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Uncontained Engine Fan-hub Failure Prompts U.S. National Transportation Safety Board Recommendations

FLIGHT SAFETY FOUNDATION

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Robert A. Feeler, editorial coordinator

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Cover photo: MD-88 uncontained engine failure. Photo: U.S. National Transportation Safety Board.

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Uncontained Engine Fan-hub Failure Prompts U.S. National Transportation Safety Board Recommendations

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U.S. National Transportation Safety Board

On July 6, 1996, Delta Air Lines Flight 1288, a McDonnell Douglas MD-88, experienced an uncontained failure of the No. 1 (left) engine front compressor fan hub during takeoff at the Pensacola (Florida, U.S.) Regional Airport.

Flight 1288 was a regularly scheduled passenger flight from Pensacola to Atlanta, Georgia, U.S., operating under U.S Federal Aviation Regulations (FARs) Part 121. On board the airplane were two pilots, three flight attendants and 142 passengers. The airplane was powered by two Pratt & Whitney JT8D-219 engines, which are part of the JT8D-200 series.

The captain rejected the takeoff following the engine failure and stopped the airplane on the departure runway. Engine fragments penetrated the aft fuselage, killing two passengers and seriously injuring one passenger. An engine fire followed, but it self-extinguished within seconds.

The investigation of this accident is continuing, but information already gathered raises serious concerns that require immediate action by the U.S. Federal Aviation Administration (FAA).

The investigation has determined that during the initial part of the takeoff roll, just as the engines were reaching peak thrust, the fan hub on the No. 1 engine separated into two large pieces. One piece was about two-thirds of the hub (containing 20 complete fan-blade slots) and the other was about one-third of the hub

Photo: U.S. National Transportation Safety Board

Pratt & Whitney JT8D-219 engine following uncontained fan-hub failure on McDonnell Douglas MD-88. Engine debris penetrated the cabin, killing two passengers.

(containing 12 fan-blade slots). Other pieces of the fan hub, fan blades and other engine debris penetrated the aft cabin.

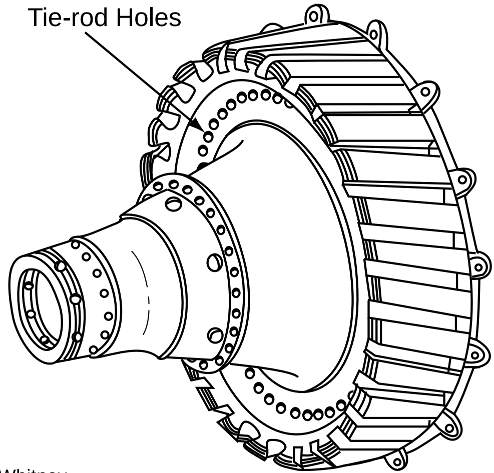
The fan hub of the JT8D-200 series engine is different from that of other JT8D engines. According to Pratt & Whitney, about 2,600 JT8D-200 series fan hubs have been produced and are operating worldwide on about 1,200 MD-80 series airplanes.

Maintenance records at Delta indicated that the fractured fan hub was inspected in December 1995, after accruing 12,693 flight cycles (a flight cycle is one takeoff and landing), and was installed on the accident engine on Dec. 29, 1995. The hub was inspected at Delta using a fluorescent dye–penetrant inspection (FPI) procedure. [In this procedure, the hub is submerged in a low-viscosity fluorescent-dye bath, then washed with a high-viscosity solution. The fluorescent dye retained by cracks or other surface defects becomes luminescent under black-light invisible ultraviolet inspection.]

The fan hub failed 1,142 cycles after the December inspection. Maintenance records indicated that all work on the hub was performed by Delta since its delivery to the airline.

Metallurgical examination of the fan hub at the U.S. National Transportation Safety Board (NTSB) materials laboratory revealed that the fracture originated in one of the 24 tie-rod holes in the hub. The tie-rod holes, which are aligned parallel to the

Pratt & Whitney JT8D-200 Series Engine Fan Hub



Source: Pratt & Whitney

Figure 1

engine shaft, are located around the circumference of the hub bore and alternate with 24 smaller-diameter stress redistribution (SR) holes (also called balance weight holes, cooling holes, lightening holes or shielding holes).

The tie-rod and SR holes cannot be inspected without disassembling the fan hub from the engine. But an eddy-current inspection technique being developed by Delta will permit inspection of the fan hub tie-rod holes "on wing" without moving the fan hub into an engine shop.

The metallurgical examination showed that the hub separation stemmed from low-cycle fatigue (LCF) cracking that originated from abusive machining (local surface hardening and cracking created when the holes were drilled). The LCF created ladder cracking and cold working of the underlying material in the microstructure inside one of the tie-rod holes about 0.5 inch (1.3 centimeters) from the aft face of the hub. A fatigue striation count using a scanning electron microscope disclosed a number of striations that was roughly equal to the total number of flight cycles for the fan hub.

The number of striations and the appearance of the fracture surface suggested that the crack was present on the aft face of the fan hub for a distance of 0.46 inch (1.2 centimeters) at the time of the last FPI. The length of the crack along the wall of the hole was about 0.9 inch (2.3 centimeters) at the time of the FPI.

The investigation found that the failed fan hub was manufactured in 1989 in Trollhattan, Sweden, by Volvo Flygmotor, which is the current manufacturer of JT8D-200 series fan hubs. A review of Volvo records for the accident hub indicated that following manufacture, a blue-etch anodize (BEA) inspection and an FPI were performed on June 14, 1989. [BEA inspection detects microstructure anomalies on the surface of a titanium component, not marks left by machining during manufacture.]

During the BEA inspection, machining marks were detected inside the tie-rod hole where the fatigue crack originated and were referred for a visual inspection. The marks were accepted because the part satisfied all Pratt & Whitney BEA- and visual-inspection criteria. The part was subsequently sent to Pratt & Whitney to be installed in a production engine.

The NTSB believes that the FAA should review the processes used by Pratt & Whitney that allowed a fan hub to be placed in service with the anomalies that led to the failure of the hub on Delta Flight 1288. Based on the review, the FAA should require that Pratt & Whitney modify, as necessary, its quality assurance standards and practices for inspection of JT8D-200 series engine fan hubs.

That the fan hub failed from fatigue cracking at the location of a BEA indication raises immediate concerns about other hubs that had BEA indications during inspection and subsequently entered airline service. On July 15, 1996, Pratt & Whitney advised the NTSB that a review of production records had identified six additional fan hubs in service that had exhibited similar BEA indications after manufacture. Pratt & Whitney immediately contacted the affected airlines and strongly urged them to remove those fan hubs from service before further flight. The airlines voluntarily complied with the request.

On July 16, the FAA formalized this action by issuing Airworthiness Directive (AD) 96-15-06, mandating removal of the six fan hubs from service. The hubs are being forwarded to Pratt & Whitney for inspection and analysis to determine what corrective actions are required. The NTSB is pleased that immediate actions were taken to reduce the safety hazards associated with those fan hubs.

Nevertheless, the NTSB remains concerned about the potential for cracks in tie-rod holes in other JT8D-200 series fan hubs. Such fan hubs may have been exposed to abusive machining or other damage during production, overhaul or rework, which was undetected by BEA and/or FPI inspection.

Furthermore, the NTSB is concerned that fatigue cracks could also occur in the SR holes. The SR holes are smaller in diameter, and the related stresses should be less than those in the tie-rod holes. But the potential for catastrophic failure of the fan hub from undetected cracks in the SR holes should also be addressed.

Inspection of the SR holes is complicated by the placement of balance weights in some holes, and the removal of the weights leaves a copper residue that makes eddy-current inspection unreliable. But the NTSB believes that the need to identify any fatigue cracks in the SR holes warrants their cleaning and inspection.

The NTSB is concerned that enhanced visual inspection techniques, including the FPI, may not be performed adequately to detect fan-hub cracks. The FPI method used at the Delta engine repair station should have readily detected the crack on the surface of the aft face of the hub, but circumstances might have prevented the detection of the existing crack.

For example, FPI relies on visual inspection to detect surface cracks in units that are typically crack-free. According to Pratt & Whitney, no crack has ever been found on a JT8D-200 series fan hub during its service life. Consequently, inspectors do not expect to find a crack.

Moreover, the NTSB is concerned that inspection procedures might make it difficult to view cracks in tie-rod holes. In addition, the training given to inspectors might not be sufficiently specific about the most likely crack locations, the orientation of a crack in a disk, the difficulty of detecting cracks in holes (particularly high-aspect-ratio holes) and the appearance of cracks in rotating parts.

Inspectors' failures to identify detectable fatigue cracks using FPI techniques have played a role in several other accidents. Earlier accidents included the United Airlines DC-10, Sioux City, Iowa, U.S., July 19, 1989; Egypt Air Airbus A-300, Cairo, Egypt, April 10, 1995; and ValuJet DC-9, Atlanta, Georgia, U.S., June 8, 1995.

[In the Sioux City accident, there was a catastrophic failure of the No. 2 tail-mounted engine during cruise. The discharge of fan-rotor assembly parts ruptured three hydraulic systems, leaving most flight controls inoperable. The flight crew was able to maneuver the airplane to the Sioux City airport, where a crash landing resulted in the deaths of 110 passengers and one flight attendant. The Cairo accident occurred during takeoff when the No. 1 engine sustained an uncontained failure of a high-pressure compressor (HPC) rotor spool (*Aviation Mechanics Bulletin*, September–October 1995). Takeoff was aborted and passengers and crew conducted an emergency evacuation, with one minor injury resulting. The ValuJet DC-9 suffered an uncontained failure of the No. 2 engine on takeoff, caused by fatigue failure of the HPC. The takeoff was aborted. Shrapnel from the damaged engine cut fuel lines, causing a fire that spread quickly. Passengers and crew were evacuated with one crew-member injury, and the fire destroyed the airplane.]

The NTSB is concerned that inspector procedures, training and supervision might not be adequate to ensure reliable FPIs of critical, rotating engine parts.

The FPI plays an important role in inspecting critical rotating engine parts, including the JT8D-200 series fan hub. Therefore, until there is a more reliable nondestructive inspection procedure, the FAA should review and revise, in conjunction with engine manufacturers and air carriers, the published guidance, inspection procedures, inspector training (including any visual aids) and supervision practices currently used in FPI and other nondestructive testing of high-energy rotating engine parts. FPI procedures for crack detection on JT8D-200 series fan hubs should be emphasized.

Pratt & Whitney is currently developing an eddy-current inspection procedure for the JT8D-200 series fan hub tie-rod and SR holes to supplement the FPI. Pratt & Whitney reports that developing and implementing the eddy-current inspection procedure may take "weeks or months." The company also reports that the new procedure will be implemented whenever the engines are removed for other scheduled maintenance.

An eddy-current inspection procedure in development at Delta, in cooperation with Pratt & Whitney, will permit "on-wing" inspection of fan hub tie-rod holes. The NTSB believes that this method will make it possible to detect cracks in these holes in a relatively short time (reportedly 14 hours per engine), and should be used until Pratt & Whitney can develop a method for inspection of all SR holes. Delta reportedly plans to begin on-wing inspections as soon as the technique is fully developed and approved by the FAA. On-wing inspection may be the only way to inspect tie-rod holes in fan hubs without substantial grounding of MD-80s, because very few spare hubs are available.

A review of the JT8D-200 series engine fleet size, fan-hub life-cycle data and the crack-propagation rate of the accident engine fan hub, as well as consultation with industry experts, indicate that the proposed on-wing tie-rod hole eddy-current inspection could be accomplished within the next 500 flight cycles with minimal impact on airline revenue service operations. Some data suggest that hubs having between 10,000 cycles and 15,000 cycles may be at greater risk than those having more than 15,000 cycles, because the latter are past the point where cracks caused by manufacturing flaws would be expected to cause the hub to fail. Inspection of all hubs with more than 10,000 cycles should be an FAA priority, but fan hubs most at risk should be inspected first.

Based on the evidence and data available, the NTSB believes that the FAA should require inspection of the tie-rod and SR hole cracking potential in two stages. First, as an interim measure, the FAA should require, within 500 cycles of the approval of a validated inspection that does not require sending the fan hub to an engine shop, an eddy-current inspection of the tie-rod holes of JT8D-200 series fan hubs that have accumulated over 10,000 cycles, giving priority to fan hubs presenting the highest risk. Second, the FAA should require, as a terminating action, both an FPI and an eddy-current inspection of all fan hub tie-rod and SR holes. The redundant inspections should be scheduled commensurately with the risk associated with propagation of a fatigue crack from a manufacturing defect in the holes.

Therefore, the NTSB recommends that the FAA:

- Require that, within 500 cycles of FAA approval of an engine “on-wing” eddy-current inspection process for Pratt & Whitney JT8D-200 series engine fan hub tie-rod holes, this inspection be performed on hubs that have accumulated more than 10,000 cycles since new; prioritize the inspections to ensure that fan hubs most at risk (those with 10,000 cycles to 15,000 cycles since new) are inspected first. This inspection can be superseded by the redundant inspection urged in safety recommendation A-96-75. (Class I, Urgent Action) (A-96-74);

- Require an inspection of all Pratt & Whitney JT8D-200 series engine fan hub tie-rod and SR holes by means of FPI and eddy current by a fixed number of flight cycles based on the risk of crack propagation from manufacturing flaws. (Class II, Priority Action) (A-96-75);

- Review and modify, as necessary, the processes by which Volvo and Pratt & Whitney permitted JT8D-200 series fan hubs to be placed in airline service following indications of mechanical damage in the tie-rod holes based on a BEA inspection. (Class II, Priority Action) (A-96-76); and,

- Review and revise, in conjunction with engine manufacturers and air carriers, the procedures, training that includes the syllabi and visual aids, and supervision provided to inspectors for performing FPI and other nondestructive testing of high-energy rotating engine parts, with particular emphasis on the JT8D-200 series tie-rod and SR holes. (Class I, Urgent Action) (A-96-77).♦

NEWS & TIPS

Papers Sought for Nondestructive Testing Conference

The American Society for Nondestructive Testing (ASNT) has issued a call for papers to be presented at its conference on Thermal/Infrared Thermography (T/IRT). The conference, "Thermal Solutions '97," will be held in June 1997. ASNT is now accepting abstracts of papers on nondestructive evaluation (NDE) in the aerospace industry, T/IRT standards and maintenance applications.

Abstracts should be about 200 words, and should be submitted before Nov. 18, 1996, to John Snell, Topical Chairman, at ASNT, 1711 Arlingate Lane, P.O. Box 28518, Columbus, OH 43228-0518 U.S. They may also be submitted by fax to (802) 223-0460, or e-mail to thermaljrs@aol.com.

ASNT is holding its Fall Conference and Quality Testing Show Oct. 14–18 at the Washington State Convention & Trade Center, Seattle, Washington, U.S. The conference theme will be "NDT — New Horizons on the Pacific," and will showcase a new central certification program, an interactive World Wide Web site called NDT Link and Volume 10 of the *NDT Handbook*.

For more information, contact ASNT at (800) 222-2768 (U.S. and Canada only) or (614) 274-6003.

FlightSafety International Introduces Master Technician Training Program

FlightSafety International (FSI) has introduced a new concept of training and certification for aircraft maintenance technicians. Called the "Master Technician Program," it focuses on training that enables technicians to earn credentials that will represent their skills, technical proficiency and achievements. The structured program leads through progressive levels of training and testing to the status of master technician. The first master technician program has been introduced at the FSI Gulfstream Center in Savannah, Georgia, U.S. for the Gulfstream IV business jet.

For more information, contact FSI's Roger Ritchie at (718) 565-4124.♦

MAINTENANCE ALERTS

Manufacturing Flaw Is Suspected Cause of Rotor-blade Failure

A McDonnell Douglas Helicopter Co. (MDHC) 369D helicopter, operating in Europe, suffered a separation of one of the five main rotor blades just before takeoff. None of the helicopter occupants were injured, but the aircraft sustained substantial damage.

Preliminary examination by the investigating agency revealed that the separated main rotor blade (part number 369D-21100-516A) had fractured chordwise near the inboard end of the blade, with the fracture crossing the most outboard bolt hole of the upper and lower root fitting. This occurred in an area where the upper and lower fittings are bonded to a doubler at the root end of the blade, and the doubler is bonded to the blade skin. The root fittings are also attached to the blade by five bolts and nuts. On removing these attachment bolts and nuts, the investigators found a bonding separation between the lower root fitting and the doubler.

The U.S. National Transportation Safety Board (NTSB) metallurgical laboratory examined the inboard portion of the failed area, and the manufacturer examined the outboard portion. The examinations revealed that about 75 percent of the fracture contained a pre-existing fatigue crack.

No metallurgical anomalies were noted at the crack origin areas. The examinations did, however, reveal areas of debonding between the trailing edge of the root fitting and the doubler, extending from the inboard end of the fitting to the outboard end.

About 30 percent of the debonded area occupied the lower root-fitting bonding-surface area and appeared to have existed since the blade was manufactured. Another 35 percent of the bond area appeared to have separated during service prior to the incident, and the remaining portion of the bond appeared to have separated at the time the main rotor blade separated from the helicopter. Although the upper root fitting had not separated because of the accident, examination of that bond area revealed nearly the same ratio of debonded, separated-in-service and intact bonded surface area as the lower root fitting.

The manufacturing process was reviewed. The investigators found that the fixtures used to apply pressure and heat to the root-fitting areas while the adhesive was curing could apply uneven pressure if the blade was improperly aligned in the fixture. Differential scanning calorimeter analysis of adhesive samples removed from the debonded area indicated that the adhesive was improperly cured.

Further analysis of the manufacturing process disclosed that, when proper pressure is applied during bonding, excess adhesive is squeezed out of the joint, forming a fillet at the edges of the root fitting. Inspection of the failed blade disclosed that this fillet of adhesive was missing for several inches and that the resulting gap had been filled with a sealant. This use of a non-adhesive filler was confirmed to be a common practice in manufacturing.

Cracking of the doubler and skin, and bonding separation between the lower fitting and doubler, had been experienced on similar models of these blades. The manufacturer had issued service information notices (SINs) DN-188, EN-81, FN-67, HN-239 and NN-008 about 60 days after this incident occurred. The SINs advised operators of the subject helicopters to perform a one-time visual inspection of the main rotor-blade root end for chordwise cracks and paint/sealant cracking between the lower end fitting and doubler. Initial inspections were called for within the next 10 hours of operation, with a 100-hour repetitive interval including a check for bonding separation. The SINs did not call for inspection of the upper root fitting and its doubler.

The U.S. Federal Aviation Administration (FAA) also issued an airworthiness directive (AD) calling for operators of models 369 and OH-6A (the military version of the 369) to visually inspect the blade-attachment lugs and lead-lag links for cracks or looseness of the lug bushings. In addition, the AD called for a visual inspection for cracking in the skin and doubler adjacent to the root fitting, but it contained no requirement for an inspection to detect a bonding separation between the root fitting and doubler.

The NTSB expressed concern that improper bonding during manufacture had caused the fatigue cracking in the main rotor blade. The NTSB also said that because the SINs issued by the manufacturer are not mandatory and the present AD is not specific to bonding inspections, bond separations could remain undetected and lead to fatigue cracking of other main rotor blades of this type.

The NTSB has, therefore, issued a safety recommendation to the FAA, calling for an AD requiring inspection of the root end of main-rotor blades in accordance with the previously issued SINs, and including specific inspections for bond separation and cracking.

Technicians maintaining and inspecting MDHC models 369D/E/F/H and OH-6A should carefully review the history of these problem areas and ensure that their inspections are thorough and adequate to detect all defects.

Exhaust-system Failures Result in Recommendation to Change Inspection Procedures

In September 1995, a Cessna 421C crashed in the southwest United States. All eight occupants were killed, and the aircraft was destroyed. The airplane was climbing through 18,400 feet (5,612 meters) when the pilot called air traffic control to report a turbocharger problem and to request clearance to return to Las Vegas, Nevada, U.S. A few minutes later, the pilot reported that the left-engine power was deteriorating and that he might not be able to maintain 10,000 feet (3,050 meters), the minimum vectoring altitude in that area. The pilot declared an emergency, and the flight was diverted to the nearest airport, which had an elevation of 1,975 feet (602 meters).

Witnesses observed the airplane overshoot the extended centerline of the runway and then enter a steep left bank that tightened into a nose-low left spin. The airplane reportedly made three or four rotations before it struck the ground.

The U.S. National Transportation Safety Board (NTSB) determined that the probable cause of the accident was the pilot's failure to maintain an adequate airspeed while maneuvering on final. Contributing factors included exceeding the aircraft's weight-and-balance limitations, the pilot's lack of recurrent training, inadequate inspection and maintenance of the engine exhaust system and an exhaust-gas leak in the left-engine exhaust system.

The NTSB examination of the wreckage showed that the left-engine exhaust system Wye duct collector (part of the engine turbocharger system) had a warped flange at the outlet to the waste gate. There was confirming evidence of exhaust-gas leakage in the warped area of the flange and on the airplane structure adjacent to the Wye duct collector.

The manufacturer's pilot's operating handbook said that a change in the flow of exhaust gases into the turbine would affect the speed of the turbocharger. A leak in the system, such as that confirmed in the accident airplane, would decrease the turbine speed and cause loss of engine power.

In 1975, the U.S. Federal Aviation Administration (FAA) issued an Airworthiness Directive (AD 75-23-08) that set forth specific inspections and part replacements required to improve the reliability of the exhaust systems of Cessna twin-engine, turbocharged airplanes. In 1986, revision R-5 to AD 75-23-08 was issued to identify new replacement parts available and to add the 421C model to the list of affected airplanes.

A review of service difficulty reports (SDRs) for 1980 through 1985 revealed 69 reports related to airplanes affected by this AD. Two incidents had resulted in in-flight fires. In 1986, the NTSB issued Safety Recommendations A-86-04/05, asking the FAA to require more detailed inspections than those required under the AD or to require scheduled replacement of certain parts, and asking that the 421C be included as an affected aircraft.

The FAA declined to establish a replacement interval because it felt that the wide variation in time-to-failure precluded such action. They also declined the request for partial-disassembly inspection of the exhaust system components on the grounds that this could induce more problems by creating loads and stress risers in those components if they were improperly reassembled. The FAA also stated that because stainless steel system components were being replaced through attrition, new Inconel components would provide improved service. [Inconel 601, from which the left-engine Wye duct collector on the accident aircraft was fabricated, is a nickel alloy. The NTSB noted in its Safety Recommendation stemming from the accident that "Inconel is superior to stainless steel for use in an exhaust system ... (because it) has greater tensile and fatigue-strength properties at elevated temperatures than stainless steel. Inconel is also able to maintain that strength if nicked or eroded."]

In the year following this action, the NTSB investigated another fatal accident and two nonfatal accidents involving failures in the Cessna 300/400 series with stainless steel exhaust systems.

In August 1995, a Cessna T310R crashed during an attempted forced landing after the pilot reported a fire in the right engine. In May 1996, a Cessna 401 made a precautionary landing after the pilot observed smoke and vapor venting from the left-engine nacelle louvers.

The NTSB has reviewed SDRs filed during the past two years and noted several additional reports of similar airplanes with exhaust system discrepancies. One of the events involved a 421C with an all-Inconel exhaust system.

The NTSB is still concerned about the reliability of the exhaust system components. Although the Inconel components appear to be less susceptible to cracking, experience has shown that it is difficult to determine what the base material is because neither stainless steel nor Inconel system parts are permanently marked. Neither the ADs nor a Cessna service letter provide a way to differentiate between stainless steel and Inconel components. FAA Advisory Circular (AC) 65-9A, *Airframe and Powerplant Mechanics General Handbook*, last revised in 1976, provides a nondestructive procedure to distinguish Inconel alloys from stainless steels. The procedure uses a solution of cupric chloride and hydrochloric acid, which should cause a copper-colored spot on stainless steel.

Tests conducted in the NTSB materials laboratory, however, did not create any copper-colored discoloration on the oxidized exhaust system parts that were later determined, through x-ray energy dispersive analysis, to be stainless steel. Even after the parts were cleaned and polished to bare metal, the FAA-recommended tests were inconclusive. The NTSB therefore recommends that the FAA remove this test from AC 65-9A.

In addition, the NTSB has recommended that the FAA:

- Amend AD 75-23-08 R5 to require that the recurring visual inspections be applicable to Inconel parts as well as to stainless steel parts;

- Revise the AD to call for permanent marking of the Inconel parts; and,

- Amend the AD to require that all Cessna twin-engine, turbocharged engine-exhaust system components that are made of stainless steel, or that cannot be conclusively determined to be made of Inconel, receive visual inspection of the disassembled exhaust system.

Technicians involved in maintenance and inspection of any Cessna twin-engine aircraft with turbocharged-engine exhaust systems should take extra care to ensure that their inspection procedures are thorough and detailed. These systems are much more sensitive to minor defects than those of nonturbocharged aircraft. Any indication of defects or exhaust gas leakage should be thoroughly investigated and corrected prior to releasing the aircraft to service.♦

New Wrench Design Is Based on Industry Recommendations

Wright Tool Co.'s new combination wrench, called The Wright Wrench, was designed according to the suggestions of distributors and users. The Wright Wrench is said to have these advantages:

- Greater strength and ease of use;
- Greater comfort in the user's hand; and,
- Improved torque-load capability, achieved by increased contact between the wrench jaws and the fastener head.

For more information contact: Wright Tool Co., One Wright Place, Barberton, OH 44203 U.S. Telephone: (800) 321-2902 (United States and Canada); (330) 848-0600; Fax: (216) 266-7559.

Flush-face Quick-connect Designed for Problem Environments

A new flush-face quick-connect designed to solve the special problems created by caustic fluids under high pressure and other problem environments has been announced by TOMCO Products Inc.

Made of stainless steel, the flush-face quick-connect has a rated operating pressure of 2,000 pounds (907 kilograms) per square inch (6.5 square centimeters). Its push-to-connect, flush-face construction and two-way valving are said to permit make-or-break coupling operations with negligible fluid loss.

Quick-connect from TOMCO Products Inc.

For more information, contact: TOMCO Products Inc., 30520 Lakeland Blvd., Willowick, OH 44095-9986 U.S. Telephone: (216) 944-9000.

Truck Combines Pallet Transport and Scissor Lift

A combination pallet truck and scissor lift that can be used to load, unload, position or move heavy items has been introduced by Lee Engineering Co.

The Presto High Lift Scissor Truck is available in hand pump– or 12-volt battery–powered models. The lifting range is from 3.5 inches (8.9 centimeters) to 32 inches (81 centimeters) off the floor. The truck can be precisely positioned and has adjustable side-stabilizer supports that automatically lock into place in the raised position.

The truck is available in models with capacities of 2,000 pounds (907 kilograms) and 2,500 pounds (1,134 kilograms).

For more information, contact: Lee Engineering Co. Inc., 505 Narragansett Park Dr., Pawtucket, RI 02861 U.S. Telephone: (401) 725-6100; Fax: (401) 728-7840.

High-temperature Aviation Hydraulic Fluid Announced

Monsanto Co. has announced that it will introduce a new-generation aviation hydraulic fluid early next year. Skydrol 5 is said to provide significant advantages compared with existing type-IV fluids, including increased thermal-stress performance. The new fluid works at an operating temperature limit of 275 degrees F (135 degrees C), compared with a design limit of 225 degrees F (107 degrees C) for type-IV fluids.

Additional claims include improved erosion protection, toxicity characteristics, paint compatibility and weight.

Skydrol 5 is fully compatible with existing type-IV fluids, and no flushing or draining is necessary in converting to the new product.

Skydrol 5 from Monsanto Co.

For more information, contact Monsanto Co., 800 N. Lindbergh Boulevard, St. Louis, MO 63167 U.S. Telephone: (314) 694-3804.

Display and Speech-recognition 'Cap' Offers Hands-free Computer Interface

The V-Cap 1000™ Digital Head-Mounted System (DHMS), just introduced by its manufacturer, Virtual Vision Inc., is an interactive speech and display interface. The device can be used by aviation technicians to activate computer data bases, view their displays and enter data using speech while simultaneously performing manual tasks. The user communicates with the computer via voice.

The device, worn like a cap, includes a visor-mounted monocular display (presenting a single image to one eye), adjustable speaker, noise-canceling microphone, computer connection and power supply. According to the manufacturer, aircraft technicians using a DHMS mobile unit can access reference libraries and search data bases for needed information without interrupting repairs. The display also allows the technician to see and hear prerecorded instructions and to access simulation software to test solutions to problems before implementing them.

For more information, contact: Virtual Vision Inc., 7659 178th Place NE, Redmond, WA 98052-4953 U.S. Telephone: (206) 882-7878; Fax: (206) 882-7373.

Aircraft Liquid-barrier Sealing Tape Introduced

The Kendall-Polyken Co. has introduced a liquid-barrier tape that meets U.S. Federal Aviation Regulations (FARs) Part 25.853(a) specifications for toxic-smoke and flame resistance.

Developed for aircraft use in areas such as galleys and lavatories where liquid spillage is likely, the Polyken® 808FR tape is said to be the first liquid-barrier tape approved by the U.S. Federal Aviation Administration (FAA). The material is constructed of high-strength, waterproof, flame-retardant polyethylene backing with a synthetic rubber adhesive and is available in 18-inch and 36-inch (46-centimeter and 91-centimeter) widths. The manufacturer says that the new tape can be die-cut or trimmed on the job.

For more information contact: Kendall-Polyken Co., 15 Hampshire Street, Mansfield, MA 02048 U.S. Telephone: (800) 987-3539 (United States and Canada); or (508) 261-2000; Fax: (800) 328-4822 (United States and Canada); or (508) 261-6275. In Europe, contact: H. Van Veldekesingel, 150/29, B-3500, Hasselt, Belgium. Telephone: 32-11-870-850; Fax: 32-11-870-851.♦

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