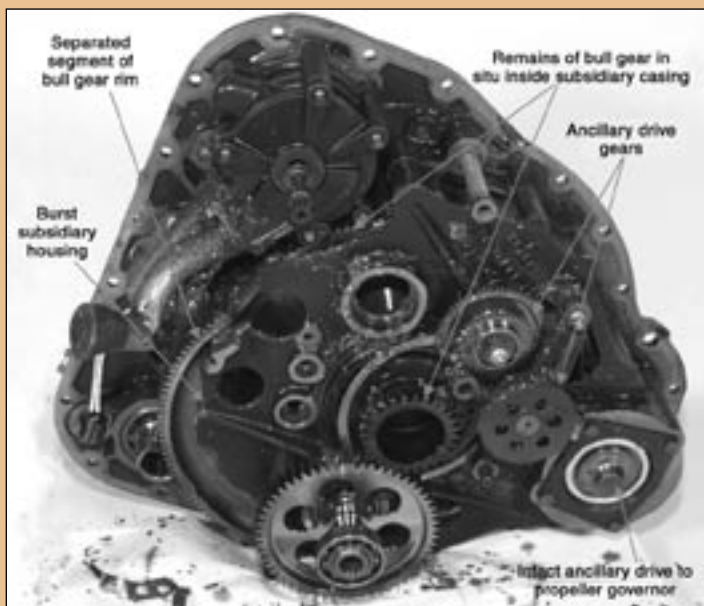




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Aviation Mechanics Bulletin

JULY–AUGUST 2005

Fatigue Cracks Trigger Failure of TPE331 Propeller Gearbox



FLIGHT SAFETY FOUNDATION
Aviation Mechanics Bulletin

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Robert A. Feeler, editorial coordinator

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On the cover: Post-incident tear-down inspection of the Honeywell TPE331-12 engine revealed extensive damage inside the propeller-reduction gearbox that was precipitated by a fractured bull gear. (Photo: U.K. Air Accidents Investigation Branch)

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Fatigue Cracks Trigger Failure of TPE331 Propeller Gearbox

The Jetstream 32 flight crew had difficulty maintaining control because of severe vibration. After feathering the propeller, they safely landed the aircraft. The report said that this incident and previous incidents led to a redesign of the bull-gear assembly in TPE331 engines.

FSF Editorial Staff

At 1930 local time Jan. 10, 2004, during a charter flight from Southampton, England, to Manchester, the flight crew of a [British Aerospace] Jetstream 3202 heard a loud bang, and the aircraft began to vibrate severely. The crew also encountered strong, oscillating roll and yaw motions, and had difficulty identifying the right engine as the engine that had failed. After feathering the right propeller, they diverted to Farnborough and conducted a single-engine instrument landing system (ILS) approach in nighttime instrument meteorological conditions. None of the 20 occupants was injured.

A report by the U.K. Air Accidents Investigation Branch (AAIB) said that the incident was caused by the failure of the bull gear (also called the spur gearshaft) in the propeller-reduction gearbox in the Honeywell (formerly Garrett and AlliedSignal) TPE331-12 turboprop engine.

The failure occurred about 25 minutes after departure from Southampton, as the commander was hand flying the aircraft in a climb through Flight Level 120 (approximately 12,000 feet) on a northerly heading. The commander, 64, had 30,000 flight hours, including 2,000 flight hours in type.

“In the darkness, there was no clearly defined horizon or external references such as ground illumination or stars, and so the aircraft was being flown by sole reference to the instruments,” the report said.

The commander had both hands on the control column and both feet on the floor when the bang was heard and the aircraft rapidly yawed and rolled right.

“Some passengers saw a shower of sparks from the right engine, swept aft by the slipstream,” the report said. “The [commander] immediately placed both feet on the rudder pedals and attempted to oppose the yaw and roll to the right with large amounts of opposite rudder and aileron. The bang had been accompanied by a severe high-frequency vibration which made reading the engine instruments very difficult, and confirmation of the right-engine problem was not possible at that stage.”

The report said the right yaw and roll were not constant, but oscillated in what the crew described as a strong Dutch-roll motion that was similar to what would result from power fluctuations. The captain told investigators that he had “great difficulty not only in correcting the departures but also in preventing himself from over-controlling the aircraft,” the report said.

Indicated airspeed decreased rapidly. The commander moved both

power levers to idle and lowered the aircraft’s nose.

“His plan was to accept a loss of altitude while maintaining a safe indicated airspeed in order to maintain control of the aircraft and give him and the [copilot] time to properly analyze the situation,” the report said.

The commander told the copilot to declare mayday, a distress condition, and to request radar vectors to the nearest airport. London Control assigned a heading of 080 degrees toward London Heathrow Airport.

“With the aircraft under control, but with the vibration still present, the [commander] advanced each power lever individually to identify the vibrating power plant,” the report said.

An increase in power from the left engine when the power levers were advanced indicated that the right engine was malfunctioning. The commander’s identification of the right engine as the malfunctioning engine was confirmed by the copilot. The flight crew then conducted the memory items from the “Engine Failure or In-flight Shutdown” checklist, which included feathering the right propeller.

The commander told investigators that the aircraft descended 2,000 feet before they were able to establish the aircraft in level, single-engine flight.

London Control told the crew that Farnborough Airport was closer than Heathrow. The commander requested radar vectors for an eight-nautical-mile (15-kilometer) final approach to Farnborough.

“The cabin attendant, who had been serving a light meal at the time of the engine failure, moved to the flight deck,” the report said. “She was aware of the high level of activity being undertaken by the two pilots and was careful to choose an appropriate moment to talk to the [pilots].”

She said that a misty vapor and an odor of burning were in the forward section of the cabin.

“All the passengers had their seat belts fastened at the time of the incident,” the report said. “Although understandably alarmed by the incident, they were calm.”

The flight crew told the cabin attendant to brief the passengers about the diversion to Farnborough.

“The cabin attendant informed the passengers of the situation and secured the cabin for landing,” the report said.

The flight crew conducted a briefing for the published ILS approach procedure to Runway 24 at Farnborough, set the navigation receivers and instruments for the approach, and completed the “Engine Failure or In-flight Shutdown”

checklist, the “Descent” checklist and the “Approach” checklist.

Weather conditions at the airport included surface winds from 220 degrees at 12 knots, 8,000 meters (five statute miles) visibility in drizzle and a 500-foot overcast.

Farnborough Approach asked the crew which direction of turn they would prefer. The crew requested left turns, toward the operating engine. The controller then provided radar vectors to establish the aircraft on the localizer course.

“An accurate ILS approach was then flown, during which the landing gear and two stages of flap were lowered,” the report said. “The [commander] maintained a higher-than-normal approach speed at 150 knots, some 20 knots faster than the 130 knots required for the [aircraft’s] weight, and he first saw the runway lights at a height of about 400 feet. After touchdown, a lower-than-normal amount of reverse thrust was used on the live engine together with moderate wheel braking to bring the aircraft to a stop.

“The aircraft was then taxied to the allocated parking stand, attended by the airfield rescue and fire fighting service, where the crew and passengers disembarked.”

The right engine, a TPE 331-12UHR-703H, was rated at 1,100 shaft

horsepower (821 kilowatts) for takeoff and at 1,050 shaft horsepower (783 kilowatts) continuous. The engine was manufactured in 1989.

“The engine had been owned by the engine manufacturer from new and had been used as a loan unit throughout its life,” the report said. “At the time of the incident, the engine had accumulated a total of 10,154 hours from new.”

The engine had accumulated 525 hours since its last overhaul in April 2000. The overhaul included replacement of the propeller-reduction gearbox high-speed pinion, bull gear and sun gear forward bearing.

The TPE331 engine has a single shaft that turns at 41,750 revolutions per minute (rpm). The rotational speed of the engine shaft is reduced in two stages to 1,591 rpm at the propeller. The high-speed pinion, which is coupled to the engine shaft, has straight-cut gear teeth that contact the gear teeth on the much larger bull gear for the first stage of rpm reduction. The sun gear, installed on the forward face of the bull gear, achieves the second stage of rpm reduction. The sun gear drives planet gears that, in turn, drive the propeller shaft.

Following the overhaul, the engine was installed on another aircraft in the operator’s fleet. In December 2000, after the aircraft was involved in a bird strike, the engine was

removed from the aircraft and sent to the manufacturer’s overhaul facility in Germany for inspection. The inspection was performed in January 2001. The engine remained in storage at the overhaul facility until it was installed on the incident aircraft on Nov. 25, 2003.

“The engine logbook contained no entries of significance to the investigation,” the report said. “The records showed that the engine had been subject to spectrographic oil-sample analyses (SOAP checks) at the intervals specified by the manufacturer to provide warning of impending gear failures. The SOAP trends showed no anomalies.”

After the incident, oil was found on the upper surface of the right wing. Ground staff told investigators that they observed oil dripping from the engine cowlings immediately after the aircraft was landed. Several cowlings fasteners were loose or missing.

“Removal of the cowlings revealed widespread damage to ancillary components mounted on the engine, consistent with exposure to severe vibration,” the report said.

No signs of damage to the rubber mounts were found when the engine was removed from the aircraft. A tear-down inspection of the engine was performed at the manufacturer’s facility in the United States.

All the gear teeth on the pinion had been stripped, and the engine shaft had sheared from the pinion coupling. No signs of deterioration or damage were found on the sun gear and planet gears. The bull gear had fractured.

“A large segment of the bull-gear rim, comprising approximately one-third of the gear’s circumference, had separated [from the web (the relatively thin section of the bull gear that connects the hub with the rim) and had burst out through the side of the subsidiary housing and had become jammed hard up against the starter-generator shaft, fracturing and crushing the hollow shaft,” the report said.

A smaller segment of the bull-gear rim, comprising four teeth, also had separated from the web. The segment of the bull gear that had not separated could be moved slightly, which showed that the bull gear was able to turn freely on its bearings.

“Close inspection of the fractured pieces of bull gear revealed clear indications of fatigue consistent with propagation from an origin region in the web at approximately 60 percent radius [approximately 3.7 inches (9.4 centimeters) from the center],” the report said.

The bull gear had fractured along two primary cracks that had propagated from the origin region.

“The shorter of the two primary cracks propagated radially outwards

for a short distance until it met the thicker section of the rim, where it turned and ran circumferentially for a short distance before reverting back to a radial direction and intercepting the free edge of the wheel at the root of a tooth,” the report said.

“The much larger primary crack propagated radially inwards initially, in opposition to [the smaller crack], then turned briefly in a circumferential direction (also away from the smaller crack) before turning back inward again to follow an oblique path toward the center of the wheel. As it approached the blend radius marking the transition from the web into the hub, the crack was deflected again and thereafter followed an oblique path back outwards toward the rim of the wheel, where it intercepted the free edge at the root of a tooth.”

Several secondary cracks had propagated from the larger primary crack.

“Significant heat discoloration was evident in the region of secondary cracking around the hub blend radius, consistent with large-scale cyclic deformations of the material in these areas at a late stage in the fracture process, prior to rim separation,” the report said.

The report said that bull-gear failures had occurred previously in TPE331-12 engines.

“The 12-series bull gear is reportedly the most highly loaded [stressed] of any gear in the Honeywell series of propulsion engines, and the bull gear itself and/or its associated components have suffered a number of failures since the type’s introduction into service in 1983,” the report said. “Some of the failures resulted in the ejection of uncontained debris, either from the gear case directly or via the air-intake duct. Of the latter, a number resulted in ejected debris being struck by the propeller and forcibly projected against the fuselage side, in one instance resulting in penetration into the cabin.

“The manufacturer identified imperfect tooth contact as being a significant causal, or contributory, factor in a majority of these failures, giving rise to:

- “Load pulses in the bull gear which excited a resonance mode leading ultimately to the initiation of a fatigue crack in the web of the bull gear and consequent separation of segments of rim; [and,]
- “Initiation of fatigue cracks in the roots of the teeth, which propagated into the rim and web of the bull gear, resulting in separation of rim segments.”

The report said that remedial measures implemented by the manufacturer to prevent bull-gear failures

— including a coating to improve resonance damping, shot-peening gear-teeth roots to increase fatigue resistance and SOAP checks at 100-hour intervals —had “variable success.” The remedial measures culminated in the development of new gear sets.

“A permanent solution to the problem was sought through a total redesign of the high-speed pinion and the bull gear,” the report said. “The revised gear sets — which incorporate a helical tooth form, thicker web, thicker rim and improved cooling — [were] implemented by SB [Service Bulletin] TPE331-A72-2114 in August 2004.”

[In the SB, which affects engines installed on Fairchild Metro IIIs and Fairchild Dornier Metro 23s as well as Jetstream 32s, Honeywell said that 20 bull-gear failures and 13 pinion failures had been reported. Sixteen bull-gear failures resulted in in-flight engine shutdowns. Three failures occurred in engines that had been maintained in compliance with U.S. Federal Aviation Administration Airworthiness Directive (AD) 2002-12-09. Issued on July 3, 2002, the AD required SOAP sampling and trend assessment, and inspections and replacement of specific gearbox components.]

The characteristics of the bull-gear failure in the Jetstream were similar to the pattern of crack propagation and rim separation that occurred in the previous

incidents, but the severe vibration was not typical, the report said.

The incident investigation focused on what caused vibration sufficient to fracture oil lines and fuel lines, creating a potential fire hazard; to loosen gearbox-case fasteners to an extent at which separation of the case and the propeller was possible; and to render flight instruments unreadable by the flight crew, which affected their ability to identify the failed engine.

Analysis of a three-dimensional computer model of the bull-gear failure showed that the separated rim segments did not prevent continued rotation of the portion of the bull gear that remained attached to the engine (see photo page 8).

Momentary disengagement of the pinion from the bull gear, due to the partial rim separation, unloaded the engine shaft and caused the engine to accelerate rapidly. The report said that the pinion gear teeth then sheared instantaneously when the pinion re-engaged the remaining portion of the bull-gear rim. At the same time, the engine shaft sheared from the pinion coupling.

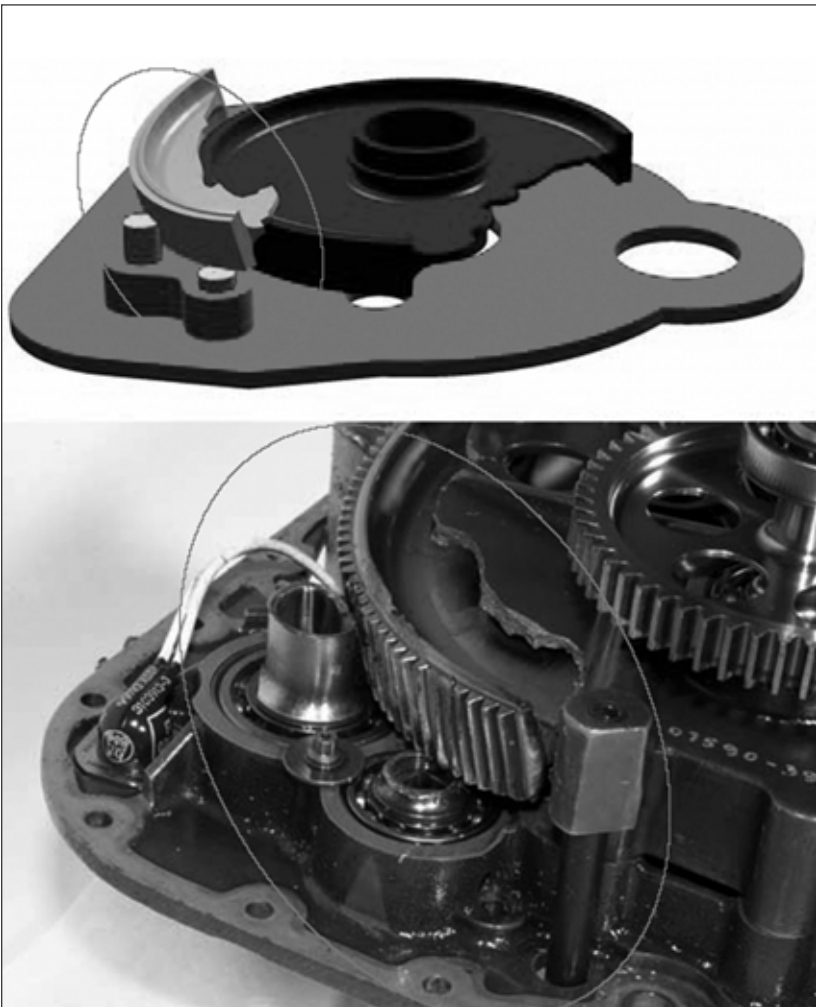
“From that stage onwards, the engine would have been disconnected from the gearbox input and ... would have accelerated rapidly until constrained by the overspeed governor,” the report said. “Continued operation of the engine, however, would not have been

possible because of collateral damage from the gear failure, which disrupted the drive to the fuel-control unit.”

Investigators concluded that the severe vibration resulted from rotational imbalance when the fractured bull gear was back-driven by the windmilling propeller. The pitch oscillations and roll oscillations encountered by the flight crew likely resulted from fluctuations of propeller-blade pitch caused by abnormal operation of the propeller-governing system and the negative-torque-sensing system. The vibration continued for approximately two minutes, until the propeller was feathered by the crew.

AAIB made no recommendations based on the findings of the incident investigation.

“The factors contributing to the failure on [the incident aircraft] also fell within the ambit of factors identified previously as having contributed to earlier failures, which have themselves been the subject of a range of remedial measures already implemented by the engine manufacturer,” the report said. “The culmination of these actions by the engine manufacturer, comprising the introduction in August 2004 (via SB TPE331-A72-2114) of a completely redesigned bull-gear assembly, renders moot any recommendations arising out of this investigation which might otherwise have been made.”◆



A computer model of the gearbox failure (top) showed that the separated segment of the bull-gear rim (bottom) did not prevent continued rotation of the portion of the bull gear that remained attached to the engine. (Photo: U.K. Air Accidents Investigation Branch)

[FSF editorial note: This article, except where specifically noted, is based on report no. EW/C2004/01/02 in U.K. Air

Accidents Investigation Branch *AAIB Bulletin No: 7/2005*. The 25-page report contains illustrations and an appendix.]

MAINTENANCE ALERTS

Corrosion Inhibitor Doesn't Inhibit

The Boeing 737-500 was on approach to Cork (Ireland) Airport when a loud noise was heard during the extension of the landing gear. After a normal landing, the captain asked for the airplane to be towed to the gate. An inspection found that the trunnion pin of the left main landing gear was sheared at its outboard end at the actuator-attachment point. No other damage was found, and there were no injuries in the incident on Sept. 8, 2003.

The trunnion pin had been removed from the right main landing gear of another B-737 and had undergone shop servicing in April 1998. After the shop servicing, the trunnion pin had been installed on the left main landing gear of the incident aircraft. Since installation, the pin had accumulated 9,806 cycles, for a total 23,922 cycles since new, the report said.

“The aircraft manufacturer stated that there had been five such fractures of this part reported to them since June 2002,” said the report. “A common factor was that a corrosion-inhibiting compound, JC5A, had been detected on these parts. The design of the pin assembly was carried through from

the 737-200 and [737]-300 series to the 737-500 series. The 737-400 trunnion pin is exempt from the JC5A issue, as the pin is installed with grease and the joint is lubricated in service.”

In May 2001, the manufacturer informed all operators that the use of JC5A as a corrosion inhibitor would be discontinued.

“JC5A, in the presence of moisture, would decompose and produce decomposition by-products,” said the report. “These in turn would attack the primer first, and then the cadmium plating underneath, resulting in the accelerated corrosion rates of the base-metal structure.”

During the laboratory examination following the B-737-500 incident, no JC5A corrosion-inhibiting compound was found on the trunnion pin, the report said. Nevertheless, “on removing and installing the pin following overhaul in 1998, JC5A was almost certainly applied, as this was the manufacturer’s approved [corrosion-inhibiting compound] and was in use in the shop. The corrosion could have commenced in the JC5A environment and continued later after the JC5A had been washed away through landing-gear pressure washing.”

Bolts Fail on Low-flight-hours Helicopter

The Agusta A109E helicopter was at 300 feet after takeoff when the pilot heard a whining noise, followed by a bang. All instrument indications were normal and the helicopter was controllable, but the pilot decided to land immediately. As he was flaring the aircraft and applying collective pitch, the helicopter's fuselage began to spin around the rotor axis. The landing-gear units were severely damaged in the landing, and the aircraft structure was distorted. The pilot and the one passenger were not injured in the March 14, 2003, accident at Leeds Bradford (England) Airport.

"It was evident that the tail rotor and its control system remained intact but [the tail-rotor] drive system was no longer functional," said the report by the U.K. Air Accidents Investigation Branch (AAIB).

The helicopter has a main-rotor gearbox mounted on a plate above the cabin section. Four brace assemblies attach the upper part of the gearbox to the top of the cabin structure. The lower end of each brace assembly terminates in a ball joint within a steel attachment bracket.

"Each of these brackets incorporates four bolt holes, which enable the

[bracket] to be bolted to the main cabin of the roof structure through similarly spaced holes in a matching abutment bracket integral with the upper-fuselage structure," said the report.

The lower attachment of the rear left brace assembly that secured the main-rotor gearbox to the fuselage had failed, the report said. "The failure took the form of the fracture of the four bolts connecting the steel attachment bracket to the aircraft structure," the report said.

The tail-rotor failure was the result of the rotating drive shaft coming into contact with the titanium-alloy tunnel, positioned between the two engines, through which it passed, the report said.

"This contact resulted from the failure of the rear left brace assembly attachment, which allowed greater-than-normal displacement of the upper end of the gearbox under load," said the report. "This permitted sufficient misalignment of both the tail-rotor drive shaft and the engine-output shafts to bring the [tail-rotor drive shaft] and one of the [engine-output shafts] into contact with the fixed titanium-alloy structure."

The helicopter had been manufactured in 2003 and, according to its records, had accumulated 276 flight hours and 327 landings. "The

evidence of fatigue failure in this low-hours machine, combined with the low number of recorded flight cycles, thus strongly suggests that the failed bolts must have been incorrectly torque-tightened,” said the report. “The evidence is consistent with incorrect torque-tightening of the bolts of the failed joint at the manufacture of the aircraft. The installed bolt tension is of critical importance to the integrity of attachment between the lower brackets of the brace assemblies and the cabin structure of the 109-series aircraft.”

Retread Softly

Between Oct. 13, 2004, and Dec. 20, 2004, seven main-landing-gear tire failures occurred during takeoffs and landings of Boeing 737s at Australian airports, the Australian Transport Safety Bureau (ATSB) said in an Air Safety Recommendation (ASR; no. R20040093) dated Dec. 23, 2004.

“Of particular concern with the ... failures are those associated with the [B-]737-800 series aircraft,” the ASR said. Six of the seven tire failures occurred on B-737-800 series airplanes.

The B-737-800 series failures involved new-generation, high-gross-weight wheel tires, on either their fourth retread (one occurrence) or fifth retread (five occurrences), the ASR said.

“Retreading of aircraft tires has been a proven practice for many years, and although failures have occurred from time to time, they are not a common event, with only four failures involving Boeing 737 aircraft reported to the ATSB during the period between January 2003 and October 2004,” said the ASR. “As such, the number of occurrences reported to the ATSB since Oct. 13, 2004, represents a significant increase in occurrences of this type.”

The ATSB’s investigation of the tire failures has not determined their nature and mode, or whether they involve tire manufacturing, retreading, maintenance or operational considerations, the ASR said.

The ASR said, “In light of the recent industry experience, the [ATSB] recommends that Australian operators of Boeing 737-800 series aircraft review the practice of fitting retread tires of R4 (fourth retread) or above, until their serviceability limitations can be identified.”

Rotor Flies, Helicopter Stays on Ground

The pilot of the Schweizer 269C-1 helicopter was conducting ground tests at a heliport at Saint-Hubert, Quebec, Canada, following a 100-hour inspection and replacement of the main-transmission gearbox. An unusual noise was heard when engine revolutions per minute (rpm)

was reduced. The main-transmission gearbox stopped turning suddenly and caused the main rotor to separate from its shaft.

The main rotor rose 150 feet above ground level and fell about 100 feet (30 meters) from the helicopter, while the helicopter remained in place. No one was injured in the March 8, 2004, accident.

“Examination of the helicopter and main-transmission gearbox after the accident revealed that the input pinion bearings were lacking lubrication,” said the report by the Transportation Safety Board of Canada (TSB).

The main-transmission gearbox, which had 2,167 hours in service since new, had undergone a special inspection on Feb. 2, 2004, after a sudden rotor stoppage, the report said. That inspection had included partial disassembly of the main-transmission gearbox for visual examination and nondestructive testing.

“When the main-transmission gearbox was being reassembled, the input-quill-bearing housing was assembled incorrectly,” said the report. “It was rotated clockwise 90 degrees in relation to the main-transmission gearbox oil inlet [ports] and outlet ports. This condition contributed to the blockage of the oil passage feeding the bearings and caused the catastrophic failure of the input-quill bearings.”

An independent inspection of the reassembly did not detect the error, the report said.

The main-rotor-fastening components were examined at the TSB engineering laboratory, and all components met the manufacturer’s specifications, the report said.

“However, theoretical strength calculations determined that the force required to shear the main-rotor shaft is higher than the force required to shear the six rotor-head-attachment bolts,” said the report. “Consequently, the rotor can separate from the shaft in the event of a sudden stoppage of the gearbox.”

Air-conditioning Fault Prompts Evacuation

While the Bombardier Canadair CL-600 RJ was being taxied to the gate after being landed at the Colorado Springs (Colorado, U.S.) Municipal Airport, the flight attendant reported to the captain that the cabin was filled with smoke. The smoke was described as blue and with an odor like burning oil. The captain stopped the airplane and ordered an evacuation. There were no injuries to the three crewmembers and 50 passengers in the April 17, 2004, incident.

“A [U.S.] Federal Aviation Administration inspector examined the airplane,” said the report by the

U.S. National Transportation Safety Board. “He noted oil coming from a vent on the bottom aft fuselage. Oil was observed covering the bottom of the aft fuselage and tail cone. An examination of the aft equipment bay showed oil covering several components, including the air-conditioning packs, the cockpit voice recorder and the flight data recorder.”

Maintenance personnel from the airline determined that the right air-conditioning pack had overheated, the report said.

“The [malfunctioning air-conditioning] pack was deferred in accordance with the airplane’s minimum equipment list,” said the report. “The airplane was subsequently serviced, ground checked, cleaned up and flown back to [Phoenix, Arizona, U.S.] for further examination. Further examination revealed that the fan-bypass check valve had failed, causing the air-conditioning pack to overheat.”

Faulty Fuel-control Unit Leads to Engine Shutdown

On April 11, 2004, a Beech Super King Air 200 was being flown on a medical-evacuation flight from Paraburdoo, Western Australia, Australia, to Albany, Western Australia. The pilot reported that, during cruise at Flight Level 310 (about 31,000

feet), the right engine surged and the inter-turbine temperature increased. The pilot shut down the engine and diverted the flight to Jandakot, Western Australia. There were no injuries to the pilot, flight nurse or passenger.

“A subsequent engineering examination by the operator’s maintenance engineers revealed that the engine had been subjected to severe over-temperature damage, resulting in turbine failure,” said the report by the Australian Transport Safety Bureau.

The engine was sent to the manufacturer’s overhaul facility, where it was confirmed that the damage resulted from over-temperature conditions in the engine.

“The engine’s fuel-control unit (FCU) was removed and tested to determine if it conformed to the required fuel-scheduling specifications,” said the report. “The testing revealed that the FCU was not metering the fuel to the appropriate schedule and that the engine may have been subject to hot-starting conditions and a rich-acceleration schedule. [Hot starting refers to a higher-than-normal temperature reached during start-up; a rich-acceleration schedule means that the FCU was providing a higher-than-normal fuel flow to the engine during start-up.] These conditions would have shortened the service life of the engine, leading to the reported failure.”

Incorrect Parts Shipped For JT8D Engines

Operators of airplanes with Pratt & Whitney JT8D-series engines should ensure that their parts inventories contain the correct second-stage turbine inner airseal pins, said the U.S. Federal Aviation Administration (FAA).

FAA on July 22, 2005, issued Special Airworthiness Information Bulletin NE-05-75 (revised Aug. 4, 2005, to correct a part-number reference) after being advised by the Mexican Civil Airworthiness Authority (CAA) that an uncontained failure of a JT8D-219 engine was caused by installation of an incorrect pin.

“Between October 2003 and December 2003, Pratt & Whitney shipped second-stage turbine inner airseal pins, part number ST2273-07, marked ‘HL12’ [and] made of titanium instead of the correct pin marked ‘HL244’ [and] made of Waspoloy,” FAA said. “The titanium pins have a smaller diameter, such that they become loose and liberated, causing damage on the turbine blades.”

FAA said that the Mexican CAA issued an airworthiness directive requiring borescope inspections of affected engines to determine if the correct pins are installed.

“Pratt & Whitney has contacted all operators and repair shops suspected

of having the incorrect titanium pins and alerted the field through an all-operators wire,” FAA said.

Heating Wire Arcs, Cracks Windshield

The Beech 1900D flight crew — who were conducting a positioning flight from Pueblo, Colorado, U.S., to Denver, Colorado, the morning of April 9, 2004 — selected the windshield anti-icing system during initial climb in instrument meteorological conditions. While establishing the airplane in level flight at 11,000 feet, they heard a popping sound and observed sparks and several cracks emanating from the lower left corner of the first officer’s windshield. The cracks rapidly progressed the length of the windshield.

The crew deselected the windshield anti-icing system, conducted the “Cracked or Shattered Windshield” checklist and landed the airplane without further incident in Denver.

Examination of the windshield revealed that six cracks in the outer pane had originated along the anti-icing terminal strip and that thermal damage had occurred between the outer pane and the inner pane.

The exterior seal, located between the outer edge of the windshield and the aluminum windshield-retaining frame, was deteriorated, and water

was found between the panes along the lower edge of the windshield.

“The windshield-heating element was corroded in the areas where water intrusion was observed,” said the report by the U.S. National Transportation Safety Board. “The airplane maintenance manual states that the primary cause of moisture ingress is a deteriorated seal.”

The report said that arcing of the windshield anti-icing system was the probable cause of the incident and that “factors contributing to the incident were improper inspection of the windshield’s external seal, deterioration of the windshield seal and water penetration through the deteriorated seal.”

Bushing Installation Blamed for MD 520 Strut Collapse

An MD Helicopters MD 520N helicopter was being landed on the deck of a ship in Gladstone (Queensland, Australia) Harbour the morning of June 21, 2004, when the right landing gear strut collapsed. The helicopter was substantially damaged when it rolled onto its right side and the main rotor blades struck the deck. The pilot and passenger were not injured.

Metallurgical examination revealed a fatigue crack in the drag-brace

attachment on the right rear strut, said a report by the Australian Transport Safety Bureau.

“The fatigue crack was due to the fitment of a nonstandard drag-brace bushing to the rear landing gear strut,” the report said. “The drag-brace bushing also was not fitted using protective coating material and would not have been provided with corrosion protection from the marine environment [in which the helicopter was operated].”

The collapse of the rear landing gear strut led to an overload failure of the front landing gear strut, the report said.

Float Switches May Present Source of Ignition in B-727 Fuel Tanks

Operators of about 800 Boeing 727s in the United States must determine whether float switches are installed in the main fuel tanks and/or auxiliary fuel tanks of their airplanes, according to an airworthiness directive (AD 2005-16-07) issued by the U.S. Federal Aviation Administration (FAA). About 1,300 B-727s are in service worldwide.

There have been reports of float switches becoming contaminated by moisture or fuel and reports of

float-switch wiring chafing against the fuel-tank conduit. FAA said that contamination and chafing “could present an ignition source inside the fuel tank that could cause a fire or explosion.”

The AD requires compliance with Boeing Alert Service Bulletin

727-28A0127, which was issued on Aug. 26, 2004. The AD says that fuel-tank inspections or review of maintenance records must be conducted within 48 months. If float switches are found, they must be replaced and/or equipped with a liner system before the airplanes are flown again.♦

NEWS & TIPS

Hydrogen Reveals Leaks

Leaks as small as a bacterium can be detected by Sensistor Technologies’ H2000, which uses hydrogen as a tracer gas, the manufacturer says.



Portable Hydrogen Leakage Tester

A compact, portable system, the detector’s operation is based on extreme sensitivity to a mixture of 5 percent hydrogen and 95 percent nitrogen, which is nonflammable. Hydrogen has the lowest viscosity (resistance to flow or “thickness”)

of any gas, which the manufacturer says enables it to spread in the test object, penetrate leakage sites and dissipate easily and efficiently in the atmosphere.

The product has dynamic background compensation to minimize background interference, and its measurements are unaffected by the temperature or volume of the test object, the manufacturer says.

For more information: Sensistor Technologies, 2 Survey Circle, #2A, North Billerica, MA 01862 U.S. Telephone: +1 (978) 439-9200.

Wiring Tester Speedy to a Fault

The hand-held, integrated 900AST (Advanced Systems Tester) from 3M locates and analyzes avionics wiring problems resulting from vibration, moisture and age.



Hand-held Wiring Tester

Using the product, technicians can diagnose wiring problems 60 percent faster than by traditional methods, the manufacturer says. The tester displays the distance to a fault in inches. The unit supports a range of individual tests to categorize and sectionalize problems.

The product includes an infrared port for uploading measurements to a personal computer; a large, backlit liquid-crystal display; an icon-based graphical user interface; and built-in help menus.

For more information: 3M Aerospace and Aircraft Maintenance Division, 3M Center, Building 223-1N-14, St. Paul, MN 55144 U.S. Telephone: 1 (800) 364-3577 (U.S.); +1 (651) 737-7501.

Liquid Withdraws Deposits

Turco 5884 is one of a series of jet-engine compressor washes from Henkel Technologies designed to remove oil, salt and solid deposits from blades, guide vanes and rotors. A concentrated liquid applied while the engine is operating, the product is listed in the General Electric Standard Practices Manual (SPM) Reference no. C04-140 and in the Pratt & Whitney Standard Practices Manual, Consumable Material (SPMC)-87.

The cleaner is formulated to be ash-free and to contain very low amounts of phenol, chloride and sulfur. It is readily mixable with water, the company says.

For more information: Henkel Surface Technologies, 32100 Stephenson Highway, Madison Heights, MI 48071 U.S. Telephone: +1 (248) 583-9300; Astronaut 36, 3824 MJ Amersfoort, The Netherlands. Telephone: +(31) 33 451 1720.

Pneumatic-tool Filters Clear the Air

Extending the life of pneumatic tools, including spray finishing guns, by filtering water, oil aerosols and dirt particles from air hoses is the goal of DeVilbiss CleanAir filtering units and

regulators. The products are said to help avoid flaws in spray finishing as well as preserve the tools used.

The CleanAir product line includes three types of filtering units, which the manufacturer says perform as follows:

- Centrifugal filter-regulator units, which filter out water, oil aerosols and dirt particles as small as five microns, and supply cleaner, drier air to each spray gun in a system;
- Coalescer filter-regulator units, which remove water, oil aerosols and dirt particles as small as 0.1 micron; and,
- Three-stage desiccant units, which in addition to particulate removal provide water-vapor filtering to a dew point of minus 40 degrees Fahrenheit (minus 40 degrees Celsius).

The manufacturer also makes an accessory, the Whirlwind disposable in-line filter. The filter attaches to the base of a spray gun or pneumatic tool and is designed to remove any remaining water, oil, dirt and rust from the air hose.

For more information: DeVilbiss Industrial Finishing, 195 Internationale Blvd., Glendale Heights, IL 60139 U.S. Telephone: 1 (800) 992-4657 (U.S.); +1 (630) 237-5000.

Packaging Keeps Parts Whole

Packaging that protects against corrosion of parts in storage is produced by Cortec Corp. in the form of CorrLam LD, a flexible material that is designed to provide a barrier to water vapor, corrosive gases and ultraviolet light.



Corrosive-resistant Packaging

The multi-layer material creates a barrier against water vapor and oxygen and provides corrosion protection for ferrous and nonferrous metals, the manufacturer says. Its tensile strength and puncture resistance suit irregularly shaped items that are difficult to package. The material is available in a variety of forms, from large-equipment covers to small-parts pouches.

For more information: Cortec Corp., 4119 White Bear Parkway, St. Paul,

MN 55110 U.S. Telephone: 1 (800) 426-7832 (U.S.); +1 (651) 429-1100.

Software Integrates Maintenance Functions

Pentagon 2000SQL is a complete software application for management of aviation support and maintenance activities. The manufacturer says that the application automatically updates a permanent, regulation-compliant database of trace, usage, transaction, engineering and accounting information.

One system module, Heavy Aircraft Maintenance, supports management of functions such as maintenance checks; routine and nonroutine job cards for each aircraft; parts-need forecasting; equipment and tool assignments; maintenance histories; and reliability reports.

For more information: Pentagon 2000 Software, 15 West 34th Street, Fifth Floor, New York, NY 10001. Telephone: 1 (800) 643-1806 (U.S.); +1 (212) 629-7521.

Video Probe Records for Two Hours

The XL PRO Plus VideoProbe features five interchangeable probes with diameters ranging from 0.15 inches to 0.33 inches (3.81 millimeters to 8.40 millimeters), two hours of full-motion audio/video recording and playback, and a

universal serial bus (USB) streaming digital S-video output. Viewing modes include comparison measurement, enhanced vision and zoom windows.

The unit operates on alternating current (nominal input 100 volts to 240 volts) or direct current (nominal input 11 volts to 14 volts). The handpiece contains an integrated color liquid crystal display (LCD).

For more information: Everest VIT, 199 U.S. Highway 206, Flanders, NJ 07836 U.S. Telephone: 1 (888) 332-3848 (U.S.); +1 (973) 448-0077; Haigerlocher Strasse 42, 72379 Hechingen, Germany. Telephone: +49 (0)7471 9882 0.

Don't Be Shocked

Insulated tools that comply with National Fire Protection Association NFPA-70E standards to protect users against electrical shock are made by Klein Tools. The tools are designed to protect against shock from sources energized up to 1,000 volts.

The insulation of pliers and cutting tools is constructed of a flame-retardant, impact-resistant outer coating and a thick high-dielectric inner coating that is bonded to the forged-steel handles. Screwdrivers and nut drivers have the same dual insulation on their shafts. Handles have a proprietary cushioned grip to enable greater torque and provide more user comfort.

The complete line of insulated tools includes pliers, cutters, wire strippers, screwdrivers, nut drivers, a skinning knife and tool kits.

For more information: Klein Tools, 7200 McCormick Blvd., P.O. Box 599033, Chicago, IL 60659 U.S. Telephone: 1 (800) 553-4647 (U.S.); +1 (847) 677-9500.

System Digitizes Wheel Hubs

The WheelScan 5 Automatic Wheel Inspection System from GE Inspection Technologies is designed to provide faster eddy-current inspection of aircraft wheel hubs. According to the manufacturer, the system offers several advantages:

- It can reduce inspection times by half compared with other commercially available wheel-inspection units;
- It can store and instantly retrieve as many as 100,000 wheel records digitally, eliminating paper printouts and the risk of human error associated with manual re-keying;
- The product is easy to set up and operate, and the operator need not be expert in eddy-current testing; and,
- The system can test all aircraft wheel hubs in use.

For more information: GE Inspection Technologies, Robert Bosch Strasse, 3, 50354 Huerth, Germany. Telephone: + 49.2233.601.0; GE Inspection Technologies, 50 Industrial Park Road, P.O. Box 350, Lewistown PA 17044 U.S. Telephone: +1 (866) 243-2638.

Eyewear Makes Tasks Larger

Safety lenses are required for many maintenance tasks, but aging workers may need lenses that magnify as well for fine detail work, reading manuals while on the job or inspection. Uvex FitLogic Safety Eyewear consists of bifocal reading glasses molded onto a clear lens, and is available in +1.5, +2.0 and +2.5 diopter strengths.

The glasses feature a “floating” lens design said to provide excellent ventilation to minimize fogging. The extended wraparound lens also provides extra cheek coverage and side coverage and blocks virtually all ultraviolet (UV) rays. The eyewear allows wearers to make adjustments at four different points to match their own head shape.

For more information: Bacou-Daloz Eye & Face Protection, 10 Thurber Blvd., Smithfield, RI 02917 U.S. Telephone: (401) 757-2220.♦

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