.O. Box 39126, Cleveland, OH 44139 U.S. Telephone (216) 248-4241. ♦