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Faulty Shift Handoff Cited in Failure to Close B-747 Static Lines

The Irish Air Accident Investigation Unit said that an 'unstructured system of shift handover' during weekends resulted in an inadequate exchange of information between workers on two shifts about incomplete tasks. The failure to re-install static drain blanking caps caused erroneous indications of airspeed and altitude that prompted the flight crew to declare an emergency.

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FSF Editorial Staff

About 1325 local time May 12, 2000, after takeoff from Dublin (Ireland) Airport on a post-maintenance check flight, a United Parcel Service (UPS) Boeing 747-200 developed a significant airframe vibration, and the crew determined that the readings from both airspeed indicators were significantly less than the actual airspeed. The crew declared an emergency, conducted trouble-shooting off the Irish coast and then returned the airplane to the airport for landing. The airplane's flap system was damaged because of inadvertent flight at excessive speed with the flaps extended, but none of the eight people in the airplane — three flight crewmembers and five maintenance personnel — was injured.

The Irish Air Accident Investigation Unit (AAIU) said, in its final report, that the incident "was caused by the failure to replace the static-drain blanking caps following maintenance."

The report said that a contributory cause was a "poor hand-over procedure between work shifts."

The crew had arrived at the airport about two hours before takeoff on a check flight following "C" check maintenance performed at the airport by Team FLS. During preflight tests, when the spoiler panels were deployed as the control wheel was being moved to the left, "a noticeable airframe vibration was detected," the report said.

The maintenance provider's inspector, who was in the airplane, conducted a visual inspection of the spoiler and said that the vibration was caused by "a low flow rate, or air, in the hydraulic system, and he informed the commander [captain] that it should disappear following engine start."

At the stand (gate), after the engines were started and spoilers were deployed, the control wheel was moved to the left and the vibration recurred.

Spoiler Problem Considered Minor

"Further discussion between the flight crew and the maintenance inspector on the matter of the vibration followed," the report said. "The maintenance inspector stated that it was not a significant problem. Furthermore, the flight crew [was] comforted by the fact that the spoilers would not normally be deployed in flight in the ground-spoiler mode. It was therefore deduced that any minor defect in the spoiler system could not pose a danger to flight. It was thus decided that the aircraft was safe for flight."

Before takeoff, the captain briefed the crew on actions to be taken in the event of flight-control problems. At 1315, during the takeoff roll, the flight crew compared airspeed indicators (ASIs), and both ASIs indicated 80 knots. The takeoff was normal but "slightly longer" than usual, the report said. When the airspeed reached 131 knots, the captain rotated the aircraft; maximum rated thrust was achieved, and after takeoff, the engine thrust was reduced. After the crew retracted the landing gear, an abnormal airframe vibration occurred.

"The [captain] suspected that it was a recurrence of the spoiler problem, while the first officer believed that an undercarriage door might have remained open," the report said.

As the airplane reached 800 feet and a pressurization pack was activated, the wind shear alarm sounded. At the time, airspeed was decreasing to near V_2 (takeoff safety speed) and the airplane's climb rate was an indicated 400 feet per minute (fpm) or 500 fpm. The captain, who initially believed that a small weather cell nearby might have caused the wind shear alarm, ordered an increase in power. Ten seconds later, the second pressurization pack was activated, airspeed decreased and the captain again ordered an increase in power. After the airplane was flown out of clouds at 1,500 feet, the captain observed that "the weather conditions were benign and could not be the cause of the wind shear warning" and that the vibration level was increasing, the report said.

"During the climb, with normal engine power settings and aircraft pitch attitude, the airspeed indication was significantly lower than expected," the report said. "The captain attempted to maintain 200 knots but determined that the airspeed and altitude indicators on both sides of the cockpit were under-reading [the actual airspeed] by a significant amount. This was verified by comparing the ASI indications with the ground speed indicated by the aircraft navigation system.

"At about this point, at an indicated speed of 180 knots, the [captain] initiated the standard turn to the right, as required for the standard instrument departure (SID) for Runway 10. During this turn, the indicated airspeed reduced towards 160 knots, and the aircraft started to descend at about 500 feet per minute. The [captain] rolled the aircraft level, and then re-attempted the turn, but more gently, with similar results — reducing airspeed and reduced rate of climb, coupled with increased vibration."

The captain decided to return to Dublin. During the flight back to the airport, the captain's altimeter repeatedly changed from electric mode to barometric mode, and when the captain tried to reset the altimeter in electric mode, it reverted to barometric mode. Nevertheless, he observed that when the mode changed, the indicator needle did not move. He also observed no movement in the instantaneous vertical speed indicator (IVSI). The pitch attitude indicator pointed down; after cross-checking the standby pitch indicator, he determined that the pitch information was accurate. Indicated airspeed was 225 knots. Because the crew could not keep the airplane out of clouds while complying with air traffic control clearances, they declared an emergency and flew the airplane toward clearer weather east of the airport.

"At this point, the [captain] had no faith in his airspeed indications, which were reading 190 [knots] to 200 knots," the report said. "He had no idea of his true altitude, except that he was staying on top of the clouds."

Flaps Did Not Deploy Fully

The crew received ATC radar vectors to the airport, and during the approach, with an indicated airspeed between 190 knots and 200 knots, the crew selected "flaps 25"; the "flap overload" light illuminated and the flaps did not deploy fully — an indication that the true airspeed was too fast for the flap setting, although the indicated airspeed was within the range for deployment. They then selected "flaps 10," and the airplane became more controllable. The "forward door warning" light and the "aft cargo door warning" light illuminated briefly.

The crew flew the airplane to intercept the visual glide path and began reducing airspeed from 190 knots to 160 knots, the maneuvering speed for flaps 10 at the airplane's landing weight.

Crew Was Aware of Higher-than-normal Speed

"On the approach, at about 170 knots indicated airspeed, the on-board inertial navigation system (INS) was indicating about 250 knots groundspeed, and ATC reported that their system showed that the groundspeed was about 300 knots," the report said. "The [captain] did not know which system, if any, was accurate. He was aware, as he approached the ground, that the speed was higher than normal."

Automatic spoiler deployment was disarmed for the landing to ensure that deployment would not result in control problems. After touchdown, the airplane was slowed with aerodynamic braking, manual deployment of the spoilers and engine thrust reversing.

A post-landing inspection revealed that the seals at the fixed trailing-edge flap fairings at the no. 1 and no. 8 positions had been blown out, that the trailing-edge boat fairings had been damaged and that the left outboard leading-edge flaps had cracked.

The incident airplane, which was manufactured in 1980, had 66,582 total airframe hours.

The B-747-200 has four pitot-static probes — two on each side of the cockpit, below the side windows. The upper probes are the main probes; the lower probes are auxiliary. Each probe includes two sets of lateral holes on the side of the probe to measure static pressure (which is affected by altitude and atmospheric pressure) and a forward-facing hole to measure dynamic air pressure (which is proportional to airspeed). The static ports on each side of the aircraft are connected to minimize errors caused by sideslip.

The report said that the main static source for the captain's ASI, altimeter and IVSI comprises the upper left probe forward static port (S1) and the lower right probe rear static port (S2). Lines from the static ports go through a selector valve and into a manifold, which distributes static pressure to the instruments. A selector valve allows the captain to select static pressure from these probes (by positioning the selector valve in the normal position) or from a common alternative static source.[1] The static line is connected to the no. 1 air data computer and a static line drain (which drains moisture from the static system) at a

T-fitting located between the selector valve and the manifold.

The main static source for the first officer's ASI, altimeter and IVSI comprises the upper right probe forward static port (S1) and the lower left probe rear static port (S2), which are part of a system that resembles that used for the captain's instrumentation. The first officer's static line is connected to the no. 2 air data computer and to a separate static line drain on the first officer's side of the flight deck.

The air data computers and their static line drains are in the forward part of the avionics and electrical bay. The drains usually are sealed with blanking caps. Nevertheless, maintenance personnel can remove the blanking caps to perform leak checks on the static system. The avionics and electrical bay is in the airplane's pressure hull, where the ambient air pressure is higher than the outside ambient air pressure; the differential increases with altitude.

Other static ports on the main probes and auxiliary probes supply static air pressure to the flight control modules and other systems but not to flight instruments.

The pitot-static system is checked for leaks during all major check procedures, including "C" checks; after any maintenance is performed on the static system; and after a replacement of instruments that are connected to the static system.

"It is essential to ensure that there are no leaks in the pitot-static system," the report said. "In particular, a leak in the static system, within the aircraft, will result in higher-pressure air coming from the pressurized environment inside the aircraft, entering the static system and causing a higher-than-normal pressure within the static system. This causes the airspeed indicator and the altimeter to under-read."

In this incident, the problem also resulted in false wind shear alerts and false transponder altitude data.

Two Methods Described For Detecting Leaks

The report said that the Boeing maintenance manual for the B-747 describes the following methods of checking the static system for leaks:

- "The first method is to fit an adapter (part no. T856-660) onto the probe. The corresponding static port on the other side of the aircraft is blocked off, using tape. A vacuum is applied to the probe adaptor using a test rig, and the leakage rate is checked. There is a problem with this procedure, in that it can be difficult to get a good seal between the adaptor and the probe. This is particularly difficult where the surface of the probe has become pitted and corroded. The anti-icing heating element in the probe accelerates the onset of such corrosion and pitting, in normal use; [and,]

- "The second method lays down that the static system can alternatively be tested for leaks by blocking the ports on both probes and by connecting the vacuum test rig to the static drain connection in the forward avionics and electrical bay, which is located underneath the cockpit area. This involves the removal of the blanking caps that normally cover these drains, followed by the connection of the test rig to the open drains. As this procedure does not use the adaptor, the sealing problem on the probe does not arise."

UPS produces its own maintenance manuals for its aircraft, and the *Consolidated Maintenance Manual* (Reference UPS 52001, Revision 13), issued in May 1999, includes only the first method of performing a static system leak test. (The second method — still authorized by Boeing — was not mentioned in the May 1999 UPS maintenance manual but had been included in an outdated 1991 UPS maintenance manual.) During the investigation, a copy of the outdated UPS maintenance manual was found in use at the maintenance facility.

"If the current UPS AMM [aircraft maintenance manual] had been used, the drain connections would not have been used for the leak tests, thereby preventing this serious incident," the report said.

An inspection of the airplane after the incident revealed that the static drains in the avionics and electrical bay were not equipped with blanking caps. An investigation revealed that, on May 5, during the "C" check maintenance, the airspeed calibration and static system leak checks had been conducted according to the second method, which involved attaching the blue static test tube of the test rig to a clear plastic tube connected to a T-fitting, which in turn was connected to two adaptors, which were connected to the static line drains in the avionics and electrical bay.

There were no leaks, but the captain's IVSI was found to be faulty, and a replacement was ordered.

Test Equipment Was Left in Place

"The avionic[s] crew manager decided to leave the test equipment attached to the aircraft, in order to complete the tests when the replacement IVSI was [installed]," the report said.

The report said that his decision was a result of his "mistaken belief … that a further leak test would be required after replacement of the IVSI."

The avionics crew manager told investigators that he recently had transferred from line maintenance to aircraft overhaul. The report said that he "had not been working on [the incident airplane] for the full duration of the check, and he had also been working on another aircraft check in [another] hangar, while the check on [the incident airplane] was in progress. He stated that he was present for the full pitot-static test. He also stated that when he was going home at 3 p.m. on Saturday, [May 6], he was not aware that the aircraft was going to be weighed later that day. The work card for the pitot-static check was signed off on Sunday [May 7]."

More Leak Checks Were Planned

The avionics crew manager said that he signed the work card, "having raised an NRC [a non-recurring card — a job card calling up one specific non-recurring task) for the IVSI replacement, but omitted to include a call-up for further leak and calibration checks of the captain's [static system] and first officer's [static] system. It was his intention to do the full checks following the IVSI replacement, and for that reason, the pitot-static test-rig lines were left connected to the aircraft."

A second avionics crew manager worked on the static-system leak checks and certified the installation of the IVSI. He said that he had told an avionics apprentice to connect the leak test rig to the static drains "as this was an acceptable method in accordance with the aircraft operator's maintenance manual used during this check."

The report said, "At 1500 hours on Saturday [May 6], on completion of their shift, all the avionic[s] personnel went home, leaving the test rig connected to the aircraft. It appears that none of these personnel were aware that the aircraft was to be weighed later that day."

The acting airframe/engine shift manager was in charge of weighing the aircraft — a process that began at 1500 on May 6.

"In order to prepare the aircraft for weighing, he gave instructions to a mechanic to disconnect the test equipment from the pitot probes," the report said. "In relation to the static pipes, he personally disconnected the colored lines from the test equipment at the quick-disconnect fittings and left them lying on the floor. He was not aware of what subsequently happened to them."

The acting airframe/engine shift manager said that there was no meeting between himself and members of the avionics crew, and "he agreed that if a meeting had taken place … this incident would probably not have occurred."

He said that during the week, crew managers from different areas of the aircraft held daily progress meetings and that they all knew that the airplane was to be weighed at 1800 on Saturday. Such meetings were not held on weekends, he said.

Another airframe/engine crew manager said that between 1715 and 1800, he rolled up the clear static tubing and placed it in the avionics and electrical bay. The blue tubing no longer was connected to the clear tubing.

About 1800, an airframe maintenance technician observed the tubing "still hanging down the A&E bay door at 1800 [hours], and he heard an instruction to disconnect the hoses in this area. Another airframe maintenance technician said that he heard "a request from somebody inside the avionics and electrical bay for an 11/16-inch [1.7-centimeter] spanner [a wrench with a semicircular head and a projection or hole at one end]. Shortly afterwards, the tubes came down to floor level."

The report said that 11/16 inch was the size of the adaptor that was screwed into the static drain fittings to connect the tubing for the static-system leak checks.

"Efforts by the investigation and the company to identify the person in the A&E bay were not successful, in spite of assurances that no blame would be apportioned to this person," the report said.

No Further Check Required

The replacement IVSI was installed May 9. Because the new IVSI had a self-sealing, quick-disconnect coupling, no further calibration or leak check was required.

"The fact that leak checks were not required following the fitting of the IVSI, due to the self-sealing fittings on the IVSI, was unknown by the avionic[s] crew manager who certified the initial check," the report said. "Thus, a safety resource that he believed to be in the system was, in fact, absent.

"This avionic[s] crew manager had recently transferred from line [maintenance] to overhaul maintenance. He was also involved in maintenance on another aircraft. His appreciation, experience and comprehension of the need for the ongoing interaction of the various teams involved in overhaul maintenance may have been less than optimum."

The report said that the difficulty experienced by some personnel who were transferred from line maintenance to the check environment "suggests need for reappraisal of aspects of personnel training within this organization."

Because of the "ineffective handover" at the shift change at 1500 on May 6, the later crew was "unaware that the checking of the pitot-static system was not complete," the report said. "An unstructured system of shift handover at weekends resulted in a poor exchange of information with the off-going [shift] and incoming shifts."

The report also said that the "failure of some personnel within the maintenance provider organization to come forward following maintenance procedures errors is a matter of concern." The report said that there might have been confusion among some maintenance personnel about the functions of the AAIU and the Irish Aviation Authority (IAA), which also investigated the incident and took regulatory action. (During a previous IAA investigation, maintenance personnel had been "formally cautioned" — an action that the IAA said is occasionally required, in incidents in which prosecution might follow, the report said.)

After the incident, the vibration problem was corrected after maintenance personnel changed the no. 8 spoiler actuator. The presence of the vibration had "hindered the flight crew's initial analysis of the vibrations experienced in flight," the report said. "The onset of airframe vibrations, which was due to excessive true airspeed with the flaps extended, was initially believed to be related to vibration in the spoiler system that was detected on the ground."

Also after the incident, the maintenance provider developed a draft maintenance safety management plan; the report said that "this investigation believes that it is appropriate that this plan be implemented."

As a result of the investigation, the AAIU issued the following maintenance-related safety recommendations:

- "The maintenance organization should review their procedures for shift handover, especially [on] weekends;
- "The maintenance organization should review their training programs for personnel transferring from line maintenance appointments;

- “The maintenance organization should review their procedures that ensure that only current versions of maintenance manuals are in use;

- “The maintenance organization should ensure that their staff are aware of the difference of function between the IAA and the AAIU and the different objectives of investigations conducted by both organizations;

- “The aircraft operator should review their procedures for post-maintenance test flights, in relation to weather [minimums], particularly in relation to cloud base and cloud cover, in order to ensure that an aircraft does not enter IMC … in the early phase of a post-maintenance test flight … ;

- “The maintenance provider should continue with the implementation of their draft maintenance safety management plan. In this plan, consideration should be given to including an explanation of the respective roles of the IAA and the AAIU with respect to the investigation of occurrences; [and,]

- “The IAA should consider an AIC [aeronautical information circular] to fully explain the air safety roles of the AAIU and the IAA in respect of air accident investigation.♦

[FSF editorial note: This article, except where specifically noted, is based on Irish Air Accident Investigation Unit (AAIU) incident report no. 2004-004. The 22-page report contains a diagram.]

Note

1. One alternate static port is located on each side of the fuselage, near the forward cargo area. The two alternate static ports are interconnected and provide a common alternate static source for the captain’s instruments and the first officer’s instruments.

MAINTENANCE ALERTS

Wheel Bearing Deteriorates in Storage

After landing the Boeing 727-277 at Perth, Western Australia, Australia, the flight crew reported that the no. 2 (left inboard) wheel of the main landing gear had separated from the landing gear. There were no injuries in the Oct. 18, 2002, incident, which occurred on a scheduled cargo flight.

The missing wheel was not found on the runway at Perth. A search conducted at the departure airport, Melbourne, Victoria, Australia, located the wheel where it had struck the perimeter fence past the Runway 34 overrun area.

"Inspection of the landing gear revealed that the outer bearing had failed, which allowed the wheel assembly to migrate over the locked retaining nut and depart from the axle," said the report by the Australian Transport Safety Bureau (ATSB).

Investigation determined that the Boeing 727 operator recently had leased the aircraft from an owner in the United States. Before transferring the aircraft to the Australian operator, the U.S. owner obtained a serviceable set of main-wheel assemblies to standardize the aircraft with the rest of the Australian operator's fleet.

"The wheels carried release-to-service documentation after overhaul from an approved American maintenance facility," said the report. "The incident wheel (no. 2) had been overhauled in accordance with approved data and released for service with the correct documentation on Nov. 14, 2000. The wheel was subsequently [installed on] the Boeing 727 on Aug. 31, 2002. The wheel was in storage for all the intervening period between release to service and [installation on] the aircraft."

The company that had overhauled the wheel assembly had returned it to the U.S. owner with the wheel bearings packed in grease and sealed in plastic bags. "The maintenance personnel who [installed] the wheels [on] the aircraft stated that the wheels were received from the [United States] with the bearings in place," the report said. "There were no reports of the bearings being received in plastic bags as described by the overhaul facility."

At the time of the incident, the operator's maintenance control manual (MCM) did not include a section about storage-life expiration and reinspection procedures for wheels, the report said. "The quality-assurance inspector for the overhaul facility stated that, although not mandated, the [overhaul] company recommended to customers to reinspect stored wheels every 12 months," the report said.

Laboratory examination found that "the development of corrosion damage over the contact surfaces of the wheel bearings was a major factor contributing to the failure," the report said. "This was evident in the bearings examined from the remaining wheels. The corrosion led to incipient contact-fatigue spalling, which … can lead to catastrophic bearing failure consistent with the circumstances of this occurrence. The bearing-lubricating grease was found to be congealed, hardened and in a dry state."

Significant factors in the incident, the report said, were the following:

- “The condition of the wheel bearings and the lubricating grease was degraded during the extended storage;
- “There was no required reinspection maintenance procedure for lubrication quality or bearing-corrosion prior to [installation of] the wheel [on] the aircraft; [and,]
- “The no. 2 wheel outer bearing failed, resulting in the inability of the wheel-retention nut to retain the wheel on the axle.”

Following the incident, the operator included a provision in its MCM setting the storage life of wheel assemblies at 12 months, the report said. The Australian overhaul facility for the operator’s wheel assemblies also introduced a 12-month storage-life limit for its stored assemblies, after which all bearings are disassembled and inspected for corrosion, and grease is reapplied.

Venturi Fan Failure Leads to Evacuation

On Jan. 4, 2003, at Telluride (Colorado, U.S.) Regional Airport, the flight crew of a Hawker Siddeley HS-125-700A started the auxiliary power unit (APU) of the aircraft about 30 minutes before engine start for a nonscheduled business flight conducted under U.S. Federal Aviation Regulations (FARs) Part 135. When engine no. 2 was started, the flight crew and four passengers smelled and saw smoke in the cabin. The flight crew shut down engine no. 2, the APU and all electrical switches. The occupants evacuated the aircraft through the main cabin door.

“An inspection of the airplane revealed [that] a venturi fan unit, located aft of the rear-cabin bulkhead, was charred,” said the report by the U.S. National Transportation Safety Board (NTSB). “Insulation, wires and air ducts in the immediate vicinity of the unit were also charred. … An examination of the venturi fan unit showed [that] the motor had overheated and subsequently failed. According to the [operator], the venturi unit was installed in 1999.”

The venturi fan unit (part no. 207640-10) was an older model that the aircraft manufacturer had identified in 1994 as being vulnerable to in-service failure involving the fan motor overheating and generating smoke in the cockpit.

“On Feb. 22, 1994, Hawker Aircraft issued an alert service bulletin requiring the inspection of all existing units at that time,” said the report. “A few months later, an airworthiness directive was issued requiring a minimum inspection period of four years on the unit.”

The report listed the probable cause of the incident as “the overheated and burned venturi fan motor.” Following the incident, the operator replaced the venturi fan units in its other two airplanes with a newer, thermal-fuse type unit that senses heat earlier and shuts down the unit before tripping the circuit breaker.

Emergency AD Issued for Embraer Rudder-control Rods

The U.S. Federal Aviation Administration (FAA) has issued an emergency airworthiness directive (AD) for owners and operators of Embraer Model EMB-135 and Model EMB-145 series airplanes. AD 2004-02-51, dated Jan. 23, 2004, concerns the aft rudder-control rods (the rudder consists of a forward section and an aft section).

The flight crew of an Embraer Model EMB-135 had experienced rudder-control difficulties during a takeoff. An emergency landing was made, and there were no injuries. The U.S. National Transportation Safety Board (NTSB) found that the upper and lower aft control rods for the aft rudder section had failed. (NTSB is investigating the cause of the failure.) In addition, the airplane was being operated without Access Panel 312AR, as allowed by the configuration deviation list (CDL).

“Failure of these control rods, if not corrected, could result in loss of rudder control, or a possible rudder jam,” said the AD. “Also, an unrestrained aft rudder could enter a flutter mode, which could result in loss of control of the airplane.”

Embraer, based in Brazil, issued Alert Service Bulletin 145-27-A105, dated Jan. 23, 2004, on the same subject. The Brazilian civil aviation authority classified the service bulletin as mandatory.

The AD requires accomplishment of the following actions:

- “A one-time general visual inspection of the aft rudder-control rods to detect any applicable corrective action;
- “If any discrepancy is found, replacement of the affected aft rudder control rod with a new or serviceable control rod, and accomplishment of a backlash test (to detect worn rudder bearings) and any applicable corrective action;
- “A general visual inspection to determine if Access Panel 312AR is installed, and reinstalling the panel; [and,]
- “A revision to the CDL to remove reference to Access Panel 312AR (thus prohibiting operation without that access panel installed).”

Defective Aft Bumper Plug Causes Loss of Control on Schweizer 269C

On March 15, 2002, a Schweizer 269C helicopter lost tail-rotor authority during a low-altitude spraying run. Normal helicopter control was lost and the pilot, unable to stop the ensuing spin, conducted an emergency landing at Karaka Downs, South Auckland, New Zealand. The pilot, the only occupant, was not injured.

The report by the New Zealand Transport Accident Investigation Commission (TAIC) determined that a defective tail-rotor-driveshaft aft bumper plug had permitted the driveshaft to disengage its drive coupling to the tail-rotor gearbox.

On Oct. 18, 2002, TAIC recommended to the New Zealand director of civil aviation that he "critically examine the requirements for duplicate inspections of aircraft-control systems, with a view to including helicopter tail-rotor drive trains as part of the duplicate inspection regime."

The director replied on Nov. 1, 2002, "I accept this recommendation; I will initiate a review of [Civil Aviation Authority of New Zealand] Rule Part 43.113, duplicate inspection of controls. This review will examine the need for duplicate inspection of vital points in an aircraft, [those that] if they were to fail would have a catastrophic effect on the flight. Helicopter tail-rotor drive trains will be considered as part of this review."

[See also "(Schweizer 269B) Missing Tail-rotor Bumper Plug Goes Unnoticed During Rebuilding and Inspection," *Aviation Mechanics Bulletin*, January–February 2003.]

Defective Generators Cause A300 Electrical Failure on Approach

The Airbus A310-300 was 12 nautical miles from touchdown at Shannon (Ireland) Airport and established on the runway localizer when the flight crew reported that both of the airplane's generators had failed. All normal alternating current (AC) and direct current (DC) power was extinguished, and the only remaining electrical power came from the standby generator. The first officer's flight instruments became inoperative.

The captain, who was the pilot flying, decided to continue with the landing instead of initiating a missed approach because the runway was in sight, the landing gear was down, the flaps were at 20 degrees and he did not want to re-enter instrument meteorological conditions with limited flight instrumentation. He was also concerned about the possibility of an electrical fire.

On touchdown, the no. 8 main tire burst. There were no injuries to the 10 crewmembers and 13 passengers in the Aug. 24, 2002, incident.

The report by the Irish Air Accident Investigation Unit said that a maintenance test report from the ground power control unit indicated that both integrated-drive generators (IDGs) had experienced a shorted-rotating-diode (SRD) event during the flight. The IDGs were removed and sent to the manufacturer in the United States for investigation and repair. The generator control units were later removed and sent to the manufacturer for extraction of the nonvolatile-memory data. The data showed that there had been SRD trips during the incident flight, as well as during the previous flight.

The report said that a materials-laboratory investigation found that the right IDG had failed first, and the left IDG had failed 2.5 seconds later. Inspection found three shorted diodes in the right IDG and two shorted diodes in the left IDG.

"A strong odor of jet fuel caused the [right] IDG to be completely torn down to inspect for damage and to ensure that the residual jet fuel was removed from all the components," said the report. "Oil samples from both units and deposits removed from the motor poles and stator of the right IDG were submitted to mass-spectroscopy examination to determine the amount of jet fuel present in the oils and the composition of the deposits."

About 20 percent Jet A aviation fuel was found in the oil sample from the right IDG. No aviation fuel was found in the sample from the left IDG.

The report said, "According to the manufacturer, a generator with damaged rotating diodes can connect to its bus bar and will operate with degraded performance. Under this condition, the generator can carry its normal bus loads but will not sustain the maximum design load it is designed to withstand. It is noted that on the flight prior to the event, the left IDG nonvolatile memory logged two occurrences of an SRD fault. The *A310 Trouble Shooting Manual* (24-00-00) indicates that a 'Gen Diode/Field' trip annunciation may require the immediate replacement of the IDG. However, the generator was reset, and such indications were not carried forward on the tech log for this aircraft.

"The IDGs were on the aircraft since [the aircraft's] manufacture in 1987. The fact that there was fuel found in the right IDG, which seeped in from the oil cooler, casts doubts on the previous maintenance practices on this aircraft, especially during heavier maintenance visits where a seepage into the oil cooler was more likely to be discovered. It is also likely that the oil which was replaced during servicing in May 2002 could have contained quantities of fuel. Both generators were substandard without the crew being aware of this at takeoff. With high-tech diagnostic circuitry installed on this aircraft, this should not have happened."

The report said that the cause of the incident was that "both left and right generators carried defects into this flight. When an ensuing fault occurred on the right generator during the approach, it tripped the system. The left generator could not carry the electrical load and it, too, tripped from the system."

Tire Separates Following Improper Installation

On Sept. 5, 2002, during takeoff from Minneapolis-St. Paul (Minnesota, U.S.) International Airport, the no. 2 (left inboard) main-landing-gear wheel separated from the axle of a Fokker 100. The wheel was found near the end of Runway 12L. The flight was continued to Chicago (Illinois, U.S.) O'Hare International Airport, where an uneventful landing was conducted. None of the 133 airplane occupants was injured.

The report by the U.S. National Transportation Safety Board (NTSB) said that prior to the incident flight, a mechanic for the airline had performed a walk-around inspection and noted that the no. 1 (left outboard) tire and no. 2 tire needed to be replaced. He said, "We removed and replaced the no. 2 main-landing-gear [tire], with nothing unusual during the tire change." The no. 1 tire then was replaced.

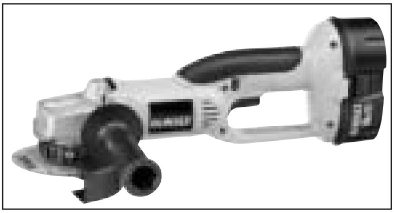
"The axle nut/spacer assembly was found with the wheel," said the report. "The axle nut lock-bolts were found installed in the axle nut/spacer assembly with safety wire connecting the lock-bolts to the axle nut. The lock-bolts were not damaged. The interfacing threads between the axle nut/spacer assembly and the axle were not stripped and the threads were not worn.

"A demonstration of a wheel installation and a review of the installation procedures were performed at the request of NTSB. In order for the lock-bolts to engage the axle key slot, the axle nut/spacer assembly had to be properly torqued and wheel bearings seated."

NTSB determined that the probable cause of the incident was "the improper installation of the no. 2 main-landing-gear wheel, including the axle nut not being properly torqued and safetied, which resulted in the wheel separation during takeoff."♦

Metal Cutting, Grinding Goes Cordless

A battery-powered cutoff and grinding tool, the DC410KA is designed for maintenance crews who need the versatility of cordless operation.



Battery-powered Cutting and Grinding Tool

The manufacturer, DeWalt, said that the tool's applications include light grinding and metal cutting for high-stress bolts. A trigger switch and lock-off button permit easy gripping, and a three-position side handle improves control during surface cutting and edge cutting, the manufacturer said.

The DC410K comes with a cutting wheel, grinding wheel, spindle lock, two 18-volt batteries, a one-hour battery charger and a heavy-duty kit box.

For more information: DeWalt Industrial Tool Co., 701 E. Joppa Road, TW425, Baltimore, MD 21286 U.S. Telephone: (800) 433-9258 (U.S.); +1 (410) 716-3900.

Lifter Makes Grate-lifting a One-person Operation

The Ultra-Grate Lifter is designed to enable one person to lift, remove and replace the grates from drains and catch basins. A telescoping handle and single pivot point provide the leverage needed to move grates, the manufacturer said.

The product can be disassembled and stored or transported in a carrying case.

Grate Lifter

For more information: UltraTech International, 11542 Davis Creek

Court, Jacksonville, FL 32256 U.S. Telephone: (800) 353-1611 (U.S.); +1 (904) 292-1611.

Hot Knife Cuts Synthetics

The HK-60 Hot Knife is designed for cutting and sealing synthetic materials such as webbing. Eliminating the repetitive motion required by scissors or the force in using razor blades, the tool melts edges while cutting. That creates a smooth finish and avoids frayed edges, the manufacturer said.

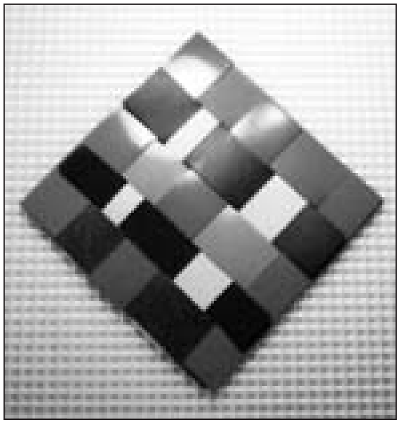
The tool features a tapered wooden handle that remains cool because the heating element is under the blade, and the copper blade can be resharpened.

For more information: M.M. Newman Corp., 24 Tioga Way, P.O. Box 615, Marblehead, MA 01945 U.S. Telephone: (800) 777-6309 (U.S.); +1 (781) 631-7100.

Hot Knife

Colored Tape Reduces Friction, Wear

Colored UHMW tape from CS Hyde Co. is designed for many applications for reducing friction, sliding, noise, wear and sticking, the manufacturer said. The tape is available in thicknesses ranging from 0.030 inch to 0.125 inch (0.762 millimeter to 3.175 millimeters), with or without adhesive backing.



Colored Tapes

Described by the manufacturer as extremely strong and abrasion resistant, colored UHMW tape is suitable for applications that require matching to any color in the Pantone color system.

For more information: CS Hyde Co., 1351 North Milwaukee Ave., Lake Villa, Illinois 60046 U.S. Telephone: (800) 461-4161 (U.S.); +1 (847) 395-0325.

Utility Knife Features Fast Blade Changing

The Klein-Kurve retractable utility knife features retractable blades that lock in three positions. Blades can be changed quickly without tools, and 10 blades can be stored inside the handle.

The knife, which measures 7.0 inches (17.8 centimeters) in length, comes with a plastic holster and belt clip. The curved handle provides a comfortable grip that is not prone to slippage, the manufacturer said.

For more information: Klein Tools, 7200 McCormick Blvd., Chicago, IL 60659 U.S. Telephone: (800) 553-4676 (U.S.); +1 (847) 677-9500.

Warning Barrier Assembles in Minutes

Warning lines for safety and fall prevention can be installed in minutes without bolts, nuts, clips or pins using the Kwik-Stand System, the manufacturer said.

Each stand consists of a rigid post with a cross-tie base. Hooks on the top of the post permit the stretching of flag lines, and a handle on the post enhances portability. For storage, the stand folds into a 39-pound (15-kilogram), slim configuration that is 39 inches (one meter) long.

A yellow-powder-coated finish is standard, and a galvanized finish for rust resistance and weather resistance also is available. Optional rubber pads protect floor surfaces.

For more information: BlueWater Manufacturing, 7914 Kerber Blvd., Chanhassen, MN 55317 U.S. Telephone: (866) 898-5237 (U.S.) or +1 (952) 926-0515.

Sump Contains Fuel, Oil Leaks

The Ultra-550 Containment Sump captures spills and leaks from 500-gallon (1,893-liter) and 550-gallon (2,082-liter) fuel tanks and oil tanks. The polyethylene construction will not rust or corrode and is chemical-resistant, the manufacturer said.

Containment Sump

The sump can be used outdoors with an optional Ultra-SelfBailer that allows storm water to passively drain from the sump while retaining hydrocarbons.

The sump weighs 108 pounds (49 kilograms) and measures 87 inches by 62.25 inches by 32.75 inches (220.98 centimeters by 158.12 centimeters by 83.19 centimeters).

For more information: UltraTech International, 11542 Davis Creek Court, Jacksonville, FL 32256 U.S. Telephone: (800) 353-1611 (U.S.); +1 (904) 292-1611.

Shrinkable Fabric Protects in Harsh Environments

Raychem HFT5000 is a flexible, heat-shrinkable woven-fabric tubing from Tyco Electronics that is designed to protect hoses, pipes and wiring harnesses from abrasion. The tubing, a combination of polyester and polyethylene, is highly flexible but able to grip securely and to be used around irregular shapes, the manufacturer said.

The tubing, which shrinks at a two-to-one ratio, will not trap heat or humidity, which makes it suitable for harsh environments, the manufacturer said. Seven sizes are available, ranging from 12 millimeters to 70 millimeters (0.47 inch to 2.8 inches) expanded diameter. Raychem HFT5000 can be cut with standard industrial cutting equipment.

For more information: Tyco Electronics, P.O. Box 3608 MS 38-41, Harrisburg, PA 17105 U.S. Telephone: (800) 522-6752 (U.S.); +1 (717) 592-2409.

Shelters Offer Alternative to Maintenance Hangars

Portable building shelters by Weather Block & Poly-Steel Shelters are said by the manufacturer to offer an alternative to maintenance hangars. The shelters can be built as much as 300 feet (91 meters) wide, 100 feet (30 meters) high and any length to accommodate multiple aircraft.

The structures are constructed of a galvanized-steel frame, over which is stretched a weatherproof reinforced fabric. They can withstand winds of up to 110 miles per hour (177 kilometers per hour), heavy rain and snow, the manufacturer said.

The shelters can be erected in days or weeks, depending on size, and modular construction makes it feasible to resize or relocate them, the manufacturer said. The shelters' ends can be open or closed.

For more information: Weather Block & Poly-Steel Shelters, 120 Southwest 5th St., Stuart, FL 34994 U.S. Telephone: (800) 330-9294 (U.S.); +1 (772) 287-9294.♦

Want more information about Flight Safety Foundation?

Contact Ann Hill, director, membership and development,
by e-mail: hill@flightsafety.org or by telephone: +1 (703) 739-6700, ext. 105.

Visit our Internet site at <www.flightsafety.org>.