New Technology Speeds Retrieval of Maintenance Information

by
Robert A. Feeler
Editorial Coordinator

In the days of the venerable Douglas DC-3 or the Beechcraft Model 18, the entire maintenance manual was one volume, and the illustrated parts catalog (IPC) was one additional volume (maybe two if engine information was included). Today, a complete set of manuals for a corporate jet will require an entire small bookcase, and the paper manuals required to document an airline transport can easily cover more than 20 feet of shelf space.

With revisions being distributed quarterly, and temporary revisions being issued in between, the technician is faced with the serious problem of ensuring that he is working with current and complete technical data. Although microfilm solved many of the problems associated with

paper manuals such as lost and misplaced pages and time-consuming revisions, it has not been the ideal answer for many users.

Enter CD/ROM Technology

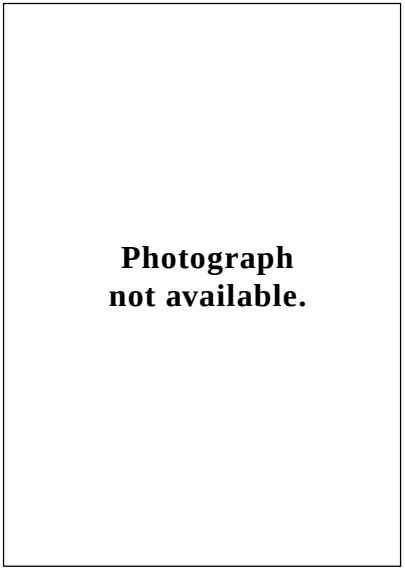
A means of making the voluminous amount of maintenance material more compact, yet more easily retrieved and updated, is available through CD/ROM technology. CD/ROM (Compact Disc/Read Only Memory) is a technology that, in itself, is not entirely new. CD/ROM technology uses digital data recording methods to process anything that can be seen or heard into digital data that can then be recorded, transmitted or reproduced in a variety of visual, aural and printed formats. Digital data technology has permitted advancements in computers, sound recording and video recording.

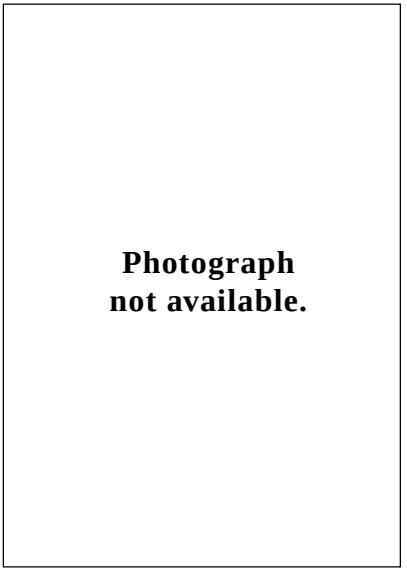
Some leading airlines have been incorporating CD/ROM technology into their maintenance activities and progress is continuing at a rapid pace ("Compact Disc Maintenance Data May Be the Wave of the Future," November/December *Aviation Mechanics Bulletin*).

The initial response by technicians and managers has been enthusiastic. At American Airlines, CD/ROM technical publications are currently in use at more than 75 maintenance facilities in support of the Boeing 757/767 fleets and additional expansion is under consideration. British Airways is also well into a changeover to CD/ROM publications.

The optical recording of digital data by means of lasers has provided the ability to put heretofore unheard of amounts of data on a small disc. At present, a single CD/ROM disc can store the equivalent of 250,000 pages of text. The most familiar use of CD/ROM and compact discs (CDs), is in the familiar CD musical medium. With the proliferation of self-standing computers (commonly called personal computers — PCs), it was inevitable that the ability to store vast amounts of digital data on a small CD would be exploited.

It is a simple matter to connect a CD/ROM reader to a PC and thus expand the ability of the computer to access this vast memory. One CD can contain an encyclopedia of printed data music or video images. As a means of recording and reproducing data, CD/ROM is presently unsurpassed. Rapid and convenient access to a specific piece of data is possible with software programs that provide the needed flexibility and ease of use.





A zoom feature allows the user to magnify a portion of a maintenance manual page (left) to provide an expanded image of a particular portion (right).

Aviation Technicians Have Unique Data Requirements

Aviation maintenance technicians have requirements for data that, while not unique, may be more critical to ensure the safety and reliability of aircraft maintenance activities. Among these special needs are:

- Readability. Is the definition adequate for information such as a detailed wiring diagram or complex schematic to be clearly seen?

- Currency. Is the data current and complete?

- Reproduction. Can the information be reproduced so that a technician can take a copy to the work site?

- Accessibility. Can the data be accessed easily even if the technician has only partial knowledge of the system or component in question?

To answer these questions, we asked one of the present users of CD/ROM publications what his experience had been. Michael Conley, project engineer at American Airlines, has been instrumental in implementing CD/ROM publications and has worked with the program since its inception. Working closely with the developer

and provider of the CD/ROM software and information retrieval system called "Pinpoint," Conley has been responsible for the installation of the equipment and training of the technicians.

American's experience to date indicates how the CD/ROM system can deal successfully with the above special concerns:

Readability. CD/ROM publications are displayed on a high-resolution color monitor that provides a full-size, single-page screen. The text and graphics are nearly equal in visual quality to that of the printed page. For complex diagrams or charts, the user has the ability to zoom on a particular portion of the diagram to enlarge the image.

For comparing text with a drawing or a parts list with an exploded view, it is possible to view two pages in a side-by-side format.

Currency. The currency of the documents is controlled by the issuance of the CD/ROM disc. The technician can only access the currently revised disc. The disc cannot be changed or typed over by the user, and is assured of being complete.

Currency is enhanced by the system's ability to incorporate a revision by means of a disc update. Temporary revisions or alert bulletins can be added to the system by the manual-issuing agency, to revise the outdated material until a new CD/ROM disc is issued. Such revisions can be sent direct to the CD/ROM station via a modem or network within the operator's system. Once the revision has been added, the technician/user is blocked from access to the obsolete data.

Reproduction. The CD/ROM workstation is typically equipped with a laser printer that prints a copy of any page selected from the manual. The reproduction is printed with 300 by 300 dot-per-inch resolution that ensures a highly accurate copy with clean and crisp definition. The copy looks like a newly printed page with black ink on white paper.

For large drawings, such as a multipage wiring diagram, the quality and match-up of adjacent pages when assembled in a mosaic has been excellent. The output is ready to use as it comes out of the printer and does not smear or smudge in use. The paper is similar to that used in a high speed copier and is reasonably durable. Printed pages can be received in less than 10 seconds per page.

Accessibility. Any page in the publication can be instantly accessed without the need for scrolling or paging through the document. The user can access the data by several means, including by page or section — but

this requires that the user be familiar with the manual or have looked up the reference in the index.

Another means of access is by part number, which requires only that the user know the number of the part or component in question. For IPC references, this allows the user to instantly access the page having the primary reference to this part by using only the part number.

A third means of access is by searching for a key phrase or title. This provides probably the greatest flexibility in terms of initiating a search. But, users report that it also has been the source of frustration. For example, a search for "oil pressure switch" may produce no response if the accepted nomenclature in the manual is "switch, oil pressure."

In practice, American reports that the time a technician spends in retrieving information in the manuals has typically been reduced as much as 80 percent when an experienced technician uses the CD/ROM system. A less experienced user has been able to locate the required data in approximately half the time it took previously.

Current systems provide a simple-to-use computer mouse which the user has only to point at the menu or data selection and press the button on the mouse. Users need not be particularly computer literate or skilled typists. American reports that a one hour training session usually enables the technician to use the system effectively.

Users' experience with CD/ROM technology for dissemination and distribution of technical publications has shown that it provides improved control of the accuracy and currency of information. The U.S. Federal Aviation Administration (FAA) and the U.K. Aviation Authority (CAA) have accepted the use of CD/ROM publications in lieu of paper or microfilm manuals. Future applications might include work card reproduction and distribution of training data.

CD/ROM maintenance manuals may not only be the wave of the future for efficiency, but also for enhancing aviation safety by easing accessibility and currency of critical information. ♦

William H. Rhodes Honored as 1992 Recipient of Joe Chase Award

William H. "Bill" Rhodes, recently retired instructor of aviation maintenance technology at the University of the District of Columbia (UDC) in Washington, D.C., U.S., has been named the 1992 recipient of the Joe Chase Award. His commitment to aviation in the spirit of the late Joe Chase was reflected in the nomination of Rhodes, citing his "efforts in furthering the technical education of individuals which, without his help, might never have had an opportunity to develop."

Rhodes has visited high schools in and around Washington, D.C., in pursuing his recruiting efforts on behalf of the UDC Aviation Maintenance Technology school. Although the school offers a relatively small mechanic training institution with limited facilities, Rhodes has instilled high standards of pride and workmanship in his students. His success is exemplified in high praise for the knowledge and attitudes exhibited by his students as confirmed by the FAA office administering their testing. Even though he is retired, Bill is still a frequent visitor to his former classrooms, students and friends at UDC.

The award is administered by the Flight Safety Foundation (FSF) and sponsored by the Professional Aviation Mechanics Association (PAMA). It recognizes the accomplishments of an aviation technician for outstanding contributions to the aviation mechanic profession and their importance to aviation safety and reliability.

Courses Offered in Composite Maintenance

Abaris Training Resources Inc., of Reno, Nev., U.S., has announced its schedule of classes for 1992. The company has been conducting "hands-on" composite courses since 1983 in the United States, as well as internationally.

Courses offered and the scheduled dates are:

Introduction to Advanced Composites (3 days) — May 27-29, and September 9-11, 1992.

Composite Structures, Fabrication and Damage Repair — Phase I (5

days) — April 27-May 1, June 1-5, July 6-10, July 27-31, Aug. 24-28, Oct. 12-16, Oct. 26-30, and Nov. 3-Dec. 4, 1992.

Composite Structures, Fabrication and Damage Repair — Phase II (5 days) — May 4-8, June 8-12, July 13-17, Aug. 3-7, Aug. 31-Sept. 4, Oct. 19-23, and Dec. 7-11, 1992.

Composite Tooling, Design and fabrication (8 days) — Sept. 15-24.

Adhesive Bonding of Metals and Composites (5 days) — June 22-26, Aug. 17-21, and Dec. 14-18, 1992.

Technicians interested in confirming class availability and details on any of these courses can contact Abaris at 5401 Longley Lane, Suite 49, Reno, NV U.S. 89511. Telephone (800) 638-8441.

Civil Aviation Manufacturers Push For Standard Airworthiness Regulations

The Aerospace Industries Association (AIA) in the United States and its European counterpart, the Association Europeenne des Constructeurs de Materiel Aerospatial (AECMA), are joining forces to encourage harmonization of airworthiness certification regulations for worldwide civil aircraft. AIA and AECMA have jointly called upon the U.S. Federal Aviation Administration (FAA) and the European Joint Aviation Authorities (JAA), stressing the importance of having compatible or identical regulations governing the airworthiness standards of civil aircraft.

The two organizations asked their respective regulating bodies to coordinate actions to foster growth and development in international aviation activities. Among the points emphasized were:

- That the current tendency to over-regulate should be eliminated.
- That new airworthiness regulations should be limited to cases supported by experience or new technology issues.
- That neither FAA nor JAA should initiate new rulemaking activities unilaterally.
- That the FAA's rulemaking process needs significant improvements. A major objective should be to reduce the delays associated with internal FAA administrative procedures.

- That the FAA and JAA should coordinate actions to meet target dates for items already under consideration.

- That the FAA and JAA should present their work schedule for updating bilateral agreements between the United States and Europe.

AIA and AECMA officials have pointed out that certifying an aircraft to national requirements unique to the country in which the aircraft is sold or operated increases the costs without necessarily improving safety.

Photograph not available.

Remote Visual Inspection (RVI) Assists Boeing Manufacturing

Boeing Commercial Airplane Group has several quality assurance groups that employ remote visual inspection (RVI), more commonly called "borescopes," in various steps of their manufacturing process. But, it was discovered that not all personnel were aware of the in-house capability, so the RVI group has been "selling" its borescopic inspection services to promote the use of this technology to those not previously aware of its potential. A videotape, a display at an employee open house event and posters were used as marketing aids.

Although normally used only to inspect for defects in hidden areas, the RVI group promoted its services for use in solving other problems in the extensive manufacturing facility at Boeing. Typical applications where RVI proved to be useful and effective included:

- Looking inside hidden areas to confirm wire routing;

- Checking functional operation of complex assemblies;

- Checking for possible foreign objects in inaccessible areas; and,

- Assuring that areas behind sidewalls or under floor panels are clear and clean without removing the panels.

In one instance, RVI personnel were able to remove a foreign object viewed through the borescope using a mechanical finger attached to the end of the scope. Another unique application of the borescope allowed an engineer to verify a wire number on an otherwise inaccessible wire bundle without extensive disassembly of panels.

Boeing and the Olympus Corp.'s Industrial Fiberoptics Division, the company's RVI equipment supplier, have found that extensive use of RVI techniques can save thousands of man-hours otherwise wasted during disassembly to access hidden locations during fabrication, assembly and testing of aircraft. ♦

MAINTENANCE ALERTS

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

Helicopter Tail Rotor Counterweight Bearing Journal Fails

A Bell 214ST helicopter operating offshore in the North Sea off Aberdeen, Scotland, reported a severe high frequency vibration approximately 34 minutes after lifting off from an oil platform en route to Aberdeen. Flying at reduced airspeed, the pilot was able reduce the vibration level and maintain control while diverting to the nearest available landing site.

After confirming the low-speed handling of the helicopter, the pilot was able to land without further incident on another platform 12 nautical miles (nm) from his original position. It was found that one of the two tail rotor counterbalance weight bellcrank assemblies was missing and that when it broke off it had struck the blade grips and the blade surface of the tail rotor blades. The complete tail rotor assembly was re-

placed and the failed assembly was subjected to a detailed examination.

It was found that the tail rotor crosshead, part number 214-010-806-101, which is splined onto the tail rotor shaft, had suffered a fatigue failure of the bearing journal to which the counterweight bellcrank attaches. The failure occurred in the machined undercut at the base of one of the journals. The bearing journal was found to have been 50 percent failed in fatigue and the final failure was then a rapid fracture of the remaining material.

Two similar occurrences of this nature had been reported previously to the manufacturer leading to the issue in February 1987—of an Alert Service Bulletin. In 1989, a new design, (part-105) crosshead, was made available but it was considered a customer option installation. The failed part in the above reported instance was the old style (part-101).

Missing Spring on Cargo Door Found Coincidental to Engine Damage

Shortly after takeoff, a Boeing 737-200 aircraft was climbing through 1,500 feet when the crew heard a series of bangs that appeared to come from the number 2 engine. At the same time, the first officer noticed a master caution warning light indicating an unsafe door condition. With the power on the affected engine reduced to idle, the engine appeared to be normal. When attempting to increase the power, however, the banging restarted and passengers reported flames from the engine tailpipe. The engine was shutdown and the landing accomplished without further incident.

Ground inspection disclosed that the forward belly cargo door was partially open, and that the nose dome of the number 2 engine was missing. The forward belly bin baggage restraint was still in place and a detailed check of the cargo disclosed that nothing was missing.

Investigators found that the cargo door operated normally. Ground personnel reported that the door's external operating handle had been found in the locked position, but with the locking rollers unlocked. This could occur if the internal handle had been used to open the door.

Further investigation revealed that a spring P/N 69-67541-1 (later superseded by P/N 69-76131-1), that returns the inner handle to the locked position when released, was missing. With this spring missing, the internal handle can be actuated with very light finger pressure. There was

no sign of this spring and it appeared that it had been omitted at the time of previous maintenance activity in this area.

The manufacturer confirmed that three previous instances of broken or missing springs of this type had occurred. It was emphasized, however, that with the aircraft pressurized, the door cannot open regardless of this latch handle position.

Inspection of the engine confirmed that the nose dome attachment bolts had stripped the threads in the casing allowing the dome to depart. There was no sign of any contact of the dome with the engine or the cowling. Previous instances of this nature had been experienced and engine surging was confirmed to be a typical result of a missing nose dome.

The investigators concluded that the sequence of events was:

- The engine nose dome attachments failed, probably due to overtorque.
- The missing nose dome caused the engine to surge.
- The vibration and shock waves from the surging engine impacted the cargo door and caused the internal handle to move to the unlocked position resulting in the door warning light.
- After landing and depressurization, the unlatched door moved to a partially open position.

Faulty Bonding Results in Trim Tab Failure

During approach to an airport in the United Kingdom, the pilot of a Cessna 421C became aware that the aircraft was out of balance laterally and that it required rudder and aileron input to maintain a wings level altitude. A passenger advised that it appeared that the flaps on the left wing had suffered damage, and the pilot elected to make a no-flaps landing which was accomplished without incident.

Investigation after landing disclosed that the skin on the left aileron trim tab had become unbonded. The tab is of lightweight construction, consisting of two end ribs joined to a spanwise spar which incorporates a piano-type hinge. A single piece of skin, folded at the trailing edge, is bonded to the ribs and spar. There was a complete failure of the bond joints, and the tab skin was prevented from becoming completely detached only by the operating arm attach-

ment which was riveted to the underside of the tab.

Subsequent investigation confirmed that the bond adhesive was not of the specified type. It also appeared that the skin had not been properly cleaned and primed prior to the application of the adhesive. The fact that there were no part numbers on the assembly led the investigators to assume that the skin had been replaced by unknown persons using faulty materials and procedures.

Sharp Bends in Wire Cited as Factor in Underfloor Fire

In March 1991, a Lockheed L-1011 TriStar operating at FL330 over the North Atlantic experienced a fire in the underfloor area of the aft cabin. A cabin attendant reported flames rising from the base of the left cabin sidewall at the next-to-last row of passenger seats. The fire was extinguished with a Halon extinguisher and a precautionary landing was accomplished safely at Goose Bay, Labrador.

The investigation was conducted by the Transportation Safety Board of Canada (TSB) with the U.S. National Transportation Safety Board (NTSB) participating. It was found that the fire originated below the floor in an area outboard of the cargo compartment wall. Although the ignition source has not been positively identified, two conditions to fire safety were noted:

- *One*. A bundle of wiring with fire damage and other wire bundles in the aircraft were sharply bent.

- *Two*. Debris including dust, lint and items from the passenger compartment had been allowed to drop below the floor and accumulate on the wire bundles and in the insulation blankets.

FAA Advisory Circular (AC) 65-15 states: "Bends in wire groups or bundles should not be less than 10 times the outside diameter of the wire group or bundle." Most manufacturers have similar standards for new manufacture and repair operations. In the aircraft involved in the reported incident and others inspected after it, wire bundles had been found installed with bend radii much less than that recommended by AC 65-15. This tight bend radii results in thinning of the insulation with greatly increased exposure to chaffing which could lead to an electrical short circuit.

The other factor noted poses a greater fire risk than normal. Although the manufacturing standards require that materials used in such areas be fire-resistant, the debris and trash allowed

to accumulate was not fire-resistant. This was suspected to have been the initial material ignited by the damaged wiring.

Technicians and inspectors should be alert to proper wire bundle routing and chafe protection during the performance of routine checks, particularly following additional rework or modification operations. In addition, the importance of good housekeeping practices in underfloor and hidden areas should also be stressed for technicians as well as utility personnel.

Birds and Bees Are Nesting Again

With the coming of spring and summer to the northern hemisphere, exposure to nesting creatures invading aircraft nooks and crannies is once again facing those who maintain aircraft. Any opening large enough to admit a bird, bee or bug becomes an invitation to home-building creatures on the wing.

Flight control hinge points and control rod openings are among the more obvious potential sites, but other possibilities include inspection panels that may be left open overnight while an aircraft is undergoing maintenance.

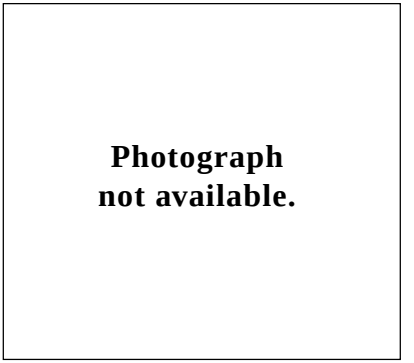
Pitot and static ports should be checked very closely, especially for aircraft not in daily operation. More than one wasp or spider has been the culprit for erroneous airspeed or altitude readings.♦

NEW PRODUCTS

Hands-free Intercom Aims at Safe Communications

Telex Communications Inc. has introduced a hands-free, two-way intercom device that allows technicians outside and inside an aircraft to communicate while their hands may be busy performing maintenance chores.

The Model EM-200A is based on the company's Ear-Mike unit that consists of a transducer worn in the ear of the user. The company states that the transducer senses internal speech vibrations of the wearer that it then transmits them via the aircraft's intercom voice-operated (VOX) system normally used for pilot-to-ground crew communications. The unit also incorporates a push-to-talk (PTT)



switch and can receive audio signals as a conventional headset.

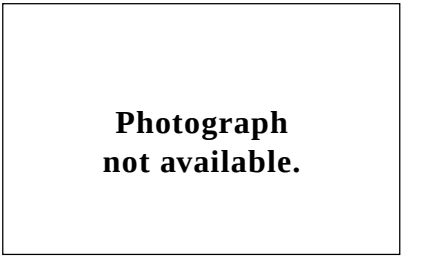
For more information, contact Telex Communications Inc., LMR Department, 9600 Aldrich Avenue South, Minneapolis, MN 55420. U.S. Telephone (612) 884-4051.

Above-ground Storage Tanks Claimed Environmentally Safe

The worldwide concern about environmental hazards due to leaking storage tanks has resulted in the development of storage tanks that incorporate secondary containment features. Areo-Power Unitized Fueler Inc., has introduced a line of above-ground storage tanks that are mounted on and within a containment dike that has a capacity of 110 percent of the storage tank.

According to the manufacturer, the tanks meet both U.S. and Canadian underwriters laboratories standards of secondary containment and are in conformity with National Fire Protection Association (NFPA) standards. The tanks are intended to provide environmentally safe storage of diesel fuel, gasoline, jet fuel, heating oil and hazardous wastes or chemicals by preventing spillage from reaching the ground. The secondary tank is said to be capable of catching any spillage or overflow that might occur during filling or venting of the tank, and provides further protection from fire hazards associated with flammable fluids.

The manufacturer claims that steps and handrails meet Occupational Safety and Health Administration (OSHA) regulations and provide con-



venient access to work platforms installed on larger units. The secondary containment is itself enclosed with rain shields to minimize the need for frequent draining of precipitation or wash water. The units are available in a wide variety of sizes from 300 gallons to 20,000 gallons and

can be provided with epoxy-phenolic coatings to reduce exposure to corrosion and resultant contamination of aircraft fuels.

For additional information, contact Areo-Power Unitized Fueler Inc. 103 Smithtown Boulevard, Smithtown, N.Y. 11787 U.S. Telephone (800) 242-2736.

Modular Work Stands Offer Ease of Positioning

R & D Constructor Inc. of Des Plaines, Ill., U.S., supplies work stands and maintenance platforms that can be dismantled for transport by the aircraft that they are designed to maintain. Each section of the work platforms is mounted on easy castering wheels that allow the stand to be positioned without the use of tugs. Once in position, each section is stabilized and leveled using built-in jacks.

Photograph not available.

Each platform section is provided with utility outlets and lighting. An additional feature is the use of metal grid flooring that permits overhead hangar lighting to penetrate the work stand, and minimize the need for supplemental lighting.

Casters provided with the stands are designed to withstand heavy use and can run over a one inch steel bar repeatedly without damage to the molded tire.

For additional information, contact Albion Industries, 800 N. Clark Street, Albion, MI 49224 U.S. Telephone (517) 629-9441.

Epoxy Keeps Floors Safe

Tennant Co. has introduced a product called 8510 Fast Patch Epoxy for repairing damaged concrete floors. The material is said to be ready for traffic after curing for four hours at 75 degrees F. Even minor holes or irregularities that can trip the technician or dump the toolbox can be repaired, according to the manufacturer.

The epoxy is packaged in measured containers and can be mixed by hand or with a low-speed electric drill. Applied with a trowel or putty knife, it can be used to fill holes or to repair eroded concrete or chipped

Photograph not available.

joints. The manufacturer claims it leaves a smooth strong surface that can withstand loads in excess of 15,000 pounds per square inch after curing, and may be top-coated with other floor coatings. Fast Patch 8510 reportedly contains no solvents or volatile organic compounds and meets standard environmental regulations for such products.

For more information contact Tennant, 701 N. Lilac Drive, P.O. Box 1452, Minneapolis, MN 55440, U.S. Telephone (612) 540-1638. ♦