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Internet Provides Information Tools for Maintenance Technicians

Used carefully, some sites on the World Wide Web can provide speedy access to much of the information that technicians need to perform their jobs. Other sites, however, may include inaccurate or misleading information. Guidance from information specialists can help maintenance personnel evaluate the sites and determine which ones will serve them best.

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FSF Editorial Staff

For some aviation maintenance technicians, the Internet[1] has become an increasingly important source of safety information, regulatory documents, education and training materials, and product information.

Maintenance technicians use the Internet to find articles about aviation safety, to download service bulletins from manufacturers' sites on the World Wide Web,[2] to take maintenance-related college classes and to review other technicians' assessments of new products.

"The Internet is making the tools required to perform the job with a high safety factor much more readily available," said Stan Mackiewicz, director of the Aviation and Space Technology Academy at Embry-Riddle Aeronautical University in Daytona Beach, Florida, U.S. "You see maintenance technicians with laptop [computers] sitting next to them for technical data. It's current and complete and readily available."[3]

André Chassé, maintenance supervisor for the Pennzoil-Quaker State

Aviation Department in Houston, Texas, U.S., said that he typically begins his workday with a quick review of several Web sites, including:

- A U.S. Federal Aviation Administration (FAA) site to determine whether FAA has issued airworthiness directives [ADs] that involve either of his department's two aircraft and whether FAA has implemented or proposed regulatory changes that would affect his department's operations; and,
- Sites maintained by the manufacturers of his department's aircraft to determine whether new service bulletins have been issued or whether any aircraft-specific problem is being discussed.[4]

"I don't spend all day on the Web; within 10 minutes, I have been all around [those Web sites]," Chassé said. "It is a tool to get quick information without waiting or digging through a lot of paperwork. … That is pretty much what you have to do now if you want to stay up to date."

Use of the Internet by maintenance personnel likely will continue to increase, said David Schober, manager of government and technical affairs for the Professional Aviation Maintenance Association (PAMA).[5]

"Use is growing because more and more sources of data are becoming available on the Web," Schober said. "And I think we're going to see more and more of that as costs [of printing and mailing] increase and people become more fluent in [the] use of various Web sites."

He said that one disadvantage in relying on the Internet involves the difficulties created by trying to use documents so large that they cannot fit on a computer screen — wiring diagrams, for example.

"But over time, I'm sure they'll come up with solutions for that, too," Schober said.

Despite the increasing reliance on the Internet, not all sites provide accurate and current information.

"It's really a mixed bag," said John Goglia, a member of the U.S. National Transportation Safety Board (NTSB) with more than 30 years experience as a maintenance technician.[6]

In addition to the sites that emphasize accuracy, Goglia said, "you get a lot of people giving advice that seems to be readily accepted just because it's on the Internet."

Misinformation is a result of one of the Internet's primary attributes: Almost anyone can establish a Web site, without subjecting the site's content to review by any outside authority and without quality-control requirements to guarantee that the site will contain accurate information.

Knowing how to determine which Web sites are relatively error-free is the first step in productive use of the Internet.

Information specialists recommend using specific criteria and asking various questions to evaluate the quality of Web sites. The following suggestions are from librarians at Wolfgram Memorial Library at Widener University, Chester, Pennsylvania, U.S.:

- Authority — Is it clear what organization, company or individual is responsible for the content of the site? Is there a link to a page that describes the sponsoring company or the purpose of the sponsoring organization? Can the existence of the company or organization be verified (by using a telephone number or postal address to contact someone for more information)?
- Accuracy — Are sources of factual information cited so that they can be verified in another source? If the site is a business site or marketing site, does it include a link to another source for product reviews or reports filed with a government oversight authority? If the site is an informational site, is there a clear indication of who is responsible for the site's accuracy? Does the information contain many typographical errors and mistakes in grammar and spelling (which, the librarians said, "not only indicate a lack of quality control but can actually produce inaccuracies in information")?
- Objectivity — If there is advertising on the site, is it clearly differentiated from informational material? On a business or marketing site, is the company's motivation clear for providing specific information? On an informational site, is the information provided as a public service?
- Currency — Does each page of a site include dates for when the page was created, placed on the site and revised? If charts and graphs are used, do they include statements about when the data were gathered and from which sources? On a business or marketing site, are dates included with information that has been taken from a company's annual report or from information filed with a government oversight authority? and,
- Coverage — Does each page of a site include information to indicate that the page is a finished document and not "under construction" (in development)? On a business or marketing site, are products described in detail, and is the same amount of

information provided for all departments in the company? For an informational site, if the information also is available in print, does the site indicate whether the entire document is available on the site? If the information was taken from a book that no longer is protected by copyright, has the material on the site been updated?[7]

Maintenance technicians also should know the most productive methods of searching the Internet for the information they require.

Although Internet search engines may function differently in compiling responses to search requests, the actions required by the person conducting the search are essentially the same: Type the search request into the appropriate box on the search page. Typically, if more words are typed into the box to make the request more specific, the results become more relevant. Most search-engine sites include recommendations on how to refine a search request to obtain a shorter and more relevant list of responses. Other considerations in conducting a search include an awareness of cultural differences between the maintenance technician and those who maintain Web sites — sometimes alternate spellings of words or alternate phrases may yield more relevant results.

Information specialists suggest that if a search does not yield relevant responses, the user should try the search using a different search engine. Because all search engines have different collections of Web pages to search, the same search request conducted with different search engines yields different results.

Some sites include site-specific search engines. These require the same input from the person conducting the search: Type the search request into the appropriate box.

In recent years, aviation maintenance classes have included instruction in how to use the Internet in connection with work, Mackiewicz said.

"We show them where data [are] available in terms of availability of certain [aircraft] parts, checking on current regulations, data on [manufacturers'] Web sites," he said.

Some of the most extensive Web sites are maintained by civil aviation authorities worldwide. These sites vary in the type and quantity of maintenance-related information available on their pages. Many include information about regulations, airworthiness directives, licensing requirements and approved training organizations:[8]

- Civil Aviation Department of Brazil <www.dac.gov.br>, in Portuguese and English. The site includes information about careers in aviation maintenance, airworthiness directives and aviation accidents;

- Civil Aviation Department of Hong Kong <www.info.gov.hk/cad>. The site includes information about the department's responsibilities, including approval and monitoring of maintenance facilities, issuance of airworthiness certificates and licensing of personnel;

- Civil Aviation Safety Authority Australia <www.casa.gov.au>. "Maintainers and aircraft" page at <www.casa.gov.au/avreg/aircraft/index.htm> includes links to listings on ADs, airworthiness bulletins (which have begun to replace airworthiness advisory circulars), Australian technical standard orders for minimum performance standards, aircraft defect reports, aircraft flight manual requirements and licensing and training;

- FAA <www.faa.gov>. One page on the site, <www.faa.gov/avr/afs/infoformechanics/index.htm>, includes links to other sections of the FAA site or other sites that include information about education and licensing, forms, regulations and other guidance, advisory circulars, ADs and research on aviation maintenance issues;

- Irish Aviation Authority <www.ia.ie>. The site includes information about personnel licensing, maintenance-related aviation accidents, airworthiness certification and aircraft registration;

- Joint Aviation Authorities (JAA) <www.jaa.nl>. The site includes information on maintenance training, harmonization of maintenance aviation requirements among JAA member nations and reports on topics such as maintenance human factors;

- New Zealand Civil Aviation Authority <www.caa.govt.nz>. The "maintenance engineers" section includes information about licensing, reporting accidents and incidents, maintenance rules, maintenance forms, maintenance advisory circulars and how to obtain airworthiness directives;

- South Africa Civil Aviation Authority <www.caa.gov.za>. The site includes information about personnel licensing, maintenance advisories, aircraft safety oversight information and aviation accident reports;

- Transport Canada <www.tc.gc.ca>, in English and French. One page on the site (<www.tc.gc.ca/ air/menu.htm>) includes "Information for maintenance technicians," with links to other pages that contain information especially relevant to maintenance personnel; and,

- U.K. Civil Aviation Authority Safety Regulatory Group

<www.srg.caa.co.uk>. The site includes information about airworthiness notices, licensing requirements and approved training organizations. Maintenance-related publications may be ordered on a page within the Web site — <www.srg.caa.co.uk/pub/pub_home.asp>.

Many government investigative authorities maintain sites that include — in varying detail — reports on aviation accidents and incidents, aviation safety recommendations and analyses of specific safety problems.

One of the most comprehensive sites is maintained by NTSB at <www.ntsb.gov>. The site includes a searchable database of aviation accidents from 1983 and a link to a searchable FAA database of aviation incidents.

Other sites maintained by investigative authorities include:

- Accident Investigation Board Finland <www.onnettomuustutkinta.fi>, with accident reports in Finnish, English and Swedish;

- Australian Transport Safety Bureau <www.atsb.gov.au>. The site includes a searchable database of 352 aviation accidents and technical analysis reports describing problems involving specific aircraft models;

- Dutch Transport Safety Board <www.rvtv.nl>, with accident reports in Dutch and English;

- French Bureau Enquêtes-Accidents <www.bea-fr.org>, with accident reports in French, English and Spanish;

- Swedish Board of Accident Investigation <www.havkom.se>, with accident reports in Swedish and English;

- Tanzania Accidents Investigation Branch <www.aviationauthority.org/aib.htm>. The site includes accident reports and a link to the site maintained by the Tanzania Civil Aviation Authority;

- Transportation Safety Board of Canada <www.tsb.gc.ca>, with accident reports in English and French; and,

- U.K. Air Accidents Investigation Branch <www.aaib.detr.gov.uk>. The site includes accident reports, accident-reporting procedures and civil aviation regulations.

Some professional aviation maintenance organizations also maintain Web sites that include career information and research material:

- Canadian Aviation Maintenance Council (CAMC) <www.camc.ca>. This site includes information about products and training material, job postings and CAMC research on human resources in aviation maintenance.

- PAMA <www.pama.org>. This site includes an extensive online technical library with links to technical data, FAA ADs and some service difficulty reports; and,

Aviation safety sites include information about accidents; accident prevention; recommended aviation safety standards, including maintenance standards; and aviation safety conferences and training products. The sites include:

- Flight Safety Foundation <www.flightsafety.org>. The site includes information about Foundation safety seminars; the Foundation's technical initiatives to improve aviation safety, including efforts to prevent controlled flight into terrain and approach-and-landing accidents;[9] and a searchable database — dating to 1988 — of the Foundation's seven aviation safety publications, including *Aviation Mechanics Bulletin*;

- Global Aviation Information Network (GAIN) <www.gainweb.org>. GAIN describes itself as an international, industry-led coalition of airlines, manufacturers of airframes and aircraft components, employee groups, government authorities and aviation organizations that was established in 1996. The organization's goal is to advance the sharing of aviation safety information about flight operations, air traffic control operations and maintenance to improve aviation safety worldwide. The site includes the organization's safety recommendations and information about its seminars;

- International Air Transport Association (IATA) <www.iata.org>. IATA is the international trade organization representing the world's airlines. The site includes descriptions of the work of IATA's divisions, including the Operations and Infrastructure Division, which is responsible for safety, security, technical operations (flight operations, engineering and maintenance) and infrastructure; IATA products and services; conferences; and training;

- International Civil Aviation Organization (ICAO) <www.icao.org>. ICAO is the United Nations agency responsible for civil aviation, and one of its primary responsibilities is the establishment of international standards and recommended practices in many aspects of aviation, including licensing of personnel, airworthiness and operation of aircraft. The site includes a detailed discussion of ICAO's goals, access to the organization's publications and an extensive list of links to civil aviation Web sites;

- International Federation of Airworthiness <www.ifairworthy.org>. The site includes information that describes the organization's efforts to ensure the continuing airworthiness of civil transport aircraft worldwide, as well as activities to promote development of human factors in maintenance advisory information and production of related training programs; and,

- The Maintenance and Ramp Safety Society <www.marss.org>. The site includes information about research into human factors in aviation maintenance.

Aviation departments of many colleges and universities maintain Web sites that not only explain their course offerings but also enable students to enroll in courses that are conducted over the Internet.

"There's been tremendous growth in computer-based learning," said Mackiewicz.

Embry-Riddle is one of the many institutions participating in that growth, he said. Some Embry-Riddle aviation maintenance courses have been available over the Internet for several years; a more comprehensive program is being developed, he said.

"[Airframe and power plant] training programs are about 2,000 hours — 1,000 hours lecture and 1,000 hours lab," he said. "A large portion of the lecture courses can be computer-based, and [so can] some [laboratory studies]."

Computer simulations are especially useful in teaching maintenance troubleshooting techniques, Mackiewicz said.

Among the education-related aviation maintenance Web sites are the following:

- Aerolearn <www.aerolearn.com>. Aerolearn — a division of Northrop Rice Aviation Institute of Technology in Inglewood, California, U.S. — is a "learning service provider" that develops and maintains online education and training programs for the aviation industry. The site includes information on establishing online training programs and provides free access to 500 short informational courses sponsored by airframe manufacturers, parts manufacturers and aviation organizations;

- Embry-Riddle Aeronautical University <www.erau.edu>. The site includes information about programs and courses offered at Embry-Riddle's two residential campuses, at nearly 100 learning centers in the United States and Europe, and through the "distance learning program" (which uses online resources and other telecommunications equipment to deliver instructional material) for students not attending the campuses or learning centers; and,

- Honeywell Aerospace Training Solutions <www.honeywelltraining.com>. The site describes training programs offered in 13 countries on most Honeywell products. Instructional videos, computer software, computer-based training programs and troubleshooting guides may be purchased on the site. A computer-based distance learning program is being developed.

The expansion of computer-based aviation maintenance education and training has extended beyond traditional programs offered by community colleges (two-year educational institutions), colleges, universities and manufacturers.

"There's a pretty broad spectrum in quality and content," Mackiewicz said. "You need to be an informed consumer."

Web sites maintained by manufacturers of airframes, engines and other aircraft components typically provide a range of product information and technical manuals. Some sites also provide for online purchases of parts, delivery of service bulletins and a range of customer-support services, and include secure pages to provide additional information and services to owners and operators.

The Web sites include:

- Gulfstream <www.gulfstream.com>. The site provides standard information about aircraft, parts and service centers, and allows customers to order technical manuals and other documents. The site contains a link to <www.mygulfstream.com>, where Gulfstream owners and operators can exchange information with each other and with Gulfstream representatives, and can obtain technical information about their aircraft;

- Pratt & Whitney Canada <www.pwc.ca>. The site includes information about products, customer-support services and training sessions, and access and registration for pages that are accessible only by customers. The customers-only section can be used by customers to gain access to service bulletins; to check prices, order parts and check the status of sales orders; to check details on ongoing engine overhauls being performed at Pratt & Whitney Canada overhaul facilities; and to use the configuration control system to check part-number revisions; and,

- Rockwell Collins <www.rockwellcollins.com>. The site contains information about products and customer-support services and a provision to allow registered customers access to several companion sites. Those sites include reliability data, service bulletins and documentation/ training information.

Some Web sites provide electronic discussion forums intended to allow maintenance personnel to exchange opinions about maintenance-related topics. The content of the sites varies; some discussion forums provide helpful suggestions about training or specific maintenance problems while other sites generate “a lot of griping,” Goglia said.

Among the electronic discussion forums are the following:

- Hangar Talk <www.landings.com>. The site includes a collection of aviation-related forums — including one about aviation maintenance. (Click on “Hangar-Talk” in the News/Forums section of the directory.);
- NBAA Air Mail <www.nbaa.org>. The site includes several discussion forums maintained by the National Business Aviation Association (NBAA). The business aircraft maintenance forum is intended specifically for maintenance personnel with experience on business aircraft; and,
- Professional Pilots Rumour Network <www.pprune.org>. The site includes an engineers and technicians forum — one of about 70 forums for aviation personnel.

The Internet has made available vast quantities of information, including information that can be essential in helping maintenance technicians perform their jobs. The Web sites mentioned here are among thousands that might be of interest to maintenance personnel. Determining which sites will be most useful to a specific individual or a specific maintenance organization requires exploration of a variety of sites and a careful evaluation of the information they provide.♦

Notes

1. “Internet” is defined by *Merriam-Webster’s Collegiate Dictionary* at <www.m-w.com> as “an electronic communications network that connects computer networks and organizational computer facilities around the world.”
2. “World Wide Web” is defined by *Merriam-Webster’s Collegiate Dictionary* at <www.m-w.com> as “a part of the Internet designed to allow easier navigation of the network through the use of graphical user interfaces and hypertext links between different addresses.” It also is called the “Web.”
3. Mackiewicz, Stan. Telephone interview by Werfelman, Linda.

Alexandria, Virginia, U.S. Jan. 24, 2002. Flight Safety Foundation, Alexandria, Virginia, U.S.

4. Chassé, André. Telephone interview by Rosenkrans, Wayne. Alexandria, Virginia, U.S. Jan. 23, 2002. Flight Safety Foundation, Alexandria, Virginia, U.S.

5. Schober, David. Telephone interview by Werfelman, Linda. Alexandria, Virginia, U.S. Feb. 6, 2002. Flight Safety Foundation, Alexandria, Virginia, U.S.

6. Goglia, John. Telephone interview by Werfelman, Linda. Alexandria, Virginia, U.S. Jan. 23, 2002. Flight Safety Foundation, Alexandria, Virginia, U.S.

7. Alexander, Jan; Tate, Marsha Ann. *Evaluating Web Resources*. <www.widener.edu/links/linklibraries.html> Aug. 8, 1996; revised July 25, 2001.

8. Internet addresses sometimes change. All Internet addresses included in this article were correct at the time of publication.

9. Controlled flight into terrain (CFIT) occurs when an airworthy aircraft under the control of the flight crew is flown unintentionally into terrain, obstacles or water, usually with no prior awareness by the crew. This type of accident can occur during most phases of flight, but CFIT is more common during the approach-and-landing phase, which begins when an airworthy aircraft under the control of the flight crew descends below 5,000 feet above ground level (AGL) with the intention to conduct an approach and ends when the landing is complete or the flight crew flies the aircraft above 5,000 feet AGL to another airport.

MAINTENANCE ALERTS

Prior Repairs of Turbine Blade Cited in Engine Failure

At 1,500 feet during the initial climb after takeoff from Hobart (Australia) International Airport on Oct. 13, 2000, the flight crew of a Boeing 737 told air traffic control that the no. 1 engine had failed. The crew shut down the engine and returned the airplane to Hobart.

An inspection of the engine — a General Electric CFM56-3C-1 — revealed that the engine failure resulted from the loss of a 15-millimeter by 20-millimeter (0.6-inch by 0.8-inch) segment of the trailing edge of a high-pressure turbine blade.

In a report on the incident, the Australian Transport Safety Bureau (ATSB) said, "The passage of the segment through the turbine resulted in extensive damage to all four stages of the low-pressure turbine assembly, rendering the engine inoperative."

The blade had been in operation 26,576 hours and 17,928 cycles since new. Maintenance records showed that the blade was repaired in manufacturer's facilities in Singapore in June 1997 and then was installed in the engine in the incident airplane. During that repair and during a July 1995 repair, alloys were used to rebuild the blade tip in an area that had eroded because of high operating temperatures and high operating pressures. Both repairs were conducted in accordance with manufacturer's repair documents. The report said that the engine manufacturer did not maintain official records about failed blades, their time in operation and repairs.

"There was no difference between the repairs as far as the extent of the blade weld repair, materials and techniques used," the report said. "The only difference was in the area of the blade coating."

The blade and the high-pressure turbine were inspected in accordance with maintenance programs prescribed by the manufacturer and the operator at intervals of no more than 1,140 operating hours. The last inspection before the incident was conducted Aug. 11, 2000. After the inspection, the blade was in operation for 660 hours before the incident.

A metallurgical examination of the failed blade revealed that the loss of the section of the blade was caused by "the progression of fatigue cracking into the blade section from an area of cracking and notching on the blade tip," the report said.

The cracking progressed into the original blade material (a René 125 nickel-based alloy) through "an extensive Inconel 625 [also a nickel-based alloy] weld repair beneath the tip notching," the report said. The report said that the Inconel 625 alloy is "inferior to the René alloys in terms of its fatigue strength" and that cracks within Inconel 625 "develop and propagate much more rapidly than equivalent cracks developed within the René alloys."

The report said that use of the Inconel 625 alloy in the 1995 repair allowed the crack in the blade tip to progress through the repaired area and into the original material underneath.

"The René alloys are successfully weldable only under tight procedural control and require high levels of preheat to reduce hot cracking," the report said. "Under conditions of restraint, such as deep-crack repairs, the use of a ductile Inconel 625 alloy as a filler improves the success rate. … The latest revisions of the appropriate repair documents that came into effect [Oct. 19, 2000] cautioned the repairers that certain cracks are not repairable with Inconel 625 weld filler and that René 80 or [René] 142 alloys are necessary for trailing edge welds below the blade-tip shelf. The documents did not prohibit the use of Inconel 625 alloy."

After the incident, the operator reduced the maximum allowable interval between high-pressure turbine inspections to 625 hours.

Incorrect Washer Installation Blamed for Landing-gear Failure

A Cessna 310R was being taxied for takeoff June 6, 2001, at Bournemouth International Airport in Dorset, England, when the pilot of the cargo flight told an air traffic controller that he felt a tire deflation. A U.K. Air Accidents Investigation Branch (AAIB) report said that the controller sent an "observer," who told the pilot that the tires appeared to be normal.

"The pilot therefore assumed that the sensation he had felt must have been caused by the aircraft running over a runway centerline marker," the report said.

The pilot conducted a normal takeoff, then moved the landing-gear handle to the "UP" position. The red "IN TRANSIT" light remained on. The pilot then moved the landing-gear handle down, and there was no illumination of the green light that would have indicated that the right-main landing gear was down and locked. The pilot moved the landing-gear handle up and down several times with the same results.

Tower controllers said that the right wheel appeared to be cocked to one side and that the right-main landing gear did not appear to be down and locked. The pilot conducted an emergency landing that resulted in damage to the right wingtip, right propeller and right-main landing gear.

An inspection revealed that the upper torque link and lower torque link on the right-main landing gear had disconnected at the center hinge point, allowing the wheel to become misaligned.

"When the landing gear was retracted, the misaligned wheel came into contact with the structure in the landing-gear bay, introducing excessive loads into the landing-gear retraction mechanism," the report said. "This caused the landing-gear actuating bell crank to fracture. Failure of the bell crank prevented the landing gear from being raised or lowered, and there would have been no means of locking it in the down position."

The bolt (part no. AN175-20) that connected the upper torque link to the lower torque link had separated from the upper torque link and remained attached to the lower torque link. The bolt was not damaged. A bushing (part no. 5041013-2) also had separated from the upper torque link and was found on the bolt, but a washer that should have been under the head of the bolt was missing.

"The absence of the washer had allowed the head of the bolt to pull through the hole in the upper torque link, pressing out the bushing in the torque link in the process and allowing the torque links to separate," the report said.

A washer was found under the nut, and the report said that an indentation on the washer indicated that it formerly may have been installed under the bolt and "may have been inadvertently transferred from under the head of the bolt to under the nut" during maintenance Feb. 21, 2000, when the landing-gear torque links were disconnected for replacement of worn components. A visual inspection of the torque links on May 22, 2001, during the airplane's annual inspection revealed no defects.

"According to the illustrated parts catalogue (IPC), a part number 5045018-1 washer should be installed under the head of the bolt and under the nut," the report said. "Although the washer found under the nut was incorrect, had it been installed under the head of the bolt, it would have most likely prevented the bolt and bushing from pulling through the torque link [because] the diameter of the washer [was] slightly larger than the nominal diameter of the hole in the torque link."

Inspection of the left-main landing gear revealed that it had been assembled incorrectly, using washers with an outside diameter of 0.5625 inch (14 millimeters) beneath the nut and the head of the bolt.

The replacement right-main landing gear, obtained from an approved U.S. supplier, also had incorrectly sized washers beneath the nut and under the head of the bolt. The washers were replaced with others with the correct part number before the landing gear was installed on the airplane.

The report said that the IPC lists the correct washer part numbers in a table of part numbers.

"However, the diagrams of the torque-link center-hinge joint in the IPC and the maintenance manual do not clearly show where the washers are to be installed, and neither is it explained in the written instructions in the maintenance manual, providing scope for misinterpretation," the report said.

Hydraulic Lines Reversed Before Landing-gear Failure

The flight crew of a US Airways Express Beech 1900D was preparing to land June 3, 2000, at Greater Rochester (New York, U.S.) International Airport when they moved the landing-gear handle to the "DOWN" position and the landing gear did not extend.

Attempts to extend the landing gear using a mechanical hydraulic pump also failed. The crew landed the airplane with the landing gear retracted. The airplane received minor damage; none of the 13 people in the airplane was injured.

The U.S. National Transportation Safety Board (NTSB) said that the probable cause of the accident was the reversal of landing-gear hydraulic lines by maintenance personnel.

The Raytheon Aircraft Beech 1900D *Airliner Maintenance Manual*, dated March 28, 1997, said that a landing-gear service valve in the left inboard wing is used with a hand pump to raise and lower the landing gear for maintenance purposes.

"Four hydraulic plumbing tube assemblies [are] connected through ports located on each side of the valve," the report said. "On the forward-facing side of the valve [are] the 'retract port' and the 'emergency-extend port.' On the aft-facing side of the valve [are] the 'hand-pump pressure port' and the 'return port,' [with] a check valve installed between the tube and port. The hydraulic plumbing-tube assemblies [are] also color-coded."

Maintenance records showed that on May 28, 2000, airline maintenance personnel replaced the landing-gear service valve after the landing gear had failed to extend. After the valve was installed, the maintenance personnel performed a "normal gear extension and retraction using the aircraft electrical system," maintenance records said. The Raytheon Aircraft Beech 1900D *Airliner Maintenance Manual*, dated March 24, 2000, did not discuss cycling the landing gear, either electrically or mechanically, after replacing the landing-gear service valve.

In a letter to the airplane manufacturer, the operator said, "The lines to and from the service valve may have been reversed on installation, thereby precluding successful manual extension. The 'hand pump pressure tube' and the 'pressure tube' can be reversed inadvertently."

The operator said that after the incident, the general maintenance manual was changed to add further instructions on service-valve installation, including instructions to cycle the landing gear electrically and manually after the installation.

Overly Tight Fitting Blamed for Hydraulic Leak

After takeoff Aug. 8, 2001, from Mount Isa, Australia, the pilot of a chartered Piper PA-31 Navajo told air traffic control (ATC) that the landing gear did not retract when the landing-gear handle was moved to the "UP" position.

When the pilot moved the landing-gear handle, the green light did not illuminate to indicate that the nose-landing gear had extended. Attempts to extend the landing gear with the emergency hand pump failed. After ATC observers confirmed that the nose-landing gear was not fully extended, the pilot conducted an approach and landing; the nose-landing gear collapsed during the landing roll, and the airplane slid to a stop on the runway. The eight people in the airplane were not injured; the airplane received substantial damage.

An inspection by maintenance personnel revealed that a landing-gear rigid hydraulic-pressure line attached to the hydraulic power pack had cracked and partially separated.

The report by the Australian Transport Safety Bureau (ATSB) said, "As a result, all the fluid from the hydraulic reservoir, including that portion contained in the power pack emergency sump, had drained out. The loss of fluid meant that the pilot was unable to retract or extend the landing gear, either by the normal [system] or emergency system."

The aircraft operator said that before the incident flight, maintenance personnel had repaired a leak "in the area of the failed hydraulic line" and had checked several line connectors to ensure that none was loose.

Further investigation revealed that an "axial twisting distortion shown by the cracked region indicated the presence of pre-existing torsional loading on the hydraulic line," the report said. "Pre-loading or residual loads add to operating loads and compound the level of stress experienced by components in service. In such cases, the potential for the initiation and propagation of fatigue cracking increases in response to the greater applied stress levels."

The report said that the torsional or bending pre-loads probably were introduced during assembly, when "one fitting was tightened sufficiently to prevent free movement of the line when the opposite end was brought into position."

The investigation did not determine whether the hydraulic line was fitted during manufacture of the aircraft or during subsequent maintenance, or when the tightening that caused the axial twisting distortion had occurred.

The airplane had accumulated 12,745 operating hours when the incident occurred.

Faulty Installation of Certificate-holding Device Blamed for In-flight Fire

About 15 minutes after departure from the William B. Hartsfield Atlanta (Georgia, U.S.) International Airport on Oct. 1, 2000, the flight deck of a Continental Airlines McDonnell Douglas MD-80 filled with smoke.

The captain said that he heard a loud popping sound and saw sparks in the area surrounding the jump seat. The occupant of the jump seat said that he "heard an explosion and leaned forward to avoid heat, which he felt on his left shoulder."

"When the jump-seat rider looked at his left shoulder, he noticed that his shirt was burning," said the accident report by the U.S. National Transportation Safety Board (NTSB). "He extinguished the fire on his shirt and put on his oxygen mask, since the cockpit was filled with smoke."

The flight crew declared an emergency and diverted the airplane, which had been in cruise at Flight Level 310 (31,000 feet) en route to Houston, Texas, U.S. The airplane was landed in Birmingham, Alabama.

The container that held the airplane's registration certificate had been modified three days before the accident in accordance with a fleet campaign directive intended to "prevent loss of the certificate or damage of the certificate that would preclude dispatch of the airplane," the report said. The directive required maintenance personnel to drill two holes above the top of the certificate and, if mounting the container on a metal wall, to install screws of an appropriate length to secure the container.

"The examination of the airplane disclosed a two[-inch] by 1 1/2-inch [5.1-centimeter by 3.8-centimeter] fire- damaged hole in the left jump seat wall," the report said. "Several heavy-gauge electrical wires were welded together on the opposite side of the wall. There were also four 50-ampere circuit breakers popped on the left circuit-breaker panel behind the pilot's seat. The hole also included an area of the left edge of the registration-certificate holder. The plastic cover of the registration-certificate holder was melted in this area, and soot damage was evident for several inches around the hole. The registration-certificate holder was attached to the wall by eight screws that extended into the cavity where the electrical fire occurred. The hole appeared to be on the left side, middle position of the certificate holder. This screw was missing."

The report said that the screws above and below the missing screw extended 0.5 inch (1.3 centimeters) into the space where the electrical fire occurred. A similar screw in the middle position "could have extended into the wiring," the report said.

After the fire, the airline said that all certificate-holding containers on similarly constructed walls should be replaced with new three-slot containers to be installed in specified locations on galley walls, which have honeycomb backings.♦

NEWS & TIPS

Aging Aircraft Conference To Be Held in September

The sixth joint FAA/DOD/NASA Aging Aircraft Conference will be held Sept. 16–19, 2002, in San Francisco, California, U.S.

The conference, sponsored by the U.S. Federal Aviation Administration (FAA), the U.S. Department of Defense (DOD) and the U.S. National Aeronautics and Space Administration (NASA), is intended to disseminate information to military aviation specialists and the commercial aviation community about maintaining the airworthiness and sustainability of aging aircraft. Presentations will discuss emerging trends, service experience, aircraft risk assessment, condition-based maintenance, corrosion assessment and prevention, and fleet-management strategies involving aging aircraft.

For more information: Dennis Flath, Galaxy Scientific Corp., 2500 English Creek Ave., Building C, Egg Harbor Township, NJ 08234-5562 U.S. Telephone: +1 (609) 645-3772, ext. 129.

Gas Turbine Technology Conference Scheduled For June

The 47th world conference on gas turbine technology, sponsored by the International Gas Turbine Institute of the American Society of Mechanical Engineers (ASME) International, will be held June 3–6, 2002, in Amsterdam, The Netherlands.

The conference — ASME Turbo Expo 2002: Land, Sea and Air — will include technical sessions with 600 papers and panel discussions involving all aspects of gas turbine technology, including aircraft applications; a gas-turbine users symposium with panel discussions and tutorials involving practical business problems; and an exhibit with displays from more than 200 manufacturers, equipment suppliers and service firms.

For more information: Mel Torre, ASME International, Three Park Ave., New York, NY 20016-5990 U.S. Telephone: +1 (212) 591-8157. For exhibiting information: +1 (404) 847-0072.

Fire-retardant Tape Seals Cargo Compartment Liners

Scapa T3605, a fire-retardant single-coated adhesive tape, has been designed to join, seal and repair aircraft cargo compartment liners, said the manufacturer, Scapa North America.

Scapa T3605 is a white polyethylene-coated glass cloth tape that accommodates angles and turns, offers good creep-resistance and maintains its seal under loads. The high adhesion prevents curling and lifting of the tape, the manufacturer said.

For more information: Scapa North America, 111 Great Pond Drive, Windsor, CT 06095 U.S. Telephone: +1 (860) 688-8000.

Epoxy Syntactic Reinforces Fasteners, Edge Fillings

Epocast 1633-A/B epoxy, an epoxy syntactic (an epoxy containing resin designed to be porous and lightweight) has been developed to reinforce fasteners and edge fillings in aerospace honeycomb composite structures, said the manufacturer, Vantico.

The product is qualified for use in Gulfstream Aerospace aircraft, and qualification is in progress at other aerospace companies, the manufacturer said.

Epocast 1633-A/B is designed to flow freely during application and to become non-flowing after application to prevent it from running out of honeycomb surfaces, the manufacturer said. Epocast 1633-A/B can withstand exposure to hydraulic fluids, oils and water.

For more information: Vantico, 5121 San Fernando Road West, Los Angeles, CA 90039 U.S. Telephone: +1 (818) 265-7210.

Charger/Analyzer Provides for In-house Battery Servicing

The Universal 60 provides four battery-servicing functions for in-house servicing of vented nickel-cadmium batteries and vented/sealed lead-acid batteries, said the manufacturer, Marathon Power Technologies Co.

The Universal 60 charger/analyzer has digital current settings, clearly labeled indicators, temperature protection, single-cell charging capability and on-site self-calibration without disassembly, the manufacturer said.

Universal 60 Charger/Analyzer

For more information: Marathon Power Technologies Co., 8301 Imperial Drive, Waco, TX 76712 U.S. Telephone: +1 (254) 776-0650.

Digital Clinometer Functions in Range of Applications

A digital clinometer has been designed for a range of applications in aerospace and other areas, said the manufacturer, Taylor Hobson.

The digital clinometer is battery-powered and compact (4.0 inches by 3.0 inches by 1.3 inches; [10.2 centimeters by 7.6 centimeters by 3.3 centimeters]), with a measuring range of plus or minus 45 degrees, 0.01 degrees resolution and accuracy within two minutes of arc. Display units can be selected by push buttons to indicate results in degrees, minutes of arc, millimeters/meters and inches. Angle measurement is possible in any quadrant, and a built-in calibration program ensures accurate calibration, the manufacturer said.

For more information: Taylor Hobson, 2100 Golf Road, Suite 350, Rolling Meadows, IL 60008-4231 U.S. Telephone: (800) 872-7265 (U.S.) or +1 (847) 290-8090.

Digital Clinometer

Hand Tools Designed for Specific Electrical Applications

Xuron Electrical Assembly Tools are hand tools designed for performing specific electrical applications and wiring applications, such as preparing leads, cutting and stripping wire, and fabricating wiring harnesses, said the manufacturer, Xuron Corp.

Electrical Assembly Tools are ergonomically designed with cushion handgrips and return springs for easier use.

For more information: Xuron Corp., 62 Industrial Park Road, Saco, ME 04072 U.S. Telephone: +1 (207) 283-1401.♦